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WINNING THE WAR

By H. Gernsback

His war, more so than any other, is a machine war. A stereotyped phrase, but, nevertheless, a very true one. When we speak of a machine war, we usually have in mind artillery of all calibres, from machine guns upwards to 42 cm. guns, and larger.

We believe that we will not be contradicted when we state that vast bodies of infantry cannot move forward nowadays without the support of protecting artillery from its rear. Logically, the conclusion follows, that if we can annihilate the enemy's artillery, he must fall back. Even trench systems without artillery support from the rear cannot be held for any length of time by the enemy. If our artillery is intact, but if the enemy is deprived of his, even tho his infantry should outnumber ours ten to one, he would have to retreat just the same. These, of course, are very obvious facts.

The British now engaged in the Western war theater realized this truth very early and set about to rectify it. The result was their present Tanks. These machines fulfill several purposes; they are used to batter down the barbed wire entanglements protecting front line trenches; secondly, they raise havoc among the enemy's men by flank fire once its lines are crossed; thirdly, the important thing is that all the Tans are supposed to annihilate the enemy's artillery either by putting the artilleryists out of the game from the rear or by driving right over the enemy's guns, thus putting them hors de combat. For the first two purposes the Tanks are ideal, for the latter they have signally failed. The reason is very simple. The Tank is an extremely slow-moving vehicle in the open field—five to eight miles an hour at the most is its speed. Even if camouflaged, a Tank makes a shining mark for the enemy gunners, who find little trouble in getting the range of it. A rapid-moving tractor. One or two shells soon puts the most ambitious Tank out of business.

Dr. S. C. Pike, in his book, has made it appear that we have not only in our cities but also in our factories and workshops, the raw material for Tank production. As a matter of fact, what we need is not only steel, but also the necessary power to produce this steel. Even if we could build the steel, we would have to import the coal necessary to produce it. And we have also to import the required for them. And we have also to import the iron ore needed to produce the steel.

In other words, the large and speedy machine obviously is the 'thing' in this war. In former articles we have shown that it is perfectly feasible to run monster machines over land at speeds from twenty miles upward. We have shown how our obsolete battleships could be readily equipped with huge channel-iron wheels to ride over land; we have also shown how 45-foot big-wheel steel monsters, steered by gyroscopic means, could be used to run over the enemy's artillery. And we have also shown how these machines could be practically immune to enemy shell fire on account of their high speed. The conditions of action are likely to be largely open iron-channel work, even a direct shell hit would not do much damage, beyond ripping out a few steel pieces.

Strange to say, monsters of this kind would claim little to life: if you see such a juggernaut of death heading your way, you simply sidestep it! Such machines are not designed to kill; they are used solely to destroy the enemy's guns, or putting them out of action.

Now the point we wish to make is that men alone will not win the war for us. A big machine is the thing. One such monster replaces several thousand men. The nation that can build the largest buildings on the Earth that has the largest mechanical resources of the Allies, can easily build these comparatively simple machines. They are feasible from an engineering standpoint. Most important of all, such machines can be readily sent to France and within a couple of hundred of them could be sent to France with the same amount of tonnage it takes to send over 25,000 of our boys. Five hundred big monsters might decide the war for us quickly: 25,000 men are a mere trifle in this war—they do not begin to make an impression.

A few weeks ago, if we had proposed a gun that could shoot 24 miles we would have been laughed at scornfully. It would have been one of our 'pipe dreams.' The trouble with us Americans is that we don't 'dream' enough, while the Germans do.

And if we do not get the big machines over to France soon, the Germans will surely beat us to it. Let us wake up.
The only way you can become an expert is by doing the very work under competent instructors, which you will be called upon to do later on. In other words, learn by doing. That is the method of the New York Electrical School.

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Electricity and Camera Give 3,000,000 Shells Third Degree

Have you ever stopped to think just how the experts of the ordnance department of our own as well as foreign governments manage to check up the huge quantities of cannon shells shipped to the front? Possibly not, when the accompanying photos will give some idea of the extremely fine electrical precision apparatus employed for the purpose, as well as the method used for safely firing faulty shells.

The photo at left illustrates the delicate electric chronograph, a highly sensitive and electrically operated camera, the whole lot of 25,000 shells was immediately returned to the manufacturer.

The electric chronographs or split-second clocks used in timing the velocity of the shells when fired, are connected up to a network of electric wires placed at certain predetermined intervals along the proving range. Briefly explained the operation of the velocity test is as follows: As the bullet or shell leaves the muzzle of the gun it strikes one net-work of electric wires, severing one of the wires, which causes one for exploding shells that have failed to go off when fired. The shells are recovered by "shell scouts" on the range and are fired off electrically by the officer in charge.

Photography played an important part in testing the 3,000,000 Russian shells at the Lakehurst proving grounds. It is said to be the first time that the electric camera was ever used in this country to determine the velocity of projectiles.

Right photo shows five of these remarkable instantaneous photos of shells in flight. These views show shells photo...
Locating and Destroying “Subs” with Electro-Magnets

THERE'S one thing certain about this war anyway, and that is that there will be no falling off in the business of the patent office. Not if the Yankee inventors can help it, at any rate. For one thing they will be able to keep the patent examiners busy on anti-submarine devices for several years to come, apparently. We thought that the magnet schemes for combating the U-boat menace were about exhausted—we said "thought," but here's a new one. And it employs electro-magnets—oodles of them if necessary. The inventor of this newest magnetic "Sub" thru the danger zone, so that a large area may be covered in a predetermined time. A substantial base is secured rigidly upon the aft deck of the vessel as shown in the illustration herewith. This base preferably extends beyond the line of the hull, as it is upon this base that most of the working parts of the device are mounted.

Pivoted at the rear end of the base is a rearwardly projecting, vertically swinging boom which is by preference extensible and retractable, set screws or clamps being provided for holding it in adjusted position. The rear end of the boom is forked as at any suitable point on the ship, a generator being provided for charging the battery to the required extent. The generator may either be driven from the internal mechanism of the ship, or from an individual motor or engine.

The two cables attached to the electro-magnet are wound upon a drum suitably mounted upon the deck base, the anchored ends of the duplex electric feed cable, being past thru the hollow shaft of the drum and secured to a pair of contact rings which are insulated from the shaft, that is the two wires which comprise the feed cable, are..
Yankee Code Not So “Bloedsinnig”

With the American Expeditionary Army, France.—’T’ll be in Oregon at 3. At 4 o’clock I’ll be fixing up that ration question with Hindenburg in London. And if you want me after that I’ll be over in Tallahassee. Just ask for the Kaiser.”

Not a quotation from the raving of a mad man—nor “balmy in the ead,” as our British friends are wont to call the chap who is a bit “locol” in his “attic.”

The foregoing conversation is just one end of a typical ‘phone talk on the front where everything is “code.”

The young divisional supply officer was about to leave on a round of the fighting points on the front. He was giving one of his subordinates instructions over the phone on how to reach him in case of need during the remainder of the afternoon.

“Oregon” is an artillery post a few kilometers from headquarters—not the Western State where the apples come from, Hindenburg is a battalion commander whose right name may be Smith, and London is a dugout in the support line “up front.” After that he was going to a brigade headquarters. On the phone he answers to the name of “The Kaiser.”

It’s simple if you have the key, but a crazy confusion of far-flung places and irreconcilable names if you don’t know what they’re talking about.

This “code” is a safeguard against enemy “listening-in” sets. By means of induction—stringing wires parallel to our trenches, tho 50 yards away in “No Man’s Land”—the sly Germans often pick up the Yankee talk over the wires. It therefore becomes plain that if a Boche listening post picked up that message the observer scanned his maps of the sector in vain for “London” and “Tallahassee.” And “Hindenburg”—there’s only one Hindenburg and he isn’t visiting London these days to consult on rationing problems. Every loyal Boche knows that. The “bloedsinnige” (idiotic) Yankees must be mad.

It is an interesting fact that where tele-distance circuits when they happened to be parallel one another for any appreciable distance. Inductive effects were manifested between the telephone cables leading from New York City to Saratoga, N. Y., and Providence, R. I., due to the proximity of these two circuits in New York City.

Every insert detail here shown gives the simple arrangement necessary for listening in by induction to conversations in a certain telephone line. The listening post of the enemy may moreover be equiped with powerful amplifiers to intensify whatever messages are intercepted. Ordinarily it is only necessary to connect up a telephone receiver to the single “paralleling” wire.

This is usually a simple matter, as the trenches frequently run nearly parallel for considerable distances. The listening wire should, of course, be insulated and part of it might be camouflaged or hidden in the dirt of “No Man’s Land,” so as to reduce the distance between the two circuits, and thus increasing the inductive effect. In some instances the telephone lines have been but a few feet apart.

An early American radio-worker, one Amos E. Dolbear, invented and patented an inductive telephone and telegraph system and actually made it “talk” one-half mile. His patent was issued in 1888, but owing to the limitations of such a system (Continued on page 66)
New Spy and Scientific Movies
By GEORGE HOLMES

There seems to be no dearth of interesting photoplays, especially among those that depend on science to attract theater patrons. One film-play in particular is very much in the limelight at present, being the exposé of numerous plots against the United States even before we were drawn into this great world conflict.

Written by that celebrated authority, Wm. J. Flynn, late retired chief of the U. S. Secret Service, the drama under the title of "The Aquarium" has just been captured by a band of German spies and taken to their headquarters in an abandoned cave on the New England coast, where they propose to force her to reveal the secret of a marvelous war invention perfected by a lieutenant in the United States Army. Jessie pretends to faint and while her guard rushes for aid she makes her way to the wireless instru-

to get money to complete her father's scientific researches, marries a wealthy man she doesn't love. A son is born to the couple only to become a barrier between them. The husband leaves for a long sea trip, is reported lost, but turns up at home just in time to see Laurel promise herself to Richard Leslie, a young doctor she had loved before her marriage. The death of their son embitters Durand, the husband, and he plans a revenge as fiendish as it is novel.

*The Eagle's Eye* leads one thru a series of episodes which show the despicable methods and plots originated to wreak vengeance and hamper as much as possible the war effort of the "Hun"!

Two of the photos show a specially built wireless-controlled torpedo which the Imperial German Government made in this country for the destruction of the flagship of the Atlantic Fleet as it was leaving New York Harbor after the review of U. S. Navy. Also there may be seen a compact land radio set tuned with the apparatus on the torpedo, so that perfect control may be had.

He pretends a deep interest in the young doctor, and thru various pretext throws the pair together on every conceivable occasion. Laurel finally discovers a serum for the cure of the deadly anthrax germ thru the medium of the man-eating turtle. She possesses but one small specimen of the turtle, the only other one being the property of the city Zoo. Supremely confident of the serum, she decides to demonstrate the efficacy of her cure for anthrax by inoculating herself with the deadly poison. Young Leslie begs her to use him (Continued on page 66.)
ELECTRICITY at high potentials has been used heretofore in an effort to stimulate the germination and growth of plant life, particularly those of a food-bearing nature. Several English experimental farms have been trying out such schemes with more or less success, but apparently the method used whereby several hundred thousand volts of high frequency current is caused to "leak off" an elevated wire net-work to the plants themselves, left considerable room for improvement.

This improvement seems to have been made by a Chicago, Ill., genius, Mr. Robert D. McCreery, who has provided a truly novel scheme whereby the high potential, high frequency currents do not have to traverse several million ohms of "air resistance" before reaching the plants, but are enabled to pass thru the earth directly to the roots of the growing plants or to the seeds undergoing the process of germination. An increase of 30 per cent and more was attained in the crop production as proved by actual "growing" tests.

"Electricity," declares Mr. McCreery, "unquestionably stimulates seed germination and subsequent plant growth. Electricity in the soil causes larger crops and healthier plant life. With the end in view of stimulating food crops in England at a time when the submarine menace was the gravest, the Government devised the plan of stringing wires across the fields and causing them constantly to disseminate an electric current.

"Undoubtedly more electricity is lost in the air than is brought into contact with roots of the growing crops. The new system aims to eliminate this waste. By employing it the electricity is diffused directly into the ground, where it is brought into contact with the metallic element covering the seeds. High frequency electricity always seeks out the points of lowest resistance. These are my metal coated seeds. "Electrodes are set at the opposite ends of the field or garden plot and electrically charged. They serve to spray electricity thru the ground devoted to the growing of the crop to be so treated. In order that the juice may reach its proper objective the seeds or shoots are surrounded with a metallic element. With ordinary seeds this can be done in large quantities and in a very few minutes. Indeed, the process is so simple that a farmer's lad operating it can coat enough seed corn in ten minutes for planting twenty acres of corn.

"The control of the electricity is brought about by metallically coating the seed with a finely divided non-deteriorating metal before planting, thus creating lines of low resistance, since high frequency waves are automatically drawn to anything metallic. (See detailed drawings in illustration herewith.)"

"After the germination of the seed—which is both hastened and assured by the electrical treatment—this metallic element continues to inhere in the roots of the plant and absorb more current, thus establishing a continuity of the system."

The idea of metalically coating the seed does not debar its use for such garden products as are grown from sprouts or from portions of the parent plant, as is the case with potatoes, celery, etc. McCreery declares that the electrical treatment will be wonderfully effective in growing garden truck.

"Where the electric system is used," he explains, "it is necessary that the individual plants have the metallic element previously alluded to. But this need not be a part of the seed itself. In fact, for certain plants it is just as well that the ground immediately around them be impregnated with the metallic property. (See illustrations.)"
The Electro-Magnet in the Operating Room

By S. Gernsback

In a modern war hospital, the electro-magnet is playing a big rôle nowadays. It is practically impossible to thoroughly clean wounds of shrapnel splinters without the use of this practical apparatus, as in many cases these particles are included by the dozens in the human body and it would be a great loss of time to the surgeon as well as pain to the patient, if each fragment had to be located and extracted separately.

When the wounded soldier is brought to a base hospital, all the big iron fragments are easily located, and are removed by hand and forceps. After this first operation a thorough search for small splinters is made, with the aid of a strong electro-magnet.

But that the electro-magnet should be in every hospital, ready to be used at any moment, is shown by the accompanying illustrations.

Some time ago a young boy was brought to a hospital in New York City on account of a swelling of the knee and excruciating pains in the same.

An X-ray examination showed that the patient had a phonograph needle imbedded deeply in his knee.

The needle must have worked itself into the patient’s knee, a boy three years of age, while creeping on the floor. It was decided to remove the needle by an operation.

Altho there was a front and side view X-ray taken, to ascertain the exact location of the needle, the surgeons at the beginning of the operation could not find the object and finally called for an electro-magnet.

After applying the current, the magnet was brought in the incision made by the surgeons in the patient’s knee and the phonograph needle was extracted at once and clung to the pole piece of the magnet.

DENTISTS TEST NERVES NOW BY ELECTRICITY.

It frequently happens that the nerve of a tooth dies, even when the tooth is apparently sound, without giving any external indication. This almost universally results in an abscess in the bone structure at the end of the root of the tooth, which abscess may not give any local pain or external indication of its presence and may exist unknown for years. During this time the pus continuously formed in the abscess is absorbed into the system and may cause various ailments, such as rheumatism, heart disease, kidney disease, etc., all really due to the pus carried by this dead tooth nerve but often attributable to other causes. The dentist may have examined the tooth many times during this period and found nothing wrong, because of the absence of any external signs.

It is the object of the invention here illustrated to provide an electric nerve-testing instrument, by which the dentist may determine absolutely whether or not the nerve of a tooth is vital. It was invented and patented by Mr. Arthur R. Darling, of Indianapolis, Ind. The instrument is provided with a probe of conducting material of suitable form to engage the tooth, and this probe has associated with it an induction coil with a variable-reluctance magnetic circuit, interconnecting the primary and secondary coils. When the dentist presses on the center rod as shown, the induction coil core is pushed in and the reluctance reduced, thereby increasing the voltage of the secondary winding of the induction coil. The secondary of this induction coil has one terminal connected to the probe and the other provided with any suitable connection whereby the secondary circuit thru the tooth may be completed, as thru the dentist’s hand, which is placed in contact with the patient’s face or neck. Preferably the make and break device for this induction coil is separate from the instrument, to avoid vibration in the instrument.

In testing the teeth the dentist grasps the instrument in the manner shown, pushing down slowly on the center core plunger which raises the secondary voltage, and hence the strength of current applied to the tooth and nerve. If the nerve is dead, the dentist can push the central core rod entirely into the spool and the patient will feel nothing in the tooth being tested. If the nerve is vital, the patient feels the current in the tooth before the rod has been pushed in very far. A whole set of teeth may be tested in a few minutes.

COST OF ELECTRIC PIG IRON.

Based on experiments at Trolhättan, 4 tons of pig iron should be produced per kilowatt-year in a plant using only one furnace, measuring the energy at the furnace, says The Engineer. Figured on the amount of energy purchased, the output should be about 3.32 tons per kilowatt-year. Better results may be expected from a plant of two, or three or four furnaces. With a plant of four furnaces, it is assumed that an efficiency of 92 per cent can be attained, and with two or three furnaces between 83 and 92 per cent respectively.
ENGLISH USE MICROPHONE TO FIND U-BOATS.

Two of the methods by which the British are effectively fighting the German submarine are by the use of new microphone detectors and explosive bombs of enormous power, according to a writer in the Tidningen, an authority on technical information.

English experts have so improved the use of the microphone on anti-submarine vessels, says the writer, that they are able to steer accurately and automatically down on the submarine, while formerly they were unable to locate a vessel beneath the surface. The microphones are placed below the water close to the keel of the vessel, and answer the same purpose as the microphone of a telephone. By listening to the beat of the submarine’s propeller they can determine the exact location of the enemy and attack him before he has the slightest idea of what is happening.

The detection instruments used with the microphones are very complex. One of them shows the distance of the submarine on a graduated scale, the indicator responding electrically to the sound from the submarine’s propellers. The variations of distance are shown with marvelous accuracy. Another device shows whether the enemy is on the port or starboard side. The electromagnetic needle moves to the side on which the sound is loudest and the ship is guided accordingly.

When the proper spot is reached bombs are dropped in the same manner as from airplanes. Their under-water force is so great that they can destroy a submarine 150 feet from the point of explosion.

ELECTRICITY AS A TRENCH DIGGER.

It is reported that the French are making extensive use of electricity at the front in the operation of all kinds of excavating machines. Working in ordinary earth, four men with two wheelbarrows and a machine driven by an electric motor can shift from twenty-five to thirty-five tons a day. In a month a shelter with sleeping accommodation for 500 men can be dug by a single company.

Zip! Goes the Motor and Plaster Cast is Off

The doctors and nurses are right on the job in the present stirring times, when it comes to having electrical devices and refinements. If you think the soldiers and sailors have a mortgage on the "juice" operated inventions with which to push the "Hun" back across the border—well, guess again. Ever see the "Doc" cut a plaster-of-Paris cast loose from a wounded patient? Yes, it was an awkward job at best. But now the electric cast cutter severs the encasement in one clip. It is provided with a special saw over a plate which slips under the cast as slung.

The Medical Corps is doing everything in human power to comfort our injured boys at the front thru the instrumentality of new surgical instruments.

When it is required to repair a part of a broken skull the new motor-driven drilling device here illustrated will bore a hole with accurate precision, so it will not affect the tissues in the head. Such operations are often necessary at the front line and base hospitals, as, for instance, when a soldier has received a heavy blow on the head. This often results in a clot of blood forming which presses on the brain, depriving the victim of some of his faculties at least. In such cases the surgeons must trephine the skull, i.e., cut out a triangular piece of the skull in order to remove the blood clot. Afterwards a silver plate is placed over the opening.

TELEPHONE CONNECTIONS ON THE EASTERN FRONT.

An interesting development in methods of electrical communication between head-quarters and the men in the trenches—namely, the use of wireless to a degree unexpected previous the war is commented upon in the French journal L'Industries Electrique. It was formerly assumed that wireless methods of communication would be unsuitable in such circumstances, owing to the ease with which messages can be intercepted by the enemy. The tendency has therefore been to rely mainly on telephone connection, notwithstanding the ease with which this connection may be ruptured by bombardment. The destructive effect of modern artillery has made the ordinary methods of laying wires along the surface of the ground or attaching them to trees of limited utility. Even buildings and wire-ducts may be destroyed at an inconvenient moment by explosive shells, and the more the depth at which such wires are buried has become continuously greater and the methods of protection more elaborate.

The Germans have sought to get over this difficulty by laying a regular network of interconnected lines, so that in the event of several being damaged there is still a path for the current. Even this precaution, however, may fail in a modern bombardment, and the Germans now appear to be relying to a much greater extent on wireless communication. The article in question quotes particulars which are said to apply to the latest German practice, according to which it would appear that the antenna are mounted 4 meters above the surface, are about 100 meters long and emit waves of 30 to 400 meters. On the Eastern front about 110 wireless detachments are said to be employed.

HIGH FREQUENCY CURRENTS HELP BRAIN TROUBLE.

The case of a model young woman who suffered from a mental aberration is described by Dr. S. St. John Wright in the American Journal of Electrotherapeutics. Some months ago she underwent a mental change, becoming morose, listless, apathetic and strange. On October 4th she declared life not worth living and would kill herself. She jerked her head and fell to the floor, and acted riotously. During a lull in the excitement, they came to me, says the doctor. A severe proctitis was found and treated by glass vacuum electrodes and the high frequency current and resorcin swab. Another slight riot occurred in the afternoon of the same day but none since. After five treatments her muddy countenance rapidly cleared. She is now herself: active, cheerful and delighted, and delighting her mother and step-father. She has resumed her music, correspondence, and domestic activities. All evidence of tenderness and pain had vanished after the second treatment. This case well illustrates the fact that mental aberrations may be due to local focal causes, and that its removal or correction at an early date restores mental equilibrium, and cheats the asylum.
Television and the Telephot

By H. Gernsback

The subject of the present article "Television, or Seeing at a Distance," is one of these inventions. Numerous inventors have busied themselves trying to invent an apparatus or machine whereby it would be possible for one person to see another while talking on the telephone, but so far nothing practical has resulted. The true instrument on which the name "Telephot" (from the Greek tele-tar, photos-light) has been settled, is supposedly an apparatus attachable to our present telephone system, so that when we speak to our distant friend, we may see his likeness not only as an immovable picture, but we will see his image exactly as we see our own image when looking into a mirror. In other words, the apparatus must faithfully follow every movement of our distant friend whether he is only five blocks away or one thousand miles. That such an invention is urgently required is needless to say. Everybody would wish to have such an instrument, and it is safe to say that such a device would revolutionize our present mode of living, just as much as the telephone revolutionized our former standard of living.

Most inventors who had been working in the past on this problem, failed to bear in mind a very important consideration.

If the Telephot is ever to be a success, it must of course be possible to attach it to the present-day telephone lines. That means that the instrument must of necessity work in conjunction with the telephone and the ground for a return "wire," which is the same thing as two wires. Over these two wires to-day, we do not only speak, but "Central" also rings your bell. In the case of a "pay-station" telephone, quite a few more functions are accomplished over these two wires, It is also possible to-day to telegraph or telephone simultaneously over two wires neither one or the other being affected. Why then should it not be possible to also send translated light impulses over the same time that the voice impulses are translated over them?

In most of the schemes offered by inventors heretofore, a plurality of wires was necessary; in some cases several thousand pairs of wires. No matter how well such an instrument might work, this alone would doom it to certain failure. Another point is that the future Telephot must not be a cumbersome machine requiring motors and all kinds of other cumbersome machinery, difficult to operate by the layman.

The future instrument must work the same as the telephone, in that all the subscriber has to do is to lift the receiver off the hook, and he will immediately see his friend just as if he were talking to him in the same room. The requirements may seem hard on the inventor, but they are absolutely necessary as a simple reflection will show.

The writer also ventures to say that no Telephot will ever amount to anything that necessitates the use of selenium. As is well known, in nearly all past suggested television schemes, the selenium cell in one form or another was used. The underlying idea of these schemes is that light rays of the object striking the selenium cell varies the resistance of it. For the same, and these various impulses are then sent over the line to be translated into a picture by various means and manners at the receiving end. The trouble with the selenium cell is that it is not sensitive enough, and on account of its inertia does not work fast enough. Also in most of the proposed television schemes, a multitude of selenium cells is required, which again means a plurality of wires, thereby dooming the scheme at once. There must be something else besides selenium that can translate light impulses into electric impulses. Indeed, such a scheme is already existing, having worked it out millions of years ago. And while it is not electrical, it illustrates what we are driving at.

The animal eye is the most marvelous television apparatus ever invented. Moreover, it is non-electrical, for when we see an object, the latter is thrown into our eye, which is nothing but a marvelously efficient camera, but instead of a photographic plate, the impulses are thrown on the Retina which records the object, not only in black and white as does the
photographic plate, but the picture is recorded in its natural colors on the retina. From here numerous fine nerve strings interlocked in the retina connect with the optical and auditory nerves. This connection with the occipital lobes of the brain, translating the various light impulses, (stimuli) with their component colors into a "picture," which is then "seen" in our mind. We say "seen" advisedly, because of course the picture is not actually seen in the mind, but the impulses which the retina has picked up are translated into another form, which we experience in turn as the sensation of seeing.\* 

As has been shown experimentally, the picture is retained on the retina for about one-tenth of a second, and as an afterimage is a complete proof of the persistence of the image. It is this phenomenon which is made use of in moving pictures, each successive picture staying on the screen for a tenth of a second before the next one is flashed on. The fact that the pictures follow each other so rapidly, gives the impression on the retina that the objects are moving on the screen, which of course they do.

Now, as we have shown that pictures can actually be transmitted at a distance, without the means of selenium cells, it is up to our inventors to devise something to do away with these cells entirely. It is safe to say that when the successful Telephot is finally developed, it will be found to be a very simple apparatus, probably not much more complicated than the present-day telephone receiver.

When one considers how many different functions the diaphragm in a telephone receiver performs, it seems that it should be a simple matter to translate light impulses into electrical impulses. Just stop and consider that a single telephone diaphragm of course can pick up several hundred pure notes as well as several thousand less pure ones, which in turn is translated into electrical impulses. These impulses are then sent over the line only to be re-translated faithfully into the same several thousand notes, which in turn are translated into electrical impulses. These impulses are thus repeated on the line over and over again. But here the telephone loses its usefulness, for no one but the receiving diaphragm at the other end of the line would ever hear anything.

Theainteractive device is therefore the speaker or receiver, and in this, the voice is translated into electrical impulses which are now sent over the line along with the voice impulses. In order that the distant person may see the speaker's face, it is of course necessary that the latter's face be illuminated. For it goes without saying that if the speaker was in the dark, his friend could never possibly see him on the other side because light impulses would be thrown on the "sending" end. For this reason it will be necessary to provide a lamp \( R \) at the top of the Teleplot, which lamp throws its ray on the speaker's face; from here the light rays are thrown onto the lens, theme to be transmitted to the distant station. Naturally goes without saying that the ideal Telephot should transmit the sound and picture simultaneously.

Quite a good many Teleplots have been imagined and described as well as patented in the past. None of these, however, have ever appeared—most of them only existing on paper. One of the first of these was invented by the Frenchman, Dussaud, in 1877. There was another one invented by Sawyer in 1888. Next we have the Biddle machine of 1891; the one of Weiller in 1889; as well as those of Szepanich and that of Dussaud of 1898. None of these, however, were of practical value. We may also mention the comparatively modern Teleplots of Rothschild of 1907; Belin apparatus of 1907; Kruth of 1910; Hoglund of 1912; A. C. and L. S. Anderson of 1912; Stille of 1912; the Rosing apparatus of 1915, and the Sindling-Larsen instrument of 1916. The more important ones among these have been described in this article.

One of the earliest Teleplots imagined by the Frenchman, Dussaud in 1898, is illustrated herewith.

This ingenious apparatus at the sending end has a camera \( A \), at the rear of which is a metal disc \( B \) perforated with certain holes. This disc is driven by clockwork contained in the case \( E \). The ingenious part of this arrangement is that the disc \( B \) is perforated in a curious manner, the holes being disposed in the form of a helix or involute spiral. In other words, when the disc rotates the perforations cut off successive points of the picture formed in the camera \( A \). Thus at each fraction of a second, a ray of light is allowed to fall on the selenium cell \( C \), and when the disc has made one full rotation, every point of the picture will have been uncovered, as will be clear by a little reflection. It is apparent that this is an arrangement which translates light impulses into electrical impulses due to the fact that more or less light reaches the cell. These impulses in turn are passed through a battery and a small transformer (induction coil) \( D \), which is grounded at one end; the other wire goes to the receiving station. At the latter point, we receive more or less intense electrical impulses, and these impulses operate a very sensitive telephone receiver \( T \), on which is hung an opaque plate \( E \), having fine transparent lines engraved on its face.

(Continued on page 51)
Electrically Heated Beds for the Wounded

Once it was thought that a patient was receiving the finest kind of treatment if he was surrounded by hot-water bottles, i.e., providing he required that kind of treatment. Now the English hospital experts have devised an electrically heated mattress for treating such cases as pneumonia and shell shock. The hot water bottle provides an uneven heat at best—and for the proper treatment of such cases as these, the heating effect must be uniform and should be capable of fine regulation.

A successful solution has now been reached by Mr. H. J. Gauvain at the Treloar Cripples' Hospital, Alton, England, where two wards are now supplied with electric mattresses which have proved both safe and convenient in practise even when a child is the occupant of the bed.

The mattress does not differ in appearance from any other except that a flexible wire enters it at the head end thru a terminal which is flush with the surface, and therefore not exposed to injury. The resistance wire is insulated by glass beads in flexible metallic tubing incorporated in the substance of the mattress. The mattress is differentially heated and the heating element is so disposed that the maximum warmth is generated at the foot-end, less in the middle, and none at all at the head end. This distribution of heat is maintained in whatever position the mattress is turned, either from head to foot or side to side.

The wires are connected with a switchboard on the wall at the head of a bed which contains a variable resistance, so that the current can be graduated to any required extent. It is so arranged that when the current is full on the temperature of the bed is raised 25° to 30° F. above that which would obtain apart from the heating, and this has been found in practise to meet the needs of the small cripples, many of whom are fastened on splints which do not allow of the close contact of the bedclothes. A fuse prevents the passage of any current exceeding this amount.

Several of the usual difficulties have thus been met: the temperature of the mattress can not rise to any dangerous degree, the and infirmaries would save much time and relieve the nursing staff of a tiresome routine. Electrically heated beds have already been found of advantage in the treatment of shell shock at field-hospitals, and for military purposes it will be seen that the current required may be instantly supplied from a portable dynamo driven by a motor-lorry or car, as shown in the accompanying illustration.

Germans Building Aluminum Transformers.

Scarcity of copper has led to the construction of transformers with aluminum windings, says a German writer, and he contends that it is possible even in normal times to build air-cooled transformers cheaper and lighter if aluminum be employed instead of copper. The ratio of the prices of insulated aluminum and copper wire is taken as 1.4:1.0. In the most economical design of transformer with copper windings it is necessary to leave considerable spaces between the coils in order to obtain adequate cooling. When aluminum windings are used this space can be conveniently reduced without prejudice to the temperature rise. Owing to the relatively greater proportion of the cross-section of the coils which is occupied by metal, the difference between internal and external temperatures is less with aluminum windings than with copper. The difficulty of making joints in the winding is rather serious.
POSSIBLY many readers have seen, or rather heard, loud-talking telephones in operation as the latter's sphere of usefulness is being extended daily. They are being used very successfully for announcing trains in railroad terminals and have been used for several years now in announcing plays from the fronts of theaters in the larger cities, such as New York, and they have also found considerable adoption in railroad train despatching, as well as in a number of other fields.

The writer, while recently riding on a subway train, thought of the idea of combining these successful and practical loud-talking telephones with a phonograph attachment, which arrangement would seem to fill a great many requirements in public places, such as in subway and elevated trains, on steamships, in department stores, for store window sales, in theaters, etc.

A diagramatic layout, embodying the principal features of the phonographic loud-talker as here proposed and as it might be applied specifically for the purposes enumerated below, is shown herewith. Briefly considered, the phonograph attachment would consist of the proper number of cylinder type phonograph records mounted somewhat after the manner shown in the drawing, so that each respective record could be put into operation in response to each push button as becomes evident.

It will probably make the matter clearer to follow thru one stage of operation on such a loud-talker, provided with automatic speaking attachment in the form of a phonograph. Let us consider that this device was to be used on such trains as those operated thru the well-known Hudson River tunnels connecting New York City with New Jersey. The trains running between the Hudson Terminal or Cortlandt Street, New York, make but four stops, and these are shown in the diagram, being respectively Cortlandt Street, Pennsylvania Railroad (Exchange Place), Erie Railroad and Hoboken. Each phonograph record would be made up with the proper number of repetition sentences for each respective stop, as, for instance, the Cortlandt Street record might contain the record, "NEXT STOP CORTLANDT STREET—NEW YORK—ALL OUT," and this might be repeated several times with a brief interval between each sentence.

This idea was conceived for one particular reason, and that is that these trains are gradually being supplied with women guards, and it was noticed by continual every-day traveling on them, and especially when the trains were crowded, that many of the women guards spoke in such a low voice that their announcements of the next station could not be heard beyond a few feet. With this arrangement, which is not only practical, but extremely feasible, the lady guard would simply push the properly labeled button on her key-board, the key-boards to be placed on the frame of the car door at which the guards are stationed, when the following operations would auto-

Why not Make a Real Practical and Useful Application of the Phonograph by Combining it with the "Loud-Talking" Telephone as Illustrated in the Accompanying Views? It Would Save Much Confusion and Misunderstanding in All Public Places, Such as in Subways, Theaters and Stores.
May, 1918

"Vol. 6, No. 1"
By "ELECTRICAL EXPERIMENTER"—Herself

My parents always say that nice people don't talk about themselves and I guess they're right. But today I'm 6 years old, so I know you will excuse me for ont. I know of coarse that littered girls should be seen an not herd, but then I am such a lusty litter thing and so big for my age that I cant help being herd all over the United States an much more ther then that. I am now herd every mons all over the civilized world from New sendall to Norwai, from india to soil, from Transval to Tchina and from Kanada to Djapahn, they all know my voice and wellkom me evry mons.

That's pretty good for a six year old isn it now! ? ? Besides I can't help being loud at Times for my parents put me in each a loud new dres evry mons thet I thinke thei kwer, the Cleveland Plane deeler, the saint-luis Post despatch, a lotsanlots of other nice litter girls all over the country print nise storis about me evry singel mons. and do you know that I am the Biggest electric young girl in the entire world now? Bigger then evry other 3 electric girls combined! I go now to over one-Hundred-
sou-sand peepel every mons! 100,000 good an stancht friends! And no make belif from ether. no sit my friends pai for rise to kom to ther. House, eat, and them, honest. An moni toalks dont it now? Do you woneder that I am prout an a bid stuk up my hands when I haf a bid stuk up my hands when I haf

Of coarse I wasnt allwas so big. Wen I was first borned I wen onli to 3000 peepels Houses evry mons but then my parents got for the Baltimor to the philadelphia to the chigago Tribun, the New York Tribune, the New York sun, the boston transkrit, the philadelphia sun, the chicago Tribune, the New York American, the Siminatti En...
E. L. Blackhouse, desert little Ain't! Can't it? All used? Thei is a knute little sigar liter, o yea!

So dad went an sent all those 100 an hundreds of letters to the Chicagoa Bull-dog sigar liter manufakterer bekaus he thet that maybe thei would give him a big ad for me. Yes like shuger thei did.

An what do you think thei went an rote dad? Thei thent him for all those nine letters but wanted to now if dad was batti in his skilite and what he ment by colling their poor dear good old bulldog a sigar liter when poor thei was a lady kurling iron heater, an not a sigar liter at all!? My wasnt dad soar when he found out the bull hed maid of that bulldog!? the aire arround him was bloo for ours an ours an he triet to blame it on everi one in the plan. Poor old dad how could he hav gesset thei figo is hallo insides of him an thet there is a heating element inside the sides to heat mas or sis kurling iron in ??? But you cant beat dad, for you now what he want an did you never gess. Thei got the nerv to rite those Bulldog pepel that with a littel change thei could convord the kurling iron heater into a sigar liter eng ny an sell em to all those pepel an thet thei should be thankful to him for having gave them sech a good idea all for nothing!?! Can you head it???

But i reeli shouldnt mak fun of dad for he gave me a lot of brant new hats for my 6th birthdal. He calls em headings an he spent a bunch of moni on em and I like em. Doant you think their reel pecchi!?? i do. The one he calls Orakel i think is the nisest an he said over 1000 years ago their

We Were Never so Humiliated in All Our Lives Met so Well and Told You Our February Issue that this most Honorable Dog was found dead in the Street—An. We Thats the Real akan, it Ain't! But what is It? We are Alack it Ain't! It's Too Glaring, so Please Read the Accom-

lived a lady in a desert in a Q-as an her nain was miss Orakel an she told all the people what thei didn't now about an she was awfull wise. An therefor now when my friends wan to know something or other i will tell them all about it thru my oarke there pretty good for a six year old isn't it now!??

Now then i've tol you all the latest gos-sib i want to ask you a favor, a favor for me and one that will help you lotsanlots.

Dad sais that my friends doant read my ads enaf, and thei dont rite often enaf to my advertisry. An he sais that if thei only would and keep it up he could add 32 texd pages to me within 6 mons. Gosh i'd never belief it but the adverstment mangr sais its so, so it must be so after all.

You see dad sent all his moni on my texd dresses and blow in moare on them then he gets bak outo my ad pages, so at the end of the mons he owns hisself moni.

An yesterdai the printr blox in with a new kontrakt an wants 20 percent moare to get me out evry mons. Good nice, i feel dad would ether drop thru the floor into the seller or sale thru the selling but he jest

(Continued on page 50)
"Sub"-Detector, Thriller In New War Play

Did you ever hiss the villain? "Ask dad" he knows! In the palmy days of the drama "pop" used to line up in the gallery and watch the villain steal the heroine, only to be foiled by the noble hero who always drops in at the right moment! Then too, we had the wily adventurer who always tried to lure our hero away from his woozy-woozy. Do you remember those days? I'll guarantee not many of you do.

In these more advanced times it's the "movie" villain who holds our attention, and he usually wears a wrist watch! Even then he can't hear you when you try and give him the razzle! Such being the sad and distressing circumstances, energetic producers have awakened to the crying need and presented the American public with a regular old-time drama, imported from England where it has played for more than a year.

Set to American ideas with none of the thrills left out, with a real American hero and heroine, villains, spies, adventuresses, henchmen and all the rest of the "fireworks" handed to you under the title of Seven Days Leave and you have a real, live, heart-throbbing, patriotic war play, that is bound to wake up that slumbering spark and send you looking for the nearest recruiting station.

The story surrounds itself with the expected arrival of Major Fielding at Colonel Sharrow's house, Hampton Sandy, England. He has with him a special device which he has been working on, that will detect the presence of submarines. Incidentally he is in love with Lady Mary Heather, a neighbor of the Sharrows.

He arrives with a model of his wonderful machine and also the working plans of the same. While there, the plans are stolen by German spies who are in the guise of Belgian refugees. Then begins a series of dramatic incidents, thrills, heart-throbs and all thrown in, which lead to the capture and end of the plotters with U.S. Destroyers in action and the final sinking of the submarine—with the lovers united again.

It is interesting to note what novel applications and innovations have been adapted to stage and screen during the past few years.

The accompanying photo is a scene from the play wherein Major Fielding and Colonel Sharrow are testing the practicability of the submarine detector. An electric cable has been laid to the water-front and a sensitive microphone placed in the water. The machine is supposed to show the presence of a submarine and also its position from the microphone. The machine on its test indicates that a submarine is present which causes them great surprise. Later, this proves true and the submarine is blown up.

The cast is noteworthy, and should be commended on the spirit shown through the play. So if by any chance "Seven Days Leave" should play your town or near your town—even if you have to walk twenty miles—by all means don't fail to see it!

—George Holmes.

RUSSIAN INVENTS ELECTRIC MACHINE TO BEHEAD 500 AT ONCE.

Shades of King Henry the VIII, what are we coming to. Modern science has come to the aid of the Bolsheviks. In case they decide to imitate the French revolution and introduce the guillotine, in the person of a Russian engineer named Blum. He has submitted a new type of that instrument to the council of people's commissaries, and which is said to work by electricity; it will behead 500 victims with one stroke! Next!

AVIATORS USE ELECTRICALLY HEATED CLOTHES.

The accompanying photo shows two members of the British Royal Flying Corps donning their electrically heated gloves and foot insoles, preparatory to starting on a cold night trip over the German lines. The current for heating the gloves is obtained from the storage battery or dynamo of the plane. In the aviation service of some of the allied forces electric heating for all the clothing has already been quite extensively adopted. The aviator will thus be enabled to attain higher altitudes without inconvenience from the extreme cold of the upper air currents.
Research and Its Importance to Human Progress

By Dr. Willis R. Whitney
Research Engineer, General Electric Company

Scientific research, or research in the natural sciences and in the industries, might be defined as the pioneer work of the developed country. In this light it is easy to see that our times are new. Not long ago our pioneer work was of another kind. It was opening up the undeveloped land. It was actively and well done. But the work must change, because our requirements have altered.

I do not want you to look at research as an old, established utility. I want you to see it as I do: a powerful factor proved by the advance of the industrial welfare of the foremost countries, and a world-experiment of less than a century's trial, but something still unappreciated in America. It is true that the earliest man and many of the lower animals accomplished ends by research, but I refer now to research in the natural sciences and to the research which in our day is necessary to our desired activities. These sciences are already very highly developed, and advanced education is demanded by them. For example, if I wish to cure physical ills, I cannot expect to do it by reciting ancient incantations, nor by using roots and herbs, as was once customary. I must first familiarize myself with an accumulation of previous experience. I must study anatomy, physiology, chemistry, bacteriology, etc. This is a relatively recent world-condition. Copper, iron and five other metals were known and used at the time of Christ. In the first 1,800 or 1,900 years of our era there were added to the list of metals in technical use (pure or alloyed) about eight more, or a rate below three a century. There has been so much industrial advance made within the past twenty to thirty years that fourteen new metals have been brought into commercial use within this period. This is almost as many in our quarter century as in the total preceding age of the world. Conditions are similar in all the applied sciences. The accumulated knowledge in any field is already very considerable, and to get into the firing line of useful work one must go up past the baggage train of knowledge and experience.

I want you to realize that in America we are going ahead in the future at a rate dependent entirely upon our preparation. Laboratories are a relatively modern thing. In most of the sciences they are a development within the last hundred years. I want you to see that we must be foremost in systematic, organized research or we shall be distanced by other countries which already well recognize the value of new knowledge.

When so much of our material welfare, the condition and extent of our manufactures, the quality of our agricultural efforts, and the health of our people, depend upon the rate of our acquisition of new knowledge, there ought to be much greater effort made along the lines of research than is at present the case. We call knowledge power, but we need to see that new knowledge is the second power of power.

I am in favor of anything which helps train the American student in the path of sanguine research. It can be done by research men themselves, but probably not by others. It is not the knowledge which the student preparing for research needs, so much as the spirit of the investigator. His thoughts should not be fettered by laws, but helped by them to fly. This can be done best by those who are optimistic almost to the extinction of reason.

All service is based on knowledge, and knowledge is an ever augmenting thing which almost anyone may increase. If the stock is eternally useful, as it is, how great must be the value of the indestructible.

(Continued on page 48.)
Modern American Electric Furnaces

By Frank C. Perkins

The accompanying illustration shows the design and construction of a powerful industrial electric furnace developed at Chicago. The photograph shows a 5 ton, 3 phase electric furnace with two electrodes mounted in a tilting roof which may be opened and closed for operation.

In the electric furnace the quality of steel produced is such that it cannot be excelled by any other process, and ordinarily cannot be equaled. The electric furnace is virtually a crucible, with the heat of electric arcs on the inside—thus making it possible to melt and refine steel without the objectionable features of the blast. It leaves the metal freer from oxygen, nitrogen and other gases or slag inclusions.

As to the cost of the produce it is competitive with, or lower than, open hearth, converter, or crucible processes. This is in general due to the fact that steel foundries using electric furnaces make up their entire charge from old scrap, which in any market is enough lower than the combined scrap and pig used for the charge in other processes to offset the quarter of a cent per pound which electricity averages for conversion.

As the material is put directly into the furnace and its constituents are not oxidized unless oxidizing materials are put in for that purpose, the process is simple and the steel maker has the simple problem of having fewer elements to deal with and it is equally advantageous for steel or iron, and will prove as profitable for the small foundry as for the big steel plant. The rapidity of the process as compared with the open hearth practises, saves molding floor space and effects numerous economies.

in the form of labor and other expense. It is maintained that electric steel has greater density and is free from the blowholes that entail so much machining loss when discovered too late, while its tensile strength is 10,000 lbs. per square inch greater than open hearth steel.

Electric steel has an elastic limit from 5 per cent to 15 per cent greater, and its working yield-point is 20 per cent to 50 per cent greater. This is largely due to the freedom of electric steel from oxygen, nitrogen, and slag impurity, while the same heating processes leave in their produce because of the limitations of all fuel-melting processes, and which the electric furnace refines out of electric steel.

The fusing material in the electric furnace is at a higher temperature than the crucible, the heat is applied inside the crucible while in fuel-melting furnaces the heat is applied outside the crucible. Chemical composition of consecutive heats can be held more closely to a standard than with any other process. This is the most noticeable when handling easily oxidizable metals, like vanadium, chromium, silicon and manganese. Alloy additions may be made in the furnace itself rather than in the ladle, which increases the factors of thorium assimilation, diffusion and homogeneity.

When the five ton, three phase furnace has its roof tilted back it is in the charge position. This furnace is equipped with two top electrodes and a bottom connection to the bath. After the charge has been dropped into the furnace, the roof is pulled forward by a motor and sealed with a dry fire clay gasket. The spout is closed and the furnace is practically airtight, resulting in the most rapid deoxidation of the steel. The electrodes are motor operated and an automatic regulator controls the motor operated electrodes.

TO THE U. S. SIGNAL CORPS.

You could get along without the infan-tree, if such a thing should really have to be; you could let up on "typewriting,"

Quit most other styles o' fightin', and keep a battle goin' 'cross the sea; but I'll make an affidavit at my dear old mother's knee there wouldn't be no battles in the trenches 'cross the sea; oh, there wouldn't be no chasnt for them to carry on the war, without the kind assistance o' the U. S. Signal Corps.

Charley Gordon, with a ukelele, sang this at Camp Upton recently... The point may be adduced in vers libre; the signal corps is, after all, the nerve system of modern warfare. Take from the artilleryman the news of what his shells and shrapnel are accomplishing out beyond in the unseen and his big guns are as good as silenced. Take from the infantryman means of quickly receiving and passing along orders—and he's a cooked goose.

ELECTRICITY TO DO ALL CHORES EVENTUALLY.

Thomas A. Edison has said: "The time is not far distant when practically all of the work now done by woman in her home-keeping, so painstakingly and laboriously, will be done better, more simply, without labor, by machine."

A noted scientist recently said: "Whenever you see a man, woman or child doing any form of manual labor, remember, that labor can either be reduced or entirely eliminated by the use of electricity; and that in nearly every case the comfort of the operator can be increased."
Electric "Sherardizing" Prevents Rust

To assure protection against rust a sherardizing process is now standard practice for many electrical and mechanical products where rust prevention is a vital necessity.

Marked improvements in methods of sherardizing have taken place since this practice was first adopted and have resulted in a uniform product with highly efficient protection to the devices so treated.

The process of sherardizing consists of baking the parts to be treated, with zinc dust of the correct chemical analysis, at a predetermined constant temperature, for a period of time depending upon the thickness of the protective coating desired. The zinc is deposited both into and onto the surface to be protected and by entering the pores of the metal becomes a part of the device itself. There is, therefore, no tendency to crack or scale off even when subjected to distortion or changes of temperature.

A feature of sherardizing is that when applied to threaded surfaces these are protected as thoroughly as the other parts and yet can be turned into place with absolute freedom. Neither does it weaken malleable iron castings, since the temperature employed during the treating process is comparatively low.

As a result of the adoption of these methods one of the largest electric companies has developed its own electric ovens for the process and its own testing plant, where pieces of the finished product are subjected to a test of 168 hours in a spray of salt water projected thru an atomizer by a spray jet. This is a condition far more severe than would be encountered in service. Experience proves that the ability to stand this test for a week forecasts indefinite resistance to atmospheric conditions.

The inordinate strength, the durability and the uniformity of the Electrically sherardized coating on steels is not generally understood. To explain these facts a microphotograph is shown in the smaller cut.

A piece of polished steel was electrically sherardized, cleaved to show the connection between coating and steel then magnified and photographed. Note the even thickness of this coating, particularly at the corner. Electric sherardizing made this possible.

The black line between the coating and the steel is the juncture of the two substances. Small as it is shown, this juncture has been magnified 150 times. The final weatherproof coating, if desired, can be given a polish equal to nickel plating.

The sherardizing equipment consists of an electrically heated revolving oven mounted on trunnions which are supported in pillow blocks. The oven is rotated by an electric motor geared to the driving shaft. Metallic resistance elements are placed on each side of the oven and current is applied to them thru collector rings. The best formula for sherardizing can be carried out properly only in an electric oven where temperature, motion and atmospheric conditions can be perfectly regulated.

Photos G. E. Co.

SCIENCE IN MODERN WARFARE.

The Great War has been called a "grand physical phenomenon" and a "battle of the sciences." To the layman this does not mean very much, but it is nevertheless a fact. It could just as well be called a "chemist's war" or an "engineer's war" or a "surgeon's war," so much has the various sciences contributed toward carrying on the war, says L. L. Edgar, in Edison Life. Most of us do not think of the part science has played in this great struggle. All we see and read of is the terrible fighting and wastage of human lives. It is very interesting to go into the subject deeper and see what has made possible all this fighting, and just where science and its application has to do with modern trench warfare.

Every known science has played an important role, including chemistry, physics, hygiene, mathematics, engineering, geography, geology, metallurgy, geodesy, bacteriology, meteorology, astronomy, and many more of the physical and natural sciences, and secondly, it cannot do without the organization of the different scientific elements in connection with the military establishments.

Today one cannot tell whether the next officer he meets was a soldier before the war or a professor of science in some college. Productive brains receive more care and protection now than any other part of the population.

Let us take some of the more important sciences and see what connection they have in waging war. The astronomer has become an important factor in preparing artillery tables and maps and in perfecting instruments. The statistician is of invaluable help in planning an offensive, as is also the meteorologist. When trenches are dug, the geologist is consulted, as he can tell the best places for shelter, and the probability of striking underground waters. The leader of the war in France, in the person of the minister of war, is a mathematician, and his personal staff are of the same profession.

The science of acoustics, about which, up to the beginning of the war, very little was known, has blossomed out into that of the greatest importance. The French have in use several systems of determining by acoustics the position of enemy batteries. It is possible by these systems to tell to within a few yards the position of a gun fifteen miles away, to determine its caliber, to tell the difference between the discharge, the flight thru the air, and the bursting. The spot from which a shell was fired has been found before the shell landed and exploded. A battery of French thirteen-inch cannon, mounted on a railway truck, fired four shots in an invisible target over fifteen miles.
Electricity Makes the Hens Lay, by Heck!

Can electricity make hens lay more eggs? Yes, say the experts. While in New London, Conn., recently Professor Kirkpatrick and R. E. Jones, of the Connecticut Agri-cultural college, visited the poultry farm of Morton E. Plant, where electricity is being used successfully in increasing egg production. The success of this plan is owing to the fact that the hens eat more feed and a better balanced ration, Mr. Hoover's secretary please copy.

In describing the working of the experiment, Mr. R. E. Jones said there are 6,000 hens on the farm, 1,200 of which are in the experiment. These are divided into groups of 400 birds each. In the first the birds have electric lights and are fed from automatic hoppers, while the lights are on. In the second group do not have lights, but are fed from hoppers, while the third are without lights and fed by hand. The lights are controlled automatically by special electric clocks which it is only necessary to wind twice a week. The automatic hoppers used in the first pen are used only during the lighted hours. At 4:45 a.m. a two-candle-power light is turned on over the roosts, and at 5 o'clock these forty-candle-power lights are lighted in each house. These remain on until daylight and are turned on again at dusk until 9 p.m., when they are replaced by the small lights until 9:15 o'clock.

The greatest increase in production is found in the case of the old hens, it is claimed.

**EDISON-TRAINED BULLETS.**

Two negroes were walking along the avenue discussing the wonderful inventions brought about by the war.

"Yes, sah," one said, "an' a friend of mine who knows all about it says de heah man Edison has done gone and invented a mag-netized bullet dat can't miss a German, kase ef dere's one in a hundred yards de bullet is drawn right smack against his steel helnet. Yes, sah, an' he's done invented another one with a return attachment. When ever dat bullet don't hit nothin' it comes right straight back to de American lines."

"Dat's what I call inventin'," exclaimed the other.

"But, say, how about dem comin' back bullets? What do dey do to keep 'em from hittin' oubl men?"

"Well, mah frier' didn't tell me about it, but ef Mr. Edison made 'em you can bet you'll life he's got 'em trained. You don't spose he'd let 'em kill any Americans, do you? No, sah. He's got 'em fixt so's dey jes' ease back down aroun' de gunner's feet an' say: 'Dey's all dead in dat trench, boss. Send me to a live place where I got a chance to do somethin'.'"

—New York Herald.

**MARCONI COMING OVER.**

It is reported that William Marconi will replace Count Macchi di Cellere, Italian Ambassador at Washington. Count Cellere, it is understood, is returning to Rome and will likely be sent to Petrograd, where Italy is now represented by a charge d'affaires. Senator Marconi, according to these reports, will go to the United States as Italian high commissioner with the rank of Ambassador.

**ELECTRIC "BONES" FOR THE MINSTREL.**

Remember the last minstrel show you saw where the "end men" rattled their "bones" so delightfully? Sure you do! Well the end men of the next minstrel performance you witness may spring a novel surprise on you, for a New York inventor, Mr. Samuel Sussman, has patented a new kind of electric, fire-spitting "bones," which give promise of being a real novelty in the hands of a good minstrel.

The purpose of this invention is to produce a dramatic lighting effect in addition to the rhythmic sounds produced by the performer with the bones and synchronous with the movement of the same.

In the accompanying drawings are illustrated the general arrangement of the invention. Two electric wires connect with two elongated parts made of bone or ebony or some such hard wood. Thru the center of these, are holes drilled part of the way thru for the insertion of wires. At or near to one end of each of the bones and at one side of each, are attached metal spark electrodes. To each of these metal parts is attached one end of a wire.

A suitable portable box is provided in which are resistance coils and a connecting wire, which wire may be used for connection with the electrical supply. There is also provided a bent frame or collar, composed of metal, which may be covered with rubber or other insulator, to be worn under the coat of the performer and at each end of this collar wires are attached connecting the same with the bones. This collar is also connected by wire with the transformer or resistance coils of the metal case.

In operation the bones are placed in the usual manner between the fingers, and, the current of the electricity having been applied, the movement of the operator in shaking the bones connects the metal parts, producing by their contact flashing electric sparks. Needless to say the effect is best produced on a darkened stage.
Fixation of Nitrogen by Electricity

By Theodore Bodde, Research Engineer, General Electric Company

It seems appropriate therefore to explain to the public the reasons for and the meaning of the expression "fixation of nitrogen." First, just what is nitrogen? Nitrogen is a gas present in large quantities in the atmosphere in which we live. In fact, four-fifths of the air which we breathe consists of the gas nitrogen, and only one-fifth part of it is the precious gas oxygen for which our lungs crave, and without which no life would be possible. This nitrogen of the air can also become precious and useful if we make out of it the powerful explosives used not only for breaking up rocks and mountains, but also for fighting the enemy in war time. Then, too, the innumerable plants in our fields and gardens could not live without nitrogen in their food. Our fertilizers are therefore made principally from that element.

The nitrogen is so abundant around us, when in the air it is like a bird in the bush. We cannot catch it, for it is extremely difficult to combine it with other elements into useful material. In fact, it is so recalcitrant to any chemical combination, that only very high temperatures or special chemical conditions are able to overcome its independence and "fix" it to other elements. Once, however, that this nitrogen has been "fixed" or combined with another element, it can be made into a liquid or solid substance, in which shape it can then be handled and transported and done with whatever we please. This is what we call "the fixation of nitrogen."
NEW AUTO HEAD-LIGHT.
In this new auto lamp here illustrated, the manufacturers have designed an exceptionally powerful projector of compact dimensions, that is capable of projecting not only a projected main beam but also a non-glare general diffused illumination.

As we analyze lamp devices, say its inventors, we find that as it appears to the eye there are two sources of glare, one the filament itself and the other the reflector surface. The inventors argue that coloring the light does not enhance the visibility with reduced glare when applied to a unit source. Neither do they believe in the possibility of prismatic deflection nor that a parabola can have an optically correct relation to a multitude of small prismatic lenses with a conglomeration of axial alignments and foci. Therefore the possibilities in glare reduction and still possessing light projection are to minimize the glare due to direct visibility of the light source and to form a main reflector of least aberration and well concealed from the direct visibility.

In this new lamp an attempt has been made to carry out this idea with precision. The light source itself is embraced to the angle of 105 degrees with a spherical curve corrected for aberration and beyond the aperture of the main reflector we have an annulus or spherical curve whose geometrical focus is at an offset as shown in the illustration and therefore the light coming from the filament onto this annulus is not returned on itself but at a distance coinciding with that angle that the frontal screen intercepts. This frontal screen is translucent and light coming from the filament will partly illuminate the same and light coming from the annulus impinges on being slightly beyond the focal point of the main reflector. It also acts as a source of illumination in conjunction with the spherical reflector. The result is a highly efficient projected beam augmented by non-glare diffused illumination.

The inventors have also found that the critical angle reflection for metal reflectors takes place at 52½ degrees. That is whenever a reflector is made to embrace a light source beyond 105 degrees the resultant increase of light flux is a positive detriment to visibility at a distance.

WHEN "UNCLE SAM" TAPS THE WINDOW, YOU LOOK!
This window attraction device is operated by an electric motor and it can be attached to any electric socket, therefore there is no necessity of disturbing your window display when starting or stopping the figure. Its life-like motion of rapping on the window, turning the head and pointing the finger towards the goods displayed, makes it one of the most attractive advertising novelties yet devised.

NEW ELECTRIC SHAVELIGHT FOR SOLDIERS.
It throws a flood of light—not in the eyes, not into the mirror or around the room, but on the face, right where you need it.

The soldier’s days are busy. He must shave, usually at night. And it’s not to be expected that his quarters—often an old barn, farm house, etc.—will be equipt with “all the modern conveniences.” He will, therefore, find this new military style electric light shaving outfit very serviceable.

The outfit consists of a high-grade safety razor, with six crucible steel blades; the electric light attachment that attaches to razor handle; stropper; battery that will supply light for one-hundred shaves; high quality aluminum trench mirror—all complete in a compact khaki case. The light attachment can be used on fountain pen or pencil for writing where light is dim or wanting—also for reading.

An electric apparatus has been devised for giving warning of impending air raids. It is claimed to be especially applicable to factories and public buildings. An electric resonator is placed on the roof, and on the sound of a given pitch being produced, the resonator causes a loud ring in the building until it is stop. It is said that large areas can be simultaneously and instantaneously warned.

A TOY CIRCUIT-BREAKER.
The accompanying illustration shows a toy circuit-breaker for protecting all types of toy transformers against injury from short-circuits. It opens the circuit automatically, and can be closed by push-button only when the cause of trouble is removed. It is low in cost and will be found of interest and service to the junior engineers and electricians who operate miniature electric railroads, motors and other various small electrical devices requiring some form of protective apparatus.

For the Boys in the Trenches or in Camp. There Is This New Electric Shavelight. It Carries Its Own Battery and the Lamp May Be Used Separately When Desired.
The Phenomena of Electrical Conduction in Gases

Part II. How Fast Ions Travel

By ROGERS D. RUSK, M. A.

IONS may sometimes travel at almost infinite speeds. The velocities of these little electrically charged particles depend largely upon existing conditions, but may sometimes be as high as the speed of light itself. This indicates that there is enormous energy back

of these particles, and if we experiment a little we may find this energy doing strange things.

For instance Franck and Hertz, two modern physicists, have recently discovered that when a gas is ionized, light may be produced when the ions become charged. Franck and Hertz worked mostly with mercury vapor, and when they raised the potential between the electrodes, they found the vapor gave off a certain amount of ultra-violet light. When they increased the potential to 12 volts they discovered that just at that point a great deal more light was given off. The first voltage evidently marks the point at which ionization begins and ions receive a single charge. The second voltage evidently is the potential required to give the ions multiple charges, and in each case charging an ion causes the 

emission of light. This is quite in keeping with the electro-magnetic theory of light, and the modern belief in the electric theory of matter, for when the electric charge jumps to the ion the electro-magnetic disturbance in the ether is started. This kind of light may be called cold light, as an increase in the potential from 4.8 volts to 4.9 volts makes little change in the temperature of the vapor, for at the former point no light is given off, while at the latter it is. If some substance other than mercury could be found, giving a greater emission of light, the whole lighting industry might be revolutionized and instead of using incandescent lamps, which waste the most of their energy in the form of heat, we might have lamps operating on 
infinite potentials and giving off little or no heat at all. The nearest approach to such a light today is the Moore vacuum tube light which works however at a very high potential.

The great variety of speeds which an ion may have depends a great deal on the fact that we may have the following four general classes of bodies in an ionized gas.

(1) Single electrons.
(2) Charged molecules.
(3) Neutral or uncharged molecules.
(4) Neutral or charged molecules.

The latter may become charged at any time by ionization thru the agency of heat, X-rays, radium, ultra-violet light, or cold.

fusion with each other. The existence of such ions may be proved by demonstrating the conductivity of the gas, and they may be removed from the gas by straining the gas thru a glass tube fitted with a plug of glass wool, or by bubbling it thru water. It will then be found to be unisoned and nonconducting.

Straining the ions out makes it seem as if the ions must all be larger than the gas molecules which get thru, but this is not necessarily the case as it is most likely their electric charges which make them stick to the glass wool or remain in the water.

It may be well to notice, before going any farther, a very great difference between conduction of electricity in gases and conduction in solids or liquids. The amount of current which may pass thru a conducting liquid or metal varies with the resistance as per Ohm's law, C = E/R. However this is only partially true with respect to gases. The higher the voltage, the more the current falls below the value it should have by Ohm's law until a point is reached that an increase in the potential does not increase the current at all. At this point the current is called the saturation current, because all of the ions are being carried out of the field, as fast as they are formed. Hence this is a maximum value for the current. Its meaning can best be understood from the curve, Fig. I, representing the variation of the current with an increase in potential. The current as will be seen rises rapidly at first, but soon begins to slow down and at last reaches a steady value at A where the slope has become zero. The current then in a gas depends upon the total number of ions being formed in the gas. However, a very interesting phenomenon is noticed if the potential is raised a great deal higher still than its value for saturation. At a certain point the curve will begin to rise again showing that contrary to expectations the current, after having reached a maximum, is now increasing again. The complete curve will now appear as in Fig. 2, where the second increase is found by observation. This is due to the fact that when the potential is raised to a much higher value, the existing ions are swept across the field so fast that they encounter neutral molecules in their flight, and ionize them by collision, thus producing fresh ions, and thereby increasing the number of carriers for the current.

In measuring the velocity of the different kinds of ions the first necessary step is to separate the positives from the negatives. As the first measurements were made on ions in vacuum tubes, this can be easily accomplished by such a tube as shown in Fig. 3. The rays between the cathode C and anode A, are a mixture of both positive and negative ions traveling in opposite directions. However, if each electrode is perforated with a small hole near the center it will be found that some of the positive ions formed at the anode will travel thru the perforation in the cathode into the space beyond it; while the same thing is true of the negative ions formed at the cathode, some of them will have time to open the anode into the space beyond. So far, it has been found that the positives travel with a comparatively slow speed while the negatives may even travel as fast as 186,000 miles per second.

There is a certain class of modern scientists who believe this velocity is the highest possible velocity that anything may ever have. Those who believe this are the upholders of the theory of Relativity. They hold that such realities as time and space cannot exist independently of each other, but are connected by a very close relationship (hence the name Relativity). They say by this relation everything else in the universe is conditioned, and that no velocity can exceed the velocity of light, which is the swiftest form of energy known traveling in the lightest medium, the ether. As this theory has met with a great deal of criticism it is probable that the question will remain open for some time as to whether a higher velocity is possible or not. However, it is interesting to note that the velocities of the ions do approach this value seemingly as a limit. Also this may tend to show that the fastest ions after all are nothing more material than light itself, and we call them unit charges of electricity.

(Continued on page 57)
Capt. E. H. Armstrong "Over There"

All American radio men are acquainted with Edwin H. Armstrong, the young genius who devised and patented the now well-known "Armstrong Circuit" for Audions, by which it became possible to make a single bulb regenerate or develop radio-frequency oscillations, so that undamped, as well as damped, waves could be received and amplified.

We are pleased to reproduce a photograph of Mr. Edwin H. Armstrong, the well-known American wireless expert, who was awarded the medal of the Institute of Radio Engineers for his discoveries in the radio art. Such an award constitutes in itself a recognition of genuine service in the cause of radio science. Mr. Armstrong was born in the United States on December 18, 1880, and after passing, with credit, thru the usual school curriculum graduated at Columbia University, from which he obtained his degree in 1913. Since that date he has concentrated his efforts on the advancement of radio-telegraphic science, working in conjunction with Professor Pi- pin, the President of the Institute of Radio Engineers, in his important research work at the Columbia University laboratories. Mr. Armstrong is himself one of the Directors of the Institute of Radio Engineers, besides occupying the post of President of the Radio Club of America.

Like so many other of his fellow citizens, he has answered the call of his country to aid her in the role she has undertaken in the present struggle, and recently received his appointment as Captain in the U. S. Signal Corps. This young scientist of twenty-eight has already won high distinction by his work in wireless telegraphy. Perhaps the invention most widely connected with his name is that of the "Armstrong Circuits," which have done so much to improve the sensitiveness to reception of wireless apparatus through the instrumentality of the three-electrode valve. Mr. Armstrong has thrown much energy and zeal into the work of the Institute and has made many valuable contributions both to its discussions and its Journal.

Captain Armstrong is now in France with the American Expeditionary Forces. His skill in the radio art will prove of supreme value to the American army.

RADIO SAILORS GET INTO TRIM FOR SEA DUTY.

The accompanying photo is an unusual interior view of the new Austin Hall operating rooms at the Harvard Radio School. Time and especially war will change all things. This room was formerly in more peaceful times, a part of the Law Library study at Harvard. Here the radio operators which are to man Uncle Sam's rapidly-growing battle fleet are taught the science of wireless by experts, many of whom were well-known radio workers in civilian life prior to the declaration of war against the Central Powers. Now one hears the constant buzz-buzz of the radio-telegraphic dots and dashes all day long. The men are not kept at code practice all day long—but as fast as one class finishes its period, another takes its place. Thousands of future naval Radio operators are being taught how to handle wireless apparatus and how to send and receive the mysterious dot and dash messages at this school. Today a battle- ship, or any vessel of the line, would be practically "blind" without its Radio equipment and squad of Radio operators—three to six of whom are supplied to each war vessel.

UNIVERSITY OF ILLINOIS OFFERS WAR COURSES.

A war course in Radiotelegraphy is being offered by the electrical engineering department of the University of Illinois to junior and senior students of this department as an elective. An oath of secrecy and appearance before a notary public by those entering the course, vowing that they will in no way divulge any facts learned in the course to any persons other than Government officials, is required. Apparatus for receiving messages (the receiving sets alone being furnished), with confidential information and instructions for their use has been loaned the University by the United States Signal Corps, Prof. Elery B. Paine, head of the department of electrical engineering, is the instructor in the course.

The department of geology is also offering an interesting course, dealing with the iron and coal factors in the warring nations of Europe, lines of communication and other topics concerning the geography and geology of the war theater. The University has pledged itself to instruct 5,000 soldiers, either engineers or regular soldiers, for skilled war service in the departments of mechanical and electrical engineering, including laboratory and shop practice. Announcement has also been made that the ground school of the work in military aeronautics will be doubled in size, providing accommodations for 1,200 students.

Speaking about the capacity of condensers, are you aware of the fact that the entire capacity of the earth is only .707 microfarads?
RADIO TAUGHT IN NEW YORK TRADE SCHOOL

There is a great demand for radio men in the Signal Corps and to meet this need classes have been formed in many parts of the country. One of the most interesting in New York City is that held at the Stuyvesant Evening Trade School. Only men who will be called in the second draft and who have been examined and placed in Class 1-A are eligible.

As these men are still earning their bread and butter, they can only do this work in the evening. Despite of this fact the results are extremely good. The men are heartily and eager to gain the required proficiency of sending and receiving 20 words per minute. This is the standard speed set by the Signal Corps. Thus the patriotic devotion of the instructors it has been found possible to have these evening classes free.

The equipment used in teaching the radio classes is of the best and very latest type. The head-bands are of the new single bar type widely used in the government sets and weigh less than any other style so far designed. The tone buzzer used is a new design giving the true 500 cycle spark pitch, so that the students are trained under as near working conditions as possible. This is more important than it might seem at first, for if the student is accustomed to hearing the signals on a low pitch tone he is very liable to be confused when he first hears a "real" wireless signal coming in on a high pitch note.

In an interview with Mr. T. H. Know, principal of the school, as well as Jacob Weiss, Head Instructor, we were informed that the instruction is entirely free, all apparatus being furnished. All the drafted Class 1-A men are eligible, and all those that are subject to call. The school can still accommodate a few more men.

We see no reason why wireless amateurs should feel discouraged on account of the closing of their radio stations. To us, we see an opportunity for the amateur to fix up his set to perfection, study up his theory, and when the war ends be ready to do efficient work.

Wireless communication was first established between Japan and the United States, July 27, 1915.

ELECTRICAL EXPERIMENTER

NEWS OF BUENOS AIRES—NEW YORK RADIO

By Leon Gireaud.

I am pleased to inform the readers of the ELECTRICAL EXPERIMENTER of the progress of wireless telegraphy in this country.

In the first place, we have the arrival of the American engineer, Mr. Charles Edbridge, who comes to direct the work of installing an ultra-powerful radio-telegraph station for direct communication between Buenos Aires and North America, the concession having been granted to a North American company a year ago. This plant will be installed in San Isidro (near Buenos Aires), and the plans have already been approved by the government. Recently, however, some modifications have been suggested. The original plan called for the antenna to be sustained by three towers 300 meters high (about 1,000 feet), but in the modification two have been suppressed. The transmission system will be such as is used in nearly all of the large stations—Poulussen 500 kw., length of wave 24,000 meters. Altogether there is no station in the city, it will have direct communication with the offices which will be established in the central boro. The price of this station is calculated to be $750,000 (American currency).

It is also worth mentioning the attempts that have been made to communicate with Nauen (45 km., from Berlin). The interested parties secured a three months' authorization to erect a station which they placed on the Florida farm in the Pleiner station. The characteristics of this station were as follows: the most modern type of receiving apparatus was used, including a Lieben valve; the copper wire antenna was sustained by 16 posts, 32 meters (105 feet) in height, and a wave length 8,400 meters; the ground constituted a network of iron wires, 800 meters (about 2,600 ft.), long, interred in the form of a fan at a depth of 1 meter; the antenna has the same reach toward the east as that of Nauen; taking into account the distance between Nauen and Buenos Aires, which is in a direct line, 13,000 kilometers, there are various difficulties.

Notwithstanding these difficulties, the constructors have been able to get into direct contact with Nauen, but owing to the great atmospheric discharges (static), have not been able to decipher the messages; these discharges are due partly to the form of the antenna, which, because of their length and height, cut thru various atmospheric strata, producing violent discharges which disturb the reception.

Nauen has a power in the antennae of 200 kw. and a wave length of 8,000 meters. Before rupture with the United States, it was supposed to be 300 kw.

At the end of the three months, the constructors asked the government for an extension of time of one month, stating that they had not been able to communicate owing to the fact that they did not know the exact time when Nauen transmitted with entire power. We note that this is not true. After several days delay, the Secretary of the Navy appointed an engineer to investigate and determine as to the probability of their having received messages from Nauen. The report was unfavorable, and he ordered the dismantling of the station.

It is probable that they were able to receive perfectly, since in 1913 the "Cape Trafalgar" could communicate with Nauen from S. de Bahia, Brazil. At that time the

WOMAN OPERATOR IN THE U. S. COAST GUARD.

Yes, the women are bound to get to the front in this war. Here we have Mrs. Myrtle Hazard, Hailing from Baltimore, Md., a Hale and Hearty Radio and Morse Operator. Now in Uncle Sam's Coast Guard Service.

Mrs. Myrtle Hazard, who is from Baltimore and the only woman electrician in the United States Coast Guard. She is one of the few women radio operators in the government service. She learned the job in four months' study at a class in the Baltimore Y. M. C. A. and past the difficult government examination easily. She is both a Radio and a Morse operator.—Photo Harris and Evans.
External Grid Vacuum Valve Construction

A Unique and Simple Means of Making Experimental Amplifiers

By R. U. CLARK, 3rd

SINCE the introduction of the first real practical hot filament detector into the radio field, it has been the one great ambition of every wireless amateur to construct experimental vacuum valve detectors for personal use. Sad to relate but very few workers in the past have had the means necessary to perform much research work in this branch of the art, owing chiefly to the expensive apparatus required for the actual construction of the bulbs.

It is regrettable that the above should be the case—especially in view of the fact that the particular instrument under consideration may still be considered in the embryonic state, and quite capable of being vastly improved.

The present high cost of all good detectors of the valve-amplifier type precludes the possibility of their being used, in furtherance of new ideas, except by those with money to spare, and in most cases places them beyond the reach of many earnest workers.

After a considerable expenditure of time and money, the writer has evolved a very simple and inexpensive method of making experimental vacuum valve detectors, of the external grid type, which will be explained at length in this article. It is the hope of the author that the idea involved, which has been thoroly proven, will be of great interest to a large class of readers. Certainly no one field offers more opportunities of interest to experimenters than the one in mind.

Considerable incentive and encouragement may perhaps be found by others in the fact that, after the direct output of much little work, the actual discovery of the double filament bulb, that plays the all-important part in making our experimental detectors, was the result of chance. During a few minutes' respite, spent in looking through a motor magazine, the writer became aware that the solution of the problem of making valves was staring him in the face in the guise of an auto head-light bulb with two filaments.

It often happens that such discoveries are the result of chance, but the fact remains that unless the particular finding fits in with the line of work being undertaken at the time of enlightenment, the incident will be forgotten or prove of little use. The author, and probably many others—had often thought of using the "High-low" type of electric light bulb for constructing valve detectors, but had always given the idea up as impractical. It remained for the urge of real necessity to demand that every possible means be given a thorough trial.

As may have been already surmised, the real workable valves which are illustrated in the views accompanying this exposition, are not only of the external grid type, but also have two filaments, and thus double life to the instrument. It will be at once apparent that, since the bulbs contain two separate filaments and circuits within them, that one is to be heated by the low voltage battery, and the other is intended to constitute the plate, and when used as such its two wire leads will be short-circuited. When one filament has burned out in use it will be reconnected to form the plate, while the other filament, formerly acting as a plate, will furnish the heat necessary to throw out the stream of desirable electrons, on which the whole action of the device depends.

In the first illustration there is shown a view of the "High-low" auto head-light bulb which does the trick. This lamp should be purchased in accordance with the following specifications, and if not obtainable at any of the big wire supply houses in the reader's home town, they can be had from the makers or others as listed elsewhere in this issue. The bulb which the author, after a good deal of searching, has found best suited to the peculiar requirements of the valve detector is rated as follows:

Maker's Number Volts C.P.
T. 14 6-9 4 & 12, also 12 & 18 C.P. semi-

Macro's with double-contact bayonet base. Usual retail price 80c, with 35% off on lots of 5, making the price 55c each.

Unless these lamps are specially ordered, send stamped self-address envelope to the editor and names of concerns supplying these lamps will be sent gratis.

From the makers, and specified in this case "without bases," it will be necessary to carefully remove the brass ferrules and separate compound, which holds together the lamp base, after first cutting the connecting wires away at the contacts to which they are soldered. This work is best done with file and a pair of nail-pincers, and much caution should be observed to prevent accidental breakage.

It will be taken for granted that the experimenter intends to prepare more than one bulb for the initial try-out. Altho there may be a slight difference noticeable in the behavior of different bulbs of the same make, the variation will be found in most cases to be very slight. The first bulb tried out, however, might be defective; hence the advisability of using more than one lamp in testing out the idea involved.

A word at this point in regard to the operation of the valves under consideration may save much trouble later, on in the game. A good deal has been said against the hot filament detector which is manifestly undeserved. It has been repeatedly stated that, unless exhausted of air to a very exact degree, devices of this nature will prove worthless as detectors. Quite naturally, this is true to a certain extent, but it is often possible to obtain almost equally good results from valves which may vary in this particular, provided the operator is willing to work to find the optimum point of filament luminescence and high voltage adjustment, as required for the utmost sensitiveness under varying conditions of vacuum within the bulb at hand.

Another point worth mentioning is that of the strange and oftentimes erratic action of this class of detectors after they have been considerable use, which calls for the same solution as above stated. The fact is that probably no one thoroly understands these bulbs as yet.

Before fitting up the lamps as detectors, the wires which lead to the inside should be tested for a possible short-circuit which must, of course, be avoided, except as explained elsewhere. In order to gain a clear conception of the new bulb circuits, which are to be obtained by rearranging the filament leads, the reader is asked to refer to the diagrams in Fig. 2. In this drawing the view A represents the normal connections as made by the manufacturers. At the point I in this view the wires should be disconnected. At B and C, same figure, the correct wiring plan for using the upper and lower filaments respectively, at incan-
descence, is shown.

(Continued on page 58)
INDEXING RADIO CALL BOOK.
Very little explanation is required. The illustration shows a method of "tab" indexing the "Official List of Radio Stations of the United States" (or any other similar book of reference) to make consultation quick and easy. These index "tabs" can be brought in any first class stationery store for 10c a box.

ELECTRICAL
frequency around series.
The in 29 screw, considered a their telegraph the It is quick store.

INDEXING
Jar ters, This Index of for and Filled is. Is Your Radio Catalog, Go to Your Stationer and Ask for a Box of "Thumb Index Tabs," Here's the Result.

MINERALS FROM BROADWAY, NEW YORK.
"What you can't get in New York, you cannot get the world over," is one of the proverbs of New York. While many curious things are found along Broadway, it will probably come as a surprise to many, that Broadway is one of the most curious mineral centers in the world. Very few people realize that on Manhattan Island over 118 varieties of minerals have been found—not only minerals, but real gems.

For instance, on Broadway and 157th Street, there have been found aquamarines weighing 1 1/2 carats. From this locality also come brown tourmaline, golden beryl and rock crystal, which can be cut into gemstones. Of particular interest to the electrical man is the fact that on Broadway and 176th Street there are found, besides beautiful green tourmaline gems, magnetite and iron ore, chalcopyrite, malachite and pyrrhotite, also a source of nickel in a crystal form, which is considered quite rare in any locality.

Many other rare minerals in addition to the few listed are used in the manufacture of the perikon detector; also the lead mineral roselignite. Other minerals of interest found along Broadway are agate, amazon-stone, amber, amethyst, crysoberyl, fire opal, garnet, peristerite, prehnite, rock crystal, rose quartz, smoky quartz, precious serpentine, tourmaline and willenite.

The commercial minerals include silver, lead, zinc, copper, iron, feldspar, molybdenite—which is used in the molybdenite detector—garnet, amethyst, mica and beryl. The radio-active minerals attinite, torbernite and uraninite are also noted. Also a very good grade of iron pyrite called the "common fool's gold" has been found in fair quantities in the upper parts of Broadway. Iron pyrite, as is well known, is an excellent mineral for detecting radio signals.

FREAK OF RADIO.
A peculiar phenomena which has never been explained well is that which takes place at several points along the Atlantic Coast. There are times when a vessel in radio communication with another and the signals gradually die out and then increase to their normal sound. A similar effect has been noted by amateurs also, when sending in one direction can cover much greater distances.

Zeppelins can attain a height of 18,000 feet, or about 3 1/2 miles. They easily remain in radio communication with their home stations.

MICROPHONE "HOWLER" FOR CODE PRACTICE.
Here is a photo and wiring diagram of three handy pieces of "Bug" laboratory apparatus showing what can be done with odds and ends of a wireless experimenter's assortment of instruments which are now idle. It consists of a telegraph key made on the principle of a Vibroplex, and it works, too, having tried it out on long telegraph lines of the A. T. & T. and Central Union Telegraph Co. A handy box for it is made from light hardwood, so that connection may be made from each pair of cells, spring clips can be seen at the end of the box, for each pair of battery-ends have these spring clip connectors.

This Genius Has Built His Own "Hy-Tone" Microphone Howler for Practising the Code. By Varying the Distance Between the Microphone and Receiver, Tone Can be Changed at Will.

The box now has a capacity for 24 cells but only 12 have been placed in it. This gives me a range of voltage from 3 to 10 at the present time.

Best of all is the contents of the small box, a tele-phones transmitter, telephone receiver placed rigidly in an extension telephone bell box, and made into a "howler" in imitation of the Sayville, L., L., station wireless tone. It gives a remarkably clear shrill tone of a frequency of 500 to 800 cycles, depending on the distance the receiver is mounted from the "howler" box. The transmitter being solidly mounted in grooves cut in the edge of the box and the receiver mounted on a screw, similar to the method used in adjusting the magnets of a telegraph relay.

Several "wireless bugs" have listened to the tone of this "howler" and pronounced it an excellent reproduction of the Sayville tone. A home-made induction coil made on one bobbin of a buzzer, and wound with a resistance ratio of 1 ohm to 50 ohms, is connected in series with the battery and transmitter-receiver and the receiver connections are taken from the secondary winding of the coil as shown in diagram. When telephone receivers are being used, the box is packed with cotton and a lid put on it so the sound of the "howler" will only be heard in the 'phones.

The ratio of the resistance of the windings of the induction coil is not according to Hoyte. I found that I only had that much wire to put on it, but a pair of receivers on the secondary winding gives the proper amount of tone to the receivers to make it sound as if its name-sake were really coming in. The "bug" key can be made from odds and ends which most every amateur has in his work shop and it surely beats sending with the old style key.

Contributed by CECIL A. RICH.
NO. 8—DETECTORS.
From time to time we will describe one particular instrument used in either the radio transmitting or receiving set, explaining just how it works, and why. We have received so many requests from new readers asking for such explanations that we have decided to publish this matter in serial form. In the course of several issues all of the principal transmitting and receiving apparatus will have been covered. The subject for the eighth paper is DETECTORS.

![Diagram](image)

The Principal Types of Radio Detectors Are Here Illustrated and Described. The Detector Is One of the Most Important Apparatus Used in Receiving and Translating Wireless Messages and Should Be Very Carefully Studied.

In all modern radio receptors, especially in those sets used by the army and navy, the detector is one of the most important parts of the whole equipment. It has been developed and refined until at the present time it is quite a respectable instrument, as far as its efficiency is concerned. The detectors now in use classify broadly into three groups, viz.: mineral rectifiers (without battery); mineral rectifiers (with battery), and vacuum valves. Each class of wave interrupter and translator seems to fulfill certain requirements best. Where the vacuum valve would prove too sensitive and delicate, as in mule pack sets, etc., the mineral type detector proves best. Where the radio set is subject to fair treatment the vacuum valve or Audion detector proves feasible. For trench and field work the mineral detector is pre-eminently the type to use; it is once rugged, simple in operation, always reliable, easily repaired, and last but not least, it requires no battery. An Audion detector is, on the other hand, liable to breakage, disarrangement of the electrical system, requires frequent adjustment, and must always have a fresh battery to light the filament, besides a 40 to 60 volt dry-cell battery for the wing circuit.

The minerals most in use as rectifiers of rendering them capable of operating the telephones at an audible frequency. This rectification process is shown graphically in Fig. 1 at A, B and C. Curve A shows several damped wave trains as rectified on a radio antenna; curve B delineates these wave trains rectified by the detector so that the current is allowed to pass only in one direction, while the dotted line indicates the form of current pulse passing thru the telephones, where the rectified current is smoothed out by the inductance of the telephone receiver windings. Thus it is seen that what the operator hears in his head phones is not the high frequency aerial oscillations, but a rectified pulsed current having a (group) frequency corresponding to the frequency of the current charging the condensers at the transmitting station. If it employs a 300 cycle detector, the operator at the receiving station hears a 300-cycle note in his head phones, etc.

As to the hook-ups used with the mineral detector, let us glance at Fig. 1. This shows how a non-battery mineral, such as galena, iron pyrites or silicon, is connected up in a simple tuned circuit comprising aerial, tuning coil C, and ground. A high resistance pair of phones is invariably used in such systems, connected either across the detector or the fixed condenser as the dotted line indicates. Fig. 2 illustrates how the battery-using mineral is commonly hooked up with a potentiometer having several thousand ohms. A heavy duty circuit and now used in the Signal Corps outfits is shown at Fig. 3-A. Here the current passes around thru the secondary of the loop transformer. Three volt or 2.5 volt cells is usually the potential applied across the terminals of the potentiometer. The potentiometer slider (or switch) is adjusted until the maximum strength of signal is heard in the 'phones. Also the direction of the current thru the mineral is important and it is well to provide some means of reversing the switch in the battery circuit so that the current can be reversed thru the detector. The mineral is usually connected to the negative battery line.

The Perikon Detector was developed by Dr. G. W. Pickard. This detector consists of two crystals—copper pyrites (Cu Fe S) and zince (zinc oxide ZnO), between which contact against each other in the manner shown. The copper pyrite crystal is mounted in a cup mounted on a spring-actuated rod provided with a suitable knob, by which it can be swung in any direction. Zince crystals are mounted in a large cup containing several pockets, the mounting of both of the minerals being effected with a low fusing solder, Wood's metal or Hugonoi alloy. The action of the Perikon detector is supposed to be based on the rectifying principle previously described; that is, it will pass current in one direction but not in the other. The receiving radio frequency oscillating (alternating) currents in the aerial are rectified and caused to give a sound in the high resistance phones connected to this detector. This detector is invariably used with a battery of about two cells and the potential applied regulated by a potentiometer. When using a battery the polarity of the current must be such that the positive wire is connected to the copper pyrite crystal.

Diagram Fig. 3 shows the simplified connection for a "Radiophone" electrolytic detector, the 'phones serving as...
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Design for a Panel Transmitting Set

By James R. Hopkins

Did you ever consider that compactness and efficiency in wireless means success? Many amateur wireless operators place their transmitting apparatus a good distance apart so that each instrument may show off to its best advantage, and by doing so they little consider the unnecessary length of the connecting leads, which offer great resistance and very often lack of resilience in the circuit, thus producing unsatisfactory results.

For the benefit of those who are looking for success I shall endeavor to describe a Rotary Gap, panel type, transmitting set, which is not only very efficient but offers a good appearance. A set of this type makes possible very short connecting leads, which are absolutely necessary in an efficient short wave radio transmitter.

The arrangement of the apparatus should be clearly seen by the accompanying drawings. Compartment A contains the transformer embedded in sealing compound. B is the adjustable condenser, consisting of twelve 8x10 inch glass plates, coated with tinfoil 6×8 inches; these are connected in sections of two plates each and controlled by switches C, mounted on the panel. Compartment D contains a rotary gap of the ring type; the ring and rotary arm should be made of Bakelite. E is a protective device to carry off kick-backs and may be of the carbon rod or of the condenser type, as the builder prefers.

The oscillation transformer F is of the pancake type. A resistance coil G is placed in series with the rotary gap motor to vary its speed, and the light H may be connected in series with the transformer for short distance work.

I am not able to give any fixed dimensions, as transformers, motors, etc., vary considerably in size; with the 1/2 K.W. set I am using, the cabinet is 12 inches long, 6 inches wide, and 18 inches high, built of 1/2 inch birch, with the exception of the panel, which is of black fiber 1/4 inch thick, this being firmly screwed to the case to prevent warping.

The hook-up is given in Fig. 1 and the general scheme of arrangement is shown in the side and back views in Fig. 2, while the front view (photo) shows the panel on which all control switches are neatly mounted.

If the general idea of construction is carried out, I am sure the builder will be greatly pleased with the results. I used this set with great success for over a year prior to the war.

A UNIVERSAL SOLDER.

A very novel scheme for making a solder that beats the ordinary solder is as follows: Mix with a good brand of soldering paste as much granulated bar or wire solder that possibly can be mixed (which is done for the sake of economy) and a solder of excellent qualities will be made. It is useful to the electrician in the wires "pin on the celling" can be soldered by applying this mixture, and it is then only necessary to apply the heat of a match. Many other ways for its use will suggest themselves to the everyday practical man. In fact, it will save lots of soldering from being wasted by dropping to the floor. This is the case when applied by the old method.

Contribution by E. DUSKIS.

TO STOP LIGHTS FlickERING.

Many radio amateurs who are annoyed, and are annoying others, by drawing too much current from their supply lines, might be interested in a way to remedy this. The diagram illustrates this without much description; a few words will not be amiss however.

Balancing Radio or High Frequency Transformers With Lamp to Prevent Flickering of Lights on Regular Lighting Circuits.

This idea is not recommended for powers exceeding one half kilowatt as the cost of operation is higher. The writer uses this with entire satisfaction on a transformer of 300 watts input; to balance this current consumption, a lamp bank consisting of three 120 watt carbon lamps is used. In the case where a transformer of higher or lower rating is used, the lamp-bank or any other resistance must be made exactly according. If important to use nothing but silver contacts on back end of key lever, of the same size as those used on transformer circuit; it is well also to have as little vertical play as possible.

Contribution by L. H. REINER.

DETECTING PHONES WOUND WITH GERMAN SILVER WIRE.

The use of high resistance 'phones for use in wireless telegraphy has led many unscrupulous manufacturers to wind their 'phones with German-silver wire, getting the necessary resistance without the efficiency of the copper wire wound 'phones.

This cannot be detected by measuring the resistance and since in many cases a few layers of copper wire are wound on over the German-silver, it is rather difficult to detect these inferior instruments.

However, we can take advantage of the fact that the coefficient of resistance of copper is much greater than that of German-silver. It is only necessary to connect a galvanometer in series with the 'phones and a few cells of dry battery. On closing the circuit note carefully the reading; allow the current to flow for several minutes and if the galvanometer needle gradually drops back you may be sure the windings are of copper wire; but if the needle stays at the same point or nearly so for several minutes, the windings are of German-silver.

Contribution by T. W. BENJAMIN.

A CORD TIP TERMINAL.

It's Always a Mean Job to Properly Connect Cord Tips to Apparatus. Here's a Good Way of Bending It.

Take a piece of springy metal, one inch long and 1/4 of an inch wide. Put a small nail in the middle and bend the strip of metal as shown, and bore a hole in each end to fit a screw. It will be the saving of much time and patience.

Contribution by L. SIMMONDS.
Theory of Tuning, Wave Lengths and Harmonics

By Prof. F. E. Austin

Instructor of Electrical Engineering, Thayer School of Civil Engineering, Dartmouth College

SO-CALLED resonance is of very great importance in the operation of wireless apparatus, and every operator should have a good working knowledge of the theory of resonance and of its practical application. Even the experimenter will work to much greater advantage, with a knowledge of the fundamental law and its careful application, in making and operating tuning coils and similar devices.

When a coil, consisting of a number of turns of insulated wire, is connected in series with a condenser, and an alternating pressure applied to the terminals of the arrangement, as indicated diagrammatically in figure 1, the alternating current in the arrangement indicated by an ammeter connected as shown may be express by:

$$I = \frac{E}{\sqrt{R^2 + \left(\frac{2\pi f L}{2\pi f C} - 1\right)^2}}$$

If a direct current pressure, having the same numerical value as the alternating pressure be applied to the same arrangement, the ammeter will show no indication at all; the condenser, having a very high resistance, really prevents any direct current from passing. Of course, a direct current does exist while the condenser is being charged, but this is so small the ordinary ammeter will seldom indicate this minute momentary current. With an applied alternating pressure, however, the result is very different: since the condenser is very rapidly charged and discharged, the ammeter indicates the presence of the current continuously.

Considering now the different symbols employed in the given equation it may be noted first that the numerator \( E \) denotes the applied alternating-pressure, having a frequency denoted by \( f \) (\( f \) means the number of complete cycles per second). \( R \) denotes the resistance of the coil, expressed in ohms. \( C \) the capacity of the condenser in farads, while \( L \) denotes the so-called coefficient of inductance of the coil, express in henrys. \( L \) depends upon the square of the number of turns of wire of which the coil is composed; that is, of two coils of the same general shape, the one having twice as many turns as the other will have four times the inductance.

Also a coil having an iron core will have very much greater inductance than the same or a similar coil without the core. When, as in wireless work, it is desired to employ very high frequencies, coils having no iron cores are used, since they may be magnetized and demagnetized very quickly and without absorbing an excessive amount of energy. The symbol \( \pi \) denotes the value of 3.1416.

It is instructive to note that if the condenser be removed from the circuit and a direct-pressure be applied to the terminals of the coil, the direct current may be express by \( I = \frac{E}{R} \); that is, according to Ohm's law.

Now, by looking at the first equation it is evident that the last equation may be obtained from the first when the numerical value of \( 2\pi f L \) is made equal to \( \frac{1}{2\pi f C} \).

When such numerical relationship obtains in any case, then resonance is said to exist.

The value of \( \pi \) is, of course, a constant at all times and the value of \( f \) is definitely fixed for any given circuit. It is, therefore, apparent that with a given fixed value for \( 2\pi f L \), a similar numerical value for \( 2\pi f C \) may be found by varying the value of \( C \).

The value of \( C \) for any condenser depends upon the number of sheets of dielectric used in making the condenser, upon the kind of material the dielectric consists of, upon the size of the dielectric sheets, and upon a numerical constant which is dependent upon the kind of units employed in expressing size or area, and thickness.

The capacity of ordinary condensers made up of sheets of dielectric and metal plates, may be express by:

$$C = \frac{\pi n a n}{t}$$

In the equation \( A \) denotes the area of each dielectric sheet in square inches, \( n \) the number of sheets used, \( k \) the so-called coefficient of inductive capacity, and \( t \) the thickness of each dielectric sheet in thousandths of an inch; that is, in mils.

The coefficient of inductance of a coil having an iron core may be approximately express by:

$$L = \frac{4\pi n^2 A}{b \times 10^6}$$

Henry's.
ELECTRICAL EXPERIMENTER

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in which \( \pi \) has its usual value, \( \omega \) denotes the number of turns of wire wound on the coil. \( A \) denotes the area of the hole thru the center of the coil, expressed in square centimeters, and \( b \) denotes the length of the coil (not of the wire), expressed in centimeters.

Returning to the consideration of the initial equation, and restating the condition for resonance as when \( 2\pi f L = \frac{1}{2\pi f C} \) it is evident that the equation may be changed to:

\[
2\pi f C = \frac{1}{2\pi f L}.
\]

The reason for the latter arrangement of the equation is because it is much easier to construct a coil to produce a variable inductance than it is to construct a condenser to give a variable capacity.

Considering the last equation, it is evident that if \( 2\pi f C \) has any given numerical value, with a definite value of frequency (value of \( f \)) then some value may be given \( L \), so that the numerical value of \( 1 \) shall be equal to the numerical value of \( 2\pi f L \) of \( 2\pi f C \).

Also decreases.

To make the matter clearer and more concrete, it will be well to assign definite and practical numerical values to the various symbols in the last equation. Let us suppose the frequency \( f \) of the applied alternating pressure is 60 cycles per second; then \( 2\pi f \) is equal to very nearly 377. Suppose further that the capacity \( C \) of the fixed condenser is 10 microfarads or

\[
0.00001 \text{ farad}.
\]

One million microfarads are equal to one farad. According to this assumption \( 2\pi f C \) becomes equal to 377 \( \times \frac{1}{100,000} \)

Next suppose that \( 1 \) \( \text{farad} \) equals .00377.

Then, since \( 2\pi f = 377, \frac{1}{2\pi f C} = \frac{1}{100,000} = .00377 \).

If, therefore, a condenser having a capacity of \( \frac{1}{100,000} \) farad is connected in series with a coil having an inductance of 0.073 henry, then resonance obtains in the circuit for a frequency of 60 cycles, and the current in the circuit is a maximum. The numerical value of the maximum current is

\[
\text{given a maximum,}
\]

depends upon the numerical value in volts of the applied pressure, and upon the resistance in ohms of the coil or part of the coil that is connected in the circuit.

Suppose the pressure is 110 volts and the ohmic resistance of the wire on the coil is 10 ohms, then under the conditions of resonance mentioned, the current will be

\[
110 \div 10 = 11 \text{ amperes}.
\]

A very striking and important phenomenon should be noted at this point, namely, the numerical value of the drop in pressure between the terminals of the coil and also between the terminals of the condenser. The drop in pressure between the terminals of a condenser when resonance obtains in a circuit is express by

\[
\frac{1}{2\pi f} \times 100,000 = 2915 \text{ volts (approximately)}.
\]

The pressure drop between the terminals of the coil may be stated by:

\[
\sqrt{R^2 + (2\pi f L)^2} \text{ which is numerically equal to } 11 \times 10^4 + (377)^2 = 2915 \text{ volts very nearly.}
\]

This condition of affairs seems a bit uncanny. It does not look exactly logical that the pressure between the

(Continued on page 59)
Building an Electric Piano Player

By CHARLES HORTON, Consulting Engineer

Contrary to the general opinion among amateur mechanics the automatic piano, aside from the instrument proper, is a comparatively simple thing. There have been developed commercially two general types of player actions, the electric and the pneumatic. The operation of the latter is as follows:—There is provided a pair of bellows arranged to be worked by the tread of the player which supply the air to run the motor for moving the record and for striking the notes. These bellows do not, as would naturally be supposed, compress air to operate the mechanism but merely it; in other words, the device operates by suction. The use of suction instead of compression is had because of the advantage that since with suction the air is drawn in thru the holes in the record, there is a strong pressure on the record causing it to adhere closely to the tracker bar and thus preventing the striking of accidental notes. Thus it is seen that the foot bellows draws air from the reservoir provided, and this suction causes the driving mechanism to turn the record feeding roll. Whenever a hole in the record comes over the tracker bar, air is permitted to pass in thru the corresponding tube and this air relieves the suction in one of the key-striking bellows, allowing it to spring open and strike the proper note.

So much for the pneumatic type of action. The electrical mechanism is similar to the action of the pneumatic except that contacts take the place of the holes in the tracker bar and magnets take the place of the bellows while a motor drive is provided to turn the record roll.

At first glance the construction of an electric action would appear to be somewhat beyond the ability of the Amateur, but a detailed examination of the apparatus herein described will show that there is nothing at all difficult in the work: but owing to the large number of similar parts the work requires a good supply of patience and persistence. However, the result is well worth the effort, particularly when it is understood that the costs of a commercial attachment runs into the hundreds of dollars.

The arrangement here described is similar to the commercial electric mechanism but is very much simplified. The record is driven by a small hand-crank (or may be driven by a small electric motor) by means of which, also, the tempo is controlled while the ordinary pedals of the piano are used in the regular manner. The loudness may, if desired, be controlled by a simple rheostat and when one has had some practise in the manipulation of the apparatus, one can get very nearly perfect expression from this simple instrument.

The apparatus takes the form of an oblong cabinet which is adjusted just above the keys of the piano and is held in position by its own weight. The record reading mechanism (translator) is mounted on top of the same as is clearly shown in Fig. 1. There is provided one magnet for each key of the piano and one corresponding contact on the tracker bar.

The apparatus plays the standard paper music rolls which range in price from ten cents to several dollars and permits the reproduction of all the standard music at a very low cost.

The construction of the simplified apparatus will now be explained in detail. Referring to Fig. 2 in connection with the following description the arrangement of
parts may be made clear. This view is a transverse section of the box containing the striking magnets. \( A \) represents one of the white piano keys, \( B \) one of the black keys and \( C \) the supporting board for the magnets. All the striking magnets are mounted on this board which is screwed to the two side strips \( 4 \), in order to prevent it bending under the weight. A detachable top \( 5 \) is screwed to these two side pieces, which arrangement allows easy inspection of the striking mechanism. Reference to Fig. 3, in connection with Fig. 2, will serve to make clear the arrangement of the magnets, etc. This illustration is a view looking down on the top of the striker box, and delineates part of the top board broken out to show the arrangement of the magnets. There are, of course, seven white keys and five black ones to each octave of the piano; consequently twelve magnets have to be provided for each octave. One magnet is mounted above the center of each key and in order to find room for so many magnets they have to be arranged in the manner shown, i.e., in four rows.

Each magnet consists as shown of a brass or aluminum tube, detail \( 6 \) (this tube must not be iron) on each end of which is forced an iron washer \( 7 \). Brass is best for the tube \( 6 \), so that the iron washers may be soldered on. The end near the lower washer \( 7 \) extends downward, thus forming a projection which enters a hole in the supporting board \( C \). The bobbin formed by the tube and the two washers is wound full of number 18 double cotton covered magnet wire, thus forming a solenoid for actuating the keys. The magnets are secured to the supporting board \( 3 \) by means of several \( 1/4 \) iron stove bolts \( 9 \), which also, together with the iron washers, complete the magnetic circuits. Within the tube \( 6 \) is arranged to slide freely the iron core \( 10 \), screwed into the bottom end of this iron core is a long brass screw with a round head which is covered with chamois to form a hammer as illustrated in Fig. 2. When the circuit containing any one of the magnets is completed, current flows around the bobbin \( 6-7 \), and causes the iron core \( 10 \) to quickly move downward, thus striking the corresponding piano key. As will be seen by examination of the detail drawings, the entire bank of magnets is divided into seven groups, each group consisting of seven white-key strikers and five black-key strikers. This arrangement is advisable in order to make the assembling easy and also permits the correct placing of the strikers above the keys without extremely accurate layout work.

In Fig. 4 is shown a front view of the record carrying mechanism, usually called the translator. This is to be mounted on top of the striker box and contains a free moving stud \( D \), and a free crank-shaft \( E \), between which the record roll is caught; a tracker bar \( F \) having on it one contact for each magnet; a comb \( G \) having one contact for each contact; and a receiving roller \( H \) for receiving the paper roll as it unwinds. The record roll is placed between \( D \) and \( E \) by pulling \( D \) to the left against the spring and placing the right-hand end of the roller against the screw-driver-like crank \( E \). The comb \( G \) is then removed from under the heads of its retaining screws by slipping it upwards and the end of the record led over the tracker bar \( F \) and fastened to the receiving roller \( H \), by slipping the ring in the end of the roller over the little hook \( J \). The comb is then replaced with its fingers bearing on the paper record and the receiving roller rotated slowly by turning the crank \( K \). Now when the holes in the paper record come under the fingers a contact will be made and the proper magnets will receive current and strike the proper keys. When the record is finished the comb is removed and the record re-rolled by means of the crank \( E \) (or by motor, if one is used for playing the piano). The tracker bar and the comb are mounted on an independent board, the construction of which is shown clearly in Detail No. 26. This board is arranged to slide sidewise in the main translator box for this purpose. The paper has a tendency to work over one way or the other on the tracker bar and thus tend to get the holes out of alignment with the comb fingers, causing imperfect reproduction, in which case it is necessary either to shift the record or the tracker bar. In this mechanism we shift the tracker board \( 24 \). This motion is usually very little and is tended to with the left hand on the knob \( M \). Reference to Fig. 5, at the right, will make clear how turning the knob one way will slide the tracker bar and comb to one side, and turning in the other direction to the other side.

(To be concluded)
Experimental Mechanics

By SAMUEL COHEN

LESSON III.

BEFORE the novice can begin to handle the lathe it is essential for him to remember that the lathe is an instrument of precision and that in working with the lathe, the operator must be guided by the rule that the ends and the parts of the machine must be handled with great care. The beginner should understand thoroughly, as each one of them is for a definite purpose. The amateur must also know how to sharpen these tools, in order that they may give the best results. All of these problems will be taken up in order.

The first thing that experimental machinists should see is that the lathe is running true. These are made of tool steel; the one in the revolving spindle is usually soft, because it turns with the work, which is hardened. The one at the tail stock is hardened. This is done because the article to be machined revolves on this center and causes constant wear. A good plan is to test occasionally the truth of these centers. In Fig. 1, a center is shown being tested for angular slope by means of a center gauge. It is very important that the end slopes to a 60-degree angle. In order to machine any round stock article between centers of a lathe, it is necessary to determine squareness of the centers on both sides of the article, then to drill and countersink each end so that it may revolve on the centers with ease.

There are several ways of centering a round piece, and of the simplest and best methods will be considered. The first one is to employ a combination square, as shown in Fig. 2, and carefully scratching across the face of the work with either a pencil, a scriber, or a countersink at right angles. The point of intersection of these two diameters will be the center of the cylinder. A center punch is set on the point of intersection and driven into the metal until a good indentation is made. This method will be found to be very useful and helpful, as it is the simplest and quickest method of centering a part. The combination square, and one can be bought for a nominal sum.

Another method of centering is to use the lathe itself. Fig. 3 shows how this is done. The article in question, A, is firmly secured in the live chuck of the headstock, B, and a drill chuck C, with a proper arbor, is secured to the spindle of the tail stock, D. A special centering drill 1 is secured in the drill chuck. By setting the main chuck holding the article and carefully bringing the centering drill to the face of the article, then gradually forcing the drill into the metal surface, it will automatically find the center and drill the hole and at the same time countersink it. Care should be taken to see that the drill does not advance too rapidly into the metal, as it might catch and break the drill. Sufficient oil should be poured on the drill when in operation. Another point to remember is to see that the article in question does not turn very fast.

These centering drills are very handy, and the amateur should not be without one, as they will be required very frequently. There are several sizes on the market and they can be bought in any reliable store carrying machinery supplies.

Accidents will happen now and then, and a center drill may break, part of the broken drill remaining in the shaft. This broken part should be immediately removed. Sometimes the experimenter may be able to work the broken part out with a chisel, but occasionally it sticks so hard it cannot be removed. When this occurs the broken part of the drill left in the shaft must be annealed; the only way to anneal it is to heat the shaft red hot and hold it there until it is entirely cooled off. It is then ready to be worked and the broken part can easily be removed. It is very important to note that every hole be properly countersunk if it is to be used between centers. The beginner will find it very advantageous to begin with the right method of countersinking and thus avoid breaking down or quickly wearing away his head center point. A very poor and improper way of countersinking is shown in Fig. 4. The center bears the point on the article without any bearing surface support. The article turns, and a load applied to the surface of the article by the cutting tool, the point would not be strong enough and thus breaks or goes off. This of course, results in a loss of time in resharpening or regrinding the center. The proper method of countersinking a hole for lathe work is delineated by Fig. 5. In this case it will be noticed that the portion bears firmly on the slope surface of the center and not on the point.

This method of countersinking is accomplished by drilling a small hole in the part where the center is desired and then countersinking it with a countersink having a 60-degree cutting edge. In other words, the countersunk portion should have the identical slope as the slope of the center of the lathe, which is also 60 degrees. It is well to remember that whenever you desire to turn a piece of work by means of the centers, see to it that its internal centers are clean, as otherwise the work will not run true or may damage the lathe centers.

If the amateur does not use a universal chuck on the live spindle for holding the work, a tool called the lathe dog will be found useful in connection with the face plate. The first photograph of the second installment shows how it is used, while Fig. 6 shows a common form of the lathe dog. The work is secured inside of the ring of the dog and firmly tightened in the same by means of the lock screw. The centers of the machined article are placed on the lathe centers while the bent portion of the dog is placed into any of the slots of the face plate. This will cause the work to turn when the live spindle is rotated by applying the driving power. There are several sizes of dogs on the market, and it is advised that at least four sizes should be on hand. The 1, 1½, 2½, and 3½-inch type will be found most satisfactory for the work which the novice will encounter at the beginning. The lathe dog cannot be used at all times, especially when a short piece of metal is desired to be machined. In this case a chuck is very helpful, and the amateur should not be without one. A 4-inch 4-jaw universal chuck with two sets of jaws will be found very useful.

The accuracy of the work will depend upon how accurate the chuck turns, and for this reason it is strongly advised that the beginner should not attempt to set the chuck on the live spindle himself, as a great deal of skill is required to do such a job. It is recommended to have a good machinist place the chuck on, if the chuck has not been directly purchased from the lathe manufacturers, who usually do this kind of work for the purchaser. The amateur has only to bring the original face plate with the chuck and its face plate to a machinist and have him fit it on. He has to properly thread the chuck face plate with the right thread, which he gages from the original face plate.

In using a lathe for cutting purposes, special tools are used for each particular
ELECTRICAL EXPERIMENTER

May, 1918

At running the tool post will be held without undue chattering.

When machining or dressing down a piece of cast iron it will be found that if a heavy cut is not made at the beginning that the surface soon of the cast iron, which is mostly sand, will ruin the cutting edge of the tool. It is advisable for this reason to take a heavy cut at the beginning so as to remove the surface scale.

The effective cutting on a metal will largely depend upon the degree of sharpness of the cutting edge and upon the manner it is ground. The tool should have plenty of clearance, a good rake and a clean cutting edge. The tool should be ground on a lathe or an emery wheel, which is running quite fast. The tool should be kept cool during grinding, and this can be done by immersing the tool into cold water every few seconds during the grinding process. After the tool has been ground on the wheel it is then well to dress up the cutting edge by hand with a small oil or fine carborundum stone. This will improve the wearing qualities of the cutting edge.

It is advisable that the novice should become a thorough master of the above facts, as they are the fundamentals to the successful operation of the lathe. If these points are observed, there is little chance of turning out a real good piece of work on the machine.

(To be continued.)

Diagram Showing How the Lathe Tool Should be Set with Respect to the Work Being Machined.

CLOCK NEWS.

By Thomas Reed.

The recent labor-flurry at the plant of a well-known clock company in Chelsea, Mass., recalls the interesting story that its

work the more firmly the tool post will be held without undue chattering.

Incorrect Center Support Correct Center Support

This Diagram Shows Clearly the Correct and Incorrect Method of Counterboring Stock to be Supported on a Lathe "Center."

ELECTROLYTIC TREATMENT OF LEAD POISONING.

Dr. L. G. Witherspoon, in Southwestern Medicine, gives his recent experience at a large industrial plant in the electrolytic treatment of lead poisoning. The method used is that of Dr. H. L. Jones of St. Bartholomew's Hospital, London, as perfected by Sir Thomas Oliver on the suggestion of T. M. Claude of that city.

Instead of immersing the patient in an electric bath, the outside bipolar system is resorted to. The patient sits on an insulated chair with the feet in a basin holding salt water, 15 grains to the pint, the hands in a similar basin, the positive wire going to the tool basin and the negative to the hand basin. A current of 16 volts passes for from 20 to 40 minutes daily or every second or third day depending on the severity of the case. Ordinary cases require at least 25 days. For prophylaxis one weekly treatment usually suffices. Severe cases with wrist drop or cerebral symptoms may demand treatment for 60 days or even longer.

The latest style of electric railroad crossing signal imitates the waving of a lantern or flag in the right hand exactly. The advantage of this lies in the fact that a moving light will attract more attention than a stationary signal.
“Shooting” Electrical Troubles on Automobiles

By THOMAS W. BENJAMIN

A rule the motorist just begins to realize that the electrical equipment of his car is subject to failure when he learns to ignore or crank the engine for the first time. Then the garage man is given a hurried call and,

more often than not, a call-down, when the bill arrives a little later.

Despite its seeming simplicity the electrical apparatus will respond to a little care and can be kept in the pink of condition if the little faults that develop are taken care of before they become large enough to cause any great trouble. For instance, it is not noticeable when one side of the battery becomes ground off; and the car may run in this condition for months, but, Ah! BUT—when the other side goes to ground it often means a new storage battery and perhaps an overhaul of the generator.

The instruments required to test the electrical equipment on the car from time to time is not costly, while it constitutes the best form of insurance one can buy. A voltmeter with a range of 0-10 volts, or 0-15 if a twelve volt system is used, and an ammeter reading 0-30 amperes, are required. Reliable small meters can be purchased for $5.00 to $8.00 each.

Test cords are required for the above meters. For the voltmeter cords, use single lamp cord, two 6 ft. lengths being cut. Fit one end of each cord with a lug to make connections to the meter, the other end having a prod made from a 6-inch length of % inch round iron rod. A suggestion for making the prods is given in Fig. 1. The cords for the ammeter are but two feet long and are made of double lamp cord, fitting one pair of terminals with lugs as in the previous case and the other ends with heavy spring test clips. Those with flat jaws are the best for the purpose.

A hydrometer is necessary, a dollar bill buys a good one— the writer has seen these on sale for a quarter, but purchase one fitted with a syringe—it’s much cleaner and easier to handle.

Altho not absolutely necessary a simple device for testing out circuits will be found

handy. The simplest form comprising a 75-ohm watch-case telephone receiver fitted to a head-band and a small two-cell flashlight battery taped to the inside of the headband, (Fig. 1). One post of the battery being connected to one terminal of the telephone, a set of 4- foot cords, fitting with small prods, are connected to the remaining terminals of the battery and phone. This completes the apparatus required. The various instruments are illustrated in Fig. 1.

We can now test any electrical equipment and locate the tiny faults that may sometime tie the car up on the road. And should trouble develop we can easily locate it. The prudent auto driver or owner always tests the electrical equipment before starting on long tours, and even before making long ones.

Motor Fails to Crank. Engine Runs Slow or Lights Are Dim.

Turn the engine over by hand to see if the bearings are not stuck. Take gravity reading on all the storage cells; this is a good indication of their condition.

If they have not been tampered with by some inexperienced person. The readings of the

cells should not vary more than twenty points and should be over 1.200. If below this the battery is discharged and should be charged at once. If the cells vary greatly in the reading locate the trouble. It may be due to a short-circuited cell, broken separator or high sediment.

The gravity is over 1.200 in all cells the battery should crank the engine and the trouble is elsewhere.

Take a voltmeter reading on the battery as shown in Fig. 2 the battery should read 6.5 volts or a little higher, with a 3 cell

battery; a 6 cell battery should be twice this. Should the voltage be below this figure and the gravity 1.200 it indicates that too much acid has been put into the cell.

With the voltmeter still across the battery, switch on the lights as in Fig. 3. There should be a very small voltage drop, if it is excessive it indicates a short-circuit on the wires that is draining the battery. Test each circuit independently to locate the circuit on which the short exists. By tracing the wiring the trouble can be removed.

Now have someone close the starter switch, if no trouble is located on the light circuits as in Fig. 4. The voltage may drop as low as 5.2 volts with a three cell battery and no trouble will be found. Should the voltage drop below this figure, the cells are low and need charging. When using the starter for testing, the switch should be kept closed long enough to take the readings for the drain on the battery is cumulative.

A test should now be made of each individual cell as in Fig. 5. Closing the starter switch after connection is made to each cell in turn. Should one cell or cells be lower than the other or others, it indicates discharge due to short-circuit, lost active material or defective separators. Should a cell give a reading, this may be due to the above causes or low electrolyte. A charge should be given the battery from some outside source or by running the engine if the generator is in operative condition.

Should the cells test O. K., attach the voltmeter leads to the cables of the battery as shown in Fig. 6. If a drop of voltage is noticed over that from the battery terminals, it indicates corroded or broken connections. Remove the cable from the battery and scrape off the corrosion, after cleaning thoroughly, rub the parts well with vaseline and reassemble, making sure that the connections are tight. Another test with the voltmeter should show no drop.

These tests practically eliminate the trouble from the batteries and attention should be turned to the other parts of the system.

The voltmeter should be connected across the terminals of the motor as in Fig. 7 and the starter switch closed for an instant. If there is a decided drop in voltage at the motor terminals over that at the battery terminals, with the starter on, the trouble lies in the wiring or the starter switch.

A test of the starter switch can be made as in Fig. 8, by slugging the voltmeter across it and closing the switch. A reading on the meter indicates a defective switch, usually

(Continued on page 69)
A Tight Squeeze for Uncle George

By THOMAS REED

I CAME near going on the stage once. Not to act, you understand—not as bad as that—but simply to show stage-managers a few things about their business. In the fresh springtime of my career, I never hesitated to butt, with a few pertinent suggestions, into any ancient or modern institution, and having, at the time of this tale, just made the acquaintance of the drama, as a means of livelihood, which had been plugging along quite a spell on scanty resources, I desired to give even that lowly calling a little attention.

The occasion was my Uncle George's taking me to the theater for the first time. In those days, people approved of the theater as heartily as they do of opium dens nowadays—that is to say, scarcely at all or less; but "Unc" had a theory that it was beneficial to make the Devil's acquaintance young, so he insisted (as much as he had to) on my going along.

We had to wait our step carefully, because a previous expedition of ours under his theory (I think it was a horse race) had caused unmistakable demur in the family. It made father almost impetuous. He said that while a peppy bachelor (Uncle George was such) might poison his own soul in any lot, so he saw fit, it meant a hell-sentence for him to lure innocent Youth into the clutches of the Evil One; and he went on to describe, for "Unc"s" special benefit, the warmth of that particular hell reserved for middle-aged republicans convicted of luring. This was before the invention of ferrets and oxy-acetylene, and the only fuel that Theology possessed, to get up steam for the sinners with, was "fire and brimstone." With the modern inflammables, father's imagination of hell would have made him such an extra hazard around the house as to vitiate our fire-insurance policy: but he did pretty well with even the old-fashioned chemicals. He did so well, anyhow, that Uncle George was the first called to take me to the matinee, thought it prudent to employ camouflage, and carried conspicuously two smell-poles and a can of bait, which he left in a vacant lot after they had created the desired atmosphere of innocence.

The "theater" that agitated the old folks so, meant plays like "Uncle Tom's Cabin," and "Ten Nights in a Bar-Room," that dripped, like a shirt in the wringer, with mortality and sadness. As even these dismal sketches were supposed irresistibly to skid the virtuous from the street and narrow path, a stupendous horror overspread the community when along in the eighties came the first "show" that actually aimed to be merry. "Good-night!" said the community: "so there was something worse, after all!"

This new show was "The Black Crook." Today, we should call it "Spectacle" and "Extravaganza," and let it go at that but to the elders, it was a moral catastrophe, without any special classification. They objected to it practically in toto, as the fellow who produced the fresh springtime of the play, or plot, because it was a down-right lie—not even "founded on fact," which at least you could say for Eliza's trip on the ice. And what did you think of the witches, and fairies, and men dressed up like animals? Didn't that give you false impressions of life? I should say so. Then, look at the dancers, and card-trick players, and actors that made believe intoxicated—all the forms of iniquity you ever heard of, and then some! But the most outrageous feature of all, the one mentioned with heaviest laced breath, was the tights. Would you believe it? Women—or beings in female form—actually came on the stage wearing nothing but—sort of stockings, you know, on their—their—well, what they wear stockings on?

It was only after "The Black Crook" had departed (it had quite a long run before all the sinners were accommodated) that my spiritual health was regarded as beyond danger.

But alas! (you get me?) it happened to conscience allowed me to reap the benefit of his misfortune. Several inventions occurred to me, so close together that they almost overlapped. I mentioned them to Uncle George, but the Amazons were marching, and he seemed preoccupied. Evidently the show as it stood was good enough for him.

The chief of these inventions was inspired by a beautiful blue light, studded with stars, which invaded the stage at certain intense moments. Something told me it was produced by a glass plate shoved in the front of the calcium light; the display being heralded by the magnified image of the chipt edge of the plate, followed by a flock of elephant-tracks, due to prints of the operator's fingers, stained by honest toil.

At the first sight of this spectacle the invention referred to burst upon me with that sort of Faradic shock familiar to inventors, particularly young ones. By the time it came again my apparatus was completed (mentally) to the last detail. By the third view I was storming the theatrical profession with it, and making lucrative contracts right and left; and the royalties were just about to pour in, when—the show was over, and Uncle George was suggest-
MAKING BATTERY 'PHONE SERVE AS "EXTENSION."

The subscriber who may desire one or more "extensions" must needs have the extra equipment installed by the 'phone company and must rent the added apparatus by the year or month, as the case may be. It is a comparatively easy matter, in a plant where private inter-communicating battery telephones are already installed or are about to be, to make the local 'phones serve as the "extensions."

For this purpose we need a very sensitive transmitter and this is recessed into a table or the top of the local telephone switch-board so that the mouthpiece stands flush with the table surface. A loud speaking receiver, properly connected with the sensitive transmitter, is mounted on a standard firmly attached to the top of the table, at such a height that the mouthpiece of the regulation desk 'phone set, when brought close up to it, is concentric with the diagram of the receiver. The arrangement is shown by the accompanying illustration. The regulation switch-board plug jack is used to connect the sensitive transmitter and receiver with the various extensions thru the medium of the switch-board. A block of wood, with a semicircular indentakes the base of the telephone set and insures that it stands always squarely in front of the loud speaking receiver.

Ordinarily, when not in use, the telephone transmitter rests on its hook in the orthodox manner. In establishing connections, between the regular 'phone and any one of the extensions, the operator plugs into the proper extension on the intercommunicating system, places the desk set squarely in front of the loud speaking receiver, and inverted the telephone receiver over the sensitive transmitter as shown, when communication is established with remarkably clearness. It is advantageous, but not essential, to have a regulation switch-board operator's head set and breast transmitter in circuit with the loud speaking apparatus so that the operator can listen in and correct errors.

Contributed by E. F. HALLOCK.

SECOND PRIZE, $2.00

AN INEXPENSIVE BICYCLE LIGHT

Use an old pocket flashlight, size 1 x 2 3/4 x 3/4 inches which may have neither battery nor bulb. First cut the lower part of the case off, as here shown, leaving a smooth edge. Then from a piece of wood cut a block B so that it will just slip into the open end of the flashlight case. Next secure a clamp from an old bicycle bell shown at C. Bore a 3/8" hole from F to C and put a small machine screw thru and countersink the nut in the other end of the block at F. Then take a piece of steel battery screws and put thru the block at D. E, a round head brass screw is put in the end of the block and connected to bolt D' by a copper wire, while bolt D is connected to the clamp and bolt C. Slip the case over the block and tack on both sides or glue it to the block. Remove the cap of the bulb and connect to the base of the flashlight case for the battery.

AMATEUR ELECTRICIANS!

ATTENTION!!

Did you read the prize contest article entitled "Utilizing Burnt-out Lamp Bulbs," which appeared in the April number of this journal? If not, procure a copy to-day. Here is your chance to make some money. Prizes are offered for the best ideas—What to do with burnt-out lamp bulbs—and prizes will be awarded as follows: First prize, $3.00; second prize, $2.00 and third prize, one year's subscription to the ELECTRICAL EXPERIMENTER. Get busy, boys, and watch for the June issue.

A Nifty Electric Bicycle Head-light is Easily Constructed From an Old Pocket Flashlight in the Manner Illustrated.

holding the lens and you will see that when push button is drawn back, the metal strip touches the screw E and connects it-with the metal case of the flashlight, also that the end of the bulb will touch the end of the bolt and thus make the circuit thru the bulb from the two binding posts D and D'. Next buy a 2.5 volt flashlight bulb which can be obtained from any electrical store. The lamp case may then be given a coat of black enamel. The two dry cells (they do not have to be new as it will burn on partly used ones) required may be fastened to the stem between the front fork and the handle bar and the block D with a strap wrap around them and the stem and allowed to rest on the bar running down to the cranks. They should be connected to the lamp on the handle bar with flexible wires so that it will not break when turning corners.

Contributed by DONALD WILSON.
TO RENDER WATER SURFACE PHOSPHORESCENT.

1. Wet a lump of loaf sugar with phosphorized ether, and throw into a basin of water; the surface of the water will become luminous, and glow beautifully in the dark. By gently blowing upon it, phosphorescent undulations will be formed, which will illuminate the air above the fluid for a considerable space. In winter the water can be blood warm.

2. To melt a coin in a nut shell.—Mix three parts of dried niter, one of sulfur, and one-fourth of dry sawdust and press into a walnut shell, also inclose within the shell a piece of silver or copper, then fill the shell with more powder and set fire to it. The metal will soon be melted while the shell will be merely blackened.

3. The alchemists' dyes.—Dissolve indigo in diluted sulfuric acid, and add to it an equal quantity of solution of carbonate of potash. If a piece of white cloth be dipped in the mixture, it will be changed to blue; yellow cloth in the same mixture will be changed to green; red to purple; and blue litmus paper to red.

4. Two solids make a liquid.—Rub together in a mortar equal quantities of crystals of Glanbers salts and nitrat of ammonia, and the two will slowly become a liquid.

Contributed by EUGENE McGOWAN.

A HOME-MADE PUSH-BUTTON. Below is a description and illustration of a home-made push-button.

Here's a Nifty Brass Push Button Made from the Shell of a Discarded Lamp Socket.

The top part of an old electric lamp socket is used for the case, as shown in Fig. 1, and the assembled button is shown in Figs. 2 and 3, which explain themselves.

Contributed by ROBERT WILLIG.

COPPER PLATING.
To copper plate a small steel object proceed in this way: Put 1/2 teaspoonful of sodium bisulphate in 1/2 glass of water.

Now add 1 1/2 teaspoonful of azurite. Heat gently to dissolve the substances. Dip the article that is to be plated into the solution and leave it for about one-half minute, and dry on a cloth.

Test to Determine the Freshness of an Egg. Put 2 teaspoonfuls of common table salt into a pint of water. A fresh egg placed in this solution will barely float. The greater tendency of an egg to float on the surface the older it is. This is due to the fact that as an egg decomposes it becomes lighter.

Contributed by S. WATSON MUGHR.

A SIMPLE TROUBLE LAMP. I describe below the plan of a very simple trouble lamp, which I have constructed.

Contributed by ROBT. S. ROYER.

ELECTRICAL EXPERIMENTER

A SELF-LEVELING MEASURING SPOON.
A set of measuring spoons with a self-leveling attachment is a recently pat-
Nitrogen Monoxid.

THIS gas, which is also known by the names nitrous oxid and laughing gas, was discovered by Priestley in 1772. Preparation.—The usual method of preparing this gas is by heating ammonium nitrat and collecting the dissociated gas over water. This relation is shown by the following equation:

\[ \text{NH}_4\text{NO}_3 \rightarrow \text{N}_2 + 2\text{H}_2\text{O} \]

Properties:—1. This is a colorless gas, producing a faint peculiar odor, and sweet taste.
2. It produces anesthesia.
3. It is a supporter of combustion. It supports the combustion of many substances as actively as does oxygen.
4. When mixed with hydrogen it is explosive when ignited.
5. It has been liquefied under ordinary atmospheric pressure, requiring —88 deg. It may be liquefied at 0 deg. by a pressure of 20 atmospheres.

As a liquid it is colorless and very mobile, boiling under ordinary pressure at —89.8 deg.

Uses:—This gas (Nitrous oxid) is extensively used by dentists in extracting teeth, where a short anesthetic effect is desired. It is obvious that for this purpose the gas must be perfectly pure. The greatest safeguard to obtain the pure gas is to employ pure ammonium nitrat, the chief impurity of which is ammonium chlorid. Ammonium chlorid if present would occasion the presence of chlorin in the gas. For the preparation of the gas for anesthetic purposes, it is past thru three wash-bottles, one of which contains ferrous sulfate solution which removes the other secondary oxides of nitrogen formed thru secondary decomposition; one of sodium hydroxid solution to remove the chlorin; and lasty one of pure water.

When mixed with air or oxygen the gas produces a condition of partial insensibility in which the patient becomes hysterical, laughing immoderately, hence the name “laughing gas.”

Table of Oxides of Nitrogen.

<table>
<thead>
<tr>
<th>Name</th>
<th>Formula</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nitrogen Dioxid</td>
<td>N_2O</td>
</tr>
<tr>
<td>Nitrous Oxid</td>
<td>NO</td>
</tr>
<tr>
<td>Nitric Oxid</td>
<td>N_2O_3</td>
</tr>
<tr>
<td>Nitrogen Peroxid</td>
<td>N_2O_4</td>
</tr>
<tr>
<td>Nitrogen Anhydrid</td>
<td>N_2O_5</td>
</tr>
<tr>
<td>Nitrogen Tetroxid</td>
<td>N_2O_6</td>
</tr>
</tbody>
</table>

EXPERIMENT NO. 123. Preparation of Nitrogen Monoxid from Ammonium Nitrat (NH_4NO_3).

10 grams of ammonium nitrat into a plain thin glass Erlenmeyer or Florence flask of 250 cc. capacity. As a precaution of not breaking the glass, put in not over 1 cc. of water in 1-2 stopper (rubber) carrying a right-angle delivery tube leading just thru a two-hole stopper in an empty 8 ounce bottle, from which another tube leads to a trough with inverted bottles filled with water. See Fig. 114. Set the apparatus on an asbestos pad over a tripod, or on the ring of the ring-stand, and apply at first gentle heat, which may afterwards be increased, but the action should not be permitted to become too vigorous. If necessary, take away the lamp, temporarily. As usual, the first portions of the gas to pass over the delivery tube should be rejected. If there is any evidence of lack suction of the water from the trough to the bottle, disconnect the stopper in the latter for a minute.

After collecting about four jars of the gas, take away the lamp and at once either loosen the stopper in the bottle or take the delivery tube out of the trough. When you disconnect the apparatus thrust a lighted splint into the gas in the flask. Note the phenomenon. When the flask is cool enough to permit being handled, pour in water thru a funnel and dissolve the residue. Test the gas that has been obtained. (See following experiments.) If a liquid is in the intervening bottle, test it with litmus. This gas is commonly called nitrous oxid; by dentists simply gas.

EXPERIMENT NO. 124. Properties and tests.

Note whether the gas in the various bottles is clear or mixt with some visible impurity. If it is impure, note any variability in that collected under greater or stronger heat. Try and determine whether such impurity is of a solid or gaseous nature. With a glass plate (as described in the Lesson on experiments with Oxygen) take one of the jars from the shelf or tray, try the odor of the gas, and then test it with a glowing splint several times, and keep the product, that is the gas which is obtained after the introduction of the splint, covered to prevent escape.

What gas does it resemble in its combustion test? In that case what do you suppose the product to be? Formulate a test for the product which you surmise, and apply this test to determine whether your conclusion is correct. If you were wrong try and find out just what the product is.

Try the action of burning sulfur in another receiver of nitrogen monoxid, using a carbon cup in the customary manner.

Nitrogen Monoxid and Oxygen. Nitric Oxid Test.

As nitrogen monoxid, (or nitrous oxid (N_2O_3),) acts very much like oxygen, especially in regard to combustion, it becomes necessary to distinguish the two gases. The following experiment gives a simple method:

Prepare two bottles of nitrous oxid (N_2O_3) (preferably in separate trays or troughs), by the action of Nitric acid on copper. Prepare also an oxygen generator (See Lesson on Oxygen) using potassium chlorate and manganese dioxid, and let the oxygen bubble up into one of these receivers filled with the nitrogen dioxid. Continue the operation as long as necessary, to determine the nature of the result. Notice any phenomena which are occasioned.

Then generate nitrogen monoxid (N_2O) (Continued on page 54)
"Electrical Laboratory" Contest

In the March issue we publisht an interesting story with a number of excellent photos, describing one Amateur Electrician's experimental laboratory. Now "Bugs"—we want to publish similar articles each month. Here's our proposition: Why not write up your "Electrical Lab." in not more than 500 words. Dress it up with several good, clear photographs. If we think it good enough we will publish the article in display style and pay you well for it. The remuneration for such articles will range from $5.00 to $10.00. And "Bugs"—don't forget to make your article interesting. Talking about Radio Amateur activities, we wish to mention the "Prospect Radio Club" of Brooklyn, N. Y., whose picture is reproduced herewith. Here's the right idea, "Bugs." A course in Radio was started last October, with the object of training the members to take the First Commercial license examination. Lectures, which are part of the course, are illustrated by projections and experiments. A practise class has also been started in conjunction with the course, to get up a speed of at least twenty words per minute. The officers for the term are as follows: President, L. Jacquet; Vice-President, Mr. C. Hild; Secretary, Mr. W. Benson; Treasurer, Mr. D. Langan. The Club would like to hear from other Brooklyn clubs, and welcomes visitors to their meetings. Address all communications to the Secretary, Mr. W. Benson, No. 4 Fuller Place, Brooklyn, N. Y. Get ready to help your Uncle Sam!!! Send all laboratory photos to Editor "With the Amateur's Prize Contest."

A GROUP OF REPRESENTATIVE AMERICAN AMATEUR LABORATORIES.

Magnetic Sander for Autos (1,257,305; issued to Bridge N. McCallum.)

A semi-automated sanding device for use on automobiles and similar vehicles. A simple switch mounted on the dash within easy reach of the driver, connects with a storage battery and two solenoid controlled sand box valves as shown. One solenoid and valve is placed on each side of the car, the sand box being placed under the rear seat. Also there are provided two nozzles which swing downward toward the road-bed whenever the magnets are operated and sand released thru the valves. A coated contractile spring normally holds the sand valves shut and the nozzles to a neutral position.

Combined Rotary Gap and Motor (1,250,385; issued to C. H. Troll.)

Combination invention relating to a gap used in radio-telegraphy, together with rotating motor drive of the gap, the stator of which is located within and concentric with the rotary gap member and thus the latter may be driven at any suitable speed by the motor embodied within the device. The motor is adapted to be operated on battery power. The poles of the motor are wound with coils of wire, as well as those of the stator, the direction of the current thru the respective windings being periodically changed by means of a commutator.

Talking Condenser (1,257,092; issued to J. W. Fuller.)

An improved form of voice reproduction apparatus operating on the principle of a condenser. The talking unit proper is composed of a number of sheets of tin-foil interposed between a number of oil-silk or similar dielectric material, connecting the alternate foil sheets to opposite sides of the exciting circuit. The inventor proposes a talking condenser made up of 100 sheets of very thin tin-foil interposed lightly, so as to be free to vibrate between an equal number of smooth paraffin paper, each sheet being denser, an induction coil, and a source of variable primary current as produced by a telegrapher, etc.

A novel patent on an illuminated spark gap frame to be worn by a person doing special work and intended to enable the person to see the work clearly, without eye-strain. Also both hands of the wearer are free to operate. A hollow socket in the glass case thru which the center of the lamp is provided, a dark sleeve inside the passage of the lamp enabling the user to see the object clearly. The eyes are said to be further protected from over-straining by limiting the view thru the openings. Provision is made for using colored lamps or colored screens when desired.

Mineral Detector Stand (1,257,526; issued to G. W. Pickard.)

An improvement in constant-pressure solid rectifiers, in which the adjustment of pressure of the contact point on the mineral is effected by a balanced bar, similar to a scale. Among other superior features claimed for this form of crystal detector stand are: Increased rectifying efficiency of practically all solid rectifiers, greater stability and adjustment and of accurate duplication of pressure adjustment. Galena is cited as one of the minerals wonderfully improved by the apparatus, reaching an efficiency unattainable heretofore in spring contact detector stands. No account of its low degree of stability and its great difficulty of adjustment. The number of operative contact points on the galena or other mineral is greatly increased with this constant-pressure contact.

Spark Gap (1,256,405; issued to Harlan S. Webster.)

An improved form of spark gap intended for radio or X-ray requirements. It is made in the form of a rotary blower as shown, thus creating a powerful cooling effect. Another object is to provide in such an apparatus means whereby the sparks produced will be of uniform length. The stationary electrodes are aligned with and in proximity to the revolving electrode, each station.

Talking Picture Control (1,254,436; issued to H. W. Rogers.)

A new method of producing talking motion pictures, especially the synchronization of voice apparatus with the picture projector. The device is applied to the magazines of the motion picture projectors now in use. The film in the present instance is past around a rotating drum which is provided with a plurality of sliding pins. As the drum revolves with the film, the pins are projected thru openings in the film, and thus brought into contact with a switch closing device. This switch, in coaction with the perforations in the film, is thus caused to synchronously control one or more sound reproducers, such as phonographs. The drum pins are projected radially outward by gravity, aided by a magnet.

Wireless Telephone (1,236,354; issued to Walton Harri son.)

A unique wireless telephone employing a usual complicated apparatus is dispensed with. Instead of using an arc or other recognized form of radio-frequency oscillation generator, Mr. Harrison makes use of a special microphonic member, connected up as shown. Ordinarily no auxiliary condenser and inductance are necessary in the operation of such apparatus. The capacity and inductance of the apparatus serving two purposes. The hook-up delineated is suitable, the inventor states, for both transmitting and receiving speech or music. Suitable coils are provided. Very low voltages are available in this system. Oscillations are set up due to the inherent instability of low-resistance microphonic devices. The microphone also acts as detector.
Phoney Patents

Under this heading are published electrical or mechanical ideas which our clever inventors, for reasons best known to themselves, have as yet not patented. We furthermore call attention to our celebrated Phoney Patent Office for the relief of all suffering daffy inventors in this country as well as for the entire universe. We are revolutionizing the Patent business and OFFER YOU THREE DOLLARS ($3.00) FOR THE BEST PATENT. If you take your Phoney Patent to Washington, they charge you $20.00 for the initial fee and then you haven't a smell of the Patent yet. After they have allowed the Patent, you must pay another $20.00 as a final fee. That's $40.00! WE PAY YOU $3.00 and grant you a Phoney Patent in the bargain, so you save $43.00!! When sending in your Phoney Patent application, be sure that it is as daffy as a lovesick bat. The daffier, the better. Simple sketches and a short description will help our staff of Phoney Patent examiners to issue a Phoney Patent on your invention in a jiffy.

PHONEY PATENT OFFIZZ

Cover All Gone From Wifey

Cover Flies Over To Wifey

Wifey Now In Possession Of Covers

First Reel

Motor

Hubby Rapidly Revolving

Second Reel

HUBBY SECURELY STRAPPED TO PULLEY BY FEET

Third Reel

Prize Winner, ELECTRIC QUILT REVERSER. Remember Those Bitter Cold Winter Nights When You Woke Up at 12 G. M., With Nothing On You But Your Night-gown? These Frigid Experiences Are Now Gone Forever, Thanks to My Wizard "Electric Quilt Reverser." If Wifey (or Hubby, If He Gets the Preferred Position First) Awakes and Finds the Other Branch of the Family Tree All Cozied Up in the Only Six Blankets in Sight—Presto! the Said Victim Simply Has to Press a Button—the Electric Motor Starts Up and Whirls the Blanket-Hog Until His (or Her) Ideas Are Separated From His Bad Habits. Inventor, Paul Patterson, Elgin, III.

Electric "Comfy Chair." The Days of the Old Man's Club Are Numbered, for Behold the Latest Electrically Equipped Club Chair! It Is Equally Efficient in a 2 x 4 Harlem Flat, for Which a Special Collapsible Style Has Been Invented, or At the Seashore. It Keeps Battery. This In Turn Runs a Motor for Rocking the Chair, as Well as Supplying Current for the Electric Cigar Lighter, Fan, Book Holder, Back Scratcher, Et Cetera, Ad Lib, Ad Infinitum. It's Great, Boys, Try It! Inventor, Le Roy Nisbet, Battle Creek, Mich.
THE ORACLE

The "Oracle" is for the sole benefit of all electrical experimenters. Questions will be answered here for the benefit of all, but only one answer will be published. Rules under which questions will be answered:
1. Only three questions can be submitted to be answered.
2. Only one side of sheet can be written on; matter must be typewritten or else written in ink, no penciled matter considered.
3. Sketches, diagrams, etc., must be on separate sheets. Questions addresed to this department cannot be answered by mail free of charge.
4. If a quick answer is desired by mail, a nominal charge of 25 cents is made for each question. If the questions entail considerable research work or intricate calculations a special rate will be charged. Correspondents will be informed as to the fee before such questions are answered.

2-INCH SPARK COIL DATA.

(918) Geo. A. Detrick, Vinton, Iowa, inquires:
Q. 1. How to wind a two-inch spark coil.
A. 1. To build a two-inch spark coil, use an iron core made of soft iron wire about 7 inches long and ¾ of an inch in diameter, upon which wrap two layers of Empire cloth. Now wind on two layers of No. 16 B. & S. double cotton covered magnet wire which is approximately 190 turns. Over this primary, wrap 6 layers of Empire cloth, and wind on the secondary in two sections, with No. 30 enamelled magnet wire, ½ lbs., of which will take care of the sections very well.
The primary condenser should consist of about 1,400 square inches of tin-foil, interleaved with paraffined paper. The connection should be as per diagram.

CONDENSER TROUBLE.

(919) J. C. Muirhead, Nova Scotia, Can, asks several condenser questions.
A. 1. We would advise that in building a glass plate condenser, where the lugs were omitted, i.e. the tin-foil was merely cut to the desired area, the best way to connect the lugs to the condenser so that the condenser when completed can be immersed in oil, would be to simply cut some extra strips of tin-foil and lay one strip on each piece of tin-foil already cut. These should be of sufficient length to protrude from each end; proceed to make connections with the protruding foil tabs.
Concerning your glass plate condenser, which has been built in three sections; when one section is connected to transformer, the spark obtained is O, K, but when three are connected to the transformer the plates are apparently punctured. The reason for this cna only be that in one or more of the condensers the insulation is defective at some place. Therefore, the best remedy is to connect the three condensers one at a time, and see if proper results are obtained.

MICROPHONE "PACKS."

(920) Win. J. Murdock, Clinton, Ind., says:
Q. 1. I have a microphone which fails to release a relay connected to it as soon as voice waves cease. How can I remedy this? A. 1. We believe the trouble you are having with your transmitter is due to the use of carbon grains, which are enclosed in the transmitter chamber. The only method by which you can perform the functions of which you speak in your question is by employing a direct contact transmitter. Such a type has been devised.

ODD PHOTOS WANTED AT $1.00 EACH!!!

Now is the time to make your Kodak pay for itself in a real practical way. We want interesting photographs of out-of-the-ordinary electrical, radio and scientific subjects and are willing to pay $1.00 cash for every one we can use. Please bear in mind that for half-tone reproduction in a magazine, a photograph should be particularly sharp and clear. Of course, if a subject happens to interest us particularly well, we can have the photo retouched. For the general run of subjects, however, it does not pay to go to such expense. Therefore, please take pains to properly focus and expose your pictures. It often happens that a really mediocre subject well photographed wins approval over an excellent subject poorly photographed. And don't send us plate or film "negatives"; send unmounted or mounted "prints" preferable a light and a dark one.
As to what to photograph: Well, that's hard for us to say. We leave that up to you, and every reader now has the opportunity to become a reporter of the latest things in the realm of Electricity, Radio and Science. But, please remember—it's the "odd, novel or practical item" that we are interested in. Every photo submitted should be accompanied by a brief description of 100 to 150 words. Give the "facts"—don't worry about the style. We'll attend to that. Enclose stamps if photos are to be returned and place a piece of cardboard in the envelope with them to prevent mutilation. Look around your town and see what you can find that's interesting.
Address photos to—Editor "Odd Photos," ELECTRICAL EXPERIMENTER, 233 Fulton Street, New York City.

THermo-COpLueS.

(921) M. Lompi, Albany, N. Y., asks:
Q. 1. What are the thermo-couples that will answer the Peltier effect?
A. 1. All thermo-couples will exhibit the Peltier effect, which is made evident in the following manner: In any thermo-couple where the junctions are of different temperatures, currents of electricity will flow in the circuit, which involve the expenditure of energy as heat, according to Joule's law, and there will be an increase or a decrease of the current in the circuit depending upon the direction of the flow of the current in the main. Heat developed due to the Peltier effect varies directly as the current produced, which differs from the heat developed in any other electrical circuit, in that the heat developed varies as the square of the current.
Q. 2. How are thermo-couples made?
A. 2. Thermo-couples are easily made by simply heating dissimilar metals at their junctions. The thermo-electromotive-force increases with the increase of the temperature, within certain limits.
Q. 3. What book treats on their action?
A. 3. We recommend the "Elementary Lessons in Electricity and Magnetism," by Sylvanus P. Thompson, supplied at $1.50 net.

STEP-DOWN TRANSFORMER.

(922) J. W. Fickler, Mason City, Iowa, inquires:
Q. 1. Hook-up and kilowatt-hours consumed by a certain step-down transformer.
A. 1. When you are obtaining an output of 25 volts and 25 amperes, the transformer will be drawing about 62½ amperes, and when you are drawing 25 volts and about 30 amperes the transformer will be consuming about 13 amperes. When the transformer is giving such a transfer of 25 amperes it consumes about 72½ of a kilowatt-hour, and when it gives an output of about

50 amperes it takes about 1.44 kilowatt-hours.

We give herewith a diagram of correct connections if such a transformer is used:

(The Light and Heavy Lines Show the Relative Voltage Proportions in a Step-down Transformer. As the voltage at the Secondary, the Current Increases, So That the Watts Remain Almost the Same.

(Continued on page 48)
I Will Teach You Electricity Practically—Thoroughly—Quickly

A. W. WICKS, Bach. Sc. E. E.
formerly with the General Electric Company; former General Manager of company manufacturing Jenney Electric Motors; also formerly with Fairbanks, Morse & Co.; now Consulting Engineer, President and Director of the Wicks Electrical Institute.

Personal Instruction By Mail

I have already helped hundreds to get out of small-paying, no-future jobs. C. A. Walker says: "Wicks training more than doubled my pay." E. Vogel says: "Am successfully installing electrical systems." O. Clausing says: "Offered a fine position." J. Obeso says: "Have a chance to run trolley systems by mail, just as I can give it to you. While you are drawing your present salary I can prepare you for a good electrical job or for a business of your own. Say to yourself now—'I will do it'—and then send the coupon now.

What You Can Earn

You know what good electricians make. If you are not sure that this is a paying business, look into it. Find out what salaries electric light and railway superintendent, telephone engineers, dynamo and motor experts and other electric men draw. See how busy every electrical contractor and supplier is. Are you doing as well as these men? Is not, why don't you get started? Look ahead. Take advantage of circumstances which have created this big present demand for electricians.

When I say that you can make a good income from electricity, I say just what you know yourself. I don't promise that you are going to step into $800 a year—and any school which leads you to think that every man who trains in electricity can earn such an income as that is going beyond the limit of reason. Some electricians do make that much and more but they are above the average—So don't accept big promises. Get the facts.

What I promise is to give you a thorough, practical education in basic principles and in the methods followed by the best electricians. I will give you my personal instruction, step by step, until you graduate, and afterward if necessary. I know from what my graduates report that, unless you are making over $25 a week with good prospects for a raise, you can study electricity to big advantage. There is all the opportunity in this field that any ambitious man can ask for. If schools which promise $1000 salaries can really help you to earn that much—surely this training ought to put you in line for even more.

Pay As You Learn. There is no big amount to pay at any time. Only a small payment down and a little each month pays for the course. I'll be with you at every step.

FREE Personal Analysis

Before you enroll, I ask you to fill out a Personal Analysis Sheet which enables me to tell just how well qualified you are to take up Electricity. Upon receipt of this I will advise you frankly whether to enroll or not. This enables you to know just what you may expect to gain from this course. No charge for this service, and no obligation upon you.

Send Coupon for Opportunity Book and Special Personal Analysis

If you are now in an occupation that promises only the ordinary or a doubtful outlook—if you are now an electrician ambitious to make quicker advancement, to better income—send without fail for this important book and Personal Analysis Report. Find out about this course. See what it offers. Let Prof. Wicks explain his method of teaching. Learn how you can put yourself years ahead by his personal instruction sent right to your home. The book, the Personal Analysis and all this information sent free. Also information on the easy monthly terms which puts this course easily within your reach. Don't put this off. No obligation or promise on your part. Send the coupon now.

ALBERT WOOD WICKS, B. Sc. E. E.
Pres. and Director
WICKS ELECTRICAL INSTITUTE
81 W. Randolph St., Dept. 309, Chicago.

You benefit by mentioning the "Electrical Experimenter" when writing to advertisers.
THE ORACLE.

(Continued from page 46.)

SUBSTITUTE FOR PLATINUM.

(923) R. B. B., New Jersey, asks:
Q. 1. Several questions relative to a substitute for platinum, particularly a com-

position known as "Densite."
A. 1. Relative to "Densite" as a substitute for platinum, we would advise that if it stands up to the tests mentioned by you it is certainly a good substitute for platinum.
We would further say that platinum is universally used wherever its best qualities are desired, and that consumed for the purpose amounts to a very large quantity yearly. There are, however, other materials on the market that are substitutes for good contacts, such as silver, tungsten, steel, etc. Therefore, a proposition wherein an excellent substitute for platinum is had at 10 per cent of the prevailing cost of platinum is really a very good one, we should say.

HEATING COIL OPERATED ON BATTERY.

(924) M. O. Dellingcr, Wolcott, Ind., asks:
Q. 1. Can I produce one thousand degrees of heat in the hollow core of a small coil operated on a six-volt storage battery? How much wire, what size, and kind shall I wind it with?
A. 1. We would make our estimation of a temperature of the intensity you state from a six-volt storage battery for any considerable length of time.
However, a copper wire made out of constanti wire, No. 24 gauge, and if about fifteen feet of this wire is wound into coil form, it can then be employed for producing a high temperature of about the intensity you desire.

ELECTRO-MAGNET QUERY.

(925) Jos. Macowick, Ravenna, Nebras-
ka, writes the "Question Box":
Q. 1. Would a soft iron plate 4 x 4 x 3/4 inches, secured on one end of an open-core electro-magnet increase its pull?
A. 1. A soft iron plate, measuring 4 x 4 x 3/4 inches, if secured on one end of an open-core type electro-magnet, will increase the attractive power at the opposite end of the electro-agent considerably. This is due to the fact that in this way the reluctance of the external magnetic circuit of the electro-magnet, or in other words, you have provided an iron plate for part of the flux, which otherwise would have to complete its circuit thru the air from one end of the core to the other (see cut herewith). The air return circuit presents a very high reluctance to the magnetic lines of force. The most efficient type is the closed core solenoid or electro-magnet, in which an iron yoke return circuit is provided.

RESEARCH AND ITS IMPORTANCE TO HUMAN PROGRESS.

(Continued from page 19.)

ble increments which any producer may achieve. Do not think due research will lead to new knowledge. I want to illustrate.

Sometimes, somewhere, centuries ago, the slag of a furnace appeared transparent; some one tried to learn more about it, and so, ultimately, glass was made. Research is still under way on that very material, and numbers of useful additions have been added to the knowledge. Glass has kept the cold from the house. It has let in the light. It has renewed our eyes as they have worn out. Thus telescope and museum hope it has shown us the greatest and the smallest things of the universe. It has bottled our drinks and held our lights. Every year still adds new service, just as experiments add new knowledge. Today we hear of a new glass permeable to ultra-violet light, glass opaque to X-rays, and glass for cooking utensils. Not one of these little increments will ever be lost, but will continue in use, so how highly should we value them? A dilator delay so long in coming thus far, and how far or fast may we still go?

Research presents a way, and not the only one, of insuring peace, of preparing successfully for defense, and of being successful in war. It is the lasting, undeviating factor that always dominates. This may sound bold and entirely extravagant in itself. It is all true. Can we learn to see it? From the military expert to the peacemaker, this unerring instrument for over 100,000 years has been almost continuous on every continent. The inventors of chip flint successfully fought those inferi ors who had not experimented with that. There were then no better arms. These also got their game even when it was scarce and other means failed, and so they still added to survival. The early example of survival was repeated a great many times before our present complex conditions were reached. You can surely continue to be repeated. The fundam entals were always the same. A 42 cm. gun is only a better flint. Trinitrotoluol is only a modern nitrocellulose. War and ammunition have changed, but just so have also changed the myriads of other important accessories to survival. This is the imp ortant point. Let us not be bound by our clothes, and niter is good for fertilizers and for guncotton. The signs that we are improving in our civilization will also indicate that we are growing more in our national defense, but this should come rather as a consequence than as an object. The world has always been improving and the real growth and development has come to those nations which have been responsible for the original research work and not for the mere storage or conservation of the knowledge.

As a means of illustrating how one thread of work starts another, I will briefly rev iew part of a single fairly connected line of work in our laboratory. In 1901 the meter department wanted electrically con ducting rods of a size in the industry. These were to be one-quarter inch diameter by one inch length. We learned how and what to mix to get a porcellain, and we made small quantities of carbonium or of graphite would give us the desired resistance once in a hundred trials. The rods could be made, but the variation of these rods was taken from the porcellain kiln, and when they were made as nearly alike as we could make them, was often a thousand fold that something new had to be done to make a practical success.

(To be concluded.)

May, 1918
$70.00 for $15.00!!

$70.00 for $15.00!!

Amateurs! Experimenters!! Opportunity Extra-Ordinaire!

Size of machine 19½ x 9½ x 8¼. Net weight 18 lbs.

These 3 tapes show how machine works

STATEMENT BY MR. H. GERNBACK, PRES.

"I have carefully read all the statements contained in this advertisement. Every word is true; nothing has been exaggerated. I believe this to be the greatest bargain,—the greatest value—that has ever been offered by my company to amateurs and experimenters, in its 14 years of existence."

HISTORY

The tape recording and perforating machine here illustrated and described is regularly manufactured by one of the largest electrical companies in the U. S. Some time ago a western telegraph company ordered a goodly quantity of these machines for their regular requirements. As we understand it, they paid over $70.00 apiece for these recording machines. The machines were duly shipped West by Express, but the telegraph company having financial troubles could not pay the heavy express charges. Thereupon the machines were returned to New York with added charges, and were finally sold at auction by the express company to recover the transportation charges, as is customary. We bought the entire lot of machines.

DESCRIPTION

This is a standard commercial, large size, perforating, telegraph recorder. It is exactly the same machine as used by the Western Union and Commercial Telegraph Companies in their main offices. This machine requires a double contact (back stop) telegraph key and a few batteries. Pressing the key operates in turn the two sets of powerful electro-magnets, which on their part operate the two ratchet wheels. These then operate two plungers which punch the holes in the tape (as illustration of tape). Since sending Morse code, the holes are punched in a certain manner. Then by feeding the tape back thru the machine and by arranging two brass contact fingers, the tape will spell out dots and dashes by means of a buzzer.

This machine has a truly wonderful spring motor. It is absolutely silent and has a centrifugal regulator speed-adjuster and stop arrangement. At the highest speed the motor runs 18 minutes, at the slowest speed 65 minutes continuously. Over all dimensions of machine are 19½ x 9½ x 8¼. Diameter of holes punched 1/16". The width of paper tape is 1/4". Aluminum reel 4½" diameter. The magnets measure 1½" x 2" and are 1½" thick. The net weight of the machine is 18 lbs. Our illus. shows machine with cover removed to show motor. The small insert shows the beautiful tandem electro-magnet arrangement, the ratchet wheels and perforating equipment. All wood work is solid mahogany.

USES

What you can do with this beautiful machine:

1ST—USE AS A PERFORATING MACHINE as already described. By means of a block of wood and a few bits of brass (or you can mount them on the base of the machine) you have a regular Morse sender and receiver. You can then ask a good operator to send a long message and you can listen to the dots and dashes as often as you wish. The tape record thus prepared will last a very long time.

2ND—AS A REGULAR MORSE REGISTER. With instructions which we supply and by using only two magnets (instead of 4) and by making a few slight changes, which any experimenter can do, the machine will write regulation dots and dashes on the tape. A pencil lead is used to do this. You can then bind an autograph to the recorder, and you are now enabled to read the messages by sight. Or you can send the message yourself with an ordinary key, etc., etc.

3RD—AS A SPECIAL REGISTER. By utilizing all four magnets a special type of dot and dash can be sent (as used in cable telegraphy). See sample of writing on the tape just leaving machine, above. This record can be read just as easy as regulation dot and dash (the dot is represented by the π sign). To send such signals a slight change is necessitated which can be made by any experimenter handy with tools.

4TH—AS A TELEGRAPHONE. Every experimenter has long wished for a real telegraphone, whereby the voice is recorded on a thin steel wire, and then reproduced over a cheap style 15 ohm pony telephone receiver. By means of this machine a very efficient telegraphone can be built by any experimenter handy with tools. No expensive extras are needed; a few bits of brass and steel will do the trick.

We furnish Blue Prints and full Directions to make all the above apparatus using the recorder. We also furnish 3 paper reel tapes, standard size.

Since does not permit listing all of the many good points of the recorder. Suffice it that the machine is the most expensive commercial type, with everything of the very best.

A similar machine is listed at $100.00 in the catalog of the Western Electric Co., a large company. We believe that the price of $15.00, below the ridiculously low price of $100.00, has never been equalled, nor can it possibly be met.

We have not a very large quantity of these machines on hand as we know that there exists a big demand for this recorder, we are almost certain that we will not run this "hot" machine. This is your one chance—each is while the machines last—you will never see such a bargain as long as you live—we are quite certain of it.

The size of the machine being 19½ x 9½ x 8¼; the net weight 18 lbs. (receiving weight 5 lbs.) it is necessary to ship it for express or freight. We guarantee immediate shipment within 24 hours after receipt of remittance. Order at once—today!—you won't regret it. If you live far away you may wish to send your order to the Electro Importing Co., 231 Fulton St., N. Y. C., and we will hold one or more machines awaiting your remittance.

Price as described complete $15.00

THE ELECTRO IMPORTING CO.

231 FULTON ST., N. Y. C.

"Everything for the Experimenter"
ELECTRICAL EXPERIMENTER

U. S. NEEDS MEN FOR SEARCH-LIGHT REGIMENT.

An excellent opportunity is being offered to young men possessing a knowledge of electricity and mechanics, as well as experienced electricians and machinists, to serve the Government effectively in its fight for democracy.

The War Department is organizing a regiment of searchlight companies for special service. These units will be highly specialized and used for battle illumination and anti-aircraft protection. The companies will be armed and equipped with regular military units and will form part of the regular army organization. They will be called upon for extremely active work in the war zone, and points are being taken in the selection of the personnel of the companies.

WHO CAN QUALIFY?

Men of proper experience who already have been drafted into service may in special cases be considered.

The plan is to obtain bright, young, intelligent and ambitious men between the ages of eighteen and twenty-one, who possess a fundamental knowledge of electricity and mechanics, as well as the experiences, qualifications and conditions found in electricians, gas-engine operators and machinists. The enlisted personnel will embrace men experienced in one or more of the following electrical specialties: (1) engine operator, machinist, motor-track driver, blacksmith, horesher, mechanic, and general labor.

Men must first enlist as privates and will be paid thirty dollars per month, together with food, clothing, medical attention, etc. Non-commissioned grades will be at rate of pay fifty dollars and thirty-six dollars per month, and future promotion is open to those of ability.

Specialized service of this character offers unusual opportunities for the man who is adequately trained. The character of the work will be highly interesting and varied. The man who has the necessary training and ability cannot serve his country better than by joining such an organization.

The foregoing summarizes the general activities of this new regiment. Information may be obtained directly to the Commanding Officer, 56th U. S. Engineers, Washington Barracks, D. C. The applicant must give the following information: (1) age; (2) address; (3) (4) married or single; (5) nationality; (6) will you enlist for the period of the war; (7) brief statement of education; (8) present occupation; (9) experience; (10) name and address of present or former employer.

SCIENCE IN MODERN WARFARE.

(Continued from page 21.)

miles away. By means of sound ranging and wireless telephony, the gun battery on the mainland, the sound was heard clearly and the four shots demolished an enemy battery. Photographs taken after the fourth shot proved it was destroyed.

This is only one example of what goes on every day at the front. Just think for a minute what such a feat means. First, an exact knowledge of the location must be known by means of maps. The preparation of these maps is a stupendous task in itself, involving triangulation from various points and measurements from airplanes and balloons. Next, the characteristics of the enemies' cannon must be obtained and their exact positions in relation to their own battery. After each shot the huge cannon must be put back into position. This is done by finely adjusted optical instruments. Then cannon fire must be made, due to differences in the weight of the shells, the weight, age and quality of the charge of powder, and the age, temperature, and state of the air all produce disturbances, which must be taken into account and corrected. All this entails an exact knowledge of many of the sciences. In addition to these the shell must explode at the proper instant and must have a proper "fragmentation." All this means exact application of science.

Acoustics are also used in mining operations, in locating airplanes at night, and in submarine detection.

Photography has also been carried to a very advanced stage. Nearly all successful offensive operations are dependent on correct maps and ranges, and the taking and correct interpretation of aerial photographs has become a military necessity. The French Army have many schools where the training of observers is taught. A well trained observer can read the art of taking photos and making maps from them.

Electricity, of course, has had many applications in warfare, the most important of which is wireless. Tens of thousands of portable outfits have been made to supply the armies. The secrecy which has been due to the prevention of interference and sorting out of the messages from among the great mass of signals, for during a battle it is a common occurrence for more than fifteen hundred separate stations to send messages simultaneously.

In chemistry, the application has been in asphyxiating gases and tear-producing gases, and, of course, in the making of gunpowder. In France alone there are over twenty city and different laboratories engaged in research work on nitrogen fixation.

VOL. 6, NO. 1.

(Continued from page 17.)

flip a coin to see which way he'd go, seller or selling but the coin fell in a crack in the floor and then he got wildly soor en sed to the printers bed I love, tales you win. An heh hee took a deep breath an said the kontrakt?? So please dear friends do you 1000,000 want you pleas sit down NOW and write to my advertisers so that we'll know how man good friends I reeli hav. You see advertisrs are awfully distrustfull folks, thei think i only got maybe 30,000 friends. Now wont you pro to em that they heve another gess koming.

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TELEVISION AND THE TELEPHOT.

(Continued from page 13)

The disposition of this black plate and the telephone receiver is shown in a separate detail sketch, $T$ being the receiver, $D$ the diafram, $E$ the plate. At $A$, we have a source of light, as for instance an electric lamp. The light falls on a planar grid or parallel rays of light which are somewhat modified by the transparent plate in front of $E$. The disposition of the light rays is such that ordinarily the plate $E$ cuts off all the light from $A$, but as soon as the telephone diafram vibrates the plate $E$, more or less light is made to pass thru the latter, which light in turn is sent through revolving plate $G$, the latter has the same helical perforations as the disc $B$ at the sending station. Therefore, therefore, the picture in motion should be formed in the camera at the receiving end, and this picture should correspond with the one sent out from the sender. This picture would then be thrown on the screen of the receiving station as shown. It goes without saying that the two revolving discs must work in synchrony. It is also necessary that the discs be revolved once in one-tenth of a second, which is just the average time of the persistence of the luminous images on the retina of the human eye, and which is supposed to build up the transmitter picture, and in turn is observed on the screen. The length of the receiving end is used merely to enlarge the picture.

(To be continued.)

A NEW PHONOGRAPHIC “LOUD TALKER” FOR PUBLIC PLACES.

(Continued from page 15)

phone attached to the “Cortlandt Street” reproducer, hence thru the lamp ballast, which is usual with the 110-volt loud-speak- ing telephone equipment now used extensively, and so on around thru the one or more multiple circuits of the loud-talking reproducers, which are fitted with horns as illustrated.

We can easily picture just how this arrangement would work out. Let us imagine for a moment that we are passing thru the under-river tube toward New York, after leaving the Pennsylvania Railroad Station in Jersey City. It would be optional, of course, as to whether the guard pushed the “Cortlandt Street” loud-talker push button, and announced the next stop as “CORTLANDT STREET—NEW YORK—ALL OUT” directly after leaving the Pennsylvania Railroad Station stop, or whether she would depress this push button shortly before arriving at the “Cortlandt Street” stop. This, of course, would be a matter for the traffic engineers of the railroad system adopting the device to work out to their own satisfaction.

The action of the apparatus is very simple, and it will be noted by referring to the diagram herewith that when the phono- graph reproducer has reached the end of its record that it would be automatically turned by hand to its original position in the same manner as the penny-in-the-slot automatic phonographs we are accustomed to in public amusement places. Also, when the microphone and reproducer unit have been returned to the starting position, the same mechanism would cause a trigger switch which contact to close a magnetic cut-off circuit, which would trip the magnetic switch when its moving core and attached contacts would at once return to their original position by gravity.

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ELECTRICAL EXPERIMENTER

May, 1918

Regarding the arrangement of the loud-talking reproducers, these could very well be placed along the ceiling of the car or they could be placed on the side of the car, spaced alternately on both sides, so as to give the best distribution of the sound waves. So far as the equipment itself is concerned, the phonograph attachment and its auxiliary mechanisms, including the electric driving motor of small size, magnetic switches, etc., could all be placed in a small cabinet which would readily fit under one of the seats. A two-wire cable only is required to connect the phonograph mechanism with the loud-talking reproducers. To some it might seem that all of the individual records might be combined into "stops," so that we may not have to be tortured many more years with frog-throated announcements of our subway and "L" train guards, which generally sound like a cross between a French artillery barrage and an advance of one of General Byng's tank squadrons.

The phonographic loud-talker would find a wide application in theaters and other public places, and in theaters it would for one thing seem very advisable for the purpose of giving "fire exit" warnings before the start of a show, and also for making announcements of future plays between acts, etc. The loud-speaking telephone itself has been successfully used in push-

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**EXPERIMENTAL CHEMISTRY.**

(Continued from page 42)

by heating ammonium nitrate, and when the gas is escaping and free from air (a condition essential to success), pass it up into the other bottle of nitrogen dioxide. It will be noticed that there is no action, barring a slight red fume due to a very little oxygen, with the nitrogen monoxide, whereas oxygen combines with nitric oxide, forming nitrogen tetroxide, which is at once dissolved in the water. Carefully study this distinction.

**Nitrogen Dioxide.**

Preparation:

1. $3 NO + NO_2 = 2NO_2$. The mixture is commonly prepared by the action of nitric acid on copper. One of many other metals act similarly. The acid should be diluted.

2. By the action of a ferrous salt upon nitric acid or a nitrat in the presence of sulfuric or hydrochloric acid.

3. $3Cu(NO_3)_2 + 2KN_3O = 3Cu(NO_3)_2 + 4H_2O + NO_2$

$6FeNO_3 + 2KNO_3 + 4H_2O = 3Cu(NO_3)_2 + 4H_2O + NO_2$

The proportions for the above reaction are 30 grams of potassium nitrate, 250 grams of ferrous sulfate, and 200 cc. of a mixture of one volume concentrated sulfuric acid and three volumes of wa. The colorless gas escapes, which, however, forms brown vapours as it comes in contact with the air; but as soon as the air has been driven from the apparatus it passes off colourless and may be then collected over water.

3. By adding sulfuric acid slowly to a mixture of a saturated solution of sodium nitrate and copper turnings.

$8NaNO_3 + 4H_2SO_4 + 3O_2 = 4Na_2SO_4 + 3Cu(NO_3)_2 + 4H_2O + NO_2$

Properties: (Physical) Nitrogen dioxide is a colorless gas. It dissolves readily in solutions of ferrous salts, forming a black-colored solution, from which it is expelled upon heating. It is upon the formation of this coloration that the test for nitric acid or nitrates is based.

(Chemical) Nitrogen dioxide only sustains the combustion of such substances whose heat liberated is sufficiently high to to cause it to break down into nitrogen and oxygen. Carbon bisulfid (a highly inflammable liquid) and phosphorus burn brilliantly in the gas, the former forming carbon dioxide and sulfur dioxide.

**EXPERIMENT NO. 126. Nitrogen Dioxide from Copper and Sulfuric Acid.**

Have a 250 cc. Erlenmeyer flask of thick glass and corrugated side neck, and a one-hole rubber stopper carrying a throttle tube; or, use a wide-mouth bottle, with a rubber stopper having two holes, one for the delivery tube, (if the flask with side-neck is used, the delivery tube is connected to this side-neck). Put into the generator 10 grams of copper scraps, and add 20 cc. of water, or enough to cover it. Prepare the tray or trough with inverted receivers (8 ounce bottles) filled with water as described in the lesson on Oxygen. After adjustment pour in 20 cc. of nitric acid. A little of the gas should first be rejected, as it is largely mixed with air. If presently the action is not vigorous, add more acid. Notice and observe carefully all phenomena.

After collecting four receivers of the gas to be tested in the following experiment, fill the generator with water, rinse the receivers several times, and then put it back into a receptacle.

**EXPERIMENT NO. 127. Tests and Properties. The Oxygen Test.**

Let one of the receivers get the full test of the gas; and test it by placing the receiver in the trough and holding it upright, noting color, odor, diffusibility. Do you recall having seen this product before? -

**EXPERIMENT NO. 128. COMBUSTION TEST.**

Remove one of the receivers with a glass plate, keeping it covered except as tested.
Thrust into it a burning splint, and notice results. Try it several times to make sure. Try another jar of the gas with burning phlogiston, observe the size of a split pea, first having it vigorously or the experiment will not succeed. Remember, gas is gas, whether phlogiston or combustion. On taking out the combustion cup keep the jar covered in order to examine the fumes.

If the phosphorous burned, observe the color of the flame and the product. How many sorts of fumes can you distinguish? From these tests do you conclude the Nitrogen of Oxygen or a non-supporter of combustion? Do you conclude it is combustible or non-combustible? Is it an oxidizer or a reducer? How would you distinguish all other gases?

Leave one bottle of the gas standing on the shelf (if the trough is used), then prepare an oxygen generator (the test tube with potassium chlorate and manganese dioxide will suffice. (See lesson on Oxygen) and pass some of the oxygen up into the bottle filled with Nitroglycerin. No result and continue the process for some time.

Explain and why you do not obtain the familiar red fumes. What property of the gas is shown by this experiment?

Finally take out the bottle with the water in it and then test it for nitrogen. What does this test show? Is it likely or not that the oxide has combinded with the water? If so, try and determine by employing equations what has formed.

**NITROGEN TRIOXID**

**PREPARATION:**

This gas, known only at low temperature, is formed thru the union of nitrogen dioxide (4 vols.) with oxygen (1 vol.) at -18 degs. 4 NO+O2=2NO2. When a gas is heated with starch, orange-red fumes are evolved which consist of a mixture of nitrogeon trioxide and teteroxide. On passing these vapors into a vessel containing starch, a fine white fume forms. The fine fume is a liquid. Pure tetoxide at -10 degs. is an indigo-blue liquid. Above 12 degs. the liquid begins to decompose; TN2O5+H2O=2NO2+HNO3. With a small quantity of water nitrogen trioxide forms nitrous acid; NO+H2O=HNO2+NO. With a large quantity of water decomposition takes place and nitric acid results: 3N2O5+H2O=2HNO3+2NO2

Nitrogen trioxide and nitrogen peroxide are red-brown gases, which can be distinguished from each other except by volumetric analysis, their chemical characters being nearly identical.

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**NITROGEN TETROXID OR PEROXID.**

**PREPARATION:**

Nitrogen tetridox is prepared by:

1. Thru the union of nitrogen dioxide and oxygen. NO+O2=NO2
2. Heating lead nitrat: Pb(NO3)2=2PbO+NO2+2NO

The gas may be liquefied by passing into a vessel immersed in ice and salt.

**PROPERTIES:**

Nitrogen Tetroxid is a dark gas which is readily cooled to a light yellow fluid. With a little cold water, nitrogen tetridox forms nitrogen dioxide and nitric acid, with an excess, as also aqueous solutions of alkalis, nitric, and sodium nitric or their salts and acids.

NO+O2+H2O=NO2+HNO3

**EXPERIMENT NO. 109.**

**NITROGEN TETROXID FROM NITRATES.**

Put into a small test tube four or five drops of water nitric acid. Hold the tube in the hand with a tube holder and point it toward the right, keeping the lower part of the tube in the hot part of the Bunsen burner, and, having a glowing splint in the right hand, thrust it into the tube near the axis of the action begins. This test is merely to show that oxygen is also liberated, together with the oxides. Be careful not to repeat several times.

Notice the sound when the crystals are heated. Note the color of the fumes and their odor.

Not all nitrates break up by the application of heat; for instance, sodium or potassium nitrit will not, and ammonium nitrit will give a different result, as you have already observed.

**EXPERIMENT NO. 130. FROM NITRIC ACID.**

Most metals heated with nitric acid give NO, either directly or indirectly by the union of oxygen of the air with the dioxid or directly. Test the action of the acid on tin-foil in small pieces, heating it if necessary.

3Sn4+HNO3+H2O=3SnO2+4NO

What kind of a substance is it? It is called *Nitric Acid.*

**EXPERIMENT NO. 131.**

Put about a gram of fine charcoal in a test tube, heat it till it glows, then let fall two or three drops of acid free water into another tube. Note any phenomena. Heated starch or other carbonaceous substance acts in a similar manner. When nitric or a nitrous acid is the immediate reduction product is NO, but in case any present either from the air or from the product itself the balance of the two is so great that combination at once occurs. Occasionally the secondary action of reduction does not give NO or NO2, but free nitrogen or even ammonia. (NH)3

**EXPERIMENT NO. 132. NITROGEN TETROXID, COMPOSITION.**

From Nitrogen and Oxygen. Invert a 50 cc. cylinder, gradually filled with water in a trough and clamp it in position so as to collect 40 cc. of gas in it.

With a nitrogen dioxid generator (using Cu and HNO3) collect the gradient in 40 cc. of the dioxid, take care to expel all gas from the generator before allowing any gas to collect, and noting exactly the volume of NO.

Arrange in another trough a second gradient which may, if desired, be smaller than the first, and close and clamp so as to collect 20 cc. of gas. Prepare an oxygen generator (employing potassium chlorate and manganese dioxide), and when all the air has been driven out of the second isotherm fully, collect 20 cc. of oxygen in the last graduate, that is, half as much as NO. Set aside both generators.

Now transfer the gas containing the dioxid to the other trough and clamp it in position. This is done by sliding the mouth of the gas into the tubing of the gas half filled with water. No air must be admitted. The reason for the transfer is that when NO is generated about 10 per cent will dissolve in water trough, and it absorbs much oxygen as the latter is poured upward.

Next unclamp the oxygen graduate and carefully pour the contents in successive portions up into the graduate containing NO. An inverted funnel may be used if necessary.

If the experiment is made with sufficient accuracy, the graduate should be completely filled with water at the end. If it was not in your case, can you see any reason?

**Record the Results:**

Volume of NO collected (v).

Volume of 0 introduced (v).

Ratio of NO to O.

Symbol of Nitrogen Tetroxid.

(To be continued.)

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FIXATION OF NITROGEN BY ELECTRICITY.

(Continued from page 2)

there is no longer danger of its dissocia-
tion, it has then reached so to say a false
harbor. In order to do this rapid cooling it
is necessary that the air be past very
rapidly thru and out of the high tempera-
ture of the electric arc, or better still that
the electric arc be past very rapidly thru the
air. This latter principle is carried out in
the famous Birkeland-Eyde process which is
used at present on a large scale in Norway,
Germany and other European countries.
The Birkeland-Eyde system is illustrated
in figure 1.

Two large electro-magnets A and B are
placed on both sides of a powerful electric
arc C. When these electro-magnets are
energized we have practically the same dis-
position as in the well-known magnetic
blow-outs, that is to say, that the arc C
will be moved or blown away by the mag-
netic field which crosses it at right angles.
As this arc is being blown out entirely, there
should be provided some means by which it
can be re-established every time that it is
blown out. In the Birkeland-Eyde process
this is done by using an electric pressure
of 5,500 volts across the electrodes. This
high pressure jumps the gap D every time
that the current ceases. This spark immedi-
ately starts a new arc, and in this way a rapid succession or train of electric arcs is ob-
ained. In reality the electrodes between which the arcs take place are hollow and water cooled and they are represented as shown in figure 2.

As alternating currents are used in this
system, the arcs are blown alternately in
the direction E, and then again in the di-
rection F. The result is a series of huge
electric flames of semi-circular shape as
represented by the dotted lines, growing
rapidly from the center and moving at a
tremendous speed away from the center.
The air thru which these arcs are being
drawn becomes very rich in nitric oxide,
and the continuous supply of air which it
is cooled off is mixed with more air
so that the nitric oxide gas which it contains
oxidizes still higher and then it is past thru water with which it combines to nit-
ic acid. It is claimed that about two per-
cent of the air which has been treated in
this way is gained in the shape of nitric
acid. As this claimed of course finds itself is rather low, the electric power used
in this process must be cheap in order to
make it go. It is for this reason the plants
for this electric fixation of nitrogen out-
of the air are almost invariably lo-
cated in the mountains where cheap water
power can be directly turned to the
required electric power. The plants using
this system claim to produce 600 kilograms
of nitric acid per kilowatt per year. A
remarkable feature of this electric system
is that it requires nothing in the way of
materials but water and air.

The process of fixation of nitrogen by means of electricity is illus-
trated in figure 3.

A long electric arc of twenty feet is main-
tained between an electrode A and the
inside wall of a long iron tube B. By
means of a water-jacket C, the upper part
of the iron tube is kept cool, so that the
electric arc, which has a natural tendency to

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RADIO AND TELEGRAPHY.

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climb up against the inside wall of the tube, can not extend farther than the line M—N. Air is forced thru this iron tube from the bottom upwards. This air passes thru the electric arc and thus the nitric oxide is formed. When this air reaches the line M—N where the cooled part of the iron tube begins, it is immediately cooled off and consequently secured against dissociation. The obtained nitric acid gas is then first oxidized to a higher degree by intermediate heating and finally treated with water so that nitric acid is obtained. In this Shöntherr process an electric pressure of 5,000 volts maintains the long electric arc. Alternating currents are used here also.

By means of side openings, the air which is blown thru the tube is given a gyratory motion, which results in the electric arc being maintained exactly along the centerline of the tube.

The Pauling process is illustrated in figure 4.

Here an alternating current of 4,000 volts pressure maintains an electric arc between two hollow ornately surmounted by a wire as represented in figure 4. This arc, when established, is driven upwards by a blast of air and is disrupted by the diverging horns. The arc will spark over at A and so on. The effect is to create an arc flame about thirty inches high and to have this flame impinging upon the moving air used to blast the arc flame. Here also the obtained nitric oxide gas is first oxidized to a higher oxide and then past thru water so that nitric acid is obtained.

The Pauling and the Shöntherr processes compete favorably with the more famous Birckeland-Eyde process. All three processes exist on a large scale in many European countries, but have hardly found their way as yet in America.

THE PHENOMENA OF ELECTRIC CONDUCTION IN GASES.

(Continued from page 25)

As ions can neither be seen or separated in order to measure their individual velocities, which no doubt vary, we have them directly as we can, let us say a race horse or a cannon ball. The method of Winkler and Weichert was first developed and is very ingenious one. He constructed a tube in which the cathode rays were made to vibrate back and forth across a screen which was the anode. He then used a mirror which was behind which another screen was located. The swinging of the rays was controlled by an oscillating field of high frequency, a period of which could be calculated. The arrangement was so timed that the rays past the first screen at the end of their swing to one side, and reached the other screen in the middle of their swing back again, so that the time taken for the rays to pass from one screen to the other was just an integral period of the oscillating field. The number of oscillations of the field was determined by small conden- sers whose capacity was known; hence it only remained to calculate the time for a quarter vibration, and reduce the distance for that time to centimeters per second. The data are accurate and constant, and the honor of making the classic determination of the velocity of such ions must be awarded to J. J. Thomson. All other indirect methods are very simple and for this reason also quite accurate. His method was to pass the current, as in Fig. 4, allowing the ions from the cathode C to pass thru a small perforation in the anode A, to a luminous screen at the opposite end of the tube. At the point EE and MM, however,
two electrodes EE, and the poles of an electromagnet MM, were situated at right angles to each other so that the rays could be deflected in opposite directions by either a magnetic or electric field. The procedure was then to first deflect the rays by an electric field of known strength to any point B on the luminous screen; then to increase the magnetic field in the opposite direction until the rays were just brought back to their original position again.

By knowing the strengths of both the magnetic and electric fields it is easy to calculate the velocity of the rays, for it is a well-known fact that the force of an electric field on an ion does not depend on the velocity of the ion, while the force of a magnetic field on an ion does depend on the velocity of the ion, or in other words upon the number of lines of force it cuts per second. These facts may be expressed by simple formulas well known to students of physics, as follows:

$$H ev = V e$$

or

$$V = \frac{H e}{v}$$

where

H and V are the strengths of the electric and magnetic fields respectively, "e" is the charge on the ion and "v" is the velocity of the ion. In the experiment the rays were brought back to zero so that it is evident both fields are equal, therefore:

$$V = \frac{H e}{v}$$

mined from V and H which are known, or can be measured.

From such determinations it has been found that the positive ions in a tube like the one shown may travel as slow as 600 miles per second, and from their size they are identified as helium atoms. Others traveling at approximately 2,000 miles per second appear to be hydrogen atoms, which are the smallest positive ions so far known. The negative ions travel in such a tube at about 100,000 miles per second or even as high as the velocity of light, and are without doubt free electrons. Under other conditions much slower moving ions are found than any mentioned and they probably correspond to the groups or clusters mentioned earlier. Much work is now being done to determine the nature of ions under different conditions, and this bears directly on the problem of the nature of Electricity itself.

EXTERNAL GRID VACUUM VALVE DETECTOR CONSTRUCTION.

(Continued from page 28)

A glimpse of a semi-finished detector is presented in Fig. 3, in which the outside grid has been lowered to give a clear view of the interior of the bulb. In this picture the base wires are shown separate not connected to the necessary leads which are shown elsewhere.

Some idea of the finished appearance of our detector may be gained from a survey of Fig. 4. The grid on these valves is made of perforated aluminum or nickle laden brass. The holes can be punched by hand or the material bought in the finished state.

It may be that some who glance at this article will form the opinion that the detectors illustrated will not give good results on account of the small area and positions of the internal parts. This, however, has not proved the case, as the author’s experiments with the bulb actually pictured here have proved them quite sensitive under the right conditions.

The matter of current regulation with this valve is a rather important one. In
order to operate the valve efficiently the filament must burn brightly and should be fed at about 20% above the specified voltage, the exact amount varying with changing conditions. For low voltage radio work the filament may be as high as 80%, but for high voltage radio work the filament should be as low as 60% to provide a margin for any condition of service.

A telephone circuit battery of about 60 volts is generally considered quite sufficient for the majority of telephone or radio-day valve operations.

In the case of the bulbs under consideration it is best to command a high voltage potential, of the order of 50 volts, although very good results can be obtained with as little as 50 volts. The current from the cells which form this battery must be controlled by a potentiometer of very high resistance, or best type, so that no radiating circuits may be substituted therefor. The author has found during his tests that a potential of 50 volts, subjected to the regulating effect encountered by using the skin of the hand or fingers as a rheostat, gave unusually good results.

The heat of using one or both of these types of body as a current regulator is, of course, impractical, but the resultant effect is so striking that it leads the author to believe that a new instrument, if developed, may take the place of the present potentiometer, which is known to be a very wasteful instrument. An adjustable bank of receivers of different resistance, such as a single pitch, connected with a common sound chamber or horn, should entirely eliminate the need of a potentiometer and it is also a characteristic of employing a variable condenser in this connection to approximate the capacity effect obtained in using the body as a resistance.

During the war it will naturally be impossible to test out any form of wireless instruments, except in the laboratory, where better type, so non-radiating circuits may be utilized, and even then there be a number of possible conditions set where the limit of sending power available now. No aerial or ground lines are permitted under the recent Radio Act.

For the real electrical experimenter and radio enthusiast it will remain a matter of considerable interest that in this field in which to work with any type of valve-amplifier that is not too highly valued to experiment with. Two of the many possible combinations of electronic circuitry may be put outside the radio field are considered separately in the following paragraphs.

Hot filament valves are slowly coming into use as rectifiers of electric current in commercial stations, but are still considered in the chrysals, or unfinished state. The great drawback in using bulbs for this purpose lies in the excessive waste of filament which takes place, making the rectifier very short lived. It would be folly to use any serious experiment for experimentation along this line, but one of our lamps, which cost only about 60c to replace, may be used without any one's being considered a pinch hitter again. By using the filaments interchangeably at intervals of a few hours each it may be possible, under the right conditions, to get a life of 500 or 600 hours from some of these bulbs when used as model rectifiers.

The most wonderful property of the vacuum valve, and the one which makes it the ideal instrument is doubtless its ability to act as an amplifier. For increasing, indirectly, electrical energy and making the electric current presents a very desirable medium. Many systems of automatic sound control are being developed with the aid of the amplifier valve. There is no limit to the possi-

bilities of experimentation in this direction. Loud-speaking megaphones, phonographs, telephones, horns, ad infinitum, all await development. Submarine destroying devices and various types of apparatus of all kinds, can be invented which will prove to be the undoing of things out of sight, but not out of the hearing of the enemy, and whose operation is augmented and sensitized by the addition of an amplifier bulb.

It is the author's hope that the foregoing ideas may prove of real interest to a very large class of readers.
Submarines, torpedoes, flying machines, machine guns, immense howitzers, the British "tanks," and an untold number of other products of American brains, are dominant factors in the Great War. We are just starting, our "YES"—ingenuity must be "YES"—Uncle Sam—the whole civilized World—is seeking ideas that will aid in the fight. Can't you help with even ONE of thousands of simple things that will win recognition—perhaps fortune for you?

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A. This is a very clever idea, and quite novel as far as we can see. We have never seen the like of it, and would advise our correspondent to get in touch with a patent attorney.

**ENVELOPE.**

(221) Leo M. La Fave, Black River, N. Y., has submitted to us a simple combination envelope and letter, the idea being to fold the letter in such a way as to make an envelope out of it. This letter has, of course, a special flap, so that the combination can be sealed. Our correspondent wishes to know if this device is new and patentable.

A. This is not a new device by any means. Quite a good many envelopes of this kind are on the market now, and we know of a number of concerns who are using such envelopes at the present time.

**GUN KICK-ABSORBER.**

(222) Erwin L. Gehrke, Cleveland, O., submits a device to be attached to a gun whereby the kick of the gun is absorbed. It is a well-known fact that a soldier firing a gun for a long stretch of time is apt to develop soreness in the shoulder by virtue of the powerful kicking back of the gun. By means of certain spring arrangements, our correspondent intends to do away with this feature.

A. This is by no means a new idea, kick absorbers of this kind exist at the present time and have existed as far back as one hundred years. Somewhat or other the idea does not seem to be very popular with the various governments, particularly nowadays, as a good deal of progress has been made in gun building, and the modern rifle does not give the heavy kick that such guns used to give, as, for instance, the old style musket.

Our correspondent, furthermore, writes as follows: "An idea has come to me concerning a method to heat the water in a boiler. This would be chiefly used in the recently invented "Doble Car."

He goes on and describes a system whereby a generator of the correct power is geared to the steam engine, storage battery to be charged by the generator while the car is running, and to be automatically disconnected when charged. The purpose of the storage battery would be to take the place of the generator while the car is at a standstill, in order to keep the correct amount of steam up continually. The heating of the boiler in this case will, of course, be electrical, and our correspondent describes his method minutely.

A. This is a very good idea, but we are not quite certain that it is of any practical value without having it tried out. In a way, the idea is quite new, and there should not be much trouble in patenting it, but we would advise caution, and at least preliminary try-out.
ELECTRICAL EXPERIMENTER

May, 1918

$50,000,000
For One Little Idea

The little tin cap with the wrinkled edge that you jerk off of beer bottles and other bottles, that simple little thing has made something like fifty millions of dollars as a patent, according to an eye that has seen many a useful device or gadget in its day, or any number of articles that we all handle in our daily life that have made fortunes for the men and women who say the worth of their inventions or the products of their craftsmanship. There's no quicker, surer, or more legitimate way of attaining wealth than through an invention. Yet how few of us take advantage of the opportunities that we all have for producing an infallibly profitable invention?

What Shall I Invent?

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AUTO GAS TANK

(226) L. B. Wilson, Kalamazoo, Mich., submits an idea for an automobile gas tank which is supposed to keep a reserve supply of gasoline. The arrangement is such that instead of the gas tank being the ordinary gas tank, it is automatically filled when the temperature rises above a certain degree, the fan will start running, thereby cooling the atmosphere. Under the Wilson system, the reply of the manufacturer and the rest of the product will be certain. A tank is connected into the circuit, which in turn throws hot air into the room, thereby heating it. A capital idea; very good and very simple. We are quite sure that our correspondent will find little trouble in securing a patent, which we are certain should prove valuable. He should get in touch with a patent attorney at once.

THEORY OF TUNING, WAVE LENGTHS AND HARMONICS.

(Continued from page 39)

If the frequency of the applied pressure were increased three-fold—that is, to 180 cycles per second—the necessary frequency to be employed with the given condenser to produce resonance would be

\[ L = \frac{1131}{1131} \times \frac{0.1131}{1131} \]

or one-ninth the amount required originally.

If the applied pressure E and the resistance of the coil is the same as before, the current in the circuit will be 11 amperes as before. It is now a simple process to comprehend the application of the foregoing to a wireless set, wireless, or low resistance telephone receivers connected as indicated in figure 4, or with high resistance receivers connected between the terminals of the condensers as indicated in figure 5.

The applied pressure E may be produced by wireless waves being reflected on the aerial. This pressure E may, of course, be of any value depending upon the energy available at the receiving device due to the distant transmitting apparatus. There may be three different wave frequencies from these different sending stations operating through space at the same time, one having twice the cycle frequency of the second and three times the frequency of the first. By slowly moving the contact P along the turn of the spiral a better coil the values of the inductance L is so varied as to produce resonance and a maximum current in the telephone receivers for one of the frequencies. The currents due to other frequencies may produce a certain small current in the receiving circuit, and weak sounds in the receiver. By moving the contact P along the position for one frequency, to another position, a certain position is found such that resonance and a maximum current is produced through the receiving circuit. The maximum current for this frequency produces a much louder note in the telephone receivers than the currents due to the remaining frequencies, which are now said to be "tuned out."

The higher the frequency of the wireless waves producing the pressure and resulting in current in the receiving circuit, the higher the pitch of the note in the receivers.

It may be well to call to mind the relation of frequency and wave length. The higher the frequency, the shorter the wave length, as indicated by the equation \[ V = \frac{E}{\lambda} \]

in which V denotes the frequency of propagation of a wave of a certain wave length, \( \lambda \) (Greek letter lambda) denotes the wave length. The velocity V of propagation is the same for all wave lengths. That is, V is a constant; so if \( f \) is decreased, then \( \lambda \) must be correspondingly increased.

The importance of the numerical value of the resistance R of the receiving circuits considered. Considering the original equation

\[ \frac{1}{2\pi^2f^2R} \]

it may be seen that when \( 2\pi^2f^2R = \sin^2 \theta \)

the current is express by \[ I = \frac{E}{R + \frac{E}{\sin^2 \theta}} \]

which shows that at perfect resonance with a given value of applied pressure, the smaller the numerical value of the resistance of the coil or of the complete circuit, the larger will be the current in the coil or circuit, or in a telephone receiver when connected as in figure 4.

In such an arrangement it is evident that the smaller the resistance of the receivers the greater will be the current in them. However, the sensitivity of a telephone receiver depends very largely upon the
ampere-turns. When arranged as in figure 5, 6, the receiver would naturally have a much greater resistance than when arranged as in figure 4, since when connected across the contacts it is exposed to very high pressures. The greater resistance does not imply, however, that they should be wound with wire having a high resistance. In fact, such is not the case, since large value of ampere-turns is desirable. If copper wire is used in winding the electromagnets of the phones, a given resistance wire can produce more ampere-turns and therefore more ampere-turns, than if wire having a higher specific resistance is employed.

Coi's wound with insulated wire so arranged with a variable contact device as to have their inductance varied at will throw out a considerable range, are called tuning coils when used in connection with wireless receiving apparatus, and it is interesting to note that as the contact P shown in figure 2 is moved so as to reduce the number of turns, that is to decrease the inductance, at the same time the resistance of the circuit has also been decreased. That is, the decrease in resistance and inductance must occur simultaneously in such a device. Reducing the number of turns reduces the actual length of wire in circuit.

The tuning might be effected by drawing an iron core in and out of a coil, which wire, when the core was drawn, would be sluggish in action, and of course would not vary the ohmic resistance connected to the primary. Another method of varying the inductance might be effected by constructing the coil of two portions, arranged to move with reference to each other, and the variations in inductance is said to be effected by mutual induction, and the ohmic resistance of such apparatus is constant.

Harmonics.—Any interesting and instructive aspect of the tuning coil is in tuning a circuit to respond loudly to the various harmonics of any single fundamental wave that is being circuit from the sending station. This may perhaps be best explained by considering the shape and composition of alternating-current waves or curves. It is impossible to define just what is meant by an "alternating-current curve or wave." A true alternating pressure, current, or magnetic field is one which has the same wave shape or respective values in each successive second, and one that is produced in accordance with a definite law: Thus, the alternating current or so-called sine curve, shown in figure 6. Such a curve is constructed by first drawing a circle, as shown at A, and laying off on a horizontal straight line, the length of the circumference of the given circle. The length is shown as OX in the figure. Op is therefore half a circumference, Oq one-fourth of a circumference. The sine curve may be constructed by first erecting at point B a vertical line equal in length to the radius of the circle, and then a vertical line equal to the line A'B, which is called the sine of the angle A'OB. In short, all the verticals erected on the horizontal base line represent the sines of corresponding angles of the center of the given circle. The dotted horizontal lines in figure 7 are the feeder idea as to the construction of the sine curve.

Now every true alternating wave of any shape whatever is made up of a certain number of these simple sine curves added together. The so-designated resultant curve in figure 7, the 1st harmonic curve, which is made up of three simple sine curves all starting at the zero point O, and all increasing in the vertical or positive direction. It may be noted that one of the component sine curves has the same frequency or wave length as the resultant curve. This sine curve may be called the 1st harmonic. Another component sine curve has three times the frequency, hence one-third the wave length of the resultant curve. This sine curve is called the 3rd harmonic. The other component sine curve has five times the frequency and one-fifth the wave length of the resultant curve. The resultant curve is composed of an infinite number algebraically the vertical heights of all three of the component sine curves at each point chosen. The resultant curve indicate those points that were chosen in order to construct the particular curve.

By algebraical addition is meant that at any given point on the horizontal all vertical distances of all sine curves extending below the horizontal must be subtracted from the vertical or the sum of the verticals extending above the horizontal at the same point. At points where all the component curves pass thru the horizontal datum line, there of course the resultant curve also passes thru the horizontal. It is evident that a great variety of resultant curves could be constructed from the three simple sine curves by simply varying the heights or amplitudes of these curves, or of only one of them. Every alternating wave of pressure if applied to any circuit will produce in the circuit an alternating curve of current that is also made up of component sine curves. It may, for example, be supposed that figure 7 denotes an alternating pressure E impressed on a circuit as shown in figure 8; if properly adjusting the movable contact P, resistance may be produced in the circuit with reference to the third or harmonic component of the applied pressure, causing the maximum current in the receiving circuit having a frequency just three times that of the fundamental or resultant pressure and current. The predominating tone in the receiver has a pitch or frequency three times that of the fundamental or resultant curve. By still further decreasing the variable inductance, the fifth harmonic may be made predominant. If an impart pressure is made up of, say, fifteen harmonics, the tone of the coil has sufficient range in adjustment, the fifteenth harmonic might be made the predominant one. As the frequency goes up, the wave length becomes lower. Thus the third harmonic has a frequency three times the fundamental, and a corresponding wave length of one-third that of the fundamental.

Another interesting fact in connection with the matter of "tuning" may be alluded to here, that has a very important relation to music. Nearly every person can distinguish the musical tones given out by a violin from those given out by a cornet or a piano. That is, tone having a definite pitch or frequency given out by a violin has a very different quality from the same tone or note of the same frequency produced by a piano or by a cornet. When all these instruments are tuned to, say, middle C, they each produce a note having the same frequency or the same pitch; that is, the same musical sound sent out by each instrument is very different.

This may be illustrated diagrammatically by figures 7 and 8. The resultant curve in figure 8 is made up of the sum of three sine waves as indicated, but has a very different shape from the resultant curve in figure 7.

The two resultant curves might have exactly the same wave length (distance from O to X), that is the same frequency, yet disturbance of the wave from one to another. Two wireless waves having exactly the same frequency may readily be distinguished by an expert operator simply because of the characteristic of quality. It may be valuable to have devices that will tune not only for pitch but also for quality.
27 YEARS THE ENEMY OF PAIN

ELECTRICAL EXPERIMENTER

THE HOW AND WHY OF RADIO APPARATUS.
(Continued from page 30)

A potentiometer resistance. The sealed-point containing the fine Wollaston wire is made positive. No adjustment is necessary with this detector. If dry cells are used, a switch being provided as shown. The electrolytic detector is extremely sensitive and can be made up in a few minutes in emergency. It does not "jar out."

The Bare-Point Electrolytic Detector has been the subject of much discussion among radio men as to who really was the basic inventor of it. But most writers of the day give credit, jointly, to Dr. Michael J. Pupin (1889), Professor Reginald A. Fessenden (1903) and W. Schloemelich (1903).

The action of this detector is based upon the fact that if an extremely fine platinum wire, measuring a few ten-thousandths of an inch in diameter is allowed to partially immerse its extremity in an acid solution (such as one composed of five parts water and one part nitric acid) that an incoming Hertzian wave current will tend to arrest the strong polarization (the production of fine gas bubbles) set up about the fine platinum wire, which is usually made the anode in the battery circuit. Further, the electrolytic detector has been found by Professor G. W. Pierce to act as a rectifier and that the inherent action is also based on polarization capacity at the electrodes as first described by Pupin in 1899. Dr. L. W. Austin and others have found that the fine platinum wire may be positive or negative for feeble oscillations with equal results. The acid solution is contained in a glass or carbon or zinc cup, and this acts as the cathode in the battery circuit. This detector possesses the function of acting as its own battery when a carbon or zinc cup is used, as this forms a minute carbon (or zinc) acid, platinum. This inherent battery action was intensified considerably by using a special amalgam in the acid solution in a detector of this class developed by H. Gernsback several years ago. The self-excited electrolytic detector has never been found (Pierce) to be as satisfactory as the externally excited one for feeble signals.

The operation of the sealed-point type ("RadioSon") is the same as in the bare-point electrolytic type of detector and a battery of two dry cells is used with it, together with a pair of high resistance telephone receivers and having the battery couple preferably by means of a high resistance potentiometer.

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The advantage of this type of electrolytic detector is that the acid is scaled in, consequently does not spill or evaporate. The tinker is used a great deal in translating undamped signals. It was devised by Poulsen and employs a small vibrator or rotary contact interrupter as shown at Fig. 4. No detector of the ordinary kind is used. The condenser connected across the phones should have about 82 m. capacity. It can be of the paper and tinfoil type.

The Fleming Value Detector of Hertzian oscillations (Fig. 5) is based upon the principle that if we have a hot or incandescent electrode, and also a cold electrode, both of which are connected to an evacuated glass chamber, a rectifying action will be created, i.e., that negative electrical charges, such as those from a battery of 30 to 40 volts or even less, can pass from the hot filament to the cold electrode, but not vice versa. In the Fleming Valve the cold electrode takes the form of a metal cylinder surrounding the incandescent filament. This arrangement acts as an electrical valve for passing or alternating currents of any frequency. The space between the cold cylinder and the hot filament is therefore said to possess unilateral conductivity. The Fleming Valve possesses a fairly high sensitivity; it is used with a pair of high resistance head phones, a suitable battery and auxiliary regulating apparatus. The wire less receiving phenomenon occurring will be evident from the foregoing and is, in a sense, of a rectifying nature similar to that possessed by the mineral detectors.

Since the Fleming valve detector has a very high resistance, the condenser C should be very small, the inductance L relatively large, and the telephone receivers wound to a very high resistance, say 4,000 to 5,000 ohms, recommends Dr. W. H. Eccles. A peculiar fact about this detector is that its action is interfered with if the glass of the bulb becomes statically charged; hence the bulb is surrounded by a copper gauze screen which is earthed by connecting it to the battery supplying the lamp filament.

The Audion Detector (Fig. 6) employs three distinct electrodes as shown, viz., a filament—a grid—and a wire or plate. The grid, composed of a wire member as indicated, is placed between the filament and the wire. The oscillations when they pass thru the Audion detector are subjected to a similar action to that occurring in the Fleming Valve when they are received, but in so doing they are claimed to also effect a relay action with respect to a high voltage battery of 40 to 50 volts potential, connected to a pair of high resistance telephone receivers in the relay circuit. With the Audion it is seen that, owing to the suggested relay action inherent in its operation, it is quite possible and practical to have a relay action occurring of considerable magnitude; that is, the ratio between the amount of energy passing into the Audion from the antenna circuit and the amount of energy controlled by the relay or trigger action in the high voltage telephone circuit may be quite large.

There was, for a number of years, a great controversy on the subject of the enveloping or the Marconi experts as to the validity of the Audion patents. This matter was decided in favor of Marconi in May, 1916, and also in the December, 1916, issues of this journal, and to those interested had read both of these excellent articles as well as a very exhaustive article explaining the electronic action of the Audion which appeared in the August, 1916, issue of The Electrical Experimenter.

The Marconi magnetic detector is a battery-less type much used on shipboard. It is illustrated at Fig. 7. The detector illustrated is equipped with a Marconi Magnetic Detector. This instrument operates on a very unique principle, viz., that of the reduction in any hysteresis effect having such a value as to almost entirely nullify the core effect of the subject to the effect of a Hertzian wave current passing thru the receiving circuit, according to the researches of C. Mairan. The complete circuit is a combination of an insulated iron wire and a portion of the primary current effect from the receiving apparatus, the iron coil is used as a magnetic circuit. It is seen, therefore, that the effect is dependent upon the nature of the secondary circuit thus resulting.

It is evident, from the foregoing explanation, that at every incoming signal there will be a sound heard in the phones as the Hertzian wave current flowing around the primary coil cause partial cessations or reductions in the hysteresis effect produced in the moving of the wire band.

One of the most important circuits used with the Audion valve is that using one valve for producing an oscillating condition. This is shown in diagram Fig. 8.
ELECTRICAL EXPERIMENTER

The circuit as here shown has been successfully used for several years by experimenters and others without the tickers, these being designed to tend to stabilize the oscillating conditions, once they are set up by turning the various inductances and capacities. The condenser capacities are correct. It is suitable for intercepting damped as well as undamped signals. The inductances are of the following dimensions—primary of loose coiler is 10 by 5 inches, wound with No. 22 S. & S. wire; the secondary is 10 by 4 1/8 inches, wound with No. 28 S. & S. wire; the secondary is 10 by 9 3/4 inches with one layer of No. 30 S. & S. wire, while the wing inductance W1 is the same size with a winding of one layer of No. 30 S. & S. wire.

Beat reception with Audion amplifier connections has been accomplished with great success by Prof. A. Hoyt Taylor in the radio laboratory of the University of North Dakota. In his circuit, which has proved sensitive enough to pick up the German stations, 4,000 miles away; and shown diagrammatically at Fig. 9, is a model of two Audions, Nos. 1 and 2, both of which are chosen so as to be capable of generating oscillations. The primary transformer M (9,000 ohms) may be made from a spark coil secondary or a couple of them, thus a soft iron core wire is past, and the whole sealed up in a tight cabinet filled with molten paraffin wax or sealing compound. This inductance M, allows current from the 3-volt battery to pass but stops high frequency or pulsatry current. The stopping condensers SC should, therefore, be small, the second one being of about 0.5 millifarad and the first of 0.001 millifarad, or 0.0001 microfarad or 0.000001 farad. The variable capacity C should not be above 4 millifarads, thus permitting L to be large. For very long waves, up to 2000 miles was used; its average height was 75 ft., and its capacity 0.013 m. It. The circuit LC is slightly mistuned from the signals and the Audion filament becomes somewhat at times, normal, when working this circuit. The beat note is thus greatly amplified when it reaches the ear of the experimenter. Prof. Taylor has done excellent work with this arrangement, hearing the German stations at Nauen (10,000 miles wave length). Elwes (7,800 miles wave length) with both the arc and the spark signals sent out from the station at Honolulu, T. H.

(To be continued)

LOCATING AND DESTROYING "SUBS" WITH MAGNETS.

(Continued from page 6)

In operation, a fleet of ships are supposed to travel abreast towing their respective electro-magnets, and the moment any one of these is brought within the vicinity of a submerged metallic object, it will be attracted to such an object. The magnetic cables are then payed out to prevent any possible collision with the magnet cable from the object and in the meantime the ship may be brought to a standstill. In some instances the force of the powerful electro-magnet may be great enough to permit raising mines, by simply winding up the cables controlling the magnet and boom. In most cases, however, this is necessary, which may itself be fitted with a self-contained magnet, and exciting means such as a battery, would be lowered to destroy the empty tramp. There is a case on record that before exploding the bomb that the vessel should move off a safe distance to prevent injury to her hull, due to the terrific concussion waves transmitted by the explosion thru the water for a distance of several hundred feet at least, in most instances.

NEW SPY AND SCIENTIFIC MOVIES.

(Continued from page 8)

as the subject of a proof of his love and faith. Overhearing her acceptance of Leslie's proposal, the now half-raised Durand believes the time has come when he can execute his scheme of vengeance. Before a large crowd of scientists and family surgeons, Durand exiles is inoculated. Durand, stealing the key to the cabinet in which the precious serum is kept, destroys it, but in so doing inoculates himself by handling it. Health has been by occasioning the ailment germs. The time arrives for Laurel to administer the serum and she discovers the theft from the cabinet. After trying frantically to get out of Denver the Zoo, she dispatches her chauffeur with instructions to bring back the only other specimen of vaccination serum at all costs. Confronting Durand, she accuses him of the theft and he confesses. After an agonizing delay, the chauffeur returns with the turpentine and is able to save Leslie from a terrible death.

Meanwhile, her husband arises from a drunken stupor into which he has fallen and finds himself locked in a small room of the laboratory. By the time he is able to attract the attention of Laurel he has become seriously ill. The girl gives Durand the two remaining injections of the serum and Laurel is confronted with the choice of risking the life of the loves or saving her husband. She decides. Due to the fine vitality of the young physician, he fights a splendid battle with death and recovers, while Durand, whose health has been hapt by indicating the ailment germs, dies. After the scathing fires of fate to which she has been subjected, Laurel finally emerges happy in the love of young Leslie and together they plan a life devoted to the serving of humanity and the true affection which they now realize they have always borne for each other.

YANKEE CODE NOT SO "BLOEDSINNIG".

(Continued from page 7)

it never materialized into anything big. It is really wonderful tho, to think that he could transmit speech a distance of one-half mile by so simple an induction he used elevated wires connected at their upper ends to large condensers and at their lower ends to the earth. Thomas A. Edison also worked with the same apparatus, and the negative system of wireless between a moving train and a "paralleling circuit" string track pole point of view of the car was metal covered and the telephone apparatus was connected to it as well as to earth thru the car wheels. Success was at hand, but never became a commercial proposition.

ELECTRICITY AND METAL COATED SEEDS BOOST CROPS.

(Continued from page 9)

High frequency electricity produces a definite vibratory impulse that is doubtless the cardinal factor in increasing plant growth. The idea that the electricity primarily heats the ground is not a correct one. The heating may be incidental to other results, and
in wet, cool weather may serve to counteract inclement weather conditions. This, however, is rather incidental to the major point.

"That it enriches the plant life and stimulates the quality of the crop," says the inventor, "I have proved to my own critical satisfaction. The electrically grown plants were so much more succulent and sugar laden than the other variety that, aloft only six feet separated two sides. Dehydrated green plants were the choice of even that sugar-loving beetle, the 'astor bug.' When the superior quality of the plants makes even pests discriminate, the method has furnished at least its first credentials.

"Do you think the electric idea might be adapted to the extermination of insect pests?"

"Certain insects are susceptible to the electric vibration even in its present form," he replied. "The electric influence has been known to force worms out of the ground. I have little doubt that the ramifications of the idea will see electricity used not only to foster plant growth but to protect the crops themselves."

It is unqualifiedly affirmed by those interested in the tests that the electrical treatment of the seeds, roots and soil increases production so markedly that the beneficial effect of the treatment cannot be gainsaid. Adjoining fields of corn and sugar beets, planted at the same time as those specifically treated with the electrode current diffusers, showed growth and production only half the results as great.

The result of tests in electrifying corn and sugar beets on eleven acres of Illinois land, as announced by R. D. McCreery, follow:

**Electrified Corn**

- Increased the germination 31% to 39%.
- Increased the rapidity of growth 30% to 50%.
- Increased the volume of stalks 33% to 40%.
- Increased the corn production 30% to 40%.
- Increased the money value of crops per acre $25 to $35.

**Electrified Sugar Beets**

- Increased the production in weight volume 15%.
- Increased the sugar content 14%.
- Increased the money value of crop per acre over $50.

The cost was less than 50c per acre for current and metallically coating the seed. Net cost of apparatus installed was less than $200.

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**A TIGHT SQUEEZE FOR UNCLE GEORGE.**

(Continued from page 39)

...when we leave the Temple of Thespis by the back entrance, it is necessary to climb a flight of stairs to handier to the car—also less handy to the public eye.

My invention consisted of alloying to the composition of the liveshows what hitherto were a "sister art!"; and my acquaintances with this sister, a modest violet now to be dragged into the garish light that beads upon the surface of a musical science."

The Riverside Press, in Cambridge, my native "burg," was a favorite prowling-ground for us kids. If you were good, and didn't chew gum, you could stand and watch one of the big presses squeeze a sheet of paper, haul it out covered with book-pages, and spank it down on top of a pile of previously printed ones, with an almost human emphasis that reminded you of the "There, thank goodness!" air of a woman ironing the last piece in the wash.

Sometimes the printer would give you a sheet of paper that was twisted by going in crooked, and you could read the middle eight pages of a detective story for nothing—though the combined love-story which both the crime and the detection extracted is very low in percentage of thrill.

Besides the printing, there were a hundred other processes visible, and each was so interesting that you never got very far in a single visit to the Press. Before you knew the words below, the machinery would slow down and stop, and the workman would thank you for your kind attention and depart to see if he could find a clean place on his desk.

One day, as I was exploring this palace of marvels, I came upon a workman over in a corner by himself, without a single power tool, and a lot of bottles. He was marking paper, and the barbaric richness of his product was enough to make you dream you dwelt in marble halls, as the song goes.

On the surface of his tank of water he sprinkled drops of brilliant-colored oils, he red, green, yellow, and vastest blues in the tinter. Each, as it struck the water, floated and spread out in a perfect circle. Scanned our eye, the beams of light swirled the surface with the simplest tools, the colored circles drew out, zigzagged, spiralled, scalloped, and finally came to rest in the intricate design of variegated marble. On this, a sheet of paper was gently let down, the oils adhered in an instant, and the design, as intangible as a bubble, was fact forever.

That was the invention which popt into my head at the theater—to project on the stage these new ever-changing designs, shifting every instant like the figures in a kaleidoscope.

The drawk speaks for itself—the invention's name was Simplicity. The tank, for blending the colors, was to be glass. The beam from a stereopticon, condensed by lenses, was to cast forward an image of the colored film, which a mirror would then reflect into a horizontal direction to flood the stage. The stirring of the colors was to be done by the beam of air through a blowpipe, to keep the cause of the changes invisible.

Fortune was mine—again. If the theatrical world would stand for that crude blue-and-star effect, unfavorable of the inventive powers of a semi-intelligent janitor, what sort of a thing do you think of in sight of my dizzying spectacle? Answer: once seen, it would be universally demanded. With the monopoly of the business in my grasp, I feel that I can be firm with Koyal, the Spectacle King of those days. He would probably try to get, for almost nothing, my invention which was destined to lift his shows absolutely out of the commonplace. The experiment had to be tried out, of course, and the janitor's purposes, and fortunately I had a small magic-lantern as so much toward the equipment. I made a tank from a window-pane surrounded by a wall of glass, and I had a janitor's workman at the Press, out of regard for Science (also, to some extent, for his own peace of mind) contributed an assortment of his liveliest pigments.

My lantern being lighted, and everything ready for the test, I scattered a few drops of the paint mixture, in my tank, blew gently across the surface thru a straw, and was delighted to see the colored dots mingle in bands like a Roman sash, or fancy forms of designs varied from moment to moment, all projected in a magnified form on the white-washed cellar wall.

So far, I had got by without exciting the...
family's suspicion of my dealings with the Powers of Darkness, the magic-lantern was a familiar household object, and I was always messing around with something or other. So, away to New York and confer my invention on the waiting public when the enterprise was wrecked—yes, absolutely wrecked—simply by extending my experiment to a wholly unnecessary realism.

At that time, my particular pal and partner in undertakings of magnitude was "Gimp" Smith, an old pal from my first school-days. The Skillingses were easy-going people, and Gimp was little harried by restrictions; in fact, he was free and easy, a prince of a man of the world, so far as it could be done on an income express in marbles and rusty nails, rather than money.

"Gimp," with his love for the theater, and his approval of my invention was enough to guarantee it in the winning class, he strongly advised adding to our equipment a model stage. It seemed superfluous to me, but "Gimp" was keen for it, claiming that Mr. Kiraly always required a stage in these business deals; in fact, it was the inevitable custom in theatrical circles.

That settled it, we went to work and built a small, neat, and solid-looking affair of soap-box-luxury, painted with a process arch and footlights, and hung with a series of cheese-cloth curtains. We reproduced the sensational finale of "The Big Things," a doll moves out of my sister's consented to assume the role of the Fairy Queen—standing, with white robe, magnificently draped, behind the innermost curtain, to be revealed at the critical moment, rescue the lovers, and save the "Crook" into his flaming pit.

The full-fledged rehearsals came off at 4 o'clock one Saturday afternoon. It was a winter day, and cloudy at that, so it was practically pitch-dark in the cellar, of course with the red-hot hearth. Gimp worked the stage properties while I handled the light. As I started the colors going, he raised the cheesecloth curtains, one by one, declaring the impressive climax of our favorite playlet—full of thee and thou's, with here and there a forsaken word. As the last curtain went up, exposing the doll in her fairy-queen rig, "Gimp" turned on the full power and said with a whispering voice: "Fear not, weak mortals, I will protect thee henceforth. And THOU, O Black Crook, down, down with thee to the nethermost torments of the damned." Whereupon "Gimp" opened the furnace door and threw in a lump of coal to represent the Crook.

Now "Gimp" was a word very much out of favor in those times. Its use was considered extremely bad form, so I thought that in the daytime at any time I would recite an appropriate speech:

"I'm not so weak, mortal, that I will protect thee henceforth. And THOU, O Black Crook, down, down with thee to the nethermost torments of the damned." Whereupon "Gimp" opened the furnace door and threw in a lump of coal to represent the Crook.

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ELECTRICAL EXPERIMENTER

May, 1918

“SHOOTING” ELECTRICAL TROUBLE

caused by the burning of the contacts when the switch is allowed to open slowly and arc. During the slow and wand stopper, parts clean and replace. Should the switch reset O. K., the trouble will then be found in the wiring; it being either a short-circuit or a broken wire. In case the test in Fig. 7 shows no de- 
ded drop at the motor terminals over that at the commutator, with the starting rheostat, the trouble lies in the motor. This may be due to a number of causes as follows:

Motor brushes may be short, stuck, in the heart of the commutator, or improperly fitted to the commutator. Weak brush springs, dirty commutator or rotor commutator. Open circuits in the armature and low sections will be indicated by the burning of a few segments of the commutator.

Most of the above troubles will be detected by noticing the parts cleaned and corrected, always using fine sandpaper for cleaning the commutator or brushes. To fit the brushes to the commutator wrap a piece of fine sandpaper around the commutator and with the brushes pressing on it, turn the armature by hand till they are ground to the same curvature as the commutator.

A grounded armature can be detected by using the ‘phone test as shown in Fig. 14 A. A short circuit is indicated by a ground.

The work of removing the ground should be left to an experienced man unless you are well acquainted with armature work. The usual method is to reverse the rotor, which is removed itself disconnect the leads from the commutator at diametrically opposite points and then test each half of the winding. The winding is lifted apart and tested, till all the grounded coil is isolated. The coil is then raised from the core and the ground found by examination of the winding. Steps can then be taken to isolate or replace the coil.

A shorted or open coil can be found by testing the armature as shown in Fig. 15. As shown in Fig. 15 A, the two terminals of dry battery and leads brought out from both sides of the interrupter. These leads are made fastened in a leather strap that passes around the com- mutator. A receiver fitted with two pointed probes is used for making the test. One of the ends of the probes placed an adjacent segment, a segment note will be heard in the receiver. The en- tire commutator should be tested by shifting the probe from segment to segment and noting if every two segments gives the same signal strength in the ‘phone. A loud note between any two segments indicates that the coil between them is open, while no note or a very weak note shows a short-circuited coil.

Should the open be in the winding itself it can be repaired temporarily by bridging the two segments with a short length of wire or a drop of solder. A shorted coil will cause the commutator to heat and eventually burn out; it should be opened if possible, shorting the segments to which it is attached, as pre- viously mentioned.

A discharged battery may be due to the generator not furnishing enough current to properly charge the cells. A method to test for this trouble is to connect the ammeter in the circuit, as shown in Fig. 10. The meter will indicate the output of the motor and the cells. The meter should then be shifted to the reference shown in Fig. 11, and will then indicate the current actually delivered to the batteries. The readings should be the same, in both cases unless current is used for ignition, when an allowance should be made. Should the difference be reasonably large the trouble lies with the wiring or the automatic cut-out switch.

Where the vibrating type of regulator is used the contacts may become burned and blackened, causing the field circuit to increase in resistance or become opened. When cleaning or dressing regulator con- tacts be careful not to remove too much of the spring on which the contacts are mounted.

Should the machine fail to give the proper output the trouble may be due to any of the defects mentioned in connection with the motor. Open fields or armatures are sel- dom found in high-speed driving fields, being due mostly to faulty contacts on regu- lating appliances. The test for a genera- tor armature may be made in the same way as for trouble in the motor armature. Some cars are fitted with the motor and generator in one unit, but the method of testing is not varied on this ac- count.

The method for testing a single wire system for a poor ground connection is to cut the ground wires, as indicated in Fig. 11 A, and then drop a ground the connection is poor. The parts should be well cleaned and covered with white powder when testing is again performed.

A ground on a two-wire system can be detected as shown in Fig. 12, by using the ‘phone tester. A click in the receiver indicates a ground, and the various circuits should be switched off until the circuit giv- ing the trouble is found, and by tracing it out the trouble located exactly and removed. This can be done by testing with a leak detector as shown in Fig. 13, with all switches open. An indication on the meter shows a short circuit on ground, and the switches, which can also be found by tracing the wires.

This covers the field of automobile testing in a general way, and any trouble not mentioned can be readily located after be- coming familiar with the instruments. The proper care of the parts of the equipment will go a long way toward the prevention of trouble.

Care of Motors and Generators

Cleanliness is the first essential in elec- trical work. A clean motor and generator should be kept clean and free from dirt. Do not put any lubricant on the commutator, and in low-voltage machines you should keep the brushes clean and in good condition. Keep the brushes and commutators clean and see that they are kept good if the brushes are to move freely, and that there is sufficient spring tension to hold the brushes firmly against the commutator, even when undergoing vibration from the engine. The generator must be kept in good condition to properly charge the battery.

Care of Storage Battery

Add nothing but pure water to the bat- teries and do so often enough to keep the solution above the plates. Distilled water is preferable in this purpose, but rain water may be used if it has been in contact with metal for any length of time. Keep battery charged, taking hydrometer readings to check its condition at least once a week. Do not use the cranking system to excess. When the starter is used often it becomes necessary to give the battery a charge from some outside source from time to time.

Note the ammeter readings on the dash to check the battery. Any fall-off in the output should be corrected at once.

Continuous operation of the battery in an over-load may destroy the battery beyond repair, necessitating replace- ment of plates or of the entire battery. The only way is to keep the bat- tery fully charged at all times.

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MAGNETIC STORMS AND WINDS

NE of the most puzzling scientific phenomena is the so-called local magnetic storm. Much has been written about this subject and many theories have been advanced, none very plausible.

Of late Professor Francis E. Nipher, of the Academy of Science of Detroit, the distinuished scientist who demonstrated experimentally gravitational repulsion—has shed new light upon the subject. Professor Nipher who, as is well known, is not a theorist, always supplies experimental evidence when announcing new scientific discoveries. Such being the case, and bearing in mind that the professor is an exceedingly exact and painstaking worker, it will come as somewhat of a shock, that an ordinary wind is one of the direct causes of local magnetic storms. At first blush, this sounds most preposterous, for who ever imagined that the motion of the air could possibly influence a magnet? Nevertheless it is a fact supported by a wealth of experimental evidence.

Professor Nipher began by reasoning that the magnetic force of a bar magnet might be diminished by draining negative electrons from it. He actually accomplished this by means of a static machine. Then it was found that while a needle carrying a magnetic needle during a wind storm in which sudden and violent wind-gusts occurred, the oscillations of the needle were suddenly and greatly changed. Careful and exhaustive experiments were subsequently carried out at Professor Nipher's home, at Hessel, Michigan, in a tent 50 feet from Lake Huron. The magnetic needle was a piece of knitting needle 7 cm. long suspended upon an unspun silk fiber 40 mm. long. The enclosing case was a large glass bottle, entirely airproof, so that no atmospheric disturbances could possibly reach the magnetic needle. Attached to the latter was a small mirror by means of which the motion of the needle was observed in the usual manner with a telescope and scale. A number of elaborate precautions (by means of control magnets) were taken to make the needle as independent as feasible from the earth's magnetic field, as well as preventing mechanical shocks from reaching the suspended and magnetized needle.

It was then found—and a mass of proofs exist to substantiate the facts—that on days when the wind blows in gusts at intervals of 1 or 2 minutes, the needle is more unsteady in its motions than on quiet days. How the needle predicts a gust of wind is best seen in the following occurrence:

At 1:10 P.M. on July 14, the needle began to vibrate to and fro, continuing in its motion for 9 minutes. Then a sudden and violent gust of wind came in from the lake to the south, overflowing a sail-boat lying 200 feet away from the observation station. About 8 minutes later the wind had practically ceased, and the oscillations of the needle had ceased as well. Many similar observations were made during the summer, all with the same results.

Professor Nipher's explanation of this strange phenomenon is that a wind disturbance, such as a tornado, among the atmospheric ions, which accumulate along the magnetic lines of force, at or near the earth's magnetic poles, is responsible for some of our widespread magnetic storms. Of course a small wind disturbance could hardly produce more than a small local magnetic disturbance, but it certainly does exist. But the wind along the sail is the real cause of local magnetic storms. The rain as well as cloud shadows produce the same effect. Thus when small clouds are scattered over the sky and a local fall of rain, the sun is at the observation station, the sunlight passing thru the air thru which the rain drops fall, a very marked magnetic storm results.

Furthermore, when the sun is hidden by clouds, the needle usually remained undisturbed. But as soon as the sun came out the needle at once began to oscillate markedly.

In an article of this kind it is impossible to present the full evidence of Professor Nipher's experiments, but it is quite apparent that local variations of the earth's magnetic field are determined wholly by local weather conditions.

Discoveries such as these tend to show how very incomplete our knowledge is as yet of magnetism and how much there remains for us to learn.

H. Gernsback.
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An Electric Aeroplane Shooting Gallery

A LL aboard for the electric aeroplane shooting gallery—three shots for a dime! Right this way, Gents. Wing a "Boche" plane in flight! This may be the speech that greets you in the large amusement parks this summer. We predict it will make a sure-hit with the amusement-seeking public, men, women and children. This recently patented contrivance is intended to give one all the sensations of actually shooting at a moving target, in this case a miniature aeroplane, from an aeroplane in flight. As the inventor, Mr. Frederic W. Thompson, points out, considerable skill will be required of the marksman to hit the moving target for the reason that the platform on which he stands will be constantly pitching and rolling, and moreover, the captive plane can be made to roll just like a real one, in two directions, i.e., up and down from side to side, and back and forth from front to tail. The whole arrangement is very cleverly designed so as to require the minimum of power to actuate it, and small electric motors do all the work of putting the flying machine thru her paces. It's quite a trick to hit a bull's eye from a moving plane, especially with a single bullet, which is quite different than the case of the regular army aviator, as there the gunner has the use of a rapid-fire machine gun which fairly sprinkles the air with bullets for a considerable area, and even then the enemy flyers do get away without being hit. In order to accomplish the desired re-

(Continued on page 132)
Moving Pictures That Really Talk

By GEORGE HOLMES

NOT so very long ago the world was startled with a new wonder, the cinematograph or motion picture as it is now known. Its rise has been phenomenal until now the “movie” business is one of the first in the

land and the aggregate capital runs into the
millions. In its present form it has done
much to relieve humanity of its cares and
worries, and for a nominal sum one may
take his family to a theatre and pass a
pleasant evening.

Nevertheless, inventors saw that there
were more possibilities in the “films” than
just a plain black and white picture; there
were those who thought that in time the
movie would eventually rival the spoken
stage, and to this end countless men have
been applying their time, money, everything
to secure films that would be clear, sharp
in Nature’s own colors and last of all—with
speech in perfect synchronism!

Color-photography has lately been real-
ized by a prominent inventor, and now
comes Mr. Eugene Lauste, a French in-
ventor, who evidently can lay claim to hav-
ing perfected a successful method of tak-
ing and reproducing “talking movies” that
are well nigh perfect, both as to tone and
synchronism.

Coming as this does from one who since
childhood has dreamt of this great ideal,
and made a persistent study of this great
art, one may have expected a great deal
from Mr. Lauste who was born in Paris in 1857. At the tender age of ten when only a mere boy he conceived the idea of "motion pictures." Taking a
strip of paper from the “Wheel of Life” or
Zenotrope, he soaked it in oil to make it
transparent and then pulled it thru a magic
lantern in a series of jerks. Of course, this
was very crude and at first no conceivable
idea could be drawn from this procedure
till one day, while adjusting the machine

another picture is drawn into place. So ob-
sest was he with the idea that from then
on it might be said that he has made it his
life work.

It might not be amiss to give a brief his-
tory of Mr. Lauste’s work in that it will
add weight to his claim of having invented
a real “talking movie.” From 1886 to 1892
he was associated with Mr. Thomas A.
Edison, first at New York and later at the
Menlo Park and Orange, N. J. laboratories.

While there in the year 1887, the Edison
Kinetoscope first saw the light of day. It
was not a projector nor did it have any
form of escapement. The film ran continu-
ously behind a peep hole and the pictures
on it were viewed directly by means of a

Specimen Record of Voice (Top) and Motion Picture (Bottom) Photographed Simultaneously.

The Voice Record is Made By a Strong Arc Light and Galvanometer. Reproduction of Speech is Caused By Light Acting On a Special Selenium Cell.

atures of the regular size. From Edison he
went to the Westinghouse Company, and
from there to the Eidoloscope Company.
Next he was associated with the Biograph
Company, where he worked the giant
cameras of the early pioneer days. In 1897
he went to England to show the Biograph
Films.

During his wide and varied career Mr.
Lauste has met and become acquainted with
many noted persons, among them being Mr.
M. J. Marey, a Frenchman, who might have
received the honor for the invention of the
cinematograph, had he foreseen the possi-
bilities of his "Photographic Gun" which he
built in 1876. It was not primarily intended
as a motion picture camera and therefore
he cannot lay claim to the title of father
of the Cinematograph, which might other-
wise have been his.

In operation the “gun” was much the
same as an ordinary gun, except that in-
stead of shooting bullets when pulling the
trigger, a number of instantaneous photo-
graphs are recorded at very short intervals.
The Marey gun has been resurrected during
the present war and is used extensively for
taking military photos from aeroplanes.

Mr. Lauste’s talking picture system is
somewhat apart from the method which
was tried several years ago and which no
doubt many people recollect, in that in his
system no phonograph and phonographic
methods are employed either in taking the
picture or in the reproduction. In this new
method a selenium cell and telephone sys-
tem are used to reproduce the sound direct-
ly from the photographic film. The film
passes continuously in front of the selenium
cell and no stylus or contact of any kind
is necessary. The sound waves are repro-
duced with utmost clarity and fidelity and
since these sound lines are directly on the
same film as the photo images, a perfect
synchronism is the result.

In the making of the “talking movie” it
is not necessary for the players to talk
into a horn as in the phonographic movies,
for a number of sensitive microphones are
distributed about the scene out of range
of the camera or else suitably screened as
in a flower vase, etc., to record the sounds,
and the players not being remanded con-
stantly by large horns or otherwise are
able to move about and do their business.

The sound waves are transferred from the
microphones thru wires and a storage
battery to a highly sensitive string galva-
nometer or oscillograph. The string or
sensitive wire is suspended in the field of
powerful electro-magnets and a very slight
variation of the electrical impulses trans-
mitted from the microphones is sufficient
to set the wire in motion. A beam of light
(Continued on page 136)
At Last! A 20,000 Shot per Minute Electric Machine Gun

HAVE you ever thrown the hammer at athletic events? If so, then you have a correct idea of what centrifugal force is, the force, so physics teaches us, which bursts flywheels as well as speeding the athlete's weight, all due to the fact that a revolving body always tends to lengthen its radius of rotation. That is, it tends to fly outward on an ever-expanding circle.

A Boston inventor, Mr. Levi W. Lombard, has brought forth a new death-dealing marvel which may prove of inestimable value to the Allies. It is nothing less than an "electric machine gun" which can hurl forth a perfect rain of bullets at the rate of 20,000 shots per minute or more.

It is therefore practically noiseless, smokeless, barrel-less and fool-proof. It has no barrel, which, is decidedly a good feature in this war, rendering it far less conspicuous than other guns provided with barrels.

Tests are said to have proved the gun's high efficiency. The new weapon has no barrel, operating on the principle of a sling.

FRENCH WAR CAPTIVES TURN HUMORISTS.

The accompanying illustration shows one of the humoristic silhouettes made by French soldier artists interned in Switzerland. It shows the Kaiser in one telephone booth and a figure representing God in the opposite booth. Evidently the Generalissimo of the "Potsdam gang" is carrying on a long distance telephone conversation with his much vaunted co-ally, "Gott," while the "Boche" guard stands at attention. If the allied army keeps up its good work of annihilating the Hun troops the private telephone line between "Me und Gott" may become much overheard; in fact, so much so that the "fuse" may blow out, leaving the Kaiser and his Potsdam miners in utter darkness so far as spiritual light is concerned. In fact, we have a strong impression that the "fuse" blew out when that 76-mile shell hit a church in Paris, killing about a hundred innocent women at worship, and we'll aver, too, that it wasn't the Kaiser's talk that overloaded the line and blew the "fuse."

The latter operates under a disc which revolves at tremendous speed. The ammunition is fed thru a funnel-like attachment from a tube which leads into two veins beneath the disc as the drawing herewith shows, and so rapidly does the gun consume bullets that the services of an operator are necessary every moment in order to keep the ammunition hopper loaded with steel missiles.

The veins center upon an opening about two inches wide and the bullets are thrown with terrific velocity. Electricity, gasoline or steam engine is the source of energy. The weapon can be placed in first line trenches and operated hundreds of feet in the rear, simply by the connection of an ammunition feeding appliance, the steam pipes or electric wires and a simple attachment for the changing of the machine's range. The inventor states that in a recent test the gun demonstrated its force and accuracy by firing hundreds of bullets into sheets of steel plates, three-quarters of an inch thick, placed hundreds of feet away. Many of the bullets went thru the plates. As high as 33,000 shots per minute can be fired with this gun, its inventor claims.

Referring to the illustrations herewith, the Lombard electric machine gun has a two- grooved disc as shown, revolved by a motor at 10,000 revolutions per minute or higher. This causes two bullets to be released thru the 5° slot in the casing at every revolution or 20,000 shots per minute. Tests have shown that bullets leave the gun at a velocity of 2,000 feet per second. The steel plate here shown is 9/16 inch thick and was penetrated by bullets fired from this gun. The bullets come out in a spray 5° wide, which can be aimed as desired.

The University of California is teaching farmers to use electricity. In the near future the indications are that the efficiency of electricity on the farm will be generally recognized and adapted.
A 100 Mile Electro-Magnetic Gun

Great Guns!!! That's what everyone is talking about these days, when the Teutons have succeeded in hurling nine-inch explosive shells into the heart of Paris from a monster cannon located at a distance of seventy-six miles away, safe within the German lines. The bombardment of Paris was started with two of these super-cannon, which were presently spotted by Allied aircraft observers as being situated in the Forest of St. Gohain, west of Laon. The first shells landed at intervals of about twenty minutes and did considerable damage to buildings, but caused relatively few casualties. At first it was thought that possibly enemy "bombing planes" were being utilized, flying at very high altitudes of say 25,000 to 30,000 feet, which, when properly camouflaged, would defy detection from the ground. When the Allied air scouts located the gigantic guns, however, it became evident that the wily Germans had conceived and executed another psychological grand-stand play in the form of a cannon that could actually bombard Paris from within their lines. The longest range attained hitherto with the standard 16 and 18 inch naval and coast defense guns has been in the vicinity of 25 miles. Ordnance experts have shown, however, that were it possible to build a successful 16-inch gun carriage...

This Illustration Shows Vividly the Great Altitude Attained By a 76 Mile Shell, Viz., 18 miles. The Shell Encounters But a Small Fraction of the Air Resistance in the Rarefied Upper Strata That Short Range Shells Do in the Lower, Denser Air Strata.

The Illustration Herewith Shows a Mighty 95-Foot Electro-Magnetic Gun, Capable of Hurling a Torrent of 19-Inch Shells, Each Containing a Charge of High Explosives. It Would Be Noiseless and Smokeless, Besides Being Mobile Enough to Permit Its Transportation From Place to Place at Short Notice. There Would Be No Wear and Tear on This Gun As Is the Case Now With the Cannon Using Explosive Charges to Expel the Projectile From the Barrel. First Described in This Journal For November, 1918.

All Illustrations Copyrighted by E. P. Co.
A report from Geneva, Switzerland, contains the statement that Lieut. Gen. von Robine, a German authority on ordnance and inspector of artillery, gives in a magazine of which he is editor additional details in regard to the long-distance German guns with which Paris is being bombarded. He says they are 20 meters (65½ feet) long. The empty shell weighs 150 kilograms (330 pounds). The projectile attains a height of 30 kilometers (18.6 miles) and descends from the sky like a meteor on its target. Refer to the accompanying illustration showing the trajectory of the projectile and how it passes thru the highly rarefied air encountered at such altitudes, the air pressure at this height varying from a fraction of an ounce to several ounces per square inch, this greatly reducing the air resistance offered the projectile in its flight thru the air, which possesses a very much greater density at low levels, the air pressure at sea level being 14.7 lb. per square inch. Even ordinary, long-range heavy ordnance fire as used today has to waste a great part of the energy given to the projectile in overcoming air resistance, the average shell traveling at say 2 miles highest altitude, for example. Now, at 2 miles the air pressure is still quite high, being 9.8 lbs. per square inch.

Gen. von Robine further says it requires about three minutes for the shell to reach its destination. The greatest difficulty in the way of increasing the range was overcome by sending the projectile high enough to reach the rarefied air.

The whole secret of such long range cannon fire lies in the elimination or suppression of atmospheric resistance, and hence it will pay us to study this subject of rarefied air in the upper atmospheric strata. The illustration showing the trajectory of the 70 mile shell also gives a clear idea of the make-up of the atmosphere surrounding the earth. The thickness of this atmospheric envelope has been variously estimated at from 30 to 50 miles. Modern researches have indicated that the earth’s atmosphere may be broadly divided into two portions,—a lower portion or stratosphere as illustrated, in which the chemical percentage composition remains tolerably uniform, since the mechanical mixture of its gases is maintained by winds and convection currents; but the pressure and temperature, however, fall as we rise upwards; and a second or higher region, the stratosphere beginning at a height of about 10 miles, when temperature ceases to fall and becomes nearly constant for an unknown further height. The lower region or troposphere is the locus of clouds and water vapor. Above the 10 mile line, in the stratosphere, the atmosphere is in a state of perpetual calm, the gases composing it actually sorting themselves out in order of density. The highest upper regions are composed entirely of the lighter gases such as hydrogen and helium. Above 45 miles the air becomes so rarefied it has no appreciable weight. Hence the struggle of heavy ordnance designers to build a gun that could be fired at the angle giving the maximum range or 43½ degrees, and thus project the shell rapidly into the highly rarefied strata of the upper atmosphere.

There have been a number of designs for powerful electro-magnetic guns brought forth by various inventors in the past 15 years. One of these electro-magnetic cannons, here pictured, was described in detail in our November, 1915, issue. It (Continued on page 122)
How to Avoid Electric Shocks

By H. WINFIELD SECOR

P EOPLE often receive an electric shock when they least expect it and sometimes the shock may be of sufficient magnitude to prove fatal. It is not unusual to read of live humans often killed in instances of receiving electrical apparatus or to discover that nightly running water, including electrical apparatus and appurtenances, in the home, is so for the reason that if the electrical light socket or switch happens to become defective in its insulation, thus permitting the current to charge the outer metal shell or plate, then when a section of such a shell is grounded, the circuit is completed thru their body to whatever grounded metal object they may touch such as water pipe attachment or standard lamp post.

To the unintimated in electrical matters, it is often a puzzle as to how such an electric circuit is formed, but the answer is simple for the reason that practically all electrical light and power systems are grounded or connected to earth at various points along the feed lines for lighting protection, and also to help to guard users of energy from transformer secondary or low-voltage circuits from receiving a dangerous high voltage shock, should the transformer insulation break down.

Figure 2 shows how a person may be severely shocked or indeed killed by touching a light socket or switch which has a piece of badly mutilated electric cord while standing in a bathtub filled with water. As becomes evident, a person so situated has provided a first-class connection thru the lower limbs due to the water in which the individual stands, and this water has been connected to earth thru the waste pipe connecting the tub to sewer line, and also thru the water pipe supply to the tub which is mechanically connected thereto. An actual case of this nature occurred in Toronto, Canada, about two years ago, when a young man nineteen years of age stood in a bathtub, and so far as is known, he must have touched a frayed electric cord connecting a portable lamp in the bathroom, with the result that he was instantly killed, due to the fact that he had unconsciously provided such an excellent and highly conducting path thru his body. Experts were immediately called in from the London hospitals and a postmortem test revealed the fact that the victim was killed by coming in contact with an ordinary lighting socket wire carrying 118 volts, 25 cycle A. C.; all of which goes to prove that firstly, it is possible for a person to be killed by a 100 to 118 volt shock, and secondly, it would not follow that the badly abraded cord in our apartments or offices as they may spell death to us.

In this connection, it is well to point out another instance. When you have a damp or wet floor of a bathroom or in a bathtub, don't touch any electric switch, wire or fixture. If you must touch an electric switch lamp or wire in such a damp location, take precaution to stand on a piece of thoroughly dry wood or on several thicknesses of dry paper or cloth.

In some cases, a person may unconsciously receive an electric shock by standing on a hot-air heating register commonly found in suburban residences and touching an electric switch lamp or wire under these conditions. An electric current through your body and to the ground through your body. If you happen to touch a grounded pipe system, such as a radiator or water pipe with your hand or in some instances a hot electric knife blade, you will receive a shock more or less severe. See Fig. 3. It might be said that some people, especially electricians, who are used to receiving shocks at 110 volts potential such as electric fans and lights ordinarily operate on, do not mind such a current, but on the other hand, the idea of a shock in the case of the bathtub victim above cited.

As a general thing women are much more sensitive to such an electric shock than men, while animals are very susceptible to such shocks, it having been on record that a horse has often succumbed to a shock of 200 volts.

If you happen to have a short-circuit start a fire in the panel switchboard in your home, office or factory, be careful not to attempt to stamp out the fire with a fire extinguisher or pail of water. There are certain fire extinguishers on the market which are particularly efficacious in quickly and effectively extinguishing electrical short-circuit configurations, and they are of course widely adopted in all power plants and engine rooms as well as in factories. However, some of the first extinguishers project a stream of acid and water on the fire, and if the operator happens to stand on a heating register or is in contact thru his feet or hands with any grounded piping or other metallic system, he is liable to receive a shock, the electric current passing along the stream of acid to the extinguisher and thence thru his body to earth.

In illustration No. 5, we wish to point out a few facts concerning fallen live wires. The first thing to do whether you are electrically educated or not, as past experience has often taught that persons touching a fallen wire, no matter whether you believe it to be only a telephone wire or some other apparently harmless wire carrying a low potential. Persons have been killed in a number of instances by not exercising the proper discretion when brought face to face with this situation. It is not always the case that a fallen live wire will indicate its dangerous condition by making a sputtering noise, but in some cases it will do this, as the writer recently had occasion to note when he nearly stepped on a fallen wire carrying 2,500 volts, alternating current, in which case the wire all but sizzled as he walked thru a group of small sparks to jump thru the insulation which was damped owing to a heavy rain on a particularly moist night, and the wire sizzled similarly to the crackle of auiotric.
How to Avoid Electric Shocks

1. Don't touch water spigot and electric socket at same time
2. Never touch electric wires or fittings when in bath tub
3. Don't touch radiator and electric fan
4. Don't stand on heating register when extinguishing electric fires
5. Leave fallen wires alone; they may be alive
6. Don't use telephone during thunderstorms
7. Keep away from power lines when using electric curling irons
8. Boys: don't throw wires over trolley lines
9. Don't stand on ground and touch live electrical switches
10. Don't stand on ground and touch live circuits or apparatus
11. Don't touch brass nozzle in fighting fires

(See opposite page for full description.)
Electromagnetic Brakes for Aeroplanes

It is a well-known fact that when the aeroplane was first brought out by the Wright Brothers of Dayton, Ohio, one of the greatest troubles they experienced was in making a safe landing. At first wooden skidding arrangements were used, while afterwards heavy rubber pneumatic tires came into vogue to take up the shock when the aeroplane alighted. When an aeroplane lands on a plain or a large grass plot and it comes to rest, the danger is, of course, over. As aerial science is progressing, however, and as aeroplanes are forced to alight sometimes on very narrow platforms, the landing becomes more and more dangerous due to the smaller and smaller landing area which economic conditions make necessary.

It is safe to predict that during the next twenty years our entire mode of life will have been revolutionized. Aeroplanes within ten years from now, particularly during the period of reconstruction after the present war, will become as plentiful as automobiles. The landing problem, therefore, becomes more and more important, and it goes without saying that when aeroplanes alight in a crowded city, they will not have large grass plots on which to land. Naturally the roofs of our tall buildings immediately suggest themselves. Nor is this a new idea. There exists today in Philadelphia a hotel, the “Bellevue Stratford,” which has a landing platform on its roof. But this platform has never been utilized as yet, for the good reason that it has been too dangerous, the landing area being too small.

Up to this time there has not existed a device whereby it was possible to make a landing on a small plot for the reason that when an aeroplane comes out of the sky it cannot stop instantly. Its momentum usually carries it forward as much as 1000 yards. Were the aeroplane to stop abruptly, it would naturally turn either a somersault or otherwise the machine would become wrecked. The same thing only on a smaller scale happens to an express train going at sixty miles an hour when the emergency brakes are set abruptly without the brakes gradually taking up the momentum of the train.

Recently it has been proposed to stop the momentum of aeroplanes by having them land on a wide strip of belting revolving in opposite direction to the oncoming flyer. While this idea is feasible it has never been used in practice, and it becomes obvious that it could not be used except from one direction. For instance, if the aeroplane came on at right angles to the moving belt, it would most likely be overturned. For that reason this device may be considered as impractical. Of course, when the weather is clear and the wind velocity is not great, an expert aviator will not have much trouble in alighting on a comparatively narrow run-way as has been proved right along by seaplanes making successful landings on battleships. At present our Navy has quite a few battleships equipped with narrow run-ways as explained above, but these are useless in a heavy sea, or when a gale is blowing. The reason is that even if the aeroplane should make a successful landing, it would almost surely be tossed into the sea by the combined pitching and rolling motion of the vessel, as well as by the wind trying to blow the aeroplanes into the ocean. Quite a number of accidents have happened in the past due to these causes, and no doubt will happen in the future until some remedy is found.

Mr. H. Gernsback who has given this problem consideration seems to have found an astonishingly simple solution whereby it comes possible to make a landing, on a very small area, no matter what its speed. The present invention on which patents are pending, is described herewith. Mr. Gernsback has also offered his invention to the Navy Department in connection with hydro-aeroplanes alighting on battleships at sea.

Our front cover illustration shows the idea clearly. This shows a future landing station “somewhere in the city of New York” on which a transatlantic aeroplane is just settling; the landing platform in this case is constructed of very heavy glass. Into this glass, which by the way is transparent, are sunk a number of large and powerful electromagnets such as are commonly used for lifting purposes. The idea of the transparent glass is that powerful searchlights can be placed beneath it and the entire glass expanse therefore will stand out sharply from its surroundings. Thus, an aeroplane from a considerable height will see the landing platform readily by night.

The electromagnets in this case would be quite large, say fifty or sixty inches across, each being capable of attracting about 200,000 pounds. These electromag-
ELECTRICAL EXPERIMENTER

June, 1918

In further explanation of Mr. Gernsback’s idea, it will be noted that the aeroplane has two iron-armored, pontoon-like projections instead of the usual wheels, or instead of the usual boats as are used on hydro-aeroplanes. It now becomes apparent that as the aeroplane comes within a few feet of these energized electromagnets, there will ensue a powerful electromagnetic attraction between the electro-

toms and the iron pontoons of the aeroplane. The tendency will be to pull the aeroplane down into contact with the electromagnets, but inasmuch as the flying machine still has considerable momentum, it will not stop at once, but will glide over a number of electromagnets until it finally comes within a few inches of the last row of electromagnets when the maximum tractive effect will be had. The aeroplane will then be pulled down entirely so that pontoons come into actual contact with the huge electromagnets, completely arresting the flight of the airship.

Now it must be understood, and it should be realized that these electromagnets have no effect whatsoever upon the iron pontoons until the latter come within two or three feet of the electromagnets. Elsewhere in this issue we show how close a metallic mass must come to an electromagnet before any appreciable attractive effect is had. From this it will be gathered that this invention does not purport to pull the aeroplane “out of the sky” as some people might think. It does not do anything of the sort. The idea simply is to arrest the motion of the aeroplane while in the act of landing and then hold the machine securely. If these electromagnets were not used, then it undoubtedly would often happen that the aeroplane could not stop quickly enough, and in this case it might slide over the edge of the landing platform down into the streets. Also while making a landing in a gale, such a huge machine which necessarily must have a large wing area becomes a toy of the elements; even if it had completely stopped, the wind might carry it away before the commander would have time to get the engines running at full speed. All this the electromagnetic brakes will prevent. Once the aeroplane has settled, the electromagnets will hold it as securely as if it had been riveted to the platform. Then after the landing has been made, the aeroplane can be readily secured to the platform by guys or ropes, so that the winds or storm will not carry it away; this being only a matter of a few minutes, the power two electromagnets, an enormous tractive effect anywhere from two hundred to four hundred thousand pounds can be readily obtained. Our illustration shows how the invention works out in practice. As soon as the operator who is in control of the electromagnets sees the oncoming aeroplane, he has it in his power to gradually switch, on current into the electromagnets. Thus for instance, the two foremost electromag-

Huge Electro-Magnets of the Type Here Shown Are Proposed in This Article to Arrest the Motion of Aeroplanes. The Illustration at the Left Pictures a 36” Traction Magnet Capable of Lifting a Maximum Weight of 45,000 Lbs. The Casting Shown Weighs 4,800 Lbs. Illustration to the Right Shows a 62” Traction Magnet Lifting a Cast Iron Column Weighing 16,000 Lbs. This Magnet Can Lift a Maximum Dead Weight of 70,000 Lbs.

cans be energized but half or one-quarter if required, so as not to jerk the aeroplane or stop it too soon. In other words a gradual braking action can be had at will of the electrician in charge. If the rolling of the boat and the wind is very strong, he will use more power, or else he can “flash” the electromagnets. By this is meant to overload the electromagnets 50 to 100 per cent. Thus, an electromagnet usually capable of attracting a weight of 100,000 lbs. can be energized by using double the quantity of the current to give a tractive effect of over 200,000 pounds. Naturally this would be only for half a minute or so, as otherwise there would be danger of burning out the windings. However, inasmuch as the aeroplane makes a landing in less than ten seconds the “flashing” of the electromagnets is of no consequence. As soon as the aeroplane has come to rest, the blue-jackets will be ready to lash it fast, and then the current can be switched off.

THE GERMAN WATCH TRICK.

A pet trick that the German soldiers employ is to leave a watch hanging on the wall of their abandoned trenches. Said watch connects by electric wires with a high explosive bomb, which explodes when the watch is removed from the wall.

LADIES! GET A MAGNET!

A magnet will attract a hook and eye which is liable to rust, while it rejects the non-liable ones. So a magnet is a handy tool for the sewing basket.
FLAPPING ELECTRIC FAN RESEMBLES "PUNKAH."

If you have ever visited India or other parts of the Orient, then you will at once recall the "punkah"—the slow-moving, feather bedecked fan, wielded by a husky native at a cost of a few cents a day. Two English inventors, who evidently had sweet memories of a trip to the Orient, have taken out a U. S. patent on just such a "flapping fan," only it is operated continuously, when desired, by the ever obedient genie—electricity.

The employment of rotary fans, say the inventors, whether of the oscillating or other type, as a means of agitating the air for the purpose of ventilation, gives rise to discomfort owing to the fact that the action of the fan produces a continuous draft, usually in one direction only, while, if a rotary fan of the so-called blower type be employed, the resulting introduction of air from outside is or may be objectionable for the reason that such air may have a temperature either too high or too low relatively to that of the air within the ventilated space and may in addition be laden with impurities or micro-organisms which it is difficult to get rid of.

It has, however, been demonstrated by experiment (as recently stated in medical journals) that, contrary to the common supposition, continual renewal of the air within a closed space is not essential to the health or even the comfort of the occupants, altho, for the sake of both health and comfort, it is imperative that the air within the space should be kept in motion. It is, moreover, true that a punkah, as commonly used in hot climates, serves for agitating the air without either creating a continuous draft in one direction or introducing air from outside. But not only are the prime and running costs of a punkah excessively relative to the benefits obtained from its use, but the fact of a punkah being of necessity permanently installed overhead or near the ceiling has the effect of seriously diminishing its efficiency, for the reason that movement is imparted chiefly to the upper strata of the air while the lower strata, which are breathed by the occupants of the apartment, are not directly affected by the agitation set up by the punkah. Who ever thought the punkah covered such a multitude of scientific laws and out-laws!

Something New At Last in Electric Fans—the "Flapper" Fan. It Brings to Mind the Oriental Breeze Producer or "Punkah" As It Is Called. It Is Said to Produce the Most Healthful Circulation of Air Possible. Its Design Is Ideal for Battery Operation.

Hence and howsoever we have with us the gently flapping electric punkah here illustrated, as perfected by Messrs. Term and Boyd of London. The fan actuating mechanism is very simple: in the case of the motor-driven type a cam shaft causes a sliding shaft to work back and forth inside the flexible goose-neck stem shown, thus causing the fan blade to rise and fall alternately. For battery (or 110 volt) systems they have perfected an extremely efficient electro-magnetic mechanism, which is attached to the sliding shaft aforementioned. This design would appear to solve the battery fan problem at last.

ELECTRIC POCKETBOOK ALARM FOILS PICKPOCKET.

A bright electrical genius of New York City, one John P. Williams, has recently taken out a patent on a remarkably electric attachment for pocket-books and such, and intended to be carried on the person, so that when the ever-present pick-pocket attempts to remove the pocket-book or wallet from your hindernest pocket, an electric bell kindly signals the news so that you can then presumably right-about face and nab your man—perhaps.

The electric alarm actuating device is made separate from the pocketbook or wallet and it is provided with a switch on the exterior, so that the owner can open the electric alarm circuit when he wishes to remove the wallet or other papers himself, without starting a riot.

As will be seen, the inventor has gone to considerable pains to make doubly sure that the pickpocket, no matter how well educated he may be in this crafty art, shall not be successful even if he tries to cut away part of the special pocket in which the wallet is placed. To this end he provided a double wall on the protective pocket holding the wallet or pickpocket, this wall containing two oppositely charged metallic plates, or other suitable arrangement of wires or conductors, separated by a layer of insulation and so connected with the battery and bell that should the thief try to pierce the wall of this pocket with any instrument or tool, he will short-circuit the two metallic plates and thus cause the bell to ring.

When the pocketbook or wallet is placed in the protective casings, which is firmly secured in the trouser or coat-pocket by means of a clip provided for the purpose, it is caused to open the alarm circuit by the force of gravity, or in other words by its own weight. The control switch is supposed to be opened while the wallet is being placed in the container, and it slides all the way down in the same, thus causing the alarm contacts to be held normally open by a spring arrangement; then the switch is closed. Should the thief now attempt to remove the wallet, the spring actuated contacts will come together and ring the bell. The inventor suggests two switches, in one of which the bell as well as the battery is placed within the wallet protector case itself, while in the second type the alarm bell and battery are placed in a separate container resembling a watch, and which may be worn in the vest pocket. In this case, the alarm case is connected with the protective watch by means of a fine flexible two-wire conductor.
The Making of an Electrical Man

By FRANK EFFINGER

WHILE America is still preparing to win the war, in other quarters preparations are being followed to provide for after the war requirements. Sad as it is, and as much as we hope 'twill not be so, war's conflicts will now down our numbers of brave, sacrificing soldiers and sailors. The law of war itself says that not as many that went shall return. And a great percentage of the ranks now in France, and preparing to go, are taken from America's industries, not a small number from the field of electrical activity. So, not only is the electrical field greatly vacant now due to the absence of electrical men enlisted in the war services of our government, but it will be more greatly vacant when war's results are counted, and the need for men to fill the industrial places of our soldier and sailor boys will swell the demand.

Moreover, the reconstruction and readjusting periods to follow in war's wake are going to increase the employment of electrical workers beyond even the natural immense requirements. Electricity is yet to do its biggest services to the world after the war. The unlimited are its boundaries now, electricity and men who know its functionary phases and operations will have even wider scope and opportunity for years after peace is declared.

To that end, a new school of engineering located at Milwaukee, Wis., is developing young men to respond to the demand for electrically trained men, developing young men to take the place of those who are not coming back, developing young men to fill the bigger duties our country will thrust upon us after the war is over.

Large quarters in two of Milwaukee's big buildings constitute this school's area, a total of 30,000 square feet. Its capacity is 1,500 students. All branches of electricity are taught and modern materials and appliances. This school has been considered in its idea, methods and equipment, as more of an electric industrial institution, rather than just a school of the orthodox type.

Only the essential theory is taught in text-books and lectures. More stress is placed on the practical instruction, however. The need is for useful men; men who not alone know, but can do. The ability to do things and knowing how things should be done, what to do, etc., is of more vital importance to both the student and the actual field of electricity, than merely a mind of theory, however brilliant, whatever the Alma Mater.

Complete chemical laboratories are contained in the school, where students prepare actual experiments to practical results, followed by full reports made out to the instructor. Also there is an electrical laboratory, where, for example a complete telephone exchange is provided—switchboards, all the intricate parts and even a wired transmission pole, built and practised on by the students. Here is learned by direct contact and operation the technical details of telephony, installation, connecting and all, attended by each student in his practical studies. This complete system is the only feature of its kind in any school. Then there are generators, motors, dynamos, connected and disconnected by students, built, disassembled and rebuilt, and operated as in an electrical plant.

A power plant is provided, fully equipped for students to actually work at and learn by practise and really seeing, as well as reading its laws and solving its problems in class room.

Whoever learned armature winding out of books? Here armature winding is taught by a unique, original method, whereby students learn the requirements of armature winding in every detail by actually
building armatures complete, from the bare iron core to the final form.

A model house is erected in the school, where students in their course of study practises, but has discovered the essential requirements of the electrician and engineer; consequently he is prepared first-hand to teach and conduct his classes to the completely wire a home. They thereby learn that important phase of electrical practise and become thoroly proficient in the art as well as the science.

Thus, in every department of electricity and all its phases, the theory taught is closely supplemented with thorow practise under actual working conditions; the same occupation students will be called upon to follow or supervise when they number themselves among the electricians and electrical engineers of the world. The practical training is given not alone to develop the students to do, but to actual contact and the experience gained, to learn the cause and effect of each detail, every step, and a thorow knowledge of an entire given electrical subject or problem. A man thus educated does not hesitate in answering a query or when put to the test, but responds instantly and emphatically, for he knows the why and the wherefore.

Another feature of practical benefit at this school is the part-time employment of students.

Arrangements are held with leading local industrial and business concerns, who employ students part time. In this way students gain actual business and technical experience, in contact with the world, which aids in their development at school. Furthermore, the students receive pay for the time employed, which adds to their bank accounts or to their school fund, many students thus helping to defray their expenses. This in no way interferes with the students' studies.

This engineering school has an unusual faculty, selected from a standpoint different than customary at most schools. Each and every number of the faculty comes from the industrial life of his vocation. Every teacher has occupied high industrial positions prior to joining the faculty and thus has determined by experience, not only the results of certain electrical and industrial best advantages, consistent with the major needs of the world.

Also, the members of the faculty, being practical men of experience, bear in mind the character development of the students, and this feature, with the fatherly companionship between teachers and student, keeps the students well ordered at school.

(Continued on page 136)

THE JOHN FRITZ MEDAL PRESENTATION.

The presentation of the John Fritz Medal to J. Waldo Smith took place in the Engineering Societies Building, New York, April 17.

At this meeting the John Fritz Medal Board of Award presented the John Fritz Medal to J. Waldo Smith for "achievement as engineer in providing the city of New York with a supply of water."

Col. John J. Carty, past president A. I. E. E., presided. The medal was presented by Ambrose Swasey, past president of the American Society of Mechanical Engineers. Other speakers were Nelson P. Lewis, vice-president A. S. C. E., Hon. A. T. Clearwater and J. Waldo Smith.

U. S. HAS GREATEST RADIO IN WORLD.

At the outbreak of war, the United States Navy took over the entire radio service of the country. On account of duplication twenty-eight commercial stations were closed. All those in existence were brought together in a comprehensive system, and other stations erected. The new stations at Pearl Harbor, Hawaii, and Cavitte, Philippine Islands, the most powerful stations in existence, have been completed, as well as the high-power station at San Diego, Cal. The Atlantic Coast stations are in direct communication with Pearl Harbor, and, with this one relay, a message can be flashed from Sayville, Long Island, to the Philippines. By New Year's direct communication had been establisht with Rome. The United States radio system stretches from Alaska in the north to the Panama Canal Zone in the south. In addition to this service, the Navy furnishes radio-operators for the rapidly increasing number of ships. To meet these needs thousands of wireless operators have been enlisted and trained.

At present there are 5,000 at the two principal schools alone, those at Harvard and Mare Island, Cal.
ELECTRO-MAGNETS, poor things, have been frequently adjudged guilty of many short-comings, as well as many, far too many, prodigal but unseemings possibilities since the start of the present world war. All of the misunderstandings and wild dreams of countless patriotic inventors throughout the land seem to be traceable to a lack of definite data as to just what a large electro-

magnet and the steel plate is about 50 tons when in contact. More will be said of this figure anon.

Let us look at the illustration. The largest standard magnet weighs about 8,000 lbs., contains over a ton of copper and requires 15.8 kilowatts of D. C. energy or 72 amperes at 220 volts, D. C. This magnet would not have sufficient capacity to attract a 2-inch cube of steel thru a verti-

ical distance greater than 18 to 20 inches. See Fig. A. Its effect on a larger object would, of course, be somewhat greater. On a steel range boiler (see Fig. B), the magnet might lift the dead weight of the steel thru a distance as great as two feet, not much further. This, of course, assumes that the boiler were stationary with respect to the magnet. If it were moving, as shown in Fig. C, the distance thru which the magnet would attract it would be considerably less. An ordinary range boiler has been selected for comparison here with a torpedo, as most persons have a clearer conception of the former body. From this it is evident that it is practically impossible to arrange booms on a ship, each of the booms being provided with one of these electro-magnets so as to attract enemy torpedoes out of their course, when traveling (Continued on page 139)
A NEW ELECTRIC VACUUM WASHER.

The new electric washing machine here illustrated is said to be a great improvement in the older types. This is a "phantom" view of the new Oscillator Vacuum Washer. Note how the dasher, which is divided into four vacuum compartments, covers the entire surface of all the clothes in the machine. In operation the dasher oscillates up and down with a rocking motion in such a manner that, as one end of the dasher is brought down against the clothes, it forces the water thru them with pressure, while at the same time the other end of the dasher is raised, drawing the water up thru the clothes by suction. Thus the water is forced thru all the clothes twice—once by pressure and once by suction—at every stroke of the dasher, with the result that, literally, many hundreds of gallons of hot water are forced thru every garment in the course of a minute's time.

It is conceded, by those who know, that the vacuum system is the most practical, therefore the machine which most completely utilizes the vacuum principle must be the most efficient type.

In the machine shown this principle has been worked out to the greatest possible degree. With this washer it is not necessary to stop the machine and adjust the clothes. It is impossible for even the smallest piece to become lodged in any part of the tub in such a manner that the dasher does not cover it.

It produces the same satisfactory results whether the tub is filled to its maximum capacity or contains only a few small pieces. The vacuum dasher automatically adjusts itself to the amount of clothes in the machine without attention on the part of the operator.

The new vacuum washer is claimed to wash perfectly the heaviest and most soiled pieces, as well as delicate fabrics and laces, without the slightest wear on material and without danger of tearing. Discs will wear and pegs will tear, regardless of statements to the contrary. Anyone knows that catching a lot of wet clothing on wooden pins or pegs, slushing and jerking them thru the water, first one way and then another, must cause wear and often results in torn clothes. The present machine does not handle the clothes, but forces the hot water and soap thru them washing absolutely clean without wearing or tearing.

Another important feature is the entire absence of valves, springs or other inaccessible parts in the dasher, to hold grease, dirt or acid from the soap. Such accumulations cause corrosion and rust, injuring the clothes. It is unnecessary to raise one side of this machine to drain it. Simply open the drain cock, to which a hose can be attached if desired, and let the water run out. Every part may then be wiped dry with a cloth.

No mechanism whatever is placed on the cover, hence the machine is easy to open and handle. It is operated by a highly efficient electric motor, which connects with any lamp socket or floor plug.

AN ELECTRIC 3-SPEED MIXER FOR THE KITCHEN.

One of the most effective labor-saving machines on the market for the modern kitchen is the new motor-driven three-speed mixer here shown. This machine is electrically operated and the operation is so simple that a child can work it. It takes a minimum amount of electricity to run these machines, it is claimed, the large heavy-duty model requiring but a one horsepower motor. The starting, stopping and changing of speeds is controlled solely by one hand on the machine. It is also possible to stop the mixer without stopping the motor. The bowls of the mixer are rapidly interchangeable, by means of a simple snap spring and can be changed with one hand.

The cut shown is that of the heavy-duty model. This size mixer is for use where heavy and continuous service is required, such as large hotels, restaurants, clubs, institutions, etc. It will mix bread, cake and pastry doughs, beat eggs, whip cream, strain soup, mash vegetables, and crumb bread; and with the extra attachments will grind meat, sharpen tools, buff silver, grind coffee, and many other varied duties.

It has been found by actual test that batches mixed in these machines are greatly improved in quality, and an increase in quantity is also evident. The thoroughness of the mixing makes this possible. Because of the raising and lowering of the bowl, the beater can be worked up and down in the batch, thus insuring that every part of the batch has been well mixed. These machines are also great labor savers, as one machine will do the work of from two to three men.

They have rapidly gained recognition in all fields, and are now being used by the pharmaceutical, drug, paint and polish manufacturers, as well as by preserving and canning houses, where they are used profitably.

NEW TELEPHONE RECEIVER CAP IMPROVES EFFICIENCY.

Here is a new way of boosting the telephone receiver's efficiency via the ear cap, according to the sponsors of the specially designed cap shown.

A scientifically true seat for the membrane "I," prevents the minutest rattling thereof. An inverted trumpet bell, tone concentrating chamber "2," insures of whole, undistorted and most efficient guidance of the sound waves and prevents their deflection and distortion the makers claim.

A radically fluted exterior trumpet bell "3," constitutes a comfortable surface for the ear and permits the impact of each ear-shocking wave to be diverted thru the flutes, which also prevent the sounds from muffling and permits the earpiece to be held in a flat manner firmly to the ear, so as to exclude exterior noises.

Thru the flutes "4," air is freely inhaled and exhaled with each to and fro vibration of the receiver membrane into the outer ear canal, in similar manner, as by the expansion and contraction of the lungs, air is inhaled and exhaled thru the nose.
ELECTRICAL EXPERIMENTER

NEW 800 WATT ELECTRIC PLANT.

Electrical contractors are now in the Farm Lighting Plant business seriously and are finding it necessary to supply their customers with outfits of a better class than the cheap plants sold during the earlier days of the business.

The private lighting plant shown in the illustration has been placed on the market by a Milwaukee concern. It is of the belted type and consists of a generator and switchboard made up in one unit and a storage battery. The various elements of the plant are of well-known standard makes. The best grade instruments and rheostat are used on the switchboard, which also includes a new type of magnetic cut-out which is of an improved design. Glass enclosed fuses are furnished. These plants are made in three standard sizes provided with sixty, ninety, and one hundred and twenty amper-hour batteries, respectively. The generator has a capacity of 800 Watts.

闪亮的新型800瓦特电能装置

电工承包商现在正在从事农用照明设备的业务，并且发现需要向客户提供质量更高的设备。早期出售的便宜设备已经过时了。

图中的私用照明设备由一家密尔沃基公司推出。它是带式类型的，由发电机和开关板组成，并且合成为一个单元。开关板和电池都是标准的，质量可靠。最好的等级的仪器和 rheostat 用于开关板，其中包括一种改进设计的磁性断路器。玻璃封装的保险丝被提供。这些装置有三种规格，分别包含六十、九十和一百二十安培时的电池。发电机的容量为800瓦特。
Burnt-Out Lamp Contest

ELECTRICAL EXPERIMENTER
June, 1918

WE have conducted a good many contests in the Electrical Experimenter in the past, but we are quite certain that our Burnt-Out Lamp Contest has broken every record by far. There seems to be a real enthusiasm on the part of utilizing burn-out lamps, and up to the time of preparing this article, over nine hundred letters have been received, and are still coming in. The oddity of the contest is, that no matter how curious the idea, each has been duplicated, triplicated, and sometimes quadruplicated many as 208 times! Here is the record:

208 Radio Detectors.
80 Florence Flasks, Miscellaneous glassware, Retorts, etc.
28 Geissler Tubes.
21 Magnifying Glasses.
13 Tesla Tubes.
12 Water Rheostats.
12 Emergency Fuses.
11 Batteries.
9 Rain Alarms.

Of this list the electrolytic detectors which rank first have been deemed impractical for actual work, and therefore have not been utilized generally. We cannot make a good electrolytic detector from a standard burn-out 110 volt lamp for the simple reason that the platinum or substitute platinum wires are too thick and at best will only give very poor signals from a powerful station located but a few miles away. The noise in a newspaper office, such a detector is entirely out of question.

Some of the chemical glass ware is being described in this article. The Geissler tube idea has also been used by many a great many times not alone in the Electrical Experimenter, but in other technical magazines. Remember, we wanted original ideas. The same pertains to Tesla tubes, as well as batteries. The magnifying glass idea while new, can hardly be called practical for the simple reason that no one would wish to fill a big bulb with water and use it around the desk for magnifying purposes.

As I mentioned before, all the ideas that came in have been duplicated. The ones which we mention in this article are those received first at our office, or bore post marks, or whatever it was that made the article been mailed first. This we merely did in justice to the various contributors, as among the duplicated articles, all apparently were equally well prepared.

Of course the curious and humorous element was not missing from this contest. Here are a few choice ones: all of these may be termed impractical. There have been suggested the following: wine bottles from 100 watt lamps, chemical fumes, cigar lighters, water heater, clothes sprinklers, and last but not least, all honors go to M. Musselman, of Velsa, N. D., who proposed to fill the bulb with liquid green soap in order to use it for shampoo purposes!!

There were furthermore the following: chemical detectors (using an inverted bent filter paper), targets for rifle practise, filling burn-out bulbs with colored liquids for window attractions. There were quite a good many suggestions of that sort, but the one that has not been seen one of these that would actually work. There were a good many variations on electrolysis apparatus, as was suggested in the original article by Mr. H. Gernsback. There were also several Helmholz resonators, which did not prove useful to us. There were a number of flower vases, fern dishes, candle holders, cigar, and match holders. There were two variable condensers which were suggested for utilizing the lowering liquids in the condenser suggested by Mr. Gernsback. A particular clever one was suggested by Mr. Monte Cohen of New York City. This lamp foil filled with evil smelling liquids in order to have them crash on the domes of "Ham" actors. The idea is to place a push button in front of every man and women in the audience, who if mispleased, simply press a button which would release the bulb onto the unfortunate stage member of the stage male-factors!

There was also a clever miniature volcano as well as a water fountain. Two Hilfs inventors suggested—not such a bad idea,—making megaphones from burnt-out lamp bulbs to be used in connection with telephone receivers. In other words, making horns from the bulbs. There were of course half a dozen inkwells; there were several galvanometers, and even an acetylene gas generator. Mr. E. W. Friedel suggests the filling of the bulb lamp by dripping water on the carbide. There were a number of experimental storage batteries, and we must not forget a clever idea for a lamp suggested by Mr. H. E. Maher of Brooklyn, N. Y. He fills the bulb with the following solution: Chloride of Calcium, 20 parts; salt, 5 parts; water, 85 parts. The bulb is thrown in the center of the fire which is extinguished by the chemicals. Several would-be inventors showed us a device which would weigh a lamp bulb before and after cutting off the tip, the difference in weight of course represents the actual weight of air. While a good idea, as a test for honesty, the experimenters had a sufficiently sensitive scale to detect the slight difference in weight, which of course does exist. There were many suggestions as to batteries which simply consist of utilizing half or three-quarter bulbs in which are placed the usual zinc and carbon elements.

The first prize goes to Elton Baker, 1316 N. 40th St., Omaha, Neb. This is on how to make a static machine by means of a burn-out lamp bulb. Baker's article is reproduced in full herewith.

PRIZE WINNER ($3.00)

A BURNT-OUT LAMP BULB STATIC MACHINE.
By Elton Baker.

The drawings, Fig. 1, show various views of a static machine which I have designed for the "Burnt-Out Lamp Bulb Contest." Also the illustrations show a small 25 watt lamp bulb, much better results can be secured by the use of larger bulbs, as this machine operates on the principle of friction alone. The charges should be collected and stored in the bulb, which is a good sized spark. The jar described by Mr. H. Gernsback in his article on "Burnt-Out Lamp Bulbs" in the April issue will do.

The idea is to make a machine of the shape indicated, made concave on one side to fit the curve of the bulb, covered first with a piece of felt or equally soft material and then with a thin tin burd. To obtain best results the part in contact with the bulb should be covered with a coating of soot, which may be blown or sucked from the back of an old mirror. The collector is made of a similar wood block from which brass tacks protrude so that they are all equidistant from the bulb, and a thin flap is attached to the rubber nearly covering the upper half of the bulb. It is for the purpose of holding the charge on the bulb until it reaches the collector.

Care should be taken that the driving belt turns the bulb towards the collector and also that the tacks on the collector and the leather on the rubber are in metallic connection with their respective brass balls.

The second prize winner ($2.00) is C. M. Cardeaz of Ottumwa, Iowa. His illustration (Fig. 2) shows a lamp made from a bulb which may be used.

The working principle is as follows: The box air, see Fig. 2, rising to the ceiling, causes the air inside the bulb to expand, thereby forcing the salt or acidulated water out of the bulb, and is collected in the cup below, closing the circuit between the two battery wires. These may be connected to a red lamp or bulb, as the owner may desire. The bulb will have nothing to do with the operation of the device, and should be entirely broken by shaking the bulb well while full of solution.

The third prize winner ($1.00) was Mr. Eugene Ruckman, 2209 E. Main St., Ottumwa, Iowa. Nothing further than the illustration to show that he has made this idea fully understandable. When used as a rheostat, slightly acidulated water, or otherwise water to one side of the base, is being added, is used. Thus required resistance can be readily had. When used as a pole tester, the solution (Continued on page 127)
ELECTRICAL EXPERIMENTER

BURNT-OUT LAMP CONTEST.

(See opposite page for descriptive text.)
EVERY time a molecule of any gas gains or loses an electron so as to become electrically charged, it becomes an ion or carrier of electricity. A molecule which loses an electron constitutes a positive ion, and the electron itself may be the negative ion unless it in turn attaches itself to a neutral molecule. When that occurs the neutral molecule becomes negatively charged and it is the negative ion. Hence the smallest negative ion known is a free electron, and the smallest positive ion known is a hydron atom which has lost an electron, the hydrogen atom being the lightest atom which exists.

Electrons may be displaced from molecules by the action of X-rays, ultra-violet light, heat, electric sparks, arcs, flames, emanations from radioactive substances, and by the collision of rapidly moving ions with molecules. Any of these ionizing agents may thus change a nonconducting gas to a conductor and the effect may be proven by placing a charged electroscope in a gas which is under the influence of any one of them, and noticing how quickly it will lose its charge. Different agencies may, however, produce different types of ionization, and a study of these different phenomena leads to a fuller understanding of electricity and matter, and especially the causes of ionization.

X-RAYS.

The X-Rays are one of the best ionizing agents known. In experimenting with ions produced by it, an ionization chamber is generally used which may be of the form shown in Fig. 1. A is the ionization chamber with an aluminum window W thru which the radiation may pass and E and E are electrodes by which the conductivity of the air gas may be measured. The experiments of Prof. Millikan, of Chicago, and others have shown that for the most part the ions seem to be singly charged, which means that when one of these short ether waves strikes a molecule of gas, an electron is displaced. If two or more electrons were displaced at one time the molecule would at once become doubly or multiply charged.

The most noticeable feature of such motion is thereby increased until it is violently shot off from the molecule. Sometimes light is absorbed without producing ionization and in that case the energy of the wave increases the kinetic energy of the molecule without causing the expulsion of an electron. The question as to whether or not a given wave will displace an electron most likely depends on the relative frequencies of the wave and the vibrating electron, and their phase relationship when they meet. A certain amount of harmonic relationship would allow absorption to take place where the lack of it no doubt would cause expulsion. Just what relation this may be is a subject for investigation.

RADIUM EMANATION.

As is well known, the emanations from radioactive substances consist of three general classes, alpha (α) rays or positive particles, beta (β) rays or negative particles and gamma (γ) rays which are very short ether waves. If a gas be ionized by means of beta rays it has been found that single electrons are displaced with very little violence, more as if they were simply set free rather than expelled violently by collision. The same is true of ionization by alpha particles, while the gamma rays act in the opposite way to the other short ether waves.

The beta particle, which is in reality an electron, is so small that it may often pass completely thru a molecule without producing ionization, and it frequently does this when traveling at a high velocity. The alpha particle, which is identified as a positively charged helium atom, may do the same, but on account of its much greater size produces ionization more frequently than the beta particle. Both kinds of rays produce more ions when traveling slow than fast because they then have a less chance of passing thru a molecule without collision, and it is thought that the alpha particle may remove several electrons at one time thus producing multiple charges, but that point is debatable.

The way in which an electron or other small rapidly moving particle may pass completely thru a molecule can be better understood by considering Fig. 2, and remembering that the electron takes up less than one hundred thousand of the volume of any atom and the nucleus or center is probably smaller still. So that as one scientist has said the atom seems to be mostly "betweeness." By the figure it is easily seen that if the separate parts of an atom are actually this small, and if the electrons (e) are rotating at high speed about the nucleus (N) the probability is very high that another small particle traveling in the direction of the arrow (I) will pass completely thru the nucleus without collision. The experiment may be tried of swinging a ball on a string and throwing marbles thru the circle described by the ball, and it will be found that rarely indeed will the ball be hit or even the string.

(Continued on page 139)
Television and the Telephot

By H. Gernsback

(Conclusion)

As we mentioned in the preceding installment of this article, all the telephot schemes which have appeared so far are more or less theoretical. Many of them have not even been the subject of an experimental stage. It seems that while most ideas look more or less practical on paper, it is quite impossible to tell if any of them would actually work in practice. At any rate the various proposed schemes here illustrated form interesting reading for the serious-minded experimenter who is working on this more or less intricate problem. Several of the schemes outlined show a reasonable way towards accomplishing the goal.

Figure 1 shows the telephot of Mr. Sidney Rothschild of New York, on which patents have been issued. Briefly summarized, this invention consists in causing a light controlled composite background to vary the intensity of electrical currents flowing over a wire, and causing these currents to control the intensity of light at the receiving station, this light being caused by an appropriate mechanism to produce a moving luminous spot of varying intensity such a manner as to reproduce the simple image disposed adjacent to the aforesaid background at the transmitting station. The outstanding features are indicated in the illustrations, and the technical details have not been discussed. These can be readily looked up in the patent specifications by anyone sufficiently interested.

At the sending station we have a subject A, whose picture is transmitted thru lens 1, the rays of which fall on the selenium cell 4, after passing thru a belt 3 which is rotated at a high speed. This belt has a number of longitudinal slots disposed crosswise, the belt travelling in the direction indicated by the arrow. A revolving cylinder 9 is provided with a series of slots, each being adapted to register with one of the sections 8 of a further selenium cell. In this manner Mr. Rothschild expects to cut up the various points of the picture and transmit the impulses over the line as shown. At the receiving end, we find a revolving wheel 6 and another rapidly revolving belt 5 which also has longitudinal slots as shown in detail C. By means of a light source shown at 11, which may be an incandescent lamp, the light rays pass thru the revolving wheel 6 and slotted belt 5. The light rays in prises a dark chamber shown in dotted lines, in which is placed a lens 6 which receives the rays issuing from the dark chamber. These rays after being refracted meet a small selenium cell 8, placed behind the prism 6. Screen 1 represents an object (in reality farther removed from the dark chamber than the drawing indicates). The light rays coming from the screen 1 after refraction in the lens 6 which is in front of the dark chamber form upon the endless ribbon 3 a real image reversed and reduced by the screen 1. This ribbon is flat continuous and opaque except at certain perforated points, arranged according to a diagonal line as shown in the detail sketch S. The distance separating the holes displaced the whole of its length, each of the points of perforation has cast into part of the image which is presented to view; thus, the entire picture is transmitted point by point.

At the receiving end we find the sender practically reversed. Here we have another moving ribbon 4 with perforated holes. In the dark chamber 13 we have a source of illumination which may be a kerosene lamp, or an electric lamp or any other kind of a lamp. This lamp throws its rays thru lens 7. Here we have also the electro-magnet 10 which is connected with the selenium cell, and a battery at the sending station. By means of an ingenious shutter arrangement 11, the light rays coming from the lamp 12 are more or less influenced, due to the fact that the electro-magnet is more or less energized by the selenium cell 8 of the sender. In other words when at the sending station, the selenium cell was energized at its maximum, in this case the electro-magnet 10 at the receiving end would be energized as its maximum also, and therefore the shutter would let pass the maximum amount of light. All providing of course that the ribbon 4 was working synchronously with the ribbon 3 at the sender. As the ribbon 4 revolves very rapidly and synchronously with the ribbon at the sender, the picture is thus reproduced point by point and is reconstituted upon the screen as shown at B. Messrs. Anderson have also incorporated into this invention an idea showing how the picture can be transmitted in its actual colors. This is a very ingenious arrangement, but is outside of the scope of this article.

The next telephot, Fig. 3, was imagined...
by Gustav E. Hoglund, of Chicago, Ill. This invention also has been patented, and relates to that class of devices for cutting up and dividing light rays emanating from an image and causing them to act upon a selenium cell capable of changing its electrical resistance under light rays of different intensity. These vibrations are sent over a line and act upon a luminous center at the other end thereof, which may be in the form of a speaking arc and cause a fluctuation in the brilliancy of said arc which will cause light rays to emanate therefrom, said rays being of varying intensity according to the

strength of the current. These rays will follow each other in the same order, and will be of comparatively the same intensity as the light rays emanating from the object. Hence, when the rays from the lamp are projected onto the retina of the eye in rapid succession, they will cause an image to be built up before the eye, which will be composed of the varying light rays of the same strength and in the same order as those emanating from the original image.

The device shown in Fig. 3 has a receiver and a sender; each of the instruments comprises a selenium cell 5, positioned in front of which is the enlarging lens 4 and the reducing lens 3. Between these lenses is a double revolving shutter composed of discs 7 and 8. These are also shown in a detail sketch. Disc 7 has a series of square perforations 10, while disc 8 has a series of slots 11. It will be seen that as these discs revolve in opposite directions, each point of the picture is cut up successively and allowed to pass thru the optical lens system. Each of the receiving instruments also comprises a lamp 1 and enlarging lenses 2. Between these lenses a ground glass plate is placed, upon which the final picture appears. Both receiving and sending instruments are connected by electrical lines as shown. The oppositely revolving discs are ordinarily actuated by means of the synchronous motor 10.

An interesting part of this invention is that these revolving shutters can be corrected if they do not run synchronously by means of handle 9. It becomes apparent that the two shutters must be brought into proper relation to one another; this can be easily determined when such a relation is found by observing the image from the receiving instrument. If the shutters are not in proper relation, the image will be nothing more than a blur, and before it can be distinctly seen, the shutters will have to be in appropriate relation to bring the openings into the desired position. The inventor therefore provides

handles 9 which extend from the shutters and by turning these handles, the shutters can be revolved until they are brought into proper relation with one another, the operation determining when such position has been reached by observing the completeness of the image reproduced by the receiving instrument. Once the shutters are in proper relation with one another, the motors are then supposed to operate them synchronously. By studying the illustration, it will be noted that the lamps 6 are varied into their proper luminosity due to the selenium cells 5 receiving more or less light.

While this scheme looks very feasible on paper, we are afraid that the lamps 6 will not respond instantaneously to the current variations in the selenium cells 5, and at best the picture would seem to us to be formed rather blurred.

The next telephopt which has also been patented in several countries is shown in Fig. 4. The inventor of this telephopt is Boris Rosing of Petrograd, Russia. In order to eliminate the synchronous motor arrangements which have been the failure of almost all telephopt schemes, Mr. Rosing does away entirely with them, substituting therefore a system comprising two oscillographs with movable reflecting surfaces. This will be apparent further on.

The optical system at the transmitting station comprises two polyhedral rotary mirrors, 1 and 2, the axis of rotation of which are at right angles to each other. They are driven at such speeds that the angular velocity of one of the mirrors is several times greater than the other; and an objective or lens 5, the focal plane of which coincides with the plane of the screen 6 and the photo-electric receiver 7. The objective 5 is arranged in such a manner that rays emitted from any point of the field of vision arrive in the photo-electric receiver only after successive reflections by the two mirrors. When the mirrors 1 and 2 are rotated, the end 8 of the optical axis thus deflected traverses the field of the picture in a zig-zag path, so that from every portion thereof light is transmitted in a certain determinate order thru the opening of the screen 6 upon the photo-electric receiver 7. Permanent electric magnets carried by the mirrors 1 and 2 and stationary bobbins 3 together form small generators producing in the corresponding bobbins pulsating currents, the periodicity of which per revolution of the mirror corresponds to the number of reflecting surfaces thereof. The currents which are produced in the conductors 9, 10, 11, 12 and transmitted thru the receiving station are proportional to the components in the directions of the axes of a corresponding system of coordinates of angular movements which the optical axis 8 executes in the field of view.

At the receiving side we find two oscillographs provided with mirrors 13 and 14. The axes of both are arranged to correspond to the axes of rotation of the mirrors 1 and 2. Lens 16 directs the rays proceeding from the luminous signaling point 15 on to the small mirror 13. There will therefore be imparted to the deflected optical axis 17 at the receiving station, the same movements in space which the deflected optical axis 8 at the sending station executes at the transmitting station. It goes without saying that the moving parts of the oscillographs naturally have much less inertia than do the revolving sets.

A different idea in which Rosing's invention is shown in insert C, Fig. 4. Here instead of using oscillographs, the inventor

(Continued on page 124)
The Dynatron—a New Vacuum Tube

The dynatron belongs to the kenotron family of high vacuum, hot cathode devices which the research engineers of the General Electric Company have developed, and was described in a paper read before The Institute of Radio Engineers by Dr. Albert W. Hull. Two members of this family, the kenotron rectifier and the pliotron, have already been described in this journal. The fundamental characteristic of kenotrons is that their operation does not depend in any way upon the presence of gas.

In construction, the dynatron resembles the kenotron rectifier and the pliotron. In principle and operation, however, the three are fundamentally different. Each utilizes a single important principle of vacuum conduction. The kenotron rectifier utilizes the uni-directional property of the current between a hot and cold electrode in vacuum. The pliotron utilizes the space charge property of this current, which allows the current to be controlled by the electrostatic effect of a grid. The dynatron utilizes the secondary emission of electrons by a plate upon which the primary electrons fall. It is, as its name indicates, a generator of electric power, and feeds energy into any circuit to which it is connected. It is like a series generator, in that its voltage is proportional to the current thru it, but it is entirely free from hysteresis and lag that are inherent in generators and in all devices which depend upon gaseous ionization.

The dynatron consists essentially of an evacuated tube containing a filament, a perforated anode and a third electrode called the plate. The essential construction is shown in Fig. 1. The plate must be situated near the anode, in such a position that some of the electrons, set in motion by the anode voltage, will fall upon it. A battery is provided for maintaining the filament at incandescence and for maintaining the anode at a constant positive potential of 100 volts or more, with respect to the filament. This voltage is not varied during operation, and the anode plays no part in the operation of the tube, except to set in motion a stream of primary electrons, and to carry away the secondary electrons from the plate that is to supply the power.

The illustration, Fig. 2, shows the construction of one of the practical types of dynatron that have been developed. The plate, as will be observed, has been bent into the form of a cylinder, in order to utilize more fully the electron emission from the filament, and the anode has been provided with a large number of holes, instead of one. This is accomplished by using a perforated cylinder, a spiral of stout wire, or a network of fine tungsten wire. The filament is a spiral of tungsten wire. The filament may be further provided with a heavy insulated wire along its axis or surrounded by an insulated spiral grid, making a "four member" tube, which is called a pliodynatron. The characteristics of the pliodynatron are discussed later on.

Electrons from the filament F (Figure 1) are set in motion by the electric field between F and the anode A. Some of them pass first the holes in the anode and fall upon the plate P. If P is at a low potential with respect to the filament, these electrons will enter the plate and form a current of negative electricity in the external circuit. If the potential of P is raised, the velocity with which the electrons strike it will increase, and when this velocity becomes great enough, they will, by their impact, cause the emission of secondary electrons from the plate. These secondary electrons will be attracted to the more positive anode A. The net current of electrons, received by the plate, is the difference between the number of primary electrons that strike and enter it and the number of secondary electrons which leave it. The number of primary electrons depends on the temperature of the filament and is practically independent of the voltage of the plate. The number of secondary electrons, however, increases rapidly with the voltage difference between plate and filament, and may become very much larger than the number of primary electrons; that is, each primary electron may produce several secondary electrons, as many as twenty in some cases.

If the dynatron be left open-circuited, as in Figure 1, it is unstable. The same instability occurs if the circuit of Figure 1, instead of being left open, is closed thru too high a resistance, so that the rate at which the plate receives electrons is greater than the rate at which these electrons can flow away thru the resistance. (Continued on page 122)
Major-General George O. Squier

Major-General GEORGE OWEN SQUIER, well known to all electrical and radio men for his important achievements in telephony and telegraphy, is at the head of the U. S. Signal Corps, one of the most important branches of our army. General Squier has a large number of problems to contend with in his capacity, for besides his multitudinous duties in building up an efficient Signal Corps arm of the Service, equal numerically to our entire army before declaration of war, he has had charge of the aviation work of the Government.

Major-General Squier was born in Dryden, Mich., March 21, 1865, in the old homestead which he still owns, and which was settled by his grandfather in 1835. In 1883 he was chosen for West Point, and in 1887 graduated seventh in a class of 65. Appointed second lieutenant in the third Artillery at Fort McHenry, Baltimore, on June 12, 1887, he put in all his spare time studying physics at Johns Hopkins University under such leaders as Rowland, Kresnell and Newcomb. There he laid the basis of his scientific knowledge, being made a fellow of the University during the years 1902, 1903, and 1904, and receiving his Ph.D. degree in 1903.

He announced before the American Institute of Electrical Engineers, in 1897, a new method of rapid telegraphy, based on the use of the alternating current with the polarizing photo-chronograph. Three years later he announced to the same society the adaptation of these principles to cable telegraphy, using the sine wave "e. m. f.'s" as worked out in experiments begun the year before with Dr. C. Crehore.

In the meantime his military career claimed him, especially during the rush of the Spanish War. In 1900 he took the cable steamer Bunsen from New York thru Suez to the Philippines, where he laid the inter-island cable still in use. During this time he rose thru various ranks till he was commissioned a Major, 2, 1903.

In 1907, as Chief of Staff to General Allen, of the Signal Corps, he was entrusted with drawing up the first specifications for a military radio telephone by any government. On September 12, of the next year, when in charge of the first tests at Fort Myer, he made the first ascent as a passenger in an airplane ever made. That December he showed his faith in the future of his cable transmission invention, which later led to its adoption. It is estimated that this doubled the capacity of the cables.

It was in May, 1916, with the war two years old and the vital importance of aviation fully demonstrated, that he was recalled to America by President Wilson to reorganize the Air Service. On the 14th of the following February he was appointed Chief Signal Officer in charge of aviation and the Signal Corps, with the rank of Brigadier General, which was increased to Major General on October 6, 1917.

During the brief eight months since he has been in charge, the Air Service has jumped from a strength of 2,000 to an authorized strength of 135,000; its appropriations have increased from about a million dollars in five years to $700,000,000 granted in one, and a billion asked in the next; its planes and aviators have increased from a hundred to thousands. The Signal Corps itself has had to meet the needs of an army eight times that of a year ago.

General Squier is a Fellow of the Physical Society of London; a member of the Royal Institution of Great Britain; the American Mathematical Society; the Franklin Institute; the American Association for the Advancement of Science; the American Physical Society; the American Geographical Society; the American Institute of Electrical Engineers; the Institute of Radio Engineers, and other scientific and professional bodies. He was awarded the John Scott Legacy Medal in 1896 by the city of Philadelphia for the polarizing photo-chronograph, and in 1912 the Elliott Cresson gold medal, the highest honor of the Franklin Institute, for his work in multiplex telegraphy on "wired wireless," by which half a dozen wireless messages run outside of, but are guided by a single wire. He has also issued inventions in the use of trees as antennas in wireless telegraphy; the electro-chemical effects of magnetization, and the absorption of electro-magnetic waves by living vegetable organisms.

Electricity plays a tremendous part in the preparations being made for the reception of American troops in France. From the refrigeration of food to the lighting of first line trenches, electricity is employed at almost every step.

SOCIETY GIRLS WILL INSTRUCT DRAFTED MEN IN RADIO.

The Women's Radio Corps of America is training at New York headquarters a corps of young ladies, most of whom are prominent in New York social circles. The members of the corps will later instruct classes of drafted men in buzzer and radio signaling. The photo shows Sergt. Georgiana B. Davids (left) and Sergt. Elise Owen, who are in charge of the students. This idea seems a capital one to our minds—instead of attempting to place women radio operators in hazardous war positions, why not train them to teach? Here's a big field, surely, one that is bound to expand as more and more of the flying cadets are marshalled in the training centers. And thousands, and even tens of thousands of these future flyers will have to be taught radio operating in the next year or so. In this way the women will find a most satisfying way of knowing and feeling that they are actually doing "their bit" for Uncle Sam.
A "Fountain Pen" Radio Receiving Set

While not an entirely new innovation the "Fountain Pen" Radio Receiving Set has laid the invariable drawbacks of all new devices, as well as lack of practical use. But now a new application has been given to it that with so many "spies" at large, it has become a necessity to detect many of these enemy aliens, who undoubtedly are using some wireless apparatus to communicate information to Germany, or between themselves.

To Dr. Lee deForest must be given the credit for developing a receiver which is only slightly larger than an ordinary "Fountain Pen." With it, a secret service man has but to walk in the vicinity where a "spy" has been suspected, with the chance that he may locate the informer at his instrument.

With this "fountain pen" Radio receiver it has been possible to hear stations eight to ten miles away, with little difficulty and only a small aerial. In the sectional view shown herewith may be seen how it is hooked up. This sensitive receiver depends entirely upon the Audion for its efficiency, and it is only the extremely sensitive detector that has made possible a truly practical receiver of this small type.

It has been found that by using what is known as a "soft" Audion a fair degree of sensitivity is achieved with a battery of only four volts whereas a standard Audion requires a potential many times that amount.

The tuning of the set is accomplished by means of a small coil, wound with No. 40 magnet wire. Taps are taken off from the coil and led to a number of points over which slides a contact mounted on the movable cap at the end of the receiver. By moving the cap one way or another the wave-length is altered to conform with the incoming wave. The tuning coil answers satisfactorily for short wave-lengths, and the Audion is connected directly to it, having an untuned secondary. The battery is placed in the middle of the receiver and at the end is placed the telephone receiver consisting of a special magnet, bobbin, diaphragm and earpiece. The antenna and ground connections are instantly made by a special double contact plug.

To operate the instrument the person using it has a metal plate attached to the heel of one shoe to which is attached the ground wire. He is leading to the set the wire being past through the trouser leg so as not to be seen. The wire to the antenna is run down through the same coil and into a hollow cane which may contain a spiral aerial or a similar arrangement.

Standing against an iron fixture which connects with the ground the operator places the metal electrode on the heel in contact with the same. The cane containing the antenna is held over the shoulder or in any position not likely to cause attraction. The earpiece is placed against the ear and the other end adjusted till the signals are heard loudest.

The transformer is about the most efficient piece of electrical apparatus, it having an efficiency of about 98%.

A specially built and cleverly contrived generator designed to give an exact reproduction of radio signals has been perfected and put into use at the Dunwoody Industrial Institute, in Minneapolis. This high frequency generator is used instead of a buzzer for producing the practise signals in the "phones." The generator has 96 poles, the rotor, which is the field, is revolved at a speed sufficient to give a clear musical note of about 600 cycles. The frequency as well as the strength of the signals can be easily varied. As a result of this arrangement the student gets practise in receiving an exact imitation of the modern radio signals, such as are sent out by undamped wave generators and quenched spark sets. The head 'phones' are connected directly to the primary coils of the Audion thru the transmitting keys. The generator is driven by a one-sixth horse-power electric motor.

This Special Yet Simple Form of High Frequency Generator is Used at A Leading Radio School to Supply the Proper Tone of 'Phone Current.
NEW RADIO KEY HAS BALL BEARING CONTACTS.

An interesting and highly efficient radio key recently perfected by a New York radio engineer, Mr. L. G. Facent, is illustrated in the accompanying photo. It is built in a precisional manner throughout, having extra long, deep-seated pivot bearings for the key lever proper, which ensure long service and accurate functioning of the complete instrument. The key is mounted on a lakelite base, giving entire freedom from dampness leakage, etc. cetera.

The contacts are extra large and made of silver. All radio men know how difficult it is to properly align key contacts, especially when badly burned, even after they have been carefully filed clean and flat again. Ingenuity on the part of the designer of the present key has solved this problem in an admirable manner. He mounts the upper contact on the key lever in the usual way; the lower contact is mounted on a ball and socket joint. With this means provided it is the work of but a moment to loosen the lock nut clamping the ball-supported bottom contact and to align it accurately with the top contact. The key has been approved by the Navy Department.

RADIO OPERATING IN ALASKA.

By Howard S. Pyle,

Electrician-Radio, U. S. N.

It may be of interest to the readers of the ELECTRICAL EXPERIMENTER to know what we of the Pacific Coast have to combat in the way of mountain ranges and other natural causes which contribute in making a commercial operator's life in Alaska, one of constant speculation as to whether his business is going to get thru or will be hung up somewhere because a station can’t “get thru.”

I recently completed a trip on the S. S. Rush of Everett, Wash., from Everett to Heringooy, Alaska, in the Bering Sea, by way of what is known as the inside passage, that is: hugging the coast of British Columbia all the way north, between the main land and numerous islands.

My kit included the new Kilbourne and Clark two kilowatt, 500 cycle mercury arc quenched transmitters and at that time was probably the most efficient type of marine equipment in use on this coast. The receiver was of the ordinary, inductively tuned type with silicon-arsenic detector, but as my crystals were of a very poor quality, I had no opportunity to hang up any receiving records. My antenna also was mountains that tower way above the vessel on either side. Here I was practically in a “dead hole,” not hearing a signal during the time of passing thru except from the S. S. Zepora, WPQ, who was just ahead of us in plain sight. After leaving the Canadian coast and entering Alaskan waters we were coming very close to Ketchikan, Alaska, (KBP) but owing to intervening mountain ranges could hear his signals only about fifty miles on either side, although there is a very efficient and powerful installation there. A vessel as close as we were has difficulty in working with him, but at a distance he is easily readable clearing business with Astoria, Oregon, every day. We progress up the Alaskan coast and when attempting to work Sitka, (NBP) found it almost impossible, except when we were all most opposite him, being on the east side of the island. This was due to mountainous country intervening between.

After leaving Hoonah, Alaska, we struck straight across for Corvallis and Kodiak and had no trouble working either of them all the way across. When we entered the water between Kodiak Island and the mainland, I lost Kodiak’s signals (NPS) altogether, until exactly opposite him when I handled a little business direct, losing him again shortly afterward. I then tried to get in touch with Dutch Harboor (NPR), but could hear nothing of him until within one hundred miles, when he came in strong. I kept in touch with him for about two hundred miles of travel in the Bering Sea and then lost him and picked up St. Paul Island, (NPO). I kept in communication with him all the way to Port Moller, where we anchored a few day on account of the ice. When we finally proceeded into Herendeen Bay in the middle of everyone. Could hear NPR, NPO, S. S. Winber, WND, at Chignik and S. S. Norwood, WSG, at King Cove very good at Port Moller, but five miles into the bay every thing faded out entirely. We lay in the bay for two weeks, during which time I was compelled to relay everything thru KWR at Port Moller, even tho the S. S. Winber was only fifty miles due south and with Audion equipment could not hear me. I could hear nothing of her either, in spite of her using high power or full two kilowatts.

Do our Radio brothers of the east coast have these troubles?

June, 1918

CODE BUZZER TRICKS.

By E. Duskis

Of late there have come out on the market some wireless practise buzzers which are very good in every way for learning and practising the code. The general form of these buzzers consists of an arrangement as shown in the diagram, Fig. 1. This is also the standard hook-up given with these buzzers.

Of course the above arrangement is satisfactory, but there may be too loud a note produced in the telephone receivers; in fact, so loud as to do harm to one's ear-drums. With the end in view of reducing the intensity of the signals in the telephone receivers, to signals of equal intensity as usually received in a wireless station, the following methods are proposed. They work well, as they have all been tried out.

The first method of connecting the buzzer in the manner shown in Fig. 1-A has the advantage of reducing the intensity of the signals just to the strength of the wireless signals.

The second method gives equally good results to the preceding method, but uses a small fixed condenser in series with the phones connected as shown. This condenser can be the standard condenser that is usually shunted across the phones in wireless circuits. The advantage of this method is that, while the key is open, no current flows in any part of the circuit, but while it has this advantage it must be seen (when comparing it with method No. 1) that it necessitates the use of a condenser, which costs more than a switch.

When using the hook-up given in method number one, it is imperative that the connections be made as per diagram given in Fig. 1-A, for if the connections are made as shown here in diagram, No. 3, there will be a click, followed by the high pitch note, in the telephone receivers. It is to be noted in connection with diagram No. 3, however, that, while it possesses the disadvantage of giving a click and then the high pitch, it is an advantage, because under these conditions it provides a fine means for learning the Morse code, and
About Learning the Code

By ALAN C. ROCKWOOD

In the January issue of the Electrical Experimenter, Thomas Reed proposed a new scheme of mnemonics for learning the Continental Code (page 615). Several years ago I attempted to learn the code by a similar system, but I never succeeded until I tried another plan. Therefore I shall tell my experiences with plan and the reasons it was unsuccessful as an aid to memory.

In learning to receive by ear the ultimate object is to be able to write down the letter as soon as the sound is heard. If this proficiency is attained the reception of a letter consists of three steps:

1. The operator hears the signal.
2. The operator thinks of the letter represented by association of ideas.
3. The operator writes down the letter.

In practise this becomes so natural that there are only two steps: the operator writes down the letter without consciously thinking.

In contrast with this process there is the method by which most people try to learn the code, by calling off the dots and dashes for each letter. In this method there are four steps:

1. The operator hears the signal, (say "ah").
2. The operator thinks of the sound as heard in the terms of dots and dashes. ("dot-dash").
3. The operator associates the combination of dots and dashes with the letter (in this case "a").
4. He writes down the letter.

The second step takes the longest time of all because the operator has to change the sound to a visual picture of the dots and dashes. In the third step he must change from the visual picture of the dots and dashes to the picture of the letter. As this takes times and must be dropped as soon as the operator is proficient, it would be much better to learn the code in some manner in which it would not be necessary to waste the time in making the transition from one process of connecting the sound with the letter to another. In my view, therefore, the most perfect system of mnemonics would be one whereby each student learned each letter by the exact sound it made in the receivers.

Upon examining the proposed plan it is seen that it does not conform to this standard, but is open to the same objection as the process of memorizing the letters by dots and dashes. It merely substitutes for the second and third steps of the second plan, as outlined in the preceding paragraph, the linking of the sound with a "Fonetic Catchword" and the linking of this with the desired letter. This is simpler because the catchword is aural, the same as the signal received, but it does not remove the entire difficulty.

The extra step is there which must be learned and unlearned. It is desirable to have a system in which it will be necessary to unlearn as little as possible. Another objection which I discovered when I tried to learn the alphabet by this method is that it is hard to keep the catchwords separate and linked with the letters they belonged with. For instance, the catchword for J was Je-ra-a-len and for L was Lo-ben-gua. Both of these were of the same number of syllables and I found, when receiving, that I would often think of them as Je-ra-a-sam and Lo-ben-gua. Therefore, at those times I would get — as L, and — as J. I believe that Mr. Reed's plan would be open to the same difficulty of confusion of characters and that some other method should be considered.

In considering the plan to be devised it is necessary to consider what we are striving for. The perfect plan would be the one that makes the easiest transition from one stage to another or in which there is no such transition. Under this each student, from the first, would know each letter by the sounds in the receiver. This is to practise over the code between lessons to make sure of himself. As it is not possible to imitate the radio signals exactly it becomes necessary either to repeat the words dot and dash for each letter, to use catchwords, or to approximate the sounds of the letters. This last scheme is the best because by its use the change from the carrying thru of each of the three steps in detail to the immediate perception of the letter is gradual. This fulfills the requirements because nothing need be forgotten. The only question is how to approximate the sound best.

Mr. Reed says that for "V" the receiver says "siss-a-siss-siss." This is an approach to it, but this cannot be used at the rate of even 20 letters per minute. Try it! The plan that was used successfully in the Iowa City High School Radio Club last year was as follows:

a. For a dash use the syllable dah (a as in arm).

b. For an initial dot use tuh (u as in up).

c. For a dot not initial use dhu (u as in up).

By remembering that a dash is equal to three dots in length, that the space between parts of letter is equal to one dot and that the space between letters is equal to three dots the cadence is gained. Thus A is tri-d a h, B is dah-duh-duh-duh. C is d a h-duh-d a h-duh, and so on.

I know personally of over a dozen people who have learned the code as I have suggested and have only heard of one who learned by catchwords—and he learned it only for visual signaling. If you have had any experience with either method or know of any better system write it in to the Editor and he will pay you for it if publish.

Don't miss the article on "Harmonics—Part II" by Prof. E. E. Austin, in the next issue of the Electrical Experimenter. It explains the analysis of irregular shaped alternating curves.
The Design and Use of the Wave-Meter

PART III

By MORTON W. STERNS

(Continued from the April Issue)

For most of the data and description of the Kolster Decimeter the author acknowledges indebtedness to the Bureau of Standards Bulletin No. 235 on the same subject. Due to the complex theory in back of the design of the condenser the reader must pardon some higher mathematics necessary in order to properly explain the design of the condenser.

The shape of the moving plate of the ordinary variable condenser in common use is such that for equal angular displacements of these surfaces from the position of minimum capacity to that of maximum capacity, an approximately straight line variation of capacity is obtained as in Fig. 1. It is evident from the figure that for any given displacement ΔC of capacity will not be equal all over the scale.

In order that the instrument may be direct reading as to decrements the capacity variation in per cent must be constant over the entire range from maximum to minimum ΔC, i.e., b must be a constant.

By a mathematical solution which the interested reader can find in the original paper the author points out that the capacity of the variable condenser must vary in accordance with the law of geometrical progression, and it is easy to formulate the equation between the value of capacity and the position of the moving plates. Since the curve of capacity must obey the law of geometric progression, we have in Fig. 2:

\[ x = 0 \text{ let } C_0 = a K^0 = a \]
\[ x = 1 \quad C_0 = a K^1 \]
\[ x = 2 \quad C_0 = a K^2 \]
\[ x = 3 \quad C_0 = a K^3 \]
\[ x = n \quad C_0 = a K^n \]

In general \( C = a K^\theta \) ......... (9)

A simpler deduction is as follows: in accordance with differential calculus, the following fundamental requirement of the condenser may be written:

\[ \frac{dC}{C} = -\frac{dx}{x} \quad \text{(10)} \]

\[ \log C = nx + h \]
\[ C = K^x \quad \text{(11)} \]

Since this is equivalent to equation (9) we may say for a rotary variable condenser where \( \theta \) is the displacement angle in degrees.

We know, neglecting edge effects, that the capacity of a condenser is directly proportional to the active area of the movable plates or

\[ A = b K \]

where

\[ A = \text{active area of moving plates} \]
\[ b = \text{constants deduced later} \]
\[ \theta = \text{angular displacement} \]
\[ E = \text{base of napierian logarithms} = 2.71828 \]

By analogy with equation (10)

\[ dA = -m d\theta \]
\[ A = b K \]

(12) or \( dA = bm E^m d\theta \)

Eq. (13) \( A = \int bm E^m d\theta = bm E^m \log E = bm \]

Referring to Fig. 3.

\[ (14) \quad dA = \frac{1}{2} (r^2 - r^2) d\theta \]

\[ r \quad \text{being distance from center 0 to enveloping curve of the plate, or radius vector} \]
\[ r \quad \text{being radius of small circular space (inactive), occupied by the separating washers between plates} \]

From (12) and (14):

\[ \frac{1}{2} r^2 - \frac{1}{2} r^2 = bm E^m \]

and

\[ r = \sqrt{2 bm E^m + r^2} \quad \text{(15)} \]

where \( b \) and \( m \) are constants which determine the maximum and minimum value of capacity.

Since equations (10) and (11) are identical we may write

\[ K = E^m \]
\[ x = \log K = m \theta \]

\[ m = \frac{x \log K}{\theta} \quad \text{(16)} \]

where \( K \) is the ratio of maximum to minimum capacity.

In the first article it was shown that 0 to 1 is a good ratio of maximum to minimum capacity, so substituting in (16), assuming \( x = 1 \) when \( \theta = 180 \).

\[ \theta = \frac{180}{180} \]

\[ \log K \]

\[ \frac{180}{180} \]

\[ .043 \]

\[ \text{if we assume some value of area in square inches for a movable plate and substitute} \]

\[ A = \int (E^x - 1) \]

Assume a value of \( r \) the radius of the washers and calculate \( \rho \) for various angles \( \theta \) to give the shape of the curve which will be a logarithmic spiral. This is the case in Fig. 4.

Now knowing the capacity wanted and the area of the plates and thickness of spacing washers we determine definitely the number of moving plates and since it is more convenient to make the stationary plates semi-circular it is merely a mechanical trick to assemble our condenser.

In the actual Kolster decimeter the capacity of the variable condenser is slightly lower (Continued on page 140)
TO PREVENT BURNING OUT AUDION FILAMENTS.

Audion bulbs are being burned out daily just because some inexperienced or even experienced operator raises the current up to what he visibly thinks is a safe point and then (if, out) goes said bulb and also your pocketbook gives a long squeal.

In the accompanying drawing I show how this can be eliminated, merely by using some means of warning. Build a small relay as shown, then adjust the spring so as it will only close the bell circuit when the danger point is about to be reached. Of course Audion circuits provided with ammeters are quite safe in this respect, but even with this precaution I have seen bulbs burned out.

I think the alarm shown in the diagram will save many a bulb; when the danger point is about to be reached, it closes the circuit and rings the bell, thus warning the operator who is adjusting the filament battery.

Contributed by E. T. J.

A DETECTOR HINT.

I have a detector which has two cups placed opposite each other and made adjustable by turning a knob. I use galena, with a light phosphor bronze wire contact. I found that by attaching a battery and rheostat in series with the cups, that the signals were greatly increased in intensity and the range of my set was greater by far. I picked up stations impossible to hear without the battery attached. Too much current will fuse the crystal. The best voltage will be determined by experiment.

Contributed by P. B. KINGSLEY.

FILING GLASS.

A file is generally employed only on metals, and glass is about the last substance that one would expect to be capable of being filed. Glass can be shaped with a file, in cases where the usual blowpipe methods are not applicable, if the file is kept wet with turpentine. A still better lubricant is made by steeping camphor in turpentine and using the resulting solution. A simple alternative method, not quite so satisfactory as the above, is to immerse the glass in water while the filing proceeds. A piece of sheet glass can be cut with a pair of scissors under water.

Contributed by H. J. GRAY.

HIGH TENSION BINDING POSTS.

Old blown out cartridge fuses can be used very economically as a high tension binding post for step up transformers, spark coils, etc., requiring a binding post that will not "leak." Take one of the old fuse (about 60 amperes) and cut it in two with a hack saw. A hole is drilled thru the metal cap large enough to take a bolt that will hold a binding post from an old battery or any good binding post. The bolt is long enough to reach thru the fuse and fasten on the top of the instrument. The connection is made on the nut under the top of the cover.

Contributed by LOUIS LOOTENS.

A SIMPLE BALL-JOINT DETECTOR.

Here is a detector stand for the amateur who wishes one for quick adjustment and one that holds its adjustment when once set. The ball and rod may be taken iron or brass. Here's a Good Method of Simplifying the Tuning of a Radio Condomenser and inductance. The Shaft is Belted or Geared to the Inductor. The Condenser Shaft is Belted or Geared to the Inductance Switch Handle.

SIMPPLYFING THE TUNING OPERATION.

The sketch herewith shows a new wrinkle for correcting loss of time in making changes of wave length as far as the secondary is concerned. It is easily seen that both condenser and inductance can be changed without the use of both hands, thereby leaving the other hand free to be used in changing primary adjustments, etc.

Contributed by E. T. J.
Building an Electric Piano Player

By CHARLES HORTON, Consulting Engineer

(CONCLUDED)

SINCE there must be eighty-eight contacts, a simple method had to be developed for forming them. They are, in this model, formed of cotton-covered magnet wires of, say, No. 12 B. & S. gage, each one being fastened under a screw in the back of the board L, then led forward over the tracker bar and back again where it is connected to its magnet wire. This is clearly shown in Fig. 6 and Fig. 5. The contact wires are inserted one by one over the tracker bar and finally all clamped tight by means of the strips 23 and 24. When this is finished several coats of thin white shellac are applied to them, and when the shellac is set hard a file is used to lave the copper wires at the highest point on the tracker bar. This is the same method used formerly in making adjustable tuning coils and is very satisfactory for this purpose. Careful examination of the drawing will be essential to a proper understanding of the arrangement, which is really very much simpler than it looks at first sight.

A wiring diagram is given in Fig. 7. This shows the connections for one contact and one magnet, and, of course, all are similar. The parts are given the same letters and numbers as in the other views. At the point N the return wires from all return of the striker. Detail 3 is one of the seven boards forming the bottom of the striker box and has twelve holes for the twelve bobbins for one octave and other holes for the retaining bolts. These retaining bolts are one-quarter inch stove bolts and should be of iron or mild steel, as it will be seen on examination that they not only hold the magnets in place, but also complete the magnet circuits of the magnets, thus making them stronger in action. Detail 11 and 12 are iron or mild steel pieces used in place of washers for retaining the third and fourth row of magnets; 8, 5, 10, 17 and 18 need no further explanation; 14 and 15 are tubes of brass slip on between the striker cores and the heads of the bolts forming the striking knobs to properly space them; 25 shows the supports for the translator comb. Detail 22 is the comb bar. The comb is shown as detail 27, and would best be made in several sections and screwed to the bar 22 by means of No. 6x3/4 machine screws. Detail 23 is the contact wire holding bars at the back of the tracker bar; 24 is the contact-wire-securing pieces shown on the top and the bottom of the tracker bar; 20 are pieces screwed inside the translator box to guide the slide L (shown best in Fig. 6).
June, 1918

All parts should be carefully made as the results will make it well worth while. All electrical connections should be sold-
ered.

**Mahogany** is specified but, of course, cheaper woods may be used if desired and stained. The best finish is shellac applied in many coats, rubbing down with sandpaper between coats and finishing up with pumice stone and oil or varnish. The final coat should be piano varnish.

If care and persistence is used in the making of the **electric piano** player here described, a vast field of pleasure will be opened to the builder which he probably never dreamed of till he has one of these machines in operation.

The best way to determine the spacing for the tracker contacts and the teeth of the comb is to buy a cheap record roll and lay them out according to this. The author could give the exact dimensions but as they run into thousandths of an inch this would only be confusing. It is a simple matter, however, if a record is used for this purpose and there is then no chance of making a mistake in the layout.

The scales shown in the various views may be cut out and used to measure any parts not dimensioned in each respective figure.

**CORRECTION IN PROF. AUSTIN'S ARTICLE.**

In the article "Theory of Tuning, Wave Lengths and Harmonics," by Prof. F. E. Austin, which appeared in the May issue, page 32, note that the inductance formula at the foot of the third column should be used only for calculating the inductance of air core coils; not iron core coils. The formula given is a general one applica-

The special counters previously used. It has also been found that the method can be used with a fork having a frequency of 100, thus reading to 0.01 second. Several meter-testing laboratories have installed duplicates of the Bureau of Standards apparatus. The electrically operated tuning fork is usually arranged with a small magn- net coil between the prongs and whose circu-

tcuit is suitably interrupted by a contact carried on the vibrating fork.

**ELECTRICALLY OPERATED TUNING FORK FOR TIME MEAS-
UREMENTS.**

This device, which has been in use in meter testing for about five years, reads directly to 0.05 second. An electrically operated tuning fork having a period of 0.05 second closes a contact which controls an electromagnetic counting device. By using a key in this circuit the arrangement acts as a stop watch. Special care has been used to drive the fork at a uniform rate. This has now been accomplished by operating it directly from a chronometer clock circuit. With slight modification it has been found feasible to use commercial "cycle counters" in place of...
Experimental Mechanics

By SAMUEL COHEN

LESSON IV.

ONE of the most important uses of the lathe in a shop is its accurate means of generating a screw or the cutting of a thread on a circular form. The thread can be cut on an outside or inside surface, both of which processes will be explained in detail.

We have several standards for various screw threads. However, in this country the general practice is to use what we call the U. S. Standard thread.

The thread of Fig. 1 shows the U. S. Standard screw thread. The pitch \( P \) is the distance of the centers between two teeth, and is numerically equal to the reciprocal of the number of threads per inch, thus:

\[
P = \frac{1}{\text{No. threads per inch}}
\]

The depth of each tooth \( D \) is numerically equal to \( D = \text{Depth} = P \times 0.6992 \).

The flat or the width of the upper portion of the tooth is equal to \( F = \text{Flat} = \frac{1}{8} \).

We also employ what we call a sharp "V" standard screw thread and this is shown in Fig. 2; this is also U. S. standard. This form of thread is generally used in small pitch threads where a large number of teeth is necessary in a given length.

The relation of pitch and depth of a sharp "V" standard screw thread is as follows:

\[
\text{Pitch} = P = \frac{1}{\text{No. threads per inch}}
\]

\[
\text{Depth} = D = \frac{P \times 0.6992}{2}
\]

The simplest way of cutting an accurate thread in a lathe is by means of employing our automatic feed on the slide rest which guides our cutting tool. In the first lesson the writer has described the feed screw which causes the carriage to move along the bed of the lathe when said feed screw is connected to the live spindle.

Like everything else, screw cutting to the beginner seems a very perplexing problem, as for instance, how to manipulate the various gears on the feed necessary to make a thread of certain pitch, etc. It is therefore the purpose of this lesson to show the amateur machinist in a simple way how to go about the work.

The first thing that we have to do is to traverse the tool along the work revolving between the lathe centers, at such ratio to the speed of the revolution as shall produce a screw of the desired fineness or coarseness, which is called the pitch, and usually express as so many threads to the inch, in length of screw.

It will now be obvious that if equal sized gears are used to connect the spindle of the headstock and the lead or feed screw which traverses the carriage and with right-hand thread. In order to cut a left-hand thread, it is necessary to cause the carriage to travel in the opposite direction to that for a right-hand thread and in order to accomplish this we introduce a fourth gear to the present simple gearing arrangement. Fig. 5 clearly shows how the addition of the fourth gear accomplishes the result. An adjustable arm or swing frame (also called a quadrant plate) is provided for holding the intermediate gears for the purpose of connecting the spindle pinion and lead screw gear. This swing frame or quadrant plate, as it is sometimes called, swivels at the end of the screw and is provided with one or two slots, having a stud and sleeve long enough to admit of two wheels side by side, and adjustable along this slot. With this means, and the swivelling motion of the quadrant plate, it will be found that any gearing may be arranged to connect the spindle with the screw. The sleeve revolving on the sliding stud of the swing frame is called the stud wheel; should there be occasion to use a second wheel on this sleeve, it will be called the pinion. Thus we have: Spindle, Stud, Pinion, Screw, or as they are frequently called—Driver Driven Driver Driven.

In Fig. 4 is shown a simple change of gears for cutting a right-hand thread, while Fig. 5 delineates two stud gears employed for making a left-hand screw. These drawings show clearly how the gears are attached to the swing frame.

We have now to consider the changing (Continued on page 120)
RADIO PROBLEM.
A peculiar phenomenon which has never been explained well is that which takes place at several points along the Atlantic Coast. There are times when a vessel is in radio communication with another and the signals gradually die out and then increase to their normal sound. A similar effect has been noted by amateurs who, when sending in one direction, can cover much greater distances.

HOW I CAUGHT A COPPER THIEF.
At the State Institution, where I am employed as electrician, we once had a motor-driven pump which was located in a field about one-fourth mile from the Institution. The line carrying the current to this pump was double O solid copper wire. Other arrangements having been made for the water supply, this pump was disused. A few days later we discovered that we had been visited by "Copper Thieves" who, evidently, knew something about "Juice," about 300 feet of wire having been stolen and the ends carefully left clear of "ground" and "short-circuits.

I then devised an electric "Thief Catcher," a sketch of which I give here. This device was located in the boiler room and a duplex telephone wire carefully "Camouflaged" about one of the O0 wires, and connected at the extremity of the line, across the line, of course.

This alarm consists of a bell, 2 or 3 dry cells, a magnet coil from an old 110 volt, D. C. rheostat, and three 16 C. F. bulbs with sockets. I have tried to make this sketch self-explanatory. Lamps L2 are placed in series with the magnet, acting as a resistance. As long as current is flowing thru the line the magnet will hold spring A. When the circuit is broken the magnet releases spring A, which then makes contact with B, completing circuit thru batteries and bell, causing the bell to ring. If one of the lamps L2 should burn out, the circuit thru the magnet would be broken, thus causing a "false alarm." For this reason lamp L1 is placed in multiple. If bell should ring and lamp L1 continue to burn, we would know it to be a "false alarm," but if bell should ring and lamp L1 cease burning, we would know that the circuit had been broken. The necessary switches were placed on the box, to cut it out of service during the day.

The thieves paid us another visit, the alarm worked, and while they were not captured, they were given a run for their life, their haste being so great that they left part of their tools behind. And that was their last visit.

Contributed by E. E. CONVER.

CURIOUS ARABIAN TIMEPIECE

Students of the history of clock-making will, we are sure, be interested in the accompanying reproduction of an early alarm-clock, common in Arabia and other countries under Mohammedan influence during the reigns of the immediate successors of the Prophet.

This mechanism, wonderfully effective in its simplicity, was in very extensive use. Many examples are found in our museums, ranging from the humble clay utensil of the camel-driver to the costly knob-kick of the sheik, with its base of Jasper or Chrysolite and its carved sockets of Silver, or even gold. The dial buja (to give it its Arabic name), consisted essentially of a series of alternate sockets, A, A, and upright, sharp-pointed pins, B, B. To set the device for operation at a desired hour, a cigarette (C) was inserted in each socket and a match (D) impaled on each pin, as shown.

The action is evident. C, having smouldered, at a known rate, down to its base, ignites D, which in turn carries the fire to the upper end of the following C. This process continues according to the number of the sockets and pins with which the particular buja is provided. The common buja of the poor seldom contained more than three sockets, the corresponding amount of sleep being the utmost they could hope to snatch from their exacting toil; but the ornate ones of the rich, who could afford to sleep as their wishes dictated, far exceeded this figure, often occurring in the sacred numbers 7 and 11, or multiples of these.

It remains to describe the sounding-device by which the sleeper is aroused. The last socket of the series (marked E in the figure) contains, instead of a cigarette, a firecracker (F) with its fuse (G) wound about the upper end of the final match. When this is ignited the more or less rapid combustion of F interrupts, momentarily, the period of silence measured off by C.

C and by the rule of contrasts almost invariably causes in the sleeper a tendency to resume consciousness.

The importation from China of firecrackers for use in buja was a well-recognized branch of trade in those times. Indeed, so important were these articles considered that we find, in the celebrated Code of Sasi Baba, severe penalties against the sale of adulterated "crackers," or those kept too long in storage.

As to the matches, those were derived in great part from—well, er—will you pardon me for a moment? I have a call on the other phone, . . .
How to Make a Water Jet Vacuum Pump

By PROF. HERBERT EDMOND METCALF

An efficient vacuum pump is a welcome addition to any laboratory, therefore one which can easily be made for a few cents and with a little patience ought to be in every amateur’s collection of apparatus. With it many interesting electrical and chemical experiments may be performed, which would be impossible otherwise.

The pump to be described is made out of glass. The equipment necessary to make it consists of an alcohol or gas flame, and a small blow-pipe. The material comprises two pieces of glass tubing, one of which will fit loosely inside of the other.

Begin by selecting a piece of the larger tubing about a foot long. In the flame draw out a constriction about one and a half inches from one end. Make the diameter of the hole thru the constriction about two or three millimeters. Put a cork in one end of the tube and direct a thin narrow flame with the blow-pipe upon a spot just above the constriction. As soon as this small spot gets hot and melts in under the force of the flame, blow into the open end of the tube, thereby blowing a hole or a bubble thru the side of the tube. Melting down the edges of the hole, and then heat one end of another small length of glass tubing the size of the first. When both are white hot stick them firmly together. They are not yet fused. Do not let the joint cool, but put a cork in the end of the tube, leaving only one opening to blow into. Direct the pointed blow-pipe flame on a small piece of paper until it bends in under the force of the flame. Then very gently blow thru the open tube until the bent-in portion is back into place. If this is done from the flame, go all around the joint in this manner finishing with a little extra care.

When finished the joint should be covered with soot in the flame, and laid aside to cool. If put on metal it will crack while cooling. If these directions are followed there will be no trouble in fusing.

The jet is now made by drawing out a smaller tube in the flame until the hole in the end is about one millimeter smaller than the constriction in the larger tube. This is done by drawing out a constriction, and then cutting it in the middle with a file. The jet is then sealed in the large tube with soot to start the constriction in the larger tube. This is done by drawing out a constriction, and then cutting it in the middle with a file. The jet is then sealed in the large tube with soot to start the constriction in the larger tube. This is done by drawing out a constriction, and then cutting it in the middle with a file. The jet is then sealed in the large tube with soot to start the constriction in the larger tube. This is done by drawing out a constriction, and then cutting it in the middle with a file. The jet is then sealed in the large tube with soot to start the constriction in the larger tube. This is done by drawing out a constriction, and then cutting it in the middle with a file.

If rubber tubing is used then it may be pinned to the small end. Once started it will continue.

The pump may be connected by a "T" to a mercury filled glass tube. This may be a "U"-tube worked by the expansion of a small bubble of air in the closed end, or by a glass tube 35 inches long, one end being put in a vessel of mercury, and the other connected to the pump. The rubber tubing on the vacuum side should be heavy walled pressure tubing in order to prevent the collapse caused by atmospheric pressure. All connections should be made air-tight with vaseline and then wired, as the slightest leakage will spoil the vacuum.

The uses of the pump are many and various. It may be used to start siphons where it is not wise to suck with the lips. It will lift water at least 20 feet or more if it will suck water thru the pump as well as air and is used to suck liquids out of inaccessible corners of vessels. It may be connected to glass tubing having platinum wires in it and used to make a study made of the behavior of electrolysis in these varying degrees of vacuum. Or, by using a small bottle connected to the pump with a rubber tubing of glass tube, water may be boiled. Also by filling this bottle half full of sulfuric ether a miniature ice machine may be made. Under a bell jar with the air exhausted, water may be boiled and frozen at the same time.

These are only a few of the interesting experiments which will instantly suggest themselves to the experimenter.

One word of caution. ALWAYS release the vacuum before shutting off or turning down the water. Otherwise the air will "blow back" from the contraction of the rarefied air in the container.

Such a machine as described, carefully made, will cost only 75 cents and raise mercury 29 inches at a barometer reading of 30 inches at sea level, and have a capacity for suction of from 2 to 3 liters of water per minute.

ANOTHER SILENT ELECTRIC ALARM CLOCK

This device is a silent electric alarm clock. Its great advantage lies in the fact that it accomplishes its purpose of waking its owner without having any noticeable effect on everyone within a hundred yards or so radius, as is the case with the common "garden variety" of alarm clock, thus saving much annoyance (profanity, possibly) on the part of those unduly disturbed.

Briefly stated, the device consists of a 25 volt ("Fon") telephone receiver, a means to rapidly interrupt its circuit with a current source at a definite predetermined hour. An Ingersoll watch with minute and second hands removed is used for the time switch, a copper wire resting on the dial at the hour figure desired. When the hour hand revolves it touches the copper wire connected at the hour set, thus making a connection between the wire and the watch case, and completing a buzzer circuit. The phone is connected to a separate binding post and the interrupter of the buzzer. The watch, buzzer and a battery switch may be mounted inside a cigar box, and the two sets of binding posts on the side. The current source may be a dry cell, or better a four or six volt storage battery, possessed by most experimenters. The buzzer should be packed in cotton to deaden the noise.

In operation, the watch is removed, wound and set, and then replaced. The copper wire is then made to rest on the proper place; for instance if it were desired to set the alarm for seven o’clock, the wire would be placed on the third hour hand. The receiver may be placed under the pillow or at the head of the bed. You know the kind of a discipline the Kaiser’s boys are brought up to—they wear special crampons on their faces at night to train their mustaches up, like Papa Wilhelms’. So perhaps, if your discipline is rigid, you won’t object to wearing a head-band while you sleep, which will hold George’s “silent alarm” right against your ear. Selah.

Contributed by GEORGE F. GEIS.

Cigar Box.

Do You Wish for a Silent Alarm Clock? Here’s How One Can Be Made. Ask an Ingersoll, Clip Off the Minute Hand, Arrange an Adjustable Contact Over the Dial, and Connect Up This Innocent-Looking Combination to a Buzzer and Telephone Receiver. You’ll Wake Up—Oh! Yes!
My Experimental Electrical Laboratory
By FRANK HUSKINSON
SPECIAL $5.00 LABORATORY PRIZE
The Old Bunsen Burner

HOW dear to my heart is the old apparatus,
The chemistry stuff that I'm using no more!
The beakers, the pincers, the test tubes and holders,
And all the old stuff that my damage bore;

CHEMICAL HINTS FOR THE EXPERIMENTER.
Never grind phosphorus and potassium chlorate in a mortar or an explosion will result. Sulfur and potassium chlorate also are liable to produce an explosion when ground. It is safest never to grind two substances together unless advised to do so by an expert.
Don't open a bottle of ether near a naked flame. Ether vaporizes very rapidly and the vapor when mixed with air is explosive. The vapor is heavier than air and will roll along the floor to a flame even if it be on the opposite side of the room.
When experimenting with hydrogen always be sure the bottle contains no air mixed with it. Collect a test-tube of the purest gas and ignite. If it burns quietly it is safe to use. If it explodes it is very dangerous to use.
Never add water to acids, but add the acid slowly to the water, stirring at the same time.
When you are thru using any apparatus clean it thoroughly and return to its place. It may take quite a while to clean anything that has been standing, whereas it would take but a few seconds to clean if it is done immediately after the particular experiment.

The pneumatic trough and the jars that stood by it.
The flasks, and the stoppers with two holes or four;
The Kipp generator, the hoods that were nigh it.
And 'em the old burner that stuck in the drawer.

The old Bunsen burner, the leaky old burner,
The rust-covered burner that stuck in the drawer.

The rust-covered burner I hailed as a treasure,
For often at noon when returned to the lab,
I found it the source of an exquisite pleasure.
The sweetest and best that a student can nab.

How ardent I sneezed when it started a-burning,
And quick to the top of the ceiling twould go;
Then soon my slipper clucked to mock terror turning,
And smelling like thunder, it gave off C.O.

The old Bunsen Burner, the leaky old burner,
The rust-covered burner, it gave off C.O.
The first time I used it, it burned me quite badly.
The second, it blew up and gave us a fright.
The pupils around me were murmuring sadly.

THE CHEMICAL HINTS FOR THE EXPERIMENTER.

An Exceptionally Fine Students Who Learned Practical Electricity with This Well Selected Apparatus Are Now Electricians, Engineers, and Other Practitioners of the Electrical Art.

ELECTRICAL EXPERIMENTER
HERE is a novel means of transmitting over radio, telegraph, or telephone systems, maps, drawings, etc. The idea is to have two of these plotting instruments exactly alike, one instrument at each end of the line of communication. The sender, making his sketch and placing it on the board, would retrace the sketch with the steel needle on the movable slider, by placing the needle at a starting point of the drawing and noting what the figures read on the beam scale and circular arc scale, and then placing the needle to the next intersecting line or angle on his instrument to correspond to the figures received. The arm is then pressed downward, making an impression of the needle on the paper and thus by drawing from point to point, as received, an exact reproduction of the drawing or sketch can be made. In order to get irregular lines or circles it requires the impressions to be made more closely together.

Carbon paper could be placed beneath the receiving copy, thus duplicating the drawing. Duplicate maps can be placed in the instruments and the exact location of a line of trenches, batteries or points of importance could be communicated over any distance. Any combination of figures or letters can be used on the scales. It has been recommended by military experts.

TREMENDOUS FORCE EXERTED BY SHORT-CIRCUIT.

"Some indication of the enormous force exerted when a short-circuit takes place close to a station was given recently when cable trouble occurred on the lines of a large Western company," writes George W. Leffean in the Electrical Review. "In searching for the damage done a slight bulge was observed on the joint sleeve, where the cable joined a submarine cable. The joint was opened and it appeared that the conductors had been crowded forward into the joint 2 in. (5.1 cm.)."

On testing the damaged submarine cable from the street end it was found that the conductors showed all three legs short-circuited and grounded, while a test from the station end showed the three conductors short-circuited but free from ground, indicating that the cable had burned apart. Resistance tests indicated that the failure had taken place three-quarters of the way between the station and the street end. The cable was dug up at this point, the break discovered and the cable found to be damaged for a distance of about 4 ft. (1.2 m.), with no damage to adjacent cables.

A photograph of a new and highly efficient map and sketch transmitting instrument shows its two graduated scales permitting very rapid location of the map co-ordinates.

A SIMPLE HELIOGRAPH.

The heliograph is handy for "Boy Scout" camping parties and the like, enabling them to use the sun's rays to keep in touch with one another over considerable distances.

This set works on the same principle as the more expensive ones built for the Army. An ordinary strap key is utilized in this design, a small hole being drilled in the center of the lever and taped to take a stirrup clamp from a head band. Secure a small pocket mirror, and make a small depression in each side of the rim to permit the mirror to be balanced between set screws V-Y. The mirror must also have an unsilvered spot C, about 1/8-inch in diameter made at the center. This spot retains its position thru all movements in any place.

The operation is as follows:—the rays of the sun are brought on to the distant station by turning the mirror A until the operator, looking thru the unsilvered center of mirror sights the distant receiving station. The heliograph is now "set" and signals are made by pressing and releasing the key B, the same as with regular telegraph instruments.
How to Build a Spark Coil Ozonator
By FREDERICK VON LICHTENOW

IT is a well-known fact that the electric discharge across an air-gap liberates "ozone" freely, and further, that the production of this ozone may be many times increased by allowing the discharge to pass between metal sheets, preferably tinfoil. Making use of these facts, the simple "ozonator"—attachment here shown constitutes a practical piece of auxiliary apparatus for any spark coil of 1-inch rating or more.

Two oblong sheets of corrugated packing board of equal dimensions; two sheets of heavy tinfoil cut to approximately the same size, but slightly longer; two pieces of medium gage copper wire, a wooden or cardboard box (without cover), and a cone-shaped tube of some material, other than metal, form the essential parts for its construction (Fig. 1).

An application of paste or shellac secures the tinfoil to the packing board, which merely serves as a support for the foil. The foil extensions—due to its being longer—are pasted around over the exposed corrugations at either end of the packing board, ending with the back edge of the latter. The whole is then fastened to the wire by running the same thru the foil into one of the centermost corrugations, at the same time furnishing the necessary electrical contact between wire and foil (Fig. 2).

The distance between the foil sheets and their respective size are governed entirely by the rated spark length of the coil employed, with a proportionate amount of generated ozone as a consequence. They should, at any rate, be placed in a position parallel to one another (in the same plane) and at such a distance where a silent discharge (in reality there is a heavy "brush-discharge," consisting of a stream of violet-colored spark-threads passing between the foil sheets, which can be easily ascertained in a dimly-lighted room) manifests itself, allowing only an occasional spark to pass. (This distance is somewhere in the neighborhood of one-half of that of the spark discharge between needle points.)

The cone is secured to the box by being pushed thru the opening on top of the latter from the inside until it fits tight. Some friction tape is finally run over the seams of the box as well as around the joint of the latter, with the cone and the whole placed over the generating apparatus (Fig. 3).

The box should be only slightly wider than the top of the spark coil, just wide enough to allow air to pass thru, and there should be ample room inside of it to clear the foil sheets all around by several inches.

An important point is that the packing board be perfectly straight and the tinfoil applied smoothly, in order to insure uniform distribution of the electrical stress between the foil surfaces. Otherwise, the discharge will localize upon certain spots, resulting in a decreased ozone output.

The "ozonator" is used for air purifying, inhaling or experimental purposes in general. If an "Electro-Bulldog" coil is available then a taller box will be required and the same slit over the spark coil as well. Semi-circular cuts on both sides for the passage of air and two small holes on one side of the box for the insertion of the primary wires are to be provided (Fig. 4). The author has a zinc spark gap mounted across the coil secondaries, which is of a great advantage, in that it permits of a far finer adjustment of the sheet electrodes than could be possibly had by using the regulation style of binding post terminals.

Good results are obtained with both types of arrangements as outlined in the foregoing.

A TELL-TALE FUSE BLOWOUT.

It is sometimes convenient to be able to tell at a glance into a fuse cabinet which fuse has just blown out, even if one is not familiar with all the circuits in the plant. A New England inventor has recently patented a fuse which visibly indicates its condition when it needs replacing.

The sketch shows the construction of his invention. A shunt wire, of high resistance, passes thru the fuse and is connected to the end caps. This shunt carries very little current until the true fuse wire is blown. An indicating spring strip outside the shell is held down by a filament connected to a small mass of some material easily melted by heat. A wire gauge cage incloses the melted material to prevent it being blown thru the hole in the shell, and is placed close to the shunt wire.

When the fuse blows a rush of heavy current passes thru the shunt, bringing the wire to a high temperature, thus melting the holding material and releasing the indicating spring strip.

Contributed by JOHN F. MAHONEY.
HOME-MADE "OMNIGRAPH" OF WIDE RANGE.

Often indeed does the amateur wish for a
omnigraph, but almost as often does he
do without one because of the expense. So
I submit herewith an easily made and in-
expensive omnigraph which I find does the
work.

The instrument consists primarily of a
tin can, covered with heavy paper, in which
are cut holes corresponding to the dots and
dashes of the code. If this breaks the cur-
rent since one wire of the circuit is con-
ected to a series of springs making contact
through the holes and the other the tin can.
A switch is connected to these springs in
series with a sounder or buzzer, thus trans-
lating any one of the messages.

With This Home-Made "Omnigraph" You
Have Available a Wide Variety of Radio Sig-
als Which Can Be Changed Instantly by
Moving a Switch.

This instrument may be run in various
ways, the best of which is by an electric
motor. However, it may be operated by a
spring motor or even by hand, the number and
size of the pulleys depending upon the
speed of the driving motor. If an electric
motor is used, a rheostat may be inserted to
vary the speed. If it is so desired, the
cylinders may be made interchangeable, thus
giving the instrument a wider range of use
albeit it is surprising how much can be
placed on a single one.

Contributed by P. G. EDWARDS.

INSULATED STOOL FOR "TESLA STUNTS."

A stool like this is a necessity for the
"Ham" who is experimenting with high-
frequency or frictional electricity. All that
is needed is a good strong board about one
and one-half feet by two feet, four strong
bottles of the same size (I used soda pop
bottles), and two wooden cleats.

Four holes are bored in the large board,
one at each corner. They should be just

Efficient Static and High Frequency Insulat-
ing Stool.

The advantages of this stool are that it
can be made easily and at little cost from
almost anything, that it will stand a high
voltage, and that it can be easily taken
apart; all that has to be done is to draw
the bottles out of the holes.

Contributed by G. W. BONAVIA.

VARIABLE CONDENSER CON-
TROL FOR PANEL SETS.

As most radio receiving sets are now
made in the panel type, and most variable
condensers work best when mounted
upright, I suggest these methods of mounting
them.

The knob is removed from the condenser
and mounted on the panel. It connects with
the condenser shaft by means of a piece
of soft rubber tubing inserted as a flexible
shaft. Also it is thoroly practicable to use
a fairly stiff spiral spring as a flexible shaft.

Contributed by WALTER PETERSON.

A NOVEL "DARK ROOM" LAMP.

I present herewith a drawing of a novel
"dark room" lamp, which I have been using
for some time. The light is adjusted by
turning the knob. Any small jar with a
screw top will serve the purpose. The cen-
ter part of the metal cover is cut away and
a wood or fiber block fitted to it. The re-
ceptacle is dip in melted wax after the
lamp is in place. Do not use too much wax
else the liquid may get too hot. I use
about one teaspoonful in a jar 3 inches
diameter, 4 inches high. The solution is
composed of red ink and water. I use this
lamp with films and find it safe.

Contributed by A. H. MATTHEWS.

TESTS FOR WATER.

Hard or Soft Water Test.—Dissolve a
small bit of soap in alcohol, let a few drops
fall in a glass of water; if the water turns
milky it is hard, if not it is soft.

Alkaline Test.—Immerse litmus paper dip
in vinegar in the water, if the paper turns
to its original color, the water contains no
alkaline or earthy matter.

Test for Carbonic Acid.—Take equal parts
of water and lime water, on mixing If a
precipitate is seen, the water contains car-
bonic acid.

Test for Iron.—Boil a few nut-galls in
water, then add some to the water to be
tested; if the water turns grey, iron is
present.

Test for Lime.—Put two drops of oxalic
acid in a glass of water, then blow on it;
if it turns milky, lime is present.

Contributed by P. G. EDWARDS.
A HOME-MADE HYGROMETER.

The Hygrometer, as we know, is an instrument for measuring the quantity of moisture in the atmosphere. It depends on the property possessed by some substances, of readily absorbing moisture from the air, and being thereby changed in dimensions or in weight. Of this kind is the Hygrometer of Saussure, in which a hair, that will expand and contract in length accordingly, as the air is more or less moist, was made to move an indicator. Similar instruments were also devised by Deloc and J. F. Daniell.

The writer recently constructed a simple Hygrometer, with which he could tell short the approach of a rain sixteen to twenty-four hours in advance. A description of the instrument follows: Referring to sketch: S, S' and S" form a wooden support. (The experimenter can construct this to suit himself, some preferring to make a more fancy one than others.) W, is a small, stiff wire, about 3" long and attached to a thin piece of wood which has been planed down to 3" by ½" by 1/16". A cat-gut string is then procured—C. (Such as the "A" string on a violin.) This string is fastened securely at the top of the support, by boring a small hole, inserting the string and then plugging the hole with a small wooden plug. X. The free end of the wire, before described, is then bent into a small loop about ¾" in diameter and is shown at L.

Next we thread the string thru the loop and give it one-half turn around the wire. It is then lead thru the indicator "R" by boring a small hole of slightly larger diameter than the cat-gut. The hole should be bored as near as possible to where the wire is secured to the indicator. The cat-gut string should now be pulled taut and plugged in the bottom of the support at "X." A small nail P is then driven into the support S to act as a stopping point. Its duty is to allow the indicator to swing about in one direction only. "Pair" and "Rain" may now be painted on the indicator and our mechanical weather-man is completed.

The builder may desire to construct a more elaborate support which he can do by making a small wooden house and decorating it with pieces of bark to give a novel log-cabin effect. However, the front must be constructed open to allow the indicator to swing around. The instrument is then placed in some open but sheltered place and is ready for use.

The action is as follows: When the cat-gut is taut it exerts a twisting motion on the wire and tends to twist the end of the indicator marked "Rain" against the stopping point "P." When there is a great deal of moisture in the atmosphere the cat-gut string will become slack and allow the end marked "Rain" to swing half way around.

In this way we can all become modern weather prophets.

Contributed by WALTER E. CUSTIS.

CASTING BARS OF SOLDER.

In the drawing herewith (a) is a gong from an electric bell with a dent (c) bent in one side of it with a pair of pincers: (b) is a rivet past thru the hole in the gong, while (e) is an iron rod riveted to (a) at (d). A pea shooter makes an admirable substitute for the iron rivet. Here (f) is a wooden handle in which grooves (hh) are made. The solder is poured from the ladle into these grooves. Sandpaper the grooves well and the solder can be easily removed.

Contributed by ALBERT RUFF.

FINE INK AND MAGIC PAPER.

Fine Ink.—This experiment is most effective in a dark room. Dissolve ½ teaspoonful of potassium nitrate in a little water (about ½ teaspoonful). Now use this liquid as an ink, writing on unglazed paper any design, making broad and heavy strokes and be sure to connect all lines. When the paper is thoroughly dry, apply a light to the end of the writing—putting out any flame that arises. If all directions have been carefully followed a glowing spark will travel the length of the design. The effect is most mysterious and best results are obtained by using soft paper and writing all lines broad and heavy.

Magic Paper.—If some people don’t believe you can write black lines with plain water show them this experiment.

On a sheet of writing paper rub this mixture—equal parts of tannic acid (powder) and tannic ammonium sulfate thoroly mixed. After the mixture has been rubbed into the paper blow off all remaining particles. The paper is now ready. Write with a piece of dip in water and black lines will appear.

Contributed by M. SANGENT.

THE "REAL" WINE AND WATER TRICK.

By Albert H. Beiler.

Many of you have heard of or seen the so-called "wine and water trick" wherein a liquid, presumably water, is poured from a bottle into different glasses, which are apparently empty, and produces wine (don’t drink it, for the love of Mike!) in some glasses and water in others. Various chemicals are used to produce this effect. One way is to have a crystal of potassium permanganate, K Mn O₄, in one glass, a solution of oxalic acid in another, and two glasses empty. Warm water when poured from a bottle into three of them will produce no result, but in the K Mn O₄, glass a red color results. When all three glasses are mixed together the oxalic acid decolorizes the K Mn O₄. Still another method utilizes potassium-sulpho-cyanide and an iron salt, and a third method, phenolphthalein.

The writer has tried all of these with varying success. And then one day we talked to one of these wonderful prestidigitators (oh, yes, it’s in the dictionary) and got the only and original formula for the real wine and water trick. You have only to try it to know it’s the REAL one.

First secure four glasses. Put a very small drop of Fe Cl₃ (iron chloride) in each of two of them, and fill another half full of H₂C₂O₄ (salicylic acid). The other one remains empty. The glasses with the chemicals should be farthest from the Audience. Fill a flask with a solution of OH₃H₂C₂O₄ (salicylic acid). The table shows how to perform the separate operations of the trick in their proper order. That is, first pour some liquid from the flask into glass No. 1. Result—colorless. Then into No. 2. Result—Red. Then into No. 3. Result—colorless. Then into No. 4. Result—Red. Two and four combined give colorless.

Arrangement of Four Glasses as Used in Producing "Wine and Water Trick" as Described by Mr. Beiler.


Wrinkles, Recipes, Formulae

EDITED BY S. GERNBACK

To write down the one hundred and eleventh formula in a formula drawer the editor of this department was induced to write down an article that might be of some assistance to the electrical experimenter in his day-to-day work. The article in question, entitled "Wrinkles, Recipes, Formulae," is intended to be of use to those who make a practice of experimental work. The following article is an excerpt from that source.

The "REAL" WINE AND WATER TRICK.

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Arrangement of Four Glasses as Used in Producing "Wine and Water Trick" as Described by Mr. Beiler.

OXIDES OF CARBON—CARBON DIOXID.

VAN HELMONT, an alchemist of the seventeenth century, noticed that the gas obtained from burning wood, fermentation, or the action of an acid on limestone, possessed different properties than ordinary air, in that it was capable of extinguishing fire. He designated "wild gas" as an appropriate name for it. Van Helmont posset an idea that vegetation was dependent on growth upon water alone. He set out to prove to his own satisfaction that this was the case, and after carefully weighing a small willow tree of 5 pounds and planting it in a pot containing exactly 200 pounds of dry earth, he watered it with rain and distilled water, and in five years he removed the tree and again weighed it, finding that its weight had increased to 169 pounds and 3 ounces, and that the earth had only depleted 2 ounces in weight. His ignorance of carbon dioxide and its functions in the air, at this time, made him believe that the tree actually fed on water alone.

Black obtained it from the carbonates of sodium and potassium, in which he said it was "fixt," and called it "fert air." Lavoisier recognized the chemical nature of the gas and proved its composition to be carbon and oxygen. Dalton showed that the molecule consisted of one atom of carbon, united with two atoms of oxygen, thus illustrating its volume composition. Faraday was the first to quantify it.

Names—Carbon dioxide: carbonic acid; carbonic acid gas; carbonic anhydride. Absorption—Carbon dioxide is a free and uncombined in the atmosphere, of which it forms at least 0.00% to 0.005%, the average being about 4 parts in 10,000 of air. It is found in all terrestrial waters, some springs being heavily charged, and is given off in large quantities from the earth in many volcanic regions. It collects in caves, mines and wells, and is quite often termed "chokes-damp." Combined with water, it forms carbonic acid, still more abundantly distributed. The principal one of these compounds is carbonic carbonate, which, as marble, limestone, and chalk, is one of the most abundant of minerals.

Preparation—1. When heated, carbonates and bicarbonates yield the gas according to the following equations:

\[ \text{CaCO}_3 + \text{CO}_2 \rightarrow \text{CaO} + \text{CO} + \text{H}_2\text{O} \]

2. When small quantities are desired it may be rapidly and conveniently prepared from a carbonate and an acid. In general, most acids will act on any carbonate and liberate carbon dioxide. Carbonate (Marble, \( \text{CaCO}_3 \)) and hydrochloric acid is most suitable for preparation in the laboratory.

\[ \text{CaCO}_3 + 2\text{HCl} \rightarrow \text{CaCl}_2 + \text{H}_2\text{O} + \text{CO}_2 \]

Carbonic acid is probably the first product, but, being very unstable, at once breaks up, as shown by the equations. A high temperature will cause decomposition of carbonates into carbon dioxide and the oxide of the metal. Heat will decompose oxalate also, liberating carbon dioxide and carbon monoxide and leaving the metallic oxide, thus:

\[ \text{CaCO}_3 \rightarrow \text{CaO} + \text{CO} + \text{CO}_2 \]

3. When a current of air is past over red-hot carbon the product is carbon dioxide, provided the air has been kept in excess. This and the method by heating a carbonate are used for furnishing the gas in the manufacture of carbonates on a large scale.

Carbon dioxide is formed whenever carbon in any form or its compounds with absorbing so much heat as to produce an intense degree of cold, thereby causing a portion of the liquid to solidify to snow-like flakes. It solidifies at about —80 deg. by its own evaporation.

It is quite beneficial as a beverage, which is known as "soda-water," and is a solution containing about 3 volumes of the gas in water.

(Chemical): It is a non-supporter of combustion and is not burned by ordinary sodium and potassium burns in it. This property may be illustrated by lowering a lighted splint or taper into a vessel of carbon dioxide, or pouring it down an inclined board upon which is placed a number of lighted candles.

A small cent of carbon dioxide in the air prevents combustion; thus it is a far superior fire extinguisher compared to nitrogen.

It is not respirable, because it shuts out the oxygen necessary for respiration.

Its action on hydroxides is to form carbonates. It is a very stable compound which is decomposed only at a temperature of 1,300 degrees, or by the continued action of the electric arc, yielding carbon monoxide and oxygen.

In the dry state it is neutral. In aqueous solutions it is capable of coloring blue litmus a faint red, which disappears on drying. It does not neutralize alkalies.

Physiological Action of Carbon Dioxide.

This is a very interesting chemical action which is continually taking place in the human system. (Refer to Fig. 118.)

We breathe in oxygen (the chief constituent of the atmosphere), which is reduced from about 21% to 16% by heat. The exhalations also contain nitrogen, argon and surplus oxygen. About a quarter of the oxygen has been consumed in heating the body and oxidizing its products, which are mainly compounds of carbon, nitrogen, hydrogen and oxygen. The union of carbon, hydrogen, etc., with oxygen takes place in all the tissues and in all parts of the body, even on the surface. Oxygen is taken into the lungs and passes from there thru the thin membrane into the blood, by reason of the attraction it has for the hemoglobin or the red corpuscles. With these corpuscles it forms a compound oxy-hemoglobin, and thus circulates to all parts of the system.

The rational molecular formula of the hemoglobin is not known. Peyer suggested the empirical formula: \( \text{CN}_{21}\text{H}_{36}\text{O}_{21}\text{N}_{2} \text{Fe} \). Jaquet has suggested a different formula: \( \text{CN}_{20}\text{H}_{33}\text{O}_{19}\text{S}_{2} \text{Fe} \). It is very

(Continued on page 128)

A Partial Vertical Section of Plant Leaf Much Magnified, Showing Carbon Dioxide Entering Stoma on Under-Side of Leaf and Oxygen Emerging. Plants are Air Purifiers.
"Electrical Laboratory" Contest

In this issue we publish an interesting story with an excellent photo, describing one Amateur Electrician's experimental laboratory. Now "Bugs"—we want to publish a similar article each month. Here's our proposition: Why not write up your "Electrical Lab," in not more than 500 words. Dress it up with several good, clear photographs. If we think it good enough we will publish the article in display style and pay you well for it. The remuneration for such articles will range from $5.00 to $10.00. And "Bugs"—don't forget to make your article interesting. Don't write—"I have a voltmeter, an ammeter, a switchboard," etc., ad infinitum. For the love of Pete put some punch in it! Tell us what you do with your instruments and apparatus. You don't mean to tell us that every Experimenter does exactly the same thing. We' know different—but from the general run of such articles which we have received in the past, one would naturally think every "Lab," exactly alike. Remember—send a photo of YOURSELF along. Typewritten articles preferred.

A GROUP OF REPRESENTATIVE AMERICAN AMATEUR LABORATORIES.

Electrical Laboratories of, 1—Charles Stewart, Cadiz, Ohio. (Prize Winner); 2—Seefred Brothers, Los Angeles, Calif.; 3—Joe Haskell, Jr., Cliftondale, Mass.; Radio Laboratories of, 4—Paul Williams, Shorewood, Wis.; 5—H. F. Inns, Jr., Bellflower, Ill.; 6—Thomas J. Donohoe, Columbus, Ohio; 7—Maynard Bodley, St. Paul, Minn.; 8—George W. J. Miller, Manitou, Colo.; 9—Ralph V. Kornhak, Braddock, Pa.; 10—H. Bamborough, Highland Park, Ill.
Electric Hair-Brush.  

(No. 1,258,375; issued to V. V. Stewart.)

An electrical hairbrush having for one of its objects the provision of a device especially adapted for straightening and drying hair. It is provided with an electrically heated plate to which are attached a plurality of metallic teeth, that are heated by the plates, whereby the hair of a person may be readily dried and straightened. This metal plate is enclosed within the hollow casing as shown, a suitable electrical heating coil being placed in position over the plate.

Electric Fountain.

(No. 1,255,711; issued to Newton Crane.)

An electrically operated and illuminated fountain suitable for interior decorations. It contains sufficient water to operate for long periods without hose connections, the water from the jets falling into a basin and reservoir, from where it is pumped up thru the jets again. An electric motor rotates the pump concealed in the hose and the water thru the revolving jets, while changing color dyes cause the jets to take on beautiful hues.

Primary Battery.

(No. 1,258,266; issued to Edward Sokal.)

The battery employs as an electrolyte a single fluid, such as a solution of ferric chloride. The electrodes are composed of carbon and zinc, respectively. This solution acts not only as a solvent on the zinc, but also as a depolarizer. No porous diaphragm is used. The battery has a high E.M.F. of 1.5 volts. Circulation of the electrolyte thru the battery is provided for by virtue of a small motor-driven pump.

Variable Radio Condenser.  

(No. 1,258,423; issued to F. Lowenstein.)

A very clever variable condenser for use in radio or other circuits, having its rotary plates cut off at such different angles as to produce a logarithmic capacity variation characteristic. In the ordinary rotary variable condenser equal angular movements of the movable plates within the range of the instrument, produce unequal percentage variations in capacity. For certain radio requirements it is desirable to have a logarithmic characteristic condenser, but heretofore it has been a complicated matter to design and build them owing to the peculiar form of moving plate required. By the present type this result is simply achieved, equal angular movements of the rotary plates producing equal percentage changes in capacity.

Talking Motion Pictures.  

(No. 1,254,684; issued to Elmer Lewis.)

This patent aims to provide means for synchronously producing sound causing to be produced supplemental musical sounds in conjunction with motion pictures. The inventor provides a means such that the several musical and sound producing instruments shall be automatically operated by the motion picture itself. To do this he photograph on the film itself a series of lines or marks, as needed in the drawing, which run parallel to the length of the film. Each line may represent a certain note or operating pedal. The light from the “movie” projector passes thru these transparent “sound marks” and is intercepted at the screen, falling upon a series of exposed, separate, selenium cells. An individual cell is provided for each “sound mark” on the film, and each ray of light is directed by a system of slots and guides to a shunt or a register with its corresponding cell.

Motor Player for Stringed Instruments.  

(No. 1,258,465; issued to W. A. Richter.)

A motor-operated hand manipulator for playing device for stringed instruments, such as violins, banjos, mandolins, guitars, etc. The device consists of a rotatable cylindrical sounding mounted on the free end of a flexible shaft connected with a small electric motor at one end. By means of the handle sleeve provided, the rapidly rotating disc (which for playing the violin is covered with horse hair) can be brought successively into contact with the musical strings to be vibrated.

Duplex Wireless System.  

(No. 1,256,889; issued to Lloyd Espenschied.)

This idea covers a scheme for simultaneously transmitting and receiving radio signals on a common aerial. Successful duplex radio communication is provided for by utilizing carrier waves of different frequencies for transmission and reception, also by neutralizing the inductive action of the transmitting system proper on the receiving system by means of balancing circuits as indicated. This is done by circuits being linked inductively with both the transmitting and receiving circuits. The function of the balancing circuit is to neutralize, with respect to the receiving circuit, the effect of the transmission current flowing in the radiating aerial circuit.

Radio Receiving Circuit.  

(No. 1,257,672; issued to Elmer E. Butcher.)

A scheme whereby the inventor claims to greatly increase the sensitiveness of the detector used in radio-telegraphy or telephony, so as to amplify minute impulses of weak energy and for the purpose of receiving radio signals. He attains this object by providing a detector circuit, such as one employing a three electrode valve detector, in which the highest possible potential output can be obtained from a given amount of energy received is imposed upon the detector. To accomplish this, the secondary circuit contains practically nothing but inductance.

Receiver of Radio Oscillations.  

(No. 1,257,637; issued to Roy A. Sokal.)

Method of detecting radio oscillations or signals, and by a peculiar and novel circuit may be used to increase the efficiency of such detecting means where it is tuned to the group frequency of the received signals. The usual detector circuit is provided in general; two variable inductances with suitable capacities are connected up in shunt with the detector. The ratio between the auxiliary inductances and that of the loose coupler secondary may be such that they may have about 1,000 times the secondary value.

Dry Cell Renewal Device.  

(No. 1,257,962; issued to E. H. Becker.)

This patent relates to a novel means for reviving dry cells after the same has stood idle for a period of time or has been in use and has become weakened. As shown in the sketch, two or more soluble metal (zinc) capsules are embedded in the cell when manufactured, these capsules containing either metal or electrolyte. The capsules are made of a material which is positive to the negative element, and of varying thickness so that the action of the battery will automatically liberate the contents at any predetermined time, depending upon the results desired. These capsules are electrically connected to the zinc shell of the dry cell by copper wires.
Under this heading are publish electrical or mechanical ideas which our clever inventors, for reasons best known to themselves, have as yet not patented. We furthermore call attention to our celebrated Phoney Patent Office for the relief of all suffering daffy inventors in this country as well as for the entire universe.

We are revolutionizing the Patent business and OFFER YOU THREE DOLLARS ($3.00) FOR THE BEST PATENT. If you take your Phoney Patent to Washington, they charge you $20.00 for the initial fee and then you haven't a smell of a Patent yet. After they have allowed the Patent, you must pay another $20.00 as a final fee. That's $40.00! WE PAY YOU $3.00 and grant you a Phoney Patent in the bargain, so you save $43.00!! When sending in your Phoney Patent application, be sure that it is as daffy as a lovesick bat. The daffier, the better. Simple sketches and short descriptions will help our staff of Phoney Patent Examiners to issue a Phoney Patent on your invention in a jiffy.

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Electric "SCHOOL-ROOM COAL-SAVER." Being a True Friend of Dr. Garfield and the Fuel Administration, I Herewith Dedicate to them and the American Coal-Famine Sufferers a Brilliant Idea Which Struck Me Last New Year's Night, When I Had Speeded Up My Mental Faculties by Imbibing 1½ Milkshakes, 15 Walnut Sundaes, and 4½ Banana Splits. Here It Is: Install in Every School-Room Through the Land My Compress Air-Electric Generating System as Illustrated. As Students Arise to Recite and Sit Down, Especially on a Tack, They Will Work the Seat Bellows; This Compresses Air Thru the Pipe System to the Air Tank; Compress Air Runs Engine Belted to Dynamo and Storage Battery. Electric Heat and Light Is Thus Obtained Absolutely Free and in Great Abundance. Think of It! 15,000,000 School Children Rising and Falling on My Pneumatic-Electric Generators! "Doc" Garfield Should Give Me a "Croix de Bituma"—What? Inventor, John Plumett, Newton Highlands, Mass.
The "Oracle" is for the sole benefit of all electrical experimenters. Questions will be answered here for the benefit of all, but only matter of sufficient interest will be published. Rules under which questions will be answered:

1. Only three questions can be submitted to be answered.
2. Only one side of sheet to be written on; matter must be typewritten or else written in ink, no penciled matter considered.
3. Sketches, diagrams, etc., must be on separate sheets. Questions addressed to this department cannot be answered by mail free of expense. Correspondents will be informed as to the fee before such questions are answered.

4. If a quick answer is desired by mail, a nominal charge of 25 cents is made for each question. If the questions entail considerable research work or intricate calculations a special rate will be charged.

RELATIVE FORCE OF MAGNETIC ATTRACTION AND REPULSION.

(926) J. C. Kane, Detroit, Mich., writes:

Q. I. With the apparatus shown in the diagram I find that the magnetic attraction between 2 "unlike" poles is much greater than the repulsion between 2 "like" poles. Why is this?

A. I. Referring to your diagram of the arrangement of four electro-magnets each having the same number of lines of force per pole and having these electro-magnets in pairs, one pair having a north (+) and (-) south pole, and the other pair having two north (+) or south poles (—) and pivoted as shown, the force exerted by the magnets (+) and (—) appears to be greater because of the law of inverse squares. This law says that the force exerted between any two bodies varies inversely as the square of the distance between these bodies.

Furthermore, when the current is turned on, producing unlike poles, attraction at once begins to take place. However as the attraction is taking place the distance between each pole is becoming less and less, hence the force becoming greater and greater. When the poles are magnetized (+) or (—) or (—) the converse action takes place. The distance between the poles becomes greater and greater, causing the force to become less and less. Thus it is seen that while the two original forces (that is, the forces exerted when the distance was the same) are the same, one increases and the other decreases according to the natural law.

The force of attraction is always equal to the force of repulsion, but in the case cited by you we must make note of the following facts: If the forces were of repulsion, they would cause the pivot-arrangement to be deflected thru a certain angular distance. Now if we increased this angular distance by a very small amount and changed the polarity of the magnets, the pivoted bar would not be attracted, but if we placed the bar at the same angular distance that it was repelled thru, and the changed polarity remained the same, the bar would at once be attracted. In your case, you began with the pivoted bar at a certain distance away from the poles.

WIRELESS TEXT-BOOKS.

(927) Chas. H. Hook, Mt. Washington, Pittsburgh, Pa., writes:

Q. I. What good wireless text-book can you recommend which give the design details for high power radio stations?

A. We believe that you obtain a copy of Professor Johann Zenneck's book entitled "Wireless Telegraphy" which our "Book Department" can supply at $4.15 prepaid. This book is one of the best that has appeared, and contains many practical chapters on the design of high power radio equipment. Also you will find Dr. J. A. Fleming's classic work entitled "The Principles of Electric Wave Telegraphy and Telephony" very valuable. This book is worth $10.00 net, and is available thru our "Book Department" also.

IS ORDINARY WATER A CONDUCTOR?

(928) Thomas H. Hill, Washington, D. C., wishes to know:

Q. I. Is ordinary water a conductor of electricity? I don't mean chemically pure water but just ordinary drinking water as found in citiesystem.

A. I. Relative to the question as to whether or not water will conduct electricity, it is generally found that chemically pure water will not conduct electricity except when very high voltages are applied to it. This matter as we see it, boils down to the fact of its conductivity or non-conductivity as related to the presence of certain foreign chemical ingredients in the water. As you state you wish to know whether ordinary water as used for everyday drinking, cooking and other general use will conduct an electric current, we would say that it will. It may not do it very perfectly, but as an example of this condition, we might mention the following fact: When Sermen have to fight a city fire where the stream of water is liable to come in contact with a live wire of even moderate voltage, a call is generally sent to the power station to have the current shut off, as it has often happened that the firemen under these conditions have been knocked out by the shock received from the current passing along the stream of water to the brass nozzle on the hose, and thence thru their body or bodies to earth.

Diagram Showing How a Fireman Can Receive An Electric Shock Thru a Stream of Water From a Fire Hose.

Path of high tension current through fire stream.

Fire hydrant.

Brass nozzle.

2500 volts.

Address photos to—Editor "Odd Photos," ELECTRICAL EXPERIMENTER, 233 Fulton Street, New York City.
STATIC MACHINE VOLTAGES.
(929) C. H. Denniston, Pulteney, N. Y., asks:
Q. 1. Several questions regarding the voltages of static machine sparks and the danger of shocks from these sparks.
A. 1. For every 1-inch spark 20,000 volts is usually figured, and as most small machines give 3-inch sparks, naturally the voltage is 60,000.

This potential of 60,000 volts for a 3-inch static machine spark is to be considered as the root-mean-square value, and not the maximum voltage. The maximum potential of static machines is generally computed at approximately 50,000 volts per 1-inch spark; this gives 150,000 volts maximum value for your machine. Moreover it is the maximum or peak value which you feel as a shock of any kind to the person when the discharge and wave form of the potential are of a certain proportion. The amplitude factor of the potential determines that the R. M. S. and the corresponding maximum or peak value shall be. For example, in the case of the static machine just cited, the amplitude factor can be taken as 2.5 and therefore if the 3-inch spark is taken as having a R. M. S. voltage of 60,000 volts, then 2.5 times this potential gives 150,000 volts. A similar value for maximum potentials of induction coil sparks is often used.

It has been stated that I-20 amperes pass thru the human heart is sufficient to cause death. To pass this current thru the heart you must of course have sufficient voltage this depends upon the health of the individual and the condition of the blood and nerves. A potential of 1,800 volts is used generally for electocuting criminals.

The average electrical man will tell you, that the reason why you don’t mind the shock from a spark coil or static machine is because of the lack of current—or amperage. For data on an induction coil voltage is thus been proven that at least for these cases, it is not the usual explanation—no amperage—that fails to spell fatal results, but sharpness of wave form and that it is the noscious potential effect. When the victim of the electric chair “gets his” he receives a slowly undulating wave of say 50 or 60 cycles R.M.S. potential. The current sinks in—generally it burns the heart. But when a person gets an induction coil or static machine discharge thru his body, every one, it is invariably the case that he only receives the current for a very small fraction of a second, and muscles are not affected. This theory is considered in by several high authorities in the electrical engineering field. A more full explanation is given in an article entitled “The Measurement of High Potentials” by H. W. Secor, in the August, 1913, issue of Modern Electrics.

WAVE METER TO MEASURE 12,000 METER WAVES.
(933) H. Holmberg, Bottineau, N. D., asks:
A. 1. For data on an induction coil voltage to be used with 500 m. variable condenser to measure waves 12,000 meters in length. A. 1. An induction coil for use in connection with a wave meter so that wave lengths up to 12,000 meters can be measured, when a variable capacity up to 500 m. is shunted across the inductance, will require an approximately 500 feet of littezhedh wire consisting of 10 stands of No. 38 B&.S. gauge.

The above result was derived in the following manner: Referring to the literature on Inductance and Capacity by Messrs. Secor and Cohen in the March, April and September issues of the Electrical Experimenter, we find that the inductance required is equal to 40,540,000 cm.

From the above you can see that it is very easy to calculate the inductance required.
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June, 1918

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required without much difficulty. As to which way would be better in winding, we advise using staggered winding, a description of the method of winding is given in past issues of the ELECTRICAL EXPERIMENTER.

RADIUS AND WIRELESS.

(931) Louis Morgen Faulkner, Washington, Conn., inquires:

Q. 1. Has any research ever been conducted on the effect of radioactivity as related to the propagation of wireless waves?

A. 1. We have consulted several authorities on the subject, and find that in 1912 Professor Dieckmann of Germany conducted some tests to ascertain whether any radioactive elements were deposited upon antenna by incoming radio waves. In this connection he used the electroscope. It was shown that a slight deposit is noticeable upon the antenna, altho it might be said that the air itself contains radio-active elements.

Further, there is no record of an electro-scope ever being used for the actual reception of radio waves, and believe there is a very good field open in this direction for research work.

EXPERIMENTAL MECHANICS.

(Continued from page 106)

of the wheels on the gear centers, to give the requisite ratio of speed between spindle and screw.

In order to cut a thread below 12 pitch, a single set of the three gears is used, namely one driver on the spindle; one driven, on the screw, and one intermediate gear on the stud. It is worth remembering that a mere idler or intermediate wheel does not effect the ratio between spindle and screw speed; it is merely used to convey motion.

The size of the gear that is involved is the number of teeth, must bear the same ratio as does the screw to be cut to the lead screw of the lathe; hence we will adopt the following rule:

Take the pitch of the lead screw as the numerator of a fraction and the pitch of the screw as denominator, multiply both by 5 or 10, and the products will be the wheels required—the numerator being the spindle gear or driver, and the denominator the screw gear or driven. In order to fully appreciate this simple rule, let us take an example. Suppose we desire to cut eight threads per inch with the lead screw having five threads per inch. The thing we want to know is, what size gears will be required to obtain this thread? Applying the rule we get:

lead screw

25 spindle or driver
screw to be cut

8

5

25 

8

40 screw or driven

The gears required.

To cut a thread of screw pitch higher than 12 per inch may require for convenience of gearing or bringing the sizes within the compass of the wheels usually supplied, that a double train (four gears) be employed; this scheme is called compounding and this method is shown in Fig. 6.

In order to compound the gears, proceed with our first rule, setting forth the ratio of screw to be cut to lead screw in a simple fraction form, then assume any two other equal wheels, for second driver or driven, in the same form, and divide one driver and one driven by any convenient divisor to bring the figures within the compass of your gears. Thus applying the above rule to a particular example, of cutting a screw of 25 threads per inch, with a lead screw having four threads per inch, we have:

\[ \frac{4}{40} = \frac{x}{10} \]

\[ x = 10 \]

Assume

100

40

25

20

25

100

and we get \( \frac{4}{40} = \frac{x}{10} \); the four wheels required. Another problem; wanted to cut nineteen threads per inch with a lead screw

of four threads per inch. Here we have:

\[ \frac{4}{40} = \frac{x}{10} \]

\[ x = 40 \]

\[ \frac{10}{40} = \frac{100}{50} \]

\[ 100 \]

40

50

90

100

100

95

100

A little study on the part of the experimenter on the above will make him a master in handling the above simple rules and allow him to figure out any combination of gears both simple and compound, for cutting a thread of any desired pitch.

When adjusting the stud, take care that the gears do not go too deep in mesh, or they will bind against each other. The stud should be so adjusted that the gears all run evenly and smoothly. It makes no difference what gear is used on the stud, as it does not enter in any way into the calculation for the pitch of the thread to be cut.

If a left-hand thread is to be cut it may be necessary to use two studs as shown in Fig. 5.

All modern lathes are furnished with a key called an index plate which gives the relation of gears for cutting any desired thread. A typical index plate is shown in Fig. 7. You will note that the size of desired thread is given in the first row, while in the second the size of the spindle gear and the last the screw gear. Then to find the size of gear necessary to cut a particular thread, look for the figure corresponding to the desired thread, then opposite you will find the given size of the spindle and lead screw gears. Any size gear is placed on the change gear bracket which will properly connect the spindle and lead screw gear.

In this lesson we have considered the subject of setting the various gears necessary to cut a particular thread, while in the next lesson we shall further consider the subject of thread cutting by giving up "How to cut the thread on the work."

(To be continued.)

Stray electric currents from a railroad are supposed to cause trees on one side of a Brussels (Belgium) street to bud again and sometimes blossom after they have shed their leaves in the fall.

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**THE DYNAOTR—A NEW VACUUM TUBE.**

(Continued from page 97)

If the circuit contains inductance and capacity, as well as resistance, a similar
action takes place. As the plate comes thru the vacuum, at a rate depend-
ing on the capacity and negative resistance, and discharge thru the circuit at a rate depend-
ing on the inductance and positive resist-
ance. If the inductance is too high, the plate will receive electrons more rapidly
than they can flow thru the inductance and will charge up to the point beyond
the point at which the rate of charge and discharge are instantaneous, equal.
The inertia of the inductor makes it go backwards, and if the resistance is not too
great it will act so as to oscillate continuously. Whether the circuit will oscillate
continuously, or come to rest, depends on the relations between inductance, positive
and negative resistance and capacity.

An ordinary dynatron short-circuited by a few turns of heavy wire will give a fre-
quency of about 20,000,000 cycles per sec-

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age means an increase in current, which may be very large if positive and negative resistance are nearly equal. For example, the maximum aperiodic voltage amplification thus far obtained with a plotron is about 15-fold, while with a phldynatron a value of 1,000-fold has been obtained. It has been shown that the dynatron will oscillate when \( Rr < \frac{L}{C} \), where \( R \) and \( r \) are the positive and negative resistance, respectively, \( L \) and \( C \) the inductance and capacity. The frequency of oscillation is approximately 

\[ 2 \pi \sqrt{\frac{L}{C}} \]

and may be given any value from 1 to 10,000,000 by changing inductance and capacity alone. It has also been shown that for low frequencies the oscillations are very nearly pure sine waves, provided \( L \) is not too great compared with \( Rr \).

Theory indicates that this should be true for all frequencies, and a search for harmonics at radio frequencies has verified the expectation.

The dynatron, therefore, satisfied all the requirements of a radio generator, and has the advantage that its generation is invariable and free from lag, and that the frequency may be given any value by changing a single inductance or capacity. Its oscillations may be controlled either by opening and closing the main circuit, or by changing any one of the four factors \( L, C, R \), and \( r \) in accordance with the condition of oscillation given above. Its efficiency is low, probably less than 50 per cent under best conditions. This is not, however, a serious limitation, except as regards the cost of power, since the tubes are capable of running very hot without deterioration. The maximum output at radio frequency of the tubes thus far constructed is about 100 watts, but no effort has been made to develop a high power tube. It is generally necessary to transform the radio energy by means of a coupled circuit.

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The simplest method of controlling the oscillations of the dynatron is to vary the negative resistance, by means of a grid around the filament, as in the pliodynatron. It has been shown that the negative resistance of the pliodynatron is inversely proportional to grid potential. Hence, if the ratio of inductance to capacity and resistance be initially just large enough to produce oscillation (which is also the condition for producing pure sine waves), a slight decrease in grid potential will stop the oscillations.

This is exactly what is required for the radiophone, and it is easy to make pliodynatrons which have this characteristic. The connections are shown in Fig. 4. The oscillating circuit has the pliodynatron connected up as shown, and is coupled inductively to the antenna. A microphone M, coupled thru the transformer T, to the grid circuit of the pliodynatron, serves to control the amplitude of the oscillations. A battery of a few volts, between grid and filament, keeps the grid always negative with respect to the filament.

It is found that, with a proper ratio of inductance to capacity, the amplitude of the radio waves is very nearly proportional to the grid potential, and hence to the instantaneous displacement in the vocal (speech) wave. This was proved for constant grid potential by means of a hot wire ammeter in the antenna circuit, and for alternating grid potentials by impressing a sine wave on the transformer T, and observing the form of the rectified radio waves in a coupled circuit containing a kenotron rectifier and oscillograph.

Under these circumstances, it was found that speech transmitted to the microphone M, and received at a station a few miles distant suffered very little more distortion than in the ordinary wire telephone. With a small tube giving about 10 watts, it was possible to talk wirelessly 10 miles (20 km.) with good intensity and articulation. No attempt has been made to telephone greater distances, or to develop high power pliodynatrons. The maximum output of a single tube is such that it is impossible to control thus far is about 60 watts.

It has been found that a pliodynatron in series with a suitable resistance is capable of producing an aperiodic voltage amplification of 1,000-fold. To maintain this amplification requires constant batteries and continuous attention. A value of 100-fold is, however, very easy to maintain. By connecting two pliodynatrons in series a total amplification of 10,000-fold has been obtained. With this amplification it should be possible to receive radiograms on an aperiodic antenna.

[Ed. note: Those interested in this article in detail may obtain a copy of the Proceedings of the Institute of Radio Engineers, Vol. 6, No. 1, copy of which can be procured thru our Book Department.]

Television and the Telephot

(Continued from page 96)

makes use of a cathode tube, the wires 9 and 10 from the revolving mirror sender 1 being connected to wires 9 and 10 which in turn go to an electro-magnet G. Wires 11 and 12 from revolving-mirror sender 2 go to 11 and 12 which are also connected to another electro-magnet H placed at right angles to electro-magnet G. Two pencils of cathode rays is thrown upon the screen in back of the tube, and this ray is influenced by the electro-magnets H and G synchronously to revolving mirrors 1 and 2 of the sender. Consequently a picture should be traced out on the screen of the cathode tube point by point, and it is feasible that the image could be readily obtained by this means. A condenser K is also arranged in the cathode tube to steady the cathode rays, and for certain other purposes which it is not necessary to delve into in this article. This is a particularly clever invention, but we do not have any information on how showing if it has ever been tried in practice. It certainly looks more promising than any of the others, particularly as it requires only four wires.

We must also mention a certain other type of telephot which strictly speaking is not a telephot, but belongs to the ordinary sense of the word because it does not transmit pictures by electricity, but optically. It shows how a picture can be transmitted practically by means of a single light ray. This idea was patented by Mr. Alf Sinding-Larsen of Christiana, Norway. The idea is to have two mirrors vibrating at a dif-

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lying on the same plane and is perpen-
dicular to the axis of oscillation of mirror 2. By these means, the elements of the in-
struments are placed in succession following a continuous zig-zag line transferred to the focus of a lens 4 placed in the opening of the reflection tube 5, said lens parallelizing the rays which meet the image point. At the receiver two similar mirrors 6 and 7 oscillating synchronously with the mirrors 2 and 3 respectively, throw the train of rays emerging from the reflection tube to the eye of an observer as indicated. The synchronous vibration of the respective pairs of mirrors is ac-
complished by ingenious means outside the scope of this article. It becomes apparent from this invention that by substituting for the lenses 4 some electrical means such as a combination of selenium cell with a revolving shutter, pictures may thus be transmitted electrically without using reflection tubes such as are shown in 5.

In fact, a system of this sort was tried some years ago by the Russian inventor Savin.

Any reader interested in the foregoing patents, by sending a self-addressed envelop to the author can ascertain the numbers of these patents which have been discussed in this article. Most of these patents are very ingenious, and contain a good deal of information on television which has not so far appeared in print outside of the patent office records.

RESEARCH AND ITS IMPOR-
TANCE TO HUMAN PROGRESS.
By Dr. W. R. Whitney
(Concluded from May Issue)

make a practical success.

A SMALL electric furnace was de-

developed so arranged that the rate of rise of temperature, the maximum temperature reached and the duration of heat at any temperature was as far control and was also recorded. The desired result was ob-
tained and this work was thus finished. It gave us a certain stock of knowledge and assurance.

At that time a very similar problem was being solved one of the engineering depart-
ments. Lightening rods and other protective apparatus for protecting lines from 

lightening, were needed. Their dimensions were 60 inches and they needed to have a definite capacity. The 60 inch long and could be placed in a porcelain kiln. The necessary variations in size were therefore made so that, in any installation, the many thousands of rods were repeatedly fired and afterward tested to yield a few hun-
dred of satisfactory product. It was evi-
dent that regulation and control of tem-
perature was necessary. This was found to be impracticable in case any considerable length were to be fired at one time, as the heated mass was so great that the rods near the walls of the retort received a very different heat treatment from those near the middle and were consequently electrically different. This difficulty led to experi-
ments along the line of a heated pipe, thru which the rods could be automatically past. Some time was spent trying to make a prac-
tical furnace out of a length of ordinary iron pipe, which was so arranged as to carry electric current to be heated to the proper baking temperature. Troubles here with oxidation of the iron finally led to substitution of carbon pipes. This re-
sulted in a carbon-tube furnace, which is merely a collection of six-foot carbon pipes, embedded in coke powder to prevent combustion, and held at the ends in water-
cooled copper clamps, which introduce the electric current. By control of this cur-

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F or years we have worked in the laboratory in every conceivable way to remove the objectionable gas from incandescent lamps. We carefully determined the effect of the last molecule of every gas which could possibly enter a lamp and found this gas to be argon. As a result, Dr. Langmuir discovered the hitherto unsuspected fact that a better tungsten filament is obtainable by filling the bulb with nitrogen or argon. There had been a long time when we felt we knew with certainty that the vacuum was necessary. But there were relevant things we did not know even then. New knowledge changed the looks of things. During the vacuum work I certainly lacked faith in the untaken effects of the resistance of tungsten filaments by introduction of rare oxids and other material which we hoped would remain in the filament when hot, and when there was no resistance of operator, some suggested adding traces of such oxides for the purposes of this article. It seemed a futile experiment, but the traces served the new purpose, while greater quantities had failed.

Why should we force new knowledge to come by such difficult and circuitous routes? Can we not train ourselves to be more ready for it, more open-minded for its reception and more sinned in our satisfaction with present knowledge?

We seem to live in a rapidly changing environment so far as Nature's laws are concerned. Of a truth, we ourselves and our conception of the universe and the world, and when we have once realized this much, there comes the possibility of directing our hope and expectations, our actions and experiments along as what may call a pragmatic path. This means more care and respect for the contents of the future.

Every chemist, even in his freshman days, learned the identical fact that all material advances will be made. Because he cannot always handle them in the ways of the advanced industries and research, led to the conclusion that research is closed to him. Yet so much useful pioneer work in all fields has been done with simple experimental apparatus, coupled with such equipment that it almost seems as though this was the rule. The telegraph and telephone started with a few little pieces of wire wound hand with paper insulation. The basic work on heredity was carried out by an Austrian monk with a few garden peas. The steam engine came from the kitchen fire, and wireless from the tricks of a little spark gap. There was however, the same general kind of mind behind each one of these discoveries—the mind of the inquiring thinker.

When Professor Hertz was making observations which were based on the effects of one spark gap on another at a distance, and it included that the electric waves in space, he was not trying to improve the telegraph or telephone. He was like an inquisitive child, asking what to him were interesting experiments. He was well trained to observe, but otherwise he was like a youth guided solely by the interest in the new things he was finding. When he had added to our knowledge the few simple facts which he observed, the results of trying things, he had laid the foundation for a major advance. If he had no accident, his service was unsought or unsupported thing. He had been trained by Helmholtz, and all his life he was engaged in certain universities to do pure research work and to encourage others to do it likewise. This is important.

The reason why we should most interest in this type of work is that the one who most develops the people who support it. The American manufacturers are probably wise enough to measure the effects of their labor on their specific problem, and they will more and more effectually employ men to solve them as men appear who are competent. In this way new truths will be discovered, but not enough, nor of the kind right. The discoveries in separate industries are usually those of further refinement, or improvement. The natural ex-
tensions of present known paths, the more or less obvious additions or economies, these are the studies of the industries. By industrial research as usually successfully carried on, few new fields of human endeavor are likely to be opened up.

Therefore, one in America must do all one possibly can to encourage that kind of seeking after the new possibilities in nature which may be called the fundamentals, the truths of matter. Some call this "pure scientific research." No matter what its name, it is the learning by trial about the things the Creator has put into our hands. Gradually and continually we must learn the new and ever-broadening uses. I say this merely because this has been the path by which civilization has thus far traveled most successfully.

It is harder to produce high voltage low wattage lamps as compared to lamps of equal wattage for use on low voltage circuits, which is due to the fact that thinner wires, which are used on the high voltage circuits are harder to make.

BURNT-OUT LAMP CONTEST. (Continued from page 92)

should be somewhat stronger. The negative pole is the one upon which the small gas bubbles appear, the other is the positive pole.

Figure 6 shows a match holder or match safe submitted by a gentleman residing at 911 Hancock St., Brooklyn, N. Y., who however, must remain nameless until next month, being that he forgot to sign his name to the letter. The illustration clearly shows how this match holder is made. This is sounder work for our ladies, and should prove rather an attractive idea. The main thing to remember, however, is that the sharp upper edge should be gone over with a Bunsen burner or other hot flame to take off the cut edge. Otherwise "Pa-Paw" is likely to throw it into the ash barrel the first time he cuts his fingers.

Figure 7 shows an electric distiller or still suggested by Mr. Robert Lindsay, 522 Brighton St., El Centro, Cal. The illustration in this instance also furnishes nearly all details. A cork is inserted into the top part of the burnt-out bulb and a glass tube is inserted in the cork. If the 110-volt current is turned on, the water will become hot and steam will soon be generated. Distilled water is formed in the other vessel as shown. Other liquids besides water can be used.

Caution: No moonshining now, boys!

Figure 8 shows the idea of Solly Weitzer, 119 Lewis Ave., Westmount, Quebec, Canada. It is an emergency fuse made from the remains of a burnt-out lamp bulb. It should prove quite attractive for our many bugs. It seems such a simple idea that it is surprising no one ever thought of it before, until this Lamp Contest came along. Then it went over the top with a big hoop, almost a dozen contributors duplicating this idea!

Two good ideas were submitted by Mr. Carl Knutson, 8028 Coles Ave., Chicago, Ill., and are shown in Figure 9. The first is a rain alarm, the idea being to fill part of the bulb with diluted sulfuric acid which must come below the level of the two

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protruding lead wires. It will be seen that as soon as it starts raining, the electrolyte will rise in the vessel which will establish a good connection between the two wires which in turn will cause the rain alarm to ring. The next idea shows an electrolytic interrupter. It is made by utilizing a bulb as shown \( h \), inverted and being the two lead wires ground off smooth with the glass. The two wires of the receptacle are joined together and form the positive and the negative pole of the interrupter; the negative pole goes to the lead strip screwed to the paraffined wooden cover, and bent around as shown. The vessel is filled with 5 parts of water and one part of sulfuric acid. This makes a fair electrolytic interrupter which, however, will not last very long, as the active wires soon give out, or the glass cracks due to the lead. For short experimenting it will prove satisfactory, however. It works on 110 volts in series with any spark coil. No resistance is required.

Figure 10 shows a deflagrating globe which was suggested by Mr. Thos. W. Benson, 1305 E. Carey St., Philadelphia, Pa. Such globes are used extensively in chemical experiments as frequently described in Experimental Chemistry in this magazine.

Figure 11 shows how to make a Florence style flask as well as an Erlenmeyer flask. These were suggested by Mr. Paul de Paolis, 20 William St., Geneva, N. Y. Naturally, these flasks require large bulbs and the 100 watt or larger variety of nitrogen or Tungsten lamps lend themselves admirably for this purpose. The illustrations clearly show how the flasks are made. Ideas along this line are quite profitable, being that the glass of such bulbs is usually a good grade, and the resulting flasks are not of a bad kind at all.

Figure 12 shows a chemical retort made from a 100 watt nitrogen lamp, and this idea is shown along the same lines as that shown in Fig. 11. Quite a good retort can be made from a bulb of this kind, and we are quite certain it will prove satisfactory to the chemical experimenter. This idea is suggested by Edwin J. Farmer, 621 S. Freedom, Alliance, Ohio.

(This finishes our Contest for this month, and we hope to have some new suggestions for July.)

**EXPERIMENTAL CHEMISTRY**

(Continued from page 114)

Evident from this that the molecule is of enormous size and exceedingly complex.

The oxyhemoglobin parts with its oxygen wherever it finds compounds of carbon, hydrogen, etc., ready to be oxidized, forming with them carbon dioxide and water. The products are carried back thru the veins to the lungs, whence by way of the system is in this way purified and the waste is supplied by the digestion and assimilation of food. The oxidation of food products, after assimilation, keeps up the heat of the body as really as the combustion of carbon or sulfur liberates heat. The average temperature in man is 37 deg. C. (98.6 deg. F.). Any excess of heat produces perspiration or is changed into other forms of energy. The maintenance of temperature is nearly a fixed thing, and the health and life, but in disease the temperature of the body deviates to some extent from the normal. In Asiatic cholera it is sometimes as low as 25-26 deg. C. (77-79 deg. F.), while in pneumonia it may rise to over 41 deg. C. (106-107. deg. F.). Considerably higher temperature than these have been noted; but if this condition is continued the blood corpuscles are killed and the person dies.
Deoxidation in Plants

Since carbon dioxide is so constantly poured into the atmosphere, why is there not more carbon dioxide and less free oxygen in the air to-day than a thousand years ago? The answer may be found in the growth of vegetation. In the leaf of every plant are thousands of little "chemical laboratories," in which the tree often has access of foliage surface exposed to sunlight and air; carbon dioxide, diffused in small quantities in the air, passes into the leaf, mainly from the under surface of the stomata, or little mouths. (See vertical section of leaf, Fig. 19.) Within the leaf, probably in the green phloemphlary grain, it is decomposed by the radiant energy of the sun. The reaction supposed to take place is:

\[ 6CO_2 + 6H_2O = C_6H_{12}O_6 + 6O_2 \]

Oxygen is given back to the air; starch \((C_6H_{12}O_6)\) is retained in the leaf and is transformed into sugar and cellulose, the latter of which constitutes the fiber of the wood and which has practically the same symbol as starch or sugar, namely, \(C_6H_{12}O_6\), or a multiple of it. Carbon dioxide contributes to the growth of plants. Oxygen, to that of animals, and the constituents of the water produced little from one organism to another. The compensation of nature is here well shown. Plants feed upon what animals discard, transforming it into matter of the same nature as the latter, while animals prepare food for plants. Practically all the carbon in plants comes from the carbon dioxide in the atmosphere. Animals obtain their supply of carbon from plants. The utility of the small percentage of carbon dioxide in the air is thus seen.

**Uses.**

Carbonic acid gas uses for making soda-water, and as a basis of mineral waters and effervescent drinks of all sorts. It is also used in bread making (causing the dough to rise), and is employed very extensively in alkaline manufacture, for example, in sodium carbonate. In chemical fire engines sulfuric acid is in one tank and is let into another tank containing sodium carbonate solution, thus rapidly liberating carbon dioxide, which is forced on to the fire in its early stages. Carbon dioxide is also used for refrigeration.

**Carbon Monoxid. History**

Lassone first discovered this gas about 1776. Priestley obtained it and named it "Phlogisticated water," about 20 years later Lassone. Lavoisier supposed it to be hydric acid in solution, in 1808, proved it an oxide of carbon.

**Names:** Carbon monoxid; carbon prooxid; carbonic acid.

**Occurrence.**

Probably the gas carbon monoxide does not occur naturally anywhere, except as a product of combustion, of coal with an incomplete supply of air, and in furnaces under like conditions. It may be easily recognized in the combustion of anthracite coal by its peculiar blue flame. Almost identical with this formation of it, is the one obtained by passing carbon dioxide over red-hot charcoal.

\[ CO_2 + C = 2CO \]

**Preparation.**

One way of producing this gas is to act upon oxalic acid \((H_2C_2O_4)\) with sulfuric acid and heat. It will be seen that oxalic acid, which is a solid, consists of \(H_2\), \(C\), and \(O\), and in the exact proportion to form water \(H_2O\), carbon dioxide \(CO_2\) and carbon monoxide \(CO\). Heat alone will break up the acid into these constituents, but sulfuric acid acts in the operation and also absorbs the water, leaving the two gases, carbon dioxide and carbon monoxide, completely intermingled. Remembering the affinity which carbon dioxide has for soluble hydrosides, we can separate it by passing the mixture over sodium hydroxide, or of potassium, or of calcium hydroxide.

\[ CO_2 + 2NaOH = Na_2CO_3 + H_2O + CO \]

The carbon monoxid, being insoluble in water, can be collected like hydrogen.

The gas can also be prepared by the action of sulfuric acid on formic acid or potassium ferrocyanide \((KFe(CN)_6)\), or by heating certain oxides, as zinc oxide or carbon dioxide, with sodium carbonate.

\[ HCO_3 + Na_2CO_3 = NaHCO_3 + CO_2 + H_2O \]

**The economical method and the one that will yield the gas rapidly, is that involving the heating of finely powdered potassium ferrocyanide with eight or ten times its weight of strong sulfuric acid, which reaction takes place according to the second equation above.**

As soon as the reaction commences the heat must be removed and the vessel cooled, if necessary, in order to prevent too rapid evolution of the gas. The water required in the above reaction is derived from the water of crystallization of the potassium ferrocyanide and from the small quantity in the commercial sulfuric acid.

**Properties.**

(Physical): It is a colorless gas. It is very slightly soluble in water. It is very poisonous, one part per cent having produced death. It liquefies at 140 deg., 36 atmospheres, and boils at -190 deg. It solidifies at -190 deg. (Chemical): It unites with chlorine to form carbonyl chloride \((COCI_2)\). It combines with the hemoglobin of the blood to form carbon monoxid hemoglobin, a stronger poison than any of the other poisoning gases, hence oxygen does not displace it and it rapidly poisons. Its poisonous effects are almost instantaneous, judging from deaths resulting from inhaling water gas.

It is a non-supporter of ordinary combustion, but red-hot carbon rob carbon dioxide of half its oxygen to form carbon monoxid in the presence of no free oxygen.

**Uses.**

Carbon monoxid is a diluent in water gas and a reducing agent in ore reductions, particularly iron. As a constituent of illuminating gas, it displaces certain poisonous gases like phosgene and other animals.

The formation of CO and CO₂ in a coal stove:

The fact that CO is formed with abundance of oxygen, and CO₂ with a limited amount, is well shown in a coal fire. (See Fig. 20.) By having plenty of oxygen enter the draught, and carbon dioxide is first formed at B.

**\[ C + 2O = CO_2 \]**

But as this rises to the middle of the hot coal, where oxygen is wanting, it gives half its oxygen to the carbon and becomes reduced to carbon monoxid.

**\[ CO + C = 2CO \]**

Here, carbon acts as a reducer, CO₂ as the oxidizer. CO as reduction product. Reaching the surface of the coke, where there is plenty of oxygen, the CO becomes CO₂, burning with a blue flame.

**\[ CO + O₂ = CO_2 \]**

The danger of having the back draft A closed when the stove door is open arises from the unburned CO being forced into the room, to be breathed by the occupants.
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AUTOMATIC LIGHTING SYSTEM.
(228) John R. Fell, Jr., Parkersburg, W. Va., sends us an idea of an automatic light scheme, the purpose of the arrangement being that when one lamp breaks or burns out the circuit is broken; this releases the armature of an electro-magnet which closes a contact, and in turn lights another light. Our advice is asked.

A: This is a very ancient idea, and has been used as far back as 1870, when the first automatic arc lamps were invented by Jablkoichoff of Paris. It is also used at present on certain automobiles to give warning when the rear light should break or burn out. Years ago, the Editor had a system of this kind on the market worked on the same principle which he termed the "Tell-Tale Tail Lamp." This was on the market in 1906.

INSULATOR.
(229) H. H., Glace Bay, Nova Scotia, Can., has submitted drawings of a certain insulator, whereby the wire can be attached to the insulator without any additional means. Our advice is asked.

A: This seems to be a very good idea, except that if the insulator is made in porcelain there would be trouble with the two screw parts, as porcelain does not lend
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Über a patent can be obtained on the idea.

Alvin Messall, Colorado Springs, Colo., submits drawings and designs whereby a fuse is incorporated right into the lamp socket, which idea he thinks would make it possible for anyone to see just exactly where the fuse had blown. A. This is not a practical idea to our mind, as it would necessitate too many fuses which are not at all necessary. We do not think that anyone would wish to adopt a plan of this kind.

A. Roy N. Bick, Colorado Springs, Colo., submits an idea of a war aeroplane using a new form of propulsion. The idea is to use a boiler, and instead of water he proposes alcohol. This is one of the main features of the scheme. A. We are afraid that such an aeroplane, while it might leave the ground, would be far too heavy, and the idea of using alcohol instead of water would probably be looked upon with disfavor by the average aviator, at least at the present time. We do not believe that such a boiler has been far enough advanced to be used on an aeroplane.

Automatic Telegraph Transmitter.

Marius Zaayer, Boston, Mass., has patented a telegraph transmitter in which, by using a condenser, the instrument is not only very useful for a commercial instrument, but for a commercial instrument, as such was described in our October, 1916, issue. Our correspondent also desires all possible information about automatic keyboard transmitters of this kind. A. We respectfully refer him to a patent...
WIRELESS SALE

On April 6th of last year, when war was declared, we had made preparations to give our patrons wonderful service and had acquired an enormous stock of our most popular wireless instruments below mentioned. We desire to reduce this stock to the extent of $5,000, still retaining a big reserve when the wireless station is not in demand. We have just slaughtered the prices. Remember that during the past year wireless keys and everything electrical has increased tremendously and it is an absolute certainty that wireless instruments manufactured when the war is over will sell at greatly increased prices. The demand will be so terrific that thousands will have to wait months for their instruments. Many are now getting their stations ready. This is your opportunity. When this stock is adequately reduced no further orders will be accepted and remittance will be returned.

GAS GUN.

(233) H. W. Seeley, Bridgeport, Conn., claims that he has experimented for some time and now he terms a "Gas Gun." The cannon is supposed to be of brass or steel and is to be fired with gas. Certain other information is given as to how to operate it, as well as other various details. He also claims that with such a gun he has hurled objects with considerable force for fairly long distances, but he admits that it is not a gun of a small size. Our advice is asked.

A. In view of the fact that late advices from Germany thru Swiss sources mention that the famous 74-mile gun which the Germans used in shelling Paris are supposed to be using gas, our correspondent's idea seems feasible. How practical such a device is, is not known to us. Until the German came along no one ever spoke of gas guns, but there is a good chance that there may be a future of this kind. We would advise our correspondent to proceed cautiously, and have a thorough patent search made before applying for patent.

AUDION.

(234) E. F. Johnson, Waseca, Minn., thinks he can construct a step-down transformer in connection with an Audion. He shows several schemes to be used in connection with the idea.

A. We are of opinion to use A. C. current in connection with such a sensitive device as an Audion, as we are almost certain that a loud hum will result when the transformer is doubled upon. If the same can be overcome entirely to make the operation of the instrument suitable. Because the arrangement is used in connection with the transformer, the constantly changing potential of the line is certain to interfere with the operation of the Audion. Everytime somebody down the line turns on a number of lights there is a disturbance along the entire circuit, which will certainly manifest itself in the Audion.

AN ELECTRIC AEROPLANE SHOOTING GALLERY.

(Continued from page 77) pathway, the target being preferably in the form of a miniature aeroplane as here illustrated.

In the front portion of the gallery there is arranged a shooter's stand and in the rear a targeting stand adapted to be shot at by the shooters or gunmen standing on the stand. The shooter's stand is preferably in the form of an aeroplane suspended in mid-air and adapted to rock from side to side. The lower wing of the stand forms a floor for the shooters to stand on and a target to face to the end portions of this floor so that the shooters can board the "aeroplane" readily.

Various mechanical means may be employed to make the aeroplane stand and for impinging a-rocking thereto, for instance, as shown in the drawings, the floor on which the marksmen stand is hinged at its ends on springs or on rods, connected at their upper ends with the cranks attached to crank shafts journalized in suitable bearings arranged on brackets and attached to an overhead beam extending along the ceiling of the gallery. The crank shafts are provided with bevel gear wheels meshing with a second set of bevel gear wheels secured on a shaft driven by an electric motor. When the motor is running then a rotary motion is transmitted by the gearing described to the shaft and cranks, whereby a rotary motion is given the links and imparting a side ways rocking motion to the shooter's stand, as is readily understood by reference to the illustration.

The rear of the suspended stand is provided with propellers and a spinning wheel and sprocket chain mechanism from an electric motor mounted on the floor, and the propellers are preferably included in a wire netting protector. When the motor is running a very realistic aeroplane effect to the shooters standing on the floor as well as to the onlookers in front of the shooting gallery.

Each of the miniature aeroplane targets is provided on top with an eye detachably engaging the return bent end of a holder, in the form of a rod provided with a flanged wheel, traveling in an endless slot formed in the target background extending across the gallery in the rear of the targets. The rear end of each holder is attached to an endless traveling sprocket chain passing around a series of sprocket wheels located in such a position as to guide the sprocket chain along the slot as is readily understood. A suitable electric driving motor is connected with one of the sprocket chain wheels traveling motion to the chain and targets.

As the marksman hit the aeroplane targets they can thus be easily replaced by an attendant located at one side of the target stand, as they are shown hooked on any of the slow moving shafts.

To give a truly realistic effect to the whole affair the inventor mentions that a moving cloud machine is provided in the gallery, that is attached to a target board, so that the resemblance to the "real thing" will be greatly heightened thereby. Also it is not necessary to have the shooting gallery in the open; it can be very effectively placed in an enclosure so that a moving earth panorama can be projected on the floor between the plane and the target.

A 100-MILE ELECTRO-MAGNETIC GUN.

(Continued from page 81) has a possible range of 90 to 100 miles when properly designed and elevated to a maximum range of 45 degrees. The principle of the electro-magnetic gun is best understood by reference to the line drawing here shown. Prof. Christian Birke- land, inventor of the gigantic solenoid gun mentioned, his patent being granted January 13, 1914, tried out a simple experiment to prove that his design was feasible and practical. This experiment was made with a single magnetic field weighing about 24 lbs., and having the dimensions given in sketch. Here is what he says:

"With a current of 200 amperes sent thru the solenoid, the iron rod was sucked in and propelled with a magnetic pull of 170 lbs. The heat generated in the coil was not over 30 degrees Fahrenheit. It is evident that this design is a great improvement upon the original design of the solenoid gun, the current required being only one-tenth of the original. The equipment of the gun is very simple and the solenoid gun is very much cheaper than the original design. It is evident that there is a great future for the electro-magnetic gun and that it will be one of the most powerful and efficient weapons in the hands of the army in the future."
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Size of machine \(19\frac{3}{4} \times 8\frac{1}{2} \times 8\frac{1}{4}\). Net weight 18 lbs.

TAPE RECORDER AND PERFORATING MACHINE

This is a standard commercial, large size, perforating, telegraph recorder. It is exactly the same machine as used by the Western Union and Commercial Telegraph Companies in their main offices. This machine requires a double contact (back stop) telegraph key and a few batteries. Pressing the key operates in turn the two sets of powerful electro-magnets, which on their part operate the two ratchet wheels. These then operate two plungers which punch the holes in the tape. By sending Morse code, the holes are punched in a certain manner. Then, by feeding the tape back thru the machine and by arranging two brass contact fingers, the tape will spell out dots and dashes by means of a buzzer.

This machine has a truly wonderful spring motor. It is absolutely silent and has a centrifugal regulator speed-adjuster and stop arrangement. At the highest speed the motor runs 15 minutes, at the slowest speed 65 minutes continuously. Over all dimensions of machine are \(18\frac{3}{4} \times 8\frac{1}{2} \times 8\frac{1}{4}\). Diameter of holes punched \(1/16\). The width of paper tape is \(1/8\). Aluminum reel \(6\frac{1}{2}\) dia. The magnets measure \(1\frac{1}{2}\) dia. and are \(1\frac{1}{4}\) high. The net weight of the machine is 18 lbs. Our line, shows machine with cover removed to show motor. The small insert shows the beautiful tandem electro-magnet arrangement, the ratchet wheels and perforating equipment. All wood work is solid mahogany.

USES: What you can do with this beautiful machine:
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3RD—AS A SPECIAL REGISTER
4TH—AS A TELEGRAPHPHONE

We furnish Blue Prints and full directions to make all the above apparatus using the recorder. We also furnish 3 paper feed tapes, standard size.

A similar machine is listed at $100.00 in the catalog of the Western Electric Co. We bought these machines cheap thru auction, hence the ridiculously low price. AND EVERY MACHINE IS BRAND NEW, has never been used, and is in perfect working order—or money back. IT COSTS ITS ORIGINAL OWNERS $70.00.

We have not a very large quantity of these machines on hand. This is your one chance—you will never see such a bargain as long as you live—we are quite certain of it.

The size of the machine being \(18\frac{3}{4} \times 8\frac{1}{2} \times 8\frac{1}{4}\), the net weight 18 lbs. (shipping weight 20 lbs.), make it necessary to ship by express or freight. We guarantee immediate shipment within 24 hours after receipt of an order.

Price as described:

- complete: $15.00

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This outfit has been gotten up solely for the Experimenters and for this reason we are selling it “Knocked Down.” In other words, the instruments come all ready for you to assemble, all the parts, wires, nuts, washers, etc., being threaded. This is the only way in which we can afford to make such an instrument. The driver, the outfit can be rendered self together in less than twenty minutes.

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The outfit when assembled comprises a highly sensitive CARBON BALL MICROPHONE with carbon discriminators of exactly the same type as used with our $15.00 Detectors. (See our Cat. No. 10.)

The “Back Plate” which holds the carbon balls has five cup shaped polished depressions, each accommodated by a separate carbon ball. The carbon balls are made of the special carbon balls furnished in a bottle.

The receiver is our No. 1820 with the difference that the magnet was taken out. For this reason that the function of

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A 100-MILE ELECTRO-MAGNETIC GUN.

(Continued from page 132)

the small line drawings herewith, showing a simple three-coil electro-magnetic gun, and undoubtedly the reader will then be able to grasp, with the aid of the following explanatory remarks, about how the various inventors of the electro-magnetic guns intend hurling their projectiles at the enemy with astonishing rapidity and accuracy.

For the sake of simplicity, we may consider that but three electro-magnetic coils are in use as at 1, 2 and 3 along the gun barrel. It may be said that invariably such a gun barrel should have an inner lining of brass or bronze, so that the projectile which is usually made of a magnetic material (such as iron or steel), will not bind within the barrel. The barrel proper can be made of iron properly divided, but an all-brass barrel is common. Now consider that the three magnet coils, 1, 2 and 3, are connected up to a switch as shown. If, then, an iron projectile is placed in the position A, and the current caused to flow thru the coil 1, the electro-magnetic field of force set up within the gun barrel will tend to pull the projectile forward in the direction of the coil 1. This should be mentioned before going further that the iron barrel (if used) of the cannon or gun is divided up into several distinct sections so as to form the gun as a magnetic pull on the projectile at each new impulse.

When the projectile has reached the position of coil 1 the control switch is moved so as to cut out coil 1 and to connect coil 2 into circuit. If this is done quickly the projectile will have been sucked forward on a line with coil 2. The operation is again repeated and the switch is moved so that coil 3 will be put into the circuit and coils 1 and 2 opened. Thus the projectile will again be sucked forward to section 3, and at the instant it reaches the center of the final coil the current is cut off and the momentum acquired by the projectile is relied upon to carry it on and out of the muzzle of the gun at B.

In one of the illustrations there is shown a probable development of a large electro-magnetic field gun mounted on a massive iron frame-work fitted with large caterpillar wheels, as observed, so that it is mobile enough to be quickly hauled from one place to another on the battlefield or for siege purposes. When used for portable requirements it will invariably be necessary, if such guns are ever adopted, to provide a complete portable electric generating plant as is shown in the picture. This would comprise a powerful gasolene engine direct connected to a suitable electric dynamo.

Some idea of the possible size of such guns may be obtained when it is stated that one of the best designs ever worked out on this principle, and due to Prof. Birkenhead, has a barrel 90 feet in length. The projectiles used in this gun would be about 2 feet long and have a diameter of 19 inches. Also to gain the maximum magnetic pull by this arrangement it is recommended that the projectile be wound with coils of wire so as to be electro-magnetically reactive in conjunction with the regular magnetic disc coils placed along the barrel of the gun. As perceived, the gun will be of such a size and weight that the shells would have to leave the gun barrel with a velocity of 4,000 ft. per second. In order to facilitate the passage of the projectile thru the barrel of the gun with the least friction we strongly suggest that suitable lubrication be provided by means of grease or oil cups placed along the barrel at intervals; these may be observed in our illustration.

It must be remembered that these guns would not heat to any appreciable extent and not at all compared to the heat produced in the modern high powered guns using explosive charges of powder. Due to this and other advantages such a gun as this can fire a great number of larger caliber shells per minute, possibly
fifty to seventy-five shells in one minute. It will be seen from the foregoing that such a discharge of 19-inch-two-ton shells, each of which contains a 1,000 lb. high explosive powder charge, would serve to quickly rout the enemy, no matter how well he might be entrenched or concealed behind fortified embankments. A rain of such monster shells would batter down almost any fortification whether natural or built by man.

A method is suggested in the illustration of this electromagnetic gun whereby a constant supply of shells for rapid firing can be always maintained before the open breach of the gun. The shells might be hoisted by means of a gasoline engine and run on the platform at the left and then allowed to slide by gravity down the inclined chute. As fast as one of the shells is sucked into the breach of the gun barrel it is followed by another right after it successively. It is easily possible to have means of firing the shells as far apart, in respect to time, as is deemed advisable, of course. The electric current supplied thru the coils along the gun barrel can be controlled thru a suitable switch by the man aiming the gun and who may be located alongside of the breach of the monster as indicated in our illustration.

The second large electromagnetic gun illustrated in the line drawing is a design suggested by Mr. Paul E. Kenny, a New York electrical engineer. This basic design principle is similar to Prof. Birkeland's, namely, to apply a very large electric current to the magnet coils surrounding the gun barrel for a fraction of a second, or in other words to create an enormous magnetic suction to act on the projectile before the magnet coils have had time to heat up, time being one of the factors governing the heating effect in any case. The shorter the time the current is on, the less the amount of heat produced. Thus does it become possible to overload the coils on the magnetic gun 10 to 12 times their normal carrying capacity, as pointed out before, to thus realize a corresponding increase in the strength of magnetic field produced.

Mr. Kenny says that he offered it to the United States Government in 1908, and proposed that a shell nineteen inches, from New York to Philadelphia, to prove what it could do, but his offer was refused, on the ground it was too big.
The making of an Electrical Man.

(Continued from page 88)

in uplifting environment and makes the right kind of men out of them, instead of the usual sort of school graduate.

All branches of electricity are taught and every grade is provided. Whatever a young man's knowledge, ability or previous education, there is the proper starting place for him at this school. There are no specific requirements other than the ambition to succeed; and each student is advanced as his ability warrants.

The courses taught are: Complete Electrical Course, D. C. and A. C. Electrical Engineering, 2 to 2 ½ years. Electrical Engineering, in 3 years (probably the only electrical engineering in 3-year course given, others requiring 4 years). In addition there are the following special Six-Month Courses: Electric Trouble and Lineman; Electric Meterman; Electric Motor Repairman; Telephone Trouble and Repairman; Draftsman.

The school is empowered, under the Laws of the State of Wisconsin, to give Bachelor, Master Science and Electrical Engineer Degrees to graduates, which substantiates its standing as an educational institution and insures its recognized strength in the field of electrical industry.

(Photos by Milwaukee School of Engineering.)

Moving Pictures That Really Talk.

(Continued from page 88)

from a powerful arc lamp is projected thru the galvanometer and in a magnified form throws the shadow of the moving wire onto the steadily moving film behind a narrow horizontal slot.

The film passes thru the camera at the rate of 20 images per second, while its movement thru the sound recorder is continuous, for the reason that it is not feasible to reproduce images and sound records side by side. The string galvanometer has received much thought and attention as to its design as it really is the heart of the invention. In the earlier form the inventor used a single wire which made a record similar to the small piece of film shown herewith. In his more recent form use is made of two wires. When current passes thru them they operate in opposite directions, so that a double row of sound waves are recorded with the points of the peaks facing each other.

In projecting the film with the sound waves on the same it has been found that these various dark and light portions of these air apparatus, is a remarkable sensitive cell, which in turn will operate a suitable form of acoustic receiver or reproducer.

The film in showing passes thru the projector proper at a slight increase of speed (the regulation film runs at 16 images per second, while Mr. Laste's film runs at 20) and then thru the sound reproducer.

A powerful, sharply focused beam of light is projected thru the sound-bearing section of the film and so on a selenium cell. In the present apparatus a remarkably sensitive cell of circular form with a range of resistance from 1,000 to 100,000 ohms is employed.

A sensitive relay is used in circuit with the selenium cell, which in turn operates a speaking horn of special design which the inventor cannot disclose at present. The horn is totally different and a radical departure from any telephonic reproducer now used, in that it operates on a valve principle similar to the human throat, thereby eliminating the metallic sounds usual with telephone apparatus. The sounds are amplified with a specially designed compact air apparatus, making it possible to hear clearly in the large auditorium or theater.
How to Avoid Electric Shocks.

(Continued from page 82)

may lie on a sidewalk or street in a very hazardous position.

If a person has been caught by a live wire and conditions demand that you try to relieve them, the first thing to consider is to eliminate or remove the wire from the body, if it is coiled about the victim, by means of a dry stick of wood several feet in length. Observers have been recorded that such a rescue was made by means of a dry coat or other cloth, if several thicknesses of the cloth are used, when a person may in an emergency grasp such a live wire, if it is not carrying too high a voltage, say not over 3,000 volts, and pull it from the victim's body. It is possible a person attempting such a maneuver should in every case endeavor to insulate himself from the ground by all means, such as by using a piece of dry wood, a rubber, or a coat, or several thicknesses of heavy dry paper. Rubber gloves, such as lineman use or even heavy leather gloves, will often serve to prevent a shock from a live wire, their body is at a similar potential, and therefore, the would-be rescuer should not touch the victim's body or clothing without taking the aforementioned precautions.

Persons have been fatally shocked when using a telephone after an artist or laborer has portrayed in Fig. 6. Such a shock may be received due to several reasons among which are the following: A severe storm may cause a strong lightning surge to be set up in the telephone circuit, and the current due to this surge may give rise to a dangerous potential being generated at a suitable telephone apparatus momentarily, or just at the moment when a person might remove the receiver from the hook and attempt to use the instrument. Another cause for receiving fatal shocks of this nature, and which are on record, is due to the fact that in rainy weather, particularly, it is a case now and then that the heavy wind of a storm may blow down a high potential feed wire, so that it crosses a telephone wire, and the telephone apparatus would be charged with a dangerously high voltage current as becomes evident, and a person using a telephone instrument might immediately become the victim of such circumstances.

The women folks are gradually becoming more attached to the excellent facilities afforded by the use of electric toilet appliances, etc., and in Fig. 7 we have illustrated a condition which might occur, in which a lady would receive a shock thru her body by placing her feet on a radiator or heating register, when an electric curling iron is in use. Ordinarily, of course, these electrical appliances are thoroughly insulated when manufactured and rarely break down. It is the exception and not the rule we wish to point out, that electrical appliances break down so that the outer covering or metal shell of the apparatus becomes what is known as a "live," and the condition is that the ground is allowed to come down between the electrical heating or other circuit inside the apparatus, and allow the apparatus to leak across the metal enclosing shell.

The apparatus in this condition is liable to give users thereof a surprising shock if their bare bodies come too near the apparatus, or are forced to the apparatus for a moment to get in contact with any grounded piping.

Boys will be boys, but we cannot too strongly caution the young dare-devils among the rising generation not to throw a wire over trolley lines! The writer can remember when he had this same big idea, but when he was ten years of age; it is invariably the case for a youth of this age to do unusual things. "Always something spectacular" is their unvarying motto. This has happened in the case of a boy, who, having met his doom thru just such tactics as this, viz., by throwing a wire or even a wet string over a trolley line, has done exactly what does not stand on the trolley track (thru which the current on trolley systems is returned to the power house and which completes the circuit from the pole line in any case), but put the ground alongside the track, he is quite likely to receive such a severe shock that it may prove fatal. Trolley systems usually employ a current of 50 to 600 volts potential, and a shock from this current or even a part of it may prove fatal. A person struck to a shock of this kind due to a falling trolley wire, or by their coming in contact with a fallen trolley conductor. (See Fig. 8.)

Illustration Fig. 9 shows how the "live" third rail is applied in numerous electrified railroad systems, and which is also found on many city electric traction systems such as in the subways and on elevated roads. There are a few pertinent facts concerning third rails which everybody should study next to the Bible, and these are the following:

Remember first that a current of 600 volts potential and in some cases a higher potential is always present between the third rail and either one of the regular car rails lying adjacent to it, and therefore never step on a third rail under any condition. If you do, you will possibly receive a full 600-volt shock thru your lower extremities, the current passing from the third rail up through the leg thru the lower abdominal organs, with a chance of reaching the victim's heart and killing him, and out thru the other leg to the car rail. You do not have to stand on a third rail and a car rail to receive a very unpleasant or dangerous shock, for if you happen to touch the third rail with one foot, with the other foot on a wet wooden tie you are liable to receive a thoroughly sufficient leak or short circuit in this way also.

In this connection, we might mention a wire which was few years ago between two men who were standing on an elevated railroad platform in New York City, and which is more scientific third rail of which we do not recommend anyone to try, for it is always fraught with danger. One of the men let the other that he could walk on the third rail without receiving any shock. His friend took up the bet, and true to his promise the first better proceeded to win the bet as follows: He jumped from the station platform down to the road-bed from the road-bed he jumped on the third rail, and then a third step along it, he jumped off the third rail with both feet simultaneously back on to the roadbed, and then climbed up to the platform and collected his reward. He never received any shock of course, whatever, owing to the fact that when he stood on the third rail, he did so with two feet and not with one foot touching an exposed charged electrode or body. This also explains how a bird can alight on high voltage lines when people frequently are amazed at. The answer is simple, as in the above case. This is so for the reason that to receive a shock you must have both feet in contact with the positive and negative sides of a circuit, or in other words, you have got to complete a circuit charged at a certain potential to the op-
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In Fig. 10 there is shown a very common way in which persons working in factories and particularly in foundries and similar shops provided with earth floors receive shocks, as under these conditions they will frequently and carelessly touch the "live" blade of a switch in starting up a motor, or they may allow their fingers to get in contact with "live" metal parts on motor starting boxes, speed controllers, etc. Under this condition they will receive a shock which sometimes proves fatal. The current passing from the live metal part of the starting box, which they happen to touch, down thru the body to the earth on which they are standing, and thence back to the opposite side of the circuit thru the usual ground of such systems. The rule to follow here is—to always stand on a piece of dry board, a wooden box or several thicknesses of dry paper; further they should always be careful not to touch any "live" parts of the switch or starting box.

Electricians and others often receive disagreeable shocks while repairing dynamos and other machinery as well as electric light sockets when they sometimes have to stand on an earth floor as in foundries and in other locations, when the danger of receiving such a shock may be readily eliminated by standing on a piece of dry board or several thicknesses of dry paper.

The writer recollects a very peculiar case when an electrician attempted to repair a live electric light socket in a fish market—but his fish hook was also shocked for. The electrician had to climb up on something in order to reach the socket, and grabbed hold of several small convenient boxes which he placed on top of the other, and these he placed in turn on a large marble slab which was used in the fish market for cleaning fish. Well here's what happened in a few words, and a more surprised electrician you never saw. The boxes looked thoroly dry, and they were dry to all appearances, but when he mounted the third box and touched one side of the socket connection he got a severe jolt, which of course at once told him that his body was earthed but how? The answer was soon evident on a little reflection. The marble slab, owing to frequent usage, was thoroly impregnated with salt brine as well as the boxes. The problem was solved by going outside on the street and purchasing a couple of newspapers for two cents. Going back to the job on hand, the electrician folded the newspapers several times and placed them on top of the uppermost box. No more shocks were received after thus solving the problem.

It has often happened that firemen have been severely shocked or killed while fighting fires, when a stream of water happened to come in contact with high tension electric light wires. The illustration hereewith, Fig. 12, shows how a fireman, or in fact any person using a hose such as a garden hose for instance, may protect themselves against such a contingency by touching the brass nozzle of the hose. They should be careful to keep hold of the rubber hose which must not be wet and which will act as an insulator, but if they grasp the brass nozzle and in case the stream of water touches the electric light wires on the house, etc., a current is liable to pass along the stream of water, and if it touches the nozzle it may pass thru his body to earth. It frequently happens that high potential feed wires pass in close proximity to houses, carrying as high as 2,500 to 5,000 volts, and thus it is possible for a person fighting a conflagration under the opposite side of that circuit charged at an opposite potential.
ELECTRICAL EXPERIMENTER

POWERFUL ELECTRO-MAGNETS
—WHAT THEY CAN LIFT.

(Continued from page 89)

at 40 to 60 miles per hour, and to nitify them out of the water before they can hit the vessel's hull and damage it. The tendency in the first place is backed by a 200 H. P. comprest air engine, and, traveling at express-train speed, its momentum can readily be imagined. Such a powerful magnetic force would not deflect a modern automobile torpedo to any practical degree, by any known application of the laws of attraction, as is the firm opinion of the Naval experts.

With these large magnets the attractive force on a steel plate is not as great as the largest magnets we expect, on account of the small cross section in the plate available for the magnetic flux. Many schemes are presented to us for removing sunken vessels by means of such large magnets acting on the plates. The large magnet here described acting on a plate 5 to 6 inches thick in contact with the magnet would have an attractive force of about 100,000 lbs. On a 3½" deck-plate, however, this lift would probably not exceed 10,000 lbs. See Figs. D and E—the effect of decreasing the thickness of the piece to be lifted is thus clearly illustrated. Thin plates cannot carry sufficient magnetic flux to render the magnets net efficient. The heavy plate can carry more of the total flux produced by the magnet, hence the combination acts more efficiently. The thin plate will not carry the large proportion of the flux is wasted by leakage thru the air, hence, the lesser lifting power.

With a 1-inch steel plate, covering about the same area as that of the magnet, the lift would only be somewhere between one and two thousand. The same results would apply to the 60- to 100-lb, steel billet, illustrated at Fig. F.

[Editor's Note:—As pointed out elsewhere in this issue, particularly in the article on "Magnetic Guns," it is possible to greatly increase the strength of electro-magnets momentarily by overloading them for a few moments. Prof. Birkeland, inventor of the most efficient magnetic gun design yet devised, thus manages to set up an almost indefinite field for a fraction of a second by greatly increasing the current past thru the magnetic coils. In most practical applications of the electro-magnet, however, the "ramping" of the magnet current is of little or no utility. A steady, even pull is most always desired and provided for.]

THE PHENOMENA OF ELECTRIC CONDUCTION IN GASES.

(Continued from page 94)

INCANDESCENT SOLIDS.

When metallic wires are heated to incandescent ions are produced. At low temperatures positive ions are usually given off and at higher temperatures negatives are also emitted. J. J. Thomson explains the production of ions by incandescence by saying that there must be free electrons in the metal which, when their kinetic energy is increased by the heating of the wire, finally break away from the wire as free negative ions. The production of the positive ions is more difficult to explain, as many experiments seem to show that they are not uniform in size, sometimes being much larger than the electrons. Evidently the heat and electrical energy together causes a disintegration in the wire itself which sets these particles free. C. T. Wilson devised a very clever experiment to show the existence of these particles about an incandescent filament. First he surrounds the filament with a gas and he then allows it to expand. At this point a visible cloud appears around the filament showing that in the neighborhood of the filament negative ions are set free and are given off by it, about which the moisture condenses to form the small visible drops of the cloud.

The salt of most any metal will produce ionization if thrown in a flame. Many phosphates, nitrates, and chlorides give off ions very readily. If thrown on the other hand, many other compounds give off negative ions freely, such as the oxides of barium, strontium, and barium. A carbonic acid contained in the filament is distinguished from most metallic filaments also gives off electrons when heated. It is this principle upon which the first arc was operated in which a current can be made to go from a separate electrode to an incandescent carbon filament, but not in the opposite direction. Something similar to this effect is also found in electric arcs.

ELECTRIC ARCS.

Dr. J. A. Fleming, who made a study of the Edison effect in carbon filaments, also made a special investigation of electric arcs, in which there are very great numbers of positive and negative ions. He found the positive pole to be worn out in a crater shape due to electrons emitted by the cathode striking it and dislodging large positive particles. He further found that if a set of terminals were connected to A and cathode C, Fig. 3, it was not necessary that both poles be incandescent and giving off ions. Fleming explored the arc with an auxiliary pole E, and he found that while the current-heating he could get a current between E and C but not between A and E, keeping E cold. In other words, he could get a current between two carbon ions when one was giving off negative ions, but not giving off positive ions. This he interpreted to show that comparatively few positives are given off and that the negatives carry most of the current. Such ions as these in electric arcs are very interesting on account of the number present and the fact that they are of many various types. It seems that the negatives are usually electrons, and the positives are frequently clusters or groups.

COLLISION.

Early scientists decided that if the pressure of a gas never decreases, the collisions of the molecules must be perfectly elastic, and this seems to be true at ordinary velocities. However, when two particles are moving fast enough collision will cause them to produce ionization, and the amount of energy which such a particle must possess represents what is called the ionizing energy. Furthermore, a modern scientist, Fertz, has proved that if a moving ion just

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June, 1918

Measurement of Logarithmic Decrement

The condenser is set at the position of complete resonance as shown by the maximum deflection on the sensitive instrument, whose readings are proportional to $F$. The capacity is now decreased until the meter reads one-half of the former value, and the decrement formula, which can be independently rotated, is set at zero and clamped so as to rotate with the condenser. The condenser is now increased in capacity so that the meter reading at present 1/2 $F$ will increase to 1 and again decrease to 1/2 $F$. The scale reading may oppose the index mark $d$ is the value $6+\delta$, $\delta$ being the decrement of the circuit under test, and $b$ being the known decrement of the instrument.

By referring to the second article of this series, we see from the resonance curve that the ratio of change of capacity at the points corresponding to 1/2 $F$ are greater than at the point corresponding to 1 $F$, therefore, any decrement formula eliminating the necessity of locating the point corresponding to 1 $F$ is to be preferred, since the points corresponding to 1/2 $F$ are more sharply defined.

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The method of measuring the decrement just explained makes use of this very property and involves the formula:

$$\delta + \beta = \pi - \delta$$

which has been explained in a previous paper, $\beta$ corresponding to the capacity above resonance, giving current 1/2 $F$, and $\delta$, being capacity below resonance, corresponding to 1 $F$.

Fig. 4 shows a schematic diagram of the circuit of the Kolster decrementer. I is a single-turn coil which may be connected in the antenna circuit under test, and since the inductance of this coil is small as compared to the total inductance, the tuning adjustment will not be changed in the majority of cases.

The coil L is the inductor of the meter, either one of the three coils furnished with the various wave-length ranges from 300 to 2500 meters may be used. Coil $L$ is so arranged that the mutual inductance between it and coil I can be easily varied.

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$C$ is the variable condenser, independent of which the wave-length scale is attached, and to the scale the coil $L$ is geared to the condenser shaft in a 6 to 1 ratio, thereby opening the divisions on the scale in the ratio of 6 to 1. The scale has a zero point in the centre and goes to .3 on both sides.

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The most important point is that the telephone receiver spool comes already wound complete, and the Experimenter will, therefore, not need to wind his own spool.

The outfit when assembled comprises a highly sensitive CARBON GRAIN MICROPHONE with carbon diaphragm of exactly the same type as is used with our $15.00 Detectiphone. (See our Cat. No. 1.)

The receiver is a special low resistance double pole type with the difference that no magnet is used in the same for the reason that the function of this instrument is electro-magnetic, the same as all loud-talking phones.

The spool is wound with special enamel wire for five ohms, standard with our Detectiphone.

This instrument works best on four dry cells, and particular attention is called to the fact that in order to work, the loud-talker requires a fairly heavy current and for that reason thick wires must be used for connecting the transmitter with the loud-talker. If this is not done, the voice will be weakened considerably. If no heavy wire is at hand, more batteries must be used to compensate.

USES: This instrument can be used to transmit phonograph music from one room to another; used as a Detectophone; as a Radio Amplifier; as a telephone extension by placing the regular telephone receiver against the sensitive transmitter with the loud-talker; for salesmen to talk through window (Loud-Talker outside in street, microphone transmitter for salesmen, talking into same); for restaurants for talking to the chef, and a hundred other uses. Many young experimenters are developing a lucrative business selling this appliance to various merchants at a good profit.

Outside of the two instrument parts, one three-foot cord is furnished with sensitive microphone as shown; instructions, etc., are furnished.

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SCIENCE AND WAR

E read a good deal lately about the futility of science in general, and the cry is long and loud that much vaunted science instead of civilizing and preventing wars, actually brings about wars and prolongs them. Parlor critics and the lay press, particularly, when things go right, are wont to ask cynically what science ever did to prevent wars, or if that were impossible, what it accomplished towards shortening wars. Science is credited with accomplishing nothing but murderous machines and devices and of calling into being destructive forces without end. Science, in short, is held up to us as a modern Frankenstein Monster, which, escaping from our laboratories, now runs rampant and wreaks vengeance not alone upon those that brought it into being, but upon our entire civilization as well.

As to science creating wars, we might state that there have been wars ever since animal life appeared upon this planet. War is a natural phenomenon, the same as, let us say, a volcanic eruption. Neither is it confined to man alone. It is the eternal war for supremacy, whether it be the fight to death between two roosters, or the war between two great animal nations, such as for example, the witnessed in ants, where hundreds of thousands are fighting for an equally large horde of supremacy, killing and maiming thousands and bringing back vast numbers as prisoners, henceforth to become slaves.

If we would only accustom our minds to the great and outstanding fact that there will be wars, small and large, as long as the earth endures, we would think of war in a totally different manner.

Therefore if we cannot altogether prevent war, with the aid of science we can certainly very largely prevent its former horrors and perhaps shorten it. Any student of history knows that creeds have become less and less frequent as the centuries roll on, while statistics go to show that, considered as a whole, there have been far fewer wars during the past century, which marks the real beginning of science. As to the murderous war inventions created by science, such inventions only seem so murderous to the uninformed. Statistics show that far from killing more people, the reverse is the case. The number of men actually killed in action, as hit by cannon, rifle, poison gas and what not, is less than 5% of the total casualties. Even now, more men die from natural causes or from bodily diseases than from man-made scientific frightfulness. There were more people killed in the United States last year by automobile and railroad accidents, casualties in factories, etc., than were killed on the road by war. A careful study of statistics will bear out this statement.

In the former great wars as high as 70% of the effective fighting forces were lost by the ravages of disease, such as cholera, typhus, etc. Napoleon’s great army after the return from Russia had dwindled down to less than 25% of its former strength, mainly thru disease. These were the former great horrors of war, now entirely conquered by science. Modern surgery, anesthetics and medical science as a whole are daily reducing the death toll among the unfortunate fighters struck down by the hand of man. Where formerly over 90% of the casualties of war thru disease was eliminated, this percentage has been reduced to less than 20. In other words out of one hundred maimed soldiers less than twenty now die of their wounds. While the entire balance may not be again fit for actual fighting, this vast percentage of disabled humanity is returned more or less intact to its peaceful pursuits. While it is not our intention to call war a benefit to humanity, the fact can not be denied that it has given medical science a wonderful opportunity to make new and important discoveries, to greatly reduce suffering, as well as treating diseases more intelligently hereafter.

Medical science alone has vast opportunities during the war, because it has more human material to work upon than in peace times. The fallen soldiers will therefore not have died in vain. Each one of them will prevent thousands of others from dying during the peace that is to come.

H. Gernsback
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Liberty Bell Heard O’er the World Via Radio

By THOMAS REED

E ver notice how Tyranny always runs true to form? Take the average baby. Having reduced his home to subjection — buffalosed, bullied and seduced it to a finish—he picks the moon as the next subject for “annexation and indemnity”: which process the moon resists, in its unwarmed, moonlike way. Action and reaction being equal, the moon probably suffers somehow for its temerity; but the principal effect is observed on the foiled baby, in the well-known everyday domestic phenomenon of “tantrums.”

When this happens, good nursery-psychology recommends diversion of the infant conqueror’s mind by dangling before him any handy object, exclaiming, as engagingly as possible, “See the pretty doggy!”

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or whatever Common Parliament names the selection. You find the same psychology applied to the spasms of the undeveloped "nondescript" wisdom behind the disarrangement in his Paris time-table, and the unaccountable hitch in his Pictorial "negotiations."

The "doggy" in his case—the Nauen wireless-station—inspires this remarkable declaration:--

"From the formidable towers of this establishment, we have the gigantic rays of which surpass all the fables of antiquity, waves are incessantly sent forth which acquaint the listening nations with everything that is in our judgment they ought to know. This wondrous invisible committee, moreover, has consistently kept us apprised of events which the enemy would gladly have withheld from us."

Gosh! The Fables of Antiquity certainly have been outstripped; and the screen shown an innocent Nation cocking its ear to catch, amid a world of deception, the only clear, snappy, reliable TRUTH, "made in Germany" expressly for its enlightenment; and in the excitation being pitted of a shy heart-throb—such as a Declaration of War! They say they are always efficient, and this patent "divertor" of theirs proves it. It's a fine divertor. It would divert anybody.

But while the bistoring is good! I have an idea.

You remember, a few years ago, how Mr. Carty, the Telephone Wizard, with his "Audittle" and various do-fummes, talked by wireless around half the world? Well, what's the matter with ringing 'em up again, and sending out a boom from the

"Chaukendew Zeitung, quoted in Boston Transcript."

---

Hats off to Thomas Reed! Here is the germ of a wonderful idea—and a typical American idea, too. Not so long ago Mr. Carty of the American Telegraph and Telephone Company succeeded in making the human voice heard by Radio half way around the earth. The voice of the operator, stationed at Washington, was heard in Paris, France, and as far as Honolulu.

Mr. Reed suggests to transmit the metallic voice of old Liberty Bell by Radio thru the ether over this war-wrecked earth of ours, symbolizing the voice of Liberty in the most unique fashion possible. Yes, the German station at Nauen would hear the voice of Liberty Bell, too—Liberty ringing its way thru the ether, in advance of the American Army. The plan is simple and practically costless, as all the apparatus are on hand. What better date could be selected for the momentous event than July 4th, 1918. Let us hope that it will come off.

Readers, Wireless enthusiasts! When you see this in print write or telegraph to the Secretary of the Navy, the Hon. Josephus Daniels, Washington, D. C., asking him to send the voice of old Liberty Bell ringing over the battle-fields in France, on to Berlin, on July 4th. If 100,000 of you urge Washington, the great event will come off—a monument of the solidarity and enterprise of American Amateurs. Show this article to your local paper and urge it to reprint it at once, sending a clipping to us.

Now all together Amateurs! Show the nations that you are still on the map!

---

Liberty Bell, in Independence Hall?

And for a starter, what's the matter with mending our Bell, so we can boom it, good and proper? It's curious that while the "whole push" from song-writers up (or down) to financiers, are calling for the Liberty Bell to "ring again," they seem to mean the ring was formerly cyclical, but it's cracked. But say, what does a crack amount to in any metal object, in these days of arc and acetylene welding? Science has moved on since we set the Bell away on a velvet cushion, and entered it up as "incurable." Broken cylinders and flywheels are being welded every day—huge things, beside which the Liberty Bell would look like a toy; mended, not merely to ring, but to resist high steam-pressure and enormous centrifugal force, and actually strong for every ward than before, since the original flaw has been eliminated.

Sure, it's the simplest thing in the world to fix our Bell, unless we prefer it broken and out of commission. But why should we—our Liberty isn't in that plight! Up to a certain point, the Bell for America was pretty closely. We founded our Freedom in 1776, and the Bell rang for us. But then the casting of our Independence, which we couldn't do before, and that's all. The casting of the Liberty Bell, which worked and widened till it broke the Nation apart; while the Bell, too, developed and expanded, and cracked from it. We welded the Nation's fracture together, better than any other castings. But there, the Bell stopt accompanying history, and the reason's why it wouldn't catch up again, now that we're setting our Liberty to the biggest job of her life.

I sure wish that old Bell was fast, and Mr. Carty's rinktums were working to and fro. If it were possible to arrive at a certain appropriate moment, when all radio traffic should stop, and for one whole minute the ether, everywhere around the world, should hum with "Liberty Vibrations" alone.

Anyhow, for the "Hum," up there in the "formidable towers," that would be a reminder of what Pioneer Peoples do to the Posts of the earth. He's had examples, in "Pats" and "Anzacs"—I name'em with respect. What with Indians and bears, rattlesnakes, bad-men, gypsy-moths and Trusts (to mention only a few of our Nearest and Dearest) we're so accustomed to swatting "vampires" that eyes can't see them. But if radio power or two come all in the day's work. With an "Ah there, neighbor!" for the new arrival, we should be over the kinks, and, whistling and busy, get after him.

Well, perhaps my scheme is only a pipe-dream. But 'you know me, Al!—while my hopes are small of entertaining an angel unaswares, I never 'ould turn away a needy pipe-dream from the door!

---

A CENTURY OF LIGHT.

1815 to 1855, sperm oil and candles, average home used 25 candle hours in light, or 9,000 per annum—cost $22.

1855 to 1865, kerosene introduced with 50% more light, same cost of $22.

1865 to 1875, kerosene and gas—average household used 20,000 to 30,000 candle hours—cost $23 to $34.

1875 to 1885, kerosene reduced to 2½ a gallon, gas to $2 per 1,000 cu. ft.; average family used 76,000 c. p. hours per year—cost $30.

1885 to 1905, kerosene disappearing—primarily due to gas mantle coming in, 200,000 c. p. hours average family used per year—cost $30.

1905 to 1915, average gas c. p. hours, 200,000. Average electric c. p. hours, 123,000 (due to saving thru switches)—cost $15.

Maximum increase of average families, 360 candles, or about 18 times that of a century ago.

With increase of 1700 per cent in amount of night lighting, reduction in cost to lighting is about 70%. Express another way, the cost of lighting per unit candle hour is less than 3% of what it was in the first half of the period.
Science and Radio in New Film Dramas

THERE seems to be no dearth of the "scientific movie" from present indications, with the vast number of serials and individual photoplays that are appearing all over the country. With the public mind literally fed up on the work of the German spies thru the daily papers, it is only natural to suppose that the screen should reap a rich harvest with film dramas showing these inner and secret workings of the Imperial German Government's espionage system in a graphic form.

First and prominent amongst these is the "Eagle's Eye," showing the story to which the German Government has resorted to hamper the work going on in this country. It is shown how a German agent's laboratory was raided by the U. S. Secret Service and the compositions discovered there tested, with the result that numerous bottles were found to contain disease germs of various kinds to be used in causing an epidemic of sickness among the longshoremen of New York, in order to paralyze the shipping of supplies to the Allies.

The upper left photograph shows the wireless room of the Criminology Club of New York City. This club is a composite organization representing the Secret Service used throughout "The Eagle's Eye" to picture the activities of the body headed by Chief Flynn, the author of the picture. The picture shows a call being received, summoning the members to the Jersey stock yards at the end of the line to burn several thousand bales of cotton and horses by the Imperial German Government, was discovered.

The remarkable "Life Restorer" pictured here (center) plays an important part in one of the closing episodes of Pathe's new serial "The Hidden Hand." After many thrilling and exciting incidents in which an heiress and a Secret Service man, who is trying to prove the girl's identity and finally "falls" in love with her, figure prominently, we arrive at the scene where the villain of the thriller known as "The Hidden Hand" has been mortally wounded and his followers carry him away unconscious. They try to revive him, but without success and then "Verda," his right hand man, orders the henchmen to try the electric re-suscitating apparatus on him. By its means he is brought back to life. The machine is essentially a large static machine and is very realistic in the semi - darkness with its large spark discharges in full operation. The basis for the introduction of the machine has been conceived by the author, Arthur B. Reeve, writer of the Craig Kennedy stories.

Last but not least we come to the General Film Company's new patriotic spy movie. "I'm a Man," in which Radio telegraphy plays a prominent part. (Lower photo.)

Frank Eisel, the son of German-born American parents, is a member of the High School Cadets. Frank's father is a banker who is desirous of having his daughter, Ruth, marry a Frenchman named Decourcy, a director of the bank and very wealthy. Ruth has another admirer. David Smith, a young bookkeeper in the bank, but their growing attachment is frowned on by the father who favors Decourcy. One day Frank notices a poster reading "Beware of Spies" and turning, sees Decourcy talking with a stranger, and he at once suspects the Frenchman of being a spy. Events prove that he is right, as Decourcy reveals himself to Frank's father as a German spy who has been masquerading for ten years as a Frenchman. On account of operations made thru the bank, he not only compels the banker to keep silent, but insists that he be received into the Eisel home.

Here he learns of Frank's amateur wireless outfit and demands that the father get the boy out of the way so that he may use it. This the father does, but Frank returns unexpectedly and intercepts a message regarding the burning of some oil wells, and he saves the wells at the risk of his life. When Frank is hovering between life and death, Dave Smith, now the accepted suitor of Ruth, notices a change in the boy's condition and instantly springs to the boy's side, revealing a secret service badge that he is wearing. Thus Frank knows that his father is no longer under suspicion, and the banker is also overwhelmed with joy, realizing that Smith knows he is a true American, and he turns to Frank saying, "Frank, my son, you are a man!"

The photograph shows young Frank Eisel operating his radio set while in close proximity may be seen his young lady love, Miss Dolly Hope.

The chief inventions used in the present war as distinguished from the Napoleonic wars: Steamship, submarine, air craft, high-power guns, smokeless powder, breech-loading gun, rapid-fire gun, revolver, automatic pistol, telephone, wireless telegraphy, automobile, poisonous gas.
Electric or Steam Railroads—Which?

By H. WINFIELD SECOR, Assoc. A. I. E. E.

YOU stand enthralled in a beautiful gorge among the Rockies, admiring the supreme grandeur of nature, when—with a roar like distant thunder—a long, snake-like train of steel cars, headed by a smokeless demon that fairly bristles with power, dashes by you at a mile-a-minute speed.

more or less interested in the comparative costs of operation for such electrification, and always, always the question comes up—Will it pay? The answer has been pretty well settled by the facts and figures presented in the past year or two by our ablest engineers, and particularly by the report of the railroad operating the long-

Notable among large steam railroad electrifications are the following: 1896, Baltimore & Ohio Tunnel; 1906, New York Central Terminal; 1906, West Jersey & Seashore; 1909, Great Northern; 1910, Detroit River Tunnel; 1910, Pennsylvania Terminal at New York; 1911, Southern Pacific; 1913, Butte, Anaconda & Pacific;

It’s the Chicago, Milwaukee and St. Paul R. R. “Olympian,” the finest transcontinental train in the west, speeding on her way to the Pacific coast. She’s driven by “juice”—3,000 volts of it, and thousands of amperes, all transmitted over a thin copper wire from mighty water-falls, high up in the mountains. There the electrical engineers have placed their electric generating stations, where gigantic turbines spin the dynamos all day long, reclaiming the power in the water—at present over 150,000 horse-power is developed by these hydro-electric plants, the most efficient of all methods in the production of electrical energy.

Now that the whole country has been aroused as to the countless possibilities of electrifying the railroads, and other arteries of commerce and industry, by the recent reports from engineers connected with the national government, everyone is est electrified mileage in the world, the Chicago, Milwaukee and St. Paul system, which now haul all their passenger and freight traffic over the Rockies from Har- lowton, Montana, to Avery, Idaho, a continuous run of 440 miles. This railroad is now arranging to “electrify” to the Pacific coast, so successful has the present installation proved. This is what Mr. C. A. Goodnow, assistant to the President of the C. M. & St. Paul R. R., in charge of the electrification, recently said: “Our electrification has been tested by the worst winter in the memory of modern railroad engineers. There were times when every steam locomotive in the Rocky Mountain district was frozen, but the electric locomotive went right along. Electrification has in every way exceeded our expectations, not only as respects tonnage handled and mileage made, but also the regularity of operation.”

1916, Chicago, Milwaukee & St. Paul; 1917, Victorian Railways, Australia; besides a host of others now joining the ranks of believers in railroad electrification.

We may profitably study for the moment this wonderful engineering feat so successfully carried out on one of the greatest railroads in the West.

The tracks of the mountain district of the Chicago, Milwaukee & St. Paul Rail- way, in surmounting the obstacles imposed by the Rocky Mountain and coastwise ranges, represent the solution of one of the most difficult problems ever mastered by railway engineers. Out of this section of rugged mountain railway, including many long grades and short radius curves, four steam engine divisions were selected for electrification, aggregating 440 miles in length. Steam engines were first abandoned on the Three Forks-Deer Lodge division,
115 miles long, and crossing the main Continental Divide, thus giving the electrical equipment its initial tryout under the severest service conditions of the entire system. The first electric locomotives were placed in regular service on December 9, 1915, and during the month of April, 1916, service was extended to Harlowton, making a total of 220 miles of electrically operated road. By the first of November, 1916, steam engines were superseded over the entire distance of 440 miles, from Harlowton, Montana, to Avery, Idaho.

This project is the most extensive steam railway electrification in the world, the length of haul being nearly six times as great as any trunk line now operating with electric locomotives. The length of track between Harlowton, Montana, and Avery, Idaho, is approximately equal to that from New York to Buffalo or from Boston to Washington.

In crossing the three mountain ranges included in the electric zone, there are several grades of one per cent or more, the most difficult of which is the 21-mile, two per cent grade between Piedmont and Donald, and the longest the 49-mile one per cent grade on the west slope of the Belt Mountains.

The curvature is necessarily heavy, the maximum being 10 degrees. There are also numerous tunnels in the electric zone, 36 in all, of which the longest is the St. Paul Pass tunnel, over a mile and a half in length, thru the ridge of the Bitter Root Mountains.

The passenger service consists of two all steel finely equipped transcontinental trains in each direction, the "Olympian" and "Columbian," and a local passenger train in each direction daily between Deer Lodge and Harlowton.

Freight traffic thru the electric zone comprises from four to six trains daily in each direction. Westbound, the tonnage is made up of manufactured products and merchandise for Pacific Coast points and foreign shipment. Eastbound tonnage includes grain, lumber, products of the mines and some live stock.

Electrification promises a very marked reduction in running time, not to mention the freedom from cinders and smoke always incident to the use of steam locomotives. It has been found, for example, that on the 21-mile two per cent grade from Piedmont to Donald, the electric locomotive can reduce the running time of passenger trains from 65 minutes to approximately 41 minutes. On the run from Deer Lodge to Butte, which, under the steam locomotive schedule, required an hour and 20 minutes (80 minutes), a saving of approximately 30 minutes can be made.

In the freight service, it has been found that on the first division where the steam locomotives have required 10 to 12 hours to make 115 miles, electric locomotives can meet a schedule of from seven to eight hours for the same distance. The heavy grades and frequent curves at certain points offer serious obstacles to steam locomotive operation even in the summer time, but with winter temperatures as low as 40° F. and heavy snowfalls in the Bitter Root Mountains, serious delays have occurred, owing to engine failures or to inability to make steam. The capabilities of the electric locomotives are in no way impaired by cold weather or by inability to obtain fuel or water in case of snow blockades. During a series of record-breaking temperatures in December, 1915, the powerful Mallet engines were frozen up at different points on the system and the new electric equipment was rapidly put into service to replace them. On several occasions electric locomotives hauled in disabled steam engines and trains which would otherwise have tied up the line.

In cold weather, such as we experience right thru the winter in the East, not to mention 40° to 60° F. in the West, the steam locomotives suffer severely in loss of all-around efficiency. The severe cold makes it harder to keep the boiler parts heated up, and even the best from the coal is used up simply to raise the water to the steaming point, owing to its extremely low temperature. The steam locomotive is about the most inefficient prime mover we know of for practical purposes. It practically never realizes above 7 to 8% over-all efficiency—i.e., in transforming the energy of the coal to tractive force at the driving wheels and draw-bar. The remaining 92 to 93% is wasted in friction and heat losses.

Recent tests in the locomotive laboratory of one of the largest American railroads have shown that under road conditions the best steam engine realizes nearly 7% than 

(Continued on page 207)
How Uncle Sam Tests Coal by Electricity

By SAMUEL COHEN

HOW much heat do we get from different grades of coal? This is the very real and important problem that confronts our manufacturers in operating their plants. The subject of determining the heat unit value of coal and its ash matter is a very important factor to be considered. Briefly, the analysis of coal is as follows:

First, in burning coal, five main points must be considered:
1. The amount of moisture, volatile combustible matter, percentage of ash, sulfur, and calorific value. The latter is the one in which we are mostly interested in the present instance, since electricity plays a very important role in its determination, while the first four items are determined by purely chemical methods.

The coal sample in question goes thru a regular analysis before it is cast and the results of the approximate analysis gives only a general idea of the heating value, by indicating the class in which the fuel belongs. Glimpse of anthracite coals can be characterized by a small percentage of volatile combustible matter (usually less than 10 per cent), while bituminous coal contains a large amount of this constituent (usually 30 to 40 per cent), while in cannel coal this is the main constituent. The proportion of this constituent is dependent on the amount of hydrogen present, as this element forms volatile compounds with the carbon. When hydrogen burns, it evokes a much larger amount of heat than is produced by the combustion of the same amount of carbon. Coals containing a large proportion of volatile combustible matter have usually, therefore, high calorific values, and water which absorbs heat when it is converted into steam. It is evident that the calorific value of a fuel can be calculated from the percentage of carbon and hydrogen present. This method is subject to an error, arising from the fact that the heat combustion of hydrogen and carbon varies with the nature of their chemical combination. Direct methods for determining calorific values are therefore more reliable. The instrument devised for this purpose is called a calorimeter. The calorimeter consists of three essential parts, namely:

1. A combustion chamber, a tank of water with a delicate thermometer for indicating the amount of heat absorbed, and an insulating device to prevent the external heat from reaching the water and the thermometer, and also to prevent the heat generated in the combustion chamber from escaping the apparatus.

A certain quantity of the sample coal is placed in a small container. This quantity is usually one gram. With this coal a certain amount of oxidizing agent is added, and this may be sodium peroxide. In the same container a fuse wire is placed and properly connected to an electric power source so as to ignite the coal mixture at a desired time. The upper right hand photograph shows clearly the sample of coal in the calorimeter capsule. Note the fuse wire on top.

The temperature of the coal when in a burning state is directly determined by means of a special electric thermometer which is inserted in the coal chamber. This thermometer consists of a fine high-resistance wire, whose resistance is determined at the beginning of the test and at the period of combustion. The resistance increases with temperature rise, and since there is a definite relation between temperature and resistance, it is therefore possible to determine the temperature corresponding to the resistance. So by measuring the resistance of the wire in the coal chamber at the period of combustion, we derive from it a mathematical relation of the temperature, and from that the calorific value. The photograph at the upper left hand corner shows a special accurate slide-wire bridge for measuring the resistance. The bridge wire is supported on the drum of the apparatus. The lower photograph shows four of these calorimeters. The wires are used to connect the igniting fuse wire with the current supply, while some of them run to the electric thermometers.

This work is of extreme importance insofar as it tells the purchaser the maximum amount of heat he can possibly obtain from a certain grade of coal.

ELECTRIC SAW MILLS.

Electrically operated saw mills of the portable type are said to be rapidly gaining in favor among lumber men. In localities where water power is abundant and has already been partially converted into cheap electric power the portable sawmill is especially popular. According to the president of a firm which is manufacturing electric portable sawmills, the demand is fast increasing in the South and West of the United States at the present time.

TELEPHONE CABLES IMPROVE WITH AGE.

It is found that the insulation resistance of telephone cables increases with the age of the cable, when it lays in the ground, because the moisture it possesses appears to be dried out.
NEW DENTAL AND X-RAY MOVIES.

D. R. E. L. CRUSIUS of New York city has announced that in co-operation with one of the leading film companies he has perfected a system for taking X-ray moving pictures which is expected to be of great service in treating injuries to the joints.

Among the pictures taken thus far are illustrations of the movements of the knee, ankle, and elbow. Dr. Crusius says that the photographs show not only the bones but the muscles, and that by moving a joint that has been injured and photographing the action of muscles and movements of bones it will be possible to find out just what parts have been injured and the treatment required.

A physician desiring to have the heart of his patient tested sends him to a radiologist to have an X-ray taken. The picture can show the size, position, and appearance of the organ, but it can not show the rising and falling of the heart beat. Again, the radiologist, during the examination, can take note of the manner of the beat, but he cannot pass his observation on its actual form. The same is true of X-rays of the lungs, stomach, intestines and other organs; than can not be shown functionally. An X-ray photo of the living stomach is shown herewith. Thru the use of the new machine radiological people. Most every one has read of the wonderful work done by the Italian army this past winter in the mountains in the campaign against the Austrian army; of the almost insurmountable difficulties that have been met and overcome, and it is only thru the medium of the moving picture that one is able to grasp the significance of this vast work.

We see the Italians transporting guns over the mountains by means of long steel cables and aerial cars or bombarding the enemy during the night under the glare of a hundred powerful electric searchlights. In the morning following, the infantry takes up the charge to gain and consolidate the ground which has been cleared by the heavy shell fire, and it is during these scenes that the dangers the camera man is exposed to, with the hail of bullets ringing the machine wherein he looks like the proverbial peanut on the watermelon.

The full significance of photography in the World War can only be realized in a small way from this brief resume of course, and only when we have returned to peaceful pursuits again and witness all that has been preserved thru the medium of the photographic film and plate will we fully appreciate the invaluable records that we can pass on to posterity.

The American Army now in France is being equipped with all the latest electrical appliances. Searchlights mounted on telescoping towers are being supplied to our forces as fast as conditions at home will permit. The other presents a complete root filling and the amputation of the same tooth. Many teeth now sacrificed may be successfully treated and give life-long service.
Will The Germans Bombard New York?

By H. Gernsback

Of late we have been reading quite a good deal in the daily press about the possibility of an aerial attack on American cities by the Germans. Many anxious inquiries have come to the writer's desk from readers of this periodical, asking if there was any chance or probability of an aerial raid at this time. Many people seem to think that raids are impending this year, while equally as many are skeptical about it. It is the purpose of this article to point out certain relevant facts relating to the above, and we will try here to show the technical aspect of the idea.

It does not bring a military advantage. What the lay critics seem to leave out from their reflections entirely is this: If the English or the French were positive that the Germans would not or could not bombard their cities, they would not have to keep hundreds or thousands of aeroplanes inland for defensive purposes, and these aeroplanes could then be used to the greatest advantage at the front.

In other words, by sending, say a dozen, bombing machines over London, Germany effectively ties up several hundred English aeroplanes inland, which then obviously cannot be used against the Germans either at the front or to bomb German cities. Therefore, it is good business from the German viewpoint to send a few machines over London or Paris at irregular intervals, thus locking up a large quantity of English or French aeroplanes that might be used to vastly better advantage against the Huns. This is the main reason, and probably the only reason why these raids occur and from a military viewpoint must occur. The Germans have no choice about it, for if they did not do it, the Allied aeroplanes would overwhelm them at the front.
preme effort to slip thousands of aero-
planes to Europe. The ocean lies between
us, and we are in a way comparatively safe
from aerial attack.

The German military command, however,
cannot view the situation but with great
alarm, and in self-protection it will be nec-
essary to establish a vast network of Ameri-
an aeroplanes on our own shores, if the trick can be done. In other words, the Germans will try to cut us off from shipping all of our aeroplanes to Europe, and they will stop at nothing to gain their end. Blowing up factories and military camps in America by their agents
will not help them much, and they will not
be able to torpedo but a very small percent-
age of our total tonnage of these aircraft.

What simpler remedy then is there for their
problem than to bombard occasionally, say,
New York, Boston or Philadelphia, thereby
practically cutting us off by a vast fleet of
aeroplanes. This is the military
aspect of it and for this reason it would be
safe in allowing ourselves to live in a fool's paradise. We should always
remember that we are facing a formidable
enemy who stops at nothing to gain his end, and the German army and navy do
to often accomplish the impossible. 

Witness the 76-mile gun which was so prepos-
teriorly described in "Flying With"—an armoured battle-plane,—
which has just made its appearance over the
Allied lines to our great discomfort. The
plane is so large that even a skilful pilot
does not dare to be an alarmist, there is but little doubt
that some of our American coast cities are in
for an aerial raid. But how can it be
accomplished?

Zeppelins may safely be left out of con-
sideration. These huge aerial sausages
have already been surpassed by the British
as well as the French, and they do not venture
to face us on the flight of their lines.
They are too vulnerable, offer too big a
target, and are easily shot down by anti-
aircraft guns, as well as by attacking aero-
planes. There seems then little possibility
of a Zeppelin making its way over the
Atlantic at the present time of writing. Even
in peace times it is questionable if a Zepp-
elin could cross the ocean at the present
day. The tremendous weight of the
fuel alone is against such an undertaking.
Aeronauts, let alone carrying bombs,
average atmospheric conditions, etc. This
leads us to the question of a Zeppelin.

While it seems quite possible, and as a
matter of fact very probable, that the At-
lantic will be crossed by an aerial vehicle
shortly, we have no assurance that the
Germans have built super-submarines from
to ten thousand tons, and we under-
stand that some have actually been 
launched. We know that submarines can
readily cross the ocean, as has been proven
by the Deutschland as well as by our own
submarines, but we have no assurance of such a craft not only the Atlantic Ocean, but the Pacific
as well. If the Germans have a 10,000-ton
submarine, it will be a very simple matter
to have a craft of such size immersible anywhere from three to five
"knocked-down" aeroplanes, and which can be
readily flown off in a few minutes' time on a temporary platform on top of
the submarine.

This problem offers no technical difficul-
ties. If aeroplanes can be launched from
a submarine, it has been declared as eminently feasible by
many authorities. A submarine as large as
ten thousand tons has quite a breadth, and is of course of great length. A light steel
or wood platform can readily be put in
place within a few hours' time, and then
the crew will find but little difficulty in assem-
bling and launching it from this platform. Our front cover shows the idea
better than words, and we are leaving the
details to the reader's imagination. We
again wonder to what extent it will be
a comparatively simple matter for
the Germans to do this. If the attempt is
made the Japs will probably send over a
number of submarines, several of them being
used to carry aeroplanes only, the others
to act as a sort of guard to ward of hostile
vessels. And the attack will most likely
be made at sunset when the air is usually
calm, and when the submarines will stand
thereby...

THE AUGUST "E. E."

Among one hundred other timely
articles to appear in the August issue are
the following, which cover the fields
of Electricity, Radio, Physics, Experimental
Chemistry and Astronomy.

An "Aerial Mono-Rail Flyer of the
Future"—It flies along on a single
steel cable at 200 miles an hour, A
dream of to-morrow, based on facts of
to-day.

Recent Developments in New
tyork's subway system.
A Page of Electrical Summer-time
Comforts.

Diamonds and Rubies Made to
Order—-rate of the Electric Furnace
Coupled to Modern Industry, by George Holmes.
The Spectroscope and How to
Build One—written by an expert
beginners in the art of spectroscopy.
A Water Jet Blast Apparatus, by Prof. Herbert E. Metcalf.
New Radio graph chart which solves
all calculations in wave-length, in-
ductance and capacity, by E. M.
Tingley.

"Gaseous Nebulae"—Part II of
Popular Astronomy, by Isabel M.
Levis.

The Phenomena of Electrical
Conduction, by G. W. S. Le Gros,
Why Ions Disappear, by Rogers D. Ruak,
M. A.

The Design and Use of the Wave-
meter—Part IV, by Morton W. Starna.

Kenotron Rectifiers Stop Smoke.
Harmonics—Part II, by Prof. F.
E. Austin.

ELECTRICAL EXPERIMENTER

When Blucher was standing on the Lon-
ton Tower looking over the vast city he
exclaimed: "What plunder! A German
availing himself of our own errors to
claim: "What an opportunity for ruthless-
ness!" There are hundreds of targets here
that would prove almost impossible to miss
for any skilful aviator—New York, New
York even at night lends itself extraordinarily
well towards such an exploit. If you have
ever been up on a 200 foot ladder over
New York on a dark night, you will
have found that it is never absolutely dark,
the two rivers always providing a certain
illumination and moonlight. A skilful
aviator would find it difficult to miss his objects.

There are, first of all, the hundreds of
docks and the bridges which, besides the
railroad stations and numerous other points so large that a skilful aviator
could hardly fail to hit his objectives when
dropping low. And we have no aerial defenses
at the present time worth speaking about.
We have heard about anti-aircraft guns
being emplaced, but we have seen nothing
far. We have not a large defending aero-
plane fleet as yet, and unless we organize
one soon, we will be practically helpless against
an aerial attack. For instance, there is
certainly a great number of some industries of course in having defending aero-
planes stationed about Long Island, who
are giving battle and fighting as they are sighted. Thise we consider of
paramount importance, and we will in time
no doubt have such a defense. It cer-

The writer desires to advance an idea
here, which, while it may not be an all-
engagingly certain to prove to be an impor-
tant factor if a raid is ever planned upon
our cities.

His idea is to throw a cordon of sensi-
tive submerged microphone buoys about
the central station which might be the
Brooklyn Navy Yard. Three to five hun-
dred of such buoys would effectively
help us to listen in for submarines at the cen-
(Continued on page 192)
The Story of A Pound of Coal

Explaining the enormous losses occurring when a pound of coal is burned under a boiler, the steam generated used to run a steam engine, and this in turn caused to drive a dynamo supplying electricity for lighting.

Did you ever stop to consider how much of the energy present in a pound of coal is actually converted into electrical energy, even in the best power plants of to-day? In a few words it is this—that out of every pound of coal burned in a steam boiler in an electric power station we only succeed in converting about one-half of one per cent of the total energy in that pound of coal into radiant light! The average person believes that in this so-called "electrical use" we have reached well-nigh perfection, but the above figure illustrates vividly that the electrical and steam engineers have many problems yet in front of them before anything like real efficiency is attained in converting the energy in coal to electric light, or for that matter into electrical energy with which to feed the lamps and other apparatus. For the largest and most highly developed steam-electric plants of to-day do not realize an over-all efficiency of much above ten per cent.

This figure of ten per cent represents the ratio between the coal burned in the boilers and the current delivered by the dynamos to the bus-bars, and shows that what most persons believe to be a wonderful and highly efficient electric power generating station is really throwing away about 90 per cent of the energy in the coal it buys. A modern water-power electric generating station may show a gross efficiency of as high as 98 per cent; therefore there is something radically wrong with our coal-burning methods, beyond the shadow of a doubt. Several well-known inventors have ventured to design a different type of apparatus for developing electrical energy direct from coal, but so far no commercially successful method has been perfected. Even Edison has tried his hand at perfecting such a machine, but so far we have not advanced beyond the periphery of 1 pound of pure water 1 degree Fahrenheit, at or near its maximum density, 39.1 degrees Fahrenheit. One B.T.U. is also equivalent to 778 foot pounds of energy, or 1 B.T.U. per hour = 0.000293 kilowatt-hour, also 1000 B.T.U. per hour = .293 K.W. hour. Having this quantity in mind the per cent loss in each apparatus is readily judged as we progress from right to left or reference to the following table prepared by Mr. Stott gives these percentages directly.

Thus we see where the energy in the pound of coal goes to before it finally reaches the switch-board bus-bars. In other words, starting with 100 per cent of energy in the coal when placed in the fire-box, we eventually throw away nearly 90 per cent of this energy, or to be exact 89.7 per cent, and deliver to the electrical system only 10.3 per cent of the power we started with, when we lighted the fire in the boiler.

If we operate electric motors from this electrical energy we fare quite well, as the motor has an efficiency of from 85 to 90 per cent or more, depending upon the size. That is, the motor converts 90 per cent of the electrical energy put into it into mechanical power at the pulley. But in converting the electrical energy into radiant light we find that the most efficient of all incandescent filament lamps—the tungsten lamp—only realizes about 5 per cent efficiency, and requires about 1 watt per candle.

(Continued on page 198)
CUTTING 260 LAYERS OF CLOTH AT ONCE.

The garment cutting department of the Atlantic division of the Red Cross has its own little trials. Its particular job is to supply with garments cut out and assembled all the Red Cross chapters in New Jersey, New York and Connecticut as fast as those chapters send in calls for materials. And that is no easy task.

The amount of work required to keep up with the demand is enormous. Recently, in one week, more than 65,000 yards of material were cut into 1,600 dozen garments. To accomplish this the Red Cross has turned itself into a factory, and highly trained workers manipulating the most efficient kinds of machines make that output possible.

Between the work-room partitions are tables ninety feet long, over which on trolleys suspended from the ceiling run various electric machines. One of them is for spreading the material, one for making stencils as long as the table and another for actual cutting.

This last has to be guided with tireless care. It is fitted with a revolving knife razor so sharp that it will cut thru 260 layers of heavy material as easily as thru one. A single slip, therefore, on the worker's part, an instant's inattention, would be a costly thing.

The stenciling machines, which have little wheels with red hot points for burning holes in paper, are time savers. In order that there shall be the least possible waste of material the patterns have to be fitted into each other with the intricacy of a clever picture puzzle. To do this down the length of a ninety foot table takes an expert worker over four hours, where once a stencil has been cut an untrained person can mark the same amount of material in fifteen minutes.

The department, which has been in operation only a short time, has until lately confined itself to cutting hospital garments. Recently for the first time it undertook refugee garments as well. After devoting its energies exclusively to these for six days, it had on hand a sufficient stock of garments of nineteen varieties and forty-seven sizes to meet any orders which the chapters may send in.

MECHANICAL EQUIVALENT OF LIGHT.

A mathematical equation has been obtained by the U. S. Bureau of Standards for the visibility curve of the average eye. This equation was combined with Planck's equation of spectral radiation of a black body. Using the radiation constants of a black body and its brightness at various temperatures, it was possible to obtain the luminous equivalent of radiation or the so-called mechanical equivalent of light.

Independent checks of this constant were obtained by measurements upon an incandescent lamp of known candle-power, using a special physical photometer. The data obtained by various methods indicated that the mechanical equivalent of light is of the order of 1 lumen = 0.0016 watt of luminous flux of maximum visibility, or 1 lumen = 49 candles.

These data are of much use to-day, so much attention from inventors in the past ten years as that involving some form of street and station indicator adapted for use on trolley or interurban railway cars. After hundreds of such schemes, including everything from wonderful talking machine arrangements up to constantly changing signs, seem to have been thought of by the conscientious inventors striving to solve the problem, but very few of these automatic street announcer schemes have been tried out and few, if any, have found favor with the trolley and railway concerns at all, so it seems.

However, the accompanying patented arrangement recently perfected by Mr. John O. Lough seems to have considerable merit. The invention comprises a suitable enclosure cabinet, inside of which there is supported a revolving drum on the periphery of which there are suspended pivotally a large number of signs, each of which is labeled progressively with the street numbers for a given car route. Just after passing each street an auxiliary electric circuit is closed which operates an electro-magnet placed within the announcer cabinet, this magnet actuating a set of pawls arranged in the manner shown in the drawing herewith. At each impulse of the electro-magnet and pawl system, the drum carrying the various street signs is moved around a short distance, just sufficient to bring the next street sign in position before the opening in the cabinet. An electric bell can be arranged to signal each change of the announcer so that passengers will pay proper attention to the device, altho once it is installed a short time patrons will soon become accustomed to it. We believe Mr. Lough deserves a vote of thanks from a long suffering public, as all that we can hope to learn concerning the name of the next street announced at present is a conglomeration of vowels and consonants that sounds like—BLLWXY?X.

"Violet rays," i.e., the discharge which takes place in a vacuum when the bulb in question is connected to a high frequency coil, can be deflected by means of an electro-magnet.
An Electric "Movie" for Show-_windows

A new type of moving picture machine for office, convention and show window has been brought out by a New York concern. This machine displays pictures which can be readily seen in broad daylight, as well as by night. Its operation is entirely automatic in all its functions. After the reel is projected it is automatically rewound and then displayed again, so that after the machine

and in the opposite direction for rewinding.

A 250-watt Mazda stereopticon lamp, with

is arranged and started it will continuously operate for an indefinite period without any further attention.

The outfit consists of two separate parts, the moving picture machine and miniature theater in which the pictures are displayed. The moving picture machine is operated by a standard type universal motor, which will operate on either direct or alternating current. Two horizontal discs carry the film which passes in one direction for projection concentrated filament, furnishes the light, which is automatically extinguished when the machine stops and during the process of rewinding.

The machine is equipped with two automatic safety switches, which are provided for in case the film breaks, in which event the machine stops and the light goes out, if this occurs while projecting; in case it happens while rewinding, the machine simply stops, the light being out.

Here it strikes a mirror set at an angle of 45 degrees, and is reflected upwards onto a screen, set on what would be termed a stage. Another 45-degree mirror reflects an image of the screen, making the picture appear to the audience to come from a screen on the rear wall of the theater.

Standard non-inflammable films in lengths of 50 to 500 feet can be exhibited. The outfit draws 2½ amperes and is approved by the National Board of Fire Underwriters.

THOSE "ODD" ELECTRICAL PHOTOS.
The accompanying photo shows a really novel electrical effect—the kind we are after and stand ready to pay $1.00 cash each for. Say, readers, we really wonder if you have ever read the notice publish

on the title page of the "Question Box" in every issue for the past six months. This notice to all readers, whether regular subscribers or not, says that $1.00 will be paid for any photo we can use—but they should be "odd ones," like that below.

Now, readers, and there are several hun-
dred thousand of you, for the love of Horse-thief Pete, get out that kodak or plate camera. Dust her off and go shoot-

ing for that "odd photo." We know it's there, but as we can't travel all over the United States and thru foreign climes to ferret out these interesting subjects, we put it up to you to get these photographs for us.

The present photo is a beautiful one and it shows the "ladder sparks" produced by the amateur photographer—Mr. Kenneth Strickfaden's—eighteen-inch spark coil in full activity. Mr. Strickfaden took this fine photo, the original being of ordinary pocket kodak size, or 3½ by 5½ inches.

WASHINGTON STATE COLLEGE TO HAVE SIGNAL CLASSES.

Washington State College, Pullman, Wash., will heed the call of the government for 15,000 trained men for the signal corps and will attempt to provide between 50 and 100 men qualified for this service in as short a space of time as is possible. Classes in signal corps work will be started immedi-
ately. Training will be given in the interna-
tional wireless code, a speed of 20 words a minute in sending or receiving being re-
quired before the completion of the course. The code to be taught is used through the signal corps service in wireless, wigwag and buzzer signaling.

The United States Government buys about 2,000,000 incandescent globes yearly.

LIGHTING THE AUTO RADITATOR FLAG.

An electric lamp for illuminating a radia-
tor flag, which may also be used as a porta-
ble inspection lamp, has been developed by a New York concern. The outfit includes a silk flag, a silver-plated parabolic reflector and a rubber-finished rolled steel bracket. It can be operated at small cost from the automobile lighting and starting battery. Where no storage battery is available, dry cells can be used.
Milestones in the Life of Thomas A. Edison

THOMAS A. EDISON, leader in American scientific thought, has accomplished so many wonders in his lifetime that to enumerate them would seem to require a lengthy article, but the following tabloid outline of the scientific milestones in his wonderful career give a succinct and comprehensive survey of his activities. This paper was presented before a meeting of the San Francisco Development League by Frank D. Fagan.

1847
Born February 11th, at Milan, Ohio.

1857
Started chemical laboratory in cellar of his home.

1859
Became newsboy and "candy butcher" on trains of Grand Trunk Railway, running between Port Huron and Detroit.

1862
Printed and published a newspaper, The Weekly Herald, on the train. The first newspaper ever printed on a moving train.

1862
Saved from death young son of J. U. Mackenzie, station agent of Mount Clemens, Mich. In gratitude, the father taught Edison telegraphy.

1863
Spent nearly five arduous years as a telegraph operator in various cities of the Central Western States, always studying and experimenting to improve the apparatus.

1868
Entered office of Western Union in Boston as operator.

1868
Made his first patent invention, electrical vote recorder. The application for patent was signed October 11, 1868.

NEW MONUMENT MARKS PLACE WHERE TELEPHONE WAS CONCEIVED.

Dr. Alexander Graham Bell, inventor of the telephone, tells us that Brantford, Ontario, Canada, is right in claiming the invention of the telephone. The invention, according to Dr. Bell, was conceived in Brantford in 1874, forty-four years ago, and born in Boston in 1875. Dr. Bell was present at the unveiling ceremony as well as leading telephone men from the United States and Canada. The great achievement of the telephone invention by Prof. Bell has thus been commemorated by the erection of a magnificent granite and bronze memorial, which is located in one of the city's parks.

1876 to 1877
Invented the carbon telephone transmitter, which made telephony a commercial art, and which was combined in 1914 with his later invention, the phonograph, to form the telescribe.

1877
Invented the phonograph. Patent was issued by United States Patent Office within two months after application, without a single reference.

1879
Invented incandescent electric lamp. The invention was perfected October 21, 1879, on which day the first lamp embodying the principles of the modern incandescent lamp was put in circuit and maintained its incandescence for over 40 hours.

1879
Invented radical improvements in construction of dynamo-electric machines, making them suitable for generators for systems of distribution of current for light, heat and power.

1880 to 1883
Established first commercial incandescent lamp factory at Harrison, N. J.

1882
Invented and installed life-sized electric railway for freight and passengers at Menlo Park, N. J.

1891
September 4, commenced operation of first commercial central station in New York City for distribution of electric current for light, power and heat.

1891
Invented the motion picture camera. By the invention of this mechanism, with the continuous tape-like film originated by Edison, it became possible to take and reproduce motion pictures as we have them at this day.

1890 to 1910
This period covers the work resulting in the invention of the Edison Alkaline Storage Battery, and its commercial introduction in 1914.

1914
Edison, being the largest individual user in the United States of carbolic acid (for making phonograph records), found himself in danger of being compelled to close his factory by reason of the embargo placed on exportation by England and Germany, the sources of supply, carbolic acid being used in making explosives. Edison devised a plan for making carbolic acid synthetically, set gangs of men working 24 hours a day to build a plant, and on the 18th day was making the acid. Within four weeks plant could turn out a ton a day.

On the night of December 9th, Edison's (Continued on page 194)
Peeling Tomatoes by Electricity and Reclaiming Waste

In the operation of canning tomatoes and other vegetables it has hitherto been practically impossible to remove the skins without first heating or partially cooking. However, a down-East genius, one William H. Chapman, of Portland, Maine, has found that if the skin of the tomato is punctured by electric sparks sufficiently near together, the effect will be to form small holes in the skin which loosen it from the pulp, so that it may be readily peeled or stripped off. He has obtained a U. S. patent on the scheme. The heat from the spark apparently has the effect, besides puncturing holes in the skin, to expand the air inside of the skin where the spark passes thru and so detach the skin from the pulp.

A comb conductor charged with a high voltage alternating electricity is located adjacent to the tomato and the apparatus is so formed and manipulated that all portions of the skin are presented to the discharging points.

In the apparatus illustrated for carrying out the process in a simple manner, the tomato is stuck on a forked support or spindle, journaled in the base of the device and slowly rotated by a suitable pulley and belt connected with an electric motor.

As here shown, the comb is connected with an alternating current line with a commercial current of 110 volts connected with the primary of a transformer. Thru the transformer, the voltage is raised to about 12,000 volts, capable of producing a spark of nearly one-half inch in length. The connection from the conductor to the transformer is made thru the carriage by means of a wire. A handle is provided for sliding the carriage back and forth to the tomato being operated upon. The holder on which the tomato is held is formed of metal or other conductor and is thoroly connected to earth. The number of alternations of the usual commercial circuit are 60 per second and the sparks will be emitted from each of the points substantially at this rate. The tomato may thus be rotated with considerable speed and the skin will be thoroly perforated with holes. In applying this process to a canning factory, much more elaborate and rapid acting mechanism would be used, but that illustrated is perfectly capable of carrying out the process.

While this process is primarily designed to be used for tomatoes, it is capable of being used with any fruits or vegetables with thin, non-conducting skins, as plums, apples, peaches, corn, etc. The body of the tomato is not affected by the current used.

Most important of all, a recent bulletin of the U. S. Department of Agriculture brings the fact that vast quantities of tomato refuse accumulating each year at tomato-pulping factories can be reduced to two products—viz, fixt oil and meal—both of which may be made commercially useful. The oil from the seeds is suitable for use as an edible oil or as a soap oil, and by proper treatment can be made useful as a drying oil for paint and varnish. The meal has valuable qualities as stock feed. The department urges the establishment of reducing plants and the adoption of a cooperative plan of manufacture in the regions where tomatoes are extensively used to make catsups and soups, the seeds and skins being at present discarded as useless. The utilization of tomato waste seems to have made much more progress in Italy than elsewhere.

A TROPICAL LINE PARTY.

Seeing in the December issue a photo of a telegraph line party in the far North, I thought that a photo of a line party in the tropics might be of sufficient interest to send to you.

The boys shown in the picture are recruited from their native villages in the Territory of Papua, and sign to work for the Government for three years at the rate of 10 shillings per month and found ($2.50), and are placed under the charge of a white lineman who instructs them in the various arts of "slinging lines"; from there they pass to fitting instruments, locating faults, etc.

After the three years are up they are sent back to their homes for a spell and, should they desire they sign again for three years, this time as operators, their wages being raised to 15 shillings a month and found.

The telephone exchange is a magneto service of a hundred lines, with several long-distance lines to plantations, the longest being 34 miles from Port Moresby.

The boys (Meros) are taught English at the Mission school during their second term: otherwise to ask for, say call 26, would sound somewhat like this—"Rua-Huey—Toura Toi."—JOHN J. BOILEAU.
Make Way for the Lady Engineers

IT'S just a bit difficult to say who the first lady engineer was. The number of women—other than typists, stenographers and clerks—employed in the engineering department of one of the largest electrical manufacturing companies has been gradually increasing in the past four years. Most of these young women who have entered the realm of real, applied engineering were college graduates to whom school teaching was evidently not the one and only resort. All of them were at first assigned to one group. Requests for translating, reference work and computations were made on this group. Later, when the telephone transmission branch started talking in terms of impedance instead of resistance, and doing other queer things, the demand for computresses in that particular branch became so great that several girls were definitely assigned to transmission work as calculators. From this beginning it was easy enough to present the girls to the various measuring devices.

Girls were tried at the calling end of telephone transmission tests, but the voice strain was found to be too great, so now their activities in this particular field are limited to listening—listening to nursery rhymes and the like for hours upon hours!

In addition to computing and making electrical measurements and transmission tests, girls are also employed on drafting and on follow-up work on jobs placed in the Model Shop.

The other laboratories of this electric company were quick to realize the value of women for certain kinds of work, so they, too, began to cast around for suitable representatives of the female of the species. In the Physical Laboratory the experimental work on telephone switchboard lamps and on filaments in general required deft fingers as well as agile brains. Here, then, was an opportunity not only for girls with some technical training, but also for those with skill in light manufacturing processes. Thus we see the entrance of girls into the realm of the breakdown demand in the Physical Laboratory as anywhere else—so the demand for mathematicians went up a few notches more.

Who Said the Women do Not Take Up Such Studies as Electrical Engineering? They're All Wrong, for Here Is Evidence to Show That Women Are Holding Their Own in a Large Research Laboratory.

Here Again We Have the Women Technicians in the Chemical Laboratory of One of the Largest Electrical Concerns. As the War Goes on We May Expect to See More and More Women in Engineering Lines.

Recently there has been a great demand for special condensers and fuses which, for various reasons, must be manufactured under laboratory conditions. This work does not of necessity call for operatives with more than average education, but it does mean the presence in the laboratory of a fairly large number of women. If any of them show special aptitude or inclination, it is a fairly easy problem to acquaint them with the workings of the simpler measuring devices and to instruct them in the making of various mechanical tests on apparatus. It has been found that women have a distinct aptitude for mathematical and engineering processes. They operate Wheatstone bridges, planimeters and slide rules with speed and precision.—Photos Western Electric Co.

ELECTRIC ORANGES.

Prof. J. A. Fleming, in a lecture at the Royal Institution, London, England, to a juvenile audience, said that not many boys and girls knew that when they cut an orange with a steel knife and a silver fork a current of electricity past thru their hands. The acid in the orange acted on the steel, and the orange acted as a voltaic cell.

X-RAY DETECTS TUBERCULOSIS.

Electricity is playing an ever increasing part in the examination of troops for medical defects. The X-ray has been employed recently in detecting whether certain New York troops have tuberculosis. Of the first 600 men examined by this means twenty-two were found to be so infected as to disqualify them for military service.
An American Ace

An unprecedented triumph! And rightfully may it be said so, with a smack of the old melodrama, Biff! Bang! of shot and shell this truly patriotic war play has arrived into its own.

The play is centered about a number of thrilling scene effects of which probably the most realistic is that where our boys go "over the top."

The story of the play is somewhat slow in action in the first part and this could stand a little speeding up. It is not until the second act that it really struck its stride and after that the action was fast and exciting.

James L. Crane was a thru and thru "pachist" in the first part until, the wavering spark of patriotism answered the call and from then on he was out to get the "Hun."

Somewhere on the battleline the Germans abandon a Belgian village, leaving behind them desolation, destruction and two spies "He" and "She" to communicate information that will enable them (the Germans) to "gaz" the Americans without warning.

The Americans arrive and take the village but are rather suspicious of the two spies and when the man is seen telephoning information to the enemy by a little "Belgian Miss," the heroine, the female spy gives an alarm so as to ward off suspicion from herself and incidentally enable her to carry on the nefarious work. The hero, who is now an "American Ace," naturally falls in love with the "little Miss" and a quaint courtship is interwoven amidst all the cannons' roar.

The villainess eventually meets her Waterloo and the final scene shows the lovers united in each others' arms atop a church tower, while down below the Americans are driving back the "Boches" with fixed bayonets.

Chief amongst the thrillers is an exciting battle in the clouds when the "American Ace" goes up and down three German planes. So realistically is this scene arranged that the spectators imagine themselves up in another plane looking on at the duels taking place. Another tense moment comes when the German planes bomb the town with aerial torpedoes, when with a crash and a bang buildings tumble down and with all the debris and plaster flying around, it might well be best to bring your own "dugout" and gas helmet with you.

THE NEW YORK MEETING OF THE A. I. E. E.

The April meeting of the American Institute of Electrical Engineers was held on the evening of April twelfth and was attended by a large number of the engineering fraternity, amongst whom were several prominent persons, including many members in uniform who are doing their all for the U. S. A.

Two important papers were presented: "A physical Conception of the Operation of the Single-Phase Induction Motor," by B. G. Lamme, and "No-Load Conditions of Single-Phase Induction Motors and Phase Converters," by R. E. Hellmuth.

Mr. Lamme read his own paper, which covered a new method of studying the actions of a single-phase induction motor, a method which he had found to be very convenient from an educational standpoint.

Starting with the assumption that a single-phase alternating magnetic field may be considered as being made up of two constant fields, each of half the peak value of the single-phase field and rotating at uniform speed in opposite directions, then if the single-phase flux distribution is of sine shape and varies sinusoidally in value, it may be replaced, or represented, by two sine-shaped fields of constant value rotating in opposite directions.

The full load conditions are next considered. A comparison is made between a two-motor unit, consisting of two similar poly-phase motors coupled together and connected for opposite rotation, and the straight single-phase induction motor. Several diagrams were shown, as well as some interesting curve charts. The paper contained a considerable amount of test data, which served to illustrate the principles and actions described in the paper.

Mr. Hellmuth was unable to attend, much to the regret of those present, and his paper was read by Mr. A. M. Dudley. The paper showed methods and derived formulas for the determination of the fields, the stator and rotor magnetizing currents, and the tertiary voltages for phase-converters and single-phase induction motors at no-load.

The treatment of the subject is uniformly based on fundamental laws. A number of different considerations are used for the various cases illustrated to assist in the solution of the problems; however, all are based on simple facts.

AN ELECTRICAL EXPERIMENTER

July, 1918

It's Hard to Tell the Imitation Soldier from the Real One These Days, Especially When the Signal Corps Members of "An American Ace," a Recent Stage Success, Start Acting.

It is quite interesting to note the faithful military atmosphere that is truthfully kept, especially when the American boys take the town. Entering in a dignified and businesslike manner they proceed to lay out plans, while the "Signal Corps" troops establish their lines of communication, switchboards, etc. A close-up view herewith shows the general staff and the chief officer issuing orders for the strengthening of various portions of the lines.

The true fire-works commence when the boys go "over the top," then Cain lets loose and by the amount of deafening reports it sounds like the Great Spring Drive transplant-ed to the United States. To your "dugouts," boys, when this big thrill comes off! Nevertheless the audience took it in great shape and it was greeted with a storm of applause.

All of the members of the cast did well and special mention might be made of the excellent hero rôle as played by Mr. Crane, the equally admirable heroine, Miss Marion Coakley, who with her sweetness and charm is a "comer"; Miss Sue MacNamara was a charming villainess.—George Holmes.

An electric magnet weighing only seven pounds that will lift fifteen times its own weight has recently been invented. It is intended for use in machine shops.

"Don't Be Impatient, Bill. You're Going to Feel It,"—Irish in the Columbian Dispatch.
A New Electric Recording Compass

By EUGENE STAEGEMANN, Assoc. A. I. E. E.,—Prof. of Mathematics and Mechanics, Vocational High School, New Britain, Conn.

The new electric-recording compass device, here illustrated, is one which nautical experts have proclaimed to be a great advancement in maritime appliances. This electric Recording Compass was invented by Dr. C. L. Jaeger of Mahwah, N. J., to supply vessels with a device which would record a permanent record of the entire route covered, to the fact that the Nautilus, Jules Verne's master creation in "Twenty Thousand Leagues Under the Sea," had every conceivable type of apparatus and appliance aboard except a recording compass.

To remedy this serious defect he began the first experiments. It is perhaps unnecessary to say that he encountered great opposition, but finally, after five years of ceaseless toil, in an attic, and great sacrifices a crude working model was particularly gratified by the results. Charged with this encouragement, Dr. Jaeger endeavored to market the invention, but met with violent opposition, not on the part of the ship owners who appeared (Continued on page 202)

Three Views of the Jaeger Electric Recording Compass, a Number of Which Are Being Built for the Navy Department. At Left—The Recording Compass With Dial Removed; At Center—Compass Complete With Spark Recorder and Chart; Right—Electrical Instruments Used With Recording Compass.

Dr. Jaeger began his first series of experiments on his recording compass about 1885, in the days when the electrical experts of the world were classified in two ways—those who knew Ohm's Law and those who didn't. He jokingly attributes his endeavor to supply vessels with a device which would record a permanent record of the entire route covered, to the fact that the Nautilus, Jules Verne's master creation in "Twenty Thousand Leagues Under the Sea," had every conceivable type of apparatus and appliance aboard except a recording compass.

An Actual Compass Record of a Cruise Up Long Island Sound Taken On Board Dr. Jaeger's Yacht. Each Angular Division Represents a Time Period of One Hour.
Rapid strides have been made during the last five years in the advancement of practically all branches of science. Especially is this true of Radium, in its various forms, and its application to relieve humanity of much of its suffering.

Early in 1912, from information that reached the U. S. Bureau of Mines, it became evident that large quantities of valuable Radium bearing ore from Colorado was being exported to foreign countries for purposes of manufacture, and undoubtedly a part of the manufactured product was being reshipped to this country.

In view of the fact that the largest known supplies of Radium bearing ore in the world was centered in the States of Colorado and Utah and on public lands of the U. S., the Bureau of Mines decided to investigate the prospect and to ascertain whether these valuable tracts could not be acquired by the U. S. and the Radium extracted under Government supervision, to be supplied at cost to the hospitals of the Army, Navy and Public Health Service.

At that time no appropriation for such work was available. However, the Bureau learned that Dr. Howard A. Kelly of Baltimore, Md., and Dr. James Douglas, of New York City, were deeply interested in the production of Radium for use in two hospitals with which they were closely associated. The suggestion was made that they form a Radium Institute, to work up the ore and keep the Radium for the use of our own people. The mines were inspected and after extensive preliminary surveys, the National Radium Institute was founded. The agreements being that the Institute was to receive the Radium from the owners of the mines on a 15 per cent royalty basis, with the stipulation that the Institute would return the uranium and vanadium contents of the ore to the company.

A considerable personnel was instituted at the radium plant and a number of large buildings erected and put in operation. The average capacity of the plant at present is about 3½ tons of ore per day, and a considerable amount of the element has been extracted up to the present time. Beyond any doubt, the amount of Radium in nature is exceedingly small. Therefore this fact, in itself, is an important factor bearing on its value today. Altho quicker and better processes are used for its extraction now than, say, four or five years ago its market value will not decrease to any extent.

To total amount of Radium element at present in the world extracted from the ore is said to be 61 grams of which amount 16 grams is held by various doctors and institutions in the United States. Dr. Howard Kelly of Baltimore has about 6 grams, the Memorial Hospital of New York has 3½ grams, and the other 6½ grams are distributed in the U. S. The remaining 45 grams are in various other countries.

It has been estimated that if all the radioactive ores were mined they would not produce more than a total of 400 grams of refined Radium element; therefore the high cost of Radium—at present $120,000 a gram, or $120,00 a milli-gram.

Radium is a chemical element, belonging to the group of metals, but unlike most other elements, it is not extraordinarily stable. It transforms itself at a measurable rate into another substance called Radium emanation. The rate of transformation, is so slow, however, that about 1700 years would be required for half a given quantity of Radium to disappear.

The emanation is a chemically inert gas, and it, too, transforms itself into a third substance called Radium A, but this is not all. Radium A transforms itself into Radium B, and Radium B into Radium C, this forming a series or chain of substances all related to each other.

None of the above substances is a gas except the emanation Radium A; B and C deposit themselves on anything and everything that comes in contact with them, including the walls of the vessel that contains the emanation.

Radium may be used in the treatment of disease either in the form of Radium salts or Radium emanation, the therapeutic effects being identical.

This Radium emanation may be collected in glass tubes or metal containers, and used with appropriate screens, as Radium salts themselves, or dissolved in distilled water or in a weak saline (salt) solution, and administered by drinking or injection. Emanation applicators are often of the greatest value in treatment of malignant...
growth, as in them it is possible to concentrate the activity per unit area to a very high degree. The 100 cc. of 1% solution of the tubes of Radium sulfit oxide generally used, measure 4 cm. in length and 0.2 cm. in diameter. It is quite easy to make an emanation tube of equal activity measuring only 0.5 cm. in length by 0.05 cm. in diameter.

Such a tube can be enclosed in an iridium pointed platinum needle with walls of 0.3 mm., in thickness, thus forming a very small but extremely powerful apparatus for the treatment of nodules in tongue, palate, breast or other organs.

Radium emanation falls to half-strength in 3.8 days, losing 10% per cent of its initial activity within the first twenty-four hours. The duration of an exposure rarely exceeds twenty-four hours, and if it is decided to give a treatment for that time with a radium emanation apparatus, of say 100 mg. strength, the apparatus leaves the laboratory with an initial activity of 109 mg. 110 mg. At the end of 24 hours its activity will have fallen to 92 to 93 mg., so that its mean activity throughout that period will have been approximately that of 100 mg.

The general principle of the operation of the apparatus necessary to fill the small capillary tubes with the Radium emanation is as follows:

Fig. 3 represents the arrangement of the glass tubes and reservoirs. The bulb A contains the Radium salt dissolved in water. Radium in solution continually decomposes the water into hydrogen and oxygen, and at the same time transforms itself into the emanation, which is set free. The total volume of the hydrogen and oxygen amounts to more than two hundred thousand times that of the emanation at the same pressure and temperature. In addition to the oxygen and hydrogen and emanation, a small quantity of helium appears, and also traces of other gases. On account of its radio-active transformation, the exact proportion between the quantity of emanation and the gases with which it is mixed, depends on the length of time the gases are allowed to accumulate.

The mixture of gases collects in A and the tube B, and also if the passage is open, in the reservoir C. Allowing the gases to collect in C, apparently increases the efficiency. The tube B is considerably longer than 76 cm., so that air may be admitted into C, if desired, without its finding its way up into the Radium solution. The trap at B protects against mercury spurtling up into the Radium solution, should some of the glass apparatus break. An ordinary water aspirator with suitable stop-cocks controls the flow of mercury between the reservoir and trap. By admitting the air into D, the mercury rises in C, pushing the mixture of gases thru the mercury trap E, into the tubes F. The mercury in the trap E holds back all but a very small quantity of the water vapor. The tubes F contain a copper wire, slightly oxidized, phosphor-pentoxide and potassium hydroxide. Altogether the mixture of gases in F is more than 75 cm. long. The whole is set in a base of concrete so as to make it impervious to all shocks which might damage the delicate apparatus.

**LET ELECTRICITY WIND YOUR PHONOGRAPH.**

A new electric motor winder adopted for attachment to any style phonograph.

Winds any Phonograph by Electricity. Attached in place of Winding Handle.

**Fig. 3, 4, 5**

ELECTRICAL EXPERIMENTER

A new electric motor winder adopted for attachment to any style phonograph.

so as to still retain the spring motor drive, which has so far proven the most satisfactory, has been invented by Joseph W. Jones, who originated the Jones Speedometer of world fame, the disc record which is the foundation of talking machine success, the taximeter, the taxi-cab meter. Any motor winder uses no current, except when actually winding up the spring.

In case of failure of lighting current or that current is available, the winder may be instantly detached and the old-style crank used.

In case the user moves to a district where current is not suitable to his motor winder, this may be exchanged by the dealer in that locality.

The use of the winder as to the mechanism is novel, as the power is applied when you use the winder.

This useful device is said to operate one month for one cent's worth of electricity. It is easily and quickly attached in place of winding crank, being applied or detached with the use of only a screw-driver in less than a minute by anyone. The winder will automatically wind your talking machine and stop when it is sufficiently wound. By pressing down the push button on top of the motor it will wind at any time, and the makers recommend doing this before playing each record. The push button cannot be prest down until the motor has been attached to both the phonograph and electric current.

**VISIBILITY OF RADIATION OF THE AVERAGE EYE.**

It is important to know how the eye responds to lights of different colors but of the same energy value. Only during the past year the investigation of the relative sensibility of the average eye to light of different colors was completed. The visibility of radiation of 130 subjects was determined, and various applications were made of these data to problems in radiometry.

A solution of salts was prepared which has a transmission curve coinciding very closely with the visibility curve of the average eye. Using a cell containing this solution, interposed between a thermopile and a source of light, further tests were made of this combination as a physical photometer. Using these visibility data, the following computation shows that the eye is so sensitive that the minimum perceptible light is probably less than one billionth erg.
Popular Astronomy

DARK STARS

By ISABEL M. LEWIS
Of the U. S. Naval Observatory

WHAT a vacation is to our tired bodies, Stellar Space should be to our minds. In the entire realm of Science there is nothing more elevating, nothing more ennobling than the study of Astronomy. Infinite space holds forth so many wonders and enlarges our mental horizon so enormously that modern man or woman must consider his or her education incomplete without at least a rudimentary knowledge of the wondrous world spread out in space all around us.

Astronomy is considered by many a dry, uninteresting science, good only for "highbrows." The opposite is the case. It is neither dry nor difficult of understanding, and once the mind becomes interested in its study, an entirely new and beautiful world is opened to it.

There is nothing more refreshing, nothing more satisfying to our minds than cutting loose for a few hours from our humdrum existence and delving into the boundless ether, where time and space are one, where a million years leave hardly an impression, and where a billion miles are so microscopically small that they are entirely lost in the gulf of infinite space . . .

The writer, an ardent student of astronomy, has always wished to present to our readers popular and non-technical articles on the wonders of the Universe. No connection, however, could be made with competent writers who could present the difficult subject in a manner acceptable to EXPERIMENTER readers.

It affords us considerable satisfaction, therefore, that we are able to present herewith the first of a series of astronomical articles from the pen of Mrs. Isabel M. Lewis. Mrs. Lewis, who is connected with the U. S. Naval Observatory, has written a great many excellent astronomical articles for the New York "Sun," and other newspapers, which have created widespread attention and very favorable comment. Mrs. Lewis, who is a very exact as well as a highly learned writer, has the rare faculty of interpreting difficult and dry subjects in a popular manner, which makes us feel certain that our many readers will welcome her articles enthusiastically.

The ELECTRICAL EXPERIMENTER has furthermore secured exclusive magazine rights for all of Mrs. Lewis' articles for the term of one year. Her articles will not appear in any other scientific magazine. The article in the August issue,—an intensely interesting subject,—will treat on "Gaseous Nebulae."

H. GERNBACK.

THE existence of dark stars and dark nebulous tracts of matter in the heavens is now considered to be an established range of the actual as well as the apparent brightness of the stars has been found to be tremendous. The brilliant Canopus at an immeasurable distance from the earth is conservatively estimated to have fully ten thousand times the light-giving power of the sun, while an excessively faint star of a deep red tinge comparatively close to the solar system possesses but a five to ten thousandth part of the light of our luminaries. The giant star Canopus has at least twenty million times the brightness of the little red dwarf star. There is no reason to believe, moreover, that this extremely faint star marks the lower limit of stellar brightness. A gradual decrease in the light-giving power of this star would place it before many ages in the ranks of extinct suns, cold, dark bodies pursuing their unseen way thru the universe in numbers that we have at present no means of estimating. The evolution of the stars has been traced thru all stages from nebulae to near-extinction and it is logical to assume that the process of evolution is still going on until the star has ceased to shine. Since the energy of a star is finite, it is assumed that the star will exist for a finite interval of time, however great this interval may appear as measured by the standards of man.

Whether or not actual collisions and close approaches of suns may start the evolutionary process anew is at present a matter of conjecture. The sudden flaring-up of temporary stars or Neva is, as they are called, is believed by some to be a visible sign of the rebirth of stars thru collisions or encounters of dark bodies or their passage thru wisps of dark nebulous tracts of matter such as are known to exist in our stellar universe. The true nature of the Novae has not yet been definitely determined, however. So far there are difficulties in the way of all theories advanced to explain these rare phenomena of the heavens, tho their connection in some way with matter previously emitting no light seems a certainty, especially since they occur without exception in the Milky Way, a portion of the heavens where dark absorbing matter of a nebulous nature is intermingled with dense star clouds. The extent of these dark nebulous tracts must be enormous since it is known that their distance is very great and they spread over a space in the heavens that would normally be occupied by many stars. Light, traveling at the rate of 186,000 miles a second, would take many years to traverse from one end to the other of these dark nebulae that emit no light appreciable to the eye.

In some instances dark regions merge into luminous wisps in which one or more stars are frequently enwrapped. The nature of these dark nebulae is extremely low and their total mass very small in comparison to the great volume of space that they fill.

Dark nebulae are presumably nebulae that for some reason never condensed into stellar form, but lost their light and heat while still in nebular condition. In many instances they may be the remains of the material swept up by the stars. The forms of some dark nebulae strikingly resemble those of a number of nebulae shining by their own light. These nebulae doubtless never possessed the conditions essential to a successful entry upon the process of stellar development and drifted on to extinction in their original form.

There are also indications that many stars do not run the full course of evolution from youth to ripe old age but become devoid of light and heat giving power even before the middle-aged period of star life is attained. Such stars are evidently lacking in characteristics essential to the successful development and prolonged maintenance of a photosphere, as the outer illuminating surface of the star is called. A study of
double and multiple star systems reveals these facts. It has been found that on the average one star in every three belongs to a star system of two or more stars revolving around a common center of gravity. Now evidently all stars belonging to the same system and physically connected came into being at the same time, and should be approximately equal in light-giving power provided they do not differ greatly in mass. As a matter of fact, while one member of a double star system is at the height of its development and shines with intense brilliancy, the other is as often as not practically devoid of light, tho in volume, and occasionally in mass, it may surpass its brilliant companion. So feeble luminous are the fainter members of some of these systems that their light is not appreciable to us at all and we only know of their presence by the disturbance they produce in the motion of the brighter companion. Tho some of these stars shine feebly, others appear to be dark in the strictest sense. For some reason they proved to be imperfect radiators and become spent before their time. On the other hand, there are some physically connected systems of stars of which all the members are far advanced in evolution. They appear to have nearly run their allotted course and are nearing extinction. Many such connected systems of stars may be traveling thru the heavens, totally devoid of light, for all we know to the contrary.

There is great diversity in double and multiple star systems and their study forms a most fascinating branch of astronomy and one most fruitful of results. The orbits of the physically connected stars may be inclined at various angles with each other and with the earth and may vary in shape from almost perfect circles to highly eccentric ellipses. The stars themselves are sometimes spherical and sometimes greatly elongated or egg-shaped under the influence of tidal forces acting between the two bodies. They may revolve almost in contact or 3.5 light years apart, or they may be so widely separated that they appear as beautiful little double stars, often of contrasting colors such as red and green or blue and yellow. In some instances a closely revolving pair performing a revolution in a few days around their center of gravity is encircled by a distant companion revolving around the close pair in a period of several hundred years.

A most powerful instrument of research in the study of double stars is the spectroscopic binaries. The great majority of double stars belong to this class.

The spectroscopic consists essentially of a glass prism for separating white light into a band of color of rainbow hue known as the spectrum. Best results are obtained when the light from the star is let in thru a slit placed usually in the focus of the telescope. The ray of composite light coming from the star after passing thru the prism is broken up into rays of various wave lengths, arranged along the visible spectrum from the red thru the yellow, green, blue and indigo in order to the violet, the longest wave lengths being in the red and the shortest in the violet end of the spectrum. Below the red come the infra-red rays and beyond the violet the ultra-violet rays, both invisible to the eye. The spectrum is viewed by the observer at the eye-end of the telescope or is photographed by placing a photographic plate in the same position. The photographed spec-
NEW ELECTRIC HOME MOTOR FOR WOMEN.

People everywhere are rapidly awakening to the fact that electrical labor-saving devices for the home are fast becoming a necessity. This year when labor of all kinds is at a premium, and the general wave of "efficiency" is sweeping the country, the demand for electrical home devices is going to be greater than ever.

The electrical motor here illustrated is easily convertible and with different attachments can be made to churn butter, whip cream, eggs, etc., polish silver, and sharpen knives. It also has a vibrator attachment for massage, with a variety of applicators. It can be made into an electric fan by attaching guard, blades, etc.

The outfit here shown is a churn and mixer motor. This outfit includes the motor with handle, cords, plug, and rheostat, supports for jar with nickel-plated top, which will fit any Mason screw-top jar; also butter churn and cream whipper. With this outfit comes complete instructions for making butter. Its cost is extremely low.

HATCHING "CHICKS" BY ELECTRICITY.

The day of the old, smelly oil-heated chick incubator is rapidly disappearing. Enter the modern electrically heated and controlled incubator of the type here illustrated. And not only do these electric incubators serve the wants of the farmer and chicken fancier, but the army department finds many diversified uses for them. Among other applications, the army medical corps is employing them for developing cultures; the army camps are using them for hatching chicks; and they have hatched almost every kind of egg from that of the silk worm, the smallest, down to the large ostrich egg, besides those of the pigeon, alligator, turkey, duck, swan, emu and the Quail.

The egg chambers are made of California redwood thruout. Double walled, lined with deadening felt and joke board. They are made of good wood, the very best insulating material, and the doors are fitted with double glass with dead air space.

The electric heaters consist of coils of special alloy resistance wire, wound on insulating cores and supported strongly above the eggs in egg chamber. The wire is distributed on the cores properly to give even distribution of heat in the egg chamber.

Regulation is effected by a special regulator operating a simple make and break switch equipped with non-fusible points which is adjusted by a single screw for higher or lower temperatures. No extra magnets or relays are needed to break the small amount of current used in these electric incubators.

Tested thermometers are furnished and an adjustable holder is supplied which holds the thermometer in proper position to be read without opening the door of machine.

The operator can be raised to remove egg tray for turning.

The egg trays are of galvanized steel with reinforced frame and galvanized steel corrugated bottom. Corrugation holds eggs in convenient position for turning. Can be stalled after hatch is finished. The fuse box is removable without opening doors of machine. The hatched chicks can be removed without disturbing eggs on tray.

A small 2 candle-power lamp is installed in the egg chamber which lights up when the regulator turns the heat into the heating coils, and goes out when the heat is turned off. An overhead lamp is the means of telling how the machine is operating. This lamp also enables the operator to read the thermometer no matter how dark the room may be.

These electric incubators are very accurate in their temperature regulation and the average difference in temperature is very low, considering the superior results obtained, as the following figures show:

<table>
<thead>
<tr>
<th>Capacity</th>
<th>Energy Consumed</th>
</tr>
</thead>
<tbody>
<tr>
<td>126 eggs</td>
<td>32 Kilowatt Hours per Hatch.</td>
</tr>
<tr>
<td>252 eggs</td>
<td>36 Kilowatt Hours per Hatch.</td>
</tr>
<tr>
<td>512 eggs</td>
<td>37 Kilowatt Hours per Hatch.</td>
</tr>
<tr>
<td>63 eggs</td>
<td>13 Kilowatt Hours per Hatch.</td>
</tr>
</tbody>
</table>

In extra well built incubator houses these figures will be somewhat lower.

ELECTRIC DRILL HAS PISTOL GRIP AND SWITCH.

The new portable electric drill here illustrated has a pistol grip and trigger switch, and has been designed with special attention to the prevention of breakage of drills when operating the switch.

The control is that of the automatic pistol, one finger operating the trigger switch without the slightest effect on the steadiness of the aim or the support of the tool. There is no releasing of the grip to turn a switch, press a button, push or pull a handle, at the moment the drill breaks thru, allowing the weight to sag on the drill bit. When the drill goes thru the work, you instinctively tighten your grip, retaining control and stopping the drill without breaking the bit.

The casing of the drill is made of aluminum, to reduce the weight. It has a specially designed series, compensated inter-

TEACHING "HER" ELECTRICITY.

By F. C. Davis

"Jack," said his best girl, one night when they were alone in the parlor, "you are so wonderful and you know so much about electricity. Won't you tell me all about it?"

"Sure thing. What do you want to know?"

"Well, what is insulation?"

"Insulation? Now let me see; how will I illustrate that? Let me put on a glove...so...so. I take your hand in mine, so...so, it is now insulated."

"I see. And a conductor?"

"A conductor? Take off your glove, please."

"Why, it's ridicuously simple! What is an amper?"

"That's a little harder to illustrate. It is the power of the electricity. The power -I take your hand- it is the power that makes me do it. You see?"

"Perfectly. But what is a volt?"

"A volt? It is the pressure of the electricity?"

He squeezed her hand tighter.

"That's voltage, electrically speaking."

"Why, everything is so easy-and nice. But what is induction?"

"Hum! That's a poser. Well, I take your hand. The power and the pressure make my heart beat faster; it induces it to speed up."

"How remarkably simple."

"Anything else?"

"Yes. What is resistance?"

"Well-well. If I were a-a-a-to attempt to explain, or kiss you, now, I would meet with resistance, wouldn't I?"

"Well, er-er-er-I don't believe I quite understand. Can't you illustrate that?"

"So he illustrated it; but there was no resistance."

"How wonderful," she fluttered between signs. "Now Jack, dear, what is a short-circuit?"

There was a loud step, and the door burst open and in rushed her father!

"I'll show you what a short-circuit is," he roared as he made for the sofa on which Jack had sat, but luckily sat no more, he having dived thru the window pane with a bang and a rush.

"Some short-circuit," mused Pa, looking over the damage.

The spindle's offset are made to it..."
Experimental Physics

By JOHN J. FURIA, A. B., M. A. (Columbia University)

Lesson 13—Static Electricity

Experiment 74.

If a fountain pen is rubbed on the sleeve of the coat and then brought near some bits of paper (or, better, pith balls), these objects will be found to jump towards the pen. The same effect can also be produced by rubbing a variety of other substances, such as glass and silk, sealing wax and a pencil, paper and rubber (ebonite) and cat's fur, etc. (This experiment was first tried in 600 B.C. by Thales of Miletus, who used amber and silk and the process is called electrification after the Greek word electron, meaning amber.) After so long a time has elapsed since electrification was discovered, even at this late date we do not know much about the nature of electricity, but we do know very well the laws governing its action.

Experiment 75.—Suspend a pith ball by a silk thread as in Fig. 69-a. The stand can be easily made by bending a piece of glass tubing after heating it in a Bunsen flame and attaching the glass base to the sealing wax. Bring the fountain pen (which has been rubbed on the sleeve) near the pith ball. The pith ball will be attracted by the pen and then immediately on touching will be repelled. Evidently the state of the pith ball is changed upon coming in contact with the electrified fountain pen. Rub a glass rod with silk and bring the rod near the pith ball. If we assume the same laws of force as we did in the case of magnetism we find that the behavior of the pith ball is easily accounted for. Referring to Fig. 69, the pith ball in (a) is neutral, i.e., it contains equal amounts of positive and negative charges. As the electrified pen is brought near (let us call its charge negative) by induction the particle near the pen becomes positive and since unlike charges attract, the pith ball is attracted. On coming in contact, however, the strong negative charge on the pen causes the pith ball to become negatively charged. If it is now brought near other objects, it will be repelled. In the case of glass, we find that the pith ball is attracted. Therefore since there is attraction and the pith ball is negative the glass rod must be charged positive, i.e., glass when charged has the opposite charge to the fountain pen when charged. Immediately on contact (Fig. 69-d) the strong positive charge of the glass rod causes the pith ball to be positively charged and repulsion takes place, (Fig. 69-e). It is obvious that just as in the case of magnetism, repulsion is a better test for electrification than attraction, since even a neutral object will be attracted by induction, but only a charged object can be repelled.

Experiment 76.—The electroscope (an instrument for measuring forces of electrification) does not lose its charge. Bring rod up its operation on the principle of repulsion between like electrical charges. Thru a rubber stopper (D) insert a piece of heavy copper wire (C) bent in shape of Fig. 70. Solder a penny (A) to this wire. Cut a small strip of gold leaf (such as is used by sign painters) about 1/6 x 1/2 and place it over the hook of (C). Insert all this in a flask or bottle. This is now a good electroscope and in diagrams is represented as (Fig. 70-b). If now a negatively charged rod (fountain pen) is brought up to the electroscope (Fig. 70-b) the positive of the neutral electroscope is attracted to the penny, leaving an equal amount of negative charge at the gold leaf. Since both sections of the gold leaf have the same charge they will repel each other and move apart; the greater the charge, the greater the force, and hence the further apart they will be forced. However, as soon as the rod is taken away, the positive from the penny will neutralize the negative of the gold and the electroscope will become neutral or discharged.

Experiment 77.—We use two methods of charging the electroscope permanently; by contact and by induction. If we bring a charged rod up to the electroscope and touch the penny with the rod, the gold leaves stay apart permanently and the electroscope is charged. As the negative rod approaches, the positive charge of the electroscope goes to the penny and the negative charge is left at the gold leaves. On contact the positive of the penny goes to the rod and tends to neutralize it, so that on removing the rod only negative electricity is left in the electroscope, i.e., by contact the electroscope is charged with the same charge as the rod used. Charging by induction is a more complicated process, but is important in that the charging rod does not neutralize, i.e., does not lose its charge. Bringing rod up to electroscope as in Fig. 70-b, then without touching the rod to the penny, place the finger on penny (Fig. 70-c). The leaves will be found to collapse, the reason being that the negative of the gold leaves has past thru your body by way of the fingers; the positive staying on the penny because it is held by the negative of the charging rod. Being careful to still hold the rod near the penny take away your finger. Next remove the rod and the electroscope will be charged by induction, since the positive will distribute itself over the instrument as in Fig. 70-d. Note that no charge has been lost by the charging rod. If one is not careful to remove the finger before the rod is removed, the charge left in the electroscope now not being held by the rod also passes thru your body and the electroscope is not charged. By induction it should be noticed that on the electroscope we get a charge opposite to the rod. (If in the above experiments a glass rod is used, a similar but not as marked an effect will result, except that all signs will be reversed, i.e., for positive we will have negative and vice versa.) If we touch a piece of metal to the penny of the electroscope and then touch the metal with a charged rod, we find that the metal allows the charge to pass from the rod to the leaves and we call the metal a conductor. On repeating this experiment, substituting glass, wood, sealing wax or hard rubber for the metal, we find that these substances do not allow the charge to pass. These materials are called insulators or non-conductors. Bring the flannel (with which you have rubbed the sealing wax or fountain pen or else the silk with which you have rubbed the glass rod) up to the electroscope, now test the charge for sign. It is found to have the sign opposite to that of the rod. Furthermore the amount of divergence of the gold leaves shows us that positive and negative electricity always appear simultaneously and in equal amounts, i.e., if we rub glass with silk the glass is charged positively and the silk negatively to the same extent.

Experiment 78.—Let an insulated metal plate be connected to the electroscope by a conductor (Fig. 71-a). Let another similar insulated metal plate be connected by a ground (grounded); charge plate A and note the deflection of the electroscope leaves. Push B toward A and observe that as it gets nearer and nearer the leaves fall gradually, so that we may now add more charge to A (Continued on page 194)
Colonel Carty Receives Edison Medal

D R. JOHN J. CARTY, Colonel in the United States Army Signal Corps and Chief Engineer of the American Telephone and Telegraph Company, has been awarded the Edison Medal in recognition of his services in developing the science and art of telephone engineering.

The medal was presented on Friday evening, May 17, at the annual meeting of the American Institute of Electrical Engineers in the Engineering Societies Building in West 99th Street, New York. Colonel Carty is the eighth American scientist to be honored in this way, the others being Elihu Thompson, Frank J. Sprague, George Westinghouse, William Stanley, Charles F. Brush, Alexander Graham Bell, and Nikola Tesla.

The Edison gold medal was founded in 1904 by the Edison Medal Association, an organization composed of old associates and friends of Thomas A. Edison. It is awarded annually by a committee of 24 members of the American Institute of Electrical Engineers, and was first awarded in 1909, the recipient being Elihu Thompson. It was designed by James Earle Fraser, and bears on its obverse a portrait of Thomas A. Edison, and on its reverse an allegorical conception of "The Genius of Electricity Crowned by Fame."

After Dr. E. W. Rice, Jr., President of the Institute, presented the medal, Colonel Carty in his speech of acceptance, gave credit for the American Telephone achievements to the engineers who have been associated with him in the Bell System and paid a tribute to Major General George O. Squier, Chief Signal Officer of the United States Army, for his work in planning before the United States entered the war, for the rapid mobilization of telephone wires and telephone men for Signal Corps work. Referring to the Bell System engineers, Colonel Carty said:

"We hear a great deal about the German scientist and the wonderful things he has done and has been planning. Many years ago, when German 'Kultur' was interpreted by many to mean German culture, it was suggested to me that we should send to Germany to get some of the Herr doctors to teach us the high science. I always be trained in our work, and that thru them we would undertake to outdistance anything that has been done in Germany. That policy has worked out successfully. The young men who have collaborated with me all these years are graduates of over one hundred universities, all here in America. When at the opening of the war there was a searching of hearts and a census and a taking account of stock, to find out who was loyal and who was to be suspected, I know you will all be pleased to hear that among all of these scientists, and all of these engineers, all working in the Bell System, all over the United States, we were not able to find one single Hun. They were all true Americans to the core."

More than any other man, Colonel Carty is responsible for the development of telephone engineering as it is known to-day, and it is peculiarly fitting that he should receive this new honor at a time when he is working day and night to promote the military use of mediums of communication which have been developed, largely thru his efforts, in time of peace for the advancement of the nation's social, commercial, and industrial activities.

Colonel Carty is well known as the engineer of the great transcontinental telephone line, the longest in the world, and as the engineer who made possible the wireless telephoning over distances up to 5,000 miles. He entered the telephone business when it was in a infancy, and it would be difficult to find a phase of its development which does not bear some imprint of his genius. The technical achievements of Colonel Carty are so numerous as to prevent full recounting. He first pointed out the correct theory of induction between telephone circuits. That was in 1887. In 1888 he developed the bridging bell and pointed out the importance of the bridging principle of telephone construction in obtaining efficient operation of telephone systems and in constructing balanced metallic.
circuit. In 1889 he invented the principle of the best and most generally used common battery system, by which a number of telephone instruments may be simultaneously operated from a single central battery. During this period he also devised important improvements pertaining to switchboard circuits having to do with the "busy test" feature and the connecting in of operators' instruments.

In 1912 the telephone engineering force built up and directed by Colonel Carty had so far overcome the difficulties in the way of underground telephony as to make possible all-underground talking between New York and Washington, and by 1913 they had extended the range of underground telephony to connect Washington and Boston.

The year 1914 witnessed the fruition of the efforts of these engineers to bring transcontinental telephony into existence, and in 1915 Colonel Carty was able to present to the world important developments in wireless telephony, which made possible the hurling of words thru space across the American continent from Washington to Mare Island, California, from Washington to Hawaii, 4,900 miles distant, and from Washington to Paris, bringing Europe and America into speaking distance of each other for the first time.

Then came the threat of war with Germany, and in 1916 Colonel Carty co-operated with the Signal Corps of the Army and with the various departments of the Navy in making arrangements which would ensure the readiness of the Bell Telephone System for military service in case this country did become involved in the great conflict. In 1917 these plans were put into active use with a marvelous degree of success.

Dr. Pupin said that—"Carty's life is filled with romance. He never went to college. At the age of 18, when other boys entered college, he entered the service of the American Bell Telephone Co. and at the age of 28 became Chief Engineer of the great New York Telephone Co. He started with the various apparatus being divided up so as to pack in separate cabinets suitable for transport over mountainous or other rugged country when necessary.

The transmitter is operated on batteries, the operator in the center of the picture being shown in the act of manipulating the key. At the extreme right the receiving set may be seen, with the second operator wearing the head 'phones.

WOMAN RADIO EXPERT TEACHES DRAFT MEN.

One of the most useful war enterprises yet entered by women is that chosen by Miss Elise Owen, a New York girl, who, an expert radio operator herself, has, with the support of the Board of Education and the sanction of the Signal Corps, opened a class in radio operating for men in Class IA of the draft. The class was started late in April and it already has an enrollment of 70 and plans are under way to increase its accommodations and activities. The accompanying photo shows Miss Owen and her Radio Class.

We have consistently advocated the teaching of radio as a patriotic as well as remunerative profession for women. The number of radio students is rapidly increasing at this time. Uncle Sam is sending out every week from 50 to 100 wireless operators from the big Harvard University school which was transferred to the government a year ago as a radio finishing school. It is the only institution of the kind in the country, and its classes have in the aggregate 5,000 ambitious youths. This being a finishing school only those who are able to copy 10 words a minute in the continental code, which is much slower than the Morse, or regular telegraph code, are admitted for the 16 weeks course. To be sent out for service at sea they must be able to receive 22 words a minute, the minimum grading. There are many experts among the teaching force whose speed runs up to 32 words a minute, but beyond that a radio message would be hard to get. From three to six operators are assigned to each ship.

The transmitter involves the use of an open-core transformer resembling a large spark coil, the interrupter being of special design. A quenched spark gap is used. The set is fitted with ammeter and voltmeter to indicate the primary current and voltage supplied the transmitter. A quickly collapsible antenna is carried with the outfit, which can be erected in a few minutes' time.
Small Portable Radio Set for Field Work

Since our entrance into the world conflict, American radio engineers have given considerable attention to the development and improvement of radio apparatus adaptable for various uses in the military service. The essential points to be considered in the making of such radio apparatus suitable for this kind of work are at once, simplicity, efficiency, and rugged construction.

All of the above necessary features have been incorporated in a new radio set designed by a New York radio engineer, Mr. A. B. Cole. The apparatus which he has evolved and which has proven very successful is operated from a battery and for this reason his transmitter is adaptable to various important military maneuvers where other, more cumbersome, apparatus would not adapt itself. The transmitter is shown at Fig. 1. The high tension e.m.f. used for charging the condenser is derived from a specially built spark coil which is enclosed in the case. A new design of independent vibrator is utilized for interrupting the storage battery current necessary to operate the coil. This interrupter is seen in the lower left hand of the panel. An ammeter and volt-meter are interposed in the primary of the induction coil and are used for the purpose of indicating the current and voltage input into the low tension primary circuit. These meters are stationed at the lower right end of the panel. A key is connected in the primary circuit and is also mounted on the panel.

The high tension and oscillatory circuit apparatus consists of a high tension condenser placed within the case; this condenser being charged by the secondary of the spark coil. The condenser is allowed to discharge thru a specially built quenched spark gap and thru the primary of a compactly built oscillation transformer. The gap is enclosed within the cabinet, and a large insulated knob is connected to the movable electrode, which is seen to the right of the independent vibrator. A very small adjustment is necessary to bring the gap to proper operation, as will be evident from the small swing of the pointer. The inductance of the primary oscillation transformer is variable, and it is controlled by a multiple point switch which is located at the upper left-hand corner of the panel, while the multiple point switch to the right of the primary switch is used to control the inductance of the oscillation transformer-

Secondary. A thermo - couple high frequency ammeter is interposed in the ground lead of the open oscillatory circuit, and this meter is located in the upper right hand corner of the panel. The two binding posts placed in the center of the panel are used to connect to the ground and antenna. The telephone switch in the foreground is used to connect the source of power necessary to operate the spark coil, which is generally a six-volt storage battery.

The complete transmitting panel is mounted in a well insulated and ruggedly constructed case and is supplied with a leather carrying belt, the complete equipment being extremely light in weight.

The receiving set accompanying the above transmitting outfit is shown opposite. Altho it is not essential to use this particular receiving set, it was found, however, that most favorable results were obtainable from the particular type of portable receiving apparatus. This set is of the tightly coupled, capacity control type. It comprises a fixed inductive coil wound on a special tube and mounted within the case. Two condensers of the variable, air dielectric type are used entirely for tuning purposes, and these are seen on the upper part of the panel. A crystal detector rectifies the incoming, radio frequency oscillations. This detector is in the lower right hand corner of the panel. A test buzzer is also a part of the equipment, this being used to adjust the detector crystal to maximum sensitivity. The buzzer push button is located in front of the crystal detector stand, while the buzzer is placed at the central left hand portion of the panel. The plug in front of the buzzer is used to connect the telephone receivers, while the plug at the upper center of the panel serves to connect the antenna and ground wires to the receiving set. A partition is provided at the right hand part of the case to accommodate the telephone receivers when the set is not in use. The case of this receiving set is substantially made so as to stand heavy wear and rough use.

Test Wireless Control.

Announcement that satisfactory tests have been made of a military airplane controlled wholly by wireless was made at San Diego, Calif., recently by Flight Instructor N. B. Robbins of the Rockwell field signal corps aviation school. The tests, he said, were made a short time ago, the controls being 12 miles apart.

The new machine, it is announced, carries neither pilot nor observer. It is equipped at present to carry only heavy freight or explosive bombs. The pilot guiding the machine may be in another airplane, in a dirigible or anywhere on the ground. Robbins says that an aviator driving the control in the machine ahead of him may remain fully 15 miles behind. He also says that the machine may be built for one-fourth the cost of a standard military machine. An electrical device for releasing a cargo of bombs is attached to the airplane.

Flight Instructor Robbins is the designer of one of the fastest airplanes ever built in this country, of a very fast motor and of a stabilizer used by the Royal British Flying Corps.
A HOLDER FOR A TUBULAR AUDION.

Those who have tubular Audions know what it is to have to connect the four wires and find them loose again after the receiving is over to put the bulb away in a safe place, so that it will not get broken or tampered with.

In this mind I constructed a holder which has no wires to connect and at the same time makes good connections, and is not apt to fall out of place and break.

The construction of the holder can be seen from the drawings. The rings, B1, B2, B3 and B4 are made of nickel plated brass pipe which can be obtained from any plumber or hardware store. The rings are made about 3/16 or 3/14 inch wide, and 1/4 inch in diameter. As can be seen the rings are held on the tube by sealing wax.

The best way to do this is to make a wooden mold as shown in figures 3 and 4. It will be necessary to get the wax good and hot in order to make it run in the mold. A hot knife blade will help a great deal in pressing the wax into place and smoothing it up afterward.

It is important to put the rings B2 and B3 on first, but connect the filament wires D and F before this. Then put in the other two rings B1 and B4 as shown in figure 1. A short piece of rubber tubing should be put over the wire at K and K1, where the filament wires go under the outside ring.

It will be seen from the drawing that the rings B and B2 are farther apart than B3 and B4. This arrangement makes it impossible to get the bulb connected up backwards as it will only fit one way. The clips are made as shown in figures 1 and 2. No dimensions are given as the builder will make them to suit himself anyway. In cutting out the strips for the clips, which are made of spring brass, do not forget the lug A, figures 1 and 2. The purpose of these is to hold the bulb from falling or sliding downward. The wires should be soldered to the rings before the wax is put in as soldering would melt the wax. The extra filament wire G, can be left short and can be soldered on to lead F, when necessary. It can be seen that this method has many advantages over the regular way, as it is a very good idea to remove the bulb and lock it up when leaving the station, so that it can not be tampered with or broken.

FRENCH BUILD RADIO TO AID AMERICA.

The French navy has just entered the international contest for the honor of building and possessing the most powerful wireless station in the world. In support of its claims that its newly constructed station exceeds all others now in operation, the French navy has just demonstrated its ability to send messages as far as Australia. The stations there, which registered the messages from the new French naval station, were not powerful enough to acknowledge by wireless their receipt, but had the courtesy to reply by ordinary cable that the French wireless communications had been received.

The new French naval wireless station is in reality an acknowledgment of gratitude of the French navy to the United States for its entrance into the war.

The moment America made its formal declaration of war against the enemies of France, the French navy decided to erect immediately a powerful wireless station that would put France into constant and sure touch with America. It was planned also as a very effective safeguard against the submarines for the stream of troop ships and munition convoys which it was realized would soon be headed for France.

A site was accordingly chosen on the French coast, where it was most likely that one of the American naval bases would be established, and from where it would be able to pick up with the greatest degree of certainty distress messages from any American boat that might encounter a submarine.

The metallic pylons of the French station are over 600 feet high. Perfected electrical equipment makes it possible to send out waves that will be received at any distance at which they can be picked up in the form of musical sounds instead of the ordinary crackle of the wireless. As a result of these musical indications the receiver is always able to pick out the waves of the French wireless plant from all the other storm or wireless waves with which the air may be filled. Waves can be sent out with a length of from 3,000 to 13,000 yards.

A RESEARCH TYPE OF DETECTOR.

Herc with I present drawings and specifications of a detector comprising two dis-
The How and Why of Radio Apparatus

By H. WINFIELD SECOR, Assoc. I. R. E.

NO. 9—TELEPHONE RECEIVERS.

From time to time we will describe one particular instrument used in radio, the telephone transmitting or receiving set, explaining just how it works, and why. We have received so many requests from new readers asking for explanations that we have decided to publish this matter in serial form. In the course of several issues all of the principal transmitting and receiving apparatus will be treated. For the ninth paper is TELEPHONE RECEIVERS.

The telephone receiver as applied to radio-telegraphy and telephony is one of the most sensitive electrical detecting instruments ever devised. Moreover, this does not mean that the radio receiver, as it is usually termed in wireless parlance, is the most efficient detector of weak electric currents. Quite the contrary, for it has been as a rule received for such a receiver has an over-all efficiency of only five per cent!* It was found by H. Abraham that less than one thousandth of the power is transferred from the wire to the air, is transmitted and returned to the air in the form of sound waves. Siemens conducted investigations which proved that the force of the air vibrations operating on a transmitter or microphone is ten thousand times greater than that of the vibrations representing the telephone current. Hence, of course, all must be wound with a pure insulated copper wire, and the size of wire used depends upon the resistance desired, from No. 30 B. & S. gage for a 75 ohm phone to No. 42 or smaller for a 1000 ohm or higher resistance phone.

The performance of the receiver set up or maintains a constant magnetic force acting on the iron diafragm, this action being more apparent from Fig. 1-B; thus, when the receiver has been wound down properly, the diaphragm will be held rigidly at a slight distance from the pole-pieces, and will be unaffected under normal conditions. The flux from the permanent magnet passes up one pole-piece across the air gap to the diafram, then down to the second air gap, thru the second pole-piece and thence completes the magnetic circuit. If the cap is not screwed down sufficiently tight, or if the magnets are not properly adjusted to the permanent magnet flux may be sufficient to pull down the diaphragm against the pole-pieces in which event the receiver has to be re-ruled, or the trouble may be overcome by tightening up the cap, or also in some cases it becomes necessary to place one or more paper rings under the diaphragm where it rests on the shell.

The action of the telephone or radio receiver is the same in every case. The vibration of the diaphragm so as to set up acoustic waves in the air is caused by sending a current of constantly changing strength around the coils in the telephone pole-pieces. These currents in the case of the telephone are controlled by a microphone in a well-known manner, and each current fluctuation along the circuit follows accurately the fluctuations of the voice. These current fluctuations, which often occur at a rate of several hundred per second pass thru the magnet coils in the receiver and cause constant changes in the magnetic flux acting on the diaphragm; the flux from the electro-magnet coils either strengthens or weakens the flux from the permanent magnet which acts normally on the diafram, keeping it under constant stress. Where great sensitivity is desired, it is claimed that a permanent magnet thus used to "stiffen" the diafram causes it to respond more readily to large alternating currents. It is becoming standard practise in the telephone field to make more and more use of plain ungalvanized receivers, which have been found to give in every case a perfectly satisfactory manner.

Probably the most important part of the receiver is the diafram. This is usually made of a high grade soft annealed iron which is then coated with Japan to prevent rusting, and in the best types of radio receivers the diafram is Sherardized to prevent rusting. Gold plated diaframes have also been used. The diafram of the receiver should be of sufficient size to transform the vibrations created in the magnetic field into corresponding vibrations of the air which constitute sound. The diafram itself may be of the magnetic system, incidently as part of the electric system, and finally as a mechanical vibrating system. In each of these relations, electrical, mechanical and acoustical, the original sound or signal requires that the motion of the diafram shall correspond in respect to the frequencies of the original sound of one, two or three octaves, etc. For radio receiver circuits where the current is usually of the order of a few milliamperes, and the voltage but relatively small, only a volt, it has been found that several parts of the receiver need redesigning and will bear a number of changes in proportion that would not augur well for the receiver designer if he attempted to work on a standard telephone circuit, where plenty of current and voltage are available. Experience in radio receiver design has shown that the diafram should be slightly less than two inches in diameter and clamped firmly all around the edge, the diafram itself being from four and eight mils thick. The natural pitch or vibration period of the diafram will be higher as the diameter and the thickness decrease. Of course, when designing the pole-pieces should be so near to the diafram as almost to pull it against them, for to this reason the magnetic pole-pieces should be adjustable, as it will be found in practice that temperature has considerable to do with the best operation of the receiver, the diafram itself reacting considerably under changes of temperature, which may easily range from several degrees below zero in northern climates up to one or fifteen degrees Fahrenheit in the Tropics.

The technical consideration of the action taking place in a radio or telephone receiver is best understood perhaps by analyzing the changes occurring in the magnetic circuit, which is of course the all-important factor involved in the transformation of electric currents into sound waves. The pull on the diafram is approximately proportional to $\phi$, where $\phi$ is the magnetic flux passing from pole to pole thru the metal of the diafram. A current in the windings makes the pull ($\phi + d\phi$). The increased pull due to the current is proportional to $2\phi + d\phi$, neglecting a relatively small quantity. Therefore, the greater the permanent flux, the greater the efficiency of a given instrument is increased by strengthening the magnets or by using thicker diaframes, also by reducing the air gaps between the diafram and pole-pieces, but magnetic diafram itself sets the limit to useful increase of strength of magnet, as readily becomes evident. If, with a certain thickness of diafram we understand the maximum strength of the magnet in the receiver, the superfluous magnetic flux which cannot be

THE HOW AND WHY OF RADIO APPARATUS—RADIO RECEIVERS

1. Watch-Case Type Receiver
2. Watch-Case Phone Details
3. "Brown" Tuned Reed Receiver
4. The Monophone
5. Condenser Telephone Receiver
6. Thermal Telephone
7. The "Pierce" Dynamometer Telephone
8. The "Baldwin" Telephone
9. Adjustable Pole-Piece Phone
10. "Leach" Aqu Diafram Phone
11. The "Berger" Mono-tone Receiver
12. The Ader Telephone Receiver

(For Description See Opposite Page)
Making a Six-Foot Piano Lamp

THE piano lamp here described may, of course, be constructed to suit the fancy of the individual as to finish and design. The finish desired will alter the kind of wood to be obtained. For a mahogany finish either birch or whitewood may be used as substitute for genuine mahogany. I used whitewood and the result was entirely satisfactory, both as to the finish it took and the ease with which it was worked. In the following explanation I will describe the lamp as I built it, but as aforesaid the design may be altered without difficulty.

WOODWORK DETAILS.

Material—Two pieces 2"x4"x3'x6". One piece 12" square by 3" thick.

Plane one 4" side of each 2"x4". Running lengthwise thru the center of each of the plane sides cut a groove 3/4" wide and 3/4" deep. These grooves extend to within two inches of each end (Fig. 1). (Grooves may best be made with a dado saw.)

Now glue the pieces together, planed sides next to each other. You now have a piece 4"x4"x3'6" with a hole 3/4" square extending thru the center to within two inches of each end. (When gluing be careful that no glue laps over into the center hole.)

When the glue is thoroughly dry the piece is ready for turning. The two inches of solid wood at each end affords a grip for the head and tail pieces of the lathe. Fig. 2 shows the piece ready for turning and the dotted lines shown at it will be when it is turned up. (Observe dimensions carefully.)

After it is turned and smoothed with fine sandpaper, remove from the lathe and cut off at A and B (Fig. 2). It will then re-

semble the dotted lines in Fig. 2 and the hole will extend completely thru the post. Now cut off one-half inch from AF (Fig. 2).

For the base take the 12"x12" piece and cut out a circular piece with as large a diameter as possible. Screw this onto a face-plate and insert in a lathe for turning. Fig. 3 shows the pattern. A hole 3/4" in diameter is bored thru the center of the piece. Another hole (A-Fig. 3) 1/2" in diameter is bored from the edge of the base to the inside hole and parallel to the bottom.

We will now leave the woodwork and turn our attention to the electrical details.

ELECTRICAL DETAILS.

Material—1 brass piece A-Fig. 4; 1 brass nipple to fit threads in the bottom of the brass piece (B-Fig. 4); 1 brass flange to fit the nipple (C-Fig. 4); 1 attachment plug; 3 brass pull-chain sockets (D & D Fig. 4); 11 feet of silk covered two-wire lamp cord.

The brass piece (A-Fig. 4) is made especially for the purpose. I found it at a hardware store that deals largely in lamps. It consists of a heavy brass tube tapped at the lower end and fitted at the upper with a piece as shown in the figure, from which two nipples extend to screw the sockets onto. This upper part is hollow to provide a place to make connections. Up thru the center of the cup thus formed and extending some distance above the top, is a rod threaded at the upper end and fitted with a nut. The cup is also provided with a cap with a hole in the center to pass the upright rod.

I took the above piece to an electrical supply house and had the nipple and flange fitted to the bottom.

The plug is either a crew plug or one that has two prongs which fit into slots in the socket.

The chains on the sockets will probably be too long. To remedy this screw both sockets onto the nipples on the post and set the post on top of the wooden post. You will then see how much too long the chains are and how many beads it will be necessary to take off. Now remove the sockets and disassemble each. Take the inside part and you will observe that the chain runs thru a short tube and over a small drum. At the end of the drum the end bead of the chain fits into a slot. Remove the chain from the slot and take off as many beads as you wish. When this is done put what is now the end link of the chain into the slot and reassemble the socket.

The cord may be obtained in brown, red, or green. A color should be chosen that will look well with the shade you select.

ASSEMBLING.

Pass one end of the twin conductor lamp cord thru hole A in foot (Fig. 3), and up thru the large one. Then pass it up thru the hole in the vertical column. Now cut off about six inches of the end of the cord, remove the outside silk covering and the cotton covering of each wire leaving two six-inch rubber covered wires. Take one of the sockets apart and screw the top part onto one of the nipples on piece A (Fig. 4) and lock it with the set screw provided. Remove the rubber from each end of each of the six inch wires. Pass an end of each wire thru the nipple and top of the socket.

(Continued on page 210)
THE power is not given to all persons, or for that matter to any person, to look into the future and see what is in store for them. Still quite a lot of amusement may be obtained from the electrical instru-

trations. At Fig. 1 is shown a side view of the device. At A is a small battery motor mounted on a shelf. The cardboard or tin disk is shown at B, and is mounted on the motor shaft by means of a good disk C, which may be cut from a small spool.

The window H allows the answers on the disk to be viewed. The window may be of any convenient size and covered with glass if desired. After determining the width of the window, the face of the disk should be divided up in a number of parts of the same width.

Inside these divisions the "answers" are written or printed by means of a pen. The edge of the disk is nicked between each answer and a light spring attached to the front of the box bears against the edge of the disk and dropping into the notches will stop the disk with a reply directly under the window.

The microphone on the front may be a regular telephone transmitter. The relay can be easily made by following the details shown in Fig. 2. The magnet may be taken from a high-resistance polarized ringer, the armature is a strip of brass bent into a loop at one end and placed over the support G, bent as shown. An iron piece is riveted on opposite the magnet. The contact F is supported by a brass standard and makes contact with the brass strip when the magnet attracts it.

The complete wiring diagram is illustrated at Fig. 5. The switch S, serves to open the two circuits when the apparatus is not in use. The posts are provided for connection to the battery, and these are shunted across the "break" of the relay and in addition to adding to the mystery of the device, will at times give the person holding them a slight shock, due to the reactance of the motor. They likewise reduce sparking at the contacts.

To use the oracle, close switch S and grasp the handles. Holding the mouth about two inches from the mouth piece of the transmitter, speak clearly and distinctly into the transmitter. The disk will start to spin and stoppage, will give the answer to the question asked. The replies may consist of any words, for instance, "Certainly," "Yes," "No," "How Foolish," "Of Course Not," "Without a Doubt," "Act Sensible," etc.

A RELIABLE WEATHER GLASS

A test tube about 10 inches long and ½ inch in diameter is fastened to a base or hung up by a wire. In this test tube are put: 248 grains of gypsum, ½ gram of potassium chromate, 2 ounces of pure alcohol, 2 ounces of water. If the ingredients do not mix easily, the tube should be put in warm water or shaken thoroly. After a cork is put in the tube, it is ready for work.

Following the weather, which the changes in the liquid denote:
- Clear liquid—Bright weather.
- Crystals at bottom—Thick air, frost in winter.
- Dim liquid—Rain.
- Dim liquid with small stars—Thunderstorms.
- Large flakes—Heavy air, overcast sky; snow in winter.
- Threads in upper part—Wi dy weather.
- Small dots—Damp weather, fog.

Rising flakes which remain high—Wind in upper air.

Small stars in winter on bright, clear, sunny days—Snow in a day or two.

Contributed by

GEORGE EDWIN SPITZMILLER.

INVESTIGATION OF INDUCTANCE COILS.

Extensive research on the inductance and resistance of standard coils at different frequencies has been carried out at the Bureau of Standards. A careful study has been made of the factors which cause the inductance of a coil to decrease and the resistance to increase with increasing frequency of current. The most important of these are (1) electrostatic capacity between the windings, (2) energy loss in the insulating material caused by dielectric hysteresis, (3) skin effect in the conductors, and (4) eddy currents in neighboring masses of metal. The effect of all of these can be reduced by proper design.

A large number of coils have been constructed and measurements made to determine the change of resistance and inductance with frequency. Methods have been devised for determining the effect of each of the factors enumerated above on these coils. The experimental determination of the skin effect has been found most difficult. In order to check the experimental values on skin effect theoretical formulas are needed. At present the only satis-

factory formulas are those which apply to a straight wire. By means of a new method other formulas are being developed.
A Reversing Switch for Small Motors

By ALLEN Q. SJOHOLM

No doubt many of the readers of this magazine are owners and operators of small low-voltage motors. Some of these motors have already been provided with reversing switches by the manufacturer, but the majority are not so well off. I present, herewith, details for the construction of such a switch.

This switch is of convenient size; it is simple in construction and operation; it may be mounted on a switchboard or it may be used wherever the motor is located. The wooden pieces of this instrument are all of ½-inch oak or any such hard wood. They should be well planed and sanded if you wish a neat-appearing instrument.

The base or back is four inches square. All the edges have a ¼-inch chamfer. A larger one will not look well. Holes may be drilled near the edge so that the instrument may be fastened to the switchboard if so desired.

The top of the box that fits on the base is 2½ inches by 1¼ inches. It has a groove, cut lengthwise thru the middle, ½ inch wide, ¾ inch deep, continuing the whole length of the top. On the base side of the groove are four holes to receive binding posts. The bottom is exactly the same as the top, except in that it has no holes for binding posts. The sides are 3 inches by 1½ inches; they are without grooves. For reasons that will be explained later, they are fastened to the other parts by screws, not nails.

The front piece is 3 inches square. In the center is a hole large enough for the shaft to turn in easily. The location of the points “forward,” “off” and “reverse” may be found in the drawings.

The inner base is 2½ inches by 2½ inches. It must be made thin enough to fit in the grooves in the top and bottom. Like the front piece, it has a hole of the same size in the center. Located on a circle ½ inches in diameter are four holes to receive switch points. These holes are placed so as to form a square whose sides are parallel to the sides of the box.

The movable part is of fiber ½ inch thick. On the side facing the inner base are fastened two circular pieces of sheet brass or copper as indicated. The lengthwise center of these strips must lie on a circle, ½ inch in diameter (see drawing). They must be in the form of an arc of a circle, 1½ inches in diameter. They should be at least ½ inch wide. Their ends must be at any rate ½ inch apart and not more than ¾ inch apart (see drawing).

The shaft or shank can be made from a nail; about an eight-penny. It is first cut to the required length. The shaft passes thru the hole in the center of the inner base; thru the movable part, and thru the front piece. To make it work more easily, a washer is placed between the head of the nail and the inner base. A washer placed between the pointer and the front piece would work to good advantage. The shaft is securely fastened to the movable piece, the pointer, and the knob. However, it must turn freely in the hole in the inner base and the front piece. The knob on the end of the shaft should be a typewriter knob, preferably. This type of knob can be fastened to the shaft more securely than any other kind. Also it can be removed more easily.

It will not be hard for the constructor to assemble this instrument, but he must observe at least two things: First, he must see that the brass strips are in good contact with the switch points, and, second, that the indicator and movable piece agree. The reason for fastening the sides by screws is this: If something should go wrong inside the box, the sides need to be removed in order to get at it.

The various positions of the movable piece according to the indicator are found in the drawings. All connections can be made more easily from the drawings, so I will omit them here.

The constructor can stain or paint his instrument any color that he may desire. If he does not, it should at least receive a coat of shellac.

It is a very good plan for the constructor to paste or cut the numbers of the binding posts on the top. These numbers will be found in the drawings. To save time and trouble, a diagram of the connections from the switch to the motor should be fastened to some convenient place on the instrument. This diagram will also be found in the drawings.

This design of switch lends itself to many other problems besides that of reversing motors. It can be used effectively in three-way lamp control systems in conjunction with the usual type of three-way switches. It serves as a four-way switch.

Wiring Diagrams and Successive Positions of Movable Blades of Motor Reversing Switch. This Switch Can Also Be Utilized as a "Four-Way" Switch in Composite, Three-Way Light Control Systems.
ELECTRICAL EXPERIMENTER

A HOME-MADE READING LAMP.
When drawing or reading, a good light is often necessary nearby. A reading lamp may be easily made from some old gas piping and odd parts, which tho not quite ornamental enough to adorn your library, will serve very well when you are “burning the midnight juice” in your den, trying to solve “trig” problems. The base of the lamp is made of a rather heavy paper weight which has a few ornamental beads turned on it for appearance. On the top of this an old switch base is fastened with two machine screws, which thread into holes in the paper weight tapt for that purpose. The weight should be at least 4" in diameter.

CAT SHOCKER.
Many a night when you were just about going into the land of dreams you were prevented from further enjoyment by musical echoes in your back yard academy. I have devised a way to stop “Tom” from making his nightly debut on your back yard fence, and it will now be up to him to hire another hall. Most amateurs are not using their coils at present and are at a loss to know what to do with them. I will tell you. Cut up several pieces of tin 2" x 3", 12 or 14 will do, and nail them along the top of your fence, separating them about 8 or 10 inches. Now run two well insulated wires along the side of the fence. These should be connected to the secondary terminals of the spark coil. Connect them as described in diagram and you won’t be bothered with any more feline opera concerts. When “Tom” gets his two front feet on one strip and his back feet on the other, press your key and "Tom" will see stars.

Contributed by FRANCIS ZIESSE.

Do You Own a Spark Coil? If So, Then "Cat Concerts" on the Back-Yard Fence at Midnight Are Soon Brought to a Grand Finale. Hook Up the Coil With Some Tin Plates Scattered Along the Fence. The Spark Coil Will Do the Rest.

AUTHORS!!!
All matter intended for publication—not only by us, but by any other magazine or newspaper as well—should be written on one side of the paper only and in ink. If it isn’t, somebody else must copy part of it off on another sheet before it is given to the printer.
An Electric Hour-Striking Mechanism

By THOMAS REED

A earnest "Bug," who had evidently just completed an electric clock according to specifications, wrote me asking how to make a striking-mechanism to go with it.

To describe its perfections, and by that time it was three o'clock.

"Now," said he, "it's going to strike." It did; Ye Gods, it did. It struck the three, and then went on to get all its striking done up for the day. The inventor, his face a beautiful pink, thumped on the case to remind the mechanism of its duty, but no it was doing. At the twenty-seventh stroke, his endurance gave way, and he stopt by poking a finger in the works.

It was a dirty trick for baby to play, just when papa's $50,000 depended on his speaking his piece right. Sometimes clocks are almost human.

Well now, to return to that "Bug," his letter seemed to bring a sort of inspiration with it; and after telling him dolefully to save the problem, with perpetual motion, to think over at night as a cure for insomnia, an answer to it happened along just as casually and naturally as a fellow doing in to cut off your gas meter for arrears. So as the "Bug" (whose name was Walter Fran- seen) furnished the inspiration, he is hereby declared joint inventor of the apparatus, which is shown in Fig. 1.

To begin with, while this mechanism could be incorporated in all time-wairs, it's better to drop it down below, and connect it with the hour-hand arbor by chain-wheels, or even pulleys and a rubber band, as there is almost no power to be transmitted. In that way, you can have the pleasure of seeing it go; and if it cuts up any shines, as Walter has, you can get at it handily with a half brick or a hammer.

As the picture is drawn, the clock is just ready to strike one. The cam A, attached to the minute-hand arbor of the clock, and moving in the direction indicated, is arranged to drop the flat spring D, which rests on the cam at D'.

When the spring does drop, the point on it where the D raises strikes on the contact point C and completes the electrical circuit. Follow it around. It first enters the little forked trigger CC. The bent top of this trigger forms a contact with the flat spring KK at the point JJ. On the circuit, thru the battery BB, support AA, spring LL, across to contact Q at point RR, thru the magnet L, and back to C, where we began.

Now, what happens? The magnet L, of course, is energized by dropping itself the armature K attached to the lever I, pivoted at J, which carries the heavy hammer EE by its stem HH. Righto! But also attached to the lever I is the stud N, carrying the pawl M. As this pawl is pushed to the right, it pushes along the circular rack S, till just as the hammer strikes the gong, it has pushed it to the extent of exactly one tooth; and the click O is holding that gain of one tooth, and will hold it till we get ready to make it let go.

Now, having struck our one o'clock on the gong, we want to stop things. Up above, in the clock-works, of course the contact D, C, is still closed; it would be separated for 10 or 15 minutes yet, as the cam A goes around with the minute-hand. But look at our excellent nubbin S', protruding like a borer thumb from the end of the rack S. The nubbin has now reached the spring LL, pushed against it, and separated the contacts Q and R. The magnet L is "killed," the armature-lever I is drawn back to the stop V by the spring F, and our mechanism goes to sleep till it's time to make preparations for striking "two."

Next, we introduce the volute-shaped piece W, well known in the clock-making art as a "snail." This snail is constantly moving in the direction of the arrow, at the same rate as the hour-hand of the clock above. Attached to the same arbor, and moving similarly, is the wheel X, with two Projecting-pins, X, X.

Fifteen or twenty minutes after we have so brilliantly struck "one," the pin X' strikes the end of the forked lever I, pivoted at U; and X', continuing further, raises T. The top fork of T, which is naturally raised also, carries the two pins T' and T, which bear on both the click O and the pawl M.

We left Mr. Click here,But he shut the rack S, and resolved to continue holding it or know the reason why. Well, the reason is here. On a little further raising of T, the click is lifted out of the tooth, and the rack S falls till the pin S' hits somewhere on the edge of the snail. The small, however, has been moving to the right, and the pin falls at the point W, where the diameter has lessened by just the amount of one rack-tooth. Two teeth in all, then, are ready for our next hour-strike.

A few minutes more, and the pin X" drops the lever T, and the latter "passes the brush," by dropping the click and pawl into the rack, ready for operation. It must be remembered that when the rack S fell, it released the spring LL, and closed the contact Q, R', but long before this, the contact D, C, back in the clock was opened, so we don't start yet. But we are all set again, and the instant DC is closed, the striking-operation is repeated; only now the rack S has two teeth to go before the

(Continued on page 210)
ELECTRICAL LABORATORY

Contest

(Special Prize $5.00)

Experimental Laboratory of John E. Woodrow

The accompanying photographs illustrate one of the most interesting, real dyed-in-the-wool Experimental Laboratories that we have ever had the pleasure of publishing, Mr. Woodrow has recently joined the U. S. Navy like many other illustrous young men thruout the country, who feel that they can do the utmost good for their government by offering their skill and talents to Uncle Sam. This youthful electrical and radio genius calls as his home town, Peoria, Illinois. Mr. Woodrow's laboratory, as the reader will quickly perceive, is not conspicuous by its size or other luxurious appointments so often associated in the minds of embryo engineers with such workshops, but what

he really has accumulated in his laboratory is a very complete assortment of tools and various rinktums, including miscellaneous parts of electrical apparatus so dear to the heart of every "Bug." One of the photographs shows the work bench which is provided with a small lathe driven by an electric motor, the bench also being provided with large and small hand vises, and so forth. The tool equipment includes screw drivers and files of all sizes, hack saws, wrenches, hammers, chisels, pliers, brushes, stocks and dies, wire, boxes containing a generous assortment of beloved "junk," machines and wood screws, nuts, washers, etc.

Among the other "high lights" in Mr. Woodrow's excellently equipt laboratory, we find an electric fan, storage batteries, a complete wireless receiving set and various parts of both large and small radio sets, primaries and secondaries for a large Tesla coil, electro-magnets and solenoids, small motors, parts of a Cooper-Hewitt mercury arc rectifier, as well as parts of a motion picture projector.

One part of the laboratory is devoted to "Experimental Chemistry" and contains a large assortment of the various chemicals needed by the experimenter in this branch of science, and as may be seen, the owner of this laboratory keeps his chemicals in well-stopped bottles and tight-fitting tin cans.

In connection with the chemical and electro-chemical experiments as well as in researches in the field of fluoroscopy, there is provided a considerable assortment of electrical apparatus, including various measuring instruments, such as ammeters and volt-meters, batteries both wet and dry type, motor generators, rheostats of various sizes, galvanometers, X-ray tubes and other special vacuum tubes, small weighing balances, and among several hundred other things, the inevitable supply of father's cigar boxes suitably decorated with highly colored lithographs of the Queen of Sheba, or some other equally famous or possibly infamous celebrity, situated in the social scale as remote as possible from the scientific and idealistic "high-brows" of budding scientists. However, these cigar boxes are possible means of obtaining "brick dust," suited for the various experimental purposes. Mr. Woodrow has started collecting cigar boxes, which are in abundance in this community, and he is doing it with the idea of making them into concrete or other building materials.

Edisons and Teslas, which fact for some reason we have never been able to fathom. Why doesn't some enterprising cigar manufacturer awake to the fact that there are several hundred thousand live, wide awake electrical and radio "Bugs" in the United States alone, who would boost the sale of any cigar no matter how close its relation might be to the well-known "piece of rope," so long as little Johnny or Thomas can influence his Dad to buy that particular smoke, for the very good reason that he wanted one more cigar box to complete his nest of drawers, each of them decorated with the likeness of some great electrical or scientific personage. Just think of it, "Bugs," what a glorious universe this would be, if the powers that reign in the tobacco world, would only take up this suggestion and make it possible for us to obtain a more or less complete collection of the invaluable cigar boxes decorated with the "physog's" of Messrs. Tesla, Edison, Steinmetz and Thompson.

Here's a Regular Experimental Laboratory and It Was All Built Up By an Amateur—Mr. John E. Woodrow, of Peoria, Ill. Note the Complete Assortment of Tools, Chemicals and Electrical Apparatus:

An Inexpensive and Thorough Way of Learning Radio Codes.

By F. V. Campbell.

The following method of learning wireless codes, without the use of teacher, other than ordinary phonograph, is as follows: In case of an Edison or other cylinder record phonograph, the student can either have a record made by a friend who is competent, or get someone to make it for him, and on reproducing the same, it will give almost an exact tone of a regular commercial wireless station, provided the record has been properly made. A disc record would necessarily have to be made at the factory, as no means are supplied whereby a person can make their own records on the discs. A phonograph is set up, with a blank record on, directed properly, and the code is then made, first, by the maker pronouncing the letter, then making it in wireless code characters, using, instead of a regular sending set, the second "C" above middle "C" on the organ, which gives approximately the same tone as a standard commercial wireless sending station. Then by voices groups or letters, first pronouncing the word, then making it in the code.

The method has been tried out by the writer in learning the Continental code, and has given the most complete satisfaction. The use of the organ in making the record gives a sustained tone pitch, which is essential to wireless receiving, and sounds almost exactly like a commercial station sending. If properly made on a wax cylinder, it will continue to give clear readable signals long after the student has mastered the alphabet from it. A great many persons would like to learn the code who have practically no one to send to them, without which they are at a great disadvantage, but who do possess a phonograph, and at very small expense could either make a record or secure one from someone who is equip to make them.

Don't miss the article on "Harmonics—Part II"—by Prof. F. E. Austin, in the August issue of the "Electrical Experimenter." It explains the analysis of irregular shaped alternating curves.
This department will award the following monthly prizes: First Prize, $3.00; Second Prize, $2.00; Third Prize, $1.00.

The purpose of this department is to stimulate experimenters towards accomplishing new things with old apparatus or old material, and for the most useful, practical and original idea submitted to the Editors of this department, a monthly series of prizes will be awarded. For the best idea submitted a prize of $3.00 is awarded; for the second best idea a $2.00 prize, and for the third best prize of $1.00. The article need not be very elaborate, and rough sketches are sufficient. We will make the mechanical drawings. Use only one side of sheet. Make sketches on separate sheets.

**FIRST PRIZE, $3.00**

**A NOVEL ALCOHOL LAMP.**

Procure six or eight inches of platinum wire, about the hundredth part of an inch in thickness; coil it round a small cylinder ten or twelve times, then drop it on the flame of a spirit lamp, so that part may touch the wick and part remain above it. Light the lamp, and when it has burned a minute or two put it out; the wire will then be ignited, and continue so long as any spirit remains in the lamp.

Lamps manufactured on this principle are sold by some of the chemists in New York and London.

A liquid produced from two solids: Mix equal portions of sulfate of soda and acetate of lead, both in fine powder; let them be well rubbed together in a mortar, when the two solids will operate upon each other, and a fluid will be produced.

A solid produced from two liquids: If a saturated solution of muriate of lime be mixed with a solution of carbonate of potash (both transparent liquids) the result is the formation of an opaque and almost solid mass. If a little nitric acid be added to the product, the solid mass will be changed to a transparent fluid.

Contributed by **Eliott Rabe.**

**GLASS INSTRUMENT FEET.**

It frequently happens that the amateur electrician wants good insulating feet for other. The size of wire given is for 110 volt A. C. circuits. I have used this scheme and found it very satisfactory.

Contributed by **Emil Capelle.**

**CONSTRUCTION OF NOVEL MAGNETIC RECTIFIER.**

The drawing submitted herewith shows the construction of a magnetic rectifier that uses the whole cycle of the A. C. current all the time, which results in a current almost as steady as from a storage battery. The rectifier is made as follows: The coils are both wound in the same direction. Wire required, 1,500 feet, No. 30 S. S. C. wound on each core. The cores measure 2 inches long by 3/16 inches diameter and are preferably made of soft iron wires.

Two bar magnets are pivoted in the center and placed as close as possible to the cores without touching them. One side of A. C. line is grounded on one core, the other side of line to the other core. The D. C. is taken from each pivot that holds permanent magnets. The permanent magnets should have poles facing each other.

**SECOND PRIZE, $2.00**

**OLD "SHOE NAILS" MAKE GOOD SHAFTS.**

Of course a "bug" can use old "shoe nails." I have used them myself as the "makings" of a laminated iron core for a small induction coil, together with some 3/4" brads. This sketch shows how the wax was used to hold them in. The nails may be annealed by heating to a dull red and then allowed to cool slowly before placing in the tube.

Contributed by **Harry W. Dryden, Jr.**

**A MOTOR-DRIVEN SCREW DRIVER SAVES TIME.**

A handy and practical screw driver, operated by a motor, will more than pay for itself in a short time. An electric motor is fastened at the left side of a base of wood. A small wooden structure at the right side is built of posts and a small hole is drilled at the top, to admit and allow the free movement of the steel shaft with the chuck. An arrangement by which the motor rotates the steel shaft (with chuck) is clearly shown. This device consists of two miter gears on one end of motor shaft and the other on the chuck shaft. A chuck is threaded on the upright shaft, and with a set of bits, drills, taps, etc., very good and quick work can be done with this apparatus.

Contributed by **George M. Croote.**

**THIRD PRIZE, $1.00**

**Here's a Simple Form of a C. Rectifier That Will Appeal to Amateur Electricians.**

Drill Tap.

Drive Your Machine and Wood Screws By Motor.
Much has been written about the guns used in the present European War and it is not out of place to dig down to the root of the whole thing and find out what is the real source of the explosion in the gun chamber. Most guns are set off by means of a priming cap and the substance used inside the priming cap is the subject of this article.

Mercuric fulminate is the active substance in the priming cap. This substance is prepared by the action of alcohol on a solution of mercury dissolved in an excess of nitric acid; and as this action is of a violent character, some care is necessary in order to avoid an explosion. On a small scale, the fulminate may be obtained without any risk by strictly attending to the following directions:

Weigh out, in a watch-glass, 25 grains of mercury, transfer it to a half-pint beaker, add half an ounce (measured) of ordinary concentrated nitric acid (sp. gr. 1.42), and apply a gentle heat. As soon as the last particle of mercury is dissolved, place the beaker upon the table, away from any flame, and pour into it, pretty quickly, at arm's length, 5 measured drachms of alcohol (sp. gr. 0.87). Very brisk action will ensue, and the solution will become turbid from the separation of crystals of the fulminate, at the same time evolving very dense white clouds, which have an agreeable odor, due to the presence of nitrous ether, ethyl hydrate and other products of the action of nitric acid upon alcohol. The heavy character of these clouds is caused by the presence of mercury, tho in what form has not been ascertained; much nitrous oxide and hydrocyanic acid are evolved at the same time.

When the action has subsided, the beaker may be filled with water, the fulminate allowed to settle, and the acid liquid poured off. The fulminate is then collected on a filter, washed with water as long as the washings taste acid, and dried by exposure to air.

On a large industrial scale, the preparation of mercuric fulminate is carried out in the open air, under sheds. At Montreal, 300 grammes of mercury are dissolved in 3 kilogrammes of colourless nitric acid of sp. gr. 1.4, in the cold. The solution is transferred to a retort, and 2 litres of strong alcohol are added. In the summer no heat is applied, and the vapors are condensed in a receiver and added to a fresh charge. When the action has ceased the contents of the retort are poured into a shallow pan, and when cold, the fulminate is collected in a conical earthen vessel partially plugged at the narrow end. It is washed with rainwater and alcohol, and it usually takes 20% of water, being stored in that state.

Mercuric fulminate is represented by the formula HgC\(\text{NO}_3\), being derived from the hypothetical fulminate Hg\(\text{CN}_2\text{O}_4\) by the substitution of Hg\(\text{CN}_3\text{O}_4\) for H\(\text{CN}_3\text{O}_4\). Its production by the action of nitric acid upon mercury and alcohol may be explained by the following reactions:

1. Mercury, dissolved in nitric acid, yields mercuric nitrat and nitrous acid.
2. Nitrous acid, acting upon alcohol (ethyl hydrate), gives nitrous ether (ethyl nitrat) and water.
3. Ethyl nitrat, acted on by another molecule of nitrous acid, gives fulminic acid and water.
4. (Continued on page 197)
Experimental Chemistry

By ALBERT W. WILSDON
Twenty-Sixth Lesson

CARBON DIOXID.

Experiment No. 133.
Preparation from Calcium Carbonate and Hydrochloric Acid.

HAVE (1) a splint; (2) 10 cc. of limewater in a test tube; (3) 10 cc. of blue litmus solution in another tube; (4) 10 cc. of barium hydroxid in a third tube. These should be ready to apply the several tests while the experiment is under way.

Either an Erlenmeyer flask of about 250 cc. or a wide-mouth bottle may be employed for the generator (see Fig. 121). Arrange the thistle and delivery tubes in the two-hole rubber stopper as shown, carrying the delivery tube at right angles into the receiving bottle. Put into the generator 20 or 25 grams of marble chips (CaCO₃) and cover with water, which serves to dilute the acid, which is next poured in thru the thistle tube, a little at a time, but enough to insure good action. First collect some of the gas by downward displacement in a wide-mouthed bottle that may be left open. When action is well under way, light the splint, and thrust it into the receiving bottle. Repeat these several times, and determine whether or not it is combustible or non-combustible; or a supporter or non-supporter of combustion.

The equation taking place in the generator is:

1. \( \text{CaCO}_3 + 2\text{HCl} \rightarrow \text{CaCl}_2 + \text{H}_2\text{CO}_3 \)
2. \( \text{H}_2\text{CO}_3 \rightarrow \text{H}_2\text{O} + \text{CO}_2 \)

Now place the delivery tube in the blue litmus solution and permit the gas to bubble thru it. What action do you notice? Further try its solubility by passing some into plain water and then testing the water with litmus paper. From these tests, does it suggest that the gas combines with the water or not? The gas may also be tested by trying to collect some over water and noting the rapidity with which it goes thru the water.

Allow the gas to bubble thru the prepared limewater (calcium hydroxid) and note the familiar effect. Permit the bubbling to continue. The precipitate should gradually dissolve. What could cause this paradoxical result? After the time in this water solution is all combined and precipitated, what would become of the surplus carbon dioxid? Knowing that most acids act on carbonates and dissolve them, if the product of that action is a soluble substance, can you explain the disappearance to use over 10 grams of the carbonate, which is then covered with water and the acid poured in in small successive amounts, the delivery tube going over into the solution to be used as a test. Employ the limewater, the barium hydroxid, litmus, and combustion tests. In this manner try the action of nitric acid and on calcium carbonate; also try sulfuric acid, separately on calcium carbonate. Make full notes of each, including tests and equations.

Next let what you consider carbonat in each of three tubes and act on it with the three acids (each in a different tube) hydrochloric, nitric and sulfuric, making full notes as you go.

Use potassium carbonate with the same acids in like manner.

What general conclusion can you draw concerning the method of preparing carbon...
"Electrical Laboratory" Contest

In this issue we publish an interesting story with excellent photos, describing one Amateur Electrician's experimental laboratory. Now "Bugs"—we want to publish a similar article each month. Here's our proposition: Why not write up your "Electrical Lab." in not more than 500 words. Dress it up with several good, clear photographs. If we think it good enough we will publish the article in display style and pay you well for it. The remuneration for such articles will range from $5.00 to $10.00. And "Bugs"—don't forget to make your article interesting. Don't write—"I have a voltmeter, an ammeter, a switchboard," etc., ad infinitum. For the love of Pete put some punch in it! Tell us what you do with your instruments and apparatus. You don't mean to tell us that every Experimenter does exactly the same thing. "We" know different—but from the general run of such articles which we have received in the past, one would naturally think every "Lab." exactly alike. Remember—send a photo of YOURSELF along. Typewritten articles preferred.

A GROUP OF REPRESENTATIVE AMERICAN AMATEUR LABORATORIES.
Animated Shadowgraphs

(1,263,355; issued to Pierre Ar-tigue.)

An improved method of producing animated shadowgraphs which involves the use of a powerful electric lamp suitably positioned after the manner illustrated. The screen on which the shadowgraphs are produced had, preferably, painted or otherwise produced thereon a suitable background of trees, buildings or other inanimate bodies. As the moving bodies are in silhouette, they conceal the underlying portions of the background, so that these portions will not show thru the solid block of the silhouette as it is projected on the screen.

Adjustable Telephone Bell

(1,260,549; issued to William Kline.)

This patent covers a clever arrangement whereby it becomes possible for anyone to readily adjust the strength of the sound given off by the bells. The patent also describes a novel spiral spring goin, a pair of which can be made adjusting in a similar manner to that described for ordinary bell goings. For the gongs here illustrated, there is provided a pair of sound dampers, or modulators, consisting of small thin pieces of fiber, felt, celluloid, or other suitable material, which are securely fastened to the outer edge of the bells.

Electric Vibrator

(1,259,396; issued to Albert E. Hartwell.)

A type vibrator is extremely simple and consists of an insulated coil with a laminated iron armature core passing thru it, and having an arm pivoted so as to be vibrated by the alternate energizing and deenergizing of the circuit, and finally said arm having attached to it the massage implement. A spiral spring is secured within the case to act against the pivoted lever arm, so that when the coil is deenergized, this spring will force the arm hardward and withdraw the opposite end of the bar from the core.

Non-Twisting Weight for Telephone Cords

(1,259,597; issued to John A. Breen.)

This patent deals with the problem of providing a satisfactory and at the same time cheap form of non-twisting weight for attachment to the flexible cord used on all desk phone sets, so as to take up the slack in the cord, and at the same time prevent the cord from twisting. A fault which these cords are un válido.

Reading By

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(1,260,549; issued to Napéleon Berg-

eron.)

As near as the reviewer can glean from the information given in the patent, the inventor sets out to solve the eternal riddle of perpetual motion. There is provided to start with, an electric boiler, the steam from which causes the steam engine to operate; this engine in turn is belted to a dynamo. The current from the dynamo can be switched on to an electric motor connected with a pump for blowing fresh cold water to the boiler, this water being pre-heated by means of the exhaust steam coming from the steam engines shown. Thus the electric circuits and steam generating apparatus work hand in hand apparently, without any energy from an outside source of electric power being supplied to the electric boiler circuits, except from a small dynamo at "starting." The

High Tension Rectifier

(1,259,149; issued to William Walk-

er Strong and Arthur Fleming Ne-

bit.)

In this rectifier the rotating commutator element is driven by a synchronous motor, and the current rectifier segments and brushes are mounted in a gas-tight chamber, so that the chamber may be filled with compressed air or suitable gases under the proper pressure. In order to maintain a suitable gas pressure the

Flapping Fan

(1,261,753; issued to August An-

dersen.)

This patent covers a unique form of oscillating electric fan or one in which the blade is made to flap up and down or sidewise as desired, by an ingenious arrangement of an electric motor supported within the commutator chamber, there is provided a small pump.
Phoney Patents

Under this heading are published electrical or mechanical ideas which our clever inventors, for reasons best known to themselves, have as yet not patented. We furthermore call attention to our celebrated Phoney Patent Office for the relief of all suffering daffy inventors in this country as well as for the entire universe.

We are revolutionizing the Patent business and OFFER YOU THREE DOLLARS ($3.00) FOR THE BEST PATENT. If you take your Phoney Patent to Washington, they charge you $20.00 for the initial fee and then you haven't a smell of a Patent yet. After they have allowed the Patent, you must pay another $20.00 as a final fee. That's $40.00! WE PAY YOU $3.00 and grant you a Phoney Patent in the bargain, so you save $37.00!! When sending in your Phoney Patent application, be sure that it is as daffy as a lovesick bat. The daffier, the better. Simple sketches and short descriptions will help our staff of Phoney Patent Examiners to issue a Phoney Patent on your invention in a jiffy.

Prize Winner. ELECTRIC HOOVERIZER. At Last Mr. Hoover May Put His Mind at Rest, for with the Application of This Marvelous Automatic Electric "Hooverizer" to All Hotels and Restaurants, not to Mention Leven-steen Million Private Families Through the Land, the Worries of Saving Grub Will Be Over for All of Us. How does it work?—Simplest Thing in the World, My Boy. You See, It Works Thusly:—When the Diner, Properly Equipped with the "Hooverizing" Machine, Eats a Certain Prearranged Quantity of War Bread, Bran Muffins and Molasses Cake, the Increase in His Girth Causes Electric Contacts B to Close, Thus Passing Current (Not Current) from Battery C, Into Alarm Bell D and Motor A. The Motor Winds Up a Cable as Shown, Which Causes the Expansible Arm to Yank the Plate E, Away from the Diner, When the Walter Appears and Scraps the Remains Into His "Hooverizing" Pail. Inventor, George I. Jones, Emporia, Kansas.

ELECTRO MUTT-MOTOR. I Hereby Declare the Following Not to Be the Correct Explanation of My World-Startling Conception for the Production of "Perpetual Motion"—First We Need a Nice Tame Mutt-Genus Mexicanos Sans Hair—His Royal Nibs Being Piously Situated on the Northeast Corner of a Lamb's-Wool Cushion, All as Illustrated. Now We Start the Motor Driving the Revolving Rubber Hands; Senior de Puppo is Much Pleased, Wags His Tail and Operates the Two Air Bellows, Thus Compressing Air Into Tank. Compressed Air from Tank Drives Pneumatic Motor Connected to Dynamo; Result, "Free Electricity" as Long as the Mutt Lives. Inventor, Harry W. Haengisen, Jr., Pompton Lakes, N. J.
OPERATING MOTORS IN SERIES.

(932) Robt. Kremr, Bronx, N. Y., writes:
Q. 1. Will it harm a small 110-volt D. C.
motor to connect in series with a large 110-
volt D. C. motor?

A. 1. Relative to the matter of connecting
a small 110-volt D. C. motor in series with
a large 110-volt D. C. motor we can assure
you that the larger machine in such a
case will have no untoward or dangerous
effect whatever with respect to the smaller
machine. The large motor, rated in this
case at 2 H. P., will not act as a "reservoir"
of electrical energy with respect to the
small motor, and it will make practically no
difference in the operation of the little ma-
chine except that so long as it is left in se-
ries with the small motor, it will cause the
speed of the latter to be below normal,
owing to the fact that the electrical resis-
tance of the 2 H. P. will cause a drop in
the E. M. F., or voltage, reaching the small
motor.

As you will see, this is in agreement with
your statement that under these conditions
the small electric drill motor does not reach
normal speed even with the large motor
starting-box arm placed in the last position
or notch for the reason above stated,—i. e.,
due to the drop of potential caused by the
resistance of the large motor. This drop in
potential is given by the formula: Drop in
E. M. F. equals resistance times current
flowing thru it.

HAMPSON'S RADIO CONTROL
SYSTEM.

(933) W. W. G., Canton, Ohio, asks:
Q. 1. Has John Hays Hammond, Jr.,
succeeded in developing his radio controlled
torpedoes so that they are interference
proof?
A. 1. As to the success attained by Mr.
John Hays Hammond, Jr., in his radio con-
trol experiments, we do not know definite-
ly as to the exact measure of success he
has found in this direction, but from all
reports which we have come in contact
with in the past few years, it seems that
he has a fairly good selective radio control
system.

We do not see, however, why you
would not do well to follow up this line of work,
as there seems to be very good room for
improvement in many ways. From our ex-
erience in radio matters, we should say
that it will undoubtedly take some very
excellent and thorough research work indeed
to make an absolutely "interference-proof"
radio control scheme for operating tor-
pedoes and the like. There is plenty of op-
opportunity for improvement in this branch
of the art regardless of the work done by
Mr. Hays Hammond's staff of experts.

BAROMETER QUERY.

(934) Electrical Experimenter, Bridg-
ton, Mo., writes the Oracle:
Q. 1. If a barometer tube is tilted at an
angle, will this change the reading?
A. 1. A particular case is that of a
water barometer, and as in any barometer
the vertical height is the important factor.
We should say that the angle at which the
tube is tilted will have no effect on the
situation except for that of the vertical
height. In other words, the length of the
line from the level of the water in the tube
is constant, no matter at what angle the
bulb is tilted.

Take note of the fact that water cannot
be raised to any greater height than 32 to
33 feet by atmospheric pressure.

WEAK MAGNETO.

(935) P. Wolfe, Alaska, asks several
queries relative to a weak ignition magneto.
Q. 1. One of the main reasons for the
magneto giving a weak spark is that the
steel magnets are usually improperly placed.
They should be placed with their N and S
poles as shown in the accompanying dia-
gram. Furthermore, the more the number
of turns of wire on the armature, the
greater the E. M. F., and the thicker the
wire, the greater the current. Therefore it
is very important to get as many turns on
as possible to get the best results for a
constant amount of current.

The way by which the steel magnets
tend to demagnetize the steel magnets of
the magneto is that the current of the battery

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cellent subject poorly photographed.
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the "facts"—don't worry about the
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envelope with them to prevent mul-
tiplication. Look around your town
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EXPERIMENTAL CHEMISTRY.
(Continued from page 186)

ings of soap, not over a gram in 100 cc. of soft water, heating the latter to facilitate solution. This should be reasonably clear; if it is not, use more water.

Now prepare some bicarbonate of calcium solution by passing carbon dioxide from a generator into 20 cc. of calcium hydroxide solution till the precipitate formed is dissolved. This solution must be clear, and if necessary to make it so, should be filtered. This solution is hard water.

Take 10 cc. of this solution and add the same volume of soap solution, both of which should be clear before mixing. Shake them well together and note the effect. Is a lather formed? This is soap hard water.

Take 10 cc. of distilled or other soft water and add an equal volume of soap solution. Is a lather formed in this case or a precipitate formed?

Boil the other 10 cc. of bicarbonate of calcium solution till the calcium carbonate is precipitated; then filter, and to the clear filtrate add an equal volume of soap solution. Shake, and note whether a lather or an insoluble substance is formed. Has the water been softened? What is your method of softening this sort of hard water?

Make a solution of magnesium sulfate in water, 2 grams of the salt to 20 cc. of water. Add soap solution, volume for volume, shake together, and, as before, note result. With the remaining 10 cc. see whether boiling has the same effect on the sulfate that it did on the bicarbonate.

EXPERIMENT No. 138.
CARBON MONOXID.
Preparation from Oxalic Acid and Sulfuric Acid.

CAUTION!!! REMEMBER THAT CARBON MONOXID GAS IS A DEADLY POISON, AND GREAT CARE SHOULD BE EXERCISED IN ITS PREPARATION, AND IN EXPERIMENTS MADE WITH IT. ONE PER CENT OF IT IN AIR: WOULD BE FATAL. IT SHOULD NOT BE MADE EXCEPT AT A "HOOD" AND WITH GOOD VENTILATION.

Put into a plain, thin Erlenmeyer flask of about 250 cc. capacity, 10 grams of oxalic acid crystals and pour thru the throttle tube 20 cc. of concentrated sulfuric acid.

The delivery tube from the two-hole rubber stopper leads into an intervening bottle, which contains a strong solution of sodium hydroxide, or carbonic acid, about half filling the bottle, the delivery tube reaching nearly to the bottom (see Fig. 123). From this bottle runs a delivery tube to the tray or pneumatic trough, the carbon monoxid being collected over water like oxygen. Set the flask on a triangle with asbestos and apply gentle heat. Collect three or four receivers of the gas, having one large bottle to collect any surplus, thus avoiding contamination must be done after the heat is withdrawn. When once started the chemical action will take care of itself and the heat can be withdrawn. In any event the action should be vigorous.

Water poured thru the throttle tube will cool and hinder the action.

The oxalic acid breaks up into carbon dioxide, carbon monoxid and sulfuric acid, which is a solid, consists of H, C, and O in the exact proportion to form the carbon dioxide, the sulfuric acid, and the carbon monoxid. The last will break up the acid into these constituents, but sulfuric acid aids in the operation and also absorbs the sulfuric acid, and the two gases carbon dioxide and carbon monoxid completely intermingled. Thus the function of the sulfuric acid in this experiment is only to produce a product for which it has great affinity. Remembering the affinity which carbon dioxide has for soluble hydrations, the use of the sodium hydroxide in this experiment with the carbon dioxide, thus permitting the carbon monoxid, which is insoluble in water, to be collected in a similar manner to hydrogen, the equation of the complete reaction is:

$$\text{H}_2\text{CO}_3 = \text{CO}_2 + \text{H}_2\text{O}$$

$$\text{CO}_2 + \text{CO} + 2\text{NaOH} = \text{Na}_2\text{CO}_3 + \text{H}_2\text{O} + \text{CO}$$

Test the gas collected, after taking out the bottles one at a time, by using a lighted splint, removing the cover glass at the time. Test with linemwater the product of combustion, some of which is left in the receiver.

What color did the flame have? Is the gas a supporter? Is it a combustible?

On detaching the apparatus burn the gas in the generator, all bottles, carefully avoiding inhaling any.

(To be continued.)

WILL THE GERMANS BOMBARD NEW YORK?
(Continued from page 157)

The New York Department also knows the exact whereabouts of its own submarines, and the propeller sounds of our own ships as well as the sounds of our own submarines, can thus be eliminated. Should the message be that a certain prescribed route, then the work of the listening-in operator would be vastly simplified.

By means of a subaqueous defense of this kind, it would become an easy matter for the Navy Department to practically make it impossible for the German submarines to break thru the defense unnoticed. In that case it would of course be impossible for the German submarines to assemble their aeroplanes and the attempted raid would be frustrated before it got well under way. A defense of this kind would not be very costly, and it is certain to be practical. Microphone buoys of this kind are usually located from thirty-five feet to fifty feet below the surface, as near the path of the possible enemy as possible. When the wave motion on top of the ocean will not interfere with the microphones, as at this depth no sound from above reaches them.

On the other hand, these buoys being only small affairs, and being submerged so deeply are quite unseen and unnoticed by the enemy who does not know their whereabouts, this being known only to the Navy Department.

The writer is confident that a device of this kind would help us towards the elimination of the submarine menace, which only fools deny exists.
THE ORACLE
(Continued from page 190)

be demagnetized is that of mechanical shock, and this should be avoided as much as possible.

BOOK ON DESIGN OF ELECTRO-
MAGNETS
(936) J. Morton, Wilmington, Del., asks:
Q. 1. What good book can you recommend on the design of electro-magnets?
A. 1. We can furnish a very good book on the design of electro-magnets and solenoids at $2.15 prepaid, entitled "Solenoids and Electro-Magnetic Windings," by Underhill.

MEANING OF D. S. C. AND S. S. C.
(937) Harold Wenzatz, Box 165, Rose, N. Y., inquires:
Q. 1. What is the exact meaning of magnet wire designations, such as D. S. C. and S. S. C.?
A. 1. With reference to the terms "D. S. C." and "S. S. C." would say that D.S.C. stands for double silk covered magnet wire, while S.S.C. stands for single silk covered magnet wire. In the trade the term wire is usually dropped now-a-days, the wire being termed simply "D.S." wire, etc.

SOLENOID DATA.
(938) N. W. Petefish, La Cygne, Kansas, wishes data on building a small solenoid.

ELECTRICITY
9' Vols. Flexibly Bound Pocket Size

Typical Design of Solenoid Or Suction Type of Electro-Magnet.

A. 1. We give details herewith necessary for the construction of an electro-magnet capable of lifting 8 lbs., thru a distance of 4".

Wind about 6 lbs. of No. 14 D. C. C. wire on the spool shown in the accompanying diagram, and then enclose this winding with very soft iron, of the dimensions shown. It is to be noted that the plunger will always be in its socket about 1" deep, the reason for this being that a larger pull is given at the start, than were the plunger to be merely at the end of the coil.

LAMP BANK AND ELECTROLYTIC INTERRUPTER.
(939) Clifton A. Sibley, Salem, Mass., asks:
Q. 1. Can I not use a lamp bank instead of an electrolytic interrupter on a 110-volt circuit with good results?
A. 1. Your assumption in using a bank of lamps in place of an electrolytic interrupter is entirely wrong. The function of the interrupter is to interrupt the current many hundreds times per second, and it accomplishes this by having a bubble of gas form at one of the electrodes which constantly breaks, and as you can see when this happens a circuit is made.

The reason why lamps are put in a circuit is solely to control the amount of current flowing thru the circuit.

Be guided by a Practical Man

Be guided in your study of electricity by an experienced Electrical Engineer of high professional standing. Terrell Croft, author of 1 of these volumes, climbed from the ranks to Electrical Engineer with the Westinghouse Company. He gained his knowledge with his knees rolled up and has met your problems in advance. He tells in plain, understandable language how to proceed by the best and most practical methods.

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MILESTONES IN THE LIFE OF THOMAS A. EDISON.

(Continued from page 161)

great plant at West Orange, N. J., was the scene of a great conflagration. Early next morning gangs of men were at work clear in up the debris. Here we find the model laboratory. Where we added during the day and work was continued 24 hours a day. Within 36 hours after the fire Edison had given full orders for the complete reorganization of the plant.

Early in the year 1915 Edison found that he was in danger of being unable to obtain a continuous supply of metal wire which he made his synthetic carbide. He de-

ected to erect his own benzol plants. He experimented and erected it in his laboratory at Orange, N. J., and was obliged with two coke oven plants to put in his benzol plants. The first was installed at the Cambria Steel Company's plant at Johnstown, Pa., which was installed and put into op-

eration in 45 days. Four other plants have since been installed.

The same year Edison conceived the idea of helping the textile and rubber industries of America by making myrbane, aniline oil and synthetic rubber, which was imported from Germany. With much effort and hard work, he installed a plant in 45 days, commencing deliveries in June, 1915. He is now manufacturing 4,000 pounds a day.

1917-

Since the United States entered the war, Mr. Edison has been constantly cooperating with the United States Government in various experiments, making them at Orange, N. J., and elsewhere.

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The United States Civil Service Commission announces an open competitive examination for radio inspector, for men only, Vacancies in the positions of radio inspector and assistant radio inspector, at entrance salaries ranging from $1,200 to $1,600 a year, depending upon the qualifications of the applicant. The appointment of the radio inspectors of the Bureau of Navigation, Department of Commerce, in Washington, D. C., and the States, will be filled from this examination.

Competitors will not be required to report for examination at any place, but will be required to report to the Bureau of Navigation, 100 F Street, N. W., Washington, D. C., at a time and place to be fixed, and will receive the relative weights indicated: 1. Physical ability, 10; 2. Education, training, and experience, 90; total, 100.

Under the second subject competitors will be rated upon the sworn statements in their applications and upon corroborative evidence of additional qualifications.

Applicants must have had the training and experience specified in one of the following groups:

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(b) Completion of a college or university of recognized standing, having pursued for at least two years, courses in radio and kindred sciences, such senior students being required to submit with their applications their furnishing proof of actual graduation within three years from the date of making oath to the application.

Applicants must have reached their twentieth birthday on or before the date of the application.

Applicants must submit with their applications their photographs, taken within two years, with their medical examination, and the fees will not be accepted.

Applicants will be admitted to their examination regardless of their residence and domicile; but only those who have been actually domiciled in the State or Territory in which they reside for at least one year previous to the date of making oath to the application, can be admitted to the examination. The government's certificate in the application form executed, may become eligible for appointment to the appropriated service in Washington, District of Columbia.

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This examination is open to all male citizens of the United States.

Applicants should at once apply for Form 1312, stating the title of the position in the Civil Service Commission, Washington, D. C.; the duty and nature of the work to be done in the office of the Bureau of Navigation, the pay, and the place of residence. Many of the former officers' certificate in the application form executed, may become eligible for appointment to the appropriated service in Washington, District of Columbia.

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Colonel Carty Receives Edison Medal.

(Continued from page 173)

the U. S. Army. If General Pershing has his way, Carty will be a General before many a day. General Pershing understands that Carty is made of stuff of which great generals are made."

John Joseph Carty was born at Cambridge, Mass., on April 14, 1861. Nature endowed him with a clear, keen mind, a liking for mechanical experimentation and an infinite capacity for work. He was graduated from the Cambridge Latin School and intended to enter Harvard University, but was put out by a serious trouble with his eyes, which made it impossible for him to prepare for the college entrance examinations.

He became interested in the telephone, then a new scientific device unappreciated by the majority of persons, and in 1879 started work in the Bell System with the Telephone Dispatch Company of Boston. In 1887 he took charge of the Western Electric Eastern Cable Department, and later of the Western Electric Eastern Switchboard Department. In 1890 he became Chief Engineer of the New York Telephone Company, then the Metropolitan Telephone and Telegraph Company, and while in this position, twice directed the technical work in connection with the reconstruction of this company's plant, once when the system was changed from ground circuit to metallic circuit, and the second time when it was changed from local battery to common battery.

Colonel Carty's honors are almost as numerous as his contributions to the science of telephony. He received the degree of Doctor of Engineering, from Stevens Institute of Technology, in 1915; Doctor of Science from the University of Chicago and Bowdoin College in 1916; Doctor of Laws from McGill University in 1917. In 1903 he received the Edward Longstreth Medal from the Franklin Institute of Pennsylvania, and in 1916 the Franklin Institute bestowed upon him its highest honor, the Franklin Medal, "in recognition of his distinguished service to mankind rendered in the field of Science."

For his service in connection with the establishment and development of the telephone system in Japan, Colonel Carty twice received the formal thanks of the Japanese Imperial Government, was decorated by the Emperor of Japan in 1909 with the Imperial Order of the Rising Sun, and in 1912 with the Imperial Order of the Sacred Treasure of the Meiji.

Colonel Carty is a past president of the American Institute of Electrical Engineers, of which he has been a member since 1890, and a fellow since 1913. He is Chairman of the Executive Committee of the National Research Council, a trustee of the Carnegie Institution of Washington, a past president and life member of the New York Electrical Society, a fellow of the American Academy of Arts and Sciences, a fellow of the New York Academy of Science, and an honorary fellow of the American Electro-Therapeutic Association. He is a member of the Society for the Promotion of Engineering Education, the Franklin Institute, the American Society for the Promotion of Industrial Education, the American Physical Society, the Franklin Institute of Philadelphia, the American Association for the Advancement of Science, the Society of Arts of the Massachusetts Institute of Technology, the Telephone Pioneers of America, the Association of Railways and Telegraph Superintendents, the American Geographic Society, and various telephone societies.
Fulminates.
(Continued from page 185)
active substances, since it would tend to increase the temperature of the flask by burning the carbonic oxide into carbonic acid, and would thus increase the ignition of the cartridge. For military caps, in this country, potassium chlorate is always mixed with the pressed, red-mercuric glass, sometimes added to increase the sensibility of the mixture to explosion by percussion. Antimonium sulfitum is sometimes substituted for antimonious glass, apparently for the purpose of lengthening the flash by taking advantage of the powerful oxidizing action of potassium chlorate upon that compound. Since the composition of the mixture is very liable to explode under friction, it is made in small quantities at a time, and without contact with any hard substance.

If a thin train of mercuric fulminate be laid upon a plate, and covered, except a little at one end, with gunpowder, it will be found on touching the fulminate with a hot wire, that its explosion scatters the gunpowder, but does not inflame it. On repeating the experiment with a mixture of 10 grains of fulminate and 13 grains of potassium chlorate (mixed upon paper with a card), the explosion will be found to inflame the gunpowder. (See Fig. 1.)

By sprinkling a thin layer of the fulminate upon a glass plate, and firing it with a hot wire, the separated mercury may be made to coat the glass, so as to give it all the appearance of a looking-glass. (See Fig. 2.)

Altho the effect produced by the explosion of mercuric fulminate is very violent in its immediate neighborhood, it is slightly felt at a distance, and the sudden expansion of the gas will burst fire-arms, because it does not allow time for overcoming the inertia of the ball, tho, if the barrel escape destruction, the projectile effect of the fulminate is found inferior to that of powder. It has been proved by experiment that the mean pressure exerted by the explosion of mercuric fulminate is very much lower than that produced by gun-cotton, and only three parts of that produced by nitro-glycerin. Its great pressure is due to its instantaneous decomposition into CO, N, and H20, and its power within a space not several times greater than the volume of the fulminate itself, which volume being very small, on account of the high density of the fulminate, the escaping gases exert an enormous pressure at the moment of explosion.

This detonating property of mercuric fulminate renders it exceedingly useful for effecting the detonation of gun-cotton and nitro-glycerin. Berthellot finds that even such stable gases as acetylene, cyanogen and nitric oxide are decomposed into their elements by the detonation of mercuric fulminate. Mercuric fulminate is generally contaminated with mercuric oxide, which is one of the secondary products formed during its preparation.

Fulminate of silver.—Silver fulminate is prepared by a process very similar to that for fulminate of mercury: but since its explosive properties are far more violent, it is not advisable to prepare so large a quantity. 10 grains of silver are dissolved at a gentle heat, in 70 minims of ordinary concentrated nitric acid (sp. gr. 1.42) and 30 minims of water. As soon as the silver is dissolved, the lamp is removed, and 200 minims of alcohol (sp. gr. 0.87) are added. If the reaction does not commence after a short time, a very gentle heat may be applied until effervescence begins, when the fulminate of silver will be deposited in minute needles and may be further treated.

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ELECTRICAL EXPERIMENTER

July, 1918

as in the case of fulminate of mercury. (Note.—If the fulminic acid and alcohol are not of the exact strength here prescribed, it may be somewhat difficult to start the action unless two or three drops of red nitric acid [containing nitrous acid] are added. Standard silver [containing copper] may be used for preparing the fulminate.) Silver fulminate is also prepared when nitrogen is more than just sufficient to form an alcoholic solution of silver nitrat. When dry, the fulminate must be handled with the greatest caution, since it is exploded far more easily than the mercury salt; it should be kept in small quantities, wrapped up separately in paper, and placed in a cardboard box. Nothing hard, sharp, or pointed should be em-
ployed in manipulating it. The violence of its explosion renders it useless for per-
cussion caps, but it is employed in detonating cracker.

THE STORY OF A POUND OF COAL

(Continued from page 158)

power. Thus the electrical energy put into the lamps we only receive five per cent in the form of radiant light,—the other 95 per cent is lost. Lost, all because we of to-day do not know enough to more effi-
cently convert electric current into radiant light. At the present energy consumption of 1 watt per lamp a tungsten lamp is sioning on the perfect idea of a transformation of the energy in one pound of coal, viz., 14,150 B. T. U. we would get (14,15 x 293 kilo-
wait-hour) (4,145 K.W.) or 14,15 candle-
power, as represented by the large lamp at the right of the illustration. As a matter of fact we only manage to get 1.45 x 293 K.W.

Analysis of Average Losses in Conversion of One Pound of Coal Into Electricity.

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To be continued...

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Fig. 1 shows the form of the light curve of Algol. In an unvarying period of 24.20 ^{h} 48^{m} 59^{s} the light of this star goes thru a cycle of change. During most of this time its light is nearly constant, but suddenly within 4 hours it rapidly declines until it has lost 64% of its original brightness. It remains at this minimum brightness (A1 in Fig. 1) for about twenty minutes and then rapidly rises to its original value in 3 hours. For a long time it was impossible to detect the secondary minimum (A2 in Fig. 1), but finally by attaching a selenium cell to the telescope, which device is particularly susceptible to light changes, the position of the secondary minimum midway between the principle minima was located. An examination of Fig. 3 will explain the nature of the light changes of Algol.

A1, A2, A3 and A4 are positions of the bright star in its orbit and a, b, c and d are corresponding positions of the dark star. The two stars are always in line with c, the center of gravity of the system. When the faint star is in the position a, it shuts off 64% of the light of a by partially eclipsing it (the two orbits are not in the same plane). When at a, the faint star is itself eclipsed by A in the position A4. The extremely small amount of the decrease in light from the systems when the stars are in this position (see Fig. 1, A4) shows how feeble the light of a. The amount of light shut off when a is eclipsed is inappreciable to the eye directly and is only recorded by the sensitive selenium cell. It was formerly believed that the star was totally dark. In the positions A1, A2, A3 and A4, the light from the system is a maximum, as it comes freely from both stars.

Fig. 2 shows the shift of four dark lines in the spectrum of Algol (the dark absorption lines of hydrogen). The spectrum taken under a too faint to give a visible spectrum and but one set of lines is seen. The normal spectrum of A is at the top (Fig. 2) and corresponds to the position A1. The position of the lines in A1 is also normal. In these two positions the radial velocity—that is, velocity in the line of sight—towards or away from the earth is zero. The motion of a star in its orbit is at right angles to the line of sight at any point; so at A1, A2 the bright star is moving across the line of sight or direction to the earth which is assumed to be toward the bottom of the page. At A3 (see Fig. 3) the star is moving at greatest speed toward the earth and the lines in the spectrum have their greatest displacement toward the violet end of the spectrum. At A4, the star is receding at greatest speed from the earth and the displacement is greatest toward the red.

The amount of these displacements measures the velocity of Algol in its orbit, after the radial velocity of the system as a whole thru space is allowed for. The total period of the shift in the lines and the period of light variations are the same, showing conclusively that Fig. 3 represents the true conditions that exist in this system.

From the duration and amount of the variation of light and the spectroscopic evidence the following facts are known respecting this system: The two stars are nearly equal in size, the dark companion being slightly larger. The distance between the centers of the stars is about 4.8 times the radius of the bright star. The surface brightness of the bright star is nearly constant, the surface brightness of the principal star and its density is slightly less. The density of Algol, the light star, is only 1/8 of the density of our own sun and its diameter is a little OVER ONE MILLION MILES. Its velocity in its orbit determined by the displacement of its lines is 260 miles per second and the orbital velocity of its companion must be about 60 miles per second.

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Prolonged exposures of twenty to one hundred hours are used in the treatment of deep-seated malignant growths; lead screens are always used, usually of 2 mm. thickness, exposing the patient in periods of six to twelve hours with an interval of at least twelve hours between successive exposures.

The Reaction. All tissues when treated with Radium respond in some manner, but the nature and extent of this response varies greatly, depending upon the particular apparatus, the amount of Radium employed, the nature of the tissue treated and the conditions of the tissues treated.

Factors in treatment to be considered are age, sex, temperament and susceptibility to actinic rays. The reaction usually appears between the seventh and fifteenth days, and four or five exposures are at least distinguished; simple erythema, Erythema followed by desquamation, Vescication with superficial ulcerations and deep ulceration, sometimes accompanied by the production of eschar are seen.

All kinds of opinions may be drawn from the reports of cancer experts and various statements appearing from time to time in newspapers, but preference should be extended to those who have had most experience in handling and applying Radium. One thing is certain and that is that a larger amount of recoveries and cures have been noticed with larger quantity application of rays and performance in the majority of hospitals have only very small amounts of the element. By this I do not mean that Radium in smaller quantities is not capable of doing a great amount of good but until we acquire experience and make a larger, broader and more universal practice of it's use, thereby acquiring more and more experience, it is not possible to receive all the benefits that undoubtedly lie apparently just behind a thin veil of mystery. Therefore while the greatest good is accomplished in general it seems, where the quantity of Radium applied is thoroly powerful enough to affect the growth or already being treated.

One of the easiest things to make is a pinhole camera. The essentials of nothing else than a box with a pinhole in the front and a ground glass screen on the side opposite, the back.

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A NEW ELECTRIC RECORDING
COMPASS.
(Continued from page 165)
to realize the benefits which they could ob-
tain from its installation aboard their ves-
sels, but on the part of the officers of the
ships. Their arguments against the inven-
tions were not direct; they merely rested on
the statement that they did not know
what they termed a "mechanical spy" on
board.

A record made by the instrument during
this period, while on a cruise up Long
Island Sound, is given herewith.

The recording compass, as its name im-
plicates, is a device which will make a di-
nuous record on a sheet of paper whatever
courses the ship may have taken during a
cruise of any duration.

By the addition of other quite simple at-
tachments, the speed of the vessel during
any interval is shown as well as the number
of revolutions of the engine and also what-
ever signals affecting the movements of the
ship which may have been given. All this
data is plotted automatically on a chart
against time.

In the event of any controversy arising
as regards the movements of the ship these
records would serve to establish the justice
or injustice of unkind criticism; and they
would be invaluable for purposes of de-
termining the relation of the speed to the
revolutions since they show precisely what
progress the vessel made at all points. In
cases when "dead reckoning" must be re-
sorted to, a record of the behavior of the
ship since she left harbor would eliminate
all risk from error and place this process
upon a scientific basis. In legal actions
based on the movements of ships, as in colli-
sion during fog, etc.; the records would
serve to show whether due caution had been
exercised and hence would fix the re-
sponsibility. The operating office would
be able, by a precise record showing whether
their orders as regards the man-
uevering of their ships had been executed;
whether the pilots were properly per-
forming their duty, etc. The value of the in-
strument for exploration purposes is readily
apparent.

The invention consists of a spark coil
capable of producing a disruptive discharge
thru one inch and of the usual ship bin-
nacle excepting that the needle is attached
to a very light aluminum spiral, with a
diameter of 1 inch, as herewhith; below the compass is a
compartment aluminum spiral a paper chart is fastened to a circular frame. This frame is slowly
revolved by means of a step by step me-
chanism which is visible in the illus-
ration. The gearing being actuated period-
ically by a master clock, a new circular motion is imparted to the chart
equivalent to 5 degrees (one small angular
division) per hour. The chart frame has a
radial conductor to which one secondary
terminal of the spark coil is attached, the
other terminal is connected to the aluminum
spiral thru the center support. A stream of sparks passing from the conductor to the aluminum spiral will perforate
the paper record which is interposed between
them. The aluminum spiral is held in a
constant direction by the directional force
exerted by the needle, while the chart
changes its angular position with respect
to the needle as the ship changes its course.
This change in angular position produces a
change of the point of intersection of the
radial conductor and spiral. Perforating
the paper by an electric spark, which will
jump thru it at this intersection point, re-
sults in a record of the behavior of the
ship as regards direction.

The spiral is arbitrarily selected so that
at the north end of the compass it is three
inches from the center, at the west point
the radius vector is two and one-half inches
at south two inches and at east one and

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one-half inches. The spiral recedes uniformly from the center at all points, hence it is the Spiral of Archimedes. From the equation of the curve $r = a \theta$, derived from the principle of instantaneous geometry, a very accurate construction of the spiral is possible.

The chart is provided with three circles spaced one-quarter of an inch apart in which are recorded the speed of the vessel, the number of revolutions of the engines and various signals which may have been given. These records are made in the same manner, that is by electrical perforation. Connection to a standard taffrail log, which may be so arranged that an electrical circuit is completed every knot or multiple thereof, affords the means of recording the speed. The number of perforations in the hour division gives a measure of the speed in knots per hour. In the same way the number of revolutions of the engines per hour is recorded. A standard revolution counter may be so connected that every ten, hundred, thousand or ten thousand revolutions are recorded on the chart. Connection could be made to the sounding devices and these recorded on the same chart.

Here is a drawing of the spiral, the radial conductor which extends under the compass reach from the flower de lis to the center and the record chart, all located in the same relative positions which they occupy in the machine. It is apparent that the distance which the spiral cuts from the flower de lis or north end of the compass box varies as the angle, and in as much as it is this distance which is indicated by means of the electric discharge upon the paper, a continuous record of the past behavior of the compass is obtained. An actual record of a cruise up Long Island Sound on board Dr. Jaeger’s private yacht, the Reco, is here reproduced. The chart reveals the fact that the yacht put out of port pointing S.E. and held this course for about an hour; in approximately fifteen minutes the course was changed to E. by S. and held for forty-six hours; at this point the course was changed again, N.E. by N., the change requiring one hour and a quarter, following this in six hours time the course N.E. was pursued for the remainder of the trip of twelve and one-half hours duration.

The yacht was a sailing vessel on which no engines were running, neither is there a log record hence the only information we can obtain from the chart is that it required forty-six hours to go out, six and one-half hours to partially reverse its direction and eighteen and one-half hours to put into port. The helmsmanship was good, since there are no abrupt changes in the trace of the course and furthermore one could gather that the sea was running fairly quiet, since the yacht being of small tonnage and draft would, in rough water, be forced into different courses, frequently resulting in an irregular record.

The view of the cabinet and apparatus shows the sundry special relays, controlling devices, switch gear and the various mechanisms which are necessary for the proper functioning of the recording compass. From its comprehensiveness the reader may obtain a general idea of the vast scope of labor which was entailed in its construction.

Upon first thought it may seem as tho the magnetic needle would be affected by the electric spark which is in such close proximity. Microscopic examination of the needle while under such influence shows no effect whatever. This is explained because of the fact that the magnitude of the current is very minute or about two milliamperes, and also because the spark is an irregular current of high frequency, consequently the resultant magnetic field would be practically zero.

(Continued on page 206)
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Soon, we plan with an inventor or manufacturer to establish his rights before sending a sketch, drawing or model to any attorney. Second, to give a frank opinion as to what will pay to patent. It is the idea, based upon a useful and practical apparatus, that assures the person the patent. Third, to obtain for him a reasonable term of protection and prevent it from being offered for sale to the public. If you are an inventor, you will find that the chance of profit is not only safe, territorial, but obtains royalty, or the independent manufacturer of the invention.


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Pocket Wireless.

(237) Robert N. Rose, Queens, N. Y., submits an idea to put a complete wireless outfit, phones excepted, in an ordinary book, which is connected to a rotary rectifying switch operated by a synchronous motor, run by current from the main, supplying the primary of the transformer. This is connected to an electro plating outfit. Our correspondent wishes to know if this idea is patentable and practicable.

Electro Plating.

(236) Robert McGib, Chicago, Ill., wants our opinion as to the patentability of a combination of a transformer, the primary of which is connected to the main, and is connected to the secondary of which is connected to a rotary rectifying switch operated by a synchronous motor, run by current from the main, supplying the primary of the transformer. This is connected to an electro plating outfit. Our correspondent wishes to know if this idea is patentable and practicable.

A. There is nothing very new about an idea of this kind, and it is certainly not patentable. Furthermore, we very much doubt if good plating will result from a combination of this kind, for the reason that a system of this kind will not deliver pure direct current necessary for good plating work.
Submarines, torpedoes, flying machines, machine guns, immense howitzers, the British "tank" and the, and an untold number of other products of American brains, are dominant factors in the Great War. We are just starting, our—YOUR—ingenuity must lead to Victory. Uncle Sam—the whole civilized world—that will aid in the fight. Can't you help with even ONE of thousands of simple things that will win recognition—perhaps fortune for you.

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Our correspondent believes that such a ring would combine the advantages of both eccentric and concentric rings without their disadvantages, and at the same time possess the much desired leak-proof feature. Our advice is asked as to the patentability and practicability of this device.

A. The sketch which we reproduce herewith shows the idea clearly. The feature seems to be a particularly happy one, and to our mind it is a new idea which seems to us patentable.

On account of the wedge shape the ring will certainly prove non-leakable. We would, however, suggest trying out the idea in practice beforehand.

**Flashlight Battery.**

(242) T. Robertson, Havre, Mont., wishes to know if any patents have been granted on flashlights having storage batteries incorporated in same. Also if they are of the wet or dry cell type.

A. There is nothing new about this flashlight battery business, but the German manufacturers as well as in France and in England by certain flashlight makers, have what are termed batteries incorporated in the usual dry cell device. Cells of this kind are usually sealed, and are compactly arranged in a small case, to make a rule contain either powdered glass, glass wool, or other electrolyte of the gelatious kind to make the liquid immovable.

**Screwdriver.**

(243) Andrew M. Boehmich, Cleveland, Ohio, submits description and illustration of a non-screwdriver, the handiest and most perfect method of die castings. An arrangement is provided so as to lock the screw driver by means of a large nut. This A. is a very good idea and very clever, but we are afraid the screwdriver will be too expensive to manufacture and of course there is always a good demand for the better class screwdrivers of this kind. We think a patent may be obtained upon the device.

**A NEW ELECTRIC RECORDING COMPASS.**

(Continued from page 203)

Another seemingly fatal disadvantage one may think of at the outset is that the spark used on the compass would send out electric waves which will interfere with the ship's wireless receiving set. That this is not the case has been demonstrated and from theoretical considerations it is apparent that an undamped electric oscillation of such short wave length, and being practically surrounded by metal, as shown in this invention, will have no effect on the wireless equipment.

Today, after a year's ceaseless toil and disappointments, the electric recording compass bids fair to become an indispensable accessory of every ship. With the ever increasing installation of recording instruments of all kinds, instantly on the alert to detect any shortcomings on the part of the machinery or crew, the recording compass has been looked upon as an essential part of the equipment. Of what value is it to know, for instance, that the boiler pressure has been kept below the customary mark, that the steam engines have been functioning at the maximum efficiency, etc., when it is not known that the course has been properly maintained and that the passengers and cargo have not received that delicate care so requisite for their safety? All pilots are required to pass stringent and exacting examinations and have kept themselves informed of the latest developments, but in spite of this we always lack the irrevocable proof that he has steadfastly done his duty. The recording compass puts the seal of excellence upon his work if it is good—the stamp of reproach it be bad.

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ELECTRIC OR STEAM RAILROADS—WHICH?

(Continued from page 153)

8% efficiency. Now consider that during cold weather this same machine often loses 40% of its efficiency, due to the heat utilized in raising the temperature of the fuel. At 85°F, then, the heat units are required per lb. of water to raise steam.

Thus it is seen that in 20°F. cold weather, 232 - 127, or 105 more heat units, are required per lb. of water to raise steam; or 105 - 232 = 45% loss in cold weather. The mercury falls to -40°F. and more, the steam locomotives use so much heat from their coal to heat the water from the low temperature that they often freeze up, as pointed out in the official reports of the C. M. & St. Paul Railway and other systems.

Some very vital and illuminating statistics are cited in respect to the efficiency, or rather inefficiency of operation of steam railroads, in the address of President E. W. Rice, delivered before the American Institute of Electrical Engineers mid-winter convention.

Among other things, Mr. Rice said: “Where electricity has been substituted for steam, the efficiency has increased 35 to 40% because of the 3% to 5% increase in the available capacity of existing tracks and other facilities has been demonstrated.

Electric locomotives have permitted a saving in time of at least 50% and a cost reduction by some 25% under average conditions. In cold weather the electric locomotive actually has its hauling time reduced by three times. Water is a necessity for the steam locomotive is using up all its energy by heat radiation from its boiler (in cold weather) and engine into the atmosphere. By the use of electricity practically no useful power is available to move the train, the electric locomotive is operating under its most efficient conditions and may even work at a greater speed than the steam locomotive. But this is by no means all. The railroads of the country consumed 150,000,000 tons of coal in the year 1917. Electricity of the railroads would save at least two-thirds, or 66 2/3% of this, or coal; or electric locomotives substituted for steam types would save about half the tons of coal used in one year. This is an amount three times as large as the total coal exported from the United States during 1917.”

Further information by Government experts shows that the railroads of the United States used in 1915 twenty-four million five-horse-power of coal to haul forty million five-horse-power of total coal output to run their trains. Think of it! And again—electric haulage, as demonstrated by actual results obtained on the St. Paul, the Pennsylvania, and the Northern & Western, could have saved two-thirds of this, or 100,000,000 tons of coal, equal to five times the total amount used by all the electric central stations of the country.

Public announcement was recently made by Sir Robert Beck, London, Ontario, that the Canadian Pacific Railway, Canada’s premier transcontinental system, and one of the world’s greatest, is moving toward electrification of its entire system. Chairman of the Hydro-Electric Power Commission of Ontario, told the Board of Trade he was in a position to announce that the Canadian Pacific Railway was in a position to announce the cost figures on the cost of electrifying the Ontario lines, for estimate on the cost of electrification, for an indication of the possibilities of securing a supply of power from the publicly owned hydro-electric system. He further stated that the Canadian Pacific Railway has been in a position to take some time with the electrical operation of Chicago, Milwaukee & St. Paul Railway. The coal famine in Canada and steam inefficiency in the rigorous winters, it is reported, has directed the attention of the Canadian Pacific Railway to electric traction.

On one of the Southern coal roads, with long hauls to reach the consumer, nearly 25 per cent. of the coal output is used on the locomotives which haul the coal to market, according to Mr. Rice. Did you ever stop to think that practically all of this 150,000,000 tons of coal consumed by the railroads has to be hauled up from the mine to various section terminals along the line, sometimes a thousand miles or more. And again, that a considerable amount of the mercury is spilled back again in the locomotive tender. Mr. Rice, Jr. in his paper cited above, stated in this connection: “It is estimated that fully 16 per cent of the total ton-mileage movement behind the engine draw-bar is made up of company coal and coal cars; including in this connection the steam engine tender and its contents. There is available in the United States 25,000,000 H.P. of water power; if this were developed and could be used in the fashion of the steam locomotive, every horsepower so used would save at least 6 pounds of coal per horse-power hour now burned under the boilers of our steam locomotives.

Water is one of the most valuable quantities by all steam locomotives, of course—millions of gallons of it annually. The illustration herewith serves to show how the water is pumped by the steam locomotive and piped or purchased, as in cities, and distributed all along the line at intervals of 20 to 30 miles.

Based on the fact that the 65,000 steam locomotives in the country operated about half the time, or, let us say, half a year, then they would consume the rainwater, of which there is over 20 trillion gallons a year. This total amount is equal to six months’ water, or 24 million five-horse-power of coal needed to heat it.

The two illustrations herewith show the latest high-power electric and steam locomotives compared with their present horse-power ratings and losses along the systems on which they operate. The engines are about equal in size and strength and give a clear idea of their relative efficiency. As already mentioned, the steam engine realizes about 7% gross efficiency, whereas it is stated that the electric locomotive, as shown, developing 4,000 H.P., shows a gross efficiency of 89%. This means but little in a way; rather, it is the over-all efficiency of the entire system that really tells the tale. Here are the facts:

Efficiency of Electrically-Railroaded

With hydro-electric power (ordinarily without regenerative braking), gross efficiency from water power to locomotive = 36%. In the case of the C. M. & St. Paul R. R., the engines deliver power back to the system when coasting down mountains to the amount of 15%. Hence the gross or over-all efficiency here equals 71%.

With mouth-of-mine centralized electric generating, stations, gross efficiency from coal burned to electricity delivered to locomotives = 10 to 12 per cent. This eliminates coal mining and haulage, reducing the labor required incidentally.

With "natural gas" engine plants, gross efficiency from gas used to electrical energy delivered to locomotives = 24 to 30%. With the "gas producer" plants operating on coal at mouth of mine, the gross efficiency from coal burned to electrical energy delivered to the locomotives = 24 to 28%.

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is shown at C. This arrangement may comprise a permanent steel magnet, X, with an electro-magnet, Y, secured at the center. The diafragram is then acted upon in this case at the center, and electrically in both sides. Some single-pole receivers utilize a permanent magnet punching similar to that illustrated at D. In this case the magnetic flux from the single-pole type of receiver has returned thru the air, thus encountering considerable reluctance (magnetic resistance) of course, and these receivers are therefore not as efficient as the double-pole type, as the magnetic reluctance of air is several hundred times greater than it is for iron or steel. At E, F, a typical pole-piece from a bipolar watch-case receiver is illustrated, where 1 and 2 are the fiber end-checks which are slotted over the pole-piece preparatory to winding the coil on it. The face of the pole-piece which is next to the diafragram is swaged over as shown to hold the coil check in place. It is common practice to provide several narrow slots as shown in the drawings, these slots extending from the face of the pole-piece to the bottom of the frame. Several of the best makes of wireless 'phones have these slotted pole-pieces, which tend to reduce the losses due to Eddy currents, which are produced in the space of the pole of any receiver whenever the diafragram moves and represent a loss in efficiency, develop heat, etc. All of the best grades of wireless 'phones are provided with some form of protective spark-gap or other device as shown at Fig. 2-F to prevent heavy static or other surges from burning out the windings in the receiver. A very small condenser is sometimes connected across the binding-post terminals of the receiver or else a high resistance. If a spark-gap is used for the apparatus, it should be of the microimeter type provided with threaded electrode screws so that it can be adjusted very closely, the gap not being over .01 inch in length.

Fig. 3 illustrates a vibrating reed radio receiver patented by S. G. Brown in England. This receiver is of the watch-case type having a shell, A, and an ear-piece or cap, B. The vibrating member comprises a thin reed, C, attached, several, of the best makes of wireless 'phones have these slotted pole-pieces, which tend to reduce the losses due to Eddy currents, which are produced in the space of the pole of any receiver whenever the diafragram moves and represent a loss in efficiency, develop heat, etc. All of the best grades of wireless 'phones are provided with some form of protective spark-gap or other device as shown at Fig. 2-F to prevent heavy static or other surges from burning out the windings in the receiver. A very small condenser is sometimes connected across the binding-post terminals of the receiver or else a high resistance. If a spark-gap is used for the apparatus, it should be of the microimeter type provided with threaded electrode screws so that it can be adjusted very closely, the gap not being over .01 inch in length.

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The condenser or electro-static receiver, as it is more commonly known, is based upon the fact that a condenser can reproduce speech when connected to a suitable circuit. The Clarke—Churchill condenser receiver was first successfully applied by Prof. Dollbear. Elisha Gray, in 1865, found it possible to use with the d'Arsonval, and he also at that time described a form of musical telephone receiver based upon electro-static attraction.

Fig. 1 shows the improved form of electro-static telephone receiver. This receiver is provided with a sound-conducting tube and ear-piece, and at its base carries a sound-sensitivity wave-meter, as shown in the drawing. In this particular design India rubber was found best for the condenser leaves, the distributing properties and low dielectric losses of the aluminum shell is provided as shown, which has an opening at the top and over which the alternating rubber and soft iron leaves are stretched. These rubber and foil leaves are firmly secured around the peripheral to prevent any irregular vibration. Each rubber leaf is about .4 mm. thick. The sound-reflecting plate at the base of the receiver serves to reflect any sounds emanating from the inner surface of the flexible shell plates for the condenser are composed of aluminum leaf about .001 mm. thick, these aluminum leaves being secured to the rubber leaves by a spring-like flexible bar. When the volume of receiver was tried with two hundred and forty volts, it was found that the volume was equal to that of an electro-magnetic loud-sounding receiver, and that volume increased substantially with three hundred and four hundred volts, respectively. One or other of the electro-static telephone receivers made and tested by Messrs. Orr & Rieger had a capacity of .008 m.f.

Several investigators have endeavored to reproduce a magnetic circuit of a direct type of telephone involving the heating and cooling of a fine electrical conductor. This principle is utilized in the telephone shown in Fig. 6. This telephone has the simplest form of telephone receiver ever designed, and of recent years has been quite successfully developed in Europe, notably by Mr. DeLange. The receiver consists merely of a small tube provided with an opening, the tube being small enough to be inserted into the ear. The armature member comprises a short loop of strip Wollaston wire secured to two heavy wire leads in the manner indicated. In practice the Wollaston wire is inserted in the aural passage: any sudden heating of this fine wire by a small current causes a sufficient and very marked vibration which in turn affects the ear drum. It has been found advantageous in some cases to have a small current passing permanently thru the loop.

The electro-dynamic receiver is illustrated in Fig. 7. This is also known as a dynamometer receiver. It is designed by Prof. G. W. Pierce for use with his type of wave-meter. This receiver is not as sensitive as the regular type, but for certain purposes has certain advantages, one of them being that it can be connected directly in series with the condenser and exploring inductance of a wave-meter (provided it is connected with the wave-meter, thus allowing for the inductance of the winding in the receiver) as in Fig. 8, in which case it will indicate the resonance point by giving a maximum strength of signal, the same as when a detector and a pair of parallel condensers are connected in series. The construction of the dynamometer telephone is very simple, comprising as it does, a hard rubber or other insulating bobbin on which the magnetic coils are wound and the resistive part of seventy-five to one hundred and fifty ohms, and in front of this there is placed a light copper or silver diaphragm. No iron is used in the receiver, and its action is based upon the fact that attraction is set up between the current in the armature winding and the magnetic poles of the receiver, or copper diaphragm. As Shepard points out, even the diaphragm may be omitted, the minute movements of a loosely wound coil being sufficient to reproduce speech or signals.

The Baldwin amplifying receiver is one of the best direct wave-meters. As before receiving instruments and possesses a remarkable sensitivity. Its sponsors state that this receiver will amplify the incoming signal so as to be heard distinctly. A considerable number of tests were made at the Radio Laboratory of the College of the City of New York, by Mr. T. T. flyer,with particular receiver and showed very superior results. As shown in the illustration, it comprises a permanent steel magnet which is furnished with soft iron poles and a coil shaped as indicated, and between which there is placed the electro-magnetic winding of high resistance, also a light, balanced, soft iron armature pivoted at the center. One end of this armature is connected by a brass wire or link to a mica or insulating tube. The soft iron armature is of normal size, akin to those not familiar with this particular instrument such might not seem the case off-hand. When, however, an alternating current is produced in the telephone winding, the soft iron armature is caused to vibrate, and these vibrations are transferred to the diaphragm by the link already mentioned. As becomes evident, this receiver is unlike all other electro-magnetic receivers, in that the iron armature and the coil are in such a manner that an incoming current passes thru the winding. This is so, owing to the fact that the flux from the permanent magnet divides equally between the magnet coil, the soft iron poles and continues thru the magnets. Owing to this division of the magnetic flux, there is therefore no constant magnetic field, as in the case of the common telephone receiver, as we learned in the forepart of this article. The superior sensitivity of this receiver is due to several reasons, among which are the following: the magnetic circuit has a very low reluctance, and also the armature of the receiver is used as a wave-meter, the current passing thru the winding, thus yielding a greater deflection of the diaphragm, and again the armature is acted upon by all the field and not by the conductor alone. By this means, the deflection of the wave-meter is proportionally increased.

Fig. 9 shows a type of radio receiver developed several years ago, in which the pole-pieces are made adjustable by virtue of a small thumb-screw protruding thru the back of the shell. As aforementioned, this type of 'phone permits the operator to control or regulate the strength of the signal, or also when temperature changes may cause the diaphragm to sag and touch the pole-pieces; for strong signals this receiver can thus increase the length of the air gap, and for weak signals he can advance the pole-pieces until they almost touch the diaphragm.

Another excellent type of adjustable air gap radio receiver is shown at Fig. 10. This receiver is known as the R.F. Mead, and is so arranged that the diaphragm is being rigidly locked in the adjustable cap, so that whenever the cap is turned on the shell, the diaphragm will be forced to ride in the air gap, regardless of the magnetic pole-pieces. The diaphragm is locked in the cap by means of a threaded ring. This phone has a graduated scale of galvanometer readings, and the indicator is mounted or engraved on the edge of the movable cap. Thus when an opera-
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“If I remember correctly—and I do remember correctly—Mr. Burroughs, the lumberman, introduced me to you at the luncheon of the Seattle Rotary Club three years ago in May. This is a pleasure indeed! I haven’t laid eyes on you since that day. How is the grain business? And how did that amalgamation work out?”

The assurance of this speaker—in the crowded corridor of the Hotel McAlpin—compelled me to turn and look at him, though I must say it is not my usual habit to “listen in” even in a hotel lobby.

“He is David M. Roth, the most famous memory expert in the United States,” said my friend Kennedy, answering my question before I could get it out. “He will show you a more wonderful things than that, before the evening is over.”

And he did.

As we went into the banquet room the toastmaster was introducing a long line of the guests to Mr. Roth. I got in line and when it came my turn, Mr. Roth asked, “What are your initials, Mr. Jones, and your business connection and telephone number?” Why he asked this, I learned later. I was picked out from the crowd the 60 men he had met two hours before and called each by name without a mistake. What is more, he named each man’s business and telephone number, for good measure.

I won’t tell you all the other amazing things this man did except to tell how he called back, without a minute’s hesitation, long lists of numbers, bank clearings, prices, lot numbers, parcel post rates and anything else the guests gave him in rapid order.

**********

When I met Mr. Roth again—which you may be sure I did the first chance I got—he rather bowled me over by saying, in his quiet, modest way:

“There is nothing miraculous about my remembering anything I want to remember, whether it be names, faces, figures, facts or something I have read in a magazine.

“You can do this just as easily as I do. Anyone with an average mind can learn quickly to do exactly the same thing which seem so miraculous when I do them.

“My own memory,” continued Mr. Roth, “was originally very faulty. Yes it was a really poor memory. On meeting a man I would lose his name in thirty seconds, while now there are probably 10,000 men and women in the United States, many of whom I have met but once, whose names I can instantly on meeting them.”

“That is all right for you, Mr. Roth,” I interrupted, “you have given years to it. But I can’t do it.”

“Mr. Jones,” he replied, “I can teach you the secret of a good memory in one evening. This is not a guess, because I have done it with thousands of pupils. In the first of seven simple lessons which I have prepared for home study, I show you the basic principle of my whole system and you will find it—not hard work as you might fear—but just like playing a fascinating game; I will prove it to you.”

He didn’t have to prove it. His Course did: I got it very soon after his publishers, The Independent Corporation. When I tackled the first lesson, I suppose I was the least remarkable man in forty-eight states to find that I had learned—in about one hour—how to remember a list of one hundred names so that I could call them off forward and back without a single mistake.

That first lesson stuck. And so did the other six.

Read this letter from C. Louis Allen, who at 52 years is president of a million dollar corporation, the Nile Manufacturing Company of New York, makers of the famous fire extinguisher:

“Now that the Roth Memory Course is finished, I want to tell you how much I have enjoyed the study of this most fascinating subject. Usually courses involve a great deal of drudgery, but this has been nothing but pure pleasure all the way through. I have derived much benefit from taking the course of instructions and feel that I shall continue to strengthen my memory, which is the best part of it. I shall be glad of an opportunity to recommend your work to my friends.”

Mr. Allen didn’t put it a bit too strong.

The Roth Course is priceless. I can absolutely recommend it now, and I can tell you the name of most any man I have met before—and I am getting better all the time. I can remember any figures I wish to remember. Telephone numbers come to mind instantly, once I have filed them by Mr. Roth’s easy method. Street addresses are just as easy.

The old fear of forgetting (you know what that is) has vanished. I used to be “scared stiff” by my feet—but I wasn’t sure. I couldn’t remember what I wanted to say.

Now I am sure of myself, and confident, and “easy as an old shoe” when I go on my feet at the club, or at a banquet, or in a business meeting, or in any social gathering.

Perhaps the most enjoyable part of it is that I have become a good conversationist—and I used to be as silent as a sphinx when I got into a crowd of people who knew things.

Now I can call up like a flash of lightning most any fact I want right at the instant I want, and I think that a ‘hair trigger’ memory belonged only to the prodigy and genius. Now I see that every man of us has that kind of a memory if he only knows how to make it work right.

I tell you it is a wonderful thing, after grooping around in the dark for so many years to be able to switch the big searchlight on your memory. To see instantly everything you want to remember. This Roth Course will do wonders in your office.

Since we took it up you never hear any one in our office say ‘I guess’ or ‘I think it was about so much’ or ‘I forget that right now’ or ‘I can’t remember’ or ‘I just look up his name.’ Now they are right there with the answer—like a shot.

Have you ever heard of ‘Multigraph’ Smith’s? Real name H. Q. Smith, Division Manager of the Multigraph Sales Company, Ltd., in Montreal. Here is just a bit from a letter of his that I saw last week:

“Here is the whole thing in a nutshell: Mr. Roth has a most remarkable Memory Course. It is simple, and easy as falling off a log. Yet with one hour a day of practice, anyone—I don’t care who he is—can improve his Memory 100% in a week and 150% in six months.”

My advice to you is don’t wait another minute. Send to Independent Corporation for Mr. Roth’s amazing course and see what a wonderful memory you have got. Your dividends in increased earning power will be enormous.

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HOMER'S Iliad tells us how the Greeks, the beleaguerers of Troy for over ten years, were unable to take the city, nor could they force the Trojans to surrender. Finally, so the legend goes, the Greeks constructed a huge wooden horse, which in its interior was filled with Greek warriors. This horse was rolled triumphantly into Troy by the Trojans, but during the night the Greek men escaped from the horse and threw open the passageway to the city. The Greek hosts having returned now swarmed into the city and sacked Troy. This was over two thousand years ago. Legends such as these, it seems, were just as popular then as they are now, at any rate the longing in the human breast for the spectacular during wartimes seems hard to eradicate.

It is only natural that war weary people should be fond of giving their imagination free reign and of hoping that by some miracle a wonderful invention will suddenly appear which will end the war with one stroke.

Unfortunately, history, with hardly any exceptions, teaches that but few wars were won by means of any one war invention. Wars in recent times from Napoleon down to this war have not been won by means of any particular invention. Napoleon did not surrender on account of a war weapon that was known only to his connoisseurs. Nor were the American Civil War, the Franco-Prussian War, nor the Russo-Japanese War won or lost by a new war machine.

If this is true of all other great wars, how much truer is it of the present cataclysm. Unheard and undreamed of inventions, that would have staggered human-ity twenty years ago, have been thrown into this inferno, and to what good? The bombing aeroplane, the submarine, wireless, telephones, heavy gas, the water tank, liquid fire, the 75 mile gun, are all first class war inventions, every one of which would have spelled victory to Napoleon, had he possessed the secret. And wonderful as every one of these inventions is, none of them alone have been able to bring about a decision.

Nor are they likely to do so. The Germans thought the submarine would bring a decision, their experts staking almost their last card upon it. It has been a ghastly failure, otherwise how could a million American soldiers have landed in France, with hardly a loss worth speaking about? They tried Chlorin gas in a desperate attempt on the Canadians, putting several thousands of them out of the fighting, but as a whole it had no effect upon the war.

Suppose we send ten thousand bombing aeroplanes over Germany. They alone will not win the war. Ten thousand or fifty thousand tanks alone will not win the war. A thousand land battleships or a thousand other fearful land cruisers alone will not win the war. Raining death and destruction upon the civilian population as a rule has only one result: It strives the people to greater deeds, to greater sacrifices, to greater hate, to greater determination to win the war. France, England and Italy are shining examples of this.

No, any one invention is not likely to win the war. Some day, perhaps, some one will invent an atomic ray, which is capable of pulverizing whole regiments at a stroke. Nothing of this sort is impossible. But it is not very probable. Rather it is the wholehearted devotion of the non-combattants to a great and just cause that will win the war. The nation that can throw into the scales the greatest amount of war implements, the heaviest weight of metal, the greatest amount of fighters, coupled with a prodigious use of ALL of the best war inventions will win in the end—PROVIDING THAT EVERY MAN AND WOMAN BEHIND THE LINES CONSTANTLY THINKS AND DREAMS OF WAR AND VICTORY AND IS PREPARED TO PUT EVERY LAST OUNCE OF STRENGTH AS WELL AS ALL WORLDLY BELONGINGS INTO THE RIGH-TEOUS CAUSE WITHOUT STINT OR RESTRAINT.

THE GREATEST WAR INVENTION IS THE FIERY UNDYING WILL TO WIN.

H. Gernsback.
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A Gigantic Exposition and Amusement Park in the Making

The New York International Exposition Which Is to Mark the 300th Anniversary of the Settlement of The Bronx

By GEORGE HOLMES

OURS is indeed an age of wondrous achievement. Altho we are in the midst of the world's greatest war, it is not to be said that we are the least bit doubtful or disconcerted with regard to the ultimate finish.

With the gigantic Merchant Marine now in the making it will eclipse all others and our flag will flutter in the breeze of every seaport in the world.

But to obtain all this foreign trade we must needs have some way of inducing the industrial expositions ever seen east of the Mississippi.

It is to be a permanent enterprise on the general style of Shepherd's Bush and Earl's Court in London. It is destined to be a clearing house of industrial ideas, efforts...
It is to be a vast educational institution for the instruction of the people along scientific, hygienic and artistic lines.

And, withal, a huge recreation center and playground where 250,000 persons can be accommodated each day.

The Exposition will be held each year from May 30 to November 1. The ex-

hibits this year will number about 250, representing eight countries and will be housed in twenty-five magnificent buildings. There will also be Government exhibits from five departments and it is planned to add more each succeeding year.

This vast enterprise is backed and under the guidance of some of the most prominent men of the commercial world in the United States. They believe that the attempt for commercial supremacy will naturally center in New York, hence this location for the Exposition.

The plans for the New York International Exposition are the most stupendous yet conceived from beginning to end. Of the twenty-five buildings some will be devoted to the display of scientific, artistic and industrial triumphs of the world, others to entertainments of the better class.

The exhibit buildings will be known as the Palace of American Achievements, Palace of Fine Arts, Palace of Manufactures and Liberal Arts, Palace of Varied Industries, Horticultural and Agricultural Hall, Mechanical Hall and Automobile Salon. In each of these will be displayed exhibits in keeping with the name of the building.

That these displays will be most interesting is evidenced by the fact that already the United States Government has announced its intention of participating with an exhibit by the Bureau of Mines of the Department of the Interior, and by ex-

hibits from the Army and Navy Departments.

There also will be a department devoted to food conservation, dehydration and scientific cookery, which will be under the direction of Mrs. A. Louise Andrea, one of the best known cooking experts of the United States, who conducted a similar department at the San Francisco Exposition of 1915.

The entire Exposition, however, is not of the serious nature to be found in the Exhibit buildings. The management knows that the people must be entertained as well as instructed, and to this end there are being erected a number of entertainment fea-

tures that bid fair to rival anything ever attempted before, even at an Exposition or Amusement Park.

With the opening date but a short distance away the grounds represent a ver-

itable beehive of activity, there being close

on to 500 carpenters, electricians, painters, plasterers, laborers, supervisors and other officials engaged in making New York's new Exposition a real, live-wire affair. The grounds cover a total of 28½ acres fronting on the Bronx River at 177th Street, a tract of land belonging to William Wal-

dorf Astor. To start with the site re-

sembled a large swamp; by gradual cutting and filling some semblance of order was finally secured, but not until many feet of solid rock had been blasted away to make room for the numerous gas, water, sewer and electric pipes and conduits. For the water supply to the various buildings and fire hydrants, over a mile and a half of main pipes have been laid down, not to mention eleven miles of small water pipes that branch out from the main supply pipe somewhat like the branches of a giant tree.

There will also be a very large number of electrical conduits and as our friend, the publicity manager, said with a mournful note—"three hundred thousand dollars have been buried in these grounds where the public will never see them."

Biggest and best of all will be the amuse-

ment features that will be the delight of the kiddies and make the grown-ups feel like little tots again. First will be the greatest inland pool ever made with real salt water from the Atlantic Ocean. It will be three hundred by three hundred and fifty feet and will have a sand beach three hundred feet long by fifty feet wide, wherein one may acquire a beautiful coat

constant motion by special gears and huge electric motors, producing rolling foaming breakers that bid fair to rival any that his majesty, Father Neptune, ever splashed Coney's bathers with. The pool proper will contain something like 2,500,000 gallons of water and gradually slopes down from the level to a four-foot depth, at which point will be placed the "life lines"; beyond this point the drop is fairly rapid until a ten-

foot depth is reached, where there will be the usual dare-devil platforms, chutes and other swimmers' paraphernalia.

Beneath this deep section on the floor of the pool there is set a series of spaces covered by a heavy glass frame, underneath which will be various colored electric light combinations. These lamps are controlled from shore and when lit up at night present a very beautiful spectacle, not to mention the series of flood and searchlights which will play on the scene.

Perhaps the greatest spectacle of all will be the gigantic illuminated waterfall at the deep end of the pool. At this end there will be a very pretty back-ground of moun-

tains, hills, Alpine houses, mountain streams, etc., and over these will trickle the water and spray, while in the center of this imposing array will be the sheer drop, like a plate of glass from the top of the mountain to the water sixty-five feet below of a dazzling waterfall, which, while a wonderful novelty in itself, will also improve the purity of the water in the pool.

Then there will be a very pretty grotto in back of this waterfall, where one may ob-

serve the seething foam below and the great array of lights.

Besides having the waterfall to purify the water, provision is made so that it can be kept going continuously, thereby adding new and clean water all the time and draining away the old water in proportion. Water is pumped about a mile to the grounds from a point where there is an 11-foot tide, this being right near Long Island Sound. The intake pipe is five feet below low tide; by having it so arranged it is possible to avoid sucking in all the drift and foreign matter which accumulates on the surface. In addition to this there are placed over the opening several metal screens of a very fine mesh. Passing thru the pipes the water will be pumped by the aid of large electric pumps into a large reservoir capable of contain-

ing about five hundred thousand gallons of water. This reservoir is "V" shaped and situated at the back of the pool and the waterfall. Here the water is allowed to

settle and then it is again pumped thru six large lime chloride filters and then thru the pipe line to the top of the "falls," where it is sent hurling over the top into the fountain below. All in all the pumping (Continued on page 267)
Electric Whirling Disk to Start and Stop Aeroplanes

OW that we have instituted a daily aerial mail service between New York and Washington and also between New York and Philadelphia as well as Boston, the matter of making sure that the mail-planes start off on their journey on time is a critical problem. Moreover, the Post Office authorities at New York have bethought themselves that it is really going around the bush to send a flying ground, located fifteen miles from the Post Office in the center of the city. It has been picked up by machines starting to Washington or Boston. He further stated that representatives from several aeroplane concerns had measured the roof of the New York Post Office and reported that in their estimation it was entirely feasible and practicable for the mail-planes to start and alight on the roof thereof. They proposed to build an aeroplane accelerating and decelerating machine for starting and stopping the aeroplanes in such a space, at a cost of something like $50,000. The proposed scheme is illustrated here.

Recently been suggested in the daily press by various writers that some scheme should be available whereby the mail-planes can fly directly over the city and alight on the Post Office building itself, and in this way save several hours daily in delivering the aerial post, as well as gaining a considerable amount of time in starting on their journey.

It was stated by Superintendent of Mails, E. M. Norris, in regard to these suggestions, that it was entirely feasible for aeroplane mail to be dropped on the roof of the New York Post Office, and provided the high buildings of the metropolis would permit the aeroplanes to fly sufficiently low, that the mail could be easily dropped, as suggested, on the roof of the Post Office under most conditions, but that it could not with, and as can be seen, it possesses many novel points. It resembles in general a carousel or merry-go-round, but which the aeroplanes are supposed to be spun around in starting until their propellers have attained sufficient speed and then be suddenly released, when they will be thrown off the disk tangentially by centrifugal force by means of a quick-acting release clutch or better still, by the utilization of powerful electro-magnets arranged around the electric motor-driven disk as proposed by Mr. H. Gernsback in the June issue of the Electrical Experimenter.

This remarkable apparatus is also supposed to prove efficacious in decelerating or gradually stopping aeroplanes as they alight from the air.

In this case there are two schemes which might be employed; the first working on the principle that the rotating disk be driven in an opposite direction to that of the aeroplane, which will in this case tend to quickly decelerate and come to a stop. The second arrangement would be to use large electro-magnets as shown herewith, and in this case the revolving disk could be driven in the same direction as that followed by the alighting 'plane, and by applying the current to the magnets gradually, and thus increasing their strength, the speed of the alighting 'plane and its attached iron arma-
Electric Sirens Warn Paris of Air Raids

AMERICANS are not just yet accustomed to aerial raid warnings, but those who live in cities near the Atlantic Coast are shortly to be initiated in all the arts and graces of "crawling into a rat hole," when the 凡orders it here. The French do not use stoves the way we do; they are accustomed to the chilling air which often blows over this part of Europe and it greatly amuses a Frenchman to see a Yankee shivering like a leaf, and calling loudly for "heat."

The chimney is a long beloved mark of distinction and artistic display on Parisian houses and some are quite large affairs. At last the war has found a practical use for them, for the chimneys, projecting up above the roofs as they do, provide the necessary elevations on which to mount the siren alarm equipment. The acoustic sound waves set up in the air by the siren must have a clear way thru the air in all directions to carry any appreciable distance; they must not be impeded by any obstruction or else they will be greatly weakened, or even dissipated in a very short distance.

These powerful sirens are practically all electrically operated and controlled and involve many unique features. Some of them operate on a blast of compressed air, which is caused to blow a large whistle or vibratory diaphragm whenever a magnetically controlled valve is opened. Others are designed upon the principle of the true siren as found in the physics laboratory, and based upon the fact that if we rapidly rotate a perforated disc in front of a stream of air, such as from a nozzle, then a shrill, whistling sound will be produced and the higher the speed of the disc the higher the pitch of the sound. The blast of air to be thus chomped up by a perforated disc or drum need not be supplied from a source of compressed air but may be that due to the high velocity of a revolving perforated drum, as is the case with the siren illustrated in Figs. 1 and 4. In this design of sound producer there are two similar drums or rings, each perforated with an equal number of perforal openings as shown. The outer drum is stationary, while the inner drum is rapidly revolved by an electric or other motor. The inner revolving drum is designed to give a fan effect and sucks in the air, in this way creating a strong air blast thru the openings in the two drums as they are rapidly opened and closed. The faster the drum rotates, the higher the pitch of the note produced. Some of the larger sirens require a motor of several horse-power, the revolving siren blade measuring 10 to 15 feet in diameter.

The powerful Blériot (French) electric siren of the vertical motor-operated type illustrated at Fig. 3, is interesting. Here

Fig. 1. This Gigantic Electric Siren, Installed on the Tower of Notre Dame, is but One of the Twenty-six Fixt "Aerial Alarm" Sirens Installed All Over Paris to Warn the People.

Fig. 4. First Electric Siren Installed in New York City in the Theater District for Warning Against Aerial Attacks. Many of These Will Be Used Throughout the City.
the base 1 contains the electric motor which drives a vertical spindle or shaft, to which are attached the necessary fan and siren elements within the casings 5 and 6. The air is drawn in thru opening 10. The siren sound waves emerge from openings 6, at the top. An electric "commande" or controller is fitted at the top of this siren, in the cap 7. To this magnetic controller there is connected a circuit linked up with a source of power and a Morse key 9. It is thus possible to actually telegraph with this siren, its shrill-piercing note having been heard at a distance of 2,500 meters or about 1 1/2 miles when the actuating motor and siren drums revolved at 5,000 revolutions per minute.

The internal arrangement of this electric telegraph siren is very ingenious. To shut off the sound rapidly, as in telegraphing, the inventor provides a third or intermediate perforated drum having openings equal in number and size to the usual fast and revolving members. This intermediate drum can be moved back and forth around its axis by means of the electro-magnetic controller 7, so as to more or less line up its openings with those in the fast and rotary drums; the nearer the openings in the three drums align, the greater the volume of sound liberated from the apparatus. The driving motor 1 revolves at constant speed. Where the signals are to be broken up at relatively long periods, say every five minutes, then it is only necessary to utilize a plain type of motor-driven siren, when by opening and closing the motor switch the desired intermittent signals will be given.

Figs. 4 and 5 show an American type of duplex siren, driven by a two-horse electric motor. At one of the southern flying fields in Texas, there is in use a powerful electric siren that gives out the "fog" and other warnings to aviators, which can be heard five miles away.

ACCOUNTING FOR THOSE 100,000 READERS

By Thomas Reed

I t was a big surprise, eh, Bugs, to learn that our Magazine had grown to 100,000 circulation? What do you think of our Little Maggie hot-footing it down the road in a cloud of dust, in the wake of the Saturday Evening Post? I'll say that's going some.

We've got to account for it in some way, same as any other weird phenomenon—make up our minds what it was punched Maggie's accelerator so. And my guess is that it's our Editor's propensity for "starting something."

I'll bet that fellow starts things in his sleep. He isn't satisfied with digging up for us the newest apparatus and processes, and research and theories, but he must have our laboratory-pictures, and "dope" how to make things with nothing to make 'em of, and burned-out lamp competitions—all sort of stimuliants to keep us awake and thinking. If one of his suggestions seems to go dead, no matter, he leaves it and starts something else.

But do they ever go dead? I don't believe so. Now and then one of 'em may appear to bury itself in the soil of Bugdom, like the "dud" shells they talk about, and be lost; but somewhere or other I'll warrant there's an obscure but diligent Bug sitting on the lost idea, prying away at its nose-cap with a screw-driver, bent on making something out of it, and in a fair way to succeed if he lasts long enough.

Different minds are open to different ideas, you see. For instance, mine was never exposed to this utilization of burned-out lamps. I might as well be a wooden man, for all the chance I stand in the contest.

I rack my weary brain, and nothing comes out but an opaque Pool idea, that stands in the door and blocks the passage for anything sensible. What do you suppose it is?—a nest-egg! It's dead wrong—don't let me, I realize it. A china nest-egg's demoralizing enough, but at least it's full of air, and that's the best it's possible to put something inside her product. But an actual vacuum—no; if she ever got wise that people paid money for that sort of contents—good night!

But, because I'm floored is no sign that some other Bug won't come across with a wonderful use for defunct Mardas—something that will lift the mortgage from the home, maybe, or provide Big Sister with a bea. Give him time.

Meanwhile, let's give due credit to our hard-working Ed. Give it to him now, while it's worth something—not wait till he's so obvious that the Sunday supplements are writing him up. If you wait till then before you say "Him? Oh, yes, I usher know him," you're liable to get back a sarcastic "Yes, you did! You knew all the celebrities, didn't you, from Steve Brodie to the Ahkond of Swat!" Wouldn't that be tough, when you really did know him after all?

I'll say right now that I'm looking for some Bug to develop an idea from "E. E." into one of the big inventions of the world. It might surprise the Ed., tho it wouldn't me, if some day one of those conscientious insects should stroll into 353 Fulton Street with a bag full of bills, and remark, "Doc, the wife says your paper was what started my invention, and here's a million dollars she held out of the last pay-envelope for you, with our compliments!" Success to "E. E." and the next 100,000 soon!

*Thanks, awkward, Tom! I compromise with the "insect" on 50% i.e., $490,000, (the $10,000 deduction represents a cash discount of 2%.) If he or it shows up at once! And if the "insect" insists that I take the other 50%—well, I'll not be harsh. I'll get out a fine supplement for the next issue, presenting each reader with a $5.00 W. S. S! For you see, it's the readers who by their support make possible the "E. E."—Tom.*

"GARABED" A FAILURE, SAY GOVERNMENT EXPERTS.

"Garabed," which was to revolutionize the world by the production of an unlimited free energy, is a failure. This was the report of the board of five scientists appointed by congressional resolution, made public by the Interior department July 1.

The report says the principles of the invention of Garabed T. K. Giragosian are unsound.
How Three New York Subways Meet and Pass One Another

Those of us who do not use the great subway systems of the larger cities such as New York are often prone to forget entirely some of the really wonderful engineering work carried out in the bowels of Mother Earth. The subway construction engineers of New York City, and including Brooklyn in this consideration, have solved in recent years some of the most difficult subway construction problems imaginable. This is so for a number of reasons, among which are the present subway plans of this first city of America, calling for a great number of intersections and cross-overs on the different lines, many of which take place under ground. Moreover, some of these underground tubes must be built under existing subways, without in any way interfering with the normal daily traffic. New York City has one of the most extensive subway systems in the world, comprising as it does more than two hundred miles of underground railway. Some of these subway routes which honeycomb the soil of the great metropolis have necessitated the boring of tubes under the East river, at enormous cost, and under difficulties which would seem to require almost superhuman endeavor.

The present illustration shows in a vivid manner one of the greatest subway engineering feats ever performed. Three great arteries of underground traffic now meet at the corner of Broadway and 42nd Street, better known as “Times Square,” and it is at this point, extending over an area from 42nd Street to 46th Street along 7th Avenue and also Broadway, that the new Brooklyn Rapid Transit subway has been constructed, so as to run under the present subway, which proceeds along 42nd Street, and all this work was done without interfering with normal traffic. The entire re-arrangement of the “Times Square” subway station and the interconnecting passageways joining the new B. R. T. subway (running along Broadway) with the old subway, which is to be operated simply as a “shuttle” between “Times Square” and the bird’s-eye view clearly indicates, it proceeds to dip under the old subway line at 42nd Street, but has no track connection with any other subway. The new B. R. T. Broadway line then extends northward to the south end of Central Park, or 59th Street, and from this point it runs directly east across the East River to Long Island City.

The new 7th Avenue subway on Manhattan Island will extend from the Battery uptown on 7th Avenue and will branch into the existing subway system just above 42nd Street and Broadway as the illustration delineates. Express service will be maintained on this route thru the new station at New York City Has Undoubtedly Solved Some of the Most Complex Subway Problems In the World. Here's a Typical Case---At the Corner of 42nd Street and Broadway Three Subways, All Heavy Arteries of Traffic, Meet and Pass on Their Way. The Old Subway Transports its Passengers by “Shuttle” Train from “Grand Central” to “Times Square”. Here They Can Descend to the New B. R. T. Subway, Which Dives Under the Present Interboro Tracks as Shown, or They Can Take a “Seventh Avenue” Express Uptown or Downtown. Counting the Trolley Service, Three Track Levels Are in Use at This Veritable “Hub” of New York’s Traffic.
Searchlights—The Night Eyes of the Army

By FRANK C. PERKINS

The accompanying photograph shows a recent design of American portable auto searchlights as demonstrated at the Marine Barracks, League Island Navy Yard, Philadelphia, Pa. It was also tested out before the Engineering Department at the Washington Barracks, and the Maryland State Militia made very interesting experiments with it in their maneuvers. It is stated that after the first test was made at League Island, a very thorough report was made by the officer in charge, which showed that on a dark night with sleet falling, each lamp gave good illumination at distances up to 1,500 yards. The military officials have taken a particular interest in this auto searchlight because of the conditions in the European war and during the operations of the American Marine Corps at Vera Cruz and Culebra showed the need and the varied uses for such an equipment.

It is pointed out that the features to be incorporated in any portable light must include reliability, ruggedness, ease of carriage and construction of such nature that all of the set may be quickly assembled and placed in operation. This particular auto searchlight in the equipment is mounted on a special body on an autocar chassis. The body is designed so as to furnish protection for the power plant, and to support the four reels of flexible cable, and the spring mounted tracks on which the two searchlight hand trucks rest. These springs are quite essential in eliminating road shocks from the delicate mechanism of the lamps.

It is of interest to note that the power plant consists of a gasoline motor with 4½" x 4½" cylinders, coupled direct to a 7-kilowatt direct-current generator. This generator is designed to run at 1200 revolutions per minute, at which speed it gives 125 volts and delivers 56 amperes. The motor is equipped with a fly-wheel governor, regulating the speed within narrow limits. The motor driving this generator is supplied with its own gasoline tank, and also an independent radiator kept cool by a high-speed fan.

It may be stated that the two hand trucks which carry the searchlights and reels of flexible wire are constructed entirely of steel and aluminum, and have each two wire wheels equipped with 28" x 3" pneumatic tires. These trucks are light in weight and rigid in construction, and so designed that they have large road clearance beneath the light to enable them to be operated in very rough country.

For supplying the necessary current each light carries 1350 feet of cable, divided into two lengths of 675 feet each, so that each lamp can be operated independently of the other at a distance of one-quarter mile from the generating plant. By means of specially designed attachment plugs and reel arrangement, the light can be operated at any distance within the limits of the cable from the power plant without unreeling all of the wire to get to the inner end. The inner ends are arranged to pass through the heads of the drums, so that the attachment may be readily made. Each searchlight measures 14 inches in diameter and has an arc of five thousand candle-power, and is effective up to a mile on a good clear night.

It is declared that in order to get the maximum value of the lamp, the observer of the U. S. Army electric searchlight, fitted with a collapsible steel mast of considerable height. These searchlights are intended for special work and can be removed from the truck when desired. They are fitted with reels of flexible cables as will be seen, these reels maintaining continuous contact with the feed wires from the dynamo at all times, by means of a brush and ring arrangement.

Electric searchlights are invaluable as a protection against enemy air raids upon towns or cities. Since many coast cities are now in darkness at this time, these pictures are of added interest.

One of the photos shows a climbing mast fully elevated. This elevating attachment is used in case the lights are hidden behind trees, walls or bushes for the purpose of concealing them from the enemy observers.

This photo was made at the Mobile Anti-Aircraft Section of the Engineering Corps, Washington Barracks, Washington, D. C.

The third photo illustrates a battery of searchlights in operation at night locating aeroplanes that are sent up for the purpose of detecting enemy aircraft.
Aerial Mono-Flyer of the Future

By H. WINFIELD SECOR

ELECTRICAL EXPERIMENTER
August, 1918

THE high-speed electric train of the future will undoubtedly be radically different in design from the railroad cars of the present day. For many locations, especially in mountainous regions, a electrically operated mono-rail car, illustrated on our front cover as well as on this page, will prove of particular value. Begin with this aerial mono-flyer is enabled to run along at speeds of 200 miles per hour or faster on a single rail or cable, thanks to the wonderful stabilizing effect, which is of a size and is being easily capable of maintaining a 100-foot car in an upright position on a mono-rail or cable. Among other interesting technical features of this thoroughly practical passenger carrier are the airplane propeller drive, unique method of supplying electric current to the car motors, safety attachments to prevent the car from deranging should the gyroscope fail, and a number of other interesting details, based on sound engineering principles which our technical experts are quite familiar with, but which have not as yet found practical application.

The mono-rail flyer is not as impractical as would at first appear for such a single-rail car carrying passengers had been operated by Brennan, the English engineer, many years ago. His car, fitted with a small stabilizing gyroscope, travelled along upright on a single rail very successfully. If you wish to demonstrate this remarkable power of the gyroscope go to the nearest toy-shop and purchase a 25 cent gyro. You will find that if you stretch a piece of string horizontally or at an angle that the upright gyro, spinning at high speed, of course, will travel along the string upright.

Another important fact is that as the gyro's speed decreases it counters gradually more and more, which action you can readily demonstrate yourself; moreover, this shows that if the mono-flyer's gyroscopic should fail at any time then the car would cant over easily, not rapidly, owing to the great momentum which the gyro wheel. Thus it is the decentering gyro and car slowly reach a neutral or hanging position, which it will safely assume when provided with guard rails such as those on a typical electric car illustration.

An ingenious arrangement of the inner passenger compartment of the monoflyer has been given. In emergency conditions, and this involves the free suspension of this compartment on roller bearings as indicated in the end-wise sectional view of the car. The inner cab is not free to rotate on its axis normally, but as soon as the gage in front of the motorman here shown, or over regular mono-rail land systems, is by high-speed air propellers. This idea may not seem feasible at first but the practicability of the scheme is attested by the gigantic Caproni triplanes, as well as the English monoplane planes, some of which have as many as four propellers and a carrying capacity of fifteen to twenty passengers. The mono-flyer propellers are driven by electric motors controlled by the motorman at the front of the car.

The next proposition is how to supply the car with current. There are three methods by which the car can be electrically operated. The first is to employ a gasoline-electric power plant; in this unit a petrol motor drives a dynamo and the current delivered by it is supplied to the propeller and gyroscopes motors thru regulating rheostats in the usual manner. The second scheme is the one illustrated herewith in which the positive and negative currents are carried by two special duplex cables, so wound as to eliminate static electric charges continuously along its surface. A specially contrived plus and minus contact trolley wheel rolls on this double polarity cable, thereby permitting positive and negative electric currents respectively. Owing to the peculiar construction of this contact wheel, with its spiral shoes and the spiral arrangement of the opposite conductors in the cable, the circuit is completed effectively. Either direct or alternating current can be utilized.

A third way of supplying electric current to the mono-flyer is by the one-wire, high tension, high frequency system of Tesla. In his works on high frequency currents Dr. Tesla shows and describes a high frequency system which he built and demonstrated successfully. This method of distributing electric energy is ideally applicable to our present railway. The steel cable upon which the car travels could be charged by a high frequency, unidirectional current and the motors operated on the Tesla one-wire method. Also, to intensify the corona transmission light feeder cable could be run along just above the car, the two cables being oppositely charged with a high tension, high frequency current. The corona leakage between such highly charged conductors is enormous, and not easily appreciated by anyone who has never seen such a discharge. This corona is but a silent effluence and will fill the air space between two opposite charged conductors separated 6 to 8 feet apart, when charged at 150,000 volts. A number of the long distance transmission lines of today utilize voltages of this order, and the reader may gasp when he thinks of what might happen if our mono-flyer was rolling along peacefully between two cables charged at 200,000 volts and a short-circuit should occur. Well he might hold his breath if the current were of 60 cycles frequency, for then there would be some fireworks. Sixty cycle current kills. But this same 200,000 volt alternating current if oscillating at half-a-million cycles per second would be harmless. Besides, the passengers in the steel car would not be shocked by any shock as the currents, in the event of a short-circuit, would pass thru the steel frame.

Two views of a Sperry ship-stabilizing gyroscope of the electric motor-driven type are illustrated herewith as of interest to readers of this article. The sectional view shows the motor mechanism inside the casing of the 24-inch diameter rotor. The motor is an A. C. squirrel cage induction motor. The gyro is fitted with a motor-operated vacuum pump which keeps the gyro chamber exhausted of air, in this way eliminating considerable losses due to the windage of the massive high.
speed wheel. The precession of such gyroscopes is taken care of automatically by a special motor gear as shown in the sectional view. Here A is the heavy steel rotor wheel, revolving on a vertical shaft B, by means of the squirrel cage induction motor C. A heavy roller bearing D carries the thrust load while the radial bearings E transmit the gyroscopic loads thru the case F to the gudgeon G, secured to the ship's or car's structure. Great gyros of this type and measuring 20 to 25 feet have been successfully installed on large battle-ships to prevent their rolling in a heavy sea, and thus provide a steady platform from which the big guns could be accurately fired. The wonderful stabilizing power posset by even the smallest gyroscopic can be gleaned from the fact that in computing the size of gyro for stabilizing a certain ship, the engineers figure on the complete gyro equipment to weigh about one per cent of the ship's total displacement. Thus for a 500-ton craft the gyro equipment would weigh but 5 tons while for a 10,000-ton battle-ship it would be only 80 tons or eight-tenths of one per cent.

The idea as here exprest is susceptible of many improvements to be sure. For one thing it is not conceivable that we have found the most efficient form of a propulsion mechanism at all. Possibly the air propelled craft of the future will have propellers shaped like huge augers and worm their way thru the air—who knows?

WILLIAM J. HAMMER NOW A MAJOR IN U. S. NATIONAL ARMY.

It is with extreme pleasure that we can announce that Mr. William J. Hammer, Consulting Electrical Engineer of New York City, and who has contributed numerous interesting electrical articles to the Electrical Experimenter in the past several years, has been appointed a major in the U. S. National Army, and is at present located at Washington, D. C. The U. S. Government is to be congratulated upon obtaining the services of so distinguished and accomplished a scholar as a co-worker to aid in solving the many diversified problems now besetting it. Mr. Hammer, who was for a number of years an early associate of Thomas A. Edison in the development and application of the electric light, has traveled extensively in Europe, and is therefore thoroly conversant with electrical inventions and developments both in Great Britain and on the Continent. Major Hammer may be addressed in care of the Inventions Section, War Plans Division, General Staff, War College, Washington, D. C. He received his appointment on June 4th, 1918.

THE VALUE OF A KILOWATT AND HOW TO SAVE IT.

By John J. Dempsey

Vice-President Brooklyn Rapid Transit Lines.

WHAT is a kilowatt?

In terms of economy—of power saving—which is in a double sense a burning issue to every industry and the nation at large today, a kilowatt represents the consumption of three pounds of coal.

In the much-discuss matter of heat, for instance: The operation of trains without heat requires four kilowatts per car mile. With three points of heat on, it requires between live and one-half and six kilowatts per car mile. Thus the heating of a car requires 30 per cent of the power required to operate it.

Obviously, then, it is the duty of every conductor to keep in mind the amount of energy wasted in the opening and closing of doors. With due care in this regard alone, a proper temperature could be maintained in the cars on from one-third to one-half less power.

During the cold weather conductors on surface cars should keep the rear doors closed as much as possible and, during non-rush hours, ask passengers to use the rear entrance entirely, thus keeping the front doors closed and contributing to the comfort of passengers. When conductors find it necessary to confer with motormen they should be careful not to stand with head and shoulders thrust out thru the open front door, but should rather step onto the front platform and close the door behind them.

Motormen, for their part, should remember that every time a brake is applied a certain amount of energy is taken out of the train, and that to restore it a further consumption of power is necessary. When a motorman, running thru a congested district, or where cars are blocked, keeps "nosing up" by throwing his power on and off to the jerky accompaniment of the brake, he might as well be shovelling coal out of the Company's bins, or money out of the Company's pockets into a ditch. The Company could really better afford to pay such a man to stay at home and not work at all.

Proper and economical operation requires a motorman to use his brake as seldom as possible consistently with safety and to coast as long and as frequently as possible consistently with his schedule.

So far as the public is concerned, it is perhaps not unnatural for persons who have no sense of the amount of coal necessary to operate a system like the Brooklyn Rapid Transit to think, because we have what seems a great quantity of coal in our bins that is sufficient to operate almost indefinitely and furnish ample heat as well. But that is only because they view the situation from the standpoint of their own coal consumption. If they stopped to think that it takes one and a half tons of coal to run one five-car train from Union Square to Coney Island and back and that two such round trips consume more coal than the average family uses in a year, they would, if fair-minded, be disposed to withhold judgment.
Reclaiming the U-Boats' Toll: A Novel Novel Salvage Operations

The toll of sunken ships occasioned by the advent of unrestricted U-boat warfare promises to be a large one by the end of the war, in spite of all of the anti-submarine devices and protective measures which have been promulgated and put into active practice. As we approach the close of four years of the World War we may well admit that the problem of reconstructing which will come to our hands in the great aftermath of the World War that we shall be confronted with is evidently formidable and an undoubted need of a greatly increased tonnage of ships to carry much needed supplies to the various countries now being devastated. Therefore, as we cannot build ships sufficient fast to catch up with the gigantic shipping requirements which are sure to face us the day after tomorrow, yet we shall need but one other ultimatum—that is, to devise some means of accurately locating and raising the hundreds of ships, both large and small, which have been sunk by the enemy submarines.

There has been a veritable flood of patents issued in the past few years on many ingenious and impractical schemes for raising sunken ships. In the present instance we shall examine the claims of three recent patentees who aim to provide apparatus for locating and raising the victims of the greatest submarine warfare ever conceived.

The first patent concerns a powerful telescopic electric searchlight for locating and insubmersible submarines. The device, in its simplest form, consists of a powerful motor or engine to generate electricity from water or other sources, a large storage battery to power the motor, and a series of electrical cables or wires to conduct the power to the searchlight itself. The searchlight is mounted on a tripod or similar support, and is directed towards the location of the sunken ship. The operator of the searchlight, sitting in a cab or similar enclosure, operates the machinery and controls the searchlight. The light from the searchlight is directed downwards, illuminating the bottom of the water, and allowing the operator to locate the ship and determine its position.

Another object of the invention is to provide a telescope of the character illustrated and having an improved form of the objective fitted with a ring of power, increasing the power of the light and making it more efficient. The telescope may be mounted in any convenient manner and may be used in conjunction with the searchlight.

The second patent is for a searching and locating machine for sunken vessels. The device consists of a powerful electric motor, a series of cables or wires, and a searchlight. The searchlight is mounted on a tripod or similar support, and is directed towards the location of the sunken ship. The operator of the searchlight, sitting in a cab or similar enclosure, operates the machinery and controls the searchlight. The light from the searchlight is directed downwards, illuminating the bottom of the water, and allowing the operator to locate the ship and determine its position.

The third patent is for a method of locating sunken ships. The device consists of a powerful magnetic coil, a series of cables or wires, and a searchlight. The searchlight is mounted on a tripod or similar support, and is directed towards the location of the sunken ship. The operator of the searchlight, sitting in a cab or similar enclosure, operates the machinery and controls the searchlight. The light from the searchlight is directed downwards, illuminating the bottom of the water, and allowing the operator to locate the ship and determine its position.

In order to operate this large exploring searchlight, the operator is equipped with a loud-speaking telephone running to the engineer's post on the large carrying the operator, which he can use to turn or move his position while inspecting a wreck, or when issuing orders to the engineer for raising or diverting the telegraph cables or wires. For the electric lamps is derived from a small dynamo driven by the steam engine of the vessel, or it can be supplied by storage batteries.

The telescopic searchlight just described is for the purpose of inspecting salvaging operations, or for locating sunken ships, etc., while the illustrations at Figs. 'B' and 'C' show two novel schemes devised for the actual work of salvaging a submerged wreck.

The salvaging apparatus illustrated in Fig. 'B' was invented by Mr. John D. Hilliard, of Glens Falls, New York. This idea involves one of the most ingenious applications of electro-magnetism that we have encountered for some time. We referred to this invention in a recent issue of the ELECTRICAL EXPERIMENTER as the "wireless pug" and the "sound-controlled electro-magnetic mechanism" devised by Mr. Hilliard can only be known by one name—"sand-hog," for sand-hog it certainly is. The series of operations to be carried out in Mr. Hilliard's ship salvage scheme is somewhat as follows:

1. First, provides an electro-magnetic, self-propelled double-ended pilot, called a "sand-hog," as we may call it. The detailed view of this most ingenious mechanism is shown at the right of Fig. "B." In brief, this almost human electro-magnetic pilot comprises a small double-ended truck or carriage attached to one end of a powerful electro-magnetic field which is self-propelled by electro-magnetic control wires, etc., may be carried. It is also possible to project a compert air or high pressure water blast thru this flexi-ble casting, which is fixed on the bottom of the wreck in front of the sand-hog. The wheels of this curious looking self-propelled pilot are somewhat like the revolving rings of a hydro- static (water pressure) or electric motor controlled from above. Powerful electro-magnetic coils encircle the steel axled wheels, magnetizing them powerfully. Thus, we see that a very curious and novel condition is provided, viz.,—that as the electric coils revolve around the motor, either backward or forward as may be desired, these same steel wheels are strongly magnetized owing to the effect of the magnetic field. When the sand-hog will therefore, if lowered into the water near the side of a submerged iron hull, tend to crawl along the surface of the water without slipping.

Armed with this semi-intelligent mechanism, the salvage engineers proceed to lower the magnetic pilot, and its attached cable from the working barge in such a direction that the sand-hog will take hold of the steel side of the ship and start working it in the direction of its own motion. The illustration at Fig. "B" clearly indicate, the sand-hog manages to cling to the steel surf-ace of the ship in any of the combinations of circumstances. It can compress air or water jet blast, a path is cleared for it continuously thru the mud or sand in which the hull may lie. It is evident that as the magnetic pilot progresses it will blow a channel or trench for itself clear around and under the bottom of the hull, until it is once more in a vertical position on the opposite side of the hull.

When the sand-hog has reached the position described, it can be moved back to the side of the barge at the time, and in this way the bottom of the hull can be blown in a narrow channel, which may then be widened by divers and the water pumped out. The salvaged ship can then be towed to the nearest harbor where the work can be completed.

The scheme for raising sunken vessels illustrated at Fig. "C" is due to Mr. Charles B. Dawson, of Seattle, Washington. Mr. Dawson's ideas are in some ways quite elaborate, but he has them well worked out, and while in some cases it may be rather (Continued on page 280)
VARIOUS SCHEMES FOR RAISING SUNKEN SHIPS

(For full description see opposite page)
WHY Sparks had stopt reading the New York Evening World: He contemplated his old meerschaum pipe meditatively while with his long and lankey index finger, stained by many acids, he carefully rubbed a long, thin and quivering nose. This was always a sign of deep, concentrated thought of the nose's owner. It also, as a rule, induced the birth of a great idea. Again, and very slowly he re-read the article, which millions that same day had read.

disturbances affected all telegraph and telephone lines extending between Chicago and the eastern cities. On telegraph wires of the Postal Telegraph Co. without regular battery being applied at terminal offices, grounded lines showed a potential of 425 volts positive, varying to 225 volts negative; the disturbance continuing between 12:15 A. M. and 9:15 A. M.

At Newark, N. J., in the Broad Street office a Western Union opera-

for you had uttered five words. His clear blue eyes, lying deep in their sockets, sparkled with life and intelligence and what Sparks did not know about electricity was mighty little indeed. I believe there is no electrical book in existence that Sparks had not devoured ravenously in his spare hours, while having lunch or else while in bed, in the small hours of the morning. His thirst for electrical knowledge was unbounded, and he soaked up every bit of information like a sponge. Yes, and he re-

... The President of the Glorious French Republic Shouts Dramatically: "Messieurs... le jour de Gloire est Arrivé... VIVE-LA-FRANCE!!"—and Throws in the Huge Switch With its Long Ebonite Handle. ...

casually, without a quiver, let alone, a nose quiver. The newspaper item was simple enough:

NEW YORK, Aug. 10, 1917—An electromagnetic storm of great violence swept over the eastern section of the United States last night. Due to a brilliant Aurora Borealis—the Northern Lights,—telegraph and long distance telephone, as well as cable communications were interrupted for hours. No telegraphic traffic was possible between New York and points West. It was impossible to work any of the transatlantic cables between 12:15 A. M. and 9:15 A. M., every one of them having "gone dead." The Aurora Borealis

tor was severely shocked, trying to operate the key, while long sparks played about his instruments.

Sparks rose excitedly and began pacing the cement floor of the vast Tesla laboratory, totally oblivious to the fact that he was sucking a cold pipe. The more he paced about, the more excited he became. Finally he flung himself into a chair and began feverishly to make sketches on big white sheets of drawing paper.

"Why" Sparks had been just an ordinary "Bug," an experimenter, when he entered Tesla's great research laboratory at the beginning of the great war in 1914. Tesla liked the keen, red-haired tousled boy, who always seemed to divine your thoughts be-
tained it, too. In short, the young prodigy was a living electrical cyclopedia and highly valued by his associates. No wonder Tesla in three short years had made him superintendent of the laboratory.

Of course, Sparks' first name was not really "Why." But someone had dubbed him with this sobriquet because of his eternal "But why is this,""Why, why should we not do it this way"—"Why do you try to do that?" In short his first word always seemed to be "Why"—it had to be, in his unending quest for knowledge. And his "Why" was always very emphatic, explosive-like, imperitive, from which there was no escape.

Ah, yes, his first name. To tell the honest
truth I don’t know it. Last year in the spring when I went up to the laboratory, I thought I would find out. So when I finally located the young wonder, behind a bus he was standing, fixing it, blue sparks by means of a screwdriver, I told him that I intended to write something about him and his wonderful electrical knowledge. Was I glad enough to give me his real first name?

He was watching a big fuse critically, and mundane-minded manner exploded: "Why?" That was his question. So for all I know his real name is "Why" Sparks.

We left Sparks with his drawings, in the laboratory. That was on a certain evening last fall. To be exact it was about 10 o’clock. At 10:05 Tesla accompanied by two Army officials strolled out of the laboratory where Sparks was still feverishly engaged with sketches lying all about him. Tesla who was working out a certain apparatus for the Government had dropped in late to show Major General McQuire the result of six weeks’ labors. The apparatus had just been completed that day and the General, a military electrical expert, had come over specially from Washington to see the "his work." But before Tesla had a chance to throw in the switch of the large rotary converter, Sparks had leaped up, and was waving excitedly, large sparks flying in Tesla’s face. He gushed forth a torrent of questioning and for fully five minutes Tesla and the two Army officials were listening spell-bound to the young inventor driven to a frenzy; two of the three men were speechless, looking awestruck at Sparks, who having delivered himself of his latest outburst, now became normally cool as a cucumber.

It was Tesla who first found his voice. "Wonderful, wonderful. Absolutely wonderful. Sparks, my boy, you will be the most talked of man on this planet. And his idea is sound." This to the General. "Absolutely without a flaw. And so simple. Why, oh why? did I not think of it before? Come, let me shake the hand of America’s youngest and greatest genius!"

Which he did.

There then followed an excited thirty-minute conversation with the two army men and an endless long distance talk with the War Department at Washington. Then there was a rush trip to Washington by Tesla and Sparks, conferences at the War Department, and finally a few days later Sparks was summoned to Washington. When he was presented to the President, who was highly enthusiastic about the model which Sparks and Tesla had contrived to the head of the Nation. Still later there were certain rush orders from the War Department to the General Electric and Westinghouse Companies for big, queer machines, and these same machines were shortly manufactured.

But here the Censor bids us an emphatic "Halt. One may not even now divulge certain military information. You appreciate that."

* * *

Baron von Unterrichter’s flying “Circus” was getting ready to bomb a certain American city that day. The American city of late had shot down entirely too many of the Baron’s flyers. Only yesterday von der Gacken, an American ace himself—and one of von Unterrichter’s old friends had been downed, and killed right inside of the German lines. So the Baron was very bloody this sunny morning. As he put it:

"Verdamnte Yankee Schweinehunde,* we will show them who is master of the air hereafter! Toting off his hat to the American lines beyond.

*Sie, Müller,” this to an orderly.

"Zu Befehl, Herr Lentzmann,” replied the young orderly as he came on the run, clicking his heels together, hand at his cap.

"Vorwärts, Port!” barked the chief, as he hastened Müller off to summon post haste every man of the aerial squadron for the usual conference before the attack.

In less than two minutes all the flyers were standing drawn up at military attention before their chief, forming a half circle about him. Von Unterrichter’s instructions were clear and definite. This was a re- ral raid; von der Halberstadt’s death must be avenged, fearfully avenged. No quarter was to be given.

IN THE SEPTEMBER “E.E.”
YOU WILL FIND:

"New Aerial Lasso to Destroy Enemy Aeroplanes," by H. Gernbach.

"Telephoning Directly To From Moving Trains," by S. Stoddard, an expert on Wave Meters.


"Artificial Diamonds and Rubies—How They Are Made in the Electric Furnace." by Dr. J. A. Glass.

"The Phenomena of Electrical Conduction in Gases V—Weighing on Ton," by Rogers D. Rusk, M. A.

"How to Build a Switch-board—How to Build a Real One," by Harlan Danner.


"Operating Modern Current Circuits—A Clear Exposition of All the Usual Problems," by Arno A. Krage, Instructor in Radio, University of St. Louis.

"Direct Reading Radio Chart Which Solves All Calculations in Wave-length, Inductance and Capacity," prepared by a Marconi Radio Engineer.


* * *

"Dieses Amerikanische Gesindel!"—here his voice rose to a screechous tenor that caused me to respect us, as never before. The orders are to bomb every American base hospital within the sector.

All this several of the men recited involuntarily, which did not escape the keen eye of von Unterrichter, who now incensed to blind fury, by this show of "mercilessness," as he put it, exhorited his men in his harriest possible terms. "And as for their flyers, you must not give quarter. They will be fitted with all or some of the machines. Kill them! Schietss die Lumpen zusammen! Pump nickel into them, if you see that they may land unhurt. In this, I am the director of all flying etiquette—a thing abhorred by any decent flyer as a rule. It is bad enough to have your machine shot down, but "sitting on a disabled enemy’s tail," pouring machine gun fire into a helpless man, strug-
Electricity and the Range-Finder in War

As many people are aware, the matter of determining accurately the range between a certain gun or battery of guns and the enemy target, is a very important factor in all military operations and naval maneuvers. Not so many years ago when the range of artillery was quite insignificant compared to that of today, the matter of range-finding as it is known, was an unknown study. All that the officer in charge of a gun battery had to do in those days was to check up the first few shots fired and by watching the effect and the point hit by the projectile thru his telescope, or in many cases simply with the naked eye, the particular gun firing the shots could be readily elevated or lowered so as to change the trajectory of the projectile. But in the past twenty-five years the hit and miss principle of range-finding has been done away with, and a number of more or less accurate range-finding instruments developed, some of which are very ingenious indeed, and extremely accurate for comparatively long ranges.

The photograph herewith shows one of Uncle Sam's latest types of accurate range-finding instruments installed on board a modern dreadnought. The Jackies are shown in the act of determining the range of an object which has been selected as a target for the ship's giant guns, several of which can be seen in the background protruding from their turrets. The operator peering so intently into the eye-piece of the range-finder, and who is wearing a pair of sensitive telephone receivers as well as a transmitter strap to his person, is one of the most important men in the crew of any fighting ship whether large or small, for if he makes an error in reading the dials of the range-finder, then the enemy may escape being hit. As becomes evident, time is the essence of every naval engagement, for in a few minutes time the enemy if not disabled by your own guns will in all probability plant the major part of a broadside attack on your superstructure and gun deck, possibly disabling your own battery.

Thus we see that the man at the range-finder has a very important mission to fulfill, when he straps the head "phones" and

left prism telescopes can be trained on the distant object, and the refracted rays from the prisms are put thru a pair of objective lenses in the manner illustrated. These right and left rays pass along thru the center of the black-slipper tube and meet in the center where there is positioned two central reflectors. At this juncture it is well to note the two views shown in the circles at the bottom of Fig. A. These two views show the image of a distant target (a church) as it appears in the eye-piece of the range-finder, before the right and left prisms are adjusted to "coincidence" and "after coincidence," the latter or right hand view being the one observed by the range-finding officer at the point where the instrument indicates on a specially calibrated dial the correct range in yards. As will be noted from Fig. A, the upper semi-circular image is the one reflected by the left hand prism. A dividing line separates the two images, and in the present case the instrument is adjusted until the tower of the church slides along toward the left until it is exactly in line with the remaining portion of the tower appearing in the lower image.

So much for the physical action of the "one-man" range-finder. But this does not tell us yet just how the range is determined, excepting that we have learned that when the images coincide, that the instrument indicates the range in yards on a calibrated dial. Probably we will do best to go back a few years to the time of the Boer War in South Africa. At that time the English Army had considerable range-finding to do among the Kaffirs of "Coxe Paul's" country. Briefly explained, the "two-man" range-finder then used works after the fashion illustrated in Fig. B. It must be considered before going further, that every

(Continued on page 278)
WOMEN TO LEARN X-RAY WORK.

It seems that with the war's progress, and its constant inroads upon our male population, it behooves itself upon the women-folk who are left at home to in some way fill these vacancies, so that the speed of war preparations may be kept up to the highest standard.

Also it is to be noted that a steady drain is being made from the ranks of technically trained men which of necessity cripples to quite a large extent the wheels of industry. Women have been excluded from the regular service of both the Army and Navy with a few exceptions, such as Yeoman, etc.

MOBILE X-RAY NOW USED AT FRONT-LINE TRENCHES.

The Committee on Public Information, Division on Woman's War Work, issues the following:

The X-ray is now carried to the front-line trench for the benefit of wounded soldiers, so that no time may be lost in ascertaining the condition of wounds. The Army Medical Department has developed a mobile X-ray outfit, carried on a standard Army ambulance slightly modified.

This outfit includes an X-ray table, a dark room, and a complete set of apparatus for the localization of foreign bodies. Fully as expert work can be done with this mobile outfit as in any base hospital X-ray department. Its use in this field makes it possible for the surgeon at the front to send a complete report of a soldier's condition when a man is transferred to a hospital back of the lines.

ELECTRIC MACHINE MAKES FIFTY YARDS OF BANDAGES A MINUTE.

The machine being operated by this nurse is expected to revolutionize the making of gauge bandages. It is the invention of J. A. Butler, of Boston, and has been installed in the New England Surgical Dressings Committee workroom.

According to reports the machine is working very satisfactorily. It produces two sizes of folded bandages, one four inches and the other three inches wide. They are folded four or eight times as desired. The machine is capable of turning out 50 yards of bandages in a minute depending on the skill of the operator, which is a great deal faster than the usual method of hand manufacture.

but it is undoubtedly a fact that their services would be much in demand in civilian walks of life were they properly trained to fill the constantly growing vacancies.

Foremost in the ranks of institutions who have started in the work of training women for war work may be mentioned the Hunter College of New York City. We have published from time to time the activities of the women folk in the radio service, including the training of drafted men. Now a new branch of scientific study is about to be placed at their service and one that will yield a substantial remuneration for the time and expense of the course, while at the same time aiding the country in its fight for Democracy.

The course is a special term from June 3rd to August 10th in X-ray work. So far there have been several hundred requests for admission to the course but the school will only be able to handle a limited number of classes. There will be ten students to a class and in making up these classes preference will be shown to those who have been nurses or are acquainted with medical practise. This was only decided upon after due consideration, and it was shown that those already having some training would be all the quicker able to fill the many vacancies at present.

The installation of the apparatus will be taken care of by a large New York X-ray apparatus concern and the cost will be near the three thousand mark. It will be of the best and capable of a very wide range of work.

The course itself will be under the supervision of Dr. Raymond Bartlett Earle. Dr. Elise Fox, Roentgenologist in charge, City Hospital, will be the X-ray instructor, and an advisory board of prominent doctors and surgeons will complete the list. There will be an afternoon course and open to one in the evening consisting of the following subjects: X-ray, including the action, care and operation of the machine, anatomy, French conversation and physics lectures, after which will come the hospital observation in which the students will act as assistants in the taking of actual X-ray photos.

The course will be very thorough, making it necessary for one undertaking it to apply oneself conscientiously to the serious work in hand and none but those attaining a mark of eighty per cent or more will receive a certificate. It is not to be doubted that all taking it up will have the ambition to make good in order that the government may call upon them when necessary.
How Birds Take Their Own Pictures Electrically

By Dr. E. Bade

It is difficult to take good animal pictures in the open for the simple reason that the camera sees differently than the human eye. The various colors of nature do not sensitize the film in proportion to their light values, and since the film is color blind, it interprets little more than light and dark.

The difficulties of approaching the animal one desires to photograph can be surmounted with the following electrical device. This contrivance consists of three dry cells, an electric bell, a small electromagnet, and a contact or switch box. The contact box consists of a strong wooden base upon which is screwed a support for a movable scale-like contrivance. A strong wire rod, or a long nail, is used for a pivot. One arm of the scale extends about four inches. At the extremity of this arm a light twig is fastened. Just behind the pivot the other arms slope gently downward and ends in a box-like receptacle into which stones, pieces of iron, or lead are placed, so that this end little more than counterbalances the other arm. The first arm, to which the twig was fastened, also carries the contacts which only closes the circuit when a bird is sitting on the branch. As can be seen from the accompanying drawing, the wires carrying the current are here interrupted and flattened. One end of the wire is rounded into a shallow groove, while the other is flat. Just above the two flattened wires is a "V" shaped piece of copper, supported by a piece of wood which in turn is fastened to the movable scale-like arm. The "V" shaped piece of metal fits loosely between the wooden support and slides with its heavier end in the groove. When the twig is pushed downward the lighter end of the metal touches the flattened wire. This closes the circuit.

The camera is placed upon a small table or an especially contrived tripod upon which the electro-magnets are fastened. The camera used in this case was a Graflex, having a push button which releases the shutter. A large angle iron was taken, a knob placed at one end, and a weight at the other. The knob was adjusted so as to come into contact with the push button, while the weight at the other end of the iron was increased until a slight pressure released the shutter. The magnets were then placed upon a projecting support so that they came within an eighth of an inch of the angle iron.

The camera is now focust upon a twig or any other suitable object fastened to the arm. The instant a bird hops upon the twig the circuit is closed and the magnet is energized, instantly drawing the angle iron downward. This releases the shutter and the photo of the bird is secured.

It will be found advantageous to introduce an electric bell into the circuit as it instantly rings when a picture has been taken, thus enabling the operator to reload the camera at once.

It will be found that certain birds frequent certain places more than others. Now, in order to secure a variety of birds, an electric push button is also introduced into the circuit. This button is placed at a little distance from the camera but still within sight of it. When the operator sees a bird advancing towards the contact box, he presses the button and the picture of the animal will be taken, provided that the birds jumps upon the twig. When he sees that other birds are in the vicinity which he does not desire to photograph, the push button is released. Should the bird hop on the twig, the circuit will not be closed, and no picture will be taken, since the circuit at the push button remains open. But press the button and the picture of the bird is instantly taken.

Of course, this device must be placed where from previous observation birds have been frequently seen. These places are usually found near or at bird-houses or bird-baths. The birds can also be attracted to certain places by food. This is placed out a few days before the camera is used so that the birds will become accustomed to this contrivance.

Big Turbine for New York.

The United Electric Light and Power Company of New York City has recently placed an order with a large Pittsburgh electric manufacturing company for a 22,000 kilowatt turbo-generator set. The gigantic generator will be rated at 25,900 kva, at 85 per cent power factor, 8,000 volts, 3-phase, 62% cycles. It will be direct-connected to a steam turbine. The order includes a 40,000 sq. ft. surface condenser and the usual auxiliaries.
The Electrical Women of England

By ALBERT H. BRIDGE

(Electrical Correspondent, The Electrical Experimenter.)

QUITE early in the war it became obvious to the British Ministry of Munitions that if fighting men were to be released from industry without reducing the output of war requirements, women must take their places. Those of us who have been more or less closely and sympathetically observing the course of events have all along known something of the difficulties that have lifted their ugly forms and spread themselves across the path of progress; we also know with what tact, adaptability and determination each new critical situation has had to be negotiated. Prejudices from employers and prejudices from workmen, had to be broken down at a bit at a time, and all the while headway had to be made with the suitable training of educated and other women. Only the most imperative demand of absolute necessity made the change possible so that it may be said that under the influences of compulsion we have been able to secure practical experience of inestimable engineering value which we might not have had in decades of normal operations.

Gradually our women were brought under training for special operations, and work to which women had never previously put their hand was soon proved to be well within the compass of their strength and their adaptability. In practise such results have been obtained as should demolish absolutely all prejudices so far as individual or ultimate efficiency is concerned. Just now, when still more men of military age are leaving the bench for the camp and the trench, experience and necessity are working hand in hand.

It was, of course, no new thing for women and girls to be engaged upon many small electrical manufacturing operations. Years before the war the writer had witnessed their efficient employment in electric wire and cable factories, in armature winding work, electric motor manufacturing,knowing, in conduit and switch work, and in the making of numerous small accessories. In one case in London a factory was run for a time in which crippled girls, exclusively, were engaged in the manufacture of electric lamps in which substitutes for platinum formed a special feature. But where in the old days ten women were engaged in electrical manufacturing activity, there are now thousands of them and the number of operations, or classes of service rendered by them, have increased correspondingly.

By courtesy of the Ministry of Munitions the writer is able to illustrate some typical examples of what English women are doing in electrical works. Before the war we regarded with distinct amusement a novel experiment in which we read in the electrical press that at some small out of the way station in the States a woman part-proprietor ran the plant. We even looked upon it as a freak—perhaps you Americans did so too—but such is not the case today. We now have women working in some of the largest power stations in the United Kingdom. Experience with them on the whole is not unsatisfactory, yet I believe I should feel pretty safe if I had to predict what would happen in this particular connection after the war.

One of the accompanying photographs shows a woman engaged in electricity works service—in charge of a switchboard for 500 kilowatts. I recently inspected the most complete and educative official collection of specimens of electrical work the product of women skill and labor—and I saw photographs of women engaged in charge of a 1,000 horsepower steam engine, another attending a 300 kilowatt direct coupled engine set, others building small commutators, operating presses for armature winding, erecting switchboards, driving 40 ton cranes, driving electric trucks, conducting electric welding operations, making electric con¬necting masts, making parts for internal combustion engines, sparking plug parts, magneto!s, lampholders, lighting switchboards for marine machinery, etc.—indeed a mere catalog of the different occupations in which they are engaged, tho it would prove their multidudinous and multifarious nature, would be monotomous. Yet what is happening in the electrical world is but an illustration of the dexterity, skill, ability and willingness that women are demonstrating every day in a host of other departments of industry directly or indirectly connected with munitions production.

The position up to date is: there are 950,000 women engaged in munitions produc¬tion! Mr. Ben H. Morgan, who was for two years Dilution officer under the British Ministry of Munitions gives us to understand that they are turning out nearly one-third of the total output!

NAVAL AVIATION WIDE OPEN FOR YOUR TRADE.

"Here's a chance to enroll in the United States Naval Reserve Force and work at your own trade. The naval aviation section needs a great number of men immediately. Good ratings and good pay are possible for qualified men. Here is the list of ratings and the necessary trades.

Machinist's Mates—General machinists, automobile mechanics and assemblers, toolmakers, diesmakers and similar mechanical trades.

Quartermasters—Cutters and cloth fitters, upholsterers, canvas workers, painters, tent riggers.

Carpenter's Mates—Woodworkers of all kinds.

Blacksmiths—Toolsmiths, forge men, furnace men, etc.
There exists in the heavens, at a conservative estimate, from half a million to a million nebulae that are visible in the greatest telescopes. A very few of these, notably the Great Nebula in Orion, the Great Spiral Nebula in Andromeda and a particularly bright nebula in the Southern Hemisphere can be faintly distinguished without telescopic aid. So extremely faint are the great majority, however, that it requires all the light-gathering power of the most powerful telescopes, aided by photographic exposures of several hours' duration, to bring out the details of their varied and intricate structure.

Altho the nebulae are most diversified in their general appearance, they may all be classified into three groups: the vast irregular nebulae, the comparatively rare planetary nebulae, and the mysterious spiral nebulae. Members of the first two groups are strictly gaseous in their nature, but the last group, which includes by far the greater number of all the nebulae, has characteristics that seem to point to an entirely different origin.

In fact, it may turn out that the spiral nebulae are not nebulae at all. This most puzzling group which has been the subject of an unusual amount of investigation and discussion in the past few years will be treated of separately in another article. We will consider here only the true gaseous nebulae—the planetary and irregular nebulae.

Gaseous nebulae can be distinguished by the nature of their light which gives, when examined with the spectroscope, what is known as a bright-line spectrum. According to the first law of spectrum analysis such a spectrum is characteristic of incandescent gases shining only by their own light under low pressure. What these gases are can be determined from the positions of the lines in the spectrum, since to each chemical element belongs always the same line or set of lines in the spectrum. It has been found that all gaseous nebulae are composed of hydrogen and helium gas and an unknown gas found only in gaseous nebulae and named for that reason neblium. This peculiar gas is characterized by a bright line in the green part of the spectrum that gives a greenish tinge to the gaseous nebulae. They are for this reason sometimes referred to as the green nebulae to distinguish them from the white or spiral nebulae. It is believed that the presence of neblium may be due to some form of electrical excitations existing in extremely rare gases.

The irregular nebulae are, there is every reason to believe, the primordial stuff from which the stars are made. They fill a tremendous volume of space but possess very low density and small total mass. This is evident from the fact that they are certainly as distant as the stars, with which they are frequently associated and yet they cover an apparent space in the heavens that would be filled normally by hundreds, or in some cases thousands of stars. When we consider that the average diameter of a star is about a million miles and that within a sphere whose radius is, according to Newcomb, 412,500 times the radius of the earth's orbit (the radius of the earth's orbit being 93,000,000 miles) there exists but one visible star, on the average, we begin to realize how enormous must be the volume of space filled by the vast irregular nebulae. Were they not of small mass and low density, their gravitational force would be so great that they would draw to them all the neighboring stars.

Estimates of the densities of the gaseous nebulae are usually placed between one...
hundred thousandth and one millionth of the density of the earth's atmosphere. It has been found very difficult to explain how the luminosity of the gaseous nebulae is maintained under the conditions of extremely low temperature and pressure that must prevail everywhere, except in the more central portions of the nebulae. It is believed that the light of the gaseous nebulae must be due partly to some form of electrical excitation. It is not understood, moreover, how the nebulae can show the complex structure that characterizes them under the force of gravitation alone. Some other forces such as electrical repulsion or radiation or light pressure must be at work as well.

Irregular and planetary nebulae bear a strong resemblance to each other in some respects, yet they are different in others. Both types show a marked preference for the plane of the Milky Way, the fundamental plane of the sidereal universe. They are found most frequently where the star clouds are densest, and they are as often as not associated with stars that are classified as young stars. They are never connected with stars of advanced type. The stars enmeshed in the gaseous nebulae are the helium stars, or as they are frequently called the Orion stars, because they occur in such great numbers in the Great Orion Nebula and its extensions. They are characterized by their extremely low density and intense blue light. Great star groups such as the Pleiades and the chief stars of the constellation Orion are sometimes enwrapped in one vast irregular nebula which often condenses locally around conspicuous stars of the group. At the very center of the Great Orion Nebula is a multiple star of six components that is beyond a doubt physically connected with the Great Nebula. All the conspicuous stars of the Pleiades are surrounded by a faint nebulous haze, which stars to show brightly by reflected light from these stars and partly by its own luminosity. Portions of these great irregular nebulae are non-luminous; dark streaks and lanes are frequently observed in the bright gaseous nebulae, particularly devoid of stars as if dark absorbing matter shut off the light from stars lying beyond. Observations of the Great Orion Nebula have shown a whirling motion of its parts, the as a whole this vast nebula is almost stationary in space. This brings us to the most marked point of difference between the irregular and the planetary nebulae, that of their motion thru space. The irregular nebulae are the most slowly moving of all celestial objects, being practically at rest or simply drifting thru space, while the planetary nebulae are to be classified among the most rapidly moving objects in the heavens, their speed averaging much higher than that of the stars. The planets are also extremely small as compared to the irregular nebulae, receiving their name from their resemblance to faint planetary disks. They are usually associated with a single star or show a star-like condensation at the center. There are, moreover, comparatively few of these objects, not more than one hundred and fifty being catalogued up to the present time. The latest observations seem to indicate that these small nebulae have arisen as a result of some celestial collision or cataclysmous haze bearing a strong resemblance in composition and general appearance to the planetary nebulae.

The spectrum of the planets is, on the other hand, very similar to a certain rare class of stars known as Wolf-Rayet stars. These stars, the Novae and the planetary nebulae are all closely confined to the plane of the Milky Way and some relationships between the three classes of objects may be traced as a result of further observations.

We may now briefly summarize the

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The Phenomena of Electrical Conduction in Gases

Part IV—Why Ions Disappear

By ROGERS D. RUSK, M. A.

The behavior of the electrically charged particles of a gas is at times almost magical in nature. Unseen forces may suddenly produce them and other unseen forces may as suddenly make them disappear. The scientist who wishes to know whether or not a gas will conduct electricity must first know whether there are any ions present in the gas. If he wants to know just how much electricity will flow through the gas, he must also know how many ions have been produced and how many have disappeared. It is a well-known fact that if an ionized gas is allowed to stand for some time it will in some way lose its ions and its power to conduct electricity. This seemingly mysterious phenomena, however, can be very easily explained by two words—diffusion and recombination.

Diffusion is the scattering of ions and then migration of a cloud of ionized gas through field lines of force, lose their charge and recombination is the reuniting of the ions of a molecule again. The numerical figures which represent the rates at which these processes continue are called respectively the coefficient of diffusion and the coefficient of recombination.

In order to obtain these coefficients or rates of disappearance of the ions it is necessary in some way or other to count the ions or determine their relative numbers at different times. An ion, however, is far too small to be visible even in the highest powered microscope. Moreover it is too small to ever be visible to the human eye. That may seem like a rash statement in this day and age of scientific miracles, and yet it must be remembered that the human eye is only sensitive to certain wave lengths of light. Now the ion would either reflect only a single pulse of light which would give it neither size nor shape, or it would reflect waves of light many, many times too short to affect the human eye. As long then as the human eye retains its present limitations, the ion will remain invisible. Notwithstanding the fact that we cannot see these particles we can prove their presence by means of the electroscope or electrometer, and we can obtain a measure of the total number present by measuring the total effect on the instrument. Much work of this kind, including the determination of the above two coefficients, has been done quite recently by the world’s leading physicists, including J. S. Townsend and J. J. Thomson of England.

Recombination is a very natural consequence of ionization and as its name implies, means the recombination of positive and negative ions just after they have been formed. For instance when a neutral molecule experiences the force of some ionizing agency it is torn asunder and forms two equal and oppositely charged ions; now these oppositely charged particles attract each other according to the laws of electric attraction, and if they are not suddenly driven far apart by some force, this attraction will cause them to reunite and thus form neutrally charged molecules again. This can be shown diagrammatically as in Fig. 1, where each stage of the action is shown. In any ionized gas then, where there are equal numbers of positives and negatives, recombination will finally remove the conductivity of the gas. If there are unequal numbers of positives and negatives, the rate of recombination will depend upon the relative numbers of each. If the ions are removed from the field as fast as they are formed, that is by a saturation current, recombination will not take place. If, however, there is no electric field acting to remove the ions, the number will increase until they are so close together that they recombine as fast as they are formed or, in other words, the rates of recombination and ionization are equal; then the gas will have reached a steady state and the number of ions will be a maximum.

Scientists define the rate of recombination as doing this mathematically as and put it equal to where is called the coefficient of recombination and is the number of ions of either sign present. It can be seen that is merely a constant which expresses the relation between the rate of recombination and the number of ions present. As the amount of current which will pass thru a gas depends upon the number of ions present in the gas and the number of ions depends upon the rate of recombination, then the current depends on the rate of recombination.

One of the earliest determinations of the coefficient of recombination was made by E. Rutherford in 1897, by the use of a metal tube similar to the one shown in Fig. 2, by blowing a current of ionized air thru it and measuring the conductivity at different distances along the source. For instance if the current from electrode C to E, is one-half what it is from A to E, then half of the ions have disappeared and the time taken for them to disappear was the time for the gas to travel from A to C down the tube. The only measurement it is necessary to take are the currents thru the gas at A and C, and the rate of flow of the gas from A to C. The rate of recombination has been found to vary with the different methods of producing ions, showing that the kinds of ions that are produced, vary with the nature of the gas, and with the temperature and pressure.

Under certain conditions the disappearance of ions by diffusion is even greater than by recombination, hence it must be taken into very careful consideration. Diffusion is the thinning out or migration of ions which may be due to the following causes: If there is a greater density of ions in one part of a certain volume of gas than in another part, the ions will spread out toward the less dense part. If ions of one sign only have been generated in a gas, any adjacent particles being of similar charge will repel each other and all of the ions will tend to spread as far away from each other as possible. This is true of like ions when both positives and negatives are present. Then when ions by any means approach the wall of the containing vessel or any

(Continued on page 279)
FARMERS LEARN ELECTRICITY.
The University of California is teaching farmers to use electricity. In the near future the indications are that the efficiency of electricity on the farm will be generally recognized and adopted.

PHOTOGRAPHING AUTO PARTS WITH MERCURY VAPOR LAMPS.
A complete and accurate catalog of parts is one of the necessities for every automobile manufacturer. Every detail must be illustrated, either separately or assembled with others into one of the parts of the car. A unique method of taking the photographs necessary for these catalogs has been worked out by a prominent automobile manufacturer.
The use is made of an elevated platform under which can be placed a large flat wooden table. On this are arranged various items, each with its appropriate title and number, printed on a card, laid beside or below it. The boundary of the photograph is marked by black wooden strips. Thru a hole in the platform the photographer focuses his camera upon the display below. Light is furnished by four mercury-vapor tubes, hung underneath and near the edges of the platform. Due to the highly actinic quality of the mercury-vapor light, the exposure is much shorter than with other illuminants having the same apparent brilliancy.

This arrangement possesses numerous advantages, among which are that it enables the various parts to be associated with descriptive text, or explanations of the workings of complex apparatus. Much greater speed can be made in getting out instructions, since only one photograph need be taken of the entire group. Photographing from above is also very much quicker than from in front, because the parts can be much more easily arranged on the horizontal platforms and removed or rearranged for the next picture, than where it is necessary to tack up the parts on a vertical background.—Courtesy Willys-Overland Co.

ELECTRICAL EXPERIMENTER

HUNS HAVE DEVICE TO HELP U-BOAT CREWS TO SURFACE AFTER WRECK.
Dutch newspapers describe a new method by which crews of U-boats escape from their boats to the surface after they have been destroyed or wrecked. Statistics prepared by the German Admiralty show that, despite popular belief, a submarine runs less danger in its operations than does the cruiser or other ship of war, and that despite the terrific strain, there has been a very small loss of life among the crews.

When the U-boat is wrecked or disabled and lies on the bottom of the sea a little compartment on top is opened and a buoy which has been filled with air is released and at once rises to the top, carrying attached to it a steel cable. Equipped with "swimming vests," also inflated with air, the men climb to the surface by means of the cable. During this climb to the surface each man wears over his mouth and nose a small apparatus containing pure air, so that he is enabled to breathe oxygen. This apparatus at the same time purifies the carbonic acid, and keeps the air pure for several hours. The buoy on the surface also is equipped with an electrical apparatus so that electric waves can be sent thru the water calling for assistance. The buoys are large enough to accommodate nearly all the men of the crew.

When danger threatens the alarm is at once sounded and this new life-saving apparatus is at once prepared for use, so that the men can leave a U-boat within a few minutes. It is said that this apparatus will make the operation of the U-boats as safe as can be desired for their crews. Thus it seems the Germans do find time to invent safety devices.

ELECTRIC CHICK PICKER.
A machine invented by O. G. Rieske, of Buffalo, picks an ordinary fowl naked in less than five minutes. Moreover, no feathers are scattered. A small electric motor turns a suction fan, and also a roller contained within the instrument itself, the power being transmitted by means of flexible cable. The roller is hollow and its outer surface is pierced by a number of slits which permit the incoming blast produced by the fan to pass freely thru it. The top of the instrument is hooded and attached to this hood in a little rubber roller which rests firmly against the surface of the large drum-like wheel. The feathers of the fowl, sucked up against the two rollers, are plucked by having to squeeze between the rollers, after which they are blown to a tank. A thumb contact permits the hood to be moved around on its axis, and thus the relative positions of the two rollers are adjusted according to the needs of each case. The smallest wild fowl or the biggest turkey may be plucked with equal ease. A fowl can readily be picked in the dry state, but ordinarily it is scalded.

EMISSIVE PROPERTIES OF TUNGSTEN.
The emissive properties of tungsten have been investigated by two methods. One investigation consisted in the determination of the selective reflection of plane, highly polished mirrors of tungsten in the visible and in the infra-red spectrum. A depression was found at 0.8 in the reflectivity curve, which is the cause of a marked selective emission band found in incandescent tungsten.

The second investigation was on the selective emission of straight and helical filaments of tungsten, in which it was shown that the increased brightness within the helix is due almost entirely to multiple reflection. The most important deduction is that the radiation from within the helix is not sufficiently close to that of a uniformly heated inclosure to be used in the calibration of pyrometers.

Photographing Automobile Parts With Mercury Vapor Lamp and Camera Set Vertically Above the Objects, Thus Saving Much Time in Arranging the Display.
A NEW TELEGRAPHIC SIGNAL LAMP FOR MOTOR-BOATS.

In the accompanying illustration a telegraphic signal lamp is shown which is now being offered by a Boston concern. This lamp as illustrated consists of a 7-inch by 10-inch brass anchor light with "Fresnal" lens. For use with it in signaling, a specially constructed Morse key is provided with heavy platinum points, the base of which encloses a condenser connected across points of the key to prevent arcing and to shorten the lag between make and break. An attachment plug and cord is provided so that the signal can be connected to any voltage electric circuit. It is very substantial and will stand any weather.

A PORTABLE ELECTRIC AIR COMPRESSOR.

Here is a novel and efficient electric air compressor that is really portable. It is built as a compact unit, with electric motor, high pressure compressor and transmission all enclosed in one frame. All one has to do is plug in the nearest lamp socket, either direct or alternating current, connect the hose to your tire and turn on the switch. The particular features in the construction of this portable compressor are that it is built as an integral unit, self-contained in a metal housing; its efficiency is increased by means of forced air draft ventilation, operated automatically, keeping the motor and cylinders cool at all times. There is no water to freeze or to evaporate.

The motor is of the compensated series, interpolated type, which will operate on either direct or alternating current, so that a different machine is not required every time you move.

The wick feed system of lubrication is used.

NEW SELF-CONTAINED MICROPHONE BUTTON.

If standard transmitters cost only a trifle, and were not much bigger than a thimble, every repair man could carry a few in his pocket. Then when a subscriber's instrument failed to work for reasons unknown to the subscriber, and the repair man's ten mile trip disclosed a faulty transmitter, he could take a new one out of his pocket, screw it into place, and be on his way.

A Chicago inventor, J. Skinderviken, has so nearly approximated this desirable condition that he is desiring in the way of transmitter repairs. He has been allowed a patent on a self-contained transmitter button which meets practically all the conditions of our first problem. Externally the button is merely a cone-shaped bit of brass with a threaded stem, a nut and a lock-nut to fit the hole in the standard transmitter diaphragm.

It has at least one paramount advantage over the regular transmitter. It takes equally well in all positions—vertical, horizontal, inverted, or at any angle. The method of repair used with this unique microphone button is to remove with a small screw-driver the metal bridge common to all standard transmitters. This bridge the repair man puts in his pocket, to be referred later to the scrap heap. The button then is screwed directly to the transmitter diaphragm, without any support but its own screw stem. The whole affair can be executed in little more than a minute.

This universal position feature makes the Skinderviken button very useful also in repairing hand-microphones, which are commonly subjected to the most severe distortions of position. The same is true to a lesser extent of the desk stand.

NEW BATTERY SWITCH FITTED WITH SPRING BINDING POSTS.

A one point and two point wooden battery switch which is equipped with the spring binding posts are now on the market. The handle of this switch is made in one piece and all the metal parts of it, including the binding posts, are fastened to the wooden handle by means of eyelets. This, it is pointed out by the maker, eliminates all screws and does away with the loosening of any parts. The switch can be quickly wired on account of the convenient construction of the spring clip binding posts which are employed, without the use of any tools.

A NEW MILKING MACHINE.

This new electric milking machine profits by all the mistakes made by others, it is claimed. The new milking machine has no rubber milk tubes. It is suspended under the cow and can't be kicked off; nor can the teat cups drop off and suck up dirt. It can milk a three- or two-tested cow as easily as a four-tested one, and can milk each teat independently. It has an exclusive type—three-sided inflation that positively insures a three-sided collapse from tip of teat to udder. It does not milk four teats at once, but two at a time. Alternately.

The milk from each teat passes thru an unbreakable, transparent, straight celluloid tube that is easily cleaned. You can see the milk flow, and as each quarter is milked you can stop the action on it. These small unbreakable tubes take the place of the long rubber hose, an essential part of most milkers, and insure getting milk always as clean and pure as it is in the cow's udder. It also has a float valve that absolutely prevents the milk being drawn back to the vacuum tank if the pipe becomes full.

And it can be operated by an electric motor and in conjunction with any lighting plant.

The teat cups are radically new in design and exert a compound action; first it sucks milk from the teat by vacuum and then shuts it off completely by atmospheric release, exactly duplicating the natural hand method. —Photo courtesy Western Electric Co.
Experimental Physics

By JOHN J. FURIA, A. B., M. A., (Columbia University)

Lesson 14—Current Electricity

A current is the flow of electric charge in motion. In an electric current, the terminals carry an electric current. (This was Oersted’s experiment.)

The Voltaic Cell—It Produces an Electric Current by the Chemical Action of Dilute Sulfuric Acid on Zinc and Copper.

Copper +

Zinc

White sulfuric acid

The terminals carry an electric current. (This was Oersted’s experiment.)

That the terminals of the cell are electrically charged before they are connected, can be shown by use of the electroscope of Lesson 13. On testing for the sign of the charge we find the copper + and the zinc —. See Fig. 73.

Experiment 81—Allow the current from a voltaic cell to pass thru a vertical wire (see Fig. 74), and sift small iron filings around the wire. We find that the magnetic field consists of concentric circles lying in a horizontal plane. On exploring with a small compass we get results as in Fig. 74. On reversing the current the compass reverses. The direction of the magnetic field (the direction in which the N pole of a compass points) is related to the direction of the current by the right hand rule which is stated as follows: "Grasp the wire in which current is flowing by the right hand so that the thumb points in the direction in which the current is flowing; then the magnetic lines encircle the wire in the same direction as do the fingers of the hand." If instead of passing the current thru a single vertical wire we allow it to pass thru a wire with a paper tube around it and iron filings are sifted around it, the filings are deflected vertically.

The Electrometer—An instrument for measuring electric charge. It is called a Faraday Disk. The Faraday Disk is an electroscope with a long stem. When charged, it will deflect through a greater number of degrees with each additional charge. On grounding it, the charges are equalized and it returns to zero. The basis of all instruments used in measuring electric charge is the Faraday Disk. A practical instrument showing how the current in a conductor sets up magnetic whirls is Oersted’s experiment. "Grasp the wire in which current is flowing with the right hand so that the thumb points in the direction in which the current is flowing; then the magnetic lines encircle the wire in the same direction as do the fingers of the hand."

The Electric Lamp—When electricity is allowed to pass thru a wire, light is produced. This is called incandescence. A. V. Seeley has invented an instrument for measuring electric charge. It is called the Faraday Disk. The Faraday Disk is an electroscope with a long stem. When charged, it will deflect through a greater number of degrees with each additional charge. On grounding it, the charges are equalized and it returns to zero. The basis of all instruments used in measuring electric charge is the Faraday Disk. A practical instrument showing how the current in a conductor sets up magnetic whirls is Oersted’s experiment. "Grasp the wire in which current is flowing with the right hand so that the thumb points in the direction in which the current is flowing; then the magnetic lines encircle the wire in the same direction as do the fingers of the hand."

The Compass—An instrument for measuring magnetic fields. It is called a compass. A compass needle placed in the center of a magnetic field will become deflected. This is the basis of all instruments for measuring magnetic fields. A practical instrument showing how the current in a conductor sets up magnetic whirls is Oersted’s experiment. "Grasp the wire in which current is flowing with the right hand so that the thumb points in the direction in which the current is flowing; then the magnetic lines encircle the wire in the same direction as do the fingers of the hand."

The Galvanometer—An instrument for measuring electric current. It is called a galvanometer. When calibrated to give the strength of current directly it is called an ammeter. The ammeter has low resistance so as to oppose the passage of electric current. Therefore, it practically nil obstruction. Because of the practically nil obstruction, all the current passes thru the wire. We get a true measure of it. The ammeter or instrument for measuring electric pressure is called the galvanometer. It is a sensitive instrument for measuring electric pressure. The basis of all instruments for measuring electric pressure is the galvanometer. A practical instrument showing how the current in a conductor sets up magnetic whirls is Oersted’s experiment. "Grasp the wire in which current is flowing with the right hand so that the thumb points in the direction in which the current is flowing; then the magnetic lines encircle the wire in the same direction as do the fingers of the hand."

The Voltmeter—An instrument for measuring electric pressure. It is called a voltmeter. The voltmeter has high resistance so as almost to oppose the passage of electric current. Therefore, there is practically nil obstruction. Because of the practically nil obstruction, all the current passes thru the wire, and we get a true measure of it. The ammeter or instrument for measuring electric pressure is called the voltmeter. It is a sensitive instrument for measuring electric pressure. The basis of all instruments for measuring electric pressure is the voltmeter. A practical instrument showing how the current in a conductor sets up magnetic whirls is Oersted’s experiment. "Grasp the wire in which current is flowing with the right hand so that the thumb points in the direction in which the current is flowing; then the magnetic lines encircle the wire in the same direction as do the fingers of the hand."

October, 1918
COMMERCIAL wireless lost a pioneer from its ranks when John Bottomley, third vice-president, secretary and treasurer of the Marconi Wireless Telegraph Company of America, died in the Post Graduate Hospital, New York, on Sunday, June 10th. Mr. Bottomley was in his seventy-first year.

John Bottomley, Director, Marconi Co., Dies

Twenty years of ceaseless activity in the radio field are credited to the deceased, for it was in 1898 that he first met Marconi and took up the responsible task of introducing wireless telegraphy to the American world of commerce. In 1902, he became the active head of the American Marconi Company. At the time of his death he was vice-president and a director of the associated Marconi Telegraph-Cable Companies, treasurer of the Pan-American Wireless Telegraph and Telephone Company, treasurer and director of The Wireless Press and treasurer of the Marconi Institute. Mr. Bottomley had been president of the New York Electrical Society and was an active member of the Engineers Club, vice-president of the

ELECTRICAL EXPERIMENTER

August, 1918

Notice to All Radio Readers

As most of our radio readers are undoubtedly aware, the U. S. Government has decided that all Amateur Wireless Stations, whether licensed or unlicensed, or equipped for receiving or transmitting, shall be closed.

For the convenience of our readers we are giving this notice on page 244, so that those who are interested in the ELECTRICAL EXPERIMENTER, for the reason that we desire to continue to publish valuable articles on the wireless art from time to time, and which may treat on both transmitting and receiving apparatus. In the first place, there are a great many students among our readers who will demand and expect a continuation of the usual class of Radio subjects, which we have published in the past four years, and secondly, there will be hundreds and even thousands of new radio pupils in the various naval and civilian schools throughout the country who will be benefited by up-to-date wireless articles treating on both the transmitting as well as receiving equipment. Remember that you must not connect up radio apparatus to any form of antenna.—The Editors.
MEMORIZING THE CODE.

I read with interest "A Short-cut to Code Learning," in the January number by Thomas Reed. I will try to describe a method used by the Swiss Boy Scouts that has proved very successful, and, in fact, so successful that it is the only way they know the code.

Each letter of the code is represented by a word that begins with the same letter, so as to simplify recognition. Also each "dot" or "dash" of the code is represented by a syllable (of the word). And, last, every syllable containing the vowel "o" means a dash in the code.

A few examples will make the process clear. Take for instance — B — - - = Bonaparte. Bonaparte contains four syllables, of the first syllable contains the vowel "o" which means that the letter in the code begins with a dash; the other syllables do not contain "o" and therefore are dots.

Thus:

G = Gondole =
A = Arnold =
H = Hilarité =
F = Farandole =
S = Sardine =
M = Moto =
E = Ehrie =

I will not give the equivalents for all the alphabet, as all these words are unfortunately in French and would be of no use, but it would be easy with enough time to make one up in English.

However, I do not think learning the code by these methods are efficient, as they only help the beginners more or less easy to the beginner and later he will have to memorize it, the usual way.

II. STARTING RECEIVING

I think that simplifying receiving would be of some help to the beginners and the method I will now describe is very useful. This method is also used in Switzerland by the Boy Scouts. (I do not know if it is used elsewhere.) And I think not only helping beginners in wireless, but it would be of service for heliographic receivers.

This method requires a chart containing the alphabet and numerals (see illustration). The letters are divided into two groups—those beginning by a "dot" and those beginning by a "dash.

A also a straight line (—) represents a "dash" and a dotted line a "dot" (. . . ). Thus when a letter begins with a "dot" look at group I and if with a dash at group II. This chart explains letter A (—) .

(1) Look at group I. (2) As the next symbol is a "dash" follow the straight line and we come to A.
(3) Take the letter Z (—). (4) Look at group II. (2) Follow the straight line. (3) Follow the dotted line. (4) Follow the dotted line. Thus to find the letter we pass thru T, M, G, and Z.

BOYS' WIRELESS SEIZED: NAVY GETS TWO RECRUITS.

Zas-szxx) (*!-*-?.szszxx- ss-splutter!
"German spies," gasped a neighbor as he heard the hissing noise and watched the sparks flashing from the home of Mrs. Pat-rick O'Shaunessy, at New Canaan, Conn.

Again came the hiss and the spark. The neighbor jumped to the telephone and the next day Federal raiders swooped down on the O'Shaunessy cottage. Mrs. O'Shaun-

nessy sobbed a plea that her only boys, William, twenty, and Thomas Francis, eighteen, be forgiven this time. But the raiders frowned. It was against the law for amateurs to fow with wireless apparatus in war time. "Schucks," laughed Tommie, "we were just studying so we could get in the navy wireless branch."

The Federal officials learned the statement was true, but had to confiscate the machine. They suggested in leaving that the boys could get practical wireless experience without interference by joining the navy. "That's what we will do," agreed the boys. And they did. Mrs. O'Shaunessy pre-

sented herself to Chief Ycwoamn Mrs. George Wheelock at the Naval Recruiting headquarters. She had Tom in tow. She explained she had tried to keep the boy at home, but had to yield.

Tom was found to be 100 per cent physi-

One Uncle Sam needs you!!

NEW "GLASS SLATE" FOR TEACH-

ING HOOK-UPS.

Patents have recently been applied for in various countries on a drawing slate invented by a Canadian Wireless Instructor.

The wireless student who has learned to draw the connections of apparatus arranged always according to a particular plan, in-
vitably encounters trouble when presented with a diagram representing the same pieces of apparatus placed in entirely different positions with respect to each other, and it is only then that he realizes he has wasted considerable time in merely accustomed himself to repeatedly drawing the same connect-
ing lines in the same order, without grasping their meaning.

The present invention, a direct product of necessity, takes the form of a framed sheet of ground glass, beneath which representations of the various parts comprising a wireless or other electrical equipment, printed in heavy black lines upon blocks of

This, I think, is the easiest method to decipher a code and by looking at the dia-
gram it is readily understood. Hoping this will interest some amateurs.

Contributed by HAROLD A. BAUMAN.
AN IMPROVED CONDENSER SCALE.

The drawing shows a special graduated scale which, when substituted for the condenser scale, will show the exact position of the condenser for each number of taps of the secondary. As you will notice by the drawing, as the turns of the secondary are increased the condenser is brought nearer zero, and in the case of NAA the more taps are taken off the greater the condenser capacity used. This, of course, is naturally necessary, but the idea of the arrangement is to show when, for instance, four taps are used the condenser scale will be at an indicated point. By this method, after noting the scale where different stations come in, it will be an easy matter to tune in these same stations again when desired.

I have been using this method to great advantage, especially when time is the prime factor, that is when one wishes to listen for two or even three stations at once, by merely changing the secondary taps and a lot of unnecessary time formerly lost by moving the condenser to the exact point and having to hunt for each one is saved.

Contributed by T. T. J., U.S.N.R.F.

UNIVERSITY OF PITTSBURGH GIVES RADIO ENGINEERING COURSE.

A course in Radio Engineering for technical graduates is being given at the University of Pittsburgh which comprises a term lasting eight weeks. This course will be open only to graduates in electrical or mechanical engineering who are recorded in Class I of the National Army Draft. Men enrolling in it will be placed by the Government in Class V until completion of the course, when they will be inducted into the Signal Corps and sent to an army school for further training. The need for men familiar with the technique of radio-communication is great, and the chances for obtaining a commission ultimately are good. There will be no charge for tuition, but students must provide their own living and travel expenses.

As the number of men is limited, application should be made at once to Prof. H. E. Dyche, Department of Electrical Engineering, University of Pittsburgh, Pittsburgh, Pa.

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HOW TO USE SHORT INTERRUPTER RODS.

Procurce a miniature coupling from an Erector building outfit, take an alloy rod that has become too short for ordinary use, put this thru the hole in the cover, take off the tube from the interrupter, and place the coupling in the tube with a piece of straight copper wire A in one end, and alloy rod C in the other. Replace tube and...

VICTROLA NOW TEACHES WIRELESS.

One of the largest talking machine companies has just announced a special course of instruction in wireless telephony by means of disc records and accompanying books of instruction. In announcing the course the company says in part: United States Army and Navy are in need of thousands of skilled wireless operators, and a complete course of study may be carried on by means of these records, and every students is paid a very small fraction of the expense that is ordinarily involved. The course consists of six ten-inch double-faced records with book of instructions.

A SOMewhat DIFFERENT ROTARY SWITCH.

Many amateurs are building receiving sets with a receiving transformer using rotary switches for regulating the number of turns of wire in use. These switch knobs and assemblies are quite expensive when bought, but can be easily and cheaply constructed at home without machine tools of any kind. The material needed will be a piece of one-fourth inch rubber or fiber sheet, a brass backing bolt with the nuts, a binding post as shown in the dotted line in the drawing, and some spring brass for the lever of the switch. Determine the size of bolt you wish, lay out the circumscribed and the proper diameter on the fiber or rubber, and then cut out the disk. A heavy gasket cutter will help do this if the knob is made of fiber. If hard rubber is used, it can be cut out by chipping off pieces with pliers till a rough disk is secured. Then this is filed down till perfect round.

Drill a hole in the center and in this place a long battery binding post, whose flat end has been filed smooth and polished. Fasten it with a nut that has been rounded, to match the round handle. Then cut a piece of spring brass to the desired shape, making it narrow at the outer end. Punch a hole at the wide end and fasten it on the bolt in the knob by means of another nut.

Next drill a hole in the board or panel on which the switch is to be mounted. This hole should be large enough to admit the binding post shown in the sketch, but not so large that it will slip. Attach a collar or wide part slip thru. A binding post of this kind can be found in practically every experimenter's shop. It is threaded at both ends to fit a battery bolt. Push the small end of this binding post into the hole, then from the rear insert a binding post on which a washer and a nut have been placed. Draw up the binding post into the hole by means of the nut at the back. Then screw the knob screw into the hole in the binding post at the front far enough so that it will not have any play and so that the blade makes good electrical contact with the switch points. If a little judgment is used in designing the layout of the switch and contacts, it will work better than many high priced switches, and will be just as serviceable.

Contributed by FRANK SAHLMANN.

RADIO WRITERS — ATTENTION ! ! !

Can you write radio articles dealing with the practical problems of wireless operating? We can use some good papers on such subjects as "the tuning of radio transmitters", "the use of the wave meter, including its application to measuring the frequency, wave length and decrement"; "operation of commercial transmitting and receiving sets"; "the operation of army trunk sets"; "improved ways of receiving undamped wave signals" also new ideas and short-cuts for learning the codes. We pay well for all articles accepted. Help yourself, your magazine and your country.

By Means of a Small Wire Connector It Becomes Possible to Use Up Short Bits of Electrolytic Interrupter Rods in the Manner Illustrated.

By Making a Special Scale for the Variable Condenser of a Radio Receiving Set, It Becomes a Simple Matter to Instantly Set the Condenser to Correspond With a Certain Tap for a Given Call.

By specially designed for the Variable Condenser of a Radio Receiving Set, It Becomes a Simple Matter to Instantly Set the Condenser to Correspond With a Certain Tap for a Given Call.
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Analysis of Irregular Wave Shaped Alternating Curves
Harmonics—Part II
By Prof. F. E. Austin
instructor of electrical engineering, Thayer school of civil engineering, dartmouth College

According to the discovery of Fourier, any periodic or regularly recurring wave of any shape whatever, is in reality the resultant obtained by adding together a number, usually a large number, sometimes an infinite number of sine waves, one of which has the same frequency or same periodic time as the original or resultant curve.

Any alternating current or pressure of any shape whatever, according to Fourier's theory, is made up of the sum of a definite number of simple sine waves of current or pressure, having various amplitudes and different wave lengths or frequencies.

Many surprising results may be obtained by simply arranging sine curves on cross section paper and adding algebraically their heights at various points and drawing a curve through the points so located. This may be illustrated by Fig. 1, in which three sine curves are arranged as indicated, and their amplitudes added together algebraically forming the resultant curve, drawn in heavy lines. It may be noted that if at any chosen position two or more sine curve heights are positive, that is extend above the horizontal datum line, then the sum of the sine curve heights extending downward below the horizontal datum line must be subtracted from the sum of the sine curve heights extending above the datum line. If the sum of the downward or negative heights exceeds the sum of the upward or positive heights, then the point of the resultant curve is located below the datum line. It may happen that the sum of two negative heights may have to be subtracted from a single positive height. Any irregular but periodic curve of current or pressure, meaning one that repeats the same irregular shape during each succeeding interval of time, may be exactly reproduced on paper by the proper selection of sine curves. Fig. 2 shows an alternating curve made up of four simple sine curves. The building up of such irregular periodic resultant curves is called synthesis. Of course, it is not possible to build up curves of any particular shape until it is definitely known exactly how many sine curves are necessary; their frequency, their amplitudes, and their starting points relative to each other. The determination of the number, frequency, amplitudes, and position of the component sine curves making up any resultant curve is called analysis; which is a somewhat complex operation; depending upon certain known mathematical relation and physical laws.

It may be well to consider for a moment why an alternating current or an alternating pressure does not have a perfectly simple pressure wave, which may be obtained from a generator depends at each instant of time upon the speed of the moving inductor line, the strength of the magnetic field thru which the inductor is moving. If for example the motion of the inductor should be perfectly uniform, but the field should be variable, then the induced pressure would vary accordingly; on the other hand should the magnetic field be perfectly uniform, but the motion of the inductor be variable then the resulting induced pressure would be irregular to conform. Again both of the variable conditions might act simultaneously, either in unison to increase the induced pressure or in opposition to reduce it.

There may also be other causes of pressure and current distortion resulting from apparatus connected into the generator circuit; such as condensers, motors, telephones, and coils of all kinds.

As it is often desirable and necessary to obtain the number and maximum values of the component sine waves or harmonics, which combine together to form alternating waves, whose shapes may be obtained in practice by the point by point method, employing a telephone receiver or other indicating device, or which combine to form the current waves which may be recorded by employing the oscillograph, a few of the simpler laws, governing the forming of wave shapes will be considered. If a curve having any irregular shape,
The Design and Use of the Wave-Meter

PART IV

By MORTON W. STERNs

However, the hot-wire type is the most generally used because of its lower internal resistance, which is a very important consideration in the design of the decremeter.

A very popular type of instrument on the market is the Marconi model, which is called a hot-wire wavemeter. Its scale is divided into one hundred divisions according to the square of the current flowing thru it. Its resistance is 6 ohms and it requires 80 milli-amperes for full scale deflection (0.084 watt).

In case only a direct reading milli-ammeter is available, if we make \( P = \sqrt{2} P_m \), if \( P_m \) is equal to 100, then \( P \) must be equal to 70.7 or \( \sqrt{2} \).

In part I of this series the author has listed the various measurements that can be made with a wave-meter and as can be readily seen it includes practically all the important measurements used in Radio Engineering to-day. We will now take up the various measurements in order.

MEASUREMENT OF TRANSMITTED OR RECEIVED WAVE-LENGTHS

The wave-length of a transmitter can be measured by bringing the inductance coil in proximity to the antenna lead of the transmitter and varying the condenser over the scale with the various coils in circuit to give the required range. The resonance point is the point at which the hot-wire instrument gives the maximum deflection or the point at which the lowest signal is heard in the head telephones, if a crystal detector and telephones are used. By noting this resonance point in degrees and referring to the wave-length curves furnished with the meter, the emitted wave-length can be readily found.

Figure 2 illustrates the method used in measuring transmitted wave-lengths and is familiar to all.

Figure 3 shows the wave-meter excited by a buzzer and coupled to the antenna thru a single turn.

If the receiver is tuned to the incoming signal and the coupling between the wave-meter and the single turn in the antenna lead made small, the buzzer signal will be superimposed on the incoming signals and will be weak enough so as not to interfere with the reception of messages.

The point on the wave-meter that gives the lowest signal in the receivers is then the wave-length at which the incoming message is being received.

An alternative method is to couple the wave-meter closely to the antenna circuit and when a signal is tuned in on the receiver, the wave-meter is varied until the signal dies out and becomes very weak, the minimum point being the wave-length of the received signal.

The reason the signal becomes weakened is due to the fact that the wave-meter absorbs most of the received energy at the resonance point, due to its close coupling.

II. Measurement of Decrement

In part III of this series, the method of measuring decrement with the Kolster decremeter was fully described.
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If only a few measurements are to be made, the simplest method is to connect the standard inductor in parallel with the condenser of known value and use a unilaterial connection for the detector and 'phones.' The unilaterial connection is used so as to make the readings more accurate and to eliminate the high resistance of the detector and 'phones' around the condenser.

Fig. 4 explains the method: The wave-meter is deflected by a buzzer is brought into inductive relation with the coil under measurement. As the condenser in the wave-meter is varied the sound of the buzzer will be heard at a sharply defined resonance point in the telephones. Then noting the wave-length shown on the wave-meter and knowing the capacity in circuit B we substitute in \( \frac{\lambda}{\lambda' C} \), and find \( \lambda' \) directly by the formula, \( \lambda = \frac{3550 \times C}{\lambda} \).

If many measurements are to be made, it is best to have a permanent set-up in place around the laboratory, so that one can go right to the corner and make measurements without a lot of fuss. Some authors have a circuit like the one described in constant use and has saved much time thereby. It is a very compact arrangement and has a range of 50-300 cm.

Coil A is a long bank-wound coil tapt at various points to give continuous wave-length ranges with the two condensers C and G, see Fig. 5. The points B and C are made up as clips to clip on the coil for the various ranges, the point B always being about half-way between A and C.

A is a 0.05 m. f. condenser connected in parallel with a smaller condenser having about .0005 m. f.

The circuit L is brought near the Audion coil and the condensers C and G, varied; resonance should be found at 50°, but due to the energy withdrawn, oscillations cease at 45° when increasing capacity and at 55° when decreasing capacity in each case, causing the characteristic "kiss," and neither point being the true resonance point. If now the coupling between the two circuits is diminished, A and C will approach B as a limit and the adjustment will be so sharp that the two points A and C will be less than one degree apart on the smaller condenser, and the mean of the two readings will determine B quite accurately. It is to be noticed that the mean of inductance and capacity in the Audion circuit need not be known.

IV. Making Resonance Curves

The whole procedure of plotting a resonance curve was explained in Part II, and should be referred to by the reader, as this is a rather important measurement to be made.

V. Making Various Antenna Measurements

To measure the effective capacity of the antenna find the natural period of the antenna by exciting it with an induction coil connected across a spark gap, the side of which is grounded and the other side of which is connected to the antenna. A coil consisting of a turn or two of wire of negligible inductance is inserted in the antenna in order to allow the wave-meter to be coupled to the antenna.

When the induction coil is energized a spark will jump the gap and the antenna will oscillate at its natural period, which we will designate as \( \lambda_1 \). A known capacity, \( C_1 \), is then inserted in the ground lead and the wave-length \( \lambda_2 \) obviously smaller than \( \lambda_1 \), is measured.

Then \( C = \frac{\lambda_2^2 - \lambda_1^2}{\lambda_1^2} C_1 \)

where \( C \) is the effective capacity of the antenna in microfarads. Care must be taken that \( C_1 \) is chosen of such a value that \( \lambda_2 \) does not vary more than 20% from \( \lambda_1 \), as the effective capacity of the antenna varies somewhat with the wave-length.

Knowing the natural period of the antenna and its effective capacity, then its inductive bias can be similarly determined. Another method would be to place a known inductance in series with the antenna and measuring the wave-length \( \lambda_0 \), then knowing the natural period of the antenna, we find the inductance of the antenna from:

\[
L = \left( \frac{\lambda_0^2}{\lambda_1^2} \right) L_0
\]

where \( L_0 \) is the inductance of antenna in cms. \( L \) is Inductance of standard in cms.

VI. An Exciter Emitting Waves of Predetermined Length

Figure 7 shows how a buzzer is connected to excite a wave-meter. By setting the condenser at any value any predetermined wave can be emitted. The theory is that the inductive kick due to the breaking of

\( \text{(Continued on page 284)} \)
How to Make a Simple Spectroscope

By DONALD S. BINNINGTON

It is a well-known fact that when white light of any description (whether from a gas, oil or electric source) is passed through a narrow band of light, it is broken up into its component colors. On this fact is based the principle of the Spectroscope, an instrument that is considerably used in both Chemical Analysis and various experimental work. An instrument of the kind here described can be made for about one dollar and will prove a welcome addition to any experimental laboratory.

The main requirement is a prism, and the best and most efficient form is made as follows: Procure, or cut a piece of glass tubing of 1 inch bore and 1½ inches long. Break this with a glass cutter or the wards of a key, till it has the shape shown in Fig. 1. Those who do not want to make the prism can purchase one at small cost from any optical shop. Then grind the edges smooth by rubbing on a piece of emery cloth moistened with turpentine in which a little camphor has been dissolved. Finally grind on very fine emery paper until the edges are smooth and at an angle of 60 degrees (Fig. 2). Then drill a small hole in the upper side of the prism, or if the tube used is thin chemical glass tubing, the hole may be made by heating (before grinding) the side of the tube with a small blowpipe flame, with the ends corked up. The heated air in the tube having no other room for expansion will blow out a small projection, which can be filed and smoothed off. When this method is not available, the hole can be made by drilling with the broken point of a round file. When this has been done it should appear as in Fig. 2.

Now cut or procure two pieces of flat glass about 1½" x 1¼". These must be cemented on to the ends of the glass tube. The cement for this purpose is made by dissolving some glue in hot water and adding a little glycerin. Care must be taken not to smear the glue over the glass. If these directions have been followed carefully it will have the appearance shown in glass, a lens having about 12 inches or less focus. This will cost about 35 to 50 cents. Proceed to make a tube by rolling up several thicknesses of brown paper into a tube about the diameter of the lens and about 10 inches long. Make a similar paper tube to just fit into this about 6 inches long. These two tubes must be blackened inside. The black pigment is made as follows: Moisten a little lampblack with a very little kerosene and rub on to the inside of the tubes. This must not dry shiny.

The last item on the list is the slit. This is made by taking a circular piece of brass or copper, marking a line exactly across the center; filing till half thru; then carefully cut with a knife blade till the slit is just through. The length of this slit must be one-third the diameter of the lens used. This slit is shown in Fig. 5. This completes the parts. All that now remains to be done is to assemble the instrument. This is done as follows: The lens is placed in one end of the larger tube and the "slit" disc in the smaller tube. The assembled apparatus is shown in Fig. 6.

The prism is glued on to a piece of pasteboard, which is in turn glued on to the base-board, the base measuring 9" long by 4½" wide and 3½" thick. The collimating tube, as the pasteboard tubes are called, is fastened on with strips of tin. A groove is cut around the prism base to take a small pasteboard box, Fig. 7, which must be carefully blackened inside.

The apparatus is now ready for use, and an ordinary telescope or a lens placed against the spy hole will magnify the spectrum if a gas or electric light is placed in front of the slit, when a band of colors will be seen in the spy hole. If now a colorless flame is placed in front of the hole (as an alcohol lamp) no spectrum will be seen. If now a little salt (sodium chlorid) is introduced into the flame on a wire, a yellow band will be seen in the spectrum. If a potash salt is used, a violet band. If a lime (calcium) salt, a whole collection of reds and yellows and greens, is seen. Many further experiments will be found in any textbook on Chemistry or Physics.

Note: Great care must be taken to keep the carbon disulfid away from flames, as it is extremely inflammable.

[Editorial Note: A sequel article describing experiments with the spectroscope will appear in an early issue.]
A FREAK SELF-CHARGING ELECTROSCOPE.

With this piece of apparatus you can puzzle those of your friends who think they know something about electricity.

The constructional details are illustrated herewith. A brass tube of any desirable length and a glass tube that will make a snug fit inside the brass tube is required.

The glass tube is to hold the dry pile that charges the gold leaves. This is made by taking several sheets of bond paper and coating one side of each sheet with a thin coat of bronze paint and the other side with oxide of manganese. Now lay the sheets on top of each other after they have dried, all the same side up, so that a bronze side and an oxide of manganese side will always be together.

Take a leather punch that has the same inside diameter as the glass tube and with a hammer proceed to cut disks out of the several thicknesses of paper. As fast as they come thru the top of the punch they should be carefully pushed into the glass tube. Continue this until the tube is full, coating more sheets if necessary.

Now take the brass tube, solder a brass ball on one end of it, insert a wad of tinfoil in the glass tube and push it up into the brass tube. In this way contact is made between the dry pile and the brass tube.

The brass tube is now inserted into a cork and its end fitted with a small stirrup to hold the gold foil. The open end of the tube may be plugged with fiber if desired.

The trick electroscope is now complete; allow it to stand awhile and the leaves will begin to spread, indicating a charged state. Touching the ball with the finger will allow this charge to escape, but the dry pile will again charge it. The electricity is formed by the dry pile in the same manner as in the Volta pile. The bronze paint and the oxide of manganese form the electrodes of the cells and the slight amount of moisture present in the paper is the electrolyte.

These cells have a very long life and the one described will continue to charge the electroscope for several years before it needs given.

A is the brass tube; B, brass ball; D, glass tube; C, paraffined cork; F, tinfoil; G, gold leaves.

Try this instrument on some wise guy who always likes to show his superior (?) knowledge of things electrical.

Contributed by THOS. W. BENSON.

Clockworks Without Gears

By THOMAS REED

SOMETHING tells me that many "Bugs" would have liked to make an electric clock as described in my articles last summer, but were discouraged by the difficulty of the wheelwork. I don't blame them. Gear movements are hard to make, there's no disguising the fact.

But I'll tell you now how to make a movement without any gears at all—without even the use of a lathe, if you haven't one, tho a lathe would make a prettier looking job.

The trick consists in substituting for the gears, plain wooden flanged pulleys, with very small rubber bands for belts.

Of course this construction couldn't possibly be used in a mechanical clock, for in those clocks the driving power is applied in a relatively large mass, by spring or weight. No belt could hold that stored power, and retail it out without slipping or undue tightness.

But in the electric clock, the power is applied at the other end of the train, in very small quantities, but constantly. So the only power or strain ever present in the wheelwork is such as one dry-cell can produce, spread over eight months; and if you'll calculate that for any given moment (in terms of electric power) you'll see that a thread-like rubber band, tight enough only to keep it straight, will easily transmit that power.

Now, then. Your first job is to find, either in your sister's workbox or a notion store, some of those smooth glass beads, the size of shot and nearly as spherical in shape that are (or were) used in fancy work.

The front and back plates of the framework as well as the posts F may be made of wood.

The outfit above described may seem unsubstantial, but I'll guarantee it to outlast the lifetime of any one of you. The rubber bands, of course, would have to be renewed every three or four years, but everything else would easily withstand such wear as it would get.

CHEMICAL "SPONTANEOUS COMBUSTION."

Purchase from your nearest drug store a small quantity of perchlorat of potash (potassium chlorate). Then powder a lump of sugar in a mortar; after which the two are mixed to the following proportions (one part of loafsugar to two parts of potassium chlorate).

Caution:—Do not mix in the mortar, but either on a paper or in a dish. When ready for the combustion, place a small quantity in a tin or old dish and add one drop of sulphuric acid (H₂SO₄). Contributed by W. DOUGLAS GELDERT.

CELLULOID CEMENT.

Hereewith is a formula for celluloid or film cement.

Formula: 4 oz. collodion 3 oz. ether 1 oz. denatured alcohol 1 oz. camphor

Mix thoroly, then add 2 feet of moving picture film that has had the emulsion removed. Contributed by GEO. W. LUCE.

GLASS-BLOWING LESSONS.

In the September number there will appear the first paper of a series by Prof. Herbert Metcalf on the art of glass-blowing. These lessons will explain every step with clear illustrations, so that you can learn the subject easily.
THREAD CUTTING

HAVING become thoroly familiar with the changing of the spindle, lead, and intermediate gears on the lathe, the student will be instructed in the present article regarding the subject of thread cutting, by taking up the successive operations necessary to cut a sharp, accurate thread.

The first and very important consideration in the cutting of a thread is to see that the object is properly secured to the live spindle and to see that the article is revolving truly on its axis. In lesson III the writer has given full particulars how to find the true center and how to secure the work to the spindle by means of a dog. This means of support is very accurate and suitable for all kinds of work.

Let us suppose the work has been secured in the lathe. The next thing is to provide the proper cutting tool and to see that its cutting edge or face is properly ground. If we are to consider the turning of an external thread, we will use the outside thread-cutting tool, Fig. 1; if an inside thread is desired, the tool in Fig. 2 is used. It will be noticed that the tools used in thread cutting are similar to the ordinary turning tool, with the exception that their points are ground to 60° "V" shape, the angle of the "V" corresponding exactly with the correct angle for the screw to be cut. There is one important difference, however, between the shape of a turning tool, i.e., that the tool point is sloped or canted at an angle. This is necessary in the screw cutting tool to prevent it from rubbing against the sides of the thread, owing to the slope or rake of the latter. The rake of a thread depends on the pitch of the screw and the diameter of the work on which it is cut; thus a screw of one-eighth pitch cut on a bolt of one inch diameter, will have a greater rake or slope than that of a thread of the same pitch cut on a bolt of two inches diameter. In other words, we must carefully consider the diameter of the stock being threaded.

In actual practice, however, it is not necessary to make a separate tool for each pitch of thread when cutting "V" threads of reasonably small pitch and diameter, the clearance angle given to the cutting edges of the tool usually being sufficient to allow for variations in the rake of the thread.

It is very essential to see that the tool is ground to the correct shape. One way is to grind it to fit between the threads of an ordinary plug-tap, but a special screw cutting gage is provided for such purposes, and it is advised that this should be in the amateur's tool kit. Fig. 3 shows how it is used and how it helps in properly setting the tool with respect to the work. Illustration in Fig. 4, shows how to set the inside thread-cutting tool with respect to the work with the use of the center or thread gage. It will be noticed that a flat steel plate "P" is laid across the end of the work "W" to form a true surface for the end of the gage to rest against.

Having carefully considered the preliminaries of this topic, we shall go into the actual cutting of threads on the object. The work being mounted between the centers and firmly secured to the face plate by means of the dog, the tool properly ground and fastened to the tool post of the slide rest, and the proper screw cutting change wheels in place, the lathe is then started and a first preliminary cut taken along the work. The tool is then withdrawn, the carriage is laid across the lever (see Lesson II) disengaged from the lead screw, the carriage is brought back to the starting point, and the tool is now set in a trifle deeper than before, the chisel being dropped into gear with the lead screw again and a second cut is taken. This series of operations is repeated until the thread is cut to a sufficient depth.

A screw-cutting tool, by reason of its shape, is weak at the point and is therefore easily broken. Consequently, the depth of cut should not be greater than the tool can easily stand, and this should be regulated in a systematic manner. A simple way is to mark with a piece of chalk the position of the cross-slide handle with which the tool is fed to the work. When the tool is withdrawn after the cut has been taken, it is wound in again before taking the next cut, so that the chalk mark is in exactly the same position as before. This shows the position of the tool during the previous cut, so that the operator can now readily judge how much further to turn the handle around to advance the tool sufficiently for the next cut. This done the old chalk mark is wiped out, and a fresh one substituted, the marking being repeated as each successive cut is taken.

Some lathes are provided with a small graduated disk on the handle of the cross feed, a fixt pointer being attached to the lathe carriage. In this case, of course, the expedients already described are unnecessary.

The second or most important precaution necessary to be observed by the novice is that the tool shall follow in the same path at each successive cut. There will be no trouble on this point when cutting any thread which is an exact multiple of the thread on the lead screw. However, if the lead screw has four threads per inch, and the screw to be cut has twelve threads per inch, the work will always be in the right position for the tool to follow in the thread when the carriage starting lever is engaged with the lead screw. It will also be true if the screw to be cut has 8, 16, 20 or any number of threads per inch which is divisible by four. This is true because the change wheel on the spindle and the change wheel on the lead screw are in exactly the same proportion to each other as the threads on the lead screw and the screw being cut.

However, to cut a thread of twelve per inch, as in the case previously mentioned, a wheel with forty teeth would be placed on the spindle and a wheel with one hundred

The External Thread Tool is Stronger than the Internal Threading Tool. It Should Have a Good Clearance and Be Accurately Ground to the Correct Angle. Self-hardening Steel is Often Used for Such Tools.
and twenty teeth on the lead screw. The spindle would therefore make three complete revolutions for each revolution of the lead screw, and the commencement of the screw thread on the work would accordingly be brought to exactly the same position in relation to the tool each time the starting carriage lever became engaged with the lead screw.

Suppose a ten thread per inch screw is desired to be cut instead of a twelve; then the wheels required would be forty on the spindle and one hundred on the lead screw. The spindle will now make only two and one half revolutions, and the work will therefore be half a revolution behind its proper position, thus causing the point of the tool to come on top of the thread instead of in the groove between the threads, if the carriage starting lever is engaged with the lead screw. If the lead screw were allowed to make half a revolution before engaging with the starting carriage lever, the work will then make another two and one-half revolutions which will bring it into the right position again for starting the tool in the proper groove. The work is therefore only in the correct position for starting a cut once during every two revolutions of the lead screw, similar to other threads which are not exact multiples of the threads of the lead screw. It will be found that to bring the tool to the right position, the starting carriage lever must only be engaged at intermediate positions of the change wheel.

In order to prevent any mistakes arising, the usual plan is to stop the lathe before the tool commences its first cut along the work, chalking a tooth on the spindle wheel and a tooth on the leading screw wheel, placing another chalk mark on the headstock opposite the former, and a chalk mark on the lathe bed opposite the latter, the starting carriage lever being then engaged with the lead screw and another cut taken. The carriage is run back to the starting point after each cut and as soon as both chalk marks on the wheels come opposite to the stationary marks again, at the same instant, the starting carriage lever may be engaged with the lead screw and another cut taken.

The writer has found from actual experience that the above troubles relative to the advancement of the tool at each starting cut can be remedied as follows: The first cut is started and ended at the proper point; then the lathe is stopt at that point. Then withdraw the tool from the work, and turn a beat mark on the tool in the opposite direction thus bringing the carriage and tool to the starting point without disengaging the carriage from the lead screw. By starting the tool at the proper cutting point and setting the point of the tool with proper reference to depth and by noting the position of the graduation on the transverse spindle the second cut is then proceeded with. This procedure is followed until the thread is cut to the proper depth. The only objection to this scheme is that it wastes considerable time by running the tool post and carriage back each time.

The above scheme of setting the carriage with respect to the lead screw and not disengaging therefrom during the completion of the thread has been found to give excellent results. It is, however, advised that the novice should become thoroughly familiar with the first as it will give considerable assistance in handling the lathe.

In cutting internal or inside threads the same methods are followed as when cutting an outside thread with the exception that an inside cutting tool is utilized and set as shown in Fig. 4. It should be remembered, however, when cutting internal threads that the diameter of the hole should be equal to the diameter at the bottom of the screw thread which is to fit into it; thus the hole intended for an inch bolt, having eight threads per inch on it, would be bored out to just under seven-eighths inch in diameter.

A very good illustration showing the various cuts and the number necessary to make a good thread is given in Fig. 5.

PHARAOH'S "SERPENT'S EGGS" TRICK.

O NE of the most amusing tricks in fireworks is the serpent's egg trick, where a little pellet when lighted, turns into a horrible snake, many, many times the size of the pellet. How awe-inspiring it is to the youngsters! Most people have no idea what terribie destruction the word allows. The explanation is simple. Mercury sulphocyanid burns with a very intense light. The little pellet is nothing more than some mercury sulphocyanid. The heat melts the ash to move off so quickly from the burning pellet that it withers and distorts itself into the shape of a miniature snake.

Lathe Set up to Cut External Threads on a Cylindrical Rod. The Stock to Be Threaded is Fastened in the Chuck and is Driven by it.

ELECTRICAL EXPERIMENTER

It requires only a little preparation and a slight knowledge of chemistry to prepare some of this compound.

Mercury nitrate (Hg (NO₃)), and ammonium sulphocyanid (or cyanid) are used in its preparation. In case these are not at hand the mercureic salt may be prepared by adding 75 c.c. of 1.2 sp. gr. nitrate to 25 c.c. metallic mercury and slowly warming till all the metal is dissolved. The excess acid should then be boiled off and the concentrated mercury salt diluted to form about a liter of solution.

The ammonia salt is prepared by adding potassium cyanid to ammeline polyphosphid, and heating slowly to dryness. (A water bath should be used if possible; if not the container holding the solution should be partly immersed in a larger container holding water so as to form a double boiler.) 25 c.c. of the KCNS (ammonium sulphocyanid) should be dissolved in 500 c.c. of water. Add 10 drops iron chloride (Fe Cl₂) to the Hg (NO₃). This will be used as an indicator. Slowly add the KCNS solution stirring constantly. A red color of Fe CNS (iron sulphocyanid) will momentarily appear but vanishes as soon as the solution is stirred. Precipitate will form. When a point is reached where the red color refuses to disappear the reaction is complete and no more of the ammonium salt need be added.

The precipitat should be filtered, washed and then about 1.5 g. dextrine dissolved in 10 c.c. of water should be added after removing the precipitat from the filter paper. The two are then thoroughly mixed and then dried for 48 hours.

When dry, the cake may be cut into little pellets of about 1/4 inch cubed. A match applied to this will produce the snakes.

Caution:—The fumes given off when burning are poisonous mercury gases and care should be taken not to inhale them. Contributed by ALBERT H. BEILER.

AMATEUR ELECTRICIANS! ATTENTION!

Did you read the prize contest article entitled "Utilizing Burnt-out Lamp Bulbs," which appeared in the April number of this journal? If not, procure a copy to-day. Here is your chance to make some money. Prizes are offered for the best ideas—"What to do with burnt-out lamp bulbs," and prizes will be awarded as follows: First prize, $3.00; second prize, $2.00, and third prize, one year's subscription to the ELECTRICAL EXPERIMENTER. Get busy, boys, and watch for the September issue.
On the Construction of Small Transformers

By Prof. F. E. Austin

As many questions are continually arising in the mind of the amateur and experimenter regarding the windings on transformers to meet certain conditions, a few fundamental principles may be explained that will enable those who so desire to either construct transformers to meet certain requirements or to remold transformers already constructed to meet new conditions of service.

Suppose a transformer has been constructed similar to the one shown in illustration, having a core one square inch in cross section, 6/4 inches long on the limbs, containing the coils and 3/4 inches on the shorter limbs. This core is made up of soft iron plates, of, say, ordinary black stove pipe iron, or even of ordinary roofing tin, which is thin iron or soft steel coated over with tin. The strips to build up the iron core are therefore 1 inch wide, and the longer strips 6/4 inches long, and the shorter ones 3/4 inches long.

If, on the other hand, the single turns were made of a band or flat ribbon of thick copper, then short-circuiting the ends of such a turn would cause a very considerable electric current, because of the very low resistance of the band and a very considerable amount of electrical energy will be supplied by the primary.

In other words, it makes no difference what the cross-section of the wire is so far as the induced pressure is concerned, but does make a difference so far as the current is concerned. So far as the load on the transformer is concerned, one turn of very large wire will produce as great a load as a large number of turns of fine wire.

It was said that the per turn pressure on the primary is very nearly the same as the per turn pressure on the secondary. Were the efficiency of the transformer 100%, meaning that just as much electrical power could be obtained from it as was supplied to it, then the per turn pressure of both primaries and secondaries would be exactly the same. If the efficiency of a transformer is 50%, then the per turn pressure of the secondary is about one-half the per turn pressure of the primary. Of course the efficiency of 50% occurs when the transformer is in operation, delivering electrical power. At no-load output, or at open-circuited secondary, the per turn pressure of the primary and secondary are the same in a well-designed transformer. When, however, the load is applied to a transformer, there is an internal pressure drop express by the resistance of the windings multiplied by the current in the windings. If the resistance of the windings does not vary in value but the current does, then the internal pressure drop will vary. As the current increases due to increased load the internal drop increases, and therefore the terminal pressure decreases.

The applied pressure is kept constant and the demanded increase in energy is supplied by the governing devices at the central station furnishing power.

For electro-welding only low pressures are required, but large currents are necessary in order to supply the necessary heat at the junctions of the two pieces of metal to be welded. A transformer for welding purposes will therefore have its secondary made of very large copper bands, and consisting of but few turns. If the same number or turns are wound on each limb or coil, then the two may be connected together in parallel, in order that the current may be doubled.

In connecting the two coils together, it will be necessary to duly regard the polarity of the terminals, as at every instant the terminals have a very positive and negative relation with each other. If two coils happen to be connected so that two positive or two negative terminals are together, the resulting pressure will be zero, provided the pressures of the coils are the same.

If the secondary winding of a transformer such as in the figure consists of two sections each having two turns, and each of No. 14 B. & S. gage copper wire, the terminal pressure of each layer will be about 5 volts at a load of about 300 watts, or a trifle less than one-half horse-power.

If copper strip about ¼ inch in width is wound on or over the secondary of No. 14 forming 2 coils of five turns each, a welding transformer will be formed, allowing, if desired, the two windings to be connected together in parallel to produce twice the current but only one-half the efficiency.

As described the transformer is a step-down transformer, stepping the applied primary pressure of 110 volts down to 5, 10, 15, 20, or 22 volts as desired by attaching to the proper terminals.

If instead of being wound with No. 14 wire, the secondary were wound with say 1040 turns of No. 28 B. & S. gage copper magnet wire, the transformer would become a step-up transformer, stepping the pressure up from 110 volts to about 200 volts.

Were a transformer capable of operating at 100% efficiency, then the pressure times the current in the secondary would be exactly equal to the pressure times the current in the primary. Then if the secondary pressure were twice the primary pressure, the secondary current would be one-half the primary current. This at once shows why such a transformer requires a small size of wire in the secondary than in the primary.

In a step-down transformer the secondary is made of much larger wire than the primary.

**Properties of Electrolytically Deposited Copper**

A preliminary report has been published of the studies of copper layers of 30 tuns on each of No. 14 B. & S. gage copper magnet wire, which transformer we have termed a step-up transformer, stepping the pressure up from 110 volts to about 200 volts.

Were a transformer capable of operating at 100% efficiency, the pressure times the current in the secondary would be exactly equal to the pressure times the current in the primary. Then if the secondary pressure were twice the primary pressure, the secondary current would be one-half the primary current. This at once shows why such a transformer requires a small size of wire in the secondary than in the primary.

In a step-down transformer the secondary is made of much larger wire than the primary.
HANFAN TAPs Holder and Cutter

The diagram herewith shows a handy friction Tape Holder and Cutter for armature winders. Without such a device one is forever hunting for the tape, besides trying to cut it with one hand.

As all of us know, there is much laying down and picking up of armature winders’ tools, and you are obliged to look all over your shop each time for the tool you want. Now this device can be clamped to the tray just where it will be the most handy and will always be found in the same place when wanted. You can pull off as much tape as you want, and then by pulling it sharply across the knife it will cut the tape. One side of the arm that hold the knife should be longer than the other and the knife set so that the tape will be cut on the bias. The knife, as you observe will do away with the handling of your shears.

As I find this a great aid to my work, I pass it on to others.

Contributed by CHARLES A. SMITH.

IMPROVED BURGLAR ALARM CIRCUIT.

In your March, 1917, number of Electrical Experimenter, on page 821 is described a “balanced burglar alarm system,” contributed by Mr. T. W. Benson, which I do not think will work very good. The contacts shown in his Figs. 1 and 2, and the battery Fig. 6, I think are all very good. The balanced relay, Fig. 3, however, will not operate exactly as described: If a “polared” ringer coil is used and the taper arm bent so that it will drop to one side, and is connected as shown in his Fig. 4, the taper will drop to one side according to the direction the current from the battery is flowing in, and stay there. I do not believe any adjustment can be made to permanently balance this relay as shown. If the permanent magnet would be removed from the ringer, the pull of the one coil would be equal to the pull of the other coil, but as the taper arm is slightly bent, when the battery circuit is closed the taper will fall in the direction it is bent, and remain there. Even if it would be possible to balance this relay, any slight vibration would cause it to drop to one side and close the contact. Another poor feature in my estimation:—When the open circuit line is closed, it will not unbalance the relay, but only allow a larger amount of current to flow thru the relay coils, due to the fact that the 20 ohm resistance is cut out of this circuit.

I submit a diagram for your consideration which I think will work better and be more reliable. As far as the contacts are concerned, Mr. Benson’s would work very satisfactory. In the closed circuit three gravity cells would be used.

The two relays are connected in series. Any style of relay having resistance of about 35 ohms would work. The armature of relay “A” is adjusted so that it will stand normally open, but will close when the open circuit contacts are closed, or if the line should be shorted. Relay “B” has a back contact, and is adjusted so that the armature is normally pulled up. When a closed circuit contact is opened or any change in the resistance of the line is made, relay “B” will open.

Relay “C” (according to my diagram) is so wired that when the contact on either relay “A” or “B” is closed, the contact on relay “C” will close and remain so, regardless of whether the contacts of relays “A” and “B” resume their normal positions. This will cause the bell to ring, or give some other alarm until switch “D” is opened.

While a separate battery is shown in the bell circuit, a connection could be made to the gravity battery to ring the bell.

Contributed by ROBERT M. WEATHER.

A NOVEL ELECTROSTATIC EXCITER.

The little machine here illustrated is very convenient for exciting influence (static) machines and for a variety of purposes when a stream of very small sparks of either + or — electricity is required. It consists of a 3-inch length of ebonite (hard rubber) tube, A, 1/2 inches in diameter, closed at the ends, so that it can be fixed to an axle, B, of stout brass wire, passing thru holes in the center of two small pieces of varnished wood, C-C, 2½ inches long. The ends of the axle are afterward bent into handles, as shown. Two thick strips of ebonite, D D, 4½ inches long, are screwed to the wooden end pieces. A hole is made in the center of each to take a 3-inch length of brass tube, which must make a tight fit. One of these has a collecting comb, E, soldered to one end and a large brass ball, F, screwed to the other. The second tube has a similar ball, G, fixed to one end, and a fur “rubber,” H, at the opposite end. The rubber is 2½ inches long and 3/4-inch wide. It is curved, as shown at f, the degree of curvature being the same as that of the ebonite tube, and consists of a piece of any suitable fur (the writer has used moleskin, though cat-skin is best) fixed to a curved strip of brass with glue. The metal backing is, of course, previously soldered to the brass tube.

It will be understood that the rubber must press very lightly against the revolving ebonite tube, while the teeth of the collecting comb must clear the tube by about½-inch. The operation of the machine is very simple. Upon turning either handle the ebonite tube is caused to revolve against the fur-rubber. Both become electrified in consequence, the fur positively and the ebonite negatively. The capacity of the machine is, of course, very limited, and only very small charges accumulate on the metal conductors. In order to obtain a constant stream of sparks, therefore, one of the conductors must be grasped in the hand to conduct away its charge as fast as it is collected. Hold F, and positive sparks are obtained from G; hold G, and negative sparks may be taken from F, as long as the handle is turned. This is the reason for making a handle at both ends.

Contributed by H. J. GRAY.

A SMALL ELECTROSTATIC EXCITER SUCH AS HERE ILLUSTRATED IS VERY CONVENIENT FOR EXCITING LARGE STATIC MACHINES AND FOR CONDUCTING SIMPLE EXPERIMENTS WITH.
**Experimental Chemistry**

By ALBERT W. WILSDON

Twenty-Seventh Lesson

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**WATER: History**

With the observation of Cavendish in 1761, that water was the product of the combustion of hydrogen, the ancient belief in its elementary nature was broken down. Lavoisier, in 1783, confirmed the experiment of Cavendish, and he decomposed water into its elements and conclusively demonstrated that it was composed of one part, by weight, of hydrogen, and eight parts, by weight, of oxygen. The volumetric composition was proven by Gay-Lussac in 1805 to consist of two volumes of hydrogen and one volume of oxygen.

Aside from its abundant natural occurrence, as we are accustomed to see it, water is very widely distributed in such a manner as to evade casual observation. In other words it is in places where we would be least likely to look. It is present in green plants to the extent of from 70 to 90 per cent; in fruits 80 to 95 per cent; in the animal body from 75 to 80 per cent; while the soil averaged from 5 to 20 per cent of moisture.

**Preparation.**

The simplest and most convenient method of forming this compound from its elements, i.e., hydrogen and oxygen, and proving the product to be water, is to burn a jet of hydrogen in air, and hold over the flame of a cool bell-jar, which will immediately become coated with a film of moisture. When they are mixed in the correct proportions, hydrogen and oxygen, the gas is brought in contact with a flame, a violent explosion results. If, however, they are brought together at the moment of their combustion, to prevent explosion, the mixture will burn with a very intense heat. The oxyhydrogen blowpipe is the apparatus by which this may be accomplished. Reference is hereby made to Experimental Chemistry, Fifth Lesson, October, 1916, issue of this journal, for a more complete description of the blowpipe with illustrations.

**Composition.**

Analytically, the composition of water may be demonstrated thru the electrolysis of water (acidulated with a small quantity of sulfuric acid) which when carried out by means of an eudiometer, yields three volumes of hydrogen, which collects in the arm containing the negative electrode, and one volume of oxygen in the other containing the positive electrode.

**Synthetically** the composition of water may be proven either by volume or weight. Volumetrically, by means of an eudiometer, yields exactly 1 volume of oxygen and 2 volumes of hydrogen over a column of mercury contained in an eudiometer tube (see Fig. 124). After exploring this, experiment by means of an electric spark, all the gas will have disappeared and the tube will be filled with mercury, excepting a very small quantity of water which has been formed. Should the two gases introduced be in proportions other than the above, any excess of one or the other will remain after the explosion. Gravimetrically, the quantitative synthesis of water is carried out by conducting pure dry hydrogen over a weighed quantity of heated copper oxide, the resulting water being collected and weighed. The weight of the copper oxide after the reduction is also noted. The loss in weight sustained by the copper oxide represents the oxygen consumed, and this subtracted from the water formed is the hydrogen. For example, 6.5 grams of copper oxide lost 1.31 grams of oxygen, which in turn yielded 1.475 grams of water. The hydrogen consumed would be equivalent to 1.475 / 1.31, equals 0.165 gram. Then the ratio of hydrogen to oxygen would be 0.165 to 1.31, or 1 to 7.94, which represents the combining weights of these two gases.

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**Properties: Physical.**

Water consists in three states, i.e., solid, liquid, and gaseous (steam) within 100 degrees (C).

It freezes at 0 deg. C. and boils at 100 deg. C. at 760 mm. pressure. Under 10 atmospheres it boils at about 190 deg. Diminished pressure lowers the boiling point. The specific gravity of water at its greatest density has been selected at 1.000; at 0 deg. it is 0.99987, thus ice (0.916) floats in water.

When water crystallizes, heat is set free, while, on the other hand, when ice is fused, heat is absorbed; this is true of all fluids and solids when they pass from one state of aggregation into another. With ice or water this heat consumption or liberation amounts to 79 calories. That is, in order to fuse 1 kilo of ice, a quantity of heat will be required which is capable of raising 79 kilos of water thru one degree centigrade.

Water is the greatest solvent known. Substances dissolved in it raise its boiling point and lower its freezing point.

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**Simple Experimental Apparatus to Be Made by the Experimentor for the Synthesis of Water.**

![Fig. 127](image-url)
This department will award the following monthly prizes: First Prize, $3.00; Second Prize, $2.00; Third Prize, $1.00.

The purpose of this department is to stimulate experimenters towards accomplishing new things with old apparatus or old material, and for the most useful, practical and original idea submitted to the Editors of this department, a monthly series of prizes will be awarded. For the best idea submitted a prize of $3.00 is awarded; for the second best idea a $2.00 prize, and for the third best price of $1.00. The article need not be very elaborate, and rough sketches are sufficient. We will make the mechanical drawings. Use only one side of sheet. Make sketches on separate sheets.

**FIRST PRIZE, $3.00**

**A MILK BOTTLE ALARM.**

A is a piece of brass cut as shown in Fig. 1, with a piece of tape or fiber (for insulation) as shown. B is a piece of spring brass cut as shown and both ends of A and B are separated by a piece of hard rubber

![Milk bottle image]

When the Milk-man Takes Your Milk Bottle from This Switch, it Closes an Electric Alarm Bell Circuit.

with tape wound around them, or else clamped together by fiber blocks. Place a bottle on the brass arm B, and as soon as anybody picks up the bottle, it causes a connection between A and B and the bell rings.

Contributed by EDWIN WOLBER.

**A SIMPLE PITH-BALL "ELECTROSCOPE."**

A simple but efficient electroscope is made as follows: A bottle made of good, clear glass and of the shape shown is necessary. A thin copper wire is bent in the shape indicated after being mounted in a tight-fitting cork. The copper wire is mounted in a poured sulfur bushing in the center of the cork. A small piece of silk thread is tied or pasted to each pith-ball and the other end is tied to the hook in the wire. When finished the pith-balls should hang two or three inches from the bottom of the bottle. Be sure the pith-balls hang exactly even in the bottle.

Contributed by MANSELL SARGENT.

**SECOND PRIZE, $2.00**

**A CIRCUIT-BREAKER FOR BATTERY CURRENTS.**

This circuit-breaker, of which a sketch is given, has proven to be very efficient. The base and uprights may be made of boxwood. The binding posts may be obtained from an old battery; the magnet can easily be made or obtained from a discarded doorbell. The dimensions may be altered but I have found the ones given very convenient. In making parts "a" and "b," care must be taken to allow for the bends at "d" and "f." The height at "d" depends on the size of the magnet; the same with the length of "a." Point "c" must fall below "a" when "a" touches the core of the magnet.

Contributed by CARL KOESTER.

**THIRD PRIZE, $1.00**

**A USEFUL HAND DRILL ATTACHMENT.**

Its principal function is to hold the hand drill straight, thus making it easier to do accurate work. Dimensions are left to be calculated by the builder to fit his particular drill. The main standard "A" must be cut in by drilling several holes in one end and then bent at an angle to fit the flat anvils on an ordinary vise. A slot may be cut in it by drilling several holes in a row, chop out with a cold chisel, and finished with files. The upper part of standard "B" is also made of 1 inch by 3/16 inch band iron, then it is bolted loosely to "a," with washers and nuts on opposite side. A clamp made of lighter material is bolted to the top to receive hand drill. To operate it is only necessary to apply pressure to top of drill.

Contributed by LEO HAASE.

---

**Tesla Current Passes Thru Glass.**

When amateur wireless stations were closed by the government, upon the entrance of the United States into the war, many operators constructed Tesla coils and resonators for use with their transformers. I am submitting a description of an experiment which requires practically no preparation, and which has a startling effect. The fact that electricity at high voltages cannot be confined by ordinary electrical insulation is well illustrated by the following experiment.

The action is as follows: When current flows thru the Tesla coil sparks leap from A and A, to the surface of the water. A steady stream of sparks also flows between D and D, at the gap G. The electricity evidently flows from A to A, thru the glasses without puncturing the glasses. If the current is allowed to flow long enough the water becomes heated.

Contributed by GEO. B. GATES. A pretty experiment, but our contributor has taken a wrong conclusion. The tumbler with water, the inside wire, as well as the outside loop forms a small Leyden jar (a condenser). Hence the easy flow of the current. However, Tesla currents easily pass thru glass.—Editor.
DRILLS MADE FROM NEEDLES.

Having occasion to use many small drills, and not wishing to incur the expense of continually replacing old ones, I used the following trick:

I procured several sewing needles of the same diameter as the drill I needed. After breaking off the eye, I ground the needle slightly flat on both sides of the large end. I then shaped the flattened end according to the sketch. These drills will do good work and will not break so easily.

Contributed by R. DANKS.

REMOVING STAINS OF ALL KINDS.

Solution No. 1. 20% solution of acetic acid or tartaric acid.

Solution No. 2. Five grams of bleaching powder (Ca(ClO)). Boil in 100 cc. of water until a pink color appears. Filter and add 50 cc. of cold water.

To remove ink, coffee, tea, fruit, and dye stains, wet the spot thoroughly with No. 1. Absorb the superfluous liquid with a blotter and apply No. 2. Rinse and repeat if necessary.

For removing common stains, treat as shown in the following table:

<table>
<thead>
<tr>
<th>Stain</th>
<th>Removed by</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acids, Grass</td>
<td>Cold water, Nos. 1 &amp; 2.</td>
</tr>
<tr>
<td>and fruit</td>
<td>Cold water, alcohol, Nos. 1 and 2.</td>
</tr>
<tr>
<td>Grease</td>
<td>Gasoline, carbon tetrachloride, carbon bisulfide, ether, chloroform, amonia, soap-suds, warm fullers earth (cover with a blotter and apply a warm iron.)</td>
</tr>
<tr>
<td>Dyes, coal tar or vegetable origin</td>
<td>Nos. 1 and 2, ammonia.</td>
</tr>
<tr>
<td>Mildew</td>
<td>Nos. 1 and 2, sunlight.</td>
</tr>
<tr>
<td>Inks</td>
<td>Inks, indelible (silver)</td>
</tr>
<tr>
<td></td>
<td>Potassium cyanide, 10%.</td>
</tr>
<tr>
<td></td>
<td>Use great caution—intensely poisonous, sodium hypobromite 20% solution.</td>
</tr>
<tr>
<td>Iodin</td>
<td>Methylated alcohol, potassium iodide Sol, 10%.</td>
</tr>
<tr>
<td>Iron Rust</td>
<td>Warm oxalic or citric acid, 10%.</td>
</tr>
<tr>
<td></td>
<td>In silk, let it alone.</td>
</tr>
<tr>
<td>Paint, varnish</td>
<td>Turpentine, benzene, carbon tetrachloride. Use no turpentine on silk.</td>
</tr>
<tr>
<td>Tar, wagon grease, soap and oil, turpentine.</td>
<td></td>
</tr>
</tbody>
</table>

Contributed by JOHN D. COLEMAN.

A WOOD SCREW WHICH CANNOT BE UNSCREWED.

Many times the experimenter has need of a wood screw which can be screwed into a piece of wood, but cannot be taken out. A screw of this kind can easily be made by taking an ordinary wood screw and filing down each side of the head, as shown in the illustration.

It will readily be seen that while it can be screwed into the wood, it cannot be unscrewed.

Contributed by G. COLEMAN.

A CHEMICAL SIPHON.

This will be especially useful to electro-chemists for siphoning off liquids from gravity batteries, etc. It is easily made by heating a glass tube till soft and drawing it out until of quite small diameter at the bend; it is bent as shown in sketch (aided by using a fish tail burner).

Its principle of operation is the "ram" action. Immersing it, keeping one finger closed over one end, and lowering horizontally into the shallow liquid. Remove finger and liquid will rush into tube, its velocity being sufficient to carry it up the narrow portion marked N, and over the bend.

Contributed by K. CLARK.

THE SYNTHETIC PRODUCTION OF RUBIES.

During the last few years, practically all of the beautiful minerals of the corundum family have been produced synthetically in the laboratory. These artificial gems are identical in beauty, hardness, and chemical composition to those obtained from the mines. The accompanying diagram shows a furnace commonly used in producing the gems.

The operations are as follows:

A trace of chrome alum is added to a solution of common alum, the chrome alum being the coloring constituent.

Then ammonia is added and a gelatinous precipitate of the hydrates of alum and chrome is formed.

This precipitate is filtered off, evaporated to dryness and calcined in a furnace at a temperature of 1000° F., into an ultimate mixture of alumina and chrome oxide. The proportion in which these two chemicals occur in the ruby are:

Alumina: 98%. Chrome Oxide: 2%.

The mixture is then ground into a powder and placed in the hopper "A." A rarely tapper which shakes the powder thru the sieve "C" into the tube "B." Thru this tube the oxygen is also supplied. Hydrogen is supplied thru the tube "E." The two gases are ignited at "F." "G" is a platform made of a highly refractory substance against which the flame strikes and on which the ruby is formed in a pear-shaped mass. The rate of flow of the powder and the temperature of the oxy-hydrogen flame must be regulated very carefully. When a bead of sufficient size has formed the heat is gradually lowered so that the gem may be free from great stresses. When it is cooled, it is broken off the base and sent to the cutter who finishes the gem.

It is important that the ingredients used in producing the minerals be of the purest obtainable.

Contributed by W. A. SCHILDKNIECHT.
Wave-Motor. (No. 1,263,041; issued to Leander W. Hammond.)

Adapted to amateur requirements in developing electric light, etc. The paddle member, which is pivoted so as to be swung back and forth by the wave action, is supported in an adjustable frame, which rises and falls with the tide, thus keeping the wave paddle at the proper height to work effectively at all times. The to-and-fro motions of the paddle cause a mechanical connected pump to force water into a tank in the manner apparent. The supply of water, which may be under pressure, in the tank on shore may be utilized for operating a wave turbine or the like, the turbine being connected to a dynamo, etc.

Electric Horn for Autos. (No. 1,264,411; issued to Henry A. Nywidler.)

A unique electric wind horn for autos and other vehicles which has a particular application to a sound-producing instrument, wherein the air currents are generated by means of a motor-driven fan. When the motor circuit is closed, it quickly accelerates the fan which draws in air through the holes opening at the rear of the fan chamber. In emerging thru the horn member the current is passed thru the musical reeds, which may be three or more in number. In this way the reeds are vibrated by the air currents passing by them.

Telegram Key Circuit-Closer. (No. 1,264,465; issued to James L. White.)

On the top of the key knob is a small lever which is normally held in such a position that the lower end of this lever permits the switch knife to close the circuit in the well-known manner. A spiral spring causes the switch knife to be normally held in the switch jaw mounted under the lower key contact. The operator when ready to send, simply pushes the switch trip to the left or against the pin on the knob, and proceeds to transmit. As soon as the knob is released, the switch closes automatically.

Talking Motion Pictures. (No. 1,265,377; issued to John M. Craig.)

He utilizes a film containing the motion pictures, and on this same film he also records the speech record in such a manner that the sound record is formed, of a substance which does not affect the transmission of ordinary white light, but which will affect the passage of rays beyond the visible rays of the spectrum. Also, the sound record on the film is made capable of transmitting ordinary white light, by being pervious to the transmission of infrared rays. The patent covers details at the rear of the battery case, either lamp can be lighted. One lamp lens gives a white light for the use of the flashlight in general illumination, and the other lens a small angle beam sharply focused for use in lighting a target.

Sound-Reproducing Diafram. (No. 1,264,215; issued to John A. Steurer.)

Diafram made, for instance, of blotting paper. This is saturated with a thin solution of a phenolic condensation product, such as bakesil or condensation, which is then dried. A circular central portion of the diafram so formed is then treated with a greater amount of the solution of such condensation product, and this part of the diafram is then permitted to dry, with the result that the central part of the diafram will absorb a much larger quantity of the sound, and consequently be much more dense. The diafram is baked to make it hard and elastic, and it has a uniform thickness, while possessing much different characteristics from an ordinary diafram of uniform density.

Heavy Current Microphone. (No. 1,263,140; issued to Lonnie Burnett Stone.)

A novel design of heavy current or high duty telephone transmitter, employing a plurality of microphonic units. These multiple microphonic units, which comprise a series of tubular chambers or shells in which carbon granules are placed, are connected in multiple with a suitable induction coil having a three-part primary winding.

Electrical Torpedo Net. (No. 1,264,820; issued to Albert Hedina.)

A net which may be used in sections, or which can be utilized separately by being arranged on a boom swinging outwards from a ship or in groups, so as to form a continuous curtain about the ship. The net is provided with a series of oppositely charged and specially insulated electrical conductors, arranged in such a manner that if a metal torpedo shell hits the net, it will cause a current to flow thru the torpedo from the oppositely charged conductors, and by virtue of the resistance offered by the passage of this current thru the shell of the torpedo, will thereby cause heat to be generated, and this heat in turn to cause an explosion of the torpedo's gun-cotton charge.
"Amateur Electrical Laboratory" Contest

In this issue we publish some interesting facts with excellent photos, describing one Amateur Electrician's experimental laboratory. Now "Bugs"—we want to publish a snappy one like it each month. Here's our proposition: Why not write up your "Electrical Lab.," in not more than 500 words. Dress it up with several good, clear photographs. If we think it good enough we will publish the article in display style and pay you well for it. The prize awarded to such articles will range from $3.00 to $10.00. And "Bugs"—don't forget to make your article interesting. Don't write—"I have a volt-meter, an ammeter, a switch-board," etc., ad infinitum. For the love of Pete put some punch in it! Tell us what you have done with your instruments and apparatus. You don't mean to tell us that every Experimenter does exactly the same thing. "We know different—but from the general run of such articles which we have received in the past, one would naturally think every "Lab." made in the same mould. Remember—send a photo of YOURSELF along. Typewritten articles preferred.

THIS MONTH'S $3.00 PRIZE WINNER—ELMER HUTCHINSON

MOST fellows do not realize the fun in having an experimental laboratory. I am in partnership with Wilbert Hartle, who lives near by. I firmly believe in partnership of two boys as one may have one thing while the other will have something else of value.

Our laboratory measures about fifteen feet by fifteen feet. We have just enough room allowing us to be purchasing and making apparatus constantly and we are usually quite crowded. The lab is located in a chemical laboratory and a desk (Fig. 1). We use the desk for correspondence, studying and drawing. In the drawers we keep magazines and catalogs. We have about three years straight of the Electrical Experimenter. Fig. 1 shows the arrangement of chemicals. We have a compound of almost every metal and salt and can therefore make any chemicals we need. I learned chemistry by having one of us mixing up something for the other to analyze.

We have a full-time stuff and countershafts ourselves and connected up the screw-cutting lathes as shown in Fig. 3. We have found this lathe very handy for turning small parts of apparatus. The small lathe (Fig. 4) is not in use at present, but as soon as we get enough time, money, and interest we will put it into use. It is used for work that is too heavy for the motor.

The pictures do not show much of the electrical apparatus among which are motors, an electric furnace, dynamo, step-up and step-down transformers, condensers, batteries, meters, etc. We have a complete "dismantled" wireless outfit.

We have many books, such as a complete set of "Hawkins Electric Guides," besides chemical, physical, drawing, astronomy and mechanical books and many I. C. S. hand-books. We learn more from our laboratory than we do from any school or book.—Elmer Hutchinson.
August, 1918

ELECTRICAL EXPERIMENTER

Phoney Patents

Under this heading are published electrical or mechanical ideas which our clever inventors, for reasons best known to themselves, have as yet not patented. We furthermore call attention to our celebrated Phoney Patent Office for the relief of all suffering daffy inventors in this country as well as for the entire universe.

We are revolutionizing the Patent business and OFFER YOU THREE DOLLARS ($3.00) FOR THE BEST PATENT. If you take your Phoney Patent to Washington, they charge you $20.00 for the initial fee and then you haven't a smell of a Patent yet. After they have allowed the Patent, you must pay another $20.00 as a final fee. That's $40.00! WE PAY YOU $3.00 and grant you a Phoney Patent in the bargain, so you save $43.00! When sending in your Phoney Patent application, be sure that it is as daffy as a lovesick bat. The daffier, the better. Simple sketches and short descriptions will help our staff of Phoney Patent Examiners to issue a Phoney Patent on your invention in a jiffy.

Prize Winner: JACKASSOMOBILE. Now that the price of gasoline has soared so high that only aeroplanes can follow its skyward rise, my new Jackassomobile will come as a boon to all gas-weary autoists. Jackass runs on endless tread in mad endeavor to eat his oats. Endless belt drives dynamo charging storage batteries. The latter, run the 60 H.P. high-speed motor which propels auto. Surplus juice feeds electric headlights, also the jackass electric spark accelerator, to urge on the Jackass, should he become a speed slacker. Inventor, Julius Lantz, Maywood, Ill.

AUTO-TROLLEY. In order to conserve our coal supply I propose to equip all trolley-cars throughout the land with spring bellows along the running-board as well as under every seat. Passengers boarding car then pump air into compressed air tank. When sitting down passengers also do likewise, and furthermore more air will be pumped into tank every time they are bounced up and down. Compressed air not only works pneumatic brakes but runs the car and the surplus power runs a dynamo which pumps juice thru trolley wire into power house. Hence power house needs no coal at all. Inventor, E. Paul Gangewere, Chattanooga, Tenn.
ELECTRIC FAN PROBLEM. (940) Arthur A. Everts Co., Dallas, Tex., inquire:
Q 1. We have a large electric fan about eight feet above the entrance to our store, directly at the door, which gives small results. This is a large four-blade fan. We realize that many customers are kept out of our store thru the necessity of opening a screen door, which we must use in conjunction with the present fan. Would one of unusual power do the work? A 1. There is only one other way that you can combat the fly nuisance, and that is by mounting several fans as shown in our diagram "A." In this manner, the fans will always blow towards the entrance and if you can arrange the fans in such a way that all the space is covered by them; in other words, that no part of the entrance is without a certain amount of draft due to the fans, then in that case we are quite certain no flies will enter.

Magnetizing Steel Bar. (941) J. C. Miller, Caney, Kan., writes the Oracle:
Q 1. That he has trouble in magnetizing a steel bar.
A 1. From your description we conceive that the trouble with your electromagnet is that it is not powerful enough to produce the results you desire. We advise using a stronger magnetizing electromagnet, and offer the following pointer in regard to magnetizing steel permanently. When the steel bar is placed over the poles of the electro-magnet, you should gently tap the steel. This is done so as to shuffle the molecules of the steel, and to cause them to set themselves all in the same direction. If you will adhere to the above, we are sure you will meet with success.

AERIAL TORPEDO. (942) Mr. A. Fiocco, Allentown, Pa., writes that:
Q 1. He has been working upon an aerial torpedo and wishes our advice on its practicability.
A 1. Relative to your Aerial Torpedo, quite possibly this may find a practical application in future military and naval operations, but at the present time, or at least to put it in another way, we would say that the efforts made by various inventors along this line, up to the present, have not been very promising.

ODD PHOTOS WANTED AT $1.00 EACH!!

Now is the time to make your Kodak pay the Hard way or way. We are after interesting photographs of out-of-the-ordinary electrical, radio and scientific subjects and are willing to pay $1.00 cash for every one we can use. Please bear in mind that for half-tone reproduction in a magazine, a photograph should be particularly sharp and clear. Of course, if a subject happens to interest us particularly well, we can have the photo retouched. For the general run of subjects, however, it does not pay to go to such expense. Therefore, please take pains to properly focus and expose your pictures. It often happens that a really mediocre subject well photographed wins approval over an excellent subject poorly photographed. And don't send us plate or film "negatives"; send unmounted or mounted "prints," preferably a light and dark one.

As to what to photograph: Well, that's hard for us to say. We leave that up to you, and every reader now has the opportunity to become a reporter of the latest things in the realm of Electricity, Radio and Science. But, please remember—it's the "odd, novel or practical stunts" that we are interested in. Every photo submitted should be accompanied by a brief description of 100 to 150 words. Give the "facts"—don't worry about the style. We'll attend to that. Enclose stamps if you desire to be returned, and place a piece of cardboard in the envelope with them to prevent mutilation. Look around your town and see what you can find that's interesting.

Address photos to—Editor "Odd Photos," ELECTRICAL EXPERIMENTER, 233 Fulton Street, New York City.

Your idea of releasing several of the aerial torpedoes so as to have them strike the water in the path of an on-coming U-boat torpedo is nothing new, as this scheme was proposed already last year by Mr. H. Gernsback. In an article in this journal was described a new form of motor-torpedo, a number of which were to be carried along on each merchant vessel. A number of inventors have worked on the scheme of aerial torpedoes to be controlled by wireless or other automatic and self-contained mechanisms, but up to this time these ideas have not proven particularly successful, so far as we are aware.

It may pay you, however, to work along the lines of a radio controlled aerial torpedo, or one that could be accurately controlled by some other means.

110 VOLT D. C. BATTERY CHARGING. (943) W. H. Jackson, New York, N. Y., asks:
Q 1. What size resistance to use in charging small storage batteries from 110 volt D. C. service.
A 1. The amount of wire for a resistance to be used directly in the 110 volt D. C. line for charging storage batteries is as follows:

Use 250 feet of No. 18 German silver resistance wire, connected as shown.

Storage Batteries Can Be Successfully Charged by Tapping off at the Proper Points Along the Resistor. Connected to a Direct-Current Circuit in This Manner.

DOES A DYNAMO "PRODUCE" ELECTRICITY. (944) Richard Bohannon, Boonville, Ind., asks:
Q 1. Does a dynamo produce electricity from D. C. service?
A 1. As to the original source of energy as developed in the dynamo, this is a rather mooted question even among the best engineers of today. It is generally considered that the dynamo does not produce electrical energy in the usual sense of the word, as the first law of physics states that energy cannot be produced—neither (Continued on page 264)
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THE ORACLE.

(Continued from page 262)

can it be destroyed. According to the latest theories advanced by scientists, a dynamo simply acts as a converter or transformer, if we might so call it, and gets in activity latent electrical forces which are always present in the dynamo before the armature is ever started. In other words, the field magnet of the dynamo produces a magnet field, which as we now know is one form of electricity. When the armature with its revolving wires or conductors is rotated in this magnetic field, a conversion takes place, so that electric currents are caused to develop and flow along the armature conductors. The collecting commutator mounted on the armature shaft and from which the current passes out into the external circuit thru suitable brushes.

It might be said in a broad way, that the static machine derives its electrical energy or charge from the air, but it is not correct to say that a dynamo derives its apparent energy from the air.

EFFICIENCY OF DYNAMO.

(945) Chas. A. Bazino, North Bennington, Vt., writes the Oracle.

Q. 1. In Mr. Cohen's article on the testing of small motors and dynamos, I fail to see how he obtains an efficiency of 40.2%; I figured it as 40.02.

A. 1. Relative to Mr. Samuel Cohen's article on the testing of Small Electric Motors and Dynamos" in a recent number of the ELECTRICAL EXPERIMENTER, we would advise that the efficiency in the example there cited is not quite 40.2%, and not 40.02% as your figures show. This is so for the reason that 150 watts divided by 373 watts equals a ratio of 373/150 which must be multiplied by 100 in order to give the result in per cent, and we therefore have 40.2%.

ELECTROLYTIC DECOMPOSITION OF WATER PIPES.

(946) W. W. Brinckerhoff, Mt. Vernon, N. Y., writes:

Q. 1. Can electricity destroy water pipes in the ground due to leakage currents, etc.?

A. 1. Regarding the decomposition of underground water pipes due to the effect of a considerable leakage of electric current from the railroad tracks as you mention, this is a case where currents in cities or other locations where there is liable to be any appreciable leakage of the electric current.

We would recommend that you look up this matter in any book treating on modern electric railway practise at your local library in which you will find the present practise outlined for obviating or overcoming this difficulty. In general, there should not be such an excess leakage of electric current from railroades tracks, that it will cause water or other pipes to be honeycombed and decomposed, often resulting in a dangerous condition or a break in the water main, but these cases have happened. It is generally due to a high resistance joint or a series of high resistance joints in the rails, which may be caused by the fact that they are not properly bonded at the joints between the rails. It has also been found to occur where the rails were of such electrical resistance that it could not carry properly the returned current to the power house. It is often the case that to overcome this trouble, electrical cables are run along the railway and connected to them at frequent intervals, and in this way they safely and properly conduct the retumed current to the dynamo at the central station.

(Continued on page 265)
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Electrical Experimenter

August, 1918

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RADIO DYNAMICS, by B. F. Miessner. Cloth bound, 211 pages; 112 illustrations; size, 5¼ x 8¼ inches. Published by D. V. Nostrand Co., New York. Price, $2.00.

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Electrical Experimenter

August, 1918

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THE MAGNETIC STORM

(Continued from page 233)

beyond repair, a child could see that. He flung it away and went over to the next nearest flyer. But the mechanic had already located the trouble—in the motor. Burnt out, too!

You've often heard a detector utterly sick at heart, aimlessly wandering about the other machines. In each case the result was the same: Every magnet armature of the fifty flyers, each separate but the wires fused together, all insulation gone!

"Aber so was", muttered von Unterrichter, looking about him helplessly. It took fully five minutes before it filtered thru his thick Prussian skull that this disaster that overtook his "circus" could by no means be a coincidence.

"Verruchtes Amerikaner", he said, "probably a new Tesla-machine of Edison!"

But what would the Kommando say to this? Instantly he stiffened as he jumped into a waiting automobile, attached to the airarmore.

"Zum Kommando, schnell!" he ordered the driver as he sank back into his seat. He must report this queer business to head-quarters at once. The driver cranked the engine, then cranked it some more. Puf . . . puf . . . puf . . . puf . . . sputtered the engine, автоматически, but it did not start. He tried again. Same result.

(Continued on page 268)
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"Donnerwetter nochmal!" stormed the Baron. "Slow over the delay "was it done — jetzt los, why in thunder don't you start, you miserable dog?" But the engine would not start. The perplexed chauffeur climbed into the seat of the old style car, which still had its faithful spark coils, so necessary to the ignition system. But the spark coil refused to work, altho the storage battery was fully charged and all the connections were right. Caustiously he pulled out one of the spark coil units from its box. Once again he sought the story.

"Augezgrubent, Herr Leutnant," he said weakly, for he had seen the burnt out magneto armatures a few minutes before.

Von Unterrichter, with eyes almost popping out of his head, was struck absolutely speechless for half a minute. "Heiliger Strohsack!" he muttered, his gaze stricken, remembering his young sister's favorite expression, whenever something out of the ordinary happened. They rapidly collected himself sufficiently and jumped out of the car.

"Zum Telefon!" he muttered to himself. He must report this uncanny occurrence at once to the Kommandeur. Not a second was to be lost. He at last understood that something momentous had happened. He made the airdrome on the run and tho it was only 200 yards away he surprised himself at the speed he made. Puffing volubly he arrived at the telephone. He gave the handle several quick turns, grasped the receiver and simultaneously hollowed into the mouthpiece in front of him:

"Hallo, hallo" . . . but he went no further. The receiver flew from his ear, for there had been a loud clattering, rattling, ear-splitting noise in the instrument that almost burst his eardrum. He made a foolish grimace, as he held his ear with his hand. Caustically he approached the receiver to within a few inches of his other ear and listened. All was quiet, not a sound. Mechanically he unscrewed the receiver cap and looked at the two bobbins. They were charred and black. The telephone was dead . . . .

The instrument slipped from his hand and dangling by its red and purple cord went crashing against the wall of the airdrome, while von Unterrichter limply sank into a chair.

Once more he got up and walked out. He might get into trouble with his General at all costs. This was becoming too serious. Ah . . . he had it, the field telegraph. There was one at the other end of the building. He went there as fast as his legs could carry him. He opened the door of the little office but one look sufficed. The young man in charge of the telegraph sat in a corner, a dumb expression in his eyes. Long purple sparks were playing about the instruments on the table. A child might have seen that it was impossible to either send or receive a telegram under such conditions. . . . Ah! an inspiration.

"Dummkopf!" he muttered to himself. "Why didn't I think of it before. Die Funkenstation! Surely the wireless must work! Ha, ha, there are no wires there at least to burn out!"

The radio station was over a kilometer away. He knew it well, for he had flown over it a great many times. To get there quick, that was the question. The Kommandeur had at least eight kilometers to the rear, and he knew he could not make that distance on foot very quickly. Ah, yes, there was a horse somewhere around. The

*All German telephones are magneto operated. To call Central you must turn the handle of the ringing magneto.
ELECTRICAL
Generators
electrical
foul-mouthed
German
alarm
spark
right,
bled
to-date
Prussian
attention
lisions.
Heine,
A
"Gott
noiseless
private
knows
jumped
poet,
are
station.
distant
here
he
years.
Germans
receive
the
field
Leutnant",
and
shut
a
hand.."
always
affair
with
or
hit
the
field.
atonal
and
trumpet
and
the
enemy.
A
spade
of
the
telephone
operation.
He
jumped
the
war.
Heine—himself
a
German—ha—puts
him.

"The
Germans
have
no
self-respect. They
are
the
only
men
in
the
world
who,
as
private
soldiers,
will
stand
still
while
an
officer
shouts
at
them
with
mud. They
receive
the
mud
with
smiles
and
stand
expectantly,
cap
in
hand."

It
is
the
Prussian-German
sort
of
"honor"
that
may
be
Zabern
affair.
Where
a
foul-mouthed
young
officer,
with
his
sword,
beats
a
helpless,
crippled
Alsatian
collie
inescapable.
A
coward
at
heart,
always
ready
to
blaspheme
his
maker,
when
things
go
right,
the
Prussian
quickly
turns
to
his
Gott,
as
soon
as
things
go
against
him.

Heine,—himself
a
German,
and
he
ought
to
know,—will
tell
you
so.
The
story
of
von
Unterrichter's
being
an
expert
wireless
man
before
the
war,
and
while
he
did
not
know
a
great
deal
about
electricity,
he
knew
well
how
to
send
and
receive
messages.

He
ran
to
the
wagon
which
carried
the
mobile
radio
field
apparatus
and
peremptorily
ordered
the
operator
in
charge
away.
"Aber
Herr
Leutnant",
expostulated
the
thus
rudely
interrupted
man,"I
tell
you...
Moal
halten,
thundered
von
Unterrichter
with
the
eye
down,
clamping
the
operator's
receivers
on
his
own
head.

He
presst
the
key
impulsively,
and
noted
with
little
satisfaction
that
the
loud
blue
spark
crashed
merrily
in
the
not
very
up-to-date
spark
gap.

As
he
sent
out
the
call
mechanically,
he
wondered
vaguely
what
the
matter
could
be
with
the
government,
because
it
did
not
even
supply
a
modern,
up-to-date
Lisch-
funktenstrecke—quenched
spark
gap—for
field
use.
Things
must
be
pretty
bad
when
the
government
must
economize
even
a
few
begrudging
pounds
of
brass,
so
necessary
for
a
noiseless
spark
gap.

But
he
could
not
give
that
matter
further
attention
for
he
had
thrown
the
aerial
switch
from
"sending"

to
"receiving."

He
had
strained
his
ears
for
a
reply
from
the
operator
on
the
Kommando.
But,
as
the
switch
was
thrown,
instead
of
a
reply
there
was
a
loud,
constant
roar
in
the
receivers,
sound
that
it
was
painful.
Off
came
the
headgear,
while
von
Unterrichter
once
more
sank
into
a
chair.

He
was
a
pitiful
sight
to
look
at,
the
fate
of
a
20th
Century
man
flung
back
a
hundred
yards.
He
screamed
into
the
distant
railroad
embankment
struck
his
eye.
No
train
was
moving.
Everything
was
at
a
standstill—how
could
a
train
move
with
ten
cars
stuck?
How
could
a
train
be
dispatched—there
would
be
a
thousand
collisions.
He
turned
to
the
radio
operator,
who
as
yet
had
not
grasped
the
situation
in
its
wholeness.

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is
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bation.
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one
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United
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or
Canada,
and
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may
be
returned
at
our
expense
if
they
fail
to
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must
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“Nördlich, nicht wahr, Herr Leutnant?” he began, thinking no doubt that the phenomenon was an ordinary form of Aurora Borealis,—the northern lights,—in other words, a magnetic storm, that would be soon over.

“Dumme Rindsviech!”... snapp the Herr Leutnant, who knew better than this. Indeed he was to know still more at once, for while he was speaking there came to his ear a noise of hammering, as if he had heard it once before, way back in 1914 when the Germans had retreated very much in a hurry beyond the Marne.

Paradoxically, though the sound was unmistakable. The German army once more was in full retreat—no it was a panic-stricken rabble that made its way back.

Like lightning the news had spread among the men at the front that uncanny things were afoot, that all communications had been cut, and that announcements of that order could be sent or received except by prehistoric couriers, that the Groesse Kampf was cut off from the army, and that in short the German army as far as communication was concerned, had suddenly found itself a century back.

For what had happened to von Unterrecht, and his band of seven, based on a large scale not only to every one along the front, but all over Germany as well! Every train, every trolly car, every electric motor and every domestic and telegraph had been put out of commission. With one stroke Germany had been flung back into the days of Napoleon. Every modern innovation,— except horse-drawn vehicles,— were at a standstill. For days the German retirement went on, till on the fifteenth day, the entire German army had retreated behind the natural defenses of the Rhine, the victorious Allies, pressing the feeble hordes back irresistibly.

And it must have been a bitter pill for the German high command to swallow when they saw that the Allied airmen were constantly flying behind their own lines and that all their airmen were without the automobiles and their trains seemed to run as well as ever behind their own lines. But no German succeeded in flying an aeroplane or in running an automobile. That mysterious force obviously was trained only against the Huns, but was harmless behind the Allied lines. The huns had flown too far out to date what caused their undoing.

Peace having not been declared as yet, I cannot, of course, divulge the full details of the reason of just how the Germans were finally flung across the Rhine. That, of course, is a military secret.

But I am permitted to give an outline of just what happened on that memorable morning, when the German “Kultur” was flung back into the dark ages where it belonged.

But first we must go back to Tesla's laboratory once more, back to that evening when “Why?” Sparks first overwhelmed Tesla and his companions with his idea. This is the part which the sparks said.

“Mr. Tesla! In 1898 while you were making your now historic high-frequency experiments in Colorado with your 300-kilocycle generator, why you were quite shown the obscure secret of the dynamo and its apparatus, which you, without knowing it, were the first to tell, and which you were in the service of writing on such a way, it appears to be now a thing quite as much as ever before the same.

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so we place a huge 3,000 kilowatt generating plant with its necessary spark gaps, condensers, etc. The feed wires from these generating plants then run into the thick wires, strung along the telegraph poles, forming the gigantic Tesla Primary Coil. Of course, you realize that in a scheme of this kind it is not necessary to run the telegraph poles actually parallel with every curve of the actual front. That would be a waste of material. But we will build our line along a huge flat curve which will sometimes come to within one-half mile of the front, and sometimes it will be as much as fifteen miles behind it. The total length of the line I estimate to be about 400 miles. That gives us 40 generating plants or a total power of 120,000 kilowatts. A parallel line is built along the Italian front, which is roughly one hundred miles long at present. That gives us another 30,000 kilowatts, bringing the total to 150,000! Now, the important part is to project the resultant force from this huge Tesla primary coil in one direction only, namely the same front. We can easily do that by using certain condenser coils. This I can find can be readily accomplished by screening the wires on the telegraph poles at the siding facing our way as well as by using certain condenser coils. The screen is nothing else but ordinary thin wire netting fastened on a support wire between the telegraph poles. The screen then acts as a sort of electric reflector. So. . . . Sparks demonstrated by means of one of his sketches.}

"Everything completed we turn on the high-frequency current into our line from the sea to little Switzerland. Immediately we shoot billions of volts over Germany and Austria, penetrating every corner of the Central empires. Every closed coil of wire through Germany and Austria, be it a dynamo armature, or a telephone receiver coil, will be burnt out, due to the terrific electromotive force set up inductively to our primary current. In other words every piece of electrical apparatus or machinery will become the secondary of our Tesla coil, no matter where located. Moreover the current is to be turned on in the day time only. It is switched off during the night. The night is made use of to advance the telegraph poles over the recaptured land,—new ones can be used with their huge primary coil wires, for I anticipate that the enemy will never fall back. Turning off the power does not work to our disadvantage, for if it is suitable to suppose that the Teutons will be able to withstand all our new coils and armatures to replace the millions that were burnt out during the day. Such a thing is impossible. Besides, once we get the German mind moving, it ought to be a simple matter to follow up our advantage, for you must not forget that we will destroy ALL their electrical communication. No aeroplane, with automobile, will move through the Central States. In other words, we will create a titanic artificial Magnetic Storm such as the world has never seen. But its effect will be vastly greater and more disastrous than any natural magnetic storm that ever visited this earth. Nor can the Germans safeguard themselves against this electric storm any more than our telegraph companies can when a real magnetic storm sweeps over the earth. Also, every German telegraph or telegraph line in occupied France and Belgium will be our ally! These insulated metallic wires actually help us to "guide" our energy into the very heart of the enemy's countries. The more lines, the better for us, because all lines act as feed wires for our high frequency electrical torrents. . . .
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A few kilometers north of Nancy, in the Department of Meurthe et Moselle, there is a little town by the name of Poincaré. It is a progressive, thrifty little French town of chief importance principally for the reason that here for four years during the great war the French army had been quartered to the German frontier than at any other point, with the exception of that small portion of Artois actually in the hands of the French.

Nomeny in the military sense is in the Toul Sector, which sector early in 1918 was taken over by the Americans. If you happened to go up in a captive balloon near Nomeny you could see the spires of the Cathedral of Metz, the great French fortress, but 16 kilometers away, always presuming that the air was clear and you had a good glass.

On a recent warm summer morning there were queues doings at a certain point in the outskirts of Nomeny. All of a sudden point seemed to have become the center of interest of the entire French, British and American armies. Since dawn the military autos of numerous high Allied officers had been arriving while the gray-blue uniforms of the French officers were forever mixing with the business-like khaki of the British and Americans.

The visitors first gave their attention to the camouflaged, odd-looking telegraph poles which looked to me like whale bones. It was with the difference that the many wires were running horizontally, the telegraph line stretching from one end of the town to the other. A few hundred yards back of this line there was an old brewery from which ran twenty thick wires, connecting the brewery with the French officers' hotel. This brewery the high officers next strolled.

An inspection here revealed a ponderous 3,000 kilowatt generator purring almost silently. On its shining brass plate the legend: "Made in U. S. A." There was also a huge wheel with large queer, round pieces. Attached to the axis of this wheel was a big electric motor, but it was not running now. There were also dozens of huge glass jars on wooden racks lined against the wall. Ponderous copper cables connected the jars with the huge wheel.

One of the French officers, who prior to the war had been an enthusiastic Wireless Amateur, was most interested in this huge wheel and the large glass bottles. "Aha!" said he, turning to his questioning^ "Can't you read the inscription on the glass bottles?" ""Eclateur rotatif et les bouteilles de Ledye."

There was little satisfaction in this, but just then a red-haired, tousel young man seemed to be busy, seeming to be the man in charge, came over and adjusted something on the huge wheel.

"What do you call all of these do-"furnaces?" our young officer inquired of him, pointing at the mysterious objects.

"Rotary spark gap and Leyden jars," was the laconic reply. The officer nodded. Just then an auto came through the gate.

President Poincaré was introduced to the red-haired, tousel young man whom he address as Monstre Sparks. Monstre Sparks speaking a much dilapidated French that was of no great help in his excellence all of the important ma-

"Le Président de la République!" instantly every man stood erect at attention. A few seconds later and President Poincaré walked in slowly, at his side General Pétain. It was then five minutes to 10.

President Poincaré was introduced to the red-haired, tousel young man whom he address as Monstre Sparks. Monstre Sparks speaking a much dilapidated French that was of no great help in his excellence all of the important ma-

"Monstre Poincaré was much impressed and visibly moved, when a French officer had gone over Sparks' ground, and re-explained the finer details.
The President now takes his stand on an electric switch which has an ebonite handle about a foot long. He then addresses the distinguished assembly with a short speech, all the while watching a dapper young French officer standing near him, with a chronometer in hand.

Somewhere a clock begins striking the hour of ten. The President still speaks but hesitates a few seconds later. The distinguished assembly applauds and cheers vociferously, only to be stopped by the dapper young officer who slowly raises his right hand and points to the chronometer. Immediate silence prevails, only interrupted by the soft purring of the huge generator. The dapper young officer suddenly sings out:

"Monsieur le President! A-ten-tion! ALLEZ!"

The President of the glorious French Republic then shouts dramatically: "Messieurs . . . le jour de gloire est arrive . . . VIVE—LA FRANCE!"—and throws it in the huge switch with its long ebonite handle.

Instantly the ponderous rotary spark gap begins to revolve with a dizzying speed, while blinding blue-white sparks crash all along the table in front of the President, like a hundred cannons set off at once. The large and electric hall intensifies the ear-splitting racket so much that every one is compelled to lean over the tables with what seems like their lives.

Quickly stepping outside the party arrives just in time to see fifteen Boche aeroplanes, volplaning down and disappearing behind the walls of the French capital. The dapper French officer who had observed the German aeroplanes, drops his glass, steps over to the President, salutes him impressively:

"Le 'cercue' du Baron d'Unterrichter! Ils sont hors de combat!"

Hors de combat is correct. Von Unterrichter was not to fly again for many a week.

We look around to tell the glad news to General Pétain, but the latter has disappeared into a low brick building where he now sits surrounded by his large force poring over maps ornamented with every kind of vari-colored pencil marks, as well as little brightly-colored pin flags. Telephone and telegraph instruments are all about the room.

Again the President shakes hands with Monsieur Sparks, congratulating him on his achievement. Luncheon is then served in the former office of the government, greatly bedecked with the Allied flags along the walls. But even here, far from the Titanic rotary spark gap, its crashing rapids is quite audible. Looking thru the window we see a wonderful sight. Altho it is broad day, the entire queere telegraph line is entirely enveloped in a huge violet spray of electric sparks. It is as if "heat-lightning" were playing continuously about the whole line, making the electric venture within fifty feet of the line. It would mean instant death by this man-made lightning.

Luncheon is soon over and more speeches are made. Suddenly the door flings open and a herald in Paris looms up. One look at his remarkable features, and all talk stops as if by magic. He crosses the room to the President, salutes and says in a calm voice, the echo of his dry impact is from the President:

"Monsieur le President, toute l'armée Allemande est en retraite!"

And the President, with the greatest and final retreat of the Kaiser's "inviolable" hordes was in full swing towards the Rhine.

More congratulations are to be offered to Sparks. A medal . . . Heavens, where is that young man? But Sparks has over to his machines and is standing in front of the noisy "thunder and lightning" wheel eyeing it enthusiastically.

"Why, oh WHY, do they call you éclateur!" he says. "Spark Gap is good enough for me!" "Oh, boy! But you aren't doing a thing to those Germs!"

THE END

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**ELECTRICAL EXPERIMENTER**

**GERMAN**

Verdammt Yankee Schweiemerden: Damned Yankee Pig-Downs.

So, Muller: You, Muller! 20 Befehle, Kamerad. At your orders, Lieu-

tenant!

Vorsammlung, sofort: Assembly, at once!

Dieses Amerikanische Gesindel: This American rabble!

Schließt die Lappen zusammen: Shoot the rag-

Vormündern für Gott-und Vaterland: Onward, for God and Fatherland.

Dollargeld: Dollar Chasers.

Eльndliche Schweiemerden: Miserable hand of pigs.

Fliegen: Flyer (aeroplane).

Himmelskreuzdonnerwetter: A popular German cuss word. Literally it means "skye-cross

thunders.

German equivalent is "A thousand

thunder.

Kopf: German slang, equivalent to our slang "busted.

Auseinanderausnahme: Take it apart!

Ausgestreckt: Bambirn.

Aber so was: Such a thing (of all things).

Vergeblich Amerikanische: Useless Americans.

Teufelsmaschine: Diabolische machine.

Zum Kommando, Geronimo, to Headquarters.

Dammerronnetz: By all thunders!

Was ist denn das: What's up now?

Heiliger Stroklupfer: Holy hag-straw, equivalent to "Holy Gee."

Dammklopfe: Blocked.

Die Punktstation: The Radio Station.

Gott sei Lob: Praise be to God.

Aber, Herr Leutnant: But, Lieutenant!

Man hat die Karten: One has the cards.

Lächeln denkenst: Quenched Spark Gap.

Khals! (wichtig): Not? Northern lights, it is not.

Dummner Rindsback: Stupid piece of cattle.

Grosse Kommando: Headquarters.

**FRENCH**

L'electricien rotatif et les bottes de Lézard: Ro-

tary spark gap and Lizard shoes.

Le President de la République: The President of the Republic.

Monsieur le President! Attention! Allé! Mr. President: Attention! Forward!

Messieurs, le jour de gloire est arrive, voie à la France! Drums begin to roll, and glory has arrived, long live France! (This is from the second verse of the "Marseillaise")

Le cercue du Baron d'Unterrichter. Ils sont hors de combat: Baron von Unterrichter's cir-

cul: They are out of the fighting!

Monsieur le President, l'armée Allemande est en retraite: Mr. President, the entire Ger-

mam army is in retreat.

**EXPERIMENTAL CHEMISTRY.**

(Continued from page 256)

Thus the most striking examples are certain electro-positive oxides, as Potassium Oxid (K₂O) and Calcium Oxid (CaO).

CaO + H₂O = Ca(OH)₂

With the oxides of certain electro-negative it combines energetically to form acids.

H₂O + H₂O = H₂SO₄

these reactions being strongly exothermic.

Under certain conditions the halogens (Cl, Br, F) will dissolve some water with the liberation of oxygen, which in turn acts as an oxidizer, while the hydrogen forms a haloid acid.

Cl₂ + 2H₂O = 4HCl + O₂

Natural Waters. These include all such waters as occur naturally upon the surface of the earth which are more or less im-

pure from the presence of dissolved gases and numerous inorganic substances. These waters may be class as rain, spring, mineral and sea waters.

Rain water is the purest form of natural water, but it frequently contains such gases...
as carbon dioxide, ammonia, sulfuric oxidz and nitric acid, salts derived from these are transparent and also conans small quantities of foreign matter which are present in the atmosphere and which are carried down by the rain drop.

Spring water is usually found to hold

salts in solution. The water supply of

cities is usually taken from lakes or rivers which are supped from the mountains, streams, and springs. These waters contain chiefly the carbonates and sulfates of calcium and magnesium, with small quantities of the alkalies, iron, silica, and organic matter, which may be either living or dead. Hard and Soft waters. For domestic or manufacturing use the chief factor which determines the value of the water is its hard-

ness. This hardness is due to the presence of calcium and magnesium salts, which form insoluble precipitates the sample of results in the latter failing to cleanse until these salts have been completely precipitated. When employed for feeding boilers hard waters form a more or less coherent deposit, commonly called boiler scale, which causes clogging and frequent burning out of the tubes. Usually the rhodium or calcium phos-

phate and sulfate of calcium with some iron oxid and silica.

Hard water is of two kinds, temporary hardness and permanent hardness. Temporary hardness is caused by the presence of the bicarbonates of calcium and magnesium, which may be removed by boiling, whereby the bicarbonate which has held the insoluble carbonates in solution, passes off and the precipitation ensues. Thus

\[ Ca(HCO_3)^+ + \text{Heat} \rightarrow CaCO_3 + H_2O + CO_2 \]

This temporary hardness may also be removed by the addition of alkali carbonates or hydroxides.

\[ Ca(HCO_3)^+ + \text{NaOH} \rightarrow CaCO_3 + 2H_2O \]

Permanent hardness. Permanent hard waters contain the sulfates or chlorides of magnesium and calcium, or both. Thus we may account for the more or less hardness of water after boiling. These may be removed through the addition of soluble carbonates, as, for instance, Sodium Carbonate or Ammonium Carbonate, whereby the calcium or magnesium precipitate as carbonates. The soluble alkali sulfates which remain in the water is a serious action when the water is used for boilers.

\[ CaSO_4 + Na_2CO_3 \rightarrow CaCO_3 + Na_2SO_4 \]

Water is said to have a certain degree of hard-

ness when it contains one part of calcium carbonate or its equivalent in one hundred thousand degree of hardness is determined by agitating a certain volume of the water with a standard solution of soap until a permanent lather is produced.

Purification of Waters. Water Supply is one of the most difficult questions confronting Mankind, especially in large cities. Ancient Rome brought her water in great aqueducts, since the Roman time, from the Apennine Mountains, forty or fifty miles away. Lake Michigan is the source of Chicago's supply. Boston has constructed a series of artificial lakes in the center of Massachusetts. These lakes are fed by water from surrounding streams. Waters from such sources cannot be pure. They contain (1) dissolved salts; (2) suspended matter; (3) Microorganisms which are usually harmless, but which may be and sometimes are the germ of disease. Epidemics of typhoid and scarlet fevers have often resulted from drinking such water. Most large city water supplies are now puri-

fied by removing impurities or water over filter beds made of gravel, laid to the depth of several feet (see Fig. 125). After flowing thru the filter beds the germs are found to be mostly removed and the water is collected in reservoirs, whence it runs in pipes to consumers. After using one bed a short time the water is turned on to an-

other, and the first bed is dried in the sunlight, destroying the germs.

Even after thus filtering, the water is hardly pure enough for drinking. It may be treated in one of three ways: (1) Boil-

ing the water for some time destroys organic life, both animal and vegetable, including microbes, thus rendering it harmless toward all volatile gases. (2) It may be filtered by forcing it thru a Pasteur or similar filter made of porcelain. (3) Distilled water is the purest. Distillation leaves behind any dissolved salts, but it does not remove gases or even liquids whose boiling point is as low as that of water (e.g. 212 F. — 100 C.). This process does not take out any dissolved salts, but these are comparatively harmless. It does remove any suspended matter, in-
cluding germs, thus making the water pure and colorless. This is the usual pro-

cess for purifying drinking water.

CHEMICAL TESTS OF WATER

Experiment No. 139.

Free Ammonia. Nessler's Test. To determine such minute quantities as 0.0025 we make use of Nessler's Solution, an alkaline solution of mercuric iodid, in potassium iodid. When a few drops of it are added to a dilute solu-

tion of ammonia or of an ammonium salt, it forms a deep red precipitate, which, even in very small amounts, is a yellow or brownish tinge to water. Thus

\[ 2HgI_2 + NH_3 \rightarrow NH_2I + 3HI \]

This precipitate, which may be considered as ammonium iodid, with two mercury atoms in place of four atoms of hydrogen, is excreted by the kidneys of heavy, for example, if alcohol was mixed with water, it would dis-

till before the bulk of the water, but would not be separated, as it boils 22 degrees lower than water. This condensate is usually employed in the laboratory for dis-

tilling water.

Nitrates. After the nitrogenous matter has been sufficiently decomposed to liberate ammonia and other similar gases, so-called nitrifying ferments, begin to oxidize this ammonia, first into nitrates and finally into nitrites. This, however, is not as delicate as Nessler's reaction; and, as the nitrates are probably a transition stage in the oxida-

tion of nitrogenous matter, it is rather rare to get a good test in perfectly pure water. For this reason, probably the significance of their presence has frequently been greater than the fact.

The reaction is based upon the formation of a scarlet coloring matter, one of the "azo" dye stuffs, by the action of nitric acid upon two aminoic or organic bases. The test is interesting as between a counterpart of the well known Ehrlich's reaction and where the nitrous and sulfanilic acids are mixed together and the compound corre-

sponding to the naphthylamine salt is fur-

nished by the urine.

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Fill two large test tubes respectively with Croton and with water. To each add a few drops of the saturated solutions of sulfanilic acid, and of naphthylamin hydrochlorat. A pink or red coloration appearing shows the presence of nitrates.

Notice the Croton water does not turn pink until it has stood for some time, and has absorbed some nitrates from the air.

Experiment No. 141.

Nitrates

We can test for these substances in two ways, either by reducing them to ammonia and using Nessler's solution, or else by directly producing a colored compound.

(a) Reduction Method. The best reducing agent is certain hydrogen, which can be evolved in the water to be tested, by dissolving aluminum in an alkali (as Sodium Aluminate).

\[ \text{Al}_3^+ + 2 \text{KOH} + 3 \text{H}_2 = 2 \text{KAlO}_2 + 3 \text{H}_2 \]

or else by the action of the water upon two different metals, such as zinc and copper. When these two, in close contact, are immersed in water, a true galeenic couple is formed, and oxide zinc is oxidized, and hydrogen is set free from the negative copper. This hydrogen slowly converts the nitrates first into nitrates and finally into ammonia, according to the following equations:

\[ \text{NaNO}_3 + \text{H}_2 = \text{NaNO}_2 + \text{H}_2\text{O} \]

\[ \text{H}_2\text{SO}_4 + \text{NaOH} = \text{NaHSO}_4 + \text{H}_2\text{O} \]

This ammonia can be accurately determined by Nessler's Test, and the quantity of nitrates calculated accordingly.

(b) Phenol-Sulfonic Acid Test. We can estimate the quantity of nitrates directly by noticing the depth of color which they produce in a solution of phenol in strong sulfuric acid. The reactions being:

\[ \text{C}_6\text{H}_5\text{OH} + \text{H}_2\text{SO}_4 = \text{C}_6\text{H}_5\text{OHSO}_3^+ + \text{H}_2\text{O} \]

and then in the presence of traces of nitric acid or nitrates.

\[ \text{C}_6\text{H}_5\text{OHSO}_3^+ + \text{HNO}_3 = \text{C}_6\text{H}_5\text{O}_2\text{NO}_2 + \text{H}_2\text{O} \]

The color is intensified by the addition of an excess of alkali.

(a) Reduction Method Experiments. Clean the zinc in a wide-mouth bottle by adding some water and a little dilute hydrochloric acid, permitting it to effervesce for a minute or two, and then rinse out thoroughly. After this, cover with water, add three or four drops of copper sulfate, and let stand for a few minutes until the zinc is fairly covered with a black deposit of metallic copper. Then rinse it out well, and fill the bottle with Croton water.

Test the reducing action of this "zinc-copper couple" on nitrates by adding two or three crystals of sodium nitrat to the water in the bottle, shaking it till they dissolve, and then letting it stand quietly until the end of the hour. Notice the slow but continuous evolution of hydrogen, and before leaving, test the solution for nitrates and free ammonia, as previously described.

(b) Phenol-Sulfonic Acid Test Experiment. Add one or two drops of sodium carbonate to 30 cc. of the well-water, and evaporate the mixture to dryness in an evaporating dish. This can be done at first over the flame, but must be finished over the water-bath. Cover the residue with a solution of phenol-sulfonic acid, made by dissolving, carefully, in a test tube, a few drops of phenol with twenty times its bulk of common sulfuric acid. Then add about 19 cc. of Croton water and an excess of potassium hydroxid. If nitrates are present in the well-water, the mixture will have a yellow or even an orange color.

(To be continued.)

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By P. Edelman

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The demand for specialists in the Army is increasing daily. Mechanics and technicians of all kinds, including radio and buzzer operators, are needed by the Signal Corps.

In nearly every large city the Federal Board of Vocational Training, thru local school authorities, has established schools of Radio-communication where men of draft age who have not been called may receive a preliminary course in the operation of radio and buzzer instruments. There are about 600 of these schools where instruction is given, usually in the afternoons and evenings. It takes about 200 hours for a student of average ability to obtain a speed of 20 words a minute, sending and receiving. Further information regarding schools may be secured from local school authorities.

DE FOREST WIRELESS SUIT

The trial of the patent infringement suit brought by the Marcon Wireless Telegraph Company against the De Forest Radio Telephone and Telegraph Company, which was to have commenced on June 12th, in the New York District Court, was, at the request of the Navy Department, suspended by Judge Mayer for the duration of the war.
remedies this fault. From this it will be seen that the main driven shaft is connected to a differential and the energy transmitted through regulator to the motor. When the energy developed by the wheel, the excess energy is used to wind up a weight. The wind is not a constant source of energy, and even when there is no work to perform, it is often noticed the wheel will stop for a few seconds. When a small weight descends and a ratchet prevents the shaft revering from the engine, the differential and keeps the generator up to normal speed."

The illustrations of this invention, and we think it is a very clever idea, also do we not have any means of working out the practical. We believe that a patent can be obtained on this device; as far as is known to us, nothing like this exists.

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ELECTRICAL EXPERIMENTER
August, 1918
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ELECTRICAL EXPERIMENTER

(Continued from page 243)

August, 1918

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when the ions are not close enough together to mutually influence each other. The distance then that any ion travels before it hits another particle of the gas is called the mean free path. When an ion is acted upon, however, by an electric field the velocity with which it is either attracted to or repelled from an electrode depends directly on the strength of the field. In order to compare the velocities of ions we must compare them in equal fields so we use the term potential difference of gas to mean the energy of an ion is defined as the velocity of that ion in a field of unit potential gradient or a field of one volt full. The potential of the solvent potential gradient would exist between two electrodes charged to 10 volts if they were 10 centimeters apart.

The determination of the mobilities of ions is only possible in the determination of velocities. A convenient method of doing so was described in a previous paper, but it gives us a very convenient way of comparing ions in different gases and different kinds of ions to see how they behave in motion.

Early experiments showed that generally when travelling more rapidly than positive ions, i.e., had greater mobility and that both travelled somewhat along the same molecule so much so that in fact it was thought the ions must be larger, heavier bodies than molecules. Further experiments, carried out on 20 molecules in a chamber, and that the identities are always smaller. More recent work however has shown that in some gases negatives are not the same, whither at lower temperatures not travel as fast as would be expected, hence they may not be suitable for all, but the slowness of their motion may be rather due to the field. This is one of the most interesting points in Modern Physics, for it would show that the weight of an ion depended upon its charge of electricity, and recent discoveries support this view which will be discussed in the following paper. However it is important to note that recombination and diffusion tell us that the conductivity of a gas will be. It also gives us an idea of the size and charge of the ion.

(To be continued.)

RECLAIMING THE U-BOATS TOLL
BY NOVEL SALVAGE APPARATUS

(Continued from page 230)

points of resemblance and difference of these two groups of gaseous nebulae. They resemble each other in the nature of their light which gives the typical bright line spectrum of incandescent gases at low temperature and under low pressure. Their luminosity also may be due partly to reflected light, which the various gases are associated and partly to some form of electrical excitation as well as to light of incandescence. The gaseous elements that enter into the composition of both groups are hydrogen, helium and the unknown gas nebulae of helium, and neon. While the density of the gaseous nebulae is very small in proportion to the great volume of space they fill up the whole space is tremendously more extensive than the planetaries. Both show the presence of dark as well as luminous matter and show periodic phenomena, which we know of stars.

The two groups are all alike in showing a decided preference for the fundamental period of the star. In the densest star clouds.

As to their most marked points of difference the stars possess a very small, rather sharply defined disk-like appearance with a strong, star-like condensation at the center. They are also moving through space with a true space velocity.
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ANALYSIS OF IRREGULAR WAVE SHAPED ALTERNATING CURRENTS.

(Continued from page 247)

two simple sine waves, shown in light lines, as indicated. One of the sine curves has the same frequency as the resultant curve, while the other sine curve has three times this frequency.

The relative positions of the two component sine curves should be noted. Positive and negative lobes always start out from the zero starting point in the same direction, and always pass the horizontal datum line in the same way. The negative lobe of sine B could be turned about the horizontal datum line as an axis until it comes into the same plane with the positive lobe A, as indicated by the horizontal line and designated by C, the complete similarity and symmetry of A and C may be made apparent.

Fig. 4 shows the same two component sine curves, displaced somewhat in position, horizontally, and added together, and forming a resultant curve having a very different shape from that shown in Fig. 3. However, the symmetry of the positive and negative lobes A and C is to be noted.

Fig. 5 shows the same two component sine curves displaced still more in position, with a slightly different shaped resultant.

It is evident then that many different shaped curves may result from the algebraic addition of only two sine curves, by simple curve addition, in any manner changing their maxima values. Many different shapes

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ty by mentioning the "Electrical Experimenter" when writing to advertisers.
would moreover reflect if the positions of the two sine curves were not changed while their maxima values were changed. Fig. 6 shows two sine curves changing in phase, with maximum value of only one of the component sine curves. The resultant curve in this case should be compared with Fig. 3. The harmonic frequency of the component curves is the same in both these figures.

Another important feature to be noted in comparing the resultant curves in Figs. 3, 4, 5 and 6 is that in passing from O to X one would arrive at the crest of the resultant curves, before arriving at the lower. The reason for this is that in Figs. 5 and 6, the feature of similarity or symmetry may be clearly established by imagining the lobes as occurring along the horizontal OX. This is precisely the case, as we have seen in the previous section of this article, and the resultant values are simply the amplitudes of the resultant sines, which are then taken in the place of the ordinates.

Curves resulting from the addition of sine curves whose frequencies are even multiples of the resultant curves are not symmetrical.

If then any alternating pressure or current curve obtained by experiment, is symmetrical as regards its positive and negative lobes, it is made up of sine-curve components whose frequencies are odd multiples of the fundamental frequency. Nearly all pressure and current waves found in practise, produced by electromagnet induction, are symmetrical in curves, and the statement is sometimes made that such curves or waves consist of the fundamental and its odd harmonics.

One practical method of determining a number of the harmonic curves or components sine waves comprising any given resultant wave curve, is by use of a frequency meter or a form of frequency meter, the vibrating reed form, is illustrated by Fig. 7. This instrument a number of small elastic or springy metallic strips or rods, 1, 2, 3, 4, etc., are carefully calibrated by filing or scraping them all rigidly fastened to the same metal base, B, having attached to it a thin iron tongue, T, which extends over the poles of an electromagnet, M. If a vibrating current is allowed to pass across the electromagnet, the iron tongue and metal base will vibrate with the same frequency as that of the alternating current. The particular reed that has the same natural frequency as that of the alternating current, will vibrate with considerable amplitude; thus indicating, if the reeds are all marked, the frequency of the wave. Fig. 7a shows the manner in which the frequency meter is worked. The table which follows gives the harmonics up to the 15th for higher frequency components only; for lower frequency components the reader may construct a table himself, similar to that here given, excepting that each successive harmonic has a lower frequency, but a higher wave length. Thus the 4th lower harmonic has a frequency of $\frac{4}{6}$ and a wave length of 4A. A table interested in this important subject should read the first article, which appeared in the "Electrical Experimenter", when writing to advertisers.
How I Improved My Memory In One Evening
The Amazing Experience of Victor Jones

"Of course I place you! Mr. Ad
don Sins of Seattle.

"If I remember correctly—and I

Mr. Bur

the lumbarman, introduced me to you at the luncheon of the

Seattle Rotary Club three years ago in May. This is a pleasure indeed!

I haven't laid eyes on you since that day. How is the grain business?

And how did that amalgamation work out?"

The assurance of this speaker—in the
crowded corridor of the Hotel

McAlpin—compelled me to turn and

look at him, though I must say it is

not my usual habit to "listen in"
even in a hotel lobby.

"He is David M. Roth, the most

famous memory expert in the United States," said my friend Kennedy, an

swering my question before I could get it out. "He will show you a lot

more wonderful things than that,

before the evening is over."

And he did.

As we went into the banquet room the

toastmaster was introducing a long line of the
guests to Mr. Roth. I got in line and

when it came my turn, Mr. Roth asked,

"What are your initials, Mr. Jones, and

your business connection and telephone number?" Why he asked this, I learned later, when

he picked out from the crowd the

60 men he had met two hours before

called each by name without a mis-

take. What is more, he named each man's

business and telephone number, for good measure.

I won't tell you all the other amazing

things this man did except to tell how he talked back, without a minute's hesi-

tation, long lists of numbers, bank clear-

ings, prices, lot numbers, parcel post rates and anything else the guests gave him in

rapid order.

**********

When I met Mr. Roth again—which you

may be sure I did the first chance I got—he rather bowed me over by saying, in his

quiet, modest way:

"There is nothing miraculous about my

remembering anything I want to remem-

ber, whether it be names, faces, figures,

facts or something I have read in a mag-

azine.

"You can do this just as easily as I do.

Anyone with an average mind can learn to

do it quickly and easily the same things

which seem so miraculous when I do them.

"My own memory," continued Mr. Roth,

"is not very faulty. Yes it was—

a really poor memory. On meeting a

man I would lose his name in thirty sec-

onds while now there are probably 10,000

men and women in the United States, many

of whom I have met but once, whose names I can call up like magic.

"That is all right for you, Mr. Roth," I

interrupted, "you have given years to

it. But how about me?"

"Mr. Jones," he replied, "I can teach

you the secret of a good memory in one-
evening. This is not a guess, because I

have done it with thousands of pupils. In

the first of seven simple lessons which I have prepared for home study, I show you

the basic principle of my whole system and you will soon know if you have

as good a memory as you may fear—but just like playing a fasci-

nating game. I will prove it to you."

He didn't have to prove it. His Course
did: I gave it a trial and I was satisfied. Since

he said his publishers, the Independent Corporation.

When I tackled the first lesson, I sup-

posed I was the most surprised in forty-
eight states to find that I had learned—in

about one hour—how to remember a list of

one hundred words so that I could call them

out forward and back without a single mis-

take.

That first lesson stuck. And so did the

other lessons.

Read this letter from C. Louis Allen, who

at 32 years is president of a million dollar

corporation, the Pyrene Manufacturing

Company of New York, makers of the fa-

mous fire extinguisher:

"Now that the Roth Memory Course is

finished, I want to tell you how much I

have enjoyed the study of this most fas-

cinating subject. Usually these courses in-

volve a great deal of drudgery, but this has

been nothing but pure pleasure all the way

through. I have derived much benefit from

taking the course of instructions and feel

that I shall continue to strengthen my mem-

ory. That is the best part of it. I shall be

glad of an opportunity to recommend your

work to my friends."

Mr. Allen didn't put it a bit too strong.

The Roth Course is priceless! I can

absolutely insist on my memory now, can
call the name of most any man I have

met before—and I am getting better all the
time. I can remember any figures I wish to

remember. Telephone numbers come to mind instantly, once I have filled

them by Mr. Roth's method. Street addresses are just as easy.

The old fear of forgetting (you know

what that is) has vanished. I used to be

"scared stiff" on my feet when I got on my

feet at the club, or at a banquet, or in a

business meeting, or in any social gath-

ering.

Perhaps the most enjoyable part of it all

is that I have become a good conversation-

alist—and I used to be as silent as a

sphynx when I got into a crowd of people

who knew things.

Now I can call up like a flash of light-

ning most any fact I want right at the in-

stant. I find it hard to believe that a "hair trigger" memory belonged only to the

proselyt and genius. Now I see that every

man of us has that kind of a memory if he

only knows how to make it work right.

I tell you it is a wonderful thing, after

growing up in industry, that it has taken

so many years to be able to switch the big search-

light on your mind and see instantly

everything you want to remember.

This Roth Course will do wonders in

your office.

Since we took it up you never hear any-

one in our office say "I guess" or I

think it was about so much" or I "forgot

that right now" or "I can't remember" or

"I must look up his name." Now they are

right there with the answer—like a shot.

Have you ever heard of "Multigraph"

Smith? Real name H. Q. Smith, Division

Manager of the Multigraph Sales Company, Ltd., in Montreal. Here is just a bit from

a letter of his that I saw last week:

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log. Yet with one hour a day of prac-

tice, anyone—I don't care who he is—can

improve his Memory 100% in a week and

1,000% in six months."

My advice to you is don't wait another

minute. Send to Independent Corporation

for Mr. Roth's amazing course and see what

a wonderful memory you have got. Your

dividends in increased earning power will

be enormous.

VICTOR JONES

Send No Money

So confident is the Independent Corpora-
tion, the publishers of the Roth Memory

Course, that once you have an opportunity
to see in your own home how easy it is to
double, yes, triple your memory power in a

few short hours, that they are willing to send

the course on free examination.

Don't send any money. Merely mail the

coupon or write a letter and the complete

course will be sent, all charges prepaid, at

once. If you are not satisfied with it, return it

back any time within five days after you

receive it and you will owe nothing.

On the other hand, if you are as pleased as

are the thousands of other men and women

who have used the course send only $5 in full payment. You take no risk and you

have everything to gain, so mail the

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Address ________________________

E. E. 68
ELECTRICAL EXPERIMENTER

August, 1918

HOW THREE NEW YORK SUBWAYS MEET AND PASS

(Continued from page 226)

Along 42nd street between "Times Square" and the "Grand Central" terminal, will undoubtedly take place the heavy cross-traffic between the two systems.

Reverting once more to the old subway system, which extends northward in the lower part of the "42nd Street" line, this will be operated as previously and will be extended by the Interboro Rapid Transit Company so as to proceed from the "Grand Central" terminal northward along Lexington Avenue, cross under the Harlem River at 120th Street and from this point it will branch out underground along Mott Avenue, via subway to 157th Street, from which point it will operate as an elevated line along Jerome Avenue to Woodlawn. After crossing under the Harlem River, this subway route will have a second branch extending eastward to 147th Street and Southern Boulevard. There before it will run via subway along Southern Boulevard and eventually change to an elevated line at Bancroft street. From here it will operate as a local route from 157th Street to the Eastern Boulevard. The new Interboro subway plans call for the extension to the present "Bronx Park" division, via elevated road, northward to 241st Street.

THE DESIGN AND USE OF THE AUTOMATIC REPEATING RIFLE

(Continued from page 249)

the current thru the buzzer coils, charges up the condenser C of the wave-meter, which in turn discharges thru the inductance L, producing radio frequency oscillations in the circuit CL. These in turn are broken up into a group frequency depending on the pitch of the buzzer. Another oscillating circuit brought into induction with the wave-meter will pick up energy as explained in several places throout this article.

VII. Measurement of Mutual Inductance

Figure 8 shows the method used in measuring the mutual inductance between two coils such as two coils of a varimeter or loose coupler. A known capacity C, is connected in shunt with the two inductances L1 and L2 which are connected in series with each other. A double-pole, double-throw switch is connected in circuit as shown so as to reverse the current in coil L2. When the switch is thrown to the side A, current flows thru the two inductances in the same direction, thus causing a current to be set up in the same direction or sid. In this position the two coils are said to be aiding.

When the switch is thrown to side B, current passes thru the coils in opposite directions, causing their fluxes to oppose each other. In this position the coils are said to be opposing. If now a wave-meter is brought near the coils the wave-length of the current can be measured on each position of the switch. Then knowing the value of the capacity and the wave-length it corresponds to in each position of the switch, the value L1 and L can be computed.

\[ L = L_1 + L_2 + 2M \]
\[ L = L_1 + L_2 \]
\[ M = L_1 - L_2 \]

where \( M \) = mutual inductance between \( L_1 \) and \( L_2 \)

L = inductance with the two coils aiding

L = inductance with coils opposing

L1 and L2 = inductance of two coils

All values in cms.

Now measuring the mutual inductance for various positions of the coils with respect to one another, as for instance, the angle of displacement between the two coils of the varimeter or the distance one coil is inside another, we should be able to use the above coupler, we can plot a curve of mutual inductance against coil position.

VIII. Measurement of the Coefficient of Coupling

The measurement of coupling is a very important measurement in radio engineering, for upon it depends the sharpness of sympathy of transmitters and receivers. Coupling is usually determined by all over 20% being considered tight coupling and all below 20% being considered loose coupling.

In order to measure coupling, the following procedure is followed: The circuit is connected as in Fig. 8, and the mutual inductance (M) measured. Then the self-inductance of the two coils as explained under III, and from this data the coupling is found by substituting in the formula:

\[ K = \frac{M}{\sqrt{L_1 L_2}} \]

where \( K \) = per cent coupling

M = mutual inductance in cms.

L1 and L2 = inductance of two coils in cms.

A curve can be plotted in this case also, showing the per cent coupling against the position of the coils.

IX. Measurement of the Distributed Capacity and Natural Period of Inductance Coils

Any coil has a certain amount of distributed capacity between each section of this coil combined with its self-inductance causes the coil to respond to some wave-length which is known as its natural period. A receiving set having a coil therein that has a natural period within the range of the receiver is very inefficient, because at some wave-length the coil cannot operate at its own natural period, and weaken the received signals considerably by absorbing energy in order to keep itself in a state of oscillation. The solution is to use a lessener degree with the transmitting helix, and for this reason helices usually have only enough turns to give the required capacity, while receiver inductances are split up, in fact by means of end-turn switches or "dead-end" breaks.

The accompanying figure 9, delineates the method of measuring the natural period of a coil. The wave-meter is excited by a buzzer and inductively coupled to the coil being measured; the measurement is taken across the terminals and is limited to the connection of the telephone and detector. As the condenser of the wave-meter is moved across the handle a fixed point will be found that gives a loud signal in the telephones. This is the natural period of the coil.

By extending the self-inductance and natural period of a coil the distributed capacity is calculated from the wave-length formula. The method of measuring the total distributed capacity is not strictly accurate, but is good enough for most practical purposes.

Conclusions

This concludes our series of articles on the wave-meter, and the author hopes he has duly impress upon the reader the wide range and variety of uses to which a wave-meter can be put. In fact it can be easily seen that a wave-meter is a wider necessity in a radio laboratory and with this one simple meter practically every important measurement used in Radio Engineering can be made.

(Conclusions)
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COLD FROM ELECTRICITY

If we pass an electrical current thru a metallic wire, the latter becomes heated. The thinner the wire and the larger the current, the greater the heat in the wire. All of our incandescent lamps work on this principle, as do our electric irons, toasters, water heaters, etc.

But few people know that electricity can and does produce cold direct, merely by passing from one certain metal to another. Nor is it a recent discovery. The device, termed "Peltier's Cross" after its French inventor, Peltier, was demonstrated in the middle of the last century. Briefly, the apparatus consists of two bars of metal, one being Antimony, the other Bismuth. The two bars are soldered together at right angles forming a cross. If we now pass a current thru the cross by connecting the positive pole of a battery to the Bismuth bar, and the negative pole to the Antimony bar, the point of junction between the two metals becomes rapidly cooled.

If we drill a shallow hole into the top bar and fill it with water, it soon turns into ice, proving the experiment.

This phenomenon is of course well-known to the electrical man, but the very surprising fact is that it has never been turned into practical use during all these years. Of course, it goes without saying that the original Peltier's Cross is not an efficient apparatus—it would be decidedly expensive in time as well as money to freeze ice cream this way!

But the principle is certainly there, and it is pretty well understood by the scientist; all it needs is improvement. And right here lies a wonderful gold mine for the man who turns out an economical electrical apparatus to produce cold commercially. Think of all the ice-less refrigerators, ice-less ice chests, ice-less ice cream freezers and what-not, for which we are eagerly waiting. It is the benefactor who will lift the great American curse—ice water! Ice water is responsible for more ruined American stomachs, and for more dyspepsia than all the other causes combined.

Water cheaply cooled to near the freezing point is what we need, so our doctors tell us. When will we see the first direct electrically cooled carafe, with its wire-covered net work, and a plug connecting it with the chandelier above the dining table?

And where is the still greater benefactor who will increase our working capacity one hundred per cent when the thermometer stands over 90°? During torrid spells, even in moderately hot weather, the entire world slows down. You simply can't work your best during the dog days, even if you happen to sit in a bathtub full of cold water, as I am doing just now, trying to write this Editorial! (The heat, by the way, furnished the idea for it.)

From late spring to early winter, millions of radiators stand idle all over the world. Why have we not sufficient intelligence to turn these perfectly good heating plants into cooling plants? The system is in the house and waiting, but we are too stupid to start the freezing water thru it, and thus reduce the room temperature to 70° or less. A visitor from Mars would laugh his head off while walking into our offices where the already hot air is made still hotter by fans—which do not cool the way, but increase the temperature. (Put your hand on a running fan—if it is not too hot—and you will know why fans do not cool a room.) Our visitor could not possibly understand why our radiators were hot instead of cold.

But we will not always be children. Some day we'll grow up and then we will know enough how to keep cool in summer, be it in the office, the house, or in the subway. But when that day comes, be prepared to shut all doors and windows, just as you do in the winter. If you don't your room will become hot just as it becomes cold in the winter, should you leave the door open again.

Yes, and then we'll all have summer colds, to be sure! 

H. Gernsback.
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How the Electric "Sea Tanks" Raided Pola

THE very latest war-time animal is the electric "Sea Tank" as used by the Italians in a recent naval raid on Pola, Austria's famous naval base. From the information available on this latest hybrid among war-time offensive devices, it is learned that the Sea Tanks measure about forty feet in length and six feet in width, and that they are propelled by electricity. Further, as our illustration herewith shows, these Sea Tanks are provided with an endless rotary chain, running lengthwise around the vessel, these rapidly moving chains being fitted with sharp steel barbs or knives which can cut their way thru nets and other obstacles just like their prototypes, the land tanks, first used so effectively by the British. This under-water demon is provided with several torpedo tubes at the bow, and from all accounts, it seems that the device was crewless, and operated by means of electrical control currents sent thru a flexible insulated cable their way thru the heavy steel nets spanning the navigable approaches to the port, within which there lay at anchor Austria's fighting fleet, and that a mighty Austrian battle-ship of the "Venusa Unitis" type of about twenty thousand tons displacement was torpedoed.

The account of the attack on Pola by the Italian Sea Tanks states that they bored the steel belts carrying the net-cutting knives or barbs are driven by powerful electric motors, which obtain current from a storage battery carried in the Italian Under-water Tank, also the arrangement whereby the steel belts carrying the net-cutting knives or barbs are driven by powerful electric motors, which obtain current from a storage battery carried in
How Artillery Observation Balloons 'Phone to Earth

When the artillery observers of our army in France, go up in balloons for the purpose of spotting the shell hits and correcting the ranges, they must have a very safe and sure means of communicating with the artillery officer on the ground.

The photograph here shows a telephone dug-out in France with two United States soldiers, who are in direct telephonic communication with the aerial observer on board a balloon above virtue of a thin copper wire which runs up to the balloon. As a work of the aerial balloon observer is more or less hazardous, and it not infrequently happens that the observer's balloon is shot down by an enemy shell, in which case he must use his wits and endeavor to make a safe landing with his parachute. On the other hand, it has often been remarked by officers who have had the opportunity of seeing service near the European battle-fronts, that these observation balloons sometimes remain aloft and unsought for days at a time. The work is extremely interesting and plenty of volunteers are always available. It takes a man of keen sight and quick perception to fulfil the duties of an observation officer, as the changes in range in some cases have to be made very quickly in order to bring about a certain military maneuver. We may safely entrust this task to Pershing's boys.

The electrical control cable in such devices as this, and where it is of any considerable length, is invariably coiled and stored in the tank or torpedo, as otherwise the device would be extremely powerful in order to pull the constantly increasing length of cable thru the water if it were swung out like a grappling hook on the tender ship.

It is entirely feasible for a device of this kind to be controlled by a warship of the destroyer class at a distance of seven miles or even eight to ten miles or more. With ingenuity and the proper design of the device the type here under discussion, and in consideration of the undoubtedly proven cleverness of the Italian engineers, there is no doubt but what such a device could be sent out and steered so as to be encountered when it neared the steel nets and to bore its way thru them, and then to rise again; also at this juncture the observation officer on the war vessel looking thru his night glasses, could press the proper electric control button and cause one or more torpedoes to be discharged at an enemy war vessel in the manner described in the report from Rome, and which now forms a part of Italian naval history.

In any event, the Sea Tank would appear to be an invaluable antagonist against such war measures as harbor nets and the like, and it is conceivable that when desired to carry a crew, and providing the craft with a powerful under-water searchlights, such a machine should prove highly effective in clearing out mine fields, and breaking up swarms of mine-infested waters as those leading up to the great German naval base at Heligoland. This maneuver by the Italian Sea Tanks in their attack on Pola may seem all the more practical and possible to the layman when it is considered that the entire Gulf of Venice is very shallow—about 120 feet at greatest depth— and such an underwater fighting monster might crawl even along the bed of the Gulf of Venice and tackle the steel nets and mines protecting Pola, much in the same manner as a gigantic turtle would crawl along the bed of a lake. In fact, some engineers venture the opinion that with the proper design of the moving caterpillar belts and bars, that the Tank could be made self-propelling in the same manner as just mentioned.

It is most probable however, that the Italian Sea Tank as now used is fitted with powerful propellers the same as the submarine, and also that it has a suitable rudder for the purpose of steering it. To prevent the cable from becoming fouled in the propeller blades, the latter are encased in substantial steel cages. The pilot light or lights are provided with shields at the front, so as to throw intermittent signal flashes sternward, and by arranging this on a telescopic mast the officer in charge can, by simply pressing the proper button, cause them to rise ten to fifteen feet above the back of the Sea Tank while it is progressing thru the water near its objective. When the Tank has prostrated sufficiently near the net or other obstruction it is to burrow thru, the proper electrical impulses are sent over the electrical control cable which starts up the water-ballast tank motor, and by filling the tanks, the craft is caused to submerge. It is a simple matter and one which has been used herefore to provide a suitable electrical position indicating arrangement, whereby it becomes possible to know at any instant the direction and location of the "Sea Tank" while it is submerged. By means of a sensitive microphone installed in the vessel, it would be possible to ascertain when the Tank had chewed its way thru the enemy nets, and it could then be caused to approach the surface again if so desired. It is not believed however, that the vessel be made to come to the surface so as to show the signal light, for by means of the position indicator apparatus just described, its exact position at any time could be known and torpedoes discharged from it at an enemy war vessel swinging at anchor within the netted area.

An electrically equipped tremelo attachment for stringed instruments has been invented which produces the desired effects when buttons are pressed.

"Sea Tank" while it is submerged. By means of a sensitive microphone installed in the vessel, it would be possible to ascertain when the Tank had chewed its way thru the enemy nets, and it could then be caused to approach the surface again if so desired. It is not believed however, that the vessel be made to come to the surface so as to show the signal light, for by means of the position indicator apparatus just described, its exact position at any time could be known and torpedoes discharged from it at an enemy war vessel swinging at anchor within the netted area.

U. S. PATENT OFFICE NEEDS EXAMINERS

The U. S. Patent Office announces a need for technically trained persons for the examining corps of the Patent Office. Men or women are desired for practical education, particularly in higher mathematics, chemistry, physics, and French or German, and who are not subject to the draft for military service, to gain practical bench experience in addition to the above is valued. The entrance salary is $1,500.

Examinations for the position of assistant examiner are held frequently before the Civil Service Commission at many points in the United States. One is announced for August 21 and 22, in Chicago. For examination, places of holding the same, etc., may be had upon application to the Civil Service Commission, Washington, D. C., or to this office.

Should the necessity therefor arise temporary appointments of qualified persons may be made pending the holding of the regular Patent Office examination. Application for such appointment should be made to the Commissioner of Patents, Washington, D. C.
Balloon Microphones to Warn of Air Raids

By LEE A. COLLINS

In the scheme of aerial raid warning here proposed balloons are sent up and held secure by means of a strong rope or cable. Sensitive electric microphones are fastened to the under-harness of the balloon. All of the sound detectors are in series with a telephone receiver and a source of electric current by means of two wires which lead down by the cable.

Military Committee reports as one of the greatest scientific achievements of the war, the telephone arrangement whereby the position of enemy guns is determined. A portion of General Bell's statement follows:

All armies now employ scientific methods of locating guns which have never been employed in warfare before. One is known as the sound-ranging method. Briefly, they have observers scattered along a curved line, which has been accurately measured, and all of these observers, of whom there are usually six, utilize electric sound-ranging apparatus by which they report instantaneously the moment they hear the sound of a gun explosion. At a central point another electric apparatus records these sounds from the six different stations, and by a scientific method they combine the knowledge gained from these six points and succeed in locating with a remarkable degree of accuracy the position of the gun that made the explosion when it was fired.

Each side has a type of telephone which is able to hear distinctly over very considerable distances conversations not intended for the listener, and for a long time the Allies employed this system of gaining information without the knowledge of the enemy; but the Germans captured one of these instruments and discovered that their conversation in the trenches had been listened to for quite a while and that the president and general manager of the company, has just closed a contract for the installation. The power of the new station, it is announced, will be 11,000 kilowatts, and three towers will be erected, each the size of Eiffel Tower.

IMPROVE NAUEN WIRELESS PLANT.

The German wireless station at Nauen has been greatly improved since the outbreak of the war, according to the Frankfurter Zeitung. Instead of a single transmission tower 300 feet high, it now has ten towers ranging in height from 890 feet to 300 feet, while the distance thru which messages can be transmitted has been extended to 6,200 miles. The Frankfurter paper is quoted as saying that the Nauen services have proved invaluable for instructing cruisers and U-boats and that both the Goeben and Breslau received thru Nauen instructions to steam into the Bosphorus.

A Number of French Cities Are Equipt With a Specially Sensitive Microphone "Listening-Posts" Placed On High Buildings or Other Elevated Structures, for the Purpose of Detecting the Approach of Enemy Aircraft. An American Inventor Here Proposes a Very Simple and Feasible Plan for Giving Aerial Alarm Protection to Our Towns and Cities. The Scheme Is Simple, Involves Two Balloons Which Carry a Series of Horns Pointing in Various Directions, Each Horn Being Connected With a Super-Sensitive Microphone; Each Microphone Is Connected By Its Wire to Earth, Where a Selective Switch and a Pair of Listening 'Phones Enable the Operator to Quickly Ascertain Which Microphone Is Being Actuated, and Thus Also From Exactly What Direction the Enemy Aeroplane Squadron Is Approaching. These Microphones Will Indicate the Approach of Aircraft Several Miles Away.

Balloons can be sent up all along our coasts or cities at suitable distances apart. In case an enemy aeroplane attempts to bomb our cities, the sounds of his aeroplane engine are caught by the sensitive microphone detectors and are heard thru the telephone receivers. One central listener could keep the receivers fastened to his ears and receive the alarm from all of the detectors, or a listener could be kept for each district that the balloons were guarding. A galvanometer indicator can be used instead of the receivers to give a signal of approaching enemy aeroplanes. The range of detection will probably be greater than most people estimate, as tests made with microphones in locating pieces of artillery have proved.

SOUND-RANGE TELEPHONES TO LOCATE GUNS.

Upon his return recently from the battle front in France, Major-General J. Franklin Bell in supplying information to the Senate
American Aviator Escapes Under Hun Electrified Fence

H

OW would you like to be captured by the Teutons, and after escaping from your captors, not to mention sleeping in swamps and woods by day, and subsisting on fruits and raw vegetables, finally reach the border line which meant your liberty, only to find that a deadly electrified wire fence stared you square in the face? Such was the experience of an American flier, Lieutenant Patrick O'Brien, member of the Royal Flying Corps of England, who managed not only to escape from his German captors, after having landed on Teutonic soil with his flying machine, but succeeded eventually in getting past the highly charged electric fence which guards every foot of the border land between Belgium and Holland. This fence serves three purposes. First, it prevents the Belgians from escaping into Holland; secondly, it keeps enemies from making their way to freedom; and thirdly, it prevents desertions on the part of German soldiers themselves.

The accompanying illustration shows one of the most remarkable experiences ever enacted by a war-tortured human being. When Lieutenant O'Brien finally emerged from his last hiding spot in the woods near the Holland border, he nearly ran into this electrified barbed wire barrier before he knew it, although he had previous knowledge of it.

The hero of our story first thought of trying to make a grand pale vault over the whole three fences including the central electrically charged one, but this idea was finally dropped as the triple fence covered a span of at least twelve feet, and in order to safely clear the last barbed wire barrier he would have had to vault at least ten feet high and fourteen feet across. With the possibility that the pole ever slpt he might be thrown on the charged wire and immediately electrocuted when in falling his body would establish the circuit between fence and ground.

Another idea which he unsuccessfully tried out was a ladder which could be placed against one of the fence posts, and this he built from small twigs and boughs which he found in the woods near the fence and bound them together with flexible twigs and strips from his underclothes.

Eventually Lieutenant O'Brien hit upon the idea which finally saved his life and gave him his liberty, and his plan is shown in the accompanying illustration. This was nothing else than to barrow under the electrified wire fence. However, this was not as easy as it may seem at first thought. The electrified fence measured about ten feet high and the charged wires were spaced about ten inches apart while the lowest charged strand was but two inches from the ground. This is not all, for when our brave Lieutenant had dug a considerable quantity of the soil away with nothing but his bare hands, he discovered a heavy underground wire about six inches below the surface of the ground. He had great difficulty in digging the earth away without being discovered by the sentry who walked up and down periodically along the German side of the fence, and again, the underground wire, which was as thick as a man's finger, would not give.

But Yankee pluck and courage finally won, and by tugging at this wire, which did not carry any charge but served merely as a guard wire against just such an escape as this, he caused the underground wire to give at several points along the fence. He then proceeded with extreme caution to crawl feet first and on his stomach thru the trench which he had dug with his hands. His nerves were none too good, but he knew that one false move of even one inch, would mean certain death, and in a few moments he successfully made the passage under the heavily charged wires and emerged into the final space between the central electrified fence and the final barbed wire which was the only remaining barrier between himself and his liberty. He kneeled down and offered thanks to his Maker for his miraculous escape, and a few minutes later he past safely between the strands of the final barbed wire into Holland.

GENIUS AND ULTRA VIOLET RAYS.

By J. MACHETTI

In a back number of the E. E. there appeared an article entitled "The Effect of Ultra Violet Rays on Milk and Other Aspects" by Dr. H. Imbination. In this he says that "the cerebral substance is decomposed by ultra violet rays causing sun-stroke, when the rays of the sun are sufficiently powerful to react on the body." He shows that it is not the heat that causes this, for we never hear of heat prostration "among workers in factories, pottery factories, etc., where a high temperature prevails. Yet these same men may be taken with a rays-stroke upon exposure to the sun."

Still it is a matter of some mystery to read in the memoirs and confessions of deceased geniuses that they accomplished better work in the intense sunlight. In fact some of them could not work unless the rays fell on their bare heads.

No doubt, the question has often presented itself to many, why many men of genius have preferred or had to compose in the scorching rays of the sun. But may we not find an answer in Dr. Bizzoni’s discovery. And when we see that genius and men of brains in the same pot, according to C. Lombroso, and that post-mortem examinations have shown degenerations of cerebral matter of these men, the mystery becomes more convincing. As the sunlight is rich in violet rays and they are capable of decomposing the cerebral substance, consequently they acted for such men digastral plants. We all know that many famous men have resorted to narcotics and other stimulants in aiding them in their creative works. So for these individuals the ultra violet rays acted as creative aids by effecting chemical changes akin to narcotic stimulants.

Also, light vibrations act beneficially by its penetration. But in the case of these men the dissolving power of the ultra violet rays was of greater consequence.

Among such "Philomiens" we find Rousseau, Lesage, Giordani, etc. Rousseau said that the action of the sun in the dog-days aided him to compose and he allowed the rays of the mid-day sun to fall on his head. The striking fact is that Rousseau’s brain showed, after death, a marked degeneration of one of the lobes. Lesage, in his old age, became animated as the sun advanced to the meridian, gradually gaining (Continued on page 351)
Making Synthetic Gems in the Electric Furnace

By GEORGE HOLMES, Ass. A.I.E.E.

THE history of jewels and the thrilling part they have played in the world's history would make the "Grimm's Fairy Tales" fade away into oblivion. Kings, Queens, Sultans and entire Kingdoms have been wrecked through the many intrigues and mysteries that have been connected with famous jewels of ancient times. There was Caesar, Anthony and Nero and the havoc they wrought on Rome and the splendid cities of the far famed east; not to mention Cleopatra, the charming Queen of the Nile, who put the skins under a number of happy rulers just because she was the best dressed woman in Egypt and changed her jewels seven times a day.

For centuries it was necessary to mine these wonderful gems, by the sweat of the brow; but now all this is changed for to-day in the very heart of New York City, a new expert electro-chemist in the person of Dr. Maurice Aisen is making precious stones with the aid of the electrical furnace that bid fair to rival all those of ancient times.

There are more large and beautiful diamonds in the world today than rubies and this has a curious explanation. Ages ago was not until the fifteenth century that the present rotating wheel method of polishing them was introduced.

In the olden days the manufacture of a perfect stone was a long and tedious operation. To-day it is a fact that jewels can be analyzed, the component minerals found, then the same proportion of ingredients assembled and synthetic jewels actually manufactured, which equal Nature's own product.

Some of the earliest experiments in artificial or synthetic jewel making were performed in Dr. Aisen's student days in the University of Paris. One day Prof. Henri Moissan, his instructor and world famed chemist, found diamond crystals in the meteor. The meteor was one which had fallen in Arizona and was shipped immediately to the University of Paris for examination. Out of the discoveries of the pure carbon or diamond crystals that the meteor contained, conclusions were formed that it was chiefly a combination of heat and pressure that made jewels.

Dr. Aisen at this point became deeply interested in gem making; and analysis of the component minerals in various jewels followed, including various tests as to the proper application of heat and pressure. In his laboratories Dr. Aisen has formulas which can produce almost all known jewels and semi-precious stones, the only exceptions being so far the diamond.

After a gem has been analyzed and its component minerals found, the same proportion of ingredients assembled and put into crucibles where they are raised to the required temperature and then are suddenly cooled. There are a number of methods used to obtain the desired high temperature necessary in this marvelous twentieth century work. Among the first is the oxygen-hydrogen flame. Various types of electric furnaces are now used and (Continued on page 354)
Deep sea diving machine designed for use in raising torpedoed vessels was tested in Long Island Sound off New Rochelle, N. Y., recently. Its inventor, W. D. Sisson, has asked for a Government trial.

The machine, propelled by an electric motor, went down ninety-eight feet, bored holes in a steel plate, inserted rivets and brought the plate to the surface. It was manipulated by two men inside. The current was furnished from a barge. Its inventor asserts that the machine can be used to fasten water filled pontoons to sunken ships. Then, when the pontoons are emptied, the ships will be brought to the surface.

Propellers on the bottom for moving up and down and two on the side for propulsion communication established with the barge. The telephone operator on the barge manipulates the necessary switches.

**ELECTRICAL RESISTANCES AT LOW TEMPERATURES**

By Harry E. Dey, E. E.

The resistance of all pure metals to the flow of electricity decreases in proportion with the temperature, until at the absolute zero, (minus 273 Centigrade) *there is no resistance*. If it were possible to extend wires to the space beyond our atmosphere, which is supposed to have a temperature of absolute zero, unlimited power could be transmitted from any one portion of the earth to the farthest point away on the film of wires and without loss, excepting on the project is capable of a development of 225,000 k. w.

**HE DUCKED THE LIGHTNING!!**

Olympia, Wash., is some speedy place—If you don't believe it read this!

"Lightning struck in the same place twice in 30 years when it destroyed the home of Mrs. D. G. Parker, on Eastside street," says a "special" dispatch to a local paper of that city.

"A neighbor climbing down an adjoining cherry tree managed to duck the flash. Fire followed that burned the Parker house. Mrs. Parker escaped without being stunned." Well! Well!

**NEW MEXICO RADIO STATION**

There has been established a new Mexican Wireless Station on the island of Lobos, off the coast of Tampico, erected mainly for the purpose of affording facilities to the various petroleum companies for communicating with their vessels over great distances at sea. This station is said to be provided with some of the most powerful apparatus available, and is expected to establish communication with the Wireless Stations at Mexico City, Tuxpan, Tampico, Vera Cruz, Progresso, Frontera, Mazatlan, Santa Rosalia, La Paz, Queretaro, Monterey, Saltillo, Torreon, and by way of Havana with various stations in the United States.

With wireless stations powerful enough to reach vessels in all of its waters, the Chinese government will establish a typhoon warning service.
The motion picture dramas seem to be filled with scientific features now-a-days, especially in connection with German spy plots. To begin with we have the big patriotic film serial “The Eagle’s Eye,” from which we show photos of three episodes. The first is the adventure of “The Brown Portfolio.” The greatest single discovery which has been made in connection with the investigation of the Imperial German Government’s spies and plots in America, came to shadow him. At the time the United States and Germany were maintaining friendly relations, sincere on the part of the Washington Government, but absolutely hypocritical as far as the Kaiser’s representatives were concerned.

So the operatives assigned to Dr. Albert merely watched him, noted his visitors and his daily routine. Everywhere he went there was an indistinguishable shadow always with him. Dr. Albert lost his portfolio because he was aroused from a doze by hearing his station called by a guard on the elevated train on which he was a passenger. He forgot the bag for a moment, and his “shadow” got possession of it.

"Doctor, if thru your carelessness those papers have fallen into the hands of the Secret Service,” the German Ambassador exclaimed, “then steps will have been taken to warn the ships which are already upon the ocean, on which bombs have been placed. Arrange to have wireless warnings intercepted.”

The Ambassador walked from the room to his own private suite. Dr. Albert seized the telephone, almost distraught. He called Captain Boy-Ed. A second call apprised Captain von Papen of the disaster. A third telephone number and Heinrich von Lertz had been summoned to do the bidding of the arch spy—the accredited Ambassador of their automobile proved unfaithful and a skid in rounding a corner wrecked the machine against a bridge (see Fig 1).

Next we have the big “Munitions Scandal.” French soldiers on the first line in France were saved from a merciless assault from most German troops at a time when the French artillery would have been useless, by the alertness of the U. S. Secret Service. Members of the Kaiser’s spy army in America had successfully started on a plan which would have made a large shipment of artillery shells of every calibre for the French artillery useless because it would have been of a size which would fit only German guns. The specifications for the manufacture of the shells had been changed, when a trivial matter of the name of the ring-leader in the plot (Continued on page 356)
STOPPING an aerial raid by means of anti-aircraft guns is a notoriously impossible undertaking. While the aeroplane itself is now, and probably will always be the most trustworthy means of combating enemy bombing planes, there has been felt for some time the want of other means to bring down the raider.

We must not lose sight of the fact that a large city like Paris or London requires hundreds of the very best fliers as well as machines to safeguard these cities. These fliers could be used to a tremendously better fire of the boche protecting anti-aircraft guns below.

Nevertheless our pilots brave his barrage and fly right thru it. They "slip," nose-spin, loop-the-loop or "pancake," making it almost impossible for the gunners to get the range. If the pilot knows his business he returns invariably to his aeridrome, barring a few holes in his wings or in the fuselage of his machine. For be it known, there is no greater disgrace for a flier than to be shot down by land guns.

If we had a positive means to bring down erratic flight of such a device made it extremely inefficient, it was soon given up and came into disuse.

In the present device the writer proposes the use of a "mother-shell" containing two explosive bombs, as well as two "liquid-fire" bombs. Each one of these bombs has a smaller companion—a heavy lead ball, the purpose of which is explained later.

All of the bombs and balls are normally housed in the metal mother-shell which need not be very heavy, as it does not contain any explosive charge itself. All the bombs

purpose at the front hunting down Hun planes, while the former are kept locked up indefinitely to ward off enemy bombing squadron.

Anti-aircraft guns firing shrapnel do not bother an intrepid flier in the least nowadays. It frequently happens that a pilot must fly as low as 2,000 feet in order to successfully set into flames a boche "Drachen," as the German observation balloons are called "Over There." These aerial missiles are fired upon at close range by the Allied pilots, who use incendiary "phosphoric" bullets to accomplish the purpose. To do so they must fly low which immediately draws the

a raiding flying machine without utilizing our own or our Allies' aeroplanes, we would, of course, have the enemy at a great disadvantage.

Bearing these things in mind, the writer advances a plan which to a certain degree accomplishes such a result. The principle itself is very old and well known, the application and the various refinements only being new.

In short the idea centers itself upon the time-worn "chain-shot," which was nothing else but chaining several cannon balls together and shooting them at the enemy with devastating results. As the

are kept in their respective places by means of a casing composed of eight pieces of reasonably thin steel. These pieces are released from the mother-shell, and fly off as soon as the time mechanism located at the apex of the mother-shell permits this. This time mechanism works on the principle of the one used on shrapnel, the purpose of the present device being to keep the mother-shell intact till it comes within a few hundred feet of the aeroplane under attack. This, of course, makes for great accuracy, as the mother-shell can be accurately timed, and being a self-contained shell like any other, its flight will naturally be true.
ELECTRICAL EXPERIMENTER

To prevent the aerial lasso from causing widespread damage thru fire or explosion, should it miss an aeroplane, the four bombs can be equipped with time fuses, exploding them, before they reach the earth. Of course, the four lead balls might cause damage, but it is no more than the myriad of shrapnel balls and shell fragments, crashing to the ground during an aerial barrage.

The aerial lasso built on a smaller scale could, of course, be used between combating aeroplanes. If our planes were equipped with them, as well as our opponents, the Boche planes certainly would be at a terrible disadvantage.

NOTICE

With the September issue nearly every magazine which heretofore sold for 15c goes to 20c. This includes every prominent scientific and technical magazine. The price of the "Electrical Experimenter" for the present remains at 15c.

Altho tremendous pressure is being exerted upon us from all sides, due to soaring prices, we will not raise the price of this magazine at present. Paper alone has advanced from $5.00 per pound three years ago, to 11c a pound now, with printing, postage, engravings, art work and labor increased proportionally.

No other scientific Journal gives as much for 15c as the "Experimenter." All other magazines in this class print the more expensive. Ours is printed in eight point type:

This is ten point type.

This is eight point type.

Note the difference. "Experimenter" pages contain 30 per cent more matter, space for space, than the other magazines. Your 15c spent on this Journal really buys more than the 10c spent on other magazines. And we believe the quality of our matter is much above the average. Won't you show your friend this copy, or tell him about it?

The Publishers.

WHAT IS HIGH SPEED?

One of the first questions the layman asks the aviator is, "How does it feel to fly?" by which is generally meant, what is the sensation of speeding thru the air at the rate made possible by the aeroplane. The following account of the experience of a man appearing in Flight should be enlightening:

An analysis of sensation is always interesting and might be expected to be exceptional so in the case of speed, yet paradoxically enough there is no such thing as a sensation of speed. There are many sensations to which we are not conscious of, e.g. that the early centuries of human existence man, tho he has since been proved to be moving thru space at the prodigious speed of 50,000 miles per hour, thought himself to be living on the immobile hub of a rotating dome of the moving planets and stars.

What then is it that we feel when we are moved rapidly by an aeroplane? The answer is the illusion of speed, inspired by the sensation of acceleration which we have the habit of associating with rapid motion. This illusion can easily be induced without the aeroplane. For example, when a rocket is launched, for example, at one of the Earl's Court exhibitions a passenger trolley on a few feet of rails was arranged at the centre of a room of which eight steel rails were mounted so as to be bodily rotated round the trolley. The trolley was given a little jerk to convey the impression of a starting acceleration, and then as the trolley became stationary the room was made to turn at an increasing speed round the exponenters, who suffered from the conviction that they were traveling on smooth rails at a high speed.

Our impression of speed is derived largely from the optical effect, due to adjacent objects flying by, and is increased by a surface or skin effect due to the wind which brushes past us and cools and presses on to our periphery an atmosphere of sufficient, but the impression is heightened by going a little further. Our past experience of other mechanisms of the animal means by which we have borrowed speed has shown us that they are rare if ever perfectly smooth in their action. After the change of the sense due to the slightest noise, there are slight irregular changes of speed and changes in the direction of the movement. These are always associated with rapid traveling; we can dream jolts and jar. We are severely, and we wrongly regard them as part of the sensation of speed, tho they are pure accidents. They ought properly to be called accelerations, and the act of starting is the only acceleration which is in fact necessary to obtain speed. Yet a forward pressure can be derived from our impressions of speed. I allude to noise, whether of whistling wind or of beating hoofs or of moving machinery. These things have no more to do with the sensation of speed than the bristles constitute a hedgehog. They are merely excrescences and causes of independent sensation. At one time or another an aeroplane elicits a surprise to all these sensations to an acute degree, and super-adds one novelty, that of the speed of view.

The following comparative table of speed is of interest:

<table>
<thead>
<tr>
<th>Type of Vehicle</th>
<th>Speed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Light and the electric telegraph</td>
<td>180,000 feet per second</td>
</tr>
<tr>
<td>Shell near the muzzle of 6-in. gun</td>
<td>2,500 feet per second</td>
</tr>
<tr>
<td>Shell from 75 mm. gun</td>
<td>1,600 f.p.s.</td>
</tr>
<tr>
<td>Sound</td>
<td>1,100 f.p.s.</td>
</tr>
<tr>
<td>Revolver bullet near the muzzle</td>
<td>500-800 f.p.s.</td>
</tr>
<tr>
<td>Tip of the blade of an air-screw</td>
<td>600 f.p.s., or 400 m.p.h.</td>
</tr>
<tr>
<td>A fast aeroplane through the air</td>
<td>150 m.p.h.</td>
</tr>
<tr>
<td>A fast aeroplane with a high wind</td>
<td>200 m.p.h.</td>
</tr>
<tr>
<td>A fast car</td>
<td>120 m.p.h.</td>
</tr>
<tr>
<td>An express train</td>
<td>80 m.p.h.</td>
</tr>
<tr>
<td>A fast steamboat</td>
<td>50 m.p.h.</td>
</tr>
<tr>
<td>A bicycle (pedaled)</td>
<td>32 m.p.h.</td>
</tr>
<tr>
<td>A race horse</td>
<td>30 m.p.h.</td>
</tr>
<tr>
<td>A man skating (for a mile)</td>
<td>24 m.p.h.</td>
</tr>
<tr>
<td>A man running (100 yards)</td>
<td>20 m.p.h.</td>
</tr>
<tr>
<td>A man running a mile</td>
<td>13 m.p.h.</td>
</tr>
<tr>
<td>A man walking</td>
<td>4 m.p.h.</td>
</tr>
</tbody>
</table>

French electrical works have arranged to employ men who have been blinded in the making of electrical instruments after the system of Dr. Schuyler Whipple in New York. It is also understood the system will be introduced in England.
New Electrical Ideas on Submarines and Torpedoes

The busy war inventors have been bombarding the Patent Office at Washington with hundreds and even thousands of new and ingenious ideas on improvements in submarine warfare. Some of the latest endeavors of Yankee inventors to the study of submarine warfare science are here illustrated and described.

The first idea represents what its inventor—August S. Trautman—prefers to call "a submarine commander's observation and navigation contrivance." His invention, purports to provide a combined life-saving and observation chamber which is normally housed within a suitable compartment on board the submarine. When the submarine happens to become disabled thru a naval engagement or otherwise, or in the event of a fire, the commander of it should want to ascertain whether any enemy war vessels were in the immediate neighborhood before rising to the surface, it then becomes possible to have an observation officer enter the buoyant chamber shown, thru suitable water-tight doors, when the buoy chamber is opened. When the buoy rises then rises to the surface.

The buoy is at all times under control by the submarine by means of a steel cable attached to the bottom of the buoyant chamber and at the other end to a motor-driven windlass on board the submarine. A telephone and electric light cable is also unreel from the buoy as it rises to the surface, so that the observation officer can at all times communicate directly with the commander below.

As the inventor points out, his device can be made large enough to hold several men instead of but one, for the purpose of saving the crew's lives in an emergency. It is all difficult to arrange the apparatus so that the life-saving buoy could be hauled down to the submarine several times in order to remove all of the crew in case of disaster. The buoy could be designed sufficiently strong and provided with a sufficient length of cable to enable it to rise thru a depth of water of two hundred to three hundred feet.

As the illustration shows, the observation buoy is fitted with telephone and electric light and as well as this it is also fitted with firing guns, photograph apparatus, binoculars, etc.

The floating compartment is provided with suitable gyroscopic apparatus driven by an electrically operated motor to stabilize it, and there is also provided a means whereby the center of gravity of the buoy can be changed if necessary, so that the gyroscope might prove inactive.

There is furthermore a propelling mechanism driven by a motor and so designed as to cause the buoy with its occupants propelled in a body of water and beneath the surface thereof, and to be guided according to the desires of the operator. The cover of the buoy may be camouflaged so as not to become readily detectable by the enemy.

An oxygen tank is fitted within the buoy for the purpose of supplying the occupants with oxygen during the time that he is confined therein, and also a reserve tank is provided whereby air which is outside may be collected and accumulated. A motor-driven pump is provided to operate the auxiliary air apparatus. The buoy is fastened to the vessel by means of a suitable rudder provided at the base of the structure.

The second idea here illustrated is that of Mr. Seymour for what is called a Dirigible Torpedo, its inventor being James M. Seymour, Jr. Mr. Seymour, provides considerable food for thought in his novel invention which comprises an electrically driven outer hull, the interior of which is subdivided into a number of separate chambers, each one of which is adapted to house the various electrical contrivances and apparatus for controlling the torpedo. This steel hull is normally submerged beneath the surface of the water, and is designed for a depth by means of a surface float which carries visible identifying means, such as colored flags or disks in the day time, and signal lights flashed several minutes as well.

In brief, Mr. Seymour's electrically controlled dirigible torpedo is of the self-propelled type, being provided with a special contrast the high engine. It is equipped for one apparatus may operate when the torpedo is under way as a dynamo, supplying current for charging storage batteries, etc. Fuel for operating the engine is contained in a suitable storage tank in the torpedo hull, and also the supply of gases ready for mixture to produce the fuel for the engine.

This device is intended to be controlled thru a fine electric cable connecting it with a war vessel operating in the vicinity. The cable being of small size is stored in the hull of the torpedo, and is wound in an ingenious manner so as to be released rapidly and easily and without danger of knotting. The inventor's design enables a very long insulated electric cable to be used for this purpose (with its consequent high electrical resistance) for the reason that the device, when projecting, will be actuated by relatively weak electric currents coming thru the cable. The front end of the torpedo hull contains a storage tank for the engine or other charge, which can be detonated at any desired moment by simply pressing a button and releasing a kind of a gun or other vessel controlling the torpedo. It may be a surprise to the reader to learn that this small yet destructive war device may have a field on the ocean surface. To twenty miles, this being the radius over which the torpedo can be sent, and a sufficient length of the cable carried therein for the purpose of being brought up for the torpedo is placed over the side of the vessel, the engine self-starter motor is set in motion by means of a pull cable running up to the top float and fastened to a button thereon.

The third electrical idea is an interesting Cable-Cutting Shears, intended to be mounted on the bow of a vessel or similar war vessel. As is well known, it is a slow job for mine-sweepers to trawl along thru minefields. A way of adapting the cutting of the submerged mine-cables and the shears are provided with large blades, which in this manner cut through the end by means of a suitable rudder provided at the base of the structure.

The invention of Mr. Seymour is particularly intended for use in machine shops.
NEW ELECTRICAL IDEAS ON SUBMARINES AND TORPEDOES

(For full description see opposite page)
DETACHED reference to this subject-matter may be found in my book, "NEW CONCEPTS IN DIAGNOSIS AND TREATMENT" where attention was first directed to the demonstration of these phenomena by apparatus not available to the laity. Telepathy is in disrepute and the scientifically minded psychologist doesn't believe it. Science demands that phenomena should be objective, capable of reproduction at all times and demonstrable by instruments of precision. The simple scientific method which I shall present shows that spiritistic phenomena are independent of disembodied spirits and referable to human energy: that it will serve as a means of dissecting the occult and will enlighten the genius of the multitude in corroborating my original investigations.

We anticipate that this article will create a sensation in scientific circles, as well as with laity, and we present it for what it is worth. We have not made any of Dr. Abrams' tests, and we print the article with an open mind—neither endorsing nor condemning it. We say with Shakespeare: "THINKING THINGS IN HEAVEN AND EARTH, HORATIO, THAN ARE DREAMT OF IN YOUR PHILOSOPHY."

Dr. Abrams is well known as a scientist; he has made this interesting subject his life work, and his views are endorsed by many prominent doctors and scientists. He is the author of numerous works, amongst them an elaborate book: "NEW CONCEPTS IN Diagnosis and TREATMENT."

Will our readers please advise us should they be successful with Dr. Abrams' experiments?—The Editors.

TECHNIQUE.—The perciptent must have a regular and comparatively large pulse and preferably be seated facing the geographical West. Colored wearing apparel must be avoided by agent and recipient; the eyes of the latter must be closed to avoid distraction, breathing regular and mind abstracted during all observations. Experiments should be executed primarily in daylight. All reference to the pulse refers to the movements of the straw connected to the perciptent's pulse. Find the latter (Fig. 1) and indicate its location with a pencil.

Cut a very small piece of adhesive plaster and roll it so that the roll presents an adhesive surface on both sides.

Fig. 1.—X indicates the site of the wrist-pulse.

Fix it parallel to the pulse. To the plaster attach one end of a very fine straw (from a broom), 3/4 inches long. Place the straw at an angle so that it will approximate a segment of ruled paper (vertical lines).

Fig. 2.—Position of arm with straw attached to the pulse.

Observe the swing of the straw directly or indirectly. In the latter event, if the light is from the South use the right and if from the North, the left pulse.

Note that the greatest amplitude of the straw is secured by the arm resting comfortably on a book or cushion with the hand dependent from the side of the table (Fig. 2).

EXPERIMENT I.—Solving the mystery of mind acting upon mind by brain waves traversing the ether.

Prove that the brain waves are correct despite the fact that, telepathic effects unlike other forms of radiant energy do not vary in intensity according to distance. The moment a person (agent) WILLS FORCIBLY (not mere thought) there is a slight hesitancy or retardation of the straw. Close observation shows a slight extra kick of the latter followed by a transitory stop (inhibition). Each time the agent wills in the direction of the perciptent (irrespective of distance), the pulse effects may be noted. Before each act of willing by the agent, at least 10 seconds must elapse to permit the perciptent's heart to recover from the excited reflex. The latter is easily exhausted by too much experimentation on the same subject. If several persons are present, their minds should be passive so that the waves from the agent alone will act. Note by the effects on the pulse that some are able to will more forcibly than others.

(Continued on page 345)
"Over There"—A Miniature War Panorama

By GEORGE HOLMES

REALISTIC and beautiful is the presentation of a great Spectacle or Panorama in the miniature, when correctly staged. This field presents a wonderful opportunity for the real genius and creative mind to bring forth truly enchanting effects of color, scene and action. A splendid example of this fascinating art may be witness in the new and timely panorama "Over There" now being presented at "Luna Park"—the far-famed heart of Coney Island, New York City's pleasure ground. To say that Luna is pre-
sening it spells its success and from all accounts it bids fair to equal in fame if not exceed the original battle panorama of "The Battle of Waterloo," done by Robert Barker, or our own "Battle of Gettysburg." The creator of "Over There" is Mr. Hugh Thomas, for years associated with the big Coney amusement resort, projector of the "Submarine Battle," and other mammoth indoor spectacles.

There is a value about the panorama which cannot be denied. First of all, it lends itself only to subjects which are in-
a serious history away from its uses as an amusement proposition will come as news. Yet its initiation is connected with no less a personage than Sir Joshua Reynolds. The invention, for it was originally patented as such, came from the brain (Continued on page 353)

PUSH BUTTON—DYNAMO SPINS—LAMP LIGHTS!

Flashlights are now used by the million all over the world—practically every well equipt soldier in the Allied as well as in the German armies, not to mention the navies, carries an electric flashlight. Think what it would mean if overnight a modern Aladdin should wave his magic wand and decree that the flashlight could stay but that the batteries must go. Such will be the magical change which will overtake us one of these fine days when the invention illustrated herewith is successfully exploited and made cheap enough to be available to every man, woman and child who have any use for flashlights.

The model of the push-button dynamo flashlight shown herewith is somewhat large as it is the first model constructed by its inventor. The principles on which it is designed are, however, correct, and it is only a matter of refining the details of its make-up in order to reduce its size and weight. As herewith illustrated, the trigger which is placed on the handle and resembling that of a revolver, is successively pulled toward the handle by a natural gripping action of the hand, and this trigger works a quick-acting worm or screw similar to that found on the well-known ratchet screw-driver. The other end of this trigger actuated ratchet is mechanically connected with a small alternating current dynamo or magnet, which supplies the necessary current to light the flashlight bulb. The bulb is mounted in the usual reflector and furnished with a suitable lens.

Several years ago a similar dynamo flashlight intended to be operated by the pressure of the hand or fingers was brought out in Europe, but due to the war conditions which followed soon after its introduction, it has never reached the United States. The type of dynamo flashlight here illustrated was invented by a Yankee genius and the model was thoroly demonstrated before the editors.

WONDERS NEVER CEASE

"The Office Dog" conducts a full page feature in the amiable Ladies' Home Companion. It is usually a very bright page and you can learn a lot from it. We like it. Dogs, however, are notoriously shy of electricity, as any boy who has a spark coil and a dog will readily testify. Dogs and electricity never mix. "The Office Dog" is no exception to that rule. He is shy on electricity too! Witness the following blossom plucked from its May, 1918, page:

"Walking in a thunder storm under an umbrella with the modern metal rod is now said to be about the most danger-ous of practices, since the metal is an almost certain conductor of electricity. The italics are ours. It was a new discovery to us, that a metal could be an almost certain conductor. Will the "Office Dog" please send us at once a sample of that remarkable metal for analysis? Will gladly send him in return an almost certain soup-bone, guaranteed to give almost certain food for thought!"
The Man Who Stayed at Home

At last! A war play without "fire-works." To say the least, our American audiences of his sweetheart, which further adds to all the troubles.

have been bombarded with a class of productions and films that tended more to the "flag-waving" and "patriotic airs" variety, than to any real semblance of plot, story or genuine interest; which would in a moderate way serve to amuse, thrill and most of all, go a long way in the moulding of opinion and stir one to real conscientious and patriotic thought.

The production in mind was presented originally under the title of "The White Feather," by Mr. William A. Brady, at the Comedy Theatre in February, 1915. This was of course before we Americans had begun to think of a war with Germany or the intrigues that were taking place daily right in our very midst. Naturally under such circumstances, the most part of us, self-centered, failed to see the moral in the piece and like many other unfortunate plays it was relegated to the storehouse.

The story of the piece has had some material changes made in it, in that now it is the American troops and their transports which must be protected from the under-sea sniper the "Hun Submarine."

The action takes place in an English coast town. Mrs. Sanderson and her son are running a boarding house as a blind, being actively engaged in spring for the Imperial German Government. Christopher Brent, an Englishman of dense or "Silly-Ass" type, is a boarder. Everyone upbraids him for being a slack; even his best girl is doubtful of him. Naturally he feels very hurt but can offer no defense on his behalf for his seeming idleness because he is a spy in the employ of the British Government! With him at the same house is his "cryptic" and beautiful female aid in the person of Miss Miriam Lee. His being so much with the afore-said personage raises rebellion in the heart.

Nevertheless, and in a truly melodramatic style, he discovers the Hun's secret wireless outfit in the fireplace and turns it to his own advantage and then wrecks it. Further thrills are experienced in the attempted burning of the house and his almost untimely end in which he puts one over on the Kaiser's spies and their final round-up.

Whereupon he wins his "lady-fair" and the glory of the whole household, even to Dad's profuse blessings!

U.S. X-RAY STATION ON WHEELS.

For operating between the field hospitals and the firing lines, a Chicago electrical genius, Mr. C. L. Fitch, has developed the complete X-ray equipment illustrated. It is mounted on an automobile and derives its power from a specially designed direct current generator, driven by the engine. This generator is equipped to deliver 2 K. W. alternating current.

The transformer will deliver a spark from 10 to 12 inches long. The transformer and synchronous motor are mounted rigidly in a cabinet. The X-ray machine is of the interrupterless type, which is superior to ordinary machines which rectify their own current in the X-ray tube.

The marble switchboard has all necessary instruments such as a time switch, pole indicator, rheostat, pilot lamps, fuses, and switch; also a volt-ampere meter for the low tension side of the transformer. On top of the cabinet is mounted a milliamperemeter for measuring the current which passes thru the X-ray tube.

The Radiographic table is full size and can be tilted 90 degrees. It is equipped with one X-ray tube under the table for Fluoroscopic work and one above for Radiographic work. The lower one moves in a longitudinal direction, while the upper one moves both longitudinally and vertically. The table has an automatic tray and cassettes (plate holders) into which the plates can be inserted from the side.

As the cabinet is built in sections locked together, it is very easily taken apart and set up with the radiograph table together in a room or inside a house. In this case the automobile would be the power station and a cable would make the connection from the dynamo to the transformer.

In the left corner of the compartment is an instrument cabinet. In the bottom of this cabinet is a lead-lined cabinet for unexposed X-ray plates. Between the X-ray cabinet and the instrument cabinet is a dark room chamber which enables the operator to load the cassettes and to develop the negatives.

On the left side opposite the radiographic table is a leather upholstered seat which folds back into the wall. Occasionally it may be used as a berth. The room is lighted with white and blue electric lights. When the doors are closed it makes a very desirable dark room for Fluoroscopic work.

The Blind Now Tape Electric Coils

A SHORT time ago the question of securing some help from the blind was taken up by the Westinghouse people with the Pennsylvania Association, a branch of which is located in Pittsburgh, and a sample lot of motor coils to be taped was sent to the Association in order that the employees might be given a chance to show what they could do. When the coils were returned, it was very evident that this work could be done in an entirely satisfactory manner by those who have been deprived of their sight. Accordingly, arrangements were made with the management of the Association to allow some of their employees to do this work, payment to be made on a piece-work basis.

As this was an entirely new line of work for them, it was decided to have a representative of the Association go to East Pittsburgh to become familiar with the work so as to be in a position to instruct those assigned to do the work. The representative selected for this training was the wife of a former Westinghouse employee, who was deprived of his sight last summer, and who is now employed at the Association. She went to East Pittsburgh and was employed until such time as the management felt that she was sufficiently proficient in the taping of coils to teach the blind and to inspect their work.

At the present time seven persons are employed and their efforts have been very satisfactory, insofar as quality is concerned.

THAT ODD PHOTO!!! IS IT AN ELECTRON?

I was taking a picture of the Mess Hall at the New Trier High School, Winnetka, Ill., with the aid of a flash-light, writes Mr. Lytton Calrow, who submits this very interesting photo in the monthly “Odd Photo Contest.” At first we thought Mr. Calrow had really photographed a wild electron shooting thru a more or less tame molecule. But we were in for a bump. Listen to what the contributor has to say:

The flash-light powder was placed a little in front of a line with the lens and the results are noticed. I have seen several well known instructors in Physics and Chemistry and Optics and none could give me a definite answer as to what the reason for the lines and perfect elliptical figures were. They must be either grains of powder or light waves, it seems to me.

THE ETCHOGRAPH MARKS DESIGNS ON STEEL.

A small portable electric outfit, which can be used to mark small tools and for marking on any steel surface, has recently been perfected. The outfit consists of an electric pencil or “etchograph” and a step-down transformer which can be connected to any lighting socket. To operate the device, the electric pencil is drawn over the steel surface of the work, when great heat is developed at the point of contact due to the high resistance of the iron or steel. The etching depth can be controlled by means of a rheostat. The pencil used, it is said, can be handled with the same facility as an ordinary pen or pencil, and script writing or any other type of lettering can be used. The outfit is made to operate on 110-volt 60-cycle circuit, or can be used on 110-volt direct current with a small rotary converter.
New Electric Fuse Lighter for Blasting

A California inventor, Mr. Albert S. Cole, has devised a clever and very useful form of fuse lighter operating on electricity supplied from a battery. Where considerable blasting is to be done, it would seem that this apparatus would find extensive favor. The complete electric fuse igniter can be conveniently carried by a coal miner or other person, the battery, spark coil and so forth being enclosed in a small leather carrying case, somewhat resembling those in which binoculars are carried. With this apparatus a stream of electric sparks is obtained between the two metal points protruding from the hand electrode, whenever the battery circuit is closed by pushing the small switch button attached to this hand member in the manner illustrated. The spark coil may be one giving a 1/4 to 1 inch spark. The battery is made up of two or more dry cells, or several flashlight batteries can be employed instead. The stream of sparks obtained with this device serves to ignite the regular blasting fuse in the place of a match. It is possible to build the apparatus at small cost, and it possesses several unique features, one of them being that it is just as efficient on rainy or stormy days as it is on clear dry days, which is not the case when matches or other sources of ignition are employed.

HYDRO-ELECTRIC POWER VERSUS COAL.

The services of half a man are required in central steam stations for every thousand tons of coal used. Therefore the total labor required for the consumption of every thou-

sand tons of coal, on a basis of one year's time, is 2.78 men.

On the average, 1,000 tons of coal in the United States produce 125 h.p. for a year of time; 35,000,000 water horsepower developed and in commission would save the necessity of mining 280,000,000 tons of coal per annum. As regards labor, this vast tonnage requires for its production, transportation and consumption 280,000 x 2.78 men, or 778,000 laborers of one kind and another. The amount of labor required to operate this 35,000,000 water horsepower may be put conservatively at 40,000 men. Therefore the net saving in the way of labor alone by the installation of this water horsepower would be approximately 740,000 men for other industries.

HYDRO-ELECTRIC power is the real efficient energy of to-morrow.
Making Electricians Over Night

THE war has changed many things. If we were a speedy nation before the war, our national speed certainly has increased to a surprising extent ever since we entered the struggle. Year ago a German writer called America "the land of unlimited possibilities." His brothers are now finding out this truth to their hearts' content. Indeed, it seems as if there is no end to what we can accomplish, but if we are to win this war we must husband all our forces, not only in materials, but in human efforts as well. War economies are not only effected in wheat, beef or coal, but the saving of human time is an enormous factor if we are to win this war. It will not do alone to turn out 91 ships in one day or sending a million men to France six months ahead of the schedule. It is the man behind the gun who helps just as much to win the war.

If we can save a great amount of time for our workers we save just that much in dollars and relieve just so many more workers for other endeavors which we could otherwise not do. This was a book from three to four years to turn out an accomplished electrician who could be entrusted with any job that came along. Only a few years ago it used to cost thousands of dollars to make an accomplished electrician; which amount was made up in expensive tuition, board, etc., as well as money lost in non-production while the student was learning. Hundreds of thousands of dollars were lost in this manner because the student, seldom, if ever, is a producer while studying. This means a tremendous loss to the nation, as a minute's reflection will readily show.

However, nothing amazes us any longer in these stirring days. We are indeed doing the impossible in all branches of human endeavor. While we say today, "It can't be done," along comes a chap who has already done it and thinks it commonplace. Out in Chicago in the "I Will" city, they now have a big machine (which isn't patented, either), where they feed raw, lanky youths thru a hopper at the top of the roof and three months later full fledged electricians, with diplomas in their hands, walk out thru the school door ready to tackle any electrical job anywhere at a minute's notice!

This seems hard to believe when one stops to think how many things the student must learn before he can call himself an accomplished electrician. His knowledge not only lies in the theoretical learning, but it must include how to do things with his own hands. While the fundamental knowledge must be readily obtained from books, the accomplished electrician necessarily must know how to do things out of his hands, knowledge and will train him to do it in his own way, and unless he has the equipment to do it with it usually proves a long and tedious job.

The concentrated instruction necessary to turn out a modern electrician is being practised and it is quite amazing to see how quickly students become experts in nearly everything electrical in this school. In walking thru the instruction rooms we find students ranging from eighteen to fifty busy at work-practical work—in every conceivable branch of electricity. In one room we find a large number of students getting instruction in wire splicing. An instructor standing among them shows them just how it is done, explaining everything necessary, and then the pupils are taught how to splice the wire themselves. Here also they do soldering, testing motors and generators, while in other rooms we find them wiring lamps, telephone systems, lighting systems, as well as electrical sign systems. Next we see them at work on students getting instruction in wire splicing. There are also classes handling every kind of installation work.

The writer on a trip thru this institution watched students at work on meters, testing motors, transformers, alternators, driving generators, etc. He watched them winding stators, repairing arc lamps and doing all sorts of every day routine work on starting, lighting and ignition systems.

In still another room are seen students working on spark coils, as well as operating all kinds of motor control apparatus, testing watt meters and building switchboards.

It is quite surprising to find what a huge equipment is collected under the roof of a school of this kind, but on the other hand a minute's reflection will reveal that unless such a tremendous equipment was provided, no practical instruction would of necessity be faulty. As a matter of fact, if the students are bright and alert at all, they will themselves demand to see as well as do work upon almost any imaginable sort of electrical devices. The writer is quite certain that there was even an electrical locomotive upon which the students worked.

Besides teaching electricity the school also teaches practical draughtsmanship, and there are also plumbing and brick laying departments. Photographs Courtesy Chicago Covent Trade and Engineering Schools.

The Way to Learn Motor and Dynamo Winding is to Actually Do the Work With Your Own Hands, As This Student is Doing.

STATIC ELECTRICITY AND GASOLINE EXPLOSIONS.

Sometime ago there was much discussion by several authorities on whether static electricity resulting from pouring gasoline thru chamois could ignite gasoline or not. In connection with this an inquiry has arisen from a reader regarding static electricity when filling tanks, especially motor cars, with gasoline says a contemporary publication. This has been the cause of fires. In reply thereto, a Canadian Insurance Inspector reports as follows:

"The fire danger inherent in static electricity is present only when the chamois skin is used as a lining for the funnel or other filling apparatus. The use of chamois skin suggests itself because of the property of chamois to pass gasoline but to retain water."

"It has been found that when gasoline runs thru a metal funnel with chamois skin, static electricity is released which in a few cases on record has generated a spark and ignited the contents of the tank. It has been demonstrated experimentally that a spark is generated only when the funnel is held in midair, without making contact with the metallic gasoline tank itself."

"Since electricity seeks the shortest path, it is advisable to ground the chamois-lined funnel, by permitting it to make contact with the metal walls of the gasoline tank. This way all danger is avoided."

A case in point of the effect of the hazard of static electricity occurred on July 2nd when an auto truck of the Imperial Oil Company at its filling plant in Vancouver, took fire. The wagon was being filled from the tank and the driver had not made the proper ground connection, the tank being insulated by the automatic filling device. During the process of filling, static electricity was generated, making a small explosion which ignited the liquid in the tank truck.
Popular Astronomy
THE SUN AND HIS SATELLITES—THIRD PAPER
By ISABEL M. LEWIS
Of the U. S. Naval Observatory

Our sun is but a star traveling thru the universe at the rate of thirteen miles in a second. It is accompanied in this journey to unknown parts of space, that lie in the general direction of the constel-

Venus in Different Parts of Her Orbit as Seen From the Earth. The Direction to the Earth is Toward the Bottom of the Page. The Planet Mercury Shows These Same Phases. Neither Planet Can Be Seen When in Line or Nearly in Line With the Earth. Except on the Rare Occasions When They Transit the Sun or Pass Directly Between the Earth and Sun. When They Appear as Black Dots Projected on the Sun’s Disc. Usually They Pass Just Above or Below the Sun and Are Then Invisible. Due to the Glaring Light. Mercury is Never More Than 29 Degrees for Venus More Than 47 Degrees From the Sun.

lation Hercules, by an extensive family of minor bodies, the eight major planets and their encircling moons, twenty-six in number, one thousand or more asteroids, and numberless comets and meteors, all moving in prescribed paths around their ruler whose intense light and heat are the result of his comparative nearness. Seen from the distance of the stars he would be only one star among the hundreds of millions of stars that form the visible universe.

The most important members of the sun’s family are the major planets. Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus and Neptune, named in the order of their distance outward from the sun. We hear occasionally of the possibility of the existence of inter-Mercurial and trans-Neptunian planets and some day an additional planet may be discovered within the orbit of Mercury or beyond the orbit of Neptune. The gravitational power of the sun extends far beyond the orbit of Neptune and there seems to be some evidence pointing to the possible existence of two planets on the outskirts of the solar system. The question of the existence of a planet within the orbit of Mercury is now, after long continued and diligent search, considered to be settled in the negative.

Were it possible to view the sun from the distance of the nearest star with the aid of the greatest telescope on earth all the members of his family would be hopelessly invisible. So, also, we cannot tell as we point our powerful telescopes at the stars whether these other suns are attended by planet families. We may only argue that it is very unlikely that there should be but one star among hundreds of millions that is attended by a group of comparatively small dark bodies that shine by the reflected light from the star they encircle.

With the exception of the two planets, Mercury and Venus, spoken of as the inferior planets, since their paths lie between the earth and the sun, all the major planets have moons or satellites of their own that encircle the mother planet just as the mother planet encircles the sun.

Saturn and its Three Concentric Rings Composed of Swarms of Moonlets in Revolution Around the Planet. Note Divisions in the Rings and Also Belts on the Planet Parallel to Its Equator.

Our planet earth has one satellite, the moon, that has the distinction of being the largest moon in proportion to the size of the mother planet. Jupiter and Saturn have moons that surpass our moon in actual size, in fact, two of the moons of the outer planets are actually larger than the smallest major planet Mercury but they are very small in proportion to the size of the planets around which they revolve. Mars, the next planet beyond the earth, the nearest of the superior or outer planets, has two tiny moons that bear the names of Deimos and Phobos. They are both less than ten miles in diameter and revolve very near to the surface of Mars. They can only be seen in very powerful telescopes. The inner moon Phobos is unique in the solar system for it makes three trips around Mars while the planet is turning on its axis or experiencing one day and night.

Jupiter the next planet outward from the sun is almost a sun himself in the eyes of his extensive family of nine moons. Four of these were first seen about three hundred years ago when Galileo pointed his first crude telescope at the heavens and any one can now see them with the aid of an opera glass. One of the four is equal in size to our own moon; the others surpass it in size. These moons are most interesting little bodies to observe and they have figured in some important astronomical discoveries as well. Their eclipses in the shadow of Jupiter, occultations or disappearances behind his disk, and the transits of their shadows as well as the bodies themselves in front of the planet are all phenomena of importance to astronomers and are therefore publish'd in the almanacs of all countries for every day that the planet is visible.

The free remaining moons have all been discovered in modern times. They are extremely small bodies visible only in large telescopes. Satellite V is the nearest of all the moons to Jupiter. The other four are at great distances from the planet.

The planet Saturn has nine moons, Titan, the largest, is nearly equal in size to Jupiter but is more than twice as far from the sun as Jupiter his moons are much more difficult to observe, tho the two largest are visible in small telescopes.

Saturn is unique in the solar system in possessing in addition to his nine satellites a most wonderful ring system composed of swarms of minute moonlets, each pursuing its individual path around the mother planet. It is this unusual ring system that makes Saturn the most interesting to observe telescopically of all the planets.

The planet Uranus has four satellites and Neptune one. Neither of these planets nor any of their satellites can be well observed on account of their great distance from the earth. The indistinctness of surface markings makes it impossible to determine the period of rotation of these two outer planets on their axes. It is believed to be very rapid, however, as is the case with the other outer planets Jupiter and Saturn. All the planets in the solar system fall naturally into two groups, Jupiter, Saturn, Uranus, and Neptune, the members of the outer group, have on the average, diameters ten times as large and therefore volumes...
one thousand times as great as Mercury, Venus, Earth and Mars, the members of the inner or terrestrial group.

The terrestrial planets are the pinnacles of the solar system, the outer planets are the giants. The density of the planets Mercury, Venus, Earth and Mars averages nearly five times that of water. One, at least, of these planets supports many varied forms of life.

The existence of life on Mercury is made impossible by the absence of an atmosphere. Venus and Mars both have atmospheres and there is a strong possibility that both of these planets may support life. Mars has probably been the most discuss of all the planets. The Venus, as the Earth's twin planet in size, mass, density, and surface gravity just as Uranus and Neptune are the twins of the outer group. It is generally believed that water and vegetation exist on Mars. The reddish color of this planet is supposed to be due to its extensive desert tracts. The existence or non-existence of certain surface markings on this planet, the "canals," still continues to be a matter of dispute. It is reasonably certain, tho', since air, water and vegetation exist on Mars that some form of animal life also exists there.

The question of life on Venus depends largely upon the length of its rotation period which is still uncertain since no definite surface markings can be found on this planet. So dense is the atmosphere of Venus that it appears to be always hidden from view beneath a canopy of clouds. It is the general belief that Venus, as well as Mercury, rotates on its axis in the same time that it takes to make a revolution around the sun. In this case the same side of the planet would always be turned toward the sun and under such circumstances life on Venus would be very difficult due to great extremes of heat and cold.

This peculiar form of rotation is by no means unknown in the solar system.

The Planet "Mars"—After a Drawing By Alfred Rondane, Made December 3, 1911. Note the Canal Lines. Which in the Larger Telescopes, Are Plainly Discernible.

Our own moon always keeps the same face turned toward the earth and the evidence seems to be that some of the satellites of Jupiter and Saturn rotate in the same way. The length of the day on Mars is known very accurately on account of the rareness of its atmosphere which enables one to make out surface markings. Its length is about 24½ hours and its seasonal changes strongly resemble our own.

Life on any one of the outer planets is impossible. The density of these planets averages about the same as the density of the sun which is a little higher than the density of but this view is no longer held. The asteroids as well as the comets and meteorites may represent the material of the primitive solar nebula that was not swept up when the larger planets were formed.

With few exceptions the asteroids are only to be seen in large telescopes and then only as star-like points of light. Most of them are simply huge rocks and all are necessarily devoid of life since such small bodies have not sufficient gravitational force to hold an atmosphere.

Law and order prevail among the different members of the solar system. The revolution of the planets around the sun and of the satellites of the planets around the primary planets are performed according to known laws that make it possible to foretell the positions of these bodies years in advance. Asteroids and comets also obey the laws of the solar system and after three observations of the positions of one of these bodies have been obtained their future movements can be followed. There is, moreover, a uniformity in the form and motions of the planets and their moons that is considered significant in connection with the origin of the solar system. All the planets and their satellites are nearly perfect spheres. They all, with few exceptions, rotate on their axis and revolve around the sun or, in the case of moons around their primaries in the same direction from west to east. When the noted nebular hypothesis was advanced to explain the origin of the solar system the exceptions were unknown. They are now considered to make doubtful the truth of the hypothesis. These exceptions are the two outermost satellites of Jupiter, the outermost satellite of Saturn, and the satellites of Uranus and Neptune. All these bodies retrograde or travel in their orbits in a direction opposite to that of all the other planets and satellites.

The paths of all the planets around the sun are nearly circular and they all lie in nearly the same plane. The asteroids have orbits that are more flattened or elliptical and these orbits are in some instances highly inclined to the planetary orbits. The comets have orbits that are usually very elongated ellipses or parabolas. Some of the comets may be only temporary members of our solar system the astronomers generally believe that they are all perman-
HAVING read with a good deal of interest Mr. Gernsback's articles in recent issues of the ELECTRICAL EXPERIMENTER in regard to winning the war by building a new type of machine called Gyroscopics, which would spread defeat and consternation in the ranks of the Hun, I beg to take issue with him on the feasibility of this plan, regardless of its astounding features:

In the May issue, he says editorially:

"This war, more so than any other, is a machine war. A stereotyped phrase, but, nevertheless, a very true one. When we speak of a machine war, we usually have in mind artillery of all calibres, from machine guns upwards to 42 inch breech-loaders. The enemy, he must fall back. Even trench systems without artillery support from the rear can not be held for any length of time by the enemy. If our artillery is intact, but if the enemy is deprived of his, even the hands of machines cannot compensate his ours ten to one, he would have to retreat just the same. These, of course, are very obvious facts."

According to reports from the fighting fronts this is true enough without the endorsement of the General Staff. In the next paragraph he writes:

"The British now engaged in the Western war theater realized this truth very early and set about to rectify it. The result has been the recent Tank attacks. These machines fulfill several purposes; they are used to batter down the barbed wire entanglements protecting the trenches; secondly, they raise havoc among the enemy's men by flank fire once across his lines, but most important of all, the Tanks are the enemy's artillery either by putting the artilleryists out of action by gun fire from the Tank or by climbing right over the enemy's guns, thus putting them hors de combat. For the first two purposes the Tanks are ideal; for the latter they have signally failed. The reason is very simple. The Tank is an extremely slow-moving vehicle in the open field—five to eight miles an hour at the most—is its speed. Even if camouflaged a Tank makes a shining mark for the enemy gunners, who find little trouble in hitting its size. The only crawling tractor. One or two shells soon puts the most ambitious Tank out of business."

And, in truth, he might have added, if the Tanks have any real military value where are they in the past big (Allied) drive? One would expect to read in the newspapers how the Tanks like bits of Gibraltar stood out in the open and stemmed the advance, but such has not been the case. There is the case of a battle in a war where nothing can live above the ground, and even steel and concrete project-

Gyroscopic put in the face of such a fire, with their limited crew and supply of ammunition, especially when the batteries of the enemy are capable of throwing up every foot of ground. A few well directed shells of the 42 cm. type would be sufficient to put them hors de combat without further ado.

Mr. Gernsback states:

"In other words, the large and speedy machine obviously is the thing in this war. In former articles we have shown that it is perfectly feasible to run monster machines over land at speeds from twenty miles upward."

Possibly, how would it be done in the mud of Flanders? The Gyroscopic with its heavy bulk would sink axle deep in the mud. Its success would depend upon dry ground and smooth ground at that. Even if it could succeed in passing the enemy's barrage and run down first line trench batteries and machine guns, it would still have its work cut out for several miles back to contend with as well as guns at a much nearer range, and would be practically blown to pieces before it could over-run them.

By this reasoning we are able to see that no machine of the Tank or Gyroscopic type can expect to achieve a decision in this war. It is in the air that we should look for results. Swiftly moving bombing planes which offer little target to the enemy can be depended upon to put the enemy's batteries out of business, no matter where they are located. As many military experts have stated the decision will be in the air. The side that controls the air will have the advantage. With thousands of bombing planes covering the Western front it would be impossible for the Hun to set foot on a bit of safe ground. With all the talk of the Allies devoting a large fleet of planes, it appears that very little has been accomplished in this direction. Because if they had how was it possible for Gernsback's work to spread such immense forces and materials on the Western front for the past spring drives.

According to the Tank and Gyroscopic defense idea, we wait until the enemy has assembled all his forces and munitions for the drive before they are called on for action. On the other hand, the bombarding plane checks the enemy while he is trying to assemble his supplies, by hunting out the most vulnerable points of attack. I can not believe that a suitable supply of bombing planes would make a big offensive impossible, by bombing everything above ground. Not only could these planes, by swiftly moving planes, capable of returning to a base of more and returning the bomber, the Tank and Gyroscopic could attain no such speed or return for supplies. On the other hand, this would mean that not until their supply of ammunition is used up and become the prey of the enemy.

While it is evident that this is a machine war, and the Tank has been tried and the Gyroscopic suggested, I am confident that the need will be accomplished with men, munitions and bombarding planes. Men and munitions, of course, are everything, but in addition to these, the practical value of the bombarding plane has been proved over the Tank and Gyroscope, and they will bring results unless some inventive genius brings forth some new type of land battleship. Nothing can escape these bombs; they are everywhere at once, carried by swiftly moving planes, capable of returning to a base for more and resuming the hunt. With the Tank and Gyroscopic the enemy's army can be destroyed and other means, one of which is the bombarding plane, must be found to overcome them.

LOUIS LEON.

Rochester, N. Y.

Leon Telegraph & Wireless School, Director Wireless Telegraphy, Mechanics Institute.

Mr. Leon's criticism is well taken, but I regret that I cannot agree with him. Quite the contrary.

My answer resolves itself into the one word: SPEED. In my article in the February 1918 issue of the ELECTRICAL EXPERIMENTER I stated explicitly:

"As we have pointed out before, what is wanted is a machine, not necessarily monstrous and weighing many thousand tons, but one that need not weigh more than the present Tank, and that can cover ground rapidly, so that it becomes almost impossible for the enemy to get the range."

I refer more specifically to the Gyroscopic, which I have also extended to the Gyro-Electric Destroyer, here illustrated, was fully described in our February, 1918 issue. This 450 horse power Monster is Steered by a Large Gyroscope Wheel, Shift ing the Latter Either to the Right or the Left, The Wheel Made of Lattice Steel Work Is Practically Proof Against Stray Shell Shots. The Destroyer Runs at a Speed of From 40 to 60 Miles an Hour and Due to Its Huge Diameter It Rolls With Ease Over Trenches and Other Obstacles.

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"It should also be noted that only a very moderate speed of the motors is necessary; inasmuch as the diameter of the wheel—45 feet—is so large that it would be impractical to drive it at a rate of from forty to sixty miles an hour with the motors running at very slow speed."
ELECTRICAL EXPERIMENTER

Exactly as the Hun submarine is helpless against our fast moving destroyers—
for it can not get the range quickly enough —so the Hun gunner is helpless against our Gyro-Destroyer. And just as our boys
in blue drop a depth charge on the prowling U-Boat in Khaki drop a bomb on the German Gun.

Mr. Leon says: "How could the Gyro-
Destroyer run thru the Flanders mud?"
The answer is simple: it doesn't why

THAT "OCTOBER" ELECTRICAL EXPERIMENTER

Something new—an automatic bul-
let-proof, steel plated electric soldier
— that will hold the front line
barrages against all odds.

Electricity—the nerve-force behind
the artillery barrage—101 things
about barrages you probably never
even dreamt about.

It's a New Lightning Rod—It up-
sets all the old theories regarding
such devices. Do you think it should
have a sharp point? Read Dr. Tesla's
statement.

Electric Power from the Ocean—A
new idea in this field of science by
Dr. Lindbergh.

The Latest Electrical and Wireless
Photos from the American Front,
The Telephone Girls with Pershing
Overseas.

Spectroscopic Methods and the
Production of Spectra—A sequel to
the article "How to Build a Spectro-
scope", in the August number, by
Donald S. Binnington.

The Revolving Mirror—How to
photograph with a dark dis-
charge, popularly explained by Prof.
Lindley Pyle.

The Burnt-Out Lamp Prize Contest
Sponsored by the Leo M. Testa
Fund, Inc., in Chicago.

Omn's Law and the Alternating
Current Circuit, An Article Every
Radio and Electrical Student Must
Read, by Arno A. Kluge, Instructor
in Radio, University of Nebraska.

Glass Blowing in the Experimental
Laboratories of the University of
The How and Why, Part II. By Prof.
Herbert E. Metcalf.

Besides One Hundred Other Lives,
with twenty-five distinct articles on
Electricity, Physics, Radio, Chem-
istry, Mechanics, and Astronomy;
and All the Usual Departments.

should it? Guns cannot advance thru mud
either, nor does an army as a rule. Both
contending forces, if mud separates them,
are deadlocked. But we can run over dry
land, and there is always plenty of that
somewhere, and we can then take the
enemy from rear and destroy his guns, before
he knows what hit him. Then if our infantry
follows the Destroyer there will be an
end to the deadlock in that section behind the
Flanders, or any other mud field.

Nowhere in my articles did I mention
that the Gyro-Destroyer could or would
win the war, but I did say:

"It is evident that a machine of
this kind should do as good work as a
thousand men in the field, and, perhaps,
last longer.

I still maintain that I am right, until
actual experience with such a machine
proves me wrong, and that I firmly believe
won't happen.

In connection with the above a curious
thing is happening of late. I am in receipt
of many letters from "Electrical Experimenter"
readers, telling me what they think of
the different articles. These letters are fair samples of the many
that come to my desk, but I will let them speak
for themselves.

Editor Electrical Experimenter:

In reference to your May Editorial
and some of the preceding ones. I
wish to state that I am totally in
sympathy with you as this "Monster
Land Battleship" is concerned. I am
well acquainted with the details of it,
as I have read your magazines as well as some of a few years ago
where you have also presented a
machine of that kind but of a different
construction. I do not agree with your
opinion in reference to the "Tanks" for
I have seen one and its clumsiness.
Now in order to let you may not appeal
in your Editorials without results
would suggest, that, being your cir-
duction reached the 100,000 mark, and
naturally all those who read the Elec-
trical Experimenter cannot but be
interested, should patriotically con-
tribute $1.00 to the Editor. The donor
should dispose of all such money by
building and perfecting one of those
Giants and prove to the Government its
effectiveness.

For the Government at the present
time is overburdened with the enormity
of its war tasks and it hardly has
time for experimentation.

I personally would be more willing
to make such a contribution and would urge it upon a wider circle.

You know how to reach the people who
should read your magazine.

JOSEPH SEAR,
No. 422 South Fourth St.,

Editor Electrical Experimenter:
The Gyro-Electric Destroyer which
adorns the cover of the February, 1918.
issue of the "E. E." is a mighty interest-
ing looking monster, and, if practical,
would do no doubt give an account of
itself on the battle field.

I suppose the Government, deluged
with ideas of all sorts, and over-
whelmed with the expense of carrying
out its army building and army moving
programmes, does not care to invest in
anything that departs so far from the
usual.

Nevertheless, looking at the thing on
paper, and dreaming of its possibilities
if it would work, makes one very puz-
lusious to see it tried.

Therefore, this let-
ter and suggestion.
What you get an "E. E." reader and
all others possible, to donate one dollar
to defray the ex-

(Cont. on page 347)
The Phenomena of Electrical Conduction in Gases

PART V—WEIGHING AN ION

By ROGERS D. RUSK, M. A.

The simplest method of measuring \( m \) is called the energy method of J. J. Thomson. It is a well-known fact that the energy of any moving body is \( \frac{1}{2} mv^2 \), and if this be the energy of one electron the total energy of \( N \) electrons is:

\[
\frac{1}{2}Nm^2v^2 = W
\]

which may be measured in terms of the amount of heat generated when these rays fall on a metal plate. But the number of electrons \( N \), is equal to the total charge \( Q \), divided by the charge on each electron \( e \), and the equation becomes

\[
m = \frac{2W}{eQ}\]

So when the heat \( W \) is measured, the quantity of electricity \( Q \) in the gas, and the velocity \( v \), are measured it is an easy matter to calculate the ratio \( \frac{m}{e} \).

There are many other ways of measuring the same quantity chief among which is a method depending on the fact that positive or negative ions may be bent by a magnetic force. As the magnetic force on the ion depends on the charge on the ion and as the amount the rays are bent will vary inversely as the mass of the ion, it is readily seen that the amount of bending can be measured in terms of these quantities and set equal to or the reciprocal of \( \frac{m}{e} \). Fig. 1 represents the deflection of ions by magnetism, in a tube similar to that used for measuring the velocities of ions.

Now to measure the mass of an ion or to weigh an ion all that is necessary is to find the quantity of electricity carried by each ion and substitute it for \( e \), in the quantity \( m \) divided by \( e \), then solve for \( m \) the mass.

The first step then is to measure \( e \), the charge on an ion, and this like other similar processes can be accomplished in several ways, but practically all methods for measuring \( e \), which have been developed so far depend on the fact that drops of water can be made to condense about ions and if sufficient ions are present a cloud is formed. It had been suspected for some time that the presence of dust particles in the air was one of the causes which made moisture collect in drops and fall as rain. In 1897, C. T. R. Wilson made the discovery that in dust free air clouds would form if electrified particles or ions were present. This discovery was immediately followed up by H. A. Wilson, J. J. Thomson and others, who made use of the new fact to enable them to determine the charge \( e \), on an ion.

As is well known the complete or total charge in the electrified gas can be readily measured by driving these ions by means of an electric field to a plate connected with an electroscope or electrometer. If the number of ions were known \( W \) would be a simple process to divide the total charge by the number of ions, and obtain the charge on each ion. Up until Wilson's discovery the counting of such minute particles as ions had been an utter impossibility. Now assuming by the laws of probability that only negligible number could form about two or more ions at the same time it was only left to count the drops and take this as the correct number of ions.

In order to insure as great accuracy as possible very small drops were used, and instead of being visibly counted their number was estimated in the following manner:

A single drop was observed in a microscope and its weight calculated from its diameter. Then the whole cloud was weighed and this total weight divided by the weight of a single drop. This gave the number of drops. The total charge was then measured as suggested above and divided by the number of drops. This was the charge on the ion, and two birds were killed with one stone for now the mass could be gotten from the various values which had been obtained for ratio of the mass and charge.

A typical apparatus for producing such a cloud is shown in Fig. 2. A is the expansion chamber and \( P \) is the pump by which a known expansion can be obtained; \( E, E \) are the electrodes. When the piston is pulled down the air is rapidly expanded and very rapid evaporation takes place (Continued on page 355).
**Experimental Physics**

By JOHN J. FURIA, A. B., M. A., (Columbia University)

**LESSON FIFTEEN**

**CURRENT ELECTRICITY**

(Continued)

**Experiment 87.** Place two test tubes with holes in their bottoms into a vessel of water (see Fig. 79). Fill two test tubes with sulfuric acid and invert them in the vessel as shown. Lead current from storage battery or other sources of at least ten volts to platinum electrodes $P$ and $P'$ (seed nails will do fairly well if platinum is not available). Bubbles of gas will appear rapidly, the negative electrode filling its test tube twice as rapidly as the positive. On testing we find that the gas at the negative electrode burns with a blue flame (a test for hydrogen). The gas at the positive electrode does not burn; but a glowing splinter when placed in the gas burns brightly, i.e., the gas supports combustion (a test for oxygen). **CARE MUST BE TAKEN WHEN MAKING THESE TESTS TO KEEP THE TEST TUBES INVERTED; OTHERWISE, THESE GASES BOTH BEING LIGHTER THAN AIR, WILL ESCAPE.** Modern theory explains this phenomenon, *electrolysis*, as follows: When the sulfuric acid is dissolved in the water, it breaks up into positively charged hydrogen ions and negatively charged sulfate ions. The current causes an electric field to be established in the solution between the electrodes. The hydrogen positively charged ions are attracted by the negative electrode and repelled by the positive electrode. On reaching the electrode their charges are neutralized and the ions combine and form hydrogen gas. The negative ions move to the positive electrode, their charges are neutralized, they react with the water liberating oxygen and forming additional sulfuric acid. The fact that we find that two parts of hydrogen are given off to one of oxygen is one of the reasons for believing that each molecule of water is composed of two atoms of hydrogen and one atom of oxygen.

**Experiment 88.** Just as water can be decomposed into hydrogen and oxygen, the elements in their right proportions can be mixed and water formed. Any of the methods can be used for securing the Hydrogen and Oxygen but the following is the simplest in which to secure and mix the elements in the correct proportions. See Fig. 80. The jar contains dilute sulfuric acid. Electrodes, thistle tube $T$, and J-tube, are connected thru a tightly fitting rubber stopper. MAKE SURE THAT THE J TUBE IS TOTALLY IMMERSED AND THAT THE "I" (TOP) TUBE IS NOT IMMERSED. The other end of the J-tube is immersed in a porcelain crucible or china cup containing a soap solution such as one uses for making good soap bubbles. When the current is turned on the solution in the J-tube breaks up into two parts Hydrogen and one part Oxygen, as in the previous experiment. The gases mix in the proportions in the space above the solution and pass out thru the tube into the soap solution forming bubbles of Hydrogen and Oxygen, each bubble containing two parts Hydrogen to one part Oxygen. The first few bubbles contain the air of the space above the solution and should be blown away. Then touch the bubble with a lighted match. A loud but harmless explosion will result (harmless because it is an inward explosion rather than an outward) and water is formed. The use of the thistle tube is obvious. Should the pressure of the gas in the jar become large because the gas is not escaping thru the J-tube as rapidly as it is generated, there would be a danger of an explosion and of the jar bursting. Instead, as the pressure increases some of the solution is forced up the thistle tube, making more room for the gas and also causing less surface of the electrodes to come into contact with the solution. This principle is extensively used in gas generators to avoid accidents. **Experiment 89.** Place a solution of copper sulfate in a vessel (See Fig. 81) AB and AA' and heavy copper wires insulated from each other and connected to a battery of at least ten volts (D.C. house current is very good) to wire $W$ is forced. The *positive wire* connect some pennies or other pieces of copper (a), (c) and (e); to the negative connect a key (b) a spoon (d) and a coin (f) (not copper). On passing the current thru, (b), (d) and (f) become copper-plated, the speed of the action depending on the current. In a similar manner by using silver instead of copper and a silver salt instead of copper sulfate we can silver-plate articles suspended on the negative wire. Wire can be carbonated and we have a nickel-plating and with gold and a gold salt we gold-plate. **SHOULD BE TAKEN TO CLEAN WELL THE ARTICLES TO BE PLATED.** The explanation is similar to that of electrolysis of water. The dissolving of the salt in the water causes the salt to dissociate into the positive metal ion (copper, nickel, silver, gold, etc.) and into the negative ion (sulfate, chlorid, etc.). The positive metal ion is attracted to the negative electrode because of the electrical field established, loses its charge and deposits itself (or plates). The negative ion passes to the positive electrode, gives up its charge and combines with the metal to form more salt which in turn dissolves (the sulfate ion loses its charge and combines with the copper to form copper sulfate, which goes into solution). Thus the strength of the solution is maintained and the metal at the positive wire is eaten up. **Experiment 90.** Electroplating is an important application of electroplating. Set up in common type the page to be electroplated. Stamp it in wax or other compound prepared for taking moulds. Coat the wax impression of the type with graphite powder to make it a conductor of electricity. Surround this at the negative electrode of a copper-plating outfit as described in Experiment 89. When a sheet of copper about 1/15 of an inch thick has been deposited on the wax mould, remove it from the solution and peel off the wax and replace it with a molten type-metal backing to give strength to the copper facsimile. From such an electrolyte many thousand impressions can be made.

**Experiment 91.** In the last lesson we learned that electricity in motion is always accompanied by a magnetic effect (Oersted's experiment) and that by using a right-hand rule for determining the direction of the magnetic field knowing the direction of the current. Let us look into this effect a little further. (Continued on page 359).
Notice to All Radio Readers

As most of our radio readers are undoubtedly aware, the U. S. Government has decreed that all Amateur Wireless Stations, whether licensed or unlicensed, or equipment for receiving or transmitting, shall be closed.

This is a very important consideration, especially to those who are readers of the Electrical Experimenter, for the reason that we desire to continue to publish valuable articles on the wireless art from time to time, and which may treat on both transmitting and receiving apparatus. In the first place, there are a great many students among our readers who will demand and expect a continuation of the usual class of Radio subjects, which we have publish’d in the past four years, and secondly, there will be hundreds and even thousands of new radio pupils in the various naval and civilicn schools throughout the country who will be benefited by up-to-date wireless articles treating on both the transmitting as well as receiving equipment. Remember that you must not connect up radio apparatus to any form of antenna.—The Editors.

U.S. Signal Corps Radio Outfit in France

The Radio Division of the U. S. Signal Corps has been wonderfully enlarged since our entrance into the great world war, and thousands of portable wireless outfits are being assembled and shipped to Europe at this time. The accompanying photograph shows one of the Signal Corps Radio Squads on duty in France. A collapsible telescopic mast is usually supplied with this apparatus so that the antenna can be raised or taken down at a moment’s notice.

When the troops are entrenched in dugouts, then the radio men install their apparatus in a well protected underground cavern and lead their antenna wires from the apparatus up thru dark passages and out to the aerial itself. In trench warfare the antenna is a low affair not extending over three to four feet above the trenches. The antenna under these conditions is given a fairly good length to make up for the low altitude.

When the army makes a rapid advance, then the radio crews move forward with the troops and carry their wireless apparatus and aerial paraphernalia on mules or horses, or still more often nowadays, on auto trucks, some of which are assigned to the radio divisions for the purpose. There are also a large number of portable wireless outfits mounted in auto trucks which can travel over the field very rapidly, and which can be put into operation in less than a minute. In some of these auto trucks are carried a telescopic aerial mast made of steel tubing, and are provided with special means for quickly raising and lowering the mast.

Quick Transmission of Telegraph or Radio Messages.

Altho there are 26 letters in the English alphabet only 23 are used frequently, the ones very seldom used are "X, Y, Z." As would be written "ston, lin, lim, practic, etc."

3rd Proposal: In such words as "Experi- menter, longer, water, writer, seeker, feeler, stronger, quicker, etc." I would eliminate the "e" before the final "r," and the words would then be written as follows: "Ex- perimenter, longer, wattr, seeker, feeler, strongr, and quicker." Also the "e" before "d" as "stored," etc.

4th Proposal: "X" at the end of a word would indicate "shun" as in "Induction, fiction, traction, fashion." The above would be written as "In- duct, flex, tracr, and fax." The "shun" in centers of words can also be written "Fax- able," as in "the end of a word would indicate "able." "Disabled, fable, table, etc." would therefore be written "Dzd, fzd, tz, etc."

5th Proposal: "Z" at the begin- ning would indicate "st" as in "stick, a t a y c d., stem, steamer, etc. They would be written as follows: "zick, zayd, zinc, and zeamr, etc."

Contributed by F. LAUFER.

One of Pershing’s Signal Corps Squads Operating a Portable Radio Outfit in France.

"One of your Radio Bugs."

Four working parties building a railroad across Australia keep in touch with one another by wireless telegraphy.

American naval officers are installing a wireless telegraph station in France. The Temps announces that the station will be ready for use in August to correspond with the station in Annapolis. It will cost $2,500,000. After the war the station will be taken over by the French.
ELECTRICAL EXPERIMENTER

The line connection is used only in cases where it is desired to receive thru head receivers, in which cases the head receivers are connected by plugging into this socket. In the event that more than one pair of head receivers is to be used at a time, they may be plugged into a connecting cord and in turn connected to the line connection in the set. This set has incorporated in it a ballast resistance which makes it possible to connect any number of head receivers without interfering with the sound of the buzzer.

The set shown herewith is furnished complete with two three-foot cords for connection to the Battery and Omnipgraph, but does not include Battery, Omnipgraph or Head Receivers.

UNCLE SAM PAYS $1,600,000 FOR POULSEN PLANT.

The PoulSEN Wireless Telegraph & Telephone Company has sold its wireless rights and plant in the United States and dependencies to the U. S. Government for $1,600,000. This payment has already been made, while important deals are said to be pending for the sale of PoulSEN rights for use in other countries.

SWEDISH RADIO TALKS TO PALESTINE.

Sweden's most powerful radio station, situated at Karlsborg, has been put into operation. Regular communication is now being conducted with Dutch Altenburg in Austria, and also Tsrskoe-Selo. Messages have also been exchanged with Spanish stations and Constantinople. Word has been received that the Karlsborg station's messages have been read by a little station in Damascus, Palestine, although the Damascus station's plant is too weak to reach Karlsborg.

CRUFT HIGH TENSION RADIO LABORATORY.

The accompanying photograph shows the excellent building and lofty latticed-steel aero mast at the Cruft High Tension and Radio Laboratory at Cambridge, Mass. This laboratory which was built several years ago, was used as a special research laboratory prior to the declaration of war by the United States. It was formerly used by the U. S. Naval Radio School at Cambridge, but it is now directly used by this school.

The Cruft Laboratory was built to carry on high class wireless and allied high tension research work, including such measurements as the quantitative and qualitative tests of radio signals, the determination of the operating characteristics of radio transmitting as well as receiving apparatus, wireless telephone experiments and tests, etc. Considerable work has been done at this laboratory in the short time it has been in operation including a large number of experiments on the wireless telephone of Prof. Chaffee.

The laboratory is fitted up with a complete equipment of the various measuring instruments necessary for conducting tests along these lines, and constitutes one of the best equipped laboratories of its kind available today.

A CONSTANT TONE RADIO BUZZER AT LAST

For a hundred and one purposes the radio man daily finds that he needs a constant tone test buzzer. For all accurate measurements of wave length and decrement such a buzzer is absolutely essential. It has remained for a well known English concern to bring out such a buzzer, which sells for something like nine dollars, but it is worth it.

This instrument, the result of exhaustive experiments, will operate continuously at constant amplitude without changing its periodicity, and the note is instantly variable by the movement of a cam, say its sponsors. A pure musical tone with a range of three octaves can be obtained. Sparking at the contact points is entirely eliminated by a small graphite rod which can be shunted either across the coil or the platinum contacts, and if desired cut out entirely.
The Einthoven Galvanometer—
Its Theory, Operation and Construction

By SAMUEL D. COHEN

The electrical measuring instrument is the most important asset to the electrical and radio experimenter, and would be impossible for him to study the actual characteristics of any electrical piece of apparatus without the aid of it. Voltmeters, ammeters and wattmeters are the ones used to the greatest extent by the engineer. However, the most important of them all is the ammeter, especially when it is used to measure a minute quantity of electricity flowing thru a given circuit. This instrument in its finer term is called a galvanometer. A galvanometer is a delicate and sensitive electrical instrument used for measuring very small electric currents. To the radio experimenter and engineer, the galvanometer is found to be most useful, insofar as unimaginably small currents are dealt with, especially in the radio receiving circuit where currents of one-thousandth part down to a few millionths of an ampere flow.

Practically all galvanometers with which the student is familiar consist of two main parts, a coil of wire thru which the current can flow to be measured, and a permanent steel magnet constituting the field. This is the moving coil type. In other forms of this instrument, the coil is comparatively large and is rigidly fast to the frame of the instrument, while the magnet is a small piece of steel suspended lightly by a fiber of untwisted silk or quartz. In other galvanometers the arrangement is reversed, and the coil or part carrying the current is made as light as possible and placed in a very powerful magnetic field produced by a large electro-magnet, which usually forms the body of the instrument. The latter type of instrument is the one in which we are interested, as it has proven to be the most sensitive of them all.

Even in this class of galvanometer, there are two types, the one developed by Prof. Korn, who utilizes two, fine parallel wires suspended in a powerful magnetic field, and a second form devised by Prof. Einthoven, who uses a fine, single silvered quartz wire placed in an extremely powerful magnetic field. The latter was found to be far more sensitive than the former, and this type of galvanometer will therefore be described in this article.

Several years ago the author constructed a very simple Einthoven galvanometer. Although not as sensitive as the commercial ones, it gives fairly accurate results in experiments which are conducted in radio receiving circuits. The instrument was sensitive enough to record radio received currents from distant transmitting stations.

A commercial form of Einthoven galvanometer is shown at Fig. 1. Here A represents the powerful magnetic poles excited by the huge electro-magnets, B, B. The case, E, contains the fine wire carrying the current to be measured. Fig. 2 shows schematically the arrangement of the suspension for the fine wire E, which must be as fine as possible. Platinum, silver or aluminum can be used, but it was found that even a smaller diameter can be obtained by using quartz or glass fibers, these being platinumized or silvered. The ends of the wire are soldered to T-shaped members, which are held by two set screws placed at the ends. Adjusting the tension of the wire is a close operation and it is carried out by mounting the upper wire carrier upon a rod having a cam at the upper end, the rod being normally pushed up by a spring. With this arrangement a very fine adjustment of the wire is secured, connection being made to the ends of the wire.

The method of noting the displacement of the wire when carrying a current in the magnetic field is shown in Fig. 2. An eyepiece, AE, is inserted in a hole in one of the collars, F, G, of the poles, B, B. A telescope in this eyepiece can be used for registering the minutest deflections of the wire. The galvanometer is adjusted by moving the eye-piece up and down, as shown by the arrow I in the eyepiece. A telescope, however, may be used if more accurate readings are required. The number of deflections is counted, as shown at J, and multiplied by the number of divisions each deflection makes.
the magnet poles, and the light is projected by the tube C and the lens F. The wire is stretched between the points C, and with the flow of the current in the direction indicated by the arrows, a deflection is obtained shown by the horizontal arrow "a," which is at right angles to the magnetic field NS. Even a minute movement by the wire is greatly magnified by the telescope. For projecting on a screen, the eyepiece is removed and by sending a powerful light ray thru C, we see the image of the middle part of the wire on the screen. The screen is placed one meter away from the wire, inasmuch as the deflection will vary with the distance. The instrument may be calibrated to note the amount of current necessary to produce a deflection of one millimeter division at one meter distance. This is a standard of calibrating all types of galvanometers.

It was found from actual experiments in determining the sensitiveness, that the string will be displaced one millimeter at currents as small as 10⁻⁸ ampere (1,000,000,000,000) or one-thousandth of an ampere. Several millimeters or even centimeters of deflection can be obtained with the aid of the optical instrument and with currents of values of 30 to 40 micro-amperes, (one micro-ampere = one-millionth ampere). It is thus seen that the instrument is extremely sensitive.

Some of the most valuable features of this instrument are:—its quick action, its dead beat, and its quick period of swing, this being due to the almost negligible weight of the moving part, its moment of inertia being extremely small. Also it possesses practically no self-induction or capacity. It was found that with a wire of standard length and thickness which is one-thousandth of an inch thick, that the period of the wire is 1 second. This is small enough for practically all speeds of code reception used by commercial radio companies.

To electrical the period of the string by an actual measurement is a difficult problem. However, the following may be found of interest, especially to the more advanced student of electricity. If a short current be sent thru the string by means of suddenly tapping a key connected with the string, it is given a jerk and is displaced thru a distance d (at the center). It then swings back to zero and then past the zero point, due to the slight moment of inertia which it possesses. Calling this distance X, the point is thus d-X from it, where d-X is less than d. If a damped oscillation is sent thru the wire, the string does not actually come to rest for a definite time. During this time there may be a complete vibration from which the natural period t/n can be ascertained. If the string be made to cast a shadow over an illuminated slit thru which the light passes when it is displaced, and this light falls on a rapidly traveling band of a highly sensitive photographic film, and a top be then given with a key or switch, a record of the movement of the string is obtained. If the rate at which the film travels is known, it is a simple matter to calculate the period of the string of the galvanometer.

The string has a shorter period if its length be shortened or its tension increased, and the damping of the oscillation can be effectually increased if a twist be given to one end of it.

It is thus seen from the above discussion that the character of the string, its material and manner of suspension has a great deal to do with the sensitiveness of the instrument. Also the intensity of the magnetic field wherein it is placed has considerable to do with its sensitiveness. The table below gives an excellent idea of the period of the string, its resistances, etc.

This will suffice for the discussion on its operation. Let us now turn our attention to the more important topic for the constructor, namely giving the reader complete dimensional details on the construction of a sensitive Einthoven galvanometer, which the author built several years ago. Fig. 4 is a photograph of the completed instrument. This galvanometer was used for experimental work in radio-communication and its sensitiveness was found to be three-hundredths of a milliampere for one millimeter deflection at one meter distance from the screen. This was found to be sensitive enough for practically all kinds of work where small currents were dealt with.

Detailed assembly of the galvanometer is given in Fig. 4 A. The base 1, is made from three-quarter inch hard wood stock, and the drilling layout is given in Fig. 5. All holes are to be drilled with a No. 18 twist drill. The magnetic field is derived from two electro-magnets 2, 2, and their construction is shown in Fig. 6. The core is a piece of wrought iron one-half inch in diameter. The ends are machined down to four and one-quarter inches. Two fiber bobbin checks are placed on each end. Two holes are made in the lower end with a

(Continued on page 345)
A Graph for Solving Wave Length Frequency Inductance and Capacity

By E. M. T. (RADIO ENGINEER)

The scale starts at the bottom with one centimeter of ordinates. The main division is for 10 centimeters, and from the starting point the following main division is for 100 centimeters. As the scale extends to 100 centimeters or 10 times the first main division, which is about one-inch long, it may be quite readily estimated that 10° diagonal of the upper right-hand rectangle. If the work is done instantly, straight lines in any direction will intersect nearly the corners of the main rectangles.

Now note this property of the double rectangular logarithmic scale used in this graph. If a straight diagonal line is drawn thru the corners of the main divisions from left to right in the downward direction, the product of the values of the vertical and horizontal lines at the intersections is constant. This may be noted by inspection. It should be noted for any other parallel line and the logarithmic subdivisions.

Now, for a constant resonant frequency, the product of the values of capacity and inductance must be constant. Therefore for any constant value of this product the frequency is constant and will give the logarithmic relation to the scales, which is much simpler than a curved line relation.

The graph is so simple that it may be easily expanded to any extent in any direction or any given section may be enlarged to any extent if greater range or greater emphasis is desired. If a straight line is drawn thru the corners of the main divisions from left to right in the downward direction, the product of the values of the vertical and horizontal lines at the intersections is constant. This may be noted by inspection. It should be noted for any other parallel line and the logarithmic subdivisions.

For instance a constant microfarad, the product of the values of capacity and inductance must be constant. Therefore for any constant value of this product the frequency is constant and will give the logarithmic relation to the scales, which is much simpler than a curved line relation.

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CLOCK-SPRING HEAD BAND.
In the ordinary watch-case receiver the loop for hanging on the hook is placed as in Fig. 1. An idea occurred to me thru an accident which happened to the receiver I was examining. I dropped it, breaking the loop off. When I picked it up I noticed the placement of the loop and an idea came to me. I thought of getting a clock spring 3/16-inch wide and bending it and placing it in as theloop had been and so forming a head band. I procured an old clock spring from a discarded clock and bent it to fit my head. I then bent it as in Fig. 1 to fit the hole in the receiver. I put the spring into place and put the piece of rubber back, and heating a large nail I ran it over the cracks left between the piece and the receiver. I then emerced the surface until it was smooth. In this way a fair head-band can be made for and by the amateur.

Bending the free end of the spring out as at Fig. 2 will avoid scratching the face.

Contributed by FRED ELLEMBERGER.

A "VEST POCKET" RADIO SET.
I give herewith a sketch and details of a small pocket receiving set. I know that many of your readers would like to make one. I have tried mine out on the big antenna at NAA, where I am an operator, and found that I can get quite a range of wave-lengths on it. The secondary is wound with No. 32; the primary with No. 30, silk-covered magnet wire, 20 turns to a contact; 10 contacts to both secondary and primary. A flat condenser is shunted across the 'phone terminals; it is made of thin tin-foil, about sixteen square inches, wrapt in waxed paper. The detector is galena. All parts are nickel plated and mounted on hard rubber. The coupling is flat. QST from NAA could be heard faintly. Waves from 300 to 1200 could be heard good.

Contributed by AUDLEY V. H. WALSH.

ELECTRICAL EXPERIMENTER

UNIQUE SCHEME FOR LEARNING THE CODE.
The writer some time ago decided to learn the code, and it occurred to him that as he had an "I. C. S." language phonograph, it might be used to advantage in this connection. At first a buzzer and telegraph key were rigged up, the recorder and a blank record was placed on the machine, and a few notes were recorded. When reproduced, the results were not entirely satisfactory as the sounds were rather weak and ragged. Then the following scheme was tried out and the results were good clear tones somewhat similar to a 500 cycle station.

A telephone of five dry cells, the primary of a local battery induction coil and a telephone transmitter were connected in series. The 75 ohm bi-polar receivers were connected in multiple, across the secondary of the induction coil. One of these receivers was supported so as to face the transmitter and be tight up against the mouth-piece. This produced the ordinary well-known "howler" effect, whenever the telegraph key was closed.

One of my indulgent commercial telegraph operator friends have become interested, volunteered to make me some records. The phonograph was adjusted to a speed of about 100 R. P. M., a blank record put on and the second receiver held in front of the speaking tube of the phonograph, while my friend tapped off the continental code, running thru the alphabet at the rate of about 8 to 10 words per minute and repeating each letter four times. Next some reading matter was recorded on another record at a slow rate of speed. When the reproducer horn were placed on the machine and the records run off, they turned out excellent and could be read anywhere in the room.

A few records made in this manner act as a constant guide to the beginner and enable him to rapidly learn what good signals should be. Assuming of course, that the records were made by a good operator.

Contributed by L. A. GARY.

HINTS ON SECONDARY TAP LEADS.
In making taps from the secondary of a loose coupler or on a primary switch, many readers undoubtedly have a great deal of trouble. A little wrinkle which I found, eliminates all the bother caused by these taps. First the taps should be taken thru the tube in the manner shown in the illustration.

After the wire is past thru the tube, apply a small speck of sealing wax, a little away from the hole thru which the tap is brought. A little more wax is placed on the wire after it has been straightened, near the ends, which will contain the switch. By this method there are no loose wires in the secondary, and therefore none liable to cross or get tangled with the support rods.

Contributed by ALBERT W. WILSON.

A CLEVER WAY IN WHICH TO SECURE AND BRING OUT THE TAP LEADS ON THE INSIDE OF A LOOSE COUPLER SECONDARIES. THEY ARE FASTENED IN PLACE WITH SEALING WAX.

A MINIATURE RADIO BUZZER.
The base of the buzzer should be made of some tough wood or fiber, the dimensions being left mostly to the maker. The single electro-magnets consist of a soft iron rivet or brand similar to boiler rivets, but much smaller, the one needed here being about 3/16-inch in diameter and 1 inch in length. A hole is bored in the base and the rivet forced thru with the head set flush with the under side, as shown. Wind the projecting end of the core with at least four layers of No. 30 B. & S. silk-covered wire. Now, connect the ends of the coil to two consecutive binding posts, three having been erected as near the edge of the base as possible.

The armature or vibrator is made of a corset spring or something similar. The corset spring must be heated to a cherry red and then bent into the desired shape. Bend the spring as shown, so that it will stay about 3/16-inch above the magnet when mounted as shown. A hole is then punched in the spring and a short piece of silver wire riveted into it. This is one contact point. A wire is now led from the armature to the remaining binding post.

The current is conveyed to the armature thru a soft copper wire bent double and hammered together at the contact. It has a piece of silver wire or platinum soldered to it at the contact point. This wire is connected to the middle binding post and then bent over so as to barely touch the contact on the armature.

This buzzer could no doubt be reduced in size until the hand could be covered over it; yet it does its work, as well as one twice or three times as large, and it can be used to an advantage in a portable wireless set or for learning the code, etc. etc.

Contributed by HAROLD LEWIS.
A Simple Hand Milling Machine

By THOMAS REED

Honest, I'm sorry about that "Arabian alarm-clock," Boggs. I know you were just beginning to feel, whenever you saw my name attached to an article, that you were assured of a sober, dependable ex-
cient except for the fact that in operation the machine is held firmly in the vise, C, which gives all the stability required.

The soul of the machine is the index-
plate, D. This is a disc of thin metal, per-
forated with rings of holes, to which the
work is attached (see Fig. 2) and as the
plate and shift turn, they carry with
them the work G, held on by the nut
H. Long pieces of work can be steadied
by the back-center S.

While the work is being operated on—say while the ratchet-
tooth J is being filed out—the index-plate is held in a fixed posi-
tion by the spring-
lever K; a peg L, on the
end of which enters one of the holes in the plate. The
leever, with its peg, is
placed in line with any
of the circles of holes by loosening the wing-nut M, on the
bolt of which the
lever K is pivoted.

The ratchet-tooth J correctly, is sure to "come out right."

The holes in the index plate should be spaced off and drilled as accurately as possible, but errors tend to eliminate themselves, from the fact that the diameter of the index-plate is so much greater than that of the work. If you drill the plate anything like near enough to satisfy you, you will be surprised at the apparently perfect regularity of the work.

It is best to make the index plate from 1/16 inch stock, but thin sheet iron will do. If we must (which is my delight) draw on our household resources, I should think the bot-
tom of a tomato-can, carefully unsoldered by rotating over a gas-flame, would make an excellent plate. And don't forget the invaluable pie tin.

The guides, Q, Q, which hold the file P, should of course, be made out of steel, and hardened. The pivots R, R, are eccentric with the shaft E, so that the file may approach the work at different angles.

Fig. 3 shows a hack-saw guide. The disc turns eccentrically at T, forming a variable bottom-stop for the saw.

Fig. 4 shows two forms of punch-guide, where pegs are desired to be set at regular intervals, as in making rotary spark-gaps. After marking the work, the punch U can be withdrawn from the sleeve W, and the hole drilled with a hand-drill. This peg-

Fig. 4 (see Figs. 5 to 13, Fig. 5 is done by a drill and hack-
saw; Fig. 6 by two hack-saw blades in the

The various forms shown in Figs. 5 to 13, Fig. 5 is done by a drill and hack-
saw; Fig. 6 by two hack-saw blades in the

Among the many-shaped files, and one or more hack-saw blades, you ought to come pretty near producing any figure

Fig. 1. General View of the Hand Milling Machine Which Every Experimental Machinist Will Want to Build. Not Only Is It An Extremely Serviceable Device, But It Gives the Fundamental Ideas of the Larger Milling Machines. This Device, Altho Quite Simple, Is Capable of a Surprisingly Large Variety of Work.
that even the wild requirements of a “Bug” may find essential to his happiness!

Oh,—as the numbers of the holes in the index-plate; a ring of 60 holes gives you the equal divisions: 2, 3, 4, 5, 6, 10, 12, 15, 20 and 30. Another ring of 56 holes would give you 7, 8, 14, and 28. This covers most of the desirable low numbers, and shows how easily you can figure for yourselves any other factors you need.

THE PRODUCTION OF RADIUM FROM U.S. CARNOTTE ORES.

As one of the results of an agreement between the National Radium Institute and the Bureau of Mines, Department of the Interior, to develop a more efficient process for the manufacture of radium out of the carnotite ores of Colorado and Utah, the Bureau of Mines now has as its share more than $180,000 worth of radium for use in the sciences. This was procured for an expenditure of less than $8,000. In addition, under the agreement, the bureau has turned over to the National Radium Institute about 6½ grams of radium, and has given the country a method of producing pure radium compound from the ore for one-third the current price of radium.

When the Bureau of Mines began this work in 1912, it found that the precious carnotite ore, constituting the largest known supply of radium ore in the world, was going to Europe, mainly to Germany, where it was being turned into radium and sold back to the United States at fabulous prices.

AUTHORS!!

All matter intended for publication—not only by us, but by any other magazine or newspaper as well—should be written on one side of the paper only and in ink. If it isn’t, somebody else must copy part of it off on another sheet before it is given to the printer.

ELECTRICAL

A MERCURY FIRE ALARM.

Here is a drawing and a description of an automatic fire alarm which I believe will be of interest to your readers.

The device makes use of the expansion of mercury when heated. It can be quickly adjusted and requires no reset setting. The fire detecting mechanism is clearly shown in figure 5.

It consists of a glass (or brass) tube about 2” long and having a bore of ½” or a trifle more. The lower electrode has a short piece of copper wire soldered to it 4” long. The rod is fitted into the tube as shown and then the end of the tube is filled with the sealing wax. The rod should not fit too tight or its expansion will break the tube.

A small rubber cork that fits the tube tightly has a needle run thru it to form the upper electrode. A short length of wire should be soldered to this needle as shown in the drawing.

The tube is fastened to the base, measuring ½” by 3” by means of a brass strip and two small screws. Binding posts are mounted on the same base, and the wires are connected to them.

A few drops of mercury are put in the tube and the rubber cork and the needle inserted as shown in figure. By regulating the distance between the needle and the surface of the mercury, the temperature at which the alarm is given can be regulated.

A good method of adjusting this apparatus is to connect a bell and battery to the terminals. Place the instrument and the thermometer in an oven bath and adjust the needle so the bell just rings when the thermometer registers 110 degrees Fahrenheit.

With such a system an annunciator may be used to indicate from where the alarm came. This device has been used by the writer for the past two years with success.

Contributed by WALTER L. MILLER.

KEEP YOUR STRAW HAT ON TO AVOID SHOCKS.

An engineer suggests in a recent issue of Safety First the wearing of straw hats with stiff brims for those employed around electrical stations. It seems that the straw hat is far superior to a felt hat from the safety standpoint; for should the head come accidentally in contact with live wires, the rim of the hat or the crown prevents injury, and gives the necessary warning. The same holds good when working around steam pipes. In a recent accident, where a man unconsciously came in contact with a 12,000-volt line, he would have been protected had he worn a straw instead of a felt hat.

The singing of telegraph wires is sometimes regarded as a weather prognostic, though opinions differ as to the kind of weather it foretells. There has been much discussion as to the cause of this sound. Probably it is simply the Aeolian harp effect, and its occurrence depends chiefly upon the direction of the wind in relation to the direction in which the wires run. Variations in the pitch of the sound depend upon changes in the tension of the wires with varying temperature. Electricity, contrary to popular belief, has absolutely nothing to do with the singing.

A SIMPLE BUT POWERFUL HAND-FED ARC-LIGHT.

The arc-light shown can be made from odds and ends at a very small cost and can be used for wide variety of purposes. A piece of wood for the base, some strips of brass, a few battery binding posts, screws, drop cord and plug, and two battery carbons in a fruit jar, with a small piece of fiber insulation are all the articles needed to construct the arc. The fruit-jar resistance is one novel feature. Two ordinary battery carbons are held at a fixed distance from each other by two strips of fiber, the bottoms being about ¼ of an inch and the tops about ½ of an inch apart. Rubber insulation cut from an old tire may be used for handles at the end of the strips holding the arc carbons. By moving these handles the arc may be raised or lowered or fed together. After the wiring is completed fill jar ¾ full of water, add a little salt and connect the plug with a regular 110 volt house light socket. This will make it necessary to put heavier fuses in the fuse block. This arc will melt any substance placed between the carbons, as it will give from 3/4 to 1 ½ flame. If a housing is placed over the base, as shown in dotted lines, and a reflector used with a common reading glass in the sleeve, the arc will cast a powerful beam for a distance as much as 2 or 3 miles.

Contributed by CARLYLE WALTZ.
The Manipulation of Glass Tubing in the Experimental Laboratory

By Prof. HERBERT E. METCALF

PART I.

In the experimental laboratory there is always a demand for small pieces of apparatus which are made out of glass, and yet are usually too high in price to be purchased on the market. Again, when the apparatus may look simple to make, most all experimenters, after breaking enough glass to nearly pay for the finished article, give up the job in disgust and worry along without the apparatus. But if they had a little knowledge of simple glass-blowing they would save many dollars, and enrich their laboratories with many pieces of apparatus not otherwise obtainable.

In the first place the manufacture of small articles out of glass tubing is not hard; in fact, with the proper glass, the proper heating agents, and a little patience, nearly every commercial article made from glass may be functionally duplicated. You will notice that I have said "functionally" because often it is not possible nor at all necessary to duplicate the article. Its function is the standard, and if the home-made machine will do as good work, that is all that is necessary.

THE KING OF GLASS TUBING TO USE.

To begin with, the glass tubing MUST BE fresh. The experimenter cannot expect good results from glass tubing which has been lying around his laboratory since the year one. That is why such poor success is attendant upon many efforts in this direction. He will have to go directly to the largest supply house in his city for the best, softest glass tubing suitable for bending. To get hard glass such as boiler glass tubing will spell failure immediately. If there is no supply house close at hand then write an order to the nearest large supply house, in all cases specifying explicitly that the tubing is to be fresh soft glass to be used in the flame. Given the proper tubing be obtained from the local hardware store, as it will probably be many years old. All this is extremely important, for the entire success of all future operations will depend upon the quality of the glass. Glass tubing becomes brittle with age, and a piece of tubing much over a year old is very apt to crack no matter how carefully heat is applied.

EQUIPMENT NEEDED FOR THE MANIPULATION OF GLASS TUBING.

For simple bends in tubing an ordinary Bunsen burner is needed, provided it be equipped with good fuel. In fact, all work which does not need fusion may be done with a burner of this kind.

For more complicated work which does require the fusion of glass, an air blast must be added to the flame in order to obtain the high degree of heat necessary for the proper joining of the glass. This may be simply a small tube held in the mouth. By blowing air thru a yellow flame a fairly good blast burner may be had, but it is not very satisfactory because a steady blow cannot be maintained, nor can the size of the flame be suitably regulated. The most practical thing to do is to buy, new or second-hand, an adjustable flame blast lamp. The air supply may be obtained in several ways; from a pump, foot blower, or a water jet air pump, of the type described elsewhere in this issue.

An asbestos mat such as used on the table may be obtained at any hardware store, and is needed to lay the hot glass on while it is cooling. Hot glass must NEVER be laid on metal to cool, and as it will burn other materials this mat is indispensable.

The blast lamp must be placed on the experimenter's table with the flame directed away from him and with the mat on his right, so that he will be able to use both hands on the glass tubing, and then place the finished product on the mat to cool. Fingers are better that pieces of any kind and a pair of kid gloves will save the hands from many a sharp burn. A supply of small corks to fit all sizes of tubing may be obtained from a supply house or may be whittled out of drugstore corks. These are very important in nearly all operations and may be used over and over again. Several feet of rubber tubing of various sizes, a generous stick of sealing wax, and a sharp three-cornered file fits us out.

Now that we have assembled before us all our materials; the glass tubing of the diameter required, the burner in its proper position connected to its gas and air supply, the asbestos mat and the corks where they may easily be gotten at; we will take up the file and proceed to the first operation, cutting the tubing to its proper length. The following operations should be very carefully read over before being performed, even going so far as to rehearse before hand, because there is nothing so discouraging as to sneak a look at the printed directions in the middle of an operation, and then returning to work only to find that the glass had cooled off while we were reading. It should have been kept hot, and when the flame played on it again it cracked.

CUTTING GLASS TUBING.

Glass tubing up to one-half inch in diameter may be cut with a sharp three-cornered file. Place the tubing in front of you and make a single deep cut in the tube at the proper length, and then break it by grasping the tube in both hands, one on each side of the cut, with the thumbs meeting directly opposite the cut, see Fig. 1. Then push outwards with the thumbs, and a square clean break will result. In case one end is short, wrap your handkerchief (Continued on page 340)
TRICK "SHOCKING BATTERY."  
A "shocking battery" represents a novel departure from the ordinary shocking coil, and is nothing more or less than just such a coil, enclosed in a case so that it closely resembles an ordinary dry cell. How to make it: First turn down a wooden block to 2 1/4" diameter and 1/4" thick. Leave a small extension 3/8" thick and 1/8" diameter on one side, to resemble the carbon rod of a dry cell. Drill holes for the binding posts and cut four small slots at the edge 90° apart for the battery supports. When finished paint the block black and place in the binding posts. It should now closely resemble the top of a dry cell. Cut two blocks to 2 1/4" diameter and 1/4" thick. Drill a hole large enough to accommodate the coil to be used in the battery. Do not drill it directly in the center, but off to one side so as to give ample room for the vibrator. The coil to be used may be an old shocking or "medical" coil, a telephone induction coil or one may be made for this purpose. Another block is now turned down to 2 3/4" diameter and 1/4" thick and properly notched for the supports. On this block is mounted a small single-pole, single-throw side-action switch and two binding posts for the primary. The complete battery is now assembled, connections being made and parts fastened together by the battery supports which are wooden strips 6" long and fit into the notches provided for them. The battery is now rapt up in some card board or heavy paper. It would be well to fill in the space around the coil with some insulating compound to increase the insulation. The whole is now placed in a sheet metal container fastened to the same with screws which is in turn placed in an old battery carton that has the bottom knocked out. A concealed flexible lead is now connected to the primary binding posts and the "battery" is ready for action. It may be operated by a flash-light battery concealed in the case with the coil. Initiate your electrical friends by having this "battery" on the table beside several other regular cells. They will see that you will bet they cannot connect up the cells properly, in series, parallel, etc. Let 'em have it, when they get to making the connections.  
Contributed by L. SVOBODA.

**A NOVEL ELECTRIC ENGINE.**

In Fig. 1 of the illustration is shown the side view; in Fig 2, the end view; while the cut Fig. 3, gives the working details of armature "S." The connections are shown in Fig. 1. In reference to the lettering of the illustration "P" are two binding posts, next a brass support for M an ordinary electro-magnet, B is a copper or phosphor bronze brush which makes contact with the projection on S. A sheet-iron swing S is made after the model in Fig. 3. It swings on the axle A'. B' is a brush-making contact with A'. A" is a shaft which joins the connecting rod C to the swing S. A 'is a shaft to which it fastened the fly-wheel F, and a small pulley. Dimensions can be made to suit the constructor.

I have used this motor for some time and have found it satisfactory in every respect.

Contributed by PAUL NACHEMSON.

**HOW TO "STEEL-PLATE" PARTS.**

"How automobile parts and all sorts of machinery are steel-plated" should be an interesting topic to the readers of the "E.E."

Purchase some Potassium Ferrocyanide in a drug store or other chemical house. Great care must be taken in handling this chemical compound as it is one of the most deadly poisons. To show its fatal effects, one can perform the following experiment. Drop a small piece of this compound into an old enamel coffee cup. Immediately its head begins to droop and then the cat stretches itself out and dies.

Dissolve some of this Potassium Ferrocyanide in water and put it in the iron to be steel-plated. This should be left in the solution for about 48 hours. After the iron is taken out it is heated in a furnace or even over a stove for a short while. Then a steel coating is permeated into the iron. From the chemical standpoint the action is a very easy matter to explain: After the iron is taken out of the Ferrocyanide it has a practically pure coating of iron. Then when it is placed in a furnace, the carbon escaping from the coal, unites with the pure iron coating to form steel.

This is used a great deal in auto parts manufacturing.

Contributed by A. MENCHER.

**HOW TO MAKE A SMALL COMMUTATOR.**

Procure a piece of brass tubing the diameter and length you wish your commutator. Push pipe used by plumbers is very good for this purpose. It comes in sizes from 3/4" inside diameter up to 2" and is seamless and uniform. Square up the ends in a lathe or if one is handy, on, if not, a file and try square will serve. Then set the dividers and scratch lines around the tube from 3/16" to 1/4" depending upon the diameter. Space off the tube into as many segments as there are slots in the armature, and, with a scriber mark the sections where they are to be divided. Use a fine hack saw, or a piece of clock spring held on edge in the vise and hacked with a sharp edge file. This makes an ideal saw for the purpose. Saw along the dividing lines from each end until you reach the lines A-A, as in Fig. 1. After all the slots are sawed take a saw file and file down each until the tube has

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*Figure 1: Cross-section of the electric engine.*

*Figure 2: Diagram of the steel-plate process.*

*Figure 3: Commutator.*

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*Harry L. Allen, Jr.*
Experimental Mechanics

By SAMUEL D. COHEN

LESSON VI.

Thread Cutting and Metal Turning

Considering that the novice has become thoroughly familiar with the rudiments of plain "thread cutting" as given in the last lesson, and taking also into consideration that the amateur has become a junior master of handling the shift gear problem, the author will now further discuss the subject.

As the student will remember from the preceding lesson the subject of cutting "V" threads was under discussion and now a second type of thread will be taken up and this is the square thread. A very good illustration showing how a square thread looks is given in the first illustration. For cutting such a thread a different type of cutting tool will be required, and in Fig. 2, we see the type of tool necessary for this kind of work. This tool is very similar to a parting tool, only that the rake must be provided for in the portion that enters the work to prevent side rubbing, thus destroying the value of an accurate thread. The tool holder as shown simplifies to a great extent the cutting of a square thread. The tool itself is filed up out of a small round piece of tool steel, which is then fixed to the tool post holder by means of a set screw. The tool steel being circular in section, can be turned around in the holder before the set screw is tightened, so as to give any desired degree of rake.

The width of cutting edge of the tool must be equal to half the pitch of the thread. This is evident from the first illustration where "I" shows the pitch of the thread, which is equal to the thickness of a thread and space. The exact width of the cutting tool should be equal to the space R, or exactly equal to one-half of P. For cutting a double or triple thread, the case becomes different as will be seen from the third illustration, which in this case represents a double thread. Here the pitch P is equal to the thickness of two threads and two spaces, so that the width of the cutting tool must be exactly equal to one-quarter of the pitch P. In the fourth drawing is shown a double thread screw with only the first thread cut. When the second groove is cut in the center of the intervening portions of the work, it results in a double thread.

A very neat way of finishing off a square thread is to drill a small hole into the work at the end of the thread for the tool to run into, as is indicated in Fig. 1. The diameter of the hole should be slightly larger than the thickness of the tool, and the depth a little greater than the depth of the thread. The lathe must be stopped just before the tool reaches the hole, and pulled around by hand for the last turn or so. As soon as the tool finishes its cut, it is withdrawn and run back again in readiness for taking a fresh cut.

In Fig. 5, the student will note the various types of threads that can be cut with the aid of a lathe. It gives a splendid idea as to the kind of work the amateur can carry out with this machine if he once becomes skilled in operating it, and experience is the best teacher.

The procedure in cutting square threads is identical as for those for cutting "V" threads, with the exception that a different shape of cutting tool is used. It is impossible to cut very fine pitch square threads as the pitch of this form of thread is dependent upon the width of each tooth, which is naturally wide. Square threads are extensively used in machinery where there is a great stress, and where a large motion is desired with a minimum angular movement of the shaft containing the square thread.

The experimental machinist will find of great help a newly devised rotating thread cutting tool, applicable only for cutting "V" threads, and this tool is shown in Fig. 6. Its application to the work is shown in Fig. 7. The tool consists, as will be seen, of a disk of steel having ten distinct teeth on its rim. These teeth are graded for cutting the thread in distinct operations of the tool. The cutter is mounted on a hand slide rest, which is bolted to the ordinary lathe carriage, and the tool is adjusted to each cut by the hand lever as shown in Fig. 7. When fine work such as for taps, etc., is required, the pawl is thrown back out of action, the micrometer adjustment used, and another trip taken across the thread. Advancing the lever one hole in
the micrometer adjustment, brings the cutting point a fraction of a thousandth of an inch forward. Successive trips with advance of lever will give the finest finish possible to a thread.

The heel of the tooth in action rests upon a stop, so that it can be ground until but an eighth of an inch in thickness, and still retain the full strength and power to do the work. When once set, neither tool nor cross-slide adjustment needs to be changed in cutting the screw or any number of screws in exact duplication. This type of tool requires very little grinding, as the point of the tool is reserved and only used in the finishing or last cut.

METAL TURNING

The author strongly advises the novice to become a thoroo master in the making of threads on his lathe as after all, experience will teach him more than a thousand articles which he will read on the subject. It was the intended purpose of the last two articles to lead the student of mechanics to obtain a fundamental understanding and allow himself to grasp it thoroly by actual practise. We will now turn our attention to the next important subject, namely, "Metal Turning."

In discussing this topic, let us take a sample at random of round stock of any predetermined diameter, and let the problem of the job be to turn down one-half of the stock to a certain diameter, also having its both ends turned to a certain prescribed length, and one end to have a hole threaded with a certain thread. The first thing to be done with the job is to cut the rod of stock one-quarter to three-eighths of an inch longer than the finished length required by the job, so as to provide sufficient material with which to "face off" the ends. Blueprints used for machining operations are marked with a lower case "f" or the word "finish" on all surfaces which are to be machined or accurately finished to size.

Having done this, the next step is to turn down the ends, and care should be exercised to see that the metal taken from each end should not exceed the amount necessary to make the rod of the exact required length. The rod is placed and firmly secured in a scroll or independent jaw chuck on the live spindle, and by means of a left or right hand side-cutting knife, depending upon the position of the chuck, the end is turned down. The amateur will find it worth while to turn to lesson 3, Figs. 7, 8, and 9, to give him proper information relative to these cutting tools. When one side is finished, the work is removed from the chuck and the other side is turned down. In the lathe cut proper precaution should be taken not to take off too much material, as it will reduce the predetermined length. The photograph Fig. 9, clearly illustrates how the piece of work is held in the chuck, and how its end is being squared.

The next step is to provide centers on each end, so as to secure the work between the live and dead centers of the lathe. This is to be used only when an accurate job is required, and especially when the work is very long. In order to do this, a center drill will be necessary, and the work should be secured to the chuck of the live spindle. The center drill is held in a drill chuck secured to the tail-stock spindle. Illustration Fig. 10, shows clearly just how this is done.

Care should be taken to see that the drill is not fed too quickly or else the drill point may break.

The third step is to place the work between the centers of the lathe, and to secure it to the face plate by means of a dog. Fig. 7 of lesson 3, shows how this is accomplished. Before starting to turn the rod, carefully oil the dead center as it will heat considerably when the end of the work revolves upon it, and thus destroy the hardness of the center. To reduce one-half of the stock to the predetermined diameter, it will be necessary to utilize a diamond-point tool in the slide rest of the lathe, and with the aid of this tool proceed to take the initial cut and run the tool approximately to the center line of the work. Then bring back the tool to the original position, and repeat taking off a certain amount of metal until the (Continued on page 339)

Fig. 10. Illustrating How the End of a Shaft is Exactly and Quickly Centered By Means of a "Centering Drill" Held in a Hand-Chuck Mounted in the Tail-Stock Spindle of the Lathe. If no Centering Drill is Available, an Ordinary Twist Drill, Ground to the Proper Angle, is Used in Many Shops.

Fig. 11. Illustrating the Use of "Precision" Outside Calipers. The Calipers Are First Set on a Steel Scale to the Size Desired on the Finished Work. Never Try To Cut Before While Revolving, and Leave a Little Overstock to Be Finished Off With a File, as You Cannot "Turn" the Surface Off Smooth Enough.
Experimental Chemistry
By ALBERT W. WILSDON
Twenty-Eighth Lesson

WATER, HYDROGEN PEROXIDE AND OZONE.

The chlorides, and especially the chloride of sodium, is universally present in natural waters, being derived both from the dried salt spray in the atmosphere and from the soil. The amount present in perfectly pure water varies enormously, depending largely upon the distance of the locality from the ocean, from saline springs, from beds of rock-salt, and also, in general, upon the nature of the soil. Besides this, common salt is always present in considerable quantities, not only in animal excreta of all sorts, but also in kitchen refuse, etc., which forms a large part of ordinary sewage.

It is easy to determine, with great accuracy, the quantity of salt present in water or in other neutral solutions, by using a standard solution of silver nitrate, with a few drops of potassium chromate to act as an indicator. The red cromat of silver produced by the latter is decomposed into silver chloride as long as any chlorides remain in solution. But directly the latter have been precipitated, the silver cromat gives a red or orange color to the solution. Thus as long as there are soluble chlorides present, 
\[ AgNO_3 + NaCl = AgCl + NaNO_3 \]

but when they have all precipitated,
\[ 2AgNO_3 + K_2CrO_7 = Ag_2CrO_4 + 2KNO_3 \]

The standard solution, of the strength used and described, contains 1 gram of silver nitrat in 401 cc. of water.

Experiment No. 142.

CHLORIDES (Quantitative Determination).

Measure 50 cc. of Croton water into a beaker, and add one drop of potassium chromat. Now run very carefully, from a burette, (See Fig 128) the standard Silver Nitrat solution, stirring constantly with a rod. Notice how the red precipitat of silver chromat which is formed by each drop of the silver nitrat solution, dissolves when it is mixed in with the yellow liquid, and is converted into a white or yellowish cloud of silver chlorid.

When the red precipitat dissolves slowly and with difficulty, add the silver nitrat solution only a drop at a time, stirring well after each addition, until the color of the mixture just changes from yellow to orange or orange red. Then stop, read the burette, and the number of cc. of standard solution used (for this quantity, 50 cc. of water) will equal the number of grains of sodium chlorid in one gallon of water. Repeat this test with well-water.

WATER FOR MANUFACTURING PURPOSES.

Experiment No. 143

QUALITATIVE TESTS.

Half fill three test-tubes with well-water, and test them as follows:

1. For Chlorides—Add one or two drops of dilute nitric acid and one or two drops of silver nitrat. Result—precipitat of silver chlorid.

2. For Sulfates—Add one or two drops of dilute hydrocholoric acid and one or two drops of barium chlorid. Result—precipitat of barium sulfate.

3. For Lime—Add one or two drops of ammonium hydroxid and ammonium chlorid then add a little ammonium oxalat. Result—precipitat of calcium oxalat.

Repeat these tests with Croton water, and notice that in this the precipitates are almost imperceptible, altho quite distinct in the well-water.

Quantitative Determination of Hardness.

Place in a stoppered bottle 100 cc. of Croton water and add, from a burette, some "Standard Soap Solution," shaking well after each addition. Stop when a permanent lather is formed, and when, on shaking, it sounds and feels soft.

Each cc. of soap solution used is equal to a quarter of a grain of calcium carbonate in one gallon of water.

Repeat this test with 50 cc. of the well-water. Notice the formation of a "false lather" of lime or magnesium soap before the true soft lather. With this quantity of water, each cc. of soap solution corresponds to half a grain of calcium carbonate per gallon.

MINERAL WATERS.

Experiment No. 144

Test the sample of mineral water as follows:

1. Bicarbonates of Sodium, Calcium and Magnesium.

(a) Notice that the water is alkaline to test paper, after it has been boiled for a minute or two to expel the carbon dioxid.

(Continued on page 341)
**HOW I MADE A "RADIUMGRAF."**

I am sending you a picture, or rather "radiumgraf," in the hope that it may prove of some interest to fellow experimenters.

The picture was made with a spinthariscope. It was made thru two thicknesses of black paper. The word "Radium" was cut out of heavy lead foil and pasted on the paper so as to read backwards. An ordinary photographic plate was placed, emulsion side up, under the paper. Then the lens of the spinthariscope was removed and the part containing the radium salt was placed over the first letter. It should be left on each letter for at least forty-eight hours to get good results.

As will be seen the lead foil stops the rays, while the black paper does not. In this respect they are similar to X-rays.—Contributed by VERNON G. CLEMENTS.

**A MINIATURE "BOOK" LIGHT.**

Here is a miniature light for use on books when traveling, etc. A simple book light can be made by bending a strip of brass ⅜-inch thick and 1 inch wide, as shown in diagram. Bore a hole thru it large enough to receive the lamp, which should fit snugly. Attach two strips of thin spring brass ⅜-inch wide to the other end of the first piece of brass to act as spring, which can be slipped over the cover of the book. The wire connections are shown in the illustration.—Contributed by MERREL HALLOWELL.

**THE COLLAR BUTTON AN ELECTRIC NOTION.**

Fig. 1 shows a spark gap made of a base and two binding posts of the type shown. Simply pass the wires from the secondary of a spark coil thru the posts. Next slip on the buttons, as illustrated, and adjust the distance.

In Figs. 2 and 3 the buttons are used as contact points (as for example, on a loose coupler). In Fig. 2 the board must be of a thickness equal to the length of the button less its head. Drill a hole large enough to pass the head of a button, which head is then flattened. Now place the wire in the hollow bottom of the button and solder it.

In Fig. 3 the board may be of a smaller thickness, as here the button is shortened by cutting off the bottom part (Fig. C). Drill a hole large enough to pass the neck of the button, but not the head. Flatten the head (if wanted) and the bottom. Then insert the wire and solder.

Contributed by B. DOPPEKE.

**FOR PLUVIUS’ SAKE—RAIN ALARMS AGAIN.**

I give herewith a diagram of a rain alarm which I think original. Its principle lies in the fact that, when a board is wet on one side, it warps. Referring to diagram, rain falls on board A, causing it to warp, closing contacts and ringing bell in circuit. Board A has one end free to permit its warping. The thumbscrew is turned until correct distance is obtained.—Contributed by JACOB E. VOLLMER.

**A "BLOWN" FUSE ALARM.**

Sometime ago while doing some experimenting which involved the blowing of fuses, I could not readily tell without testing for current, whether my fuse was blown or not, so I hit upon this scheme.

I first procured a base of wood of the size measuring two inches larger than the rod R, which can be of brass or copper and should have three small holes bored in it. The one at the top holds the fuse wire F. The other end of the fuse wire is twisted around the post connected to the feeder. The center hole has a spring fastened so that its tension draws the rod up against posts C, closing the bell circuit and ringing the same. The rod is pivoted at the bottom hole. The feeder should be connected to

**GLASS-BLOWING LESSONS.**

In the October number there will appear the second paper of a series by Prof. Herbert Metcalf on the art of glass-blowing. These lessons explain every step with clear illustrations, so that you can learn the subject easily.—Contributed by BERNARD COHAN.
ELECTRO ZINC PLATING.

To zinc plate steel and other metallic objects mix the following: 3 parts of zinc sulfate with 4 ounces of water. Place this solution in an ordinary glass jar; next fasten a wire to the positive pole of a battery. Let this wire lay submerged in the solution. The wire which you have fastened to the negative pole of the battery should be arranged so that it will hold some metal object which is to be zinc plated. Drop the wire with object to be plated in the solution. Care must be taken not to let the two wires touch, for this will cause a short circuit of the battery. Using a 4-volt 60-ampere hour storage battery the action of the solution will be much quicker and the quicker will the zinc deposit itself on the object connected to the cathode.

Contributed by ED. H. RANSON.

THE MYSTERIOUS FIGURE NINE.

Has it ever occurred to you what strange feats may be performed with figures? Take the simple example of multiplying it by 2, and you get 18; and 1 and 8 make 9. Five 9's are 45 and 4 and 5 make nine again. Three 9's, and 1 and 9 make 9. Four 9's are 36, and 3 and 6 make 9. Take any row of figures you fancy, say 804, and if you reverse them and subtract 804—246—you have left 074, which added together makes 18, or twice 9. Take the 18 and 1 and 8 make 9 again. If you take five figures, say 78643, reverse them, 34657, which added together makes 27—that is, 2 and 7 make 9, or three 9's are 27. Thirty-seven is another number specially adapted for future guessing. Multiply by three, 37 becomes 111: and no matter what multiple of three you use the figures in the results will all be alike. Twelve times 37 is 444, 37x21 becomes 777, and so on.

HOW TO DRAW LINES WITH WRITING PEN.

Those who have tried to draw straight lines with their writing pen and take nine times out of ten have obtained an unsightly blot for their labors. Next and clean-cut lines may be drawn with the use of the following device. The thickness of the lines will depend on the kind of pen points used. The guide arm (A) may be constructed of brass, although steel is preferable in this case. The band (B) should be made of spring steel, a piece of spring of an old clock would be sufficiently elastic. What is required of the material would be that it should hold its form and not be easily bent.

Contributed by D. HUGHES.

WAX FOR BOTTLE SEALING.

Mix resin or cheap sealing wax with an equal amount of beeswax in a water-bath. Dip bottles in hot solution and lay on side until dry.

MISCELLANEOUS RECIPES AND FORMULAS.

TO SOLIDIFY ALCOHOL.—Heat 500 parts of denatured alcohol over a water bath to about 140 deg. F., and add 1 part of gumlac and 15 parts of dry Venetian soap (powdered).

BLUING (COLORING STEEL)—Small articles made of steel are very often blued. A very convenient method for the experimenter is to place the articles in an iron pan containing a quantity of clean dry sand over a fire. Move the pieces around constantly until the desired color is achieved, then remove and plunge into clean oil. It is very necessary that the metal be colored clean.

TO GIVE STEEL A BLUE-BLACK COLOR.—At times a blue-black color is preferable to a blue. Melt together in an iron dish 10 parts of saltpeter and 1 part black oxid of manganese, and heat until a pine shaving thrown on the surface will catch fire. DO NOT ALLOW IT TO BOIL. Wire each piece of work and suspend in the mixture. Be sure that each article is completely covered. Do not let them touch the container at any point. When the desired color is obtained, wash in hot water, dry in clean savadust and oil. TO COLOR BRASS A STEEL-BLUE.—Dissolve 3 drams antimony sulfid and 4 oz. calcined soda in 1½ pints of water.

To this add 5½ drams kermes. Filter and mix this solution with 5½ drams tartar, 11 drams sodium hyposulfite and 1½ pints of water. Polished sheet brass placed in the warm mixture will assume a steel-blue color.

TO GIVE APPEARANCE OF CASE-HARDENING.—To 20 parts water add 1 part nitric acid. Immerse the piece in the solution for about 30 seconds, remove and wash in clean warm water and oil.

TO REMOVE PAINT.—To remove paint without leaving any traces use ether on a piece of cheesecloth.

NO-GLARE HEADLIGHTS.—Paste a piece of ordinary blotting paper on the inside of the glass. A light so fixed is lawful and gives a good driving light.

LITMUS PAPER.—This paper is prepared by boiling litmus, and steeping the paper in the liquid; this paper turns red when touched by acids.

ROSEWOOD COLOR.—Boil in ½ gal. of water, 1 pound logwood chips and ½ pound red sandalwood. Apply to the wood, then go over it with a mixture of asphaltum and water.

ACID PROOF TABLE TOPS.—The following solutions render a table top impervious to all reaction of acids and alkalis.

Solution No. 1—Iron Sulfate............ 2 parts Copper Sulfate............ 2 Pot. Permanganate............ 4

A rivet is fitt to hold the guide arm and band together. Make a dent with a center punch above the rivet both in the arm and band to hold the former in place, as in the case of the extension or commonly called zigzag rule. No dimensions are given, although for ordinary pen-holder (A) could equal 9", B=½", C=1½", D=½", and XY=1¼". A desirable feature of the device is that the guide arm may be folded so that the pen may be dipped in the ink bottle as shown in Fig. 1, and in that position it can be used as a clip to hold it in the pocket also. The band may be constructed in any design suitable to the maker.

Contributed by W. H. W. (Chemist.)
Automatic Aircraft Steering Mechanism
(No. 1,264,906, issued to Gustave Nordstrom.)

When any key is depressed for either a short or a long period of time, the various operations necessary to complete the printing of a character and to return the typewriter to normal position will be automatically and progressively carried out. The movement of the type bars as the various keys are depressed is caused by electro-magnetic means, and to reduce sparking at the contacts whenever the electro-magnetic circuits are opened, the inventor provides a suitable condenser to absorb the stray energy created in the circuit by the self-induction of the magnet windings. A set of selective electro-magnets and an electro-magnetic power armature are utilized in operating this electric typewriter.

Multi-Unit Telephone Transmitter
(No. 1,264,507, issued to William Wallace Hanscom.)

A novel scheme for mounting the carbon cells is employed, and also in conjunction therewith a common cooling chamber is devised so that a continuous stream of cold water or other liquid can pass into the microphone chamber and circulate by the thin walls of the carbon cells, and thus carry off the heat produced in these cells when the microphone is carrying a heavy current. In the design shown, six carbon chambers are used.

Electric-Driven Refrigerator
(No. 1,263,633, issued to Heinrich Zeidry.)

This refrigerator embodies an electric motor at the top as indicated and there is also incorporated in the makeup of the machine a special form of compressor which is used in compressing the refrigerating medium, which may be methyl chloride, and which in the course of the refrigerating process is used over again. The refrigerating mechanism and receiving scheme for installation on ships, etc., the principal object of which is a motor-operated switch which alternately cuts in the radio transmitting and receiving set on the antenna. The speed of the switch can be regulated so that radio signals can be sent out and received in alternation during brief or sufficiently prolonged periods to be effective. The switch may be operated by electric motor.

A. C. Telegraph Sounder
(No. 1,265,585, issued to Arthur W. Headsinger.)

He provides a duplex core so arranged that there will be a mutual attraction between the two parts thereof, irrespective of the character of the current passing thru the solenoid or magnet. In this way, the inventor claims, the results are such that the residual magnetism in the two core members will at all times be great enough to hold the same in memory during the passage from a positive to a negative wave.

Current Amplifier
(No. 1,264,813, issued to August J. Klimek.)

An amplifying telephone relay is interposed between the signal stations, embracing two dynamo-electric current generators designed with suitable differential regulating coils as the diagram shows. Also the inventor provides relay members in these relays which do not have any collecting rings or commutators. The amplifying coils of the relay generators are arranged so as to be cut by lines of residual magnetic force at a rotating armature shank, which is induced in the latter thru the field coils of a generator. A current from a transmitter enters in the same direction thru the central coil as thru the main field coil and thus energizes the generator; but an amplified current from this generator enters thru a differential coil in the opposite direction to that in the main coil, thus nullifying its action.

Automatic Wireless Signal
(No. 1,265,615, issued to Gustaf Engellbrecht.)

An automatic wireless transmitting and receiving scheme for installation on ships, etc., the principal object of which is a motor-operated switch which alternately cuts in the radio transmitting and receiving set on the antenna. The speed of the switch can be regulated so that radio signals can be sent out and received in alternation during brief or sufficiently prolonged periods to be effective. The switch may be operated by electric motor.

REVOLVING ELECTRIC SIGNAL FOR WATER TANKS
(No. 1,268,175, issued to Frederick J. William Meyer.)

This novel patent covers specific means for mounting the revolving electric sign which is of the circular type and so arranged as to be suspended on tracks running around the tank. An electric motor works in a toothed rack mounted around the interior surface of the sign so that it will be carried around continuously as long as the motor is operated. Electric current for operating the lights on the revolving sign is carried to the lamps thru insulated rings and brushes.

A Lamp Socket Meter
(No. 1,264,922, issued to Edmund O. Schweitzer.)

This meter involves a small electrolytic cell which is appropriately connected into the lamp socket so that after a certain length of time the elements making up this cell will be decomposed by the passage of the current feeding the lamp, and which will cause the circuit of that lamp or apparatus to open. Before this lamp or apparatus can be again used, and more electric power consumed, the owner has to screw another meter unit into the socket, a supply of which he could have on hand at all times. Novel contacts are provided whereby the consumer is notified by a flickering of the light for a short time before the current is shut off by the electro-chemical decomposition of the meter elements, so that he will not be left in the dark.
"Amateur Electrical Laboratory" Contest

In this issue we publish some interesting facts with excellent photos, describing one Amateur Electrician's experimental laboratory. Now "Bugs"—we want to publish a snappy one like it each month. Here's our proposition: Why not write up your "Electrical Lab." in not more than 500 words. Dress it up with several good, clear photographs. If we think it good enough we will publish the article in display style and pay you well for it. The prize awarded to such articles will range from $5.00 to $10.00. And "Bugs"—don't forget to make your article interesting. Typewritten articles preferred. Address the Editor of this Department.

THIS MONTH'S $3.00 PRIZE WINNER—EUGENE MCGOWAN

Herewith are five photographs of my experimental laboratory. The lower right-hand photograph shows my chemical laboratory. The table upon which the apparatus stands was constructed from an old counter that was once used in a grocery store. In the center of the table there is a small basin that serves for washing test tubes, etc. There are also spigots for hot and cold water. Shelves were placed on the top to hold the chemical bottles as the picture shows. It may be of interest to the readers of the ELECTRICAL EXPERIMENTER to know that this table cost less than $4.00 to make, including the shelves, sink and the pipe fittings. There are about one hundred chemical reagents, including a few of the rarer elements like Radium, Bromid 40X and Uranium Metal. I also have balance scales, Kipp's apparatus for generating suffocated hydrogen, condensers, burettes, and other common laboratory glass ware.

The center and upper left-hand views show the Electrical "Lab." and most of this apparatus was constructed from data given in articles that have appeared in the "E. E." In the right-hand corner of one photo may be seen the vacuum pump, which was constructed according to the directions given in the "E. E." by Raymond F. Vase, November, 1917, issue. There are also spark coils, Tesla coils, a Hughes induction balance, galvanometer, storage batteries, static machine, Leyden jars, a small dynamo, several motors, Geissler tubes, a synchronous motor made according to the one described in the "E. E." April, 1918. Storage batteries are kept in a box under the table. The top right-hand photo illustrates my Tesla coil in actual operation. It stands two feet high and throws a discharge about one foot long and several inches thick.

Phoney Patents

Under this heading are published electrical or mechanical ideas which our clever inventors, for reasons best known to themselves, have as yet not patented. We furthermore call attention to our celebrated Phoney Patent Office for the relief of all suffering daffy inventors in this country as well as for the entire universe.

We are revolutionizing the Patent business and OFFER YOU THREE DOLLARS ($3.00) FOR THE BEST PATENT. If you take your Phoney Patent to Washington, they charge you $20.00 for the initial fee and then you haven't a smell of a Patent yet. After they have allowed the Patent, you must pay another $20.00 as a final fee. That's $40.00! WE PAY YOU $3.00 and grant you a Phoney Patent in the bargain, so you save $37.00! When sending in your Phoney Patent application, be sure that it is as daffy as a love-sick hat. The daffier, the better. Simple sketches and short descriptions will help our staff of Phoney Patent Examiners to issue a Phoney Patent on your invention in a jiffy.

Prize Winner: BALDHEADFLYSWATTER. Be it known that I, Dickson Reck, have invented a startling and withal hair-raising invention for the purpose of refreshing baldpated old ladies' and ginks' who are troubled in the summertime with the usual nuisance—flies. My apparatus, which is simplicity itself, operates as follows: A small but powerful mutt "A," preferably of the genius "homo gazabo" is caused to run perpetually after the bone "B," on a tread power, said tread power being connected by means of a suitable belt to a series of cups mounted on an endless belt. This belt carries the cups around thru a tank of water, and the cups as they reach the maximum of their upward movement, discharge the water into a basin "D," which allows the water in it to ooze thru a nozzle onto a water turbine, "E." The water discharged from the turbine passes thru a shoot and back into the original water tank. The turbine "E" is belted to a flexible rubber fly-swatter "F," which when not busy killing flies and other insects, causing them to fall into the combination fly-container and cuspidor, is caused to massage the owner's baldpate with his choice brand of hair tonic. The belt from the top of the water bucket holst, connects with the ham bone "B," to make it wabble thus irritate the mutt "A" more efficiently. Inventor, Dickson Reck, Gary, Indiana.

COLLARBUTTONFINDER. Behold my latest and greatest invention! An automatic electric collar-button-finder or retriever which should be a boon indeed to all bachelors; not to mention the married gents, whose wives regale them periodically and regularly, especially on bright Sunday mornings, with long-winded exhortations and admonitions to "get out at once for church." Zipi goes that infernal collar button under the bed, of course. I provide herewith a guaranteed retriever for all unruly collar buttons, involving an automatic electric vacuum cleaner which is connected with a series of openings one foot apart all over the boudoir floor. Storage battery connects with the lighting rod on the house and is charged free. The storage battery runs the motor, and the motor runs the vacuum pump. Zipi goes his button—Wham! goes the electric switch, and Presto! comes the button from the trenches right into your jewelry tray.—Inventor, Franklin Kral, Washington, D. C.
ELECTRICITY

The "Oracle" is for the sole benefit of all electrical experimenters. Questions will be answered here for the benefit of all, but only matters of sufficient interest will be published. Rules under which questions will be answered:

1. Only three questions can be submitted to be answered.
2. Only one side of sheet to be written on; matter must be typewritten or else written in ink, not penciled matter considered.
3. Sketches, diagrams, etc., must be on separate sheets. Questions addressed to this department cannot be answered by mail free of charge.
4. If a quick answer is desired by mail, a nominal charge of 25 cents is made for each research work or intricate calculations a special rate will be charged. Correspondents will be answered.

ARC WELDING OF RAILS.

(947) Lewis F. Bailey, Spartanburg, S. C., writes the Oracle:

Q 1. He asks several questions relative to arc welding.

A 1. Your information is at hand; such a welding scheme is quite possible, but you have forgotten to mention the voltage, etc.

ELECTROLYTIC GAS PRODUCERS.

(949) John L. Shaw, Hickman, Ky., asks several questions concerning the electrolytic gas producer.

A 1. If an electric spark is past thru the medium wherein oxygen and hydrogen are mixed, the gases are instantly hurled through the entire area.

Utilizing the Intense Heat of the Electric Arc Steel Rails and Plates are Now Welded by This Method.

However, the general method is to ground one terminal of the apparatus as shown in the accompanying diagram, and the other terminal is usually of steel or carbon, depending upon the particular case for which you desire to use it.

If you refer to the article on the Electrical Furnace in the April, 1918, issue of this journal, you will obtain some idea of the use of electrodes to be used.

We make note of a particular case where in the railway companies use an electrode of steel and the rail as the other electrode, and whereby the arc causes the metal to be welded to the rail, which is the other electrode.

COMPUTING CAPACITY OF CONDENSER.

(948) R. Howell, Los Angeles, Calif., asks:

Q. 1. About the size of secondary capacity for one-inch spark coil and how to compute the area of dielectric required.

A 1. The value of the capacity for use across the one-inch spark coil secondary should be adjustable to .02 m.f., and should consist of about 2,000 square inches of tin-foil placed between glass plates at least 1/5 of an inch thick. Below is given the formula for calculating the area of active dielectric:

area = \frac{t \times C \times 10^4}{K \times 2.248}

Where: \( t \) = thickness of dielectric in inches.
\( C \) = dielectric factor.
\( K \) = capacity in micro-farads.
Area in square inches.

mass, which will cause a sudden increase in volume, or in other words an explosion will take place.

An extensive article covering a new invention which utilizes the electric current to decompose the water so that the hydrogen gas can be used for an explosive mixture in connection with engines for autos, etc., was given in the June, 1917, issue of the ELECTRICAL EXPERIMENTER. The rate of production of these gases depends upon the area of the electrodes, the amount of current flowing, the resistance of the electrolyte, etc., and it must be borne in mind that by properly adjusting any of the above values, we can maintain a constant production of gases.

RADIO TROUBLES.

(950) C. Vetter, Wessington Springs, S. D., writes the Oracle about several radio problems which are puzzling him. We advise him as follows:

A 1. The Tigerman vacuum tube to our mind is as good as the rest of the tubes from our experience. This tube can be used with good results as an amplifier.

A 2. The appended diagram shows the connection for two-step amplification. For one step amplification, leave out the third Audion circuit and place the telephone receivers where the transformer \( T_1 \) now is. A 3. We herewith give dimensions for several types of loose couplers. (3,000 meters.)

Primary 5" long x 4" dia. with No. 24 or 26 S. C. C. Secondary 4½" long x 3½" dia. with No. 28 S. C. C.

The secondary should be wound with No. 34 (Audion circuits.)

6,000 Meters

Primary 8½" long x 5" W with No. 24 S. C. C. Secondary 8" long x 4½" W with No. 30 S. C. C.

The secondary should be wound with No. 34 (Audion circuits.)

12,000 Meters

Primary 11" x 7½" with No. 24 S. C. C. Secondary 10" x 7" with No. 30 S. C. C.

The secondary should be wound with No. 34 (Audion circuits.)

Two-Step Amplification with the Tigerman Vacuum Valve and an Audion Bulb

We use finer wire on the secondary because by doing so and with a given number of turns, an increase in volume is obtained, the induced E. M. F. being propor-
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SMITH & HEMENWAY CO., INC.
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IRVINGTON, N. J.

THE ORACLE.

(Continued from page 336)

Ducing the magnetic field, the motion of the copper disc is retarded on the armature; in fact, the effect is sometimes so great as to stop it entirely.

You will therefore see that since your motor is thus limited, it must be done to this extent, and we advise you to shellac each plate of the armature and the field, and we are sure that when this is done the motor will run all right at the desired speed.

The running effect of the motor is not hampered much in your particular case in reference to the magnetic condition of the field poles. You state that the armature was turned down, the slots were cut in, etc. This is very bad for as you see the idea in the shellacking of the laminations is to insulate the stampings from one another, and therefore it is necessary to file off the slightly projecting sharp edges which result from such operations.

BOOK REVIEW.

(Continued from page 336)


A timely and useful book which should find a ready demand from all interested in aero matters, especially those belonging or intending to join the Aviation Section of the Army or Navy.

Much attention is given to details and the author has certainly covered his subject well. With a brief history of flying the reader progresses, step by step through the important phases of the art.

The reason why an airplane flies is clearly set forth, as well as the mechanical condition of the various conditions of the air, gravity, stability, pressure, etc.

A comprehensive chapter is devoted to the building of airplanes, covering practically every detail from the general design, wings, etc., to rudders and running gear.

The engine is discussed from every point of view, giving its theory, construction and application, with due such refinements as self-starters.

The closing chapter deals with the qualifications necessary to become a successful pilot, where to learn to fly, etc. The aeroplane's uses in the present war and interesting notes and data giving rules and regulations for obtaining a Pilot's Certificate are included.

A large appendix contains the following information: The Barometer, Table of Altitudes, The Sphygmatic Synchronized Engine, How to Make Aeroplane Calculations, and a chart showing the Organization of the Air Service of the U. S. Army.


It is a treatise on the subject of physical training, and gives in a very complete way the subject of marching, attention, exercises, and setting up exercises. It treats at the beginning on the rudiments of military requirements which are very essential. The different physical exercises are illustrated in various motions.

The chapter on rifle exercises is well presented. The illustrations therein show how the soldier of arms performs the various exercises with the aid of the rifle. The subject of gymnastics is treated at length. It includes exercises, gymnastic contests, one-legged tug of war, and the "tug." The subject of swimming is explained in a very clear manner, and the illustrations show the various motions and strokes. The authors give an excellent description of bayonet fighting.

OUR ARMY AND NAVY AND HOW TO KNOW IT. Edited by A. A. Hopkins, publish by Munn & Co., New York, 4 x 7 1/2 inches, profusely illustrated, 114 pages, lithographed stiff paper covers. Price, 50 cents.

The book is divided into two parts. In the first half of the book the author discusses the Army, and gives in the opening chapters the names of the
various organizations and the salaries of the men in the U. S. Army. Many illustrations are given of various items of the different branches of the U. S. Army to familiarize the civilian, or the man in the service with the different branches. A complete table is given of the forts, arsenals and catteries of the U. S. Army, also special army schools, officers' training camps, National Guard training camps, etc., attached to the army of the United States. A colored chart of Army insignia hat bands is also given, designating the character of service. An excellent double-page illustration showing the leading types of American airplanes is given. Several pages are devoted to different types of war medals.

The publishers of this book print it in a reverse manner, so that half the book is consigned to the Army and Navy. In the second half the subject of our Navy is taken up, and the same order is followed in this portion as the first. Various colored plates are given, showing the rank of the Navy officers. An excellent color plate on shoulder marks for line officers, and insignia of rank of naval officers which are worn on the sleeves is also shown, including the various badges in signs as worn by enlisted men. There can be very little chance for a civilian to be mistaken in determining the rank of the officers both in the Army and Navy, if he will compare this chart with the various manuals as given in this book.

EXPERIMENTAL MECHANICS.
(Continued from page 327)

predetermined diameter is reached. In order to guide one's self to cut to the proper diameter of the work, it will be necessary to use a measuring tool set to this diameter. The tool, known as the caliper, is of two types, one called an inside caliper used in measuring the inside diameters, and second an outside caliper for determining outside diameters. The latter is the one which we are interested in since we desire to cut an outside diameter to a certain value. It will be advisable at first to set the legs of the calipers to the value of the predetermined diameter. Fig. 8 shows how a pair of calipers are set on a stock and adjusted until the other leg touches the value which is required in the turned down rod. The cutting tool is caused to travel back and forth and a cut at each pass should be continued until the work is reduced in size so that it will allow the calipers to just pass over. At this point the diameter of the portion of the work is the correct diameter of the predetermined size. Don't jam the calipers over the work: feel the cut carefully. This is one of the tricks of the trade.

On very accurate jobs, the cutting tool is prevented from taking off any metal at a point where the diameter of the work is a trifle less than the predetermined diameter. The remaining metal is removed by either a flat file or else with emery paper or cloth. This is done because the knife is unable to take a very fine cut, so it is practicable to use a file to bring the work to the proper finished diameter. Never use the calipers to gauge the diameter of the work when it is revolving, as it will spoil the calipers or it may catch on the work, and may cause damage or an accident. Fig. 11, shows that a piece of turned down work is of a certain diameter and the manner of applying the calipers in measuring it.

This is the first job that the amateur should thoroly master, and he will be surprised to see how much patience and time is necessary to be given in producing a perfect piece of work. This is a fundamental job and should not be overlooked, as a number of the most important basic operations are inherent in this first job. Each and everyone of the progressive students of "Experimental Mechanics" should try his hand on this work and in the Seventh Lesson further interesting details as to "Metal Turning" will be given.

(Next installment will appear in an early issue)

Note the number of I. C. S. Students in your State

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<thead>
<tr>
<th>State</th>
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<tr>
<td>Alaska</td>
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**The Manipulation of Glass Tubing in the Experimental Laboratory**

(Continued from page 324)

around the short end before trying to break it, to prevent the glass from flying and cutting you in case you haven't had a long break. Immediately after breaking, smooth off all sharp edges of the broken ends with short quick strokes of the file. This is much quicker than cutting them with emery or coarse sandpaper. The file serves the same purpose. Never leave glass tubing around the laboratory with sharp edges, for it is not as safe as you think it is, as they are broken, and save yourself and your friends from being cut.

Tubing larger than one-half inch in diameter is somewhat harder to cut successfiully. If one has a special cutter which will cut a groove around the inside of the tube it may easily be done. One way, if no center is available, is to cut a deep groove half way around the outside of the tube and then try and break it as with the smaller sizes. This method is not successful, depending on the quality of the glass.

Trying to cut very large glass tubing without a special cutter is very unsatisfactory, yet may sometimes be accomplished with a file and a hot iron. File a deep notch at the point where the cut is to be made and then touch the red hot point of a spike directly over it. Repeat until there is a tiny crack started. Then by repeatedly touching the tube just ahead of the crack with the hot iron, the crack may be led around the tube. The tube is then broken and the edges smoothed off.

The old method of breaking tops off bottles may be used to obtain large tubes from tall olive jars. Wrap several layers of string around the jar and then soak the string in gasoline, alcohol or kerosene. Light the string and just before the flame goes out plunge the jar into water. It ought to crack in a fairly circular way. In doing this, if it does not, try until it does. Keep the jar turning all the time so that the heat from the burning string may be evenly distributed.

Tubes made from bottles of this kind cannot be worked in the flame as they are made from too brittle glass, but are very useful in making certain kinds of apparatus, as for instance battery jars, etc.

**MAKING SIMPLE BENDS.**

Bends in glass tubing are progressively harder as the tubing enlarges. The entire success of the bend depends on the handling of the glass in the flame. It is not enough to stick the tube in the flame and then bend it when it gets red hot. A bend made in this manner on a cold bottle will always break and will break under the slightest strain.

To obtain a sharp bend, the narrow edge of the fish-tail burner should be used, twirling the tube rapidly until there is an even reddish white glow around the tube at the place where the bend is to be made. The tube must then be taken out of the flame and immediately bent to its proper shape. A bend of over 90 degrees cannot be made in this manner. Also the tubing must not be too hot or the result will be ruined. Remember in all operations with glass tubing that it should be heated slowly, otherwise it will crack.

After a bend has been made and before it has been cooled, it must be annealed. This is done by holding the tube in the flame, without bending it, until the edge is thoroughly softened. A bend which has not been annealed has no strength.

To all widening bends a greater length of tubing must be heated. For this we use the entire length of the fish-tail burner and proceed as we did with the sharp bend. The greater the curve or bend, the larger the tubing the larger the curve will have to be. In bending large diameter tubing care should be taken that the tube is very evenly heated through its circumference, otherwise the inner part of the tubing will be weak when it is bent. A bend of the buckled sort will not be strong, and will usually break while cooling.

Making all bends these things must be kept in mind and carefully observed. First, the tube must be evenly heated and heated over the bend, second, it must be heated too hot. Third, the bend must be annealed by cooling it down gradually in a yellow flame until it acquires a coating of soot. Fourth, the bent tube must be laid down on the mat to cool.

Bends made in the above manner may take a little longer to make than the ordinary ones; and the experimenter will be amply repaid by the stability of the bent tubes, for the bend will be as strong as any other part of the tube.

It can easily be seen that by varying the length of the heated portion of the tube, and the condition of the heat during the bending, all these different shapes may be made. In small tubing bends may be made 360 degrees if necessary. In large tubing this is not practical and four right angle bends will do the work with ease when it is bent. A bend of the buckled sort will not be strong, and will usually break while cooling.

**CLOSING THE ENDS OF GLASS TUBING.**

To close the end of a glass tube properly the end should be slowly heated for a very short distance only. While the end is melting down the tube should be carefully rotated so that the closure will be even. It is quite a common mistake of many experimenters to melt until the glass meets—but the end is not fused. The glass must be firmly fused over the end or there will be leakage thru the minute hole in the unheated portion of the glass. You will find that the closed end will be much thicker than the rest of the tube and will break easily. These faults may be remedied by first blowing in the open end just as the glass fuses, and then by careful annealing of the end by soothing. Ends are most easily closed with a blast lamp as it allows the end to close quickly enough to prevent the glass from thickening. To obtain a square end on a glass tube after it has fused, it may be pressed or rotated. If this is not done, the end may be annealed and allowed to cool. The sealing of tubes containing liquids will be described later.

(See Part II in next issue)

**POPULAR ASTRONOMY.**

(Continued from page 311)

ent members. Paths of comets pass around the sun at all angles and some comets move in their orbits from west to east while others move in the opposite direction or retrograde. The behavior of the asteroids and comets is not all explained with the theory that was, until recently, universally advanced to explain the origin of the various members of the solar system.

Some astronomers have made attempts to modify the nebular hypothesis that had been the generally accepted way for so many years in order to make it fit in with more recent discoveries but none of these claim that a theory is required to explain the origin of the solar system. Several theories have been advanced but no new theory has yet definitely replaced the old nebular theory of the noted French astronomer Laplace.

(Next installment will appear in October issue.)
ELECTRICAL ENGINEER

ALGERIA HAS IMMENSE WATER POWER SITES.
A French engineer has found 53 localities in Tunis where dams can be constructed that can be made to yield from 30 to 600 horsepower of continuous energy.

EXPERIMENTAL CHEMISTRY.
(Continued from page 325)
(b) Add some acid to the water. Notice the effervescence of carbon dioxide gas.
(c) Boil some of the water in a beaker for 5 minutes. Notice the white deposit of calcium carbonate and magnesium carbonate, which dissolved with effervescence in acids.

2. Chlorides, principally Sodium Chlorid.
Determine the amount of sodium chloride in the water, as described above, using however, only 5cc of water for the test, diluting it with a little Croton water (distilled water will give more accurate results). In this case the number of grains of salt per gallon is found by multiplying by 10 the number of cc of solution used.

3. Sulfates.—Test for these with barium chloride and hydrochloric acid. In most of the common mineral waters this test will yield a faint result.

4. Iron.—In siphon waters and in most of the table mineral waters this element will not be present. When testing Saratoga waters, however, many others where even small traces of iron are present it is generally possible to notice the brownish flakes of Fe(OH)₃ floating in the water. To prove its presence, add enough nitric acid to make the water slightly acid, warm for a minute or two, and test for (Ferric) Iron with NH₄CNS.

5. Calcium and Magnesium.—Add ammonium hydroxide, ammonium chloride and ammonium oxalate to some of the water. Result—precipitate of calcium oxalate. Heat, filter carefully, and test the filtrate for magnesium with Na₂HPO₄.

HYDROGEN PEROXID.
Hydrogen Peroxid, H₂O₂, was first prepared by Thenard in 1818, who named it "oxygenated water." Its occurrence in nature is not abundant, but it is sometimes found as traces in the atmosphere, rain and snow.

Preparation:—
Almost any acid acting on barium dioxid (BaO₂) will yield hydrogen peroxid, thus:

BaO₂ + H₂S₂O₃ = BaSO₄ + H₂O

Other reactions being:

Na₂O₂ + 2HCl = 2NaCl + H₂O
BaO₂ + H₂P₄O₆ = Ba(HPO₄)₂ + H₂O
BaO₂ + CO₂ + H₂O = BaCO₃ + H₂O

Hydrogen peroxid solution when used for medical purposes must be as free as possible from soluble salts, especially barium, and for this reason, only such acids as sulfuric and phosforic (usually both), which form insoluble barium compounds, are used.

For bleaching, oxidizing, and as a preservative agent, the Magnesium or Calcium peroxid may be used in conjunction with such organic acids as give rise to harmless soluble salts, thus:

2CH₂O₂H₂ + 3MgO₂ = Citric Acid

Mg₃(C₄H₆O₇)₃ + 3H₂O
Mg₂(C₂H₃O₄)₂

Sodium peroxid (Na₂O₂), when dissolved in water, forms the unstable meta-borat (Na₂B₂O₄), which with the carbon dioxid of the water is converted into borax and sodium carbonate.

From Wiring Bells to Chief Electrician at $5200 a Year

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NaBO₃ + H₂O = NaB₂O₄ + H₂O
4 NaBO₃ + CO₂ = Na₂B₂O₄ + Na₂CO₃

By using 14 grams of perborate for each 100 cc. of water, a 10 volume hydrogen peroxid solution is obtained.

For preparing the medicinal solution of hydrogen peroxid, barium dioxid is first hydrated: BaO₂ + H₂O = BaO(OH),
by slowly adding to it about double its weight of distilled water, ice cold, and, after standing about 30 minutes, either phosforic or sulfuric acid with water is gradually added with constant stirring, keeping cold by employing ice, until the mixture remains slightly acid. It is then made neutral by adding more of the dioxid.

Properties:
Physical:— It is a nearly colorless (slightly blue in quantity), syrupy liquid.
It possesses a metallic, corrosive taste, and pungent odor. It is miscible in water.
Its specific gravity is about 1.5.

It volatilizes at about 84 degrees F.
Chemical:— It readily decomposes into oxygen and water, even when in dilute solution, especially if exposed to heat or sunlight. Concentrated solutions are unstable, and will decompose, increasing in rapidity with rise of temperature, and near 100 deg. decomposition usually takes place with explosive violence.

2H₂O₂ = 2H₂O + O₂

Explosion of concentrated solutions may also be caused by the introduction of solid matter or finely divided platinum, iron, manganese, etc., or of oxygen.

It is one of the strongest oxidizing agents and antiseptics, and will even oxidize silver, due to liberation of free oxygen, perhaps as ozone.
Strong solutions bleach the skin white, as well as bleaching organic pigments, hair, feathers, bone, etc.

It also reduces, as well as oxidizes and is a powerful disinfectant and germicide.

Uses:
The chief use of hydrogen peroxid is as an antiseptic and germicide. While this is by far the most important use, the solution is employed sometimes by artists to renovate old paintings. Its oxidizing action adapts it as a bleaching agent for cotton, wool, silk, ivory, hair, oils, etc. It is also used for sterilization and preservation of foods. It is employed in photography to remove the last traces of "hypo" from prints. Tests:

Upon the addition of hydrogen peroxid to a dilute solution of potassium iodid con-

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either (CrO₄) oxygen which forous. (guaiac, blue.

beer September, e If ozone

Ozone HISTORY.

When a static electric machine is in use, a peculiar and characteristic odor is present. It is also observed, to a slight extent, in the air after a thunder-storm. Van Marum, in 1785, described his observations, and that he had obtained the same odor in the gas given off from the anode when alkalized water was subjected to electrolysis. Schönbein applied the name ozone, signifying a smell.

PREPARATION.

Ozone is evolved at the positive pole in the electrolysis of water alkalized with either sulfuric or chromic acid. It is also formed by the current discharge of electricity throng air or oxygen. Fig. 131, shows a tube known as Siemens Ozone Tube consisting of a glass tube covered with tinfoil, which is divided and has the larger one covered on the outside with tinfoil. The outer and inner coatings are connected to an induction coil while a current of air or oxygen passes thru.

It is also obtained when phosphorus is permitted to slowly oxidize in the air, or when oxygen is past over pieces of moist phosphorus.

PROPERTIES.

Ozone is a colorless gas with a peculiar odor, such as is noticed about moist phos-

phorus. It reverts very gradually into ordinary oxygen, which is change hastened upon heating. Ozone dissolves readily in the volatile and fixed oils, and at 12 degrees water dissolves one-half volume of the gas, which solution is gradually converted into oxygen and hydrogen peroxide, thus: H₂O + O₃ = H₂O₂ + O₂

It bleaches organic colors, such as indigo, litmus, etc., phosphorus, sulfur, arsenic, and all metals, excepting gold and platinum, are commence to react into their respective basic oxides, ammonia being oxidized to ammonium nitric. Silver is blackened through the formation of black peroxide, and lead sulfide is converted to lead sulfate.

Detection:

1. (Paper moistened with potassium iodide solution and starch paste turns blue when exposed to an atmosphere of ozone, thus:

2KI + H₂O + O₃ = O₂ + 2KOH + I₂

Other oxidizing agents, as chlorine, bromin, nitrogen dioxide, also produce this reaction.

2. Paper impregnated with a tincture of guaiac, and moistened with water, turns blue.

3. The bright surface of silver is blackened by ozone, no other oxidizing agent producing the same effect.

4. Paper moistened with a solution of tetra-methyl-diamido-dipheny1-methan in acetic acid, gives a violet color with ozone, yellow with nitrogen dioxide; deep blue with bromin or chlorine; and no color with hydrogen peroxide.

Uses — Ozone is employed in industrial bleaching processes; for the destruction of fusel oil in alcohol; for the cleansing of wine and beer flasks; and, for the sterilization of water.

(To be continued)
EXPERIMENTERS! ATTENTION!!

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The most important point is that the telephone receiver spool comes already wound complete, and the Experimenters will, therefore, not need to wind his own spool.

The outfit when assembled comprises a highly sensitive CARBON GRAIN MICROPHONE with carbon diaphragm of exactly the same type as is used with our $15.00 Detectophone. (See our Cat. No. 19.)

The receiver is a special low resistance double pole type with the difference that no magnet is used in the same for the reason that the function of this instrument is electromagnetic, the same as all loud-talking phones.

The spool is wound with special enamel wire for five ohms, standard with our Detectophone.

This instrument works best on four dry cells, and particular attention is called to this fact. In order to work, the loud-talker requires a fairly heavy current, and for that reason thick wires must be used for connecting the transmitter with the loud-talker. If this is not done, the voice will be weakened considerably. If no heavy wire is at hand, more batteries must be used to compensate.

USES: This instrument can be used to transmit phonograph music from one room to another; used as a Detectophone; as a Radio Amplifier; as a telephone extension (by placing the regular telephone receiver against the sensitive transmitter with the loud-talker); for salesmen to talk "through" window (Loud-Talker outside in street, microphone transmitter for salesmen, talking into same); for restaurants for talking to the chef, and a hundred other uses. Many young experimenters are developing a lucrative business selling this appliance to various merchants at a good profit.

Outside of the two instrument parts, one hundred feet cord is furnished with sensitive microphone as shown; instructions, etc., are furnished.

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The Einthoven Galvanometer, Its Theory, Operation, Construction.

(Continued from page 319)

No. 30 drill, and are used to take out the leads from the winding. Core the ball end is carefully shelled and covered with two layers of paper for insulation. The bobbin is then wound evenly, full with No. 24 double cotton-covered magnet wire. Leads are carefully removed from both ends and properly secured so as to prevent them from breaking off at the ends. The magnet yoke is made from wrought iron bar and its lay-out is given in Fig. 7. It is very essential that the drilling should be very accurate and dimensions carefully followed, as the accuracy of the whole instrument assembly depends upon the drilling of these few holes. After the coils are wound they are then set in the respective holes in the yoke and firmly secured therein by set screws or by a close fit.

The active magnetic pole pieces 5, 5a are used for concentrating the magnetic field in the string region, and Fig. 8 shows their construction. They are also made from wrought iron. Altho their shape may seem peculiar, yet it was found thru actual test that the magnetic field was strongest with this type of construction than with any of the others that were tried. These pole pieces are fastened to the electro-magnet pole pieces by means of 8-32 set screws as noted. Two auxiliary pole pieces 6, 6a are used to increase the magnetic path service and also as a means of supporting the viewing telescope. Their details are given in Fig. 9. The telescope hole is drilled to receive a three-eighths inch tap. This should be of No. 40 thread pitch.

The movable wire-supporting stand 7, is made as shown in Fig. 10. It is composed of a solid brass rod three-quarters of an inch in diameter and cut to size with two 8-32 tap holes at each end as indicated. This is secured to the wood base, and a projecting arm 8, Fig. 11, is used to support the wire containing tube 10. It is made from stock brass measuring 3-5/8x7/8x1/8, and the two holes are made at each end, one 7/8 and the other with a No. 18 drill, as shown in the figure. A tension controlling tube 10, is inserted in the 7/8 hole, and this is made as indicated in Fig. 12. The 4-32 tap hole is used to secure a notch piece, Fig. 13, to prevent the tension rod Fig. 14, from turning when it is tightened or released. This rod is made from a No. 10 brass rod. One and one-half inches from the end, cut a three-sixty-four inch slot, three-sixty-fourths of an inch deep. This can be done easily without either a shaper or milling machine, by taking two hacksaw blades and securing both of them in the hacksaw frame. Care should be taken that the teeth of both be in the same direction. The rod should be firmly secured in a vise.

(To be continued)

<table>
<thead>
<tr>
<th>Material of Fibre</th>
<th>Diameter of Fibre</th>
<th>Resistance in ohms</th>
<th>Period in seconds</th>
<th>Magnification Factor of Merit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Silver wire</td>
<td>0.020 mm.</td>
<td>4.7</td>
<td>-</td>
<td>500</td>
</tr>
<tr>
<td>Silver plated</td>
<td>0.020 mm.</td>
<td>30.000</td>
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<td>63,000</td>
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<td>&quot;</td>
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**POPULAR DEMONSTRATION OF THE THOUGHT TRANSFERENCE AND OTHER PHENOMENA.**

(Continued from page 304)

To note the action on the pulse over a great distance, suspend a coil of wire from a room fixture (aerial) and to the latter connect a wire (see experiment III and Fig. 3) with the pit of the stomach of percipient (overcloth). If you are not willing at a distance (in the percipient's direction) the latter may be informed over the telephone the moment he wills by another who announces the fact the moment the pulse of the percipient is retarded. I have successfully conducted this interesting experiment at a distance of 41 miles.

**EXPERIMENT II.**—Showing the effects of concentrated thought. When sudden concentrated thought (arithmetic problem) is executed, some agents may influence the pulse but all may do so if RED MATERIAL is placed on the agent's head.

Note the influence of different colors on intense thought or willing by the agent. RED and PINK, or RED and PURPLE decreases the effects of the pulse.

**EXPERIMENT III.**—Showing that concentration of the mind is literally true. To prove this brain focusing, let the agent concentrate the mind on one of several wooden or paper objects in the room. One end of a...
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hands are extended at the latter site, no effect on the pulse can be noted until one hand is removed. The human is essentially a battery, and the finger tips of one hand positive electricity is discharged and from the other hand, negative electricity. One electrical action on another female and therefore, no energy evolved until one hand is removed.

The vibrations from the hand cause a contraction of the heart (reflex) which is practically telekinesia on a small scale. Note that, with subdued light the energy from the fingers will cause normally no effect at all. If a magnet is placed opposite the fingers, it is seen that the energy is there, but no concomitant action on the pulse at a further distance than in the light.

Man is a transformer of energy which be, however, in various parts of the body. It is noticed that the pulse effects are greater after exposure of your body to an intense light or a charged magnet than before it.

Note that when several persons grasp hands and one of the persons presents the fingers of his disengaged hand at the pit of the stomach of the percipient a greater affect is noted.

EXPERIMENT VII.—Showing that polarity is a matter of magnetizer of magnetic materials. On either side of the windings in the neck, (Fig. 4) are the right and left pneumogastric nerves. When these nerves are reversed, the normal movements show less amplitude and when they are deprest the movements show greater amplitude.

Fig. 4.—Lines indicating the site of the right and left pneumogastric nerves.

Take a bar-magnet (held at end with fingers at right angles and directed at a right angle) into a following effect on the amplitude of the needle:

**MALE**

Right Pneumogastric Nerve—
Positive pole (N) Increases amplitude
Negative pole (—) Decreases amplitude

Left Pneumogastric Nerve—
Positive Decreases amplitude
Negative Increases amplitude

**FEMALE**

Right Pneumogastric Nerve—
Positive pole Decreases amplitude
Negative pole Increases amplitude

Left Pneumogastric Nerve—
Positive Increases amplitude
Negative Decreases amplitude

Note that the foregoing refers only to the normal male and female. If, in a male or female, the polarity is reversed, the male would react like a female and vice versa. Sexual inclination is a matter of polarity and its determination may thus be demonstrated. A mistake in your deduction is a serious matter. Note that the extended finger tips of the right hand of a normal male directed to the pneumogastric nerves act like the positive pole of a bar-magnet whereas the fingers of the left hand act like the negative pole. The opposite holds good in a normal female. Note that Yellow Material, on the head or body of a normal male or female, will reverse the polarity of their finger tips. That is, the male will show female and the female, male polarity.

Changes in influence sex tendencies. Show effects with the positive or negative end of any dry cell like with the magnet. Phoebe's case experiment will suggest themselves to the interested experimenter. Remember, however, that the most mystifying phenomena rest upon the least clear explanation and the simpler a thing is, the harder it is to understand. Observe all the details as suggested. To demonstrate phenomena which have heretofore baffled the scientific world is at least worthy of patience.

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**THE GYRO-ELECTRIC DESTROYER—ONCE MORE.**

(Continued from page 313)

I urge you to make the attempt. You have the journey and it won't cost a whole lot to make the attempt. The result might astonish you, and if our joint efforts could shorten this struggle one month, even the money would be well spent.

Why not go to:

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All of the letters received read practically alike, but the strangest part about the whole story is that it is in correspondence with certain U. S. Senators, to whose attention I had brought the Gyro-Electric Cruiser, I had never thought about bringing up again and subsequently turning it over to Uncle Sam.

But, EXPERIMENTER readers evidently know and sense more than I, with my nose to the everlasting grindstone, so if my reader-friends desire to wish a new job on me—well I can only say that they will find me not to be capricious.

It is quite an idea at that, and I am glad it did not originate with me. I'd much prefer the "other fellow" endorse the scheme.

Besides, Readers, wouldn't it sound good if, after the War, we could say, casually, "I am the Gyro-Destroyer. Yes!" My dollar went into the first one—and that dollar proved SOME fighter!"

Here's my plan: A small model about 10 feet high and $8,000, figuring materials, labor, engineers, shop equipment to build it, etc. A half "life" size model, (20 feet high) would cost as much as $20,000. But what is that for 100,000 readers? Let every reader send in his contribution of any amount he can afford and we will build a model. The total amount received enables us to. If every reader contributes $1.00 we can build a complete full size Destroyer to turn over to Uncle Sam. It is self-understood that I must account for every cent taken in as well as spent. Each contribution will be printed in the magazine, as well as a final statement showing how the money was spent. If less than $5,000 is taken in the money will be returned to its owners. If a sufficient amount is collected a real working model will be built as fast as it is possible, and while EXPERIMENTER readers will be kept informed as to the progress of the Destroyer.

As soon as it is completed it will be formally turned over to the War Department in the name of the readers of the Electrical Experimenter, while a printed list giving the names of the contributors will be furnished the officials at the same time.

Now you know the arguments of the case. Judge for yourself. If you close remember that in the February issue, for military reasons, I did not divulge certain important features which tend for great efficiency of the Cruiser. I furthermore did not divulge a very important protective feature, to prevent the Destroyer from being bombed from aeroplanes above. All these features would of course be incorporated into the model, and as we would no doubt be able to obtain Government contracts for the same, when the model was being built, there would be little chance of important information leaking out.

Now, the Gyro-Electric Destroyer is in your hands. Don't be afraid to annoy us, with a stereotyped patriotic appeal urging you to sign the appended blank. As a matter of fact, I do not wish to urge you. It is entirely a matter of your judgment and whether you believe in the Destroyer.

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P. EDELMAN, Feb.

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GOVERNMENT TO CONTROL ALL WIRE SYSTEMS.

A bill to authorize the government during the war to take over control of all telegraph and telephone communication, cables and wireless stations, was recently signed by President Wilson.

The National communication lines went under Government control on July 31. It is reliably reported that the control will include telegraph, telephones and cables. The radio systems of the country already are under Government supervision.

ELECTRIC FURNACE TO MAKE WAR ALLOYS.

Plans for the erection of an electric furnace in Spokane, Wash., for the production of alloys for war uses, on a site to be furnished by the Washington Power Water Company, which is also to furnish the power for the experimental purposes, were discussed at a recent meeting held under the auspices of the industrial committee of the chamber of commerce. Those present pledged $1,000 toward the $2,000 needed. Washington State college has pledged $500.

As a symptom of the recent rapid development of Japan's commercial interests in Shanghai, Japanese lighting interests are now supplying a large proportion of the electric lamps for the city which were formerly imported chiefly from the General Electric Company in America. The fact is pointed out in the report of the Japanese consul-general at that point.

H. GERSNSBACK

A. Nothing of this kind is patentable. We presume our correspondent refers to small trench tanks which are sent out over "No Man's Land," the motion being controlled by a cable or wire. Quite a good subject of this kind have been proposed, but unless there are unusually new features connected with it, we doubt if a patent could be obtained.

Linotype Gas Lighter.

(255) Walter Lichtenberg, Tacoma, Wash., submits a diagram and sketch of an electric automatic linotype gas lighter, the idea being to have it controlled by a clock so that the gas could be turned on at a certain pre-arranged time in order that the linotype operator would not have to wait until the metal is molten.

A. This scheme is very clever, but we are quite certain that no patent can be obtained because there are no new functions contained in this idea. It is merely an adaptation of well known as well as old principles towards something that may not have been done before.

Phonograph.

(256) J. Brenton Berry, Orangeburg, S. C., thinks he has an idea whereby the volume of a Victrola can be greatly increased and the music be made more distinct. He thinks that by attaching a small piece of expanding or some such material to the arm to which normally the phonograph needle is attached, the sound will be greatly increased.

A. From the sketch and description which accompanied this article, we fail to see any greater volume of sound should be obtained by this system. All phonograph sound boxes are a microphone for reproduction.

Street Car Indicator.

(257) Gerald Lyons, Cleveland, Ohio, submits a diagram and description of a street car indicator. The idea is to have a ratchet wheel driven by a protruding notch placed on the rail. Every time the ratchet wheel hits this notch, a drum will be advanced which shows the street indicated.

A. There is nothing intrinsically new about this idea, and the worst feature about this is that schemes of this kind have always been looked upon with great disfavor by the traction companies, for the reason that anything that tends to interfere with the regular operation of their standardized equipment is not popular. It would also be more or less as useless for vehicular traffic, to have an abundance of notches of this kind on rails going thru streets, etc.

Air Compressor.

(258) G. Clarke, Toronto, Can., submits an idea of a complete air tank system whereby a large...
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automatically cuts off the electric current from the motor as soon as the speed becomes too high. This scheme is readily understood by studying the attached diagram. Our advice is asked as to patentability, etc., and if the scheme is feasible.

A. While the specific means to cut off the current as shown in the diagram is new, the general underlying principle is quite old, as nearly all compressors work on a principle of this kind, and particularly those used on elevated and subways trains. Usually a gage is made use of which has two diaphragms, the latter, when expanding, makes or breaks the contacts. It appears to us that the scheme as outlined by our correspondent seems somewhat more complicated than the existing means of this kind.

Bicycle Brakes.

(259) G. L. Koch, Braddock, Pa., writes as follows:

I have an idea for an emergency brake to be used on bicycles, to keep the right side of the front wheel tightly clamped. Such brakes could be made and sold for 25 cents.

A. There is nothing new about an idea of this kind, quite a number of bicycle brakes of this sort being in existence now.

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magnet (see Fig. 83-1). (See Lesson 12.) We could easily have predicted this result for can we not consider the helix to be many of the discs of the preceding experiment placed together? When this series of discs are placed side by side all the poles are neutralized except those at the two ends; since in the other cases a N pole is in contact with S pole. This is obviously analogous to a bar magnet. The right-hand rule slightly modified as follows is convenient in determining the direction of the field of a helix, knowing the direction of the current and vice versa. GRASP THE HELIX IN THE RIGHT HAND SO THAT THE FINGERS BEND UPRIGHT IN THE DIRECTION IN WHICH THE CURRENT IS FLOWING IN THE WIRE. THE THUMB THEN POINTS IN THE DIRECTION OF THE NORTH POLE OF THE HELIX. IF THE HAND IS PLACED SO THAT THE THUMB POINTS IN THE DIRECTION OF THE NORTH POLE OF THE HELIX, THE FINGERS WILL SHOW THE DIRECTION IN WHICH THE CURRENT IS FLOWING. (See Fig. 83-1.)

The writer suggests that the reader test himself on the knowledge of these important rules by considering the battery so as not to know the direction of the current and determine the direction of current flow, and also by removing the compass and determining the polarity.

(To be continued)

GENIUS AND ULTRA VIOLET RAYS.

(Continued from page 296)

his imaginative power together with his cheerfulness. At the day declined his mental activity diminished until he fell into a lethargy which lasted to the following day. "Giordani could only compose in the sun, or in the presence of abundant light and great heat." There have been also many geniuses who could compose only in the presence of great heat. Sylvester, a great mathematician, tells how when on board the "Invicta" beneath the vivifying rays of a powerful sun, the method of solving a multiplication problem occurred to him, and he succeeded without pen or pencil. Many other examples could also be cited but the reader can refer to them himself in many biographies.

We then see that not only is the sun the "all life giver" but that he has aided geniuses in their creative works by means of its ultra violet rays acting on the cerebral substance as stimulants.
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The process is not only practicable, but is comparatively inexpensive and simple. By means of a small disc of radium and a color screen attached to any motion picture camera, several color values of the image photographed, are given to the screen, from which positive frames are printed by a secret chemical process. A film is thus produced which contains a series of images so colored as to give, when projected, a moving picture in natural colors, without the use at all of the rotary colored shutter which is usually required. By this contrivance, the brilliance and intensity of the projected colored picture is increased and a stereoscopic effect is obtained, impossible in black and white. There is no more light required than is used in projecting white and, a speed of only 24 to the second is required; thus certain experiments being made, this speed will be reduced. The cost of the film, which is, by this process is slightly more than that for making black and white ones, while the one reproduced in the Radium Furnace moving motion pictures is considerable.

The effects obtained are marvelously true to nature. The range of tints and hues unlimted. The presence of grays and neutral tints which are always present in nature, and which soften and tone down the harsh colors, are plentiful in these pictures. Thus, in addition to showing the vivid colors, all the delicate shades and hues of flesh tints, of cloths and draperies, of the gradually changing sky tints of sunrise and sunset, are reproduced with magical subtlety.

The author had the pleasure of seeing the new wonder pictures and they certainly merited the frequent applause, as each new possibility was unfolded on the screen. In order to bring out all the beauties of these three charmingly clad young women in Greek garb danced on a lawn, and the pictures showed wonderful coloring, the trees, lawn, bushes, and soft natural hues of the girls' costumes hung beyond comparison. Then followed the scenic wonders of Yosemite Valley, Yellowstone Park, Brehal Real Veil Falls, the pleasing bathing girl pageant at a southern Californian resort, all in natural colors.

MAKING SYNTHETIC GEMS IN THE ELECTRIC FURNACE.

(Continued from page 297)

so far they have been the most successful in this class of work.

The first amongst these is the resistance furnace with electrodes of graphite with the crucible placed between the electrodes and directly into the flame. Another way of making the synthetic diamonds is to have the electrodes set in a flame of arc about 3,000 degrees Fahrenheit and the ingredients are dropped thru the flame in one batch and caught in a crucible set underneath, the crucible setting in water so that the molten mass is suddenly cooled, thus obtaining the necessary application of extreme heat and rapid cooling with the attendant and much desired pressure.

Lately Dr. Aisen's son has been the discoverer and has actually made artistic diamonds that bid fair to rival the genuine. The results have been the crowning effort of many years of thought and experiment and investigation. The method of procedure is somewhat along the following order:

1. In a crucible set in the electric furnace is placed iron of the best grade which is
super-heated until in a molten state. Then a pure grade of carbon is added and allowed to combine with the iron; when brought up to the desired degree the crucible containing the highly heated mass is plunged into cold water. As carbon is absorbed less in cold iron than in super-heated iron the action of the cooling of the mass serves to throw out the excess of carbon from the mixture. This carries, of course, some of the iron with it which forms around the edges of the crucible in the shape of diamond crystals. This is perhaps one of the greatest of all accomplishments in this field.

A very interesting procedure is the actual making of a synthetic jewel and the author had the good fortune to see the operation. One of the accompanying photos shows Dr. Aisen watching the slow process of the making of a precious stone as it grows gradually before the eyes. It is necessary to wear heavy goggles—dark ones of course—as the glare from the arc is very binding. The component elements are contained in the cup at the top of the arc and every three or four seconds it receives automatically a slight tap which allows a very minute quantity to drop from the hollow electrode and onto the stone that is in the process of making. The stone itself is perched on top of the lower electrode and the tapping process is controlled by a motor-driven arm.

In another view we see the bank of electric furnaces wherein the elements are placed in a crucible and then heated to the desired degree where they are "set" to cool in the furnaces gradually. When cool the mass is removed and the solid chunk of glass, for that is what it resembles, is broken and then comes the final processes of cutting, grinding and polishing. In all of the methods used, it is necessary to go thru the usual routine of cutting, grinding and polishing, the same as with natural stones as found in the rough.

Numerous methods have been employed in the artificial manufacture of precious gems, which apparently sound very simple as explained here, but one must not forget that many years of patient laboratory research were first necessary, to mention the study of numerical scientists who have devoted their lives in the search for Dame Nature's secrets. So that it is indeed wonderful as one always considers these beautiful man-made jewels, the product of the electrical furnace, the great stride made in the advance of the chemist's art.
ELECTRICAL EXPERIMENTER

September, 1918

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October 1, 1918, E. H. Biltz, 3296 W. Thirty-second St., Chicago, Ill.

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THE WAR MICROBE

By H. Gernsback

If we go back to the dawn of the human race we find that at the beginning the population of the earth was very small. It took literally hundreds and thousands of years before a million human beings were actually living at the same time on this globe. Many men had enemies who preyed on his existence and made life almost unendurable. Only very gradually did the race multiply. After man had conquered the more savage animals, new enemies beset him to keep the race from increasing too rapidly. Man's arch-enemy was, and still is, hunger. As long as he dwelt in the forest, primordial man had sufficient meat, which he obtained by killing animals, and being well fed, his health was good. But as agricultural man multiplied and kept on multiplying, there was soon not enough to eat and he began to starve much and often. This weakened his body considerably and a new enemy sprang up to slay him by the million—disease.

This was Nature's inexorable method to propagate a healthy race, for only by slaying myriads of human beings, for whom there was nothing to eat, could the race be perpetuated.

The human race had and still has to contend with many forms of disease, whether it be pestilence, cholera, tuberculosis or war. All of these diseases are working for Nature to keep up her “average,” i.e., the proportion of food to human beings. Let there be a food shortage for only a few years, and the population of the districts so affected will be materially reduced. Often, too, the thus reduced and starving nation becomes diseased with war and falls upon the richer nation, which by high living can afford not a weak resistance as a rule and succumbs. Thus for a time a balance between the two nations is re-established by Nature.

But well-nourished man is not always immune from disease, as is well known. He may succumb to the cholera germ as well as to the war germ, strictly in accordance with Nature's farseeing plan.

Thus, nations who have enough to eat for the time being and who consequently may be inoculated with the war microbe, as has happened so many times in history and as has occurred to the Huns in 1914. Here, too, we see Nature working out her “averages.” Side by side were France and Germany, each country of about the same area. But in Germany there were 66 million human beings, in France only about 39 million. Nature in her omniscient way to bring about a “balance” inoculated the German with the war disease, and we now witness the result where Germany is losing from three to five males, to every French male, this for the reason that the French at the outbreak of the war summoned her Allies who, now greatly outnumbering the Huns, slay them, thus reducing their numbers, thereby inadvertently executing Nature's decree. Exactly the same thing happens in every human nation, whether it be in the Middle Ages, where, in order to keep up “averages” between bees and food, the bees, after each swarming season is fall upon the males, the greater part of them being ruthlessly massacred by the workers, as in the dread of their consuming too much of the common store.

The human race has conquered many diseases and it will isolate the war microbe in time. But before that happens Nature will see to it that the non-food producing, prepondering city population is reduced in favor of the country population, so that there will be enough food for the rapidly increasing human race.

If we think of war as a disease, which finds its origin in hunger, and treat it as such, we will abolish it that much sooner.

H. GERNSBACK

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O UR NEW 400,000 C.P. AEROPLANE FLARES

For carrying out night operations under war-time conditions the Teutons, as well as the Allied air forces have often resorted to the use of "flares" as they are called. These are usually dropped from airplanes or dirigible balloons, and, suspended from parachutes, they give an intense illumination over considerable areas.

Uncle Sam's ordinance experts have something new to spring on the "All Highest" shortly—a new "flare" light that will give 400,000 candle-power, and light up a circular area one and one-half miles in diameter!

An airplane flare, with a brilliancy equaling that of 400,000 candles has been perfected, says our official report from Washington. When hanging from its parachute over a German munition plant it lights up an area so brightly that an airman, thousands of feet in the air, can select any building he is directed to make a target for his aerial bomb, and, it may be added, American aviators are becoming so expert in bombing that they can usually hit the target at which they shoot.

In every European city within the zone of aerial raiding operations, the rule is rigidly enforced against the burning of lights in any building that might possibly be used as a target. Therefore, the airman must be able to supply his own means of locating the object of this attack.

When orders are received to bomb, say a particular railroad center, the aviator proceeds very much in the same manner.
Electrical

The drops, to "Hand sufficient" lifted H in idle power, section, terrain powerful.

"Flare" just what a night "Flare" can do is readily imagined by looking at this photo of a British "Heavy" and its crew lighted up by a German Star Shell. Note the camouflage on the barrel and also the captured "Boches" working at the left.

"Flare" is equal to that of a battery of from 150 to 1,750 street arc lamps, or of from 15,000 to 17,500 ordinary incandescent lamp bulbs such as are used in the home!

As soon as the flare gets into operation, a huge parachute made of the best quality of silk opens and holds the brilliant light in suspension in the air for a sufficient time to allow the aviator to select his objective or target. Having located the factory, railroad depot, ammunition dump, hangars, munition plant, or whatever the target may be, the aviator drops the bomb and proceeds on his way. His aim is certain to be most deadly with such perfect illumination as is provided by this newly perfected "flare" light.

The height at which an aviator flies when attacking depends, of course, on surrounding conditions. If the enemy is aware of his presence and is preparing for attack, he must keep up and out of range of anti-aircraft guns. An idea of the effective light thrown on the ground by this flare may be gained from the fact that, when suspended at a height of from 1,500 to 2,000 feet, it will clearly light a circular area one and one-half miles in diameter.

Belgian use new electric trench mortar.

A new development in mortars on the Belgian frontier, makes use of electricity as the prime agent of operation. Its purpose is to clear the barbed wire entanglements in the line of advance. A very novel method of timing the explosion is employed.

It can be used in close quarters where there is not ample time for the shell to enter the mortar, by grasping the shell by the wire and swinging it over the head, then throwing it into the enemy trench. When put to the latter use it functions the same as when fired from the trench mortar. The pin is pulled when the shell is lifted and swung by the wire; the action is explained by the accompanying diagram.

The shell shown here is one of the units that is placed into a metallic container and fired with its rear end forward. It is aimed

Just What a Night "Flare" Can Do Is Readily Imagined by Looking at This Photo of a British "Heavy" and Its Crew Lighted Up by a German Star Shell. Note the Camouflage on the Barrel and Also the Captured "Boches" Working at the Left.

The Belgian Electric Trench Bomb Used for Destroying Barbed Wire Fences, Etc. It Can Also Be Used as a "Hand Grenade."
How "Blimps" and Telephone Aid Artillery

THE accompanying illustration shows a Telephone Exchange Lorry of the British Royal Air Force in communication with a dirigible balloon. Many of these balloons are used for observation purposes and the observer has to be ready for almost any emergency, as he is in constant danger of being attacked by enemy shell fire or aircraft. Should the observer be attacked he descends by means of a parachute. The observer is connected to this Lorry by telephone by which he can communicate with headquarters.

The balloons used for the purpose are of several types, some being of the simple gas-filled "blimp" variety, held by a steel cable from the upper end of which they swing about in the breeze, while others are of the dirigible gas-filled design here illustrated. The dirigible carries a gasoline engine power plant and propeller at the front of the nacelle or crew's basket, by which means it can move about in the air and maintain any desired position in a considerable wind. The dirigible balloon does not have to depend on an anchoring cable and winch to pull it down, but can ascend and descend by its own power, suitable rudders largest electrolytic gas generating plants existant. These generators have a series of large cells fitted with oppositely charged plates which are immersed in water. The passage of the electric current thru the water decomposes it into its constituents—hydrogen and oxygen gas (H₂O). The hydrogen gas is led off thru suitable passageways and pipes and fed into the balloons in their "beds." There are fifteen balloons now in use at Ft. Omaha.

This balloon instruction camp, one of the most efficient and best equipped, has recently installed besides the electrolytic gas generator, the first silicon plant in this country. In this new form of balloon gas plant hydrogen is made from caustic soda and ferro silicon. As many as twenty-two steel bottles, each with a capacity of 2,000 cubic feet, under compression of 200 pounds to the square inch, are filled in a single day. In actual war service on the battle-fields of Europe, powerful motor lorries, each loaded with several dozen of these gas bottles are dispatched to the various balloon depots as required. Sometimes the bottles of several trucks are all connected up to a common pipe leading to the balloon "beds."

To be a balloon observation officer is a real distinction, for besides being fully at the mercy of enemy aeroplanes, who may pump him full of bullets before he can down the attacker with his rifle or Hotchkiss gun, he must be an accomplished map reader and map draftsman—not to mention the knowledge of spotting shell hits instantly, radio operating, telephony and telegraphy, balloon rigging and maneuvers, weather forecasting, etc. When the balloonist leaves the U. S. Army school he must know all these things and many more, and be able to note and record shell hits at a distance of four miles.

An electrically operated vacuum cleaner for the teeth has been patented. Let's introduce them to our after dinner speakers!
The Artillery "Barrage"—How It Works

By H. WINFIELD SECOR

By means of the artillery barrage as it is usually employed, three major operations are carried out in a short space of time, once the hundreds of guns have been lined up almost hub to hub for the purpose, and these are as follows:—First, either a portion or all of the guns start firing on the second in a "searching barrage" extending over a considerable stretch of the enemy's ground behind his trenches for the purpose of cutting off his communications, preventing the bringing up of supplies, and reinforcements of troops. Secondly, and meanwhile some of the guns keep up a "standing barrage" on the enemy first and second line trenches. It is interesting to note that the watches used by the infantry officers in the Allied trenches, as well as those used by the artillery officers, are of the split-second type, because while the troops are to advance behind a barrage, perfect coordination must exist between the artillery and the infantry—in order that when the troops advance, the curtain of explosive shell shall advance at a certain prearranged distance ahead of the wave or waves of infantry.

The "searching barrage" is set up several hours before the time that the infantry is ordered to advance, after the enemy trenches, filling the landscape for several miles with shell holes and craters, and smashing his wagon and auto supply trains, putting an end to the enemy's possible communications. The thunderous detonation of bombs, shells, and gas shell raises the devil with the enemy, not to mention his casualties and the destruction of enemy guns, ammunition, and ammunition dumps.

Thus far we have the preliminary "searching barrage" and the "standing barrage", which latter is kept firing on the enemy's front line trenches. We then come to the critical moment when our troops are to go "over the top", and this exact time is, of course, very critical. On this is based the entire strategy of the allied artillery and infantry officers concerned. Part of the artillery barrage batteries, just prior to the moment when the infantry is scheduled to go "over the top", is ordered to start the third operation, called the "creeping barrage", which is a barrage, b e h i n d which the "dough-boys" are to advance behind the enemy trenches. The accompanying diagram of a creeping barrage, and the time-table shows how wonderful this operation actually is, especially when one stops to consider the several dozen different and highly diversified factors which enter into the firing of even a three-inch field gun. For who would believe that one could tell a hair as to just what pressure a certain charge of explosive in a cannon barrel will create, and how far it will throw the projectile? Then again we have such variables as the wind velocity, the humidity of the air, gun erosion or pitting due to wear, etc. Inverting once more to the "creeping barrage", and the troops' advance on the enemy trenches, we learn that the creeping curtain of shell-fire starts about twenty-five paces in front of the Allied trenches. In one minute the barr-
A Comprehensive Panorama of a Section of the Western Battle-front When the "Doughboys" Make an Advance Behind a "Creeping Barrage" or Curtain of Shell-fire. For Hours Previous the "Searching Barrage" Has Combed the Enemy Trenches and Supports to a Depth of Several Miles. It Has Taken Days and Weeks to Prepare the "Barrage"—But it is Worth It.
Movie Tricks Exposed

By W. EDOUARD HAEUSSLER

HOW often has it annoyed you, while lounging comfortably in your favorite motion picture theater, endeavoring to enjoy the latest photo-plays to be seated behind the pest who claimed to be on speaking terms with Francis X. Cushman and Mary Ford pick and who was forever "explaining" to his friends beside him how all of the mysteries and illusions of the movies were made and worked out in the studios. Did you ever stop to reason how they make an automobile race toward you and at the psychological moment when the auto appears to come crashing into the camera, forward movement as reverse motion. This method is also employed to produce the illusion of a man jumping from the third-story window of a building to the sidewalk and then back again, without any mechanical means or hoisting apparatus.

The various films showing an enormous speed of action are of the "Speedex" class. This novelty was first released to the public in a series of screen travelogues by Burton Holmes. In one of the films showing a steamship passing thru several canal locks, the time for the actual operation of which is figured in hours, is very rapidly portrayed on the screen in the course of a few minutes. This method also enables one to see the action of very slow and hardly perceptible motions, extending over a long period of time. In this particular type of subject, the moving of a five-story house can be cited. A freak film can be obtained by camera and one is not surprised to see a ship racing thru the water at an unbelievable rate of speed. This unique process is accomplished by taking the pictures at a reduced rate of speed, that is, less than 16 frames per second; and at successive intervals in the case of a subject, the completion of which may be a matter of weeks. When these films are projected on the screen at the normal rate of speed, they appear noticeably accelerated.

It is a peculiar fact that films photographed at a speed less than normal (16 pictures or frames per second) and projected at the normal speed show a very rapid motion. Likewise a film when exposed at a high rate of speed above normal attains a very slow action when projected.

The Ultra-cinematographic Film Camera is based on this latter principle. This type of film is exposed at the rate of 100 frames per second. When projected at normal speed, the photograph of an athlete jumping a hurdle is so slow in action, that every muscular movement can be analyzed, and exceptional detailed action giving the entire hurdle jump a floating appearance as tho the athlete actually had a pair of wings.

In Figure 5, is shown the chronological progression in the manufacture of a "movie" from the time that the camera first opens its shutter upon the scene until you are thrilled by the same scene at your favorite playhouse.

The second phase is the taking of ordinary photographs termed "Still". These photos are obtained during the taking of the scene at a signal from the director to stand still. The photo is then taken. In some instances after the scene has been filmed, the director calls for a reassembly of some crucial tableaux for a still picture. These "stills" are used for advertising purposes and are displayed in front of all Motion Picture theaters. A common belief
that one often hears expect is to the effect that these advertising placards are made by enlarging the small \( \frac{3}{4} \times 1 \) inch frames. This is, of course, utterly impossible as a distinct and sharp outline could not be obtained were these small pictures to be enlarged to one of from four to five feet in size.

The developing of the exposed films is the third stage of the process. After the films have been developed they are placed on large reels and whirled rapidly until thoroughly dry, as illustrated by Fig. 1. Black objects when photographed, appear as white on the master or negative film; white likewise appears as black. This condition is transposed in the fourth step, that of printing or the making of positive films.

Some firms procure the positive films in a non-perforated state and make use of the machines shown in Fig. 2. These positive films are put by placing them upon the master film and exposing to a strong light. They are then fixe in a chemical bath so as to retain their images without any further treatment.

Figure 3 will give you an idea of the intricate and delicate machinery and instruments that are employed for this step. After the films have been printed, these positives are run thru the polishing machine. This is an important operation, as it removes all particles of dirt and dust from the celluloid side of the film. A photograph of this machine is shown in Fig. 4. "Matting" is the fifth and most tedious portion of filmic art. Under this heading all of the scenes are placed in proper sequence. This work is again checked under the heading of inspection. Here the film goes under the close scrutiny of a trained eye to pick out all mutilated sections, blurs, scratches and the operator cuts out faded, overexposed and blurred portions of the reel. The censor's review is the "anxious seal" of all films and if they are past upon, they are ready to be distributed to exhibitors throughout the various countries. The last phase is for you, Mr. and Mrs. Reader, to decide—that of the romance, acting as a Board of Critics. For it is according to how you "take to" the film that determines its future success or failure. Film producers are attempting to please all manner of tastes and are succeeding remarkably well. This is proven beyond a doubt by the crowds that frequent the innumerable photo-play houses and theaters.

There is still another and most interesting part of the Cinematograph Industry. These diagrams are a series of visual lectures on the screen portrayed by animated drawings produced by the Bray Studios. Mr. J. R. Bray is the originator and creator of animated drawings and cartoons, a strip of which is shown in Fig. 6. His previous wonderful gift to the Motion Picture. Followers of this distinct type of comedy has stood alone in its field. Its scope has been enlarged upon by Mr. Jacob F. Leventhal, an associate of Mr. Bray, by an ingenious adaptation of Mr. Bray's creation for scientific uses. It lends itself to an unlimited degree of adaptability and has been most successfully applied. The most noteworthy use in the scientific field to which this class of motion picture film has been put is to teach rapidly and efficaciously warfare to "Our Boys" by this new method. The moving picture is being widely used in the training of American pilots in England.

The young flying officers who are sent to the Armament School there to acquaint themselves with the use of airplane guns and gun gears find their three weeks' course a most interesting one, owing partly to the large share which the moving-picture machine plays in the instruction.

The pupil is not required to sit out a lengthy lecture and read aloud from the notes of an instructor. Instead, the various branches of gunnery training, such as the stripping and assembling of guns and the various points to be observed before, during, and after flying, are demonstrated by films, accompanied by concise explanations by competent officers.

There are numerous and interesting tricks employed by the various producers to attain certain desired results. Take as an example a feature representing "Satan." He suddenly vanishes amid a cloud of smoke. This disappearing phenomena when portrayed on the screen is awe-inspiring and remarkably well executed. During the production of this scene the disappearance is (Cont'd on page 408)
The Automatic Soldier

By H. Gernsback

A science advances, and as all sorts of infernos which have thrown into a modern war, the men in the front line trenches become less and less anxious to bear the full brunt of high explosive shells, liquid fire and what not. No matter how courageous a body of soldiers, their morale is bound to deteriorate considerably under a mustard gas attack, or under a modern barrage.

As has been so often demonstrated in this war, if the men in the first and second line trenches can be demoralized, the enemy as a rule can tear quite a gap into the lines, and make his assault in strength. If we could devise some sort of device who was bomb and shell proof and who did not mind either liquid fire or the most vicious kind of gas, our front line trenches would be very much more secure than they are now. It would be difficult to storm such trenches.

This is exactly what a Danish engineer has had in mind when he recently obtained patents on a device which he terms an "Automatic Soldier." Trials recently made with the device, in which soldiers are reported to have been eminently successful.

Our front cover as well as the accompanying illustration show in a clear manner the "soldier" briefly consists of a special double steel cylinder made of shell-proof Tungsten steel or the like. There is one stationary cylinder, and a second inner cylinder, the latter telescoping into the stationary one. The entire device is set into trenches as shown in our illustration, the inner cylinders taking the place of a human soldier. These automatons may be spaced from one to three yards apart, and the operation is as follows: As there are two cylinders—one, the outer, in the form of a can, and the inner one, in can-shape, too, but with a dome at the top, and a base at the bottom. The inner cylinder rises and falls down vertically and normally the dome is level with the surrounding land. When the 'soldier' goes into action, the inner cylinder rises eighteen inches, which brings it above the parapet of the trench. In other words, the automatic soldier normally is invisible, and can be seen when the inner cylinder rises. The guns as well as the entire mechanism are entirely controlled by wireless, operated from five or more miles at a distance. If the commander wishes to open battle with his automatons—he merely notifies his wireless control station, which immediately sends out impulses, and these in a well-known manner operate the automatic soldier.

The first impulse raises the inner cylinder above the trench. The second impulse pushes the machine guns thru the slots of the dome, while the third impulse moves the inner cylinder so as to direct the fire. The fourth impulse may set off the machine guns, each of which, according to its invention, may be far enough away to give it hundreds of rounds into any given direction.

Our front cover shows the disposition of the aerial wires which encircle the main steel cylinder. It goes without saying that the fire of the machine gun can be stopt by radio by sending out the correct impulses at any desired moment. The aerial observer flying over the trench lines containing the automatic soldiers sends back his wireless reports so that the fire of the automatics can be directed where it does the most good.

The action of the device is such that the instant the guns stop firing, the inner cylinder immediately sinks into the outer one, thus disappearing from view. It goes without saying that the device cannot only be used to pump bullets into the oncoming enemy, but they can be used as well for other purposes, such as to belch forth liquid fire or to let loose a gas attack as depicted in our cover illustration. Perhaps it would not be a bad idea to equip every automatic soldier with a gas tank, all of which will certainly tend to stop the most gallant as well as vicious attack of the enemy.

While machines of this kind seem very cumbersome, and perhaps not efficient, because it may be argued that they cannot think, nevertheless they would offer an extremely much more valuable than the average soldier. For one thing, the machine knows no morale—it never retreats. It is not affected by shell shock or musketry, and liquid fire has no effect upon it. It never surrenders and never turns traitor. In order to be overcome, the automatic must be destroyed by one, possibly only by exploding large quantities of T.N.T. against its sides. As long as the ammunition lasts no soldier would care to approach it, as he would never know when the wireless would set it off, which would immediately bring the automatic into action, no doubt killing the attacker.

It is difficult to see how ordinary infantry could overcome these automatons if planted three or four lines deep. Each trench line would thus be tremendously odds, and there is not a soldier living who would stand up under the withering fire of such automatons who know no fear.

A device of this kind, of course, not chimeric, but entirely within the realms of present day science, and we would be very much surprised, indeed, if the automatons would not make their appearance soon at strategical points along the front. Nor are they difficult or expensive in construction, each unit of the automatics does not necessarily cost more than five or six thousand dollars, which is but the price of a modern torpedo. The wireless apparatus does not take up much room, while the motors which drive the entire mechanism may be readily operated by a 24-volt storage battery placed at the bottom of the large cylinder. All the parts of the mechanism is readily worked by compressed air which can be replenished easily at night after the automatics have been in action during the day.

This is the case also of ammunition, gas or chemicals for liquid fire, all of which can be replenished during the night time by men walking up to the machine thru lateral trenches.

Of course if there was no action during the day, there would be no need for replenishing gas or chemicals.

It should also be understood that these automatons can be operated singly or in groups by means of electric cables buried into the trenches, if it is preferable to use this method instead of the not always so reliable wireless.

HISTORY OF THE RELAY WHEN "HUN" MET "YANK."

There is a curious fact connected with the history of the telegraph relay. It could not be patented in Germany, and therefore could not with safety be exposed. In 1846 two young Americans named Charles Robinson and Charles L. Chapin had gone there with Morse apparatus to try their fortunes in building lines. Wheatstone had a rival instrument which he offered to sell to the government, and the price was fixed.

Some time later, the American government threw open the contract to English manufacturers. These heeded the call, and built a line from London to the French border. The English line was finished the next year, and the American government then called upon the firm of Chapin and Robinson to build a line from Washington D.C. to the Chesapeake Bay. The line was built and the government was satisfied. The word spread that the apparatus was not very satisfactory.

Once in a while, the government would throw open contracts to private enterprise. That is just what happened when the government let a contract for a line from the Lake of the Woods to the Mississippi River. The government was satisfied with the work, and the line was ready for operation.

Perhaps it is not generally known, but the government had at this time a mixed motive in the introduction of electric telegraphy. It seems that the government was more interested in the apparatus than in the lines. It wanted to get the apparatus for its own use, and the government was not satisfied with what it could buy from the English manufacturers. The government decided to build the apparatus itself, and the result was the...
Locating Submarines by Reflection

Devices for locating or detecting the presence of submarines are in great demand nowadays, for once a war vessel or merchantman becomes apprised of the fact that he is face to face with a sub-sea fighter, the officer in charge will at once put himself on the qui vive. The gun crews can at once be summoned to quarters, and if the enemy is to be located at night, the searchlight can be caused to sweep the waters, and the vessel put on a zig-zag course, these precautions having saved many vessels from a disastrous finish as the press reports of such encounters have indicated in the past. Only recently there was a case where an English merchantman spotted the periscope of a submarine—in other words, he was at once apprised of the fact that he had to face two kinds of warfare, by torpedo and by gun fire. To show that it proved valuable for the skipper of this vessel to know what conditions he was up against, it can be said that the captain caused the vessel to pursue a zig-zag course, and shortly after starting this maneuver, the boat managed to just miss by a few yards a white-nosed German torpedo. Presently the submarine arose to the surface and started firing with her deck guns. The merchantman, however, had the best of the game, for being provided with guns both fore and aft, the U-boat was efficiently bombarded and after the twenty-sixth shot the sub-sea craft was rendered helpless, and according to the report of the merchantman’s commander, the U-boat was undoubtedly sunk.

All of which leads us to the invention here presented which comprises an optical submarine detector invented by Edward S. Jones, of Mobile, Ala. In the words of the inventor, “This invention relates to improvements in a scientific instrument for locating submarines, floating mines, and other objects of menace to navigation, within a certain radius about the ship. It consists primarily of a series of reflectors, cooperatively so arranged as to show upon a magnifying mirror the surface of the sea and objects thereon within a given radius, so that it may be observed from the look-out cage at the top of the mast, as the illustration herewith depicts, thus enabling the proper officers on board the vessel to be instantly warned of any danger so as to defend the ship if armed, and to escape if unarmèd.”

As the drawing shows in detail, the look-out cage is fitted with speaking tubes as well as telephones for maintaining constant communication with the bridge and officers’ quarters. In the form of the invention here illustrated, the reflecting mirror is concaved, and has its upper end broadened so as to reflect images on the surface of the water as indicated by the dotted lines on to the magnifying mirror, on which the officer looks. This magnifying mirror is preferably graduated by very fine lines running at right angles to each other, their purpose being to assist the observer in locating the distance the reflected image is from the ship. The farther away the submarine or mine happens to be, the smaller, of course, will its image appear on the magnifying mirror, and vice versa.

A powerful electric searchlight or series of searchlights are arranged above the optical locating device just described for use at night, and the searchlight compartment is arranged with suitable windows and shutters so that the one or more beams of light used can be swept over the water rapidly in any formation desired. The device is effective over 180 degrees of horizon.

Here's the Latest Anti-Submarine Invention. The Patentee of the Scheme Illustrated Proposes to Mount a Large Concaved Reflecting Mirror and a Magnifying Mirror at Some Elevated Point, as for Instance on the Mast of a Ship, and to Thus Pick Up By Reflection the Image of a U-Boat or Its Periscope. The Magnifying Mirror Is Ruled Off in Squares to Facilitate Measuring the U-Boat's Range and Direction.

GERMANS USING MEXICAN RADIO?

Activities of Germans or German-Americans from the United States across the Mexican Lower California border, where a wireless plant is located, are now under investigation by Government agents.

Reports indicate that for months groups of about fifty Germans, changing every week or ten days, have been found in Mexicali, a torrid little collection of baked shacks just across the border from Calexico, Cal.

The Germans, who were never known to visit the town before the war, now congregate at a store started recently by a German. This German is known to have been active in propaganda work in the United States before the war. The Germans have used the wireless station there, which is capable of communicating with Mexico City.

Government officials profess not to know how the Germans reached the town from the United States, since the railroad is carefully watched. It is suspected they cross the border at a number of points in sparsely settled communities.
An Electric Speed and Direction Indicator for Trans-Atlantic Planes

It is easy enough to read of making a Trans-Atlantic aeroplane flight, but when it comes down to actually making such a trip, no one but an experienced aviator, or one who has studied the subject very closely, can imagine just what this means. In the first place, the layman thinks mostly in terms of horse-power and wing surface, and he argues: Given sufficient of these two quantities and a good pilot, there should be no trouble at all to fly across the Atlantic Ocean at its greatest breadth, of say three thousand miles or more. But he forgets one thing, and that is, that it is almost impossible for an aviator, no matter how experienced or well traveled he may be, to steer a course across such a vast expanse of water as the Atlantic Ocean, for he cannot check his route by any familiar or well-known land-marks; and even when using the latest scientific apparatus, such as the Sperry Synchronized Drift Set, which utilizes the wave movement or a succession of movements to warn the aviator how his machine is being drifted or forced sidewise from the desired course, he would be at a loss to utilize such an instrument whenever the visibility happened to be low, and particularly when low-flying clouds or mists were encountered, which would cut off his view of the underlying water. The same problem would confront him during night flying, especially when the moon happened to be obscured.

The idea held by most of the aeronautical engineers who have discussed this idea in the technical press. As has been pointed out in several of the discussions concerning this method of indicating the direction of flight of an aeroplane and the mileage covered, there is the objection, albeit slight, that

(Continued on page 412)
Searchlights Mounted on Anti-Aircraft Cannon

The electric searchlight has been advantageously combined with many different forms of war machinery in the past few years of the great international calamity across the sea, but possibly one of the most unusual adaptations of the electric searchlight is that shown herewith, which illustrates how the English cannon employed for the defense of London against enemy aircraft, was fitted with a small searchlight in order to increase the rapidity and accuracy of fire. The anti-aircraft gun is mounted on a tall building or promontory, or else on a high powered motor truck so as to speed rapidly from place to place. Such a combination spells deadly accuracy of fire, as anyone who has experimented with the electric flashlight pistol will have found, for when the searchlight or flashlight beam was centered on the target, and the shell or bullet dispatched, it struck the center of the spot of light on the target; in the present case, it would strike in the center of the beam from the searchlight. It can readily be imagined with what rapidity the gunners can "spot", an enemy aeroplane or dirigible and bring it down.

McAdoo Would Electrify All Railroads

Director-General of Railroads McAdoo said recently on his return from a trip that his observation of the vast resources of water power during the two months he had been absent from Washington since the close of the last bond campaign, had impressed him with the idea of electrifying the railroads of the United States. If the Government were to continue the administration of the railroads of the country for any prolonged period, he said, he would be in favor of resorting to the use of electricity just as far as it could be practically employed.

Director General McAdoo said that for the present nothing could be done toward substituting water-power for coal-produced steam, but it might come as a plain matter of necessity while this war was on.

U-BOAT IN SPANISH PORT DIRECTS RAIDS BY RADIO

Investigation has disclosed that the German submarine U-56, recently arrived at Santander, Spain, under its own power, had been in communication with other U-boats at sea.

Commander Reisser of the U-boat, repeatedly was seen signaling toward the sea, while the Spanish government intercepted wireless messages from the U-56 after a French steamer was sunk and its crew killed by a submarine.

It is quite obvious that the U-56 was sent to Santander to organize the destruction of Allied and Spanish shipping from a favorable spot, it is believed.

French View of Electricity in Modern War

The important part played by electricity in the modern war is set forth in an entire number recently given over to the subject by the leading French magazine, Je Sauve Ton. Trench warfare has imposed the use of the telephone for the transmission of orders, for reports and for communications of all kinds. In order, however, that it should be the ideal agent of communication, there are certain features attending the use of electricity in this connection not necessary in times of peace.

Communication must be secret, and the wires must be placed so that they cannot be destroyed by shot or shell. In the first days of the war the Boches quite successfully tapped the French wires. Their listening posts were discovered, and the telephone officer attached to each regiment has so disposed of wires and currents that secrecy is now assured.

A means of making use of the electric magnet under water has been devised in Japan, and it promises to be of great assistance in locating sunken vessels, to recover which salvage operations on a big scale are expected after the war.

ARC-WELDING SAVES MONEY

Arc-welding by electricity has been brought prominently before the public through the fact that it was used to restore the broken engine castings of the interned German steamships. When breaking these castings the much learned Englishmen thought they could not be repaired, and that it would require a year or more to replace them. However, even before the
WHILE all of the vast resources of the country are being combed and recomb by the various experts connected with the National Gov-

ernment in order to produce the greatest output of war materials at the most economical cost, and also to conserve the
great resources of the nation to the highest possible degree, a stupendous amount of power is daily and hourly going to waste, viz., that hydro-electric power which is not being developed as yet.
The rivers, lakes and waterfalls of the country represent a source of energy suf-
ficient to care for a large proportion of all the needs required for our industrial and social life, if they could be harnessed and applied to our requirements in an efficient manner; some of these waterpower develop-
ments, however, would prove uneconomical owing to the high initial cost in harnessing them to our needs.

Waterpower is not, however, confined to rivers, lakes and waterfalls, but there is constantly millions of horse-
power going to waste in the action of the ocean waves along our sea-coasts of which we have several thousand miles on the Atlantic and Pacific seaboards. With the idea in mind of utilizing the gigantic power inherent in this constant wave motion which perpetually rolls up on our beaches day after day, year in and year out, a Yankee inventor, Mr. E. T. Stodder of New Rochelle, N. Y., has given a large amount of his time to the study of wave motion and devices inten-
tended to turn into industrial use the great power which they possess. His invention is shown in the illustrations here-
with.

The larger view shows how Mr. Stodder's wave motor would be installed in a manner which much resembles one of the large steel piers to be found at any of our seashore resorts.

The basic idea of this wave motor involves the utilization of the powerful lifting force exerted by the waves as they rise and fall, and to this end the inventor proposes the used of large steel float members, each float in a commercial sized machine to measure about eighty feet square, thus giving an area on which the wave can exert a lifting action, of 6,400 square feet, while a num-
ber of these floats can be placed along the pier as our illustration shows. At each end of these steel float members, which are air-tight of course, there are two steel cables which lead upward to specially devised air compressors, so that no matter in which direction the float rises or falls, efficient work is performed by each and every move-
ment of the float.

All of the comprest air generators connected with the cables from the floats, are connected with a main pipe line, and this in turn feeds a comprest air motor connected with an electric dynamo. The dy-
namo produces electrical energy which can be fed into storage batteries, and also to the wires supplying electric lights, etc. The smaller illustration shows a perfect model of this unique wave power plant built by Mr. Stodder, and in which the float member is shown suspended by the upper and lower end cables aforementioned, each cable be-

The Latest Idea in Wave Motors—it comprises an extended series of buoyant tanks or "floats," each float rising and falling with the waves and serving to compress air. The comprest air drives a pneumatic motor connected to a dynamo, thus producing free electric-

ity from the ocean waves.

Model of New Wave Motor Built by its Inventor, and Demonstrating How Each "Float" Operates Alternately Eight Air Compressors, Thus Utilizing Effectively Every Motion of the "Float."
This Car Carries a Complete "Power House"

What is believed to be the most powerful self-propelled car yet built in the United States has been placed in service on the lines of the Nashville, Chattanooga & St. Louis Railroad.

Built by a New York locomotive concern, it has a 150-horsepower oil engine of the standard four-cycle eight cylinder marine type direct connected to a 100 K. W. differential compound wound 250-volt direct-current generator running at a constant speed of 1,000 r.p.m.

A storage battery having a rated capacity of 483 ampere hours at a five-hour rate is also installed, the combination of generator and storage battery providing ample reserve power for peak loads. The car is propelled by electric motors attached to the axles, thus providing the most flexible control possible. It is the same principle as that used in the new electric-drive warships, which have shown the quickest and most flexible control of any arrangement hitherto utilized. The engine burns either kerosene or fuel oil. The oil passes from the storage tank to a gas generator placed in the muffler of the exhaust. From the generator the gas passes directly to the cylinders of the engine, being mixed with air in the proportion of one part of gas to six of air.

The storage battery is suspended underneath the car body and operates in parallel with the generator, which is so constructed that the voltage automatically coincides with that of the battery. The generator will deliver current up to its capacity, while at the same time it works in unison with the storage battery which delivers any excess of current the load may require. The battery will deliver 400-horsepower for five minutes, 210-horsepower for fifteen minutes, 93-horsepower for one hour, and 30-horsepower for five hours. This power is in addition to the 150-horsepower developed by the engine. Thus the car has an abundance of power for acceleration or while ascending heavy grades. With this arrangement the engine works at nearly full load at all times, and the efficiency is therefore a maximum. All the power required above the capacity of the engine is supplied by the battery, and all power generated by the engine and not required to drive the car is employed to charge the battery, which furnishes a convenient source of energy for starting the engine, lighting the car, operating the auxiliaries and in case of emergency driving the car itself.

According to an Italian scientist's figures, a square mile of the earth's surface in six hours of sunshine receives heat equivalent to the combustion of more than 2,000 tons of coal. And we scientific barbarians can't as yet harness 1/1,000 of one per cent. of it. Some day we may learn how.

The Latest Type of Gas-Electric Car. It is Driven by Electric Motors Which Derive Their Power from an Oil Engine. Electric Drives are Used to Care for Extra Demands On Ascending Grades, Etc. No Trolley is Required as the Power Plant is Self-Contained. Electric Drive is Used to Maintain Even Engine Speed and Great Flexibility of Drive.

A Remarkably Fast Electric Blue-Printing Machine. It Prints, Washes and Dries the Prints—All in One Continuous Operation. One of These Machines Has a Capacity of Five to Six Linear Feet of Finished Blue-Print Per Minute.

ELECTRIC RIVETERS WORK RAPIDLY.

Electric riveting machines are now being used in the erection of the huge steel work. The machines hammer home the rivets in short order, and by their use some good speed is being made in the work.

An electric heater has been invented to prevent moisture collecting on an automobile wind shield.

MODERN ROTARY ELECTRIC BLUE-PRINTERS.

By Frank C. Perkins

The accompanying illustration shows a rapid, continuous electric blue-printing machine in operation in connection with an automatic washing and drying machine, as developed at Chicago, Ill., and showing the course of paper thru the machine.

It is pointed out that in these days of business activity every engineering department feels the necessity of having its own up-to-date blue-print plant. Today the blueprint is the expression of the finished work of the drafting-room and they are being used in an ever-increasing volume, especially by the Army and Navy Departments.

The photograph shows in operation a new blue-printing equipment, which is really three machines in one—printing, washing and drying by one continuous operation. No valuable space is taken up by open wash trays and there are no wet floors and no lines of dripping prints. The equipment occupies only 5' x 6'5' feet of floor space, and is clean and noiseless.

There is only one operator required. He stands in front of the printing machine, which places the tracings on the sensitized paper as it is passing thru the machine. Together the tracings and paper are carried up past a tank of powerful arc lamps, the tracings being returned automatically to the tray in front of the operator, while the exposed paper is carried back, passing first thru a bath of clear water, then thru a bath consisting of a weak solution of bichromat of potash or bichromat of soda, and lastly thru another clear-water wash, after which it passes up over the dryer and down into the rolling-up device at the back of the machine, where the finished prints are automatically wound up into a loose roll, perfectly free from wrinkles or distortions and ready for use. The entire process is accomplished without waste.

It is claimed that these machines have a capacity of five to six linear feet per minute, or 100 to 120 yards (the equivalent of 150, 24 x 36-inch prints) per hour, which has been proven to be as fast as an operator can properly handle the average run of tracings and keep the paper covered. At this speed the greatest economy is effected; no light or paper is wasted, and the prints are thoroly washed and evenly dried. By this method blue-prints of the finest quality are produced on either paper or cloth.

It may be stated that the electric dryer is provided with a series of switches so that the heat can be regulated in accordance with the speed at which the printer is being run.

The arc lamps are especially rich in the actinic or violet ray necessary for blue-printing. Each lamp is independently connected in at the bottom, and is controlled by a knife switch mounted in a metal box of approved design, which is located at the left-hand end of the machine. It is only necessary to burn a sufficient number of lamps to cover the width of the paper being printed. Thus again no electricity is wasted. There is a fan for circulating the air mounted on the left-hand end of the printer, and obviates all danger of breakage of the contact glass.
TREATING OLD MASTERS WITH X-RAY.

Interesting experiments have been conducted at Munich and Vienna in the examination of old portraits with Roentgen rays. One of the curators of the art museum used the X-rays on an old Madonna portrait and discovered evidence of a later overpainting. In Vienna, Prof. Max Dvorak applied the same test to a picture of the Mantegna School, which had been badly disfigured by later attempts at reconstruction. The X-ray photograph disclosed perfectly the original contour of the painting.

ELECTRIC ESCALATOR HANDLES RAILWAY STATION TRAFFIC.

Every railway terminal where the tracks are either elevated or depressed, or where passengers must be moved from level to level, will find the electric escalator or moving stairway of service.

The watchful and progressive railroad companies have spared no expense to make travel pleasant and comfortable, and now many of them are improving their terminal service by installing these escalators. The photo shows one of these interesting installations in the Pennsylvania Railroad Terminal in New York City.

During the morning hours the service is taxed practically to its capacity, about 11,000 people per hour. That the escalator is popular with the traveling public has been proved many times. Ninety-eight per cent of the people using this exit, travel on the escalator. The old-time stairway adjoining has been practically abandoned. No one will say his strength or waste his energy in climbing stairs when he can ride, and many people will walk considerable distances to ride one or two stories on an escalator.

The continuous stairway belt is driven by electric motors. They are so designed that the passengers' clothes cannot be caught and furthermore, the upper or lower floor levels the peculiar shape of the step elements causes the feet to be pushed off on the floor without danger of catching.

TREATING ROENTGEN RAY ILLS WITH RADIUM.

The Journal of the American Medical Association publishes a paper by Dr. Robert Abbe on "Roentgen Ray Epithelioma, curable by Radium, as Apparent Paradox," which was read at the last session of the association in San Francisco in May. The surgeon after citing cases wherein were effected cures ofRoentgen ray injuries, so common among those who work with the X-rays, says:

"I may say that no cases have presented themselves to me of chronic dermal Roentgen ray disease in the early stages of thick patches, cracked, ulcerated and painful, or of the epithelial growths of basal cell type on the back of the left hand of those who have in past years used that hand to test the tubes which have not yielded to radium therapy."

Dr. Abbe presented to a gathering of roentgenologists of the British Medical Association meeting two years ago the possibility of curing the disease in its early stage by radium, and most of the physicians present were skeptical but he met one from Australia who had found in his own experience that the application of radium had kept his hands well. Dr. Abbe said that no efficient action of radium is beneficial in the advanced stage of epitheliomas, so far as he can yet see, but in the early stage of the disease, he said, the cure may be assured.

He treated his first case in 1903. The patient developed typical epithelioma on the back of the left hand, and one application of radium cured it. There has been no recurrence after twelve years. Ten cases of physicians whose hands, disfigured by the Roentgen ray, were treated by him and all, he said, have shown the happy result of radium treatment.

"It seems almost a paradox of radiology," Dr. Abbe said, "that the accepted use of a large dose of radium from a Roentgen ray tube will cause a diseased condition of the skin which a similar radiation from a tube of radium will cure. This becomes intelligible when we know that the output of the Roentgen ray tube is almost wholly composed of hard, penetrating, irritating gamma rays." This is indeed good news.

ELECTRICAL EXPERIMENTER

In England the air warning signals are now supplemented by electric signs which flash out the unwelcome news as soon as

| London and All the Larger English Cities Are Now Supplied With Electric "Air Raid" Warning Signs. As Soon As a "Boche" Aerial Attack Is Imminent the Signs Flash "Take Cover"—When the Raid is Over They Show "All Clear." Electric Bells and Sirens Give the Audible Signal. |

| RADIUM IN GOLF BALLS. |

The use of radium in golf balls is explained in the following manner. It is not the radium itself, but the residue after the radium is extracted.

There is about 10 cents worth in the ball that is on the market now, which seems to be about the right proportion.

Uranium, which is the ore that radium is extracted from, is not expensive, but when it requires so many different processes to get the tiniest bit of the pure article, the cost amounts to a fabulous sum.

It is the heat in the radioactivity that warms the rubber and keeps the ball alive. Warm rubber will respond to the driver much quicker than if it were cold. Ouimet has used these balls with great success.
SINCE the introduction of the lightning rod over one hundred years ago by Benjamin Franklin, its adoption as a means of protection against destructive atmospheric discharges such as lightning bolts, has been practically universal. In a recent discussion on the subject of lightning protection, Dr. Nikola Tesla of New York, brings out many interesting facts not generally known concerning the real efficacy of the ordinary lightning rod as installed on houses, barns and public buildings all over the world.

Says, Dr. Tesla, "The efficacy of the ordinary lightning rod is to a certain degree unquestionably established thru statistical records, but there is generally prevalent, nevertheless, a singular theoretical fallacy as to its operation, and its construction is radically defective in one feature, namely its typical pointed terminal." In his new form of lightning protecting rod and ter-

more, inducing in the earth an equivalent area which a number of lightning rods could not neutralize in many years. Particularly to instance conditions that may have to be met, reference is made to an actual case in 1903 where it is probable that upon one occasion approximately 12,000 strokes occurred within two hours, all within a radius of less than 31 miles from the place of observation.

But also the pointed lightning rod is quite ineffective in the one respect noted, for the attraction effect, attracting lightning to a high degree—firstly, because of its improbable shape and secondly, because it ionizes and renders conductive the surrounding air. This has been unquestionably established in long continued tests with the Tesla wire-less transmitter above-mentioned, the inventor claims, and in this feature lies the recent disfavoring of the Franklin type of protector.

In Figs. A and B, different forms of such low density terminals and the arrangement of the same are illustrated. In Fig. A, there is a cast or spun metal shell of ellipsoidal outline, having on its under side a sleeve with a bushing of porcelain or other insulating material, adapted to be slipt tightly on a metal rod, which may be an ordinary lightning conductor. Fig. B shows another form of terminal made up of rounded or flat metal bars radiating from a central hub, which is supported directly on a metal rod and in electrical contact with the same. The specific object of this type is to reduce the wind resistance, but it is essential that the bars have a minimum area to insulate to least density, and also that they are close enough to make the aggregate capacity nearly equal to that of a continuous shell of the same dimensions. The general view of the building shows a cupola-shaped and earthed metal dome carried by a chimney, serving in this way the twofold practical purpose of hood and protector.

From the foregoing it will be clear that in all cases the new Tesla terminal prevents leakage of electricity and attendant ionization of the air. It is also independent of whether it is insulated or not. Should it be struck the current will pass readily to the ground either directly or, as in Fig. A, thru a small air-gap between. But such an arrangement is rendered extremely improbable owing to the fact that there are everywhere points and projections on which the terrestrial charge attains a high density and where the air is ionized. Thus the action of the improved protector is equivalent to a repellant force. This being so, it is not necessary to support it at a great height, but the ground connection should be made with the usual care and the conductor leading to it must be of as small a self-induction and resistance as practicable. Tesla has taken out a patent on this new lightning protector.

ELECTRIC VEHICLES IN NORWAY.

Electric vehicles are now receiving considerable attention and encouragement in Norway for every form of mechanical propulsion. Heretofore gasoline cars have been practically the only machines in use in the country. For the last year or two, however, electric cars have been received, and as there are but few electric cars in Norway, automobiles have practically disappeared.
Are Aeroplane Parachutes Practical?

By W. Edouard Haussler

The writer, who has been following aviation for the past few years, and who has had experience in actual flying, having owned an aeroplane, became interested in an editorial debate on the subject of “Aeroplane Parachutes” appearing in the New York Times, wherein Mr. Adrian Van Muffling, by profession a Chief Aero Engine Instructor at a New York Aeroplane School, gives utterance to such speeches as: “If an aeroplane comes down ‘out of control’ it is the duty as well as the natural tendency of the pilot to ‘stick it out’ and to do his utmost to regain equilibrium. If he happens to be high enough the chances are in favor of his doing so before connection with the ground is made. By the time he realizes that it is too late for him to right his machine before crashing it will be too late for the parachute to open, provided he could possibly manage to jump clear of it space.”

Wherein he shows that his estimation of the value of an aviator, the cost of whose training aggregates some $10,000, is less than the value of the machine in which he is flying and further that if the machine comes down out of control it is the duty of the pilot to come down with it, and calmly “stick it out.”

Were I to be granted the opportunity of seeing Mr. Muffling in a flying machine that was equipped with a “parachute,” despite his weak reasons why this is impossible, I am most positive that he would use the parachute in the case of an accident and would not adhere to the duty of “sticking it out.” The balance of his text explains in a large volume of words the idea that it is impossible to get out of the pilot’s seat and fall clear of the dropping plane, by the use of a parachute.

The diagram shown in the semi-circular illustration below will give the reader a clear idea of the various positions in which the machine may fall while out of control, and that in these positions the parachute will operate with sufficient certainty that a great percentage of the fatalities up to date could have been prevented.

It may also be of interest to make reference here to a parachute being used successfully in Rheims on October 10, 1913, by a young French aviator, Louis Renaul Piercer. He was the designer of the parachute device shown in our illustration and he attached his invention to a Nieuport monoplane. On the day that he made his test flight, he sat in the observer’s seat and had the parachute strapped to his shoulder belt. Another aviator piloted the machine. The weather was squally and he was warned not to make the trip; he, however, started, heedless of the admonition and when about 2,000 feet in the air and making a turn, a sudden gust of wind struck his right plane and crumpled it. His life was saved by his parachute device, while the pilot “stuck it out” and was killed!

Piercez was killed in 1914 in an automobile accident, and his device has not been explored any further, except by the Huns. The action of the device is simple and easy to understand. The lever marked A, is pulled when it is desired to release the parachute which is placed on the upper side of the fuselage.

The puling of the lever causes air curtain C, to slide down or up, according to the position of the machine. It is spring loaded and is forced down with a snap. The forward or downward motion of the plane causes a rush of air which fills the parachute and lifts the pilot free of the machine; the machine dropping from under him. It therefore becomes apparent that he has not so difficult a task to become free from the machine as Mr. Muffling would have it. The Times editors, who are very keen on correcting letters from the readers that may in any way be misunderstood, make comment on Mr. Muffling’s letter, under the heading of “His answer hardly convincing” — wherein one of the paragraphs is directly to the point and fully coincides with the writer’s ideas on the subject. This editorial paragraph in part read: — “that if this device were always at the aviator’s command some of the fatalities that now occur could be prevented, or that to have the lives of even a few of these enormously valuable men would be worth while. Still less did the expert’s argument meet the fact that, according to a report of trustworthy origin, a German aviator was seen, this week, to extricate himself and a parachute from an airplane that was falling in flames.” And that an aviator “is not a man who can be replaced by the first man on whom the Government is willing to make another like expenditure. He is literally a rare bird and to lose him unnecessarily is worse than unwise.” Therefore one may readily see that even the daily press is not falling in line and “gobbling up” mere mention of a certain thing being impossible, and letting it go at that. We are now living in an era where impossible and can not should be stricken from our vocabulary. This is the age of wonders and when an idea does not work against the principles of Nature, it is possible. At least let us try it out thoroly.
Popular Astronomy

THE PLANET MARS—FOURTH PAPER

By ISABEL M. LEWIS
Of the U. S. Naval Observatory

As a result the distance of Mars from the earth at opposition, when it is best seen, varies from thirty-five million miles for a near or favorable opposition to sixty-one million miles for a distant or unfavorable opposition, depending upon the position of Mars in its orbit at the time of the opposition. Of course the apparent diameter of the planet’s disk and its brilliancy are considerably less when opposition occurs near the aphelion point in its orbit than when it occurs near the perihelion point. The relative brightness of the planet in the two positions are in the ratio of one to four. Favorable oppositions of the planet occur every fifteen or seventeen years and at such times the unusual brilliancy of the planet makes it a most striking object in the heavens, the rival of Jupiter in splendor. Furthermore, Mars is always easily distinguished from all the other planets by its deep red tint.

The year of the Martians, granted there are such, is 687 days, or 1 year 10% months in length, but the time that elapses between successive oppositions of Mars with the earth is greater, due to motion of the earth in the interval. It is equal to 780 days or a little more than two years. Since all observations of the planet, which can only be made satisfactorily near the time of opposition, are obtained in alternate years for several months preceding and following the date of opposition.

The equator of Mars is inclined nearly twenty-four degrees to the plane of its orbit, which is about half a degree more than the inclination of the earth’s equator to its orbit. As a result Mars has a year very similar to our own, a little more pronounced, since the inclination is greater, and nearly twice as long since the Martian year is nearly equal to two of our years.

Observations of surface markings on Mars have been recorded for more than two hundred and fifty years, the earliest observations being those of Hooke and Cassini in 1666. One result of these long continued observations has been a very accurate determination of the length of the Martian day, or the period of its rotation on its axis, which is given as 24h 37m 22.6s. This value is in error less than two hundredths of a second and shows to what a high degree of accuracy it is possible to determine certain astronomical results.

Mars, then, closely resembles the earth in the length of its day and night.

The mean annual temperature of the earth is 60° Fahrenheit. If it were situated at the distance of Mars from the sun it would receive per unit area only 43% of the light and heat that it now receives and it can be shown that its temperature would be 39° below zero on the Fahrenheit scale. If, then, the atmosphere of Mars were similar in composition and density to our own and if the nature of surfaces of the two planets were the same, two very doubtful assumptions, the temperature of Mars would approximate —35° F. There are reasons for assuming that this estimate of the average yearly Martian temperature is much too low. Prof. W. H. Pickering, one of the leading observers of the planet Mars at the present time, advances evidence to show that the mean daily temperature at the Martian equator throughout the year cannot be far from the freezing point and that tropical fogs are to be expected at any Martian season and, in fact, have been observed during the opposition just past in the Martian morning.

Even the early observers of Mars with the aid of telescopes far inferior to the best instruments of today were able to mark prominent markings of the planet’s surface.

Two Views of the Planet Mars, Photographed With the Mount Wilson 60-Inch Reflector. The Large View is a Photo Taken on October 4th, While the Small Photograph Was Taken on November 3rd. At the Time the First Picture Was Taken Mars Was Near Opposition and Consequently Showed Up Much Larger Than When the Second Picture Was Taken As By That Time Mars Had Receded Quite a Good Deal and Therefore Appears Smaller.
Two Different Views of the Planet Mars. As Mars is Turning On Its Axis Once in Every Twenty-four Hours the Same as the Earth, We Are Able to See the Entire Surface of the Martian Globe During That Time. The Views Shown Here Are Taken Six Hours Apart From Each Other. Photographs Were Made During the Opposition of 1911 When Mars Was Some 47 Million Miles Distant From the Earth. In 1924 the Two Planets Will Be About 36 Million Miles Apart, the Smallest Distance Ever Reached Being 35 Million Miles. Photos Show the Top South—the Bottom North, as in the Telescope All Objects Are Turned Upside Down. The Southern Cap Is Not in Evidence, It Having Already Melted At the Beginning of the Martian Summer. The Melted Water Has Been Conducted Equatorward By the Canals. The Light Areas Are Supposed to Be Deserts. Nearly All Canals Are Perfectly Straight, the Ones Near the Edges of the Photograph Appearing Curved Only Because We Are Looking on a Globe and Not on a Plane Surface. Photo Courtesy of the Late Prof. Percival Lowell, Flagstaff Observatory, Flagstaff, Ariz.

the white polar caps and their seasonal changes, the reddish or orange-colored tracts that cover five-sevenths of the planet's surface and which they spoke of as "deserts," and the greenish or greenish-grey regions which they incorrectly named "maria," considering them to be seas or lakes.

In the year 1877 occurred one of the favorable oppositions of Mars and this date was epoch making in the study of the planet for it marked both the discovery of the two tiny moons of Mars, Deimos and Phobos, by Prof. Asaph Hall, with the 26-inch equatorial, which had just been installed at the U. S. Naval Observatory and the discovery of the far-famed "canals" by the Italian astronomer Schiaparelli at Milan. This keen-eyed observer of Mars noted at the extremely favorable oppositions of 1877 and 1879 a number of fine, narrow, dark lines crossing the orange-colored regions in all directions and usually connecting the maria or dark regions. Schiaparelli gave these markings the name of "canali," meaning "channels," which has been translated, rather unfortunately, into "canals." Whatever the nature of these peculiar surface markings they bear no resemblance to terrestrial canals. The more conspicuous of these markings average from one thousand to two thousand miles in length and from one hundred to two hundred miles in width. Schiaparelli's discovery of the canals was confirmed by a number of observers, including Perrotin and Thollon at Nice, the late Prof. Lowell, who observed the planet continually under excellent atmospheric conditions at Flagstaff, Arizona, from 1894 to the date of his death in 1916, and Prof. W. H. Pickering of the Harvard College Observatory, who started observations of the planet in 1880 and is now observing it at Jamaica under atmospheric conditions as fine as are to be found at the Lowell Observatory at Flagstaff. Prof. Lowell's observations of Mars are being continued at this observatory under the able directorship of Dr. V. M. Slipher, who was Prof. Lowell's assistant for many years. There are, however, many skillful observers who have been unable to see the canals, tho they have been added by the largest reflectors and refractors in the country. Such observers include Barnard, with the 40-inch Yerkes refractor; Hale, with the 60-inch Mt. Wilson reflector, and Prof. W. W. Campbell and other observers at the Lick Observatory. All these observers see a great variety of other surface markings, however. The canals of Mars are as much the subject of discussion and controversy to-day as they were twenty-five years ago and the reality of the canal system is still denied by certain astronomers.

The discovery, made by Lowell and a number of other observers, that the canals traversed the maria or seas as well as the desert tracts and also the variety of shade and detail visible in these dark green or greenish-grey regions, led to the gradual abandonment of the early belief that they were bodies of water. They are now believed to be marshy tracts of vegetation that are watered by the melting of the polar caps during the spring and summer seasons. A dark blue line is always observable on the border of the melting polar cap and since this dark line is not to be seen except when the polar cap is decreasing in size, or melting, it seems to prove conclusively that the Martian polar cap is similar to the terrestrial polar cap and consists of snow and ice. Moreover, the melting of the cap is attended by a decided darkening of the canal system and the greenish regions due, one would naturally assume, to the quickening of vegetation with the advent of spring.

The theory held by the late Prof. Lowell, that the canals are strips of vegetation bordering water-ways or irrigation ditches, built by intelligent beings to conserve the water supply of the planet, which is believed (Continued on page 428)

Nine Different Telescopic Views of the Planet Mars Taken With the Yerkes 40-Inch Refracting Telescope at Short Intervals. A Slight Shift of the Martian Configuration Will be Noted Due to the Rotation of Mars on Its Axis. The Brilliant White Spot at the Top is the South Polar Snow-Cap and It is Summer in the Southern Hemisphere of Mars.
The Gyro-Electric Destroyer

ALTHO the Electrical Experimenter has only been out for the past ten days, as we go to press with this article, and tho the September issue of this magazine is not as yet in the hands of most of the readers, I feel rather encouraged at the result of my last month's article. In that issue, as will be remembered, I took the advice of several readers who suggested that I build a model of the Gyro-Electric destroyer, the latter to be turned over to our Government. The funds were to be supplied by "Experimenter" readers.

The magazine was hardly out in New York before many people whom I had never seen before began pouring into my office with their dollar bills and signed blanks. All were enthusiastic and earnest about the idea, all glad to be permitted to "do their bit" and to "wipe the Hun artillery from the face of the map," as one elderly gentleman put it when shaking hands with me and wishing luck to the enterprise. Then remittances began to pour in, in amounts from $10.00 down ward, and while the amounts so far received are relatively small, due to the fact that the magazine at this time of writing is hardly in the hands of 5% of our readers, all signs point to the actual building of the Gyro-Electric Destroyer.

In the November issue will be printed the first list of readers who subscribed to the funds, as well as the total amount collected up to that date. All amounts received up to September 23rd (the closing date for the November issue) will be found in the next issue.

This month I will content myself to print a few extracts from the letters of enthusiastic contributors to the Gyro-Electric Destroyer Fund. Here they are:

EVERY LITTLE HELPS.
"...I am a regular E. E. reader and have watched the development of the idea from the start. I also have faith in it and therefore my support, although it may be small, will help if all of the readers are as faithful and patriotic. Wishing you success in the matter, I remain yours truly,

The Gyro-Electric Destroyer, a 45-Foot Monster, Built of Steel and Running at High Speed, Due to its Large Circumference, Easily Rides Over Shell Holes and Trenches and Other Formidable Obstacles. Its Use Is Mainly to Harass and Pout Out of Action Enemy Artillery by Either Grinding it Into the Ground or Otherwise Bomb the Artilleries With Their Guns Out of Their Positions. Experimenter Readers Are Going to Build a Model of This Machine to Be Turned Over to "Uncle Sam." The Above Illustration Shows the Front Cover Illustration of the Largest French Scientific Monthly Featuring This American Destroyer.

THINGS I NEED IN MY LAB: But if you need another dollar let me know so I can help wipe the Hun out of the world. I have faith in the Gyro-E.-D."
T. D. Cooper, Winterville, N. C.

WE TOO HOPE!
"Hope all the other 'Bugs' do the same."
Theodore Collins, Kewaunee, Ind.

I HAVE FAITH.
"I have read 'Modern Electronics' and the Electrical Experimenter ever since they first started. I have faith in your Gyro-Electric Destroyer. Go to it and if more money I needed I can help a little at least." Yours for success,
F. A. Barber, Manager of Service Department, Boxwood, De Fennes & Fellon, Master Cinematographers, Wilkesbarre, Pa.

ASTOUNDINGLY INTERESTING.
"...In my estimation it is an 'astoundingly excellent' idea. I would like to wish the best wishes for its early completion."
Yours,
Walter E. Hoagland, c/o M. L. W. P., Co., Maya Landing, N. J.

GOOD LUCK—AND A P.S.
"Good luck to the current and to the Gyro-Electric Destroyer, and to you and to your organization. P. S. I may come across with another dollar for the 'G. E. D.' in a few days."
A. L. Terry, 1422 Hurt Bldg., Atlanta, Ga.

"IT IS MY DUTY."
"I am not sending you this dollar because I want my name published in your magazine, but because I want to do something for you because it is my duty as an American citizen under the protection of the Stars and Stripes. Thanking the originator of the idea and yourself I remain yours,
"Jeremiah L. Westheimer, 3707 Washington Ave., Avondale, Cincinnati, Ohio.

As a sign of the times, and merely to show what others think of the Gyro-Electric Destroyer, we reprint herewith the cover illustration of the famous French monthly Science et la Vie (Science and Life).

Science et la Vie is the greatest and most widely read French popular scientific magazine. It is a really great publication, the current issue of course is a matter of number, numbering 192 pages. They choose for their cover illustration, which is printed in four colors, the Gyro-Electric Destroyer (Cont. on page 389)
Autumnal Uses of the Electric Fan

By Grace T. Hadley

HERE are the latest directions for drying fruits and vegetables before an electric fan:

All the vegetables must be thoroughly washed and dried and in the case of root vegetables pared thinly, then sliced as thin as possible and placed on cheese cloth over racks. Then start the fan. Have it at an angle of about 30 degrees so there may be a slightly upward current of air thru the racks.

Vegetables such as turnips, carrots, etc., if allowed to stand for about ten minutes (after slicing) in a 4 per cent. water solution (1 teaspoonful salt in 1 qt. water) will not discolor in the drying process.

Corn should be put into boiling water for—from five to ten minutes to set the milk before the cutting from the cob; then spread the cut corn upon the cheesecloth.

Green vegetables such as string beans and wax beans should be blanched in hot water, for from five to ten minutes before drying.

Fruits such as berries are merely thoroly washed then placed on racks to dry. These will take a little longer to dry because of the somewhat higher water content. Berries are dried enough if they do not stain the fingers when pressed.

Other fruits and vegetables should have a pliable, leathery appearance when dry and should not be dried so long that they become brittle.

It is best not to pack and seal the dried products for several days, but keep them in open trays or pans covered with a clean cloth. If the products appear to be too moist they should be returned to the drying racks for a short time. Ability to judge accurately as to when fruit has reached the proper condition for removal from the drier can be gained only by experience. It should be so dry that it is impossible to press water out of the freshly cut ends of the pieces, yet not so dry that it will snap or crackle.

Two other practical uses for the electric fan in hot weather are illustrated herewith—the first, that of drying dishes by blowing a breeze over them and the second, cooling electric lamps for the city which were formerly imported chiefly from the General Electric Company in America. The fact is pointed out in the report of the Japanese consul-general at that point.

Splicing links and a unit made of a non-conducting material have been invented for insertion in electric light chains to assure that they are insulated.

AN ELECTRIFIED CAT.

A cat has been in the habit of sleeping on a rubber mat under a dynamo in Cleveland's power house, runs the yarn in a Cleveland paper. Somebody removed the mat and the cat slept on an iron plate. It didn't seem to hurt the cat, but her fur became so charged with electricity that ever since it has stood stiff on end like bristles of a hairbrush.

(Perhaps the cat's hair was scared stiff! Ed.)

The chief inventions used in the present war as distinguished from the Napoleonic wars are: Steamship, submarine, aircraft, high-power guns, smokeless powder, breech- loading guns, rapid-fire gun, revolver, automatic pistol, telephone, wireless telegraphy, automobile, poisonous gas. Yes, and German "Peace-Offensives!"

AIR MAIL PILOTS GO THRU THUNDER STORMS.

The air mail pilot is solving the problem of flying in all sorts of weather. Prior to the establishment of the Air Mail Service it was regarded as impracticable to make flights with airplanes during severe storms.

The practise of this daily service has shown that the mail can be carried thru the air in the teeth of a storm. On three or four occasions the air mail pilots have encountered severe thunder and lightning, wind, hail, and rain without being apt when in flight. No flight attempted in a storm has yet failed.

Recently Lieut. Stephen Bonsal from Philadelphia to Washington ran into a violent thunderstorm at Laurel, Md., at an altitude of 5,000 feet and proceeded on his way to the landing field in Washington without interruption. It was impossible to distinguish any landmarks in such torrents of rain. When he descended to a lower altitude for observation he was near the wireless towers at Radio, Va. To observers he appeared to drop out of the clouds from nowhere at an angle of 45° to a height of about 300 feet when he leveled the plane and made a perfect landing at Potomac Park in the midst of a torrent of rain. The plane arrived on schedule time, not being delayed by the storm. The propeller was slightly damaged by the pelting rain.

Lieut. Bonsal was not assisted by radio guide but depended entirely up on his compass and his judgment from familiarity with the route.
CURRENT ELECTRICITY (concluded)

EXPERIMENT 93

Insert a piece of soft iron in the helix shown in Lesson 15, and allow the current to pass thru the helix. On testing the strength of the poles now (by bringing the helix near a compass or by picking up iron filings) we find a great increase in the magnetism. The iron core which was inserted has been magnetized by induction just as if it had been placed in the field of a permanent magnet; and now we have added to the magnetism of the helix the magnetism of the core, which accounts for the increase in strength. A helix with a core is called an electro-magnet, the commercial form being usually in horse-shoe form (see figure 84-A) in order to double the strength of the magnet. Figure 84-B shows the arrangement of the lines of force thru an electro-magnet m, and its armature a (piece of soft iron) which cuts off the force passing thru the magnet. The strength of an electro-magnet depends upon the ampere-turns (product of the amperes or amount of current, times the number of turns of wire in the helix). The importance of the electro-magnet in modern electricity cannot be over-estimated. One has but to recall its use in the bell, current measuring instruments, motor, dynamo, telephone, telegraph, induction coil, and an indefinite number of devices.

EXPERIMENT 94—The electric bell illustrates the use of the electro-magnet to produce an intermittent action. The construction is simple (see figure 85); c and f are binding posts, d a screw with platinum point, e a flat piece of spring steel, fastened to binding post g, and to a hammer consisting of hairpin with ball-bearing soldered to the end, i is gong, and k an electro-magnet consisting of two spools wound with magnet wire, two screws for cores and iron nail connecting the cores.

On closing the switch b (equivalent to pushing the button) current flows from battery to binding post f, from f thru connecting wire to the magnet, from the magnet to the binding post g, from g thru the spring steel to screw d and thence out thru binding post c. The passing of the current causes k to become magnetized, and k draws the spring steel toward it, thereby breaking the contact at the screw d. This causes the current to suddenly stop, and its effect is to magnetize the spring of the steel causes it to snap back to the screw which closes the circuit again; the current then flows thru the magnet once more. These operations are repeated over and over again as long as switch b remains closed. Hence the hammer is alternately drawn to and pulled away from the gong, and the bell “rings.”

EXPERIMENT 95—Cut in half a lead pencil having a large size lead. Shave off the wood from the lead; connect the leads thru a battery of about thirty volts, and separate the leads about an eighth of an inch. An arc will be formed similar to that of the commercial arc lamp, but of course not as bright. After a few minutes cut off the current and examine the leads. One will be found to be concave and the other convex. The concave is the positive and the convex the negative. (The polarity can be determined as suggested in Lesson 15.) This is just as you might have expected; for the current is going from + to — has carried some of the carbon with it and deposited it on the other electrode. Try bringing the leads as close together as possible without their touching. No arc will be formed unless the leads are first touched together. If the leads are not touched together the resistance of the air prevents electricity of such low voltage from passing thru the gap however small it may be. But when the leads are first touched together and then drawn apart (the heat of the current while the leads are in contact vaporizes the leads and fills the gap with carbon particles which offer but slight resistance to the passage of the current); the current now passes thru the gap and the hot particles glow. Using regular commercial carbons and the proper voltage (50 volts) an arc of great brilliancy is obtained. In the more up to date forms the carbons are impregnated with lime, magnesia, silica, or other minerals which give off a very brilliant light when heated to incandescence.

Figure 86-A, shows a three wire "hook-up" for controlling current from two different points. This hook-up is extensively used where it is desired to control a source of electric power. (See figure 86-B) cd are single double throw switches (or the two button type). The middle wire is used as the neutral, and connections are made to the outside wires. If b and d are closed, the circuit is closed and current passes thru the lamp L. If person at the left wishes to extinguish the light he opens b and closes a—b and c now both being open, the circuit is open. The person at the right can open or close the circuit by similarly manipulating the switch d. (The reader should try all possible combinations of the switches ab and cd and trace out the various paths of the current.)

EXPERIMENT 96—No doubt Oersted’s discovery of the magnetic effect accompanying an electric current thru a conductor led to Sturgeon’s discovery of the electro-magnet in 1825, six years later. Sturgeon’s discovery in turn attracted the attention of physicists the world over, to the production of an electric current by means of a magnet (the electro-magnet being so much more powerful than the ordinary magnet). The year 1831 marked the beginning of modern electricity when Joseph Henry in America and Michael Faraday in Great Britain discovered independently and simultaneously the dynamo principle. Now electricity on a commercial scale for the production of light heat and power was possible. The principle is simple and can be easily understood without recourse to the intricacies of the modern dynamo.

Wind a coil of about 500 turns of number 22 copper wire, with a diameter of about two inches. Connect this coil with a galvanometer or other current detecting device. A simple galvanometer can be made by suspending a coil of about 200 turns of number 30 copper wire between the poles of a strong electromagnet (see figure 86-B). Thrust the coil c down over the S-pole of the magnet. The deflection of the needle P of the galvanometer will indicate that a current is passing thru the coil. If, how-
New Developments in Telephotography

By LeROY J. LEISHMAN.

A cathode ray may be diverted from its path by a magnet, and the same thing is true of many other rays. Quite a variety of optical effects may be produced in a magnetic field, many of which lend themselves to the uses of telephotography because the effect of gravity and friction is not felt, and the inertia is nil, compared with mechanical ways of receiving. In a rough manner, these rays may be used by causing them ordinarily to pass over an electromagnet thru the aperture of the dark box; they work as fast as the lag in several hundred miles of wire will permit them.

Without synchronism, telephotography would be impossible. In my previous article, I explained a manually controlled synchronizer, and made reference to an automatic system. In connection with this machine, I have arranged automatic starting and stopping features.

When the machines are not in operation, the starting relay on the receiver is connected direct to the binding posts, to which

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This Diagram Shows the Electrical Connections and Arrangement of the Various Apparatus in Mr. Leishman's Newest Telephotographic Instrument, Intended for Transmitting Pictures Over Telephone or Telegraph Wires. Among Other Interesting Departures the Inventor Makes Use of a Novel Polarized Light Ray, Which Is Deflected by an Electromagnet.

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are attached the wires from the sending machines. The arm of this relay is held by gravity against a contact to effect this connection. The arm is then inclined about 15 degrees from the perpendicular. When the sending machine starts, the first impulse causes this relay to pull its arm against a different contact, against which it is held by gravity, as the position is 15 degrees the other side of the perpendicular. This breaks the relay connection and starts the motor which operates the machine.

An important part of the synchronizer is

(Continued on page 414)
Original "Valves" Used by Dr. J.A. Fleming

Professor J. A. Fleming in 1904 was the first to apply the phenomena of thermionics to the rectification of alternating electric currents, whether of high or low frequency.* The device which he made to effect this may take one of several forms, some of the original ones of which are shown in the photograph herewith. It consists of an ordinary carbon filament incandescent lamp provided with a separate insulated electrode, in the shape of a flat or cylindrical metal plate, or another carbon filament, sealed into the bulb. When the carbon filament is rendered incandescent by a source of electric current it will be found that a single cell will pass a current thru the vacuous space between the insulated electrode and the hot filament provided that the negative pole of the cell is connected to the negative side of the filament. If the connections of the cell are reversed, practically no current passes, the small amount of current obtained being due to positive ions formed from the residual gas in the bulb. This is what we should expect from the fact that the hot filament is emitting negatively charged particles, and in order to draw these across the gas space to the cold electrode the latter must be raised to a positive potential with respect to some portion of the incandescent filament.

The space between the cold and hot electrodes, therefore, possesses unilateral conductivity, and the arrangement acts as an "electrical valve", passing electric currents in one direction but not in the opposite direction. Fleming next found that this device could be used, on this principle, to convert either audio or radio frequency electric oscillations into unidirectional currents, which may then be detected by means of an ordinary galvanometer.

Fleming found later that greatly improved results were obtained when the valve was constructed with a tungsten filament and an insulated copper cylinder surrounding it. This is due to the fact that the tungsten can be raised to a much higher temperature than carbon without volatilisation and gives a much greater electronic emission, and this type of thermionic valve is almost universally constructed at the present time with either a tantalum or tungsten filament.

The next step in the evolution of the thermionic valve was made by Dr. Lee de Forest and consisted in the introduction of a third electrode into the evacuated bulb. Lee de Forest had been working on the simple rectifying valve containing a metal or carbon filament and one insulated electrode (already described) at practically the same time as Fleming, and his results were first described in a paper before the American Institute of Electrical Engineers in October, 1906. Considerable controversy has since then ensued as to the relative priority of the inventions of the Fleming valve and the "Audion", the name assigned to the valve by de Forest; but this has now been settled in favor of Fleming for the original valve, Lee de Forest having the credit of introducing another insulated electrode into the bulb, thereby transforming it from a rectifying valve into a kind of gas relay, having an amplifying effect on the received oscillations.—Photo courtesy Wireless World.

AN UNUSUAL TYPE OF ELECTRON RELAY.

The hot filament rectifier or electron relay illustrated herewith is of rather unusual type, being encased in a perforated aluminum jacket, made from an individual egg boiler.

The advantage of the construction shown lies for the most part in the decrease of filament current required, due to the heat being retained by the metal covering.

Three connections are made to the inside of the bulb and the fourth to the outside shell.—R. U. Clark, 3rd.

*See British Patent 24,850—1904.
THE type of radio frequency Hot-Wire Meter shown in Fig. 1 is of extremely low resistance and is designed to operate at a low temperature, thereby allowing a heavy overload without burning out as well as keeping the case from heating up. This low resistance insures a minimum of losses in the circuit. It is made in two models, flush and full case type, measuring 3 inches in diameter. The meter is contained in a portable aluminum case suitable for laboratory uses. The expansion strip is of thin platinum and defies oxidation which gradually changes the readings of most instruments of this type. The steel shaft is supported by sapphire bearings and a zero adjusting button on the front of the instrument allows instant calibrating of the pointer. The range of the meter varies from 1/2 to 10 amperes. It is finished in satin black and all of the parts and movements are interchangeable.

The new radio frequency Decade Bridge (Fig. 2) is made up of resistances in suitable arrangement for bridge measurements adapted to the measuring of inductance, capacity and resistance at high frequencies, using a sine wave generator or oscillating vacuum tube, as well as to D.C. measurements. Its operation is identical to the Wheatstone bridge. In measuring capacity and inductance on this bridge, one arm of the bridge compensates for the resistance of the capacity or inductance under measurement as compared to that of the standard, thus giving an indication of the resistance as well as the capacity and inductance at the particular frequency employed. The bridge is mounted in a compact and convenient cabinet and arranged to eliminate losses at high frequencies. This bridge is accurate up to 1,500,000 cycles.

Fig. 3 illustrates the latest development in the form of a Vernier Condenser a Finely Graduated Capacity is Attainable. This Instrument Makes a Laboratory Condenser of Any Variable Capacity, Fig. 3.

With This "Vernier Condenser" Shunted Across Any Standard Variable Condenser a Finely Graduated Capacity is Attainable. This Instrument Makes a Laboratory Condenser of Any Variable Capacity. Fig. 3.

The Telephone Transformer (Fig. 4) is designed to give a large field of variable inductance values and that represents its advantage over the old type of open-core telephone induction coil or Audion transformer now in use. It is substantially constructed and will stand rough usage. The eight binding posts on the front hard rubber panel make it very simple to connect into a circuit for any desired inductance ratio very readily. Photos courtesy General Radio Co.

THE GYRO-ELECTRIC DESTROYER.

(Continued from page 384)

The Gyro-Electric Destroyer, presumably because the French scientific editors thought the machine feasible. The copy featuring the machine is the July 1918 issue and reached New York just as the September issue of the EXPERIMENTER had gone to press.

If the French scientists have faith in the Gyro-Electric Destroyer—and they surely ought to know—EXPERIMENTER readers should back up an America idea for all that it is worth. I firmly believe that the machine is thoroly practical and feasible. And I am just as certain that if we had twenty of these machines in France just now with which to grind the Hun artillery into the ground, or by blowing it to pieces, the war would be ended much sooner. Deprive the Huns of their guns, and we will have them back to the Rhine in no time. This is a machine war—let's have the best machine. In the meanwhile—if you share this view with me—you might sign the subscription blank.

H. Gernsback.

Using a modified wireless receiving instrument, a French scientist has been able to detect thunder storms more than 300 miles distant.

PIPING UNDER SAYVILLE WIRELESS.

A Mineola contractor in the use of his steam traction trench digger has just completed an extensive underground piping system at the Sayville Wireless Station, which adds to the efficiency of this huge wireless plant, now such an important factor with the United States Government.

U. S. SHIPS HEAR "HUN" RADIO TO U-BOATS.

Wireless operators on an American and other ships crossing the Atlantic at night frequently "pick up" orders being sent by the German Admiralty to submarines at sea. The messages are in code, of course, and the submarines never acknowledge receipt of the orders, because if they did some war-ship of the enemy might get a clue as to the location of one or more of the undersea boats.

These messages to the submarines are from Nauen, a small town near Spandau, where Germany has its great wireless station. Electrical waves produced there will reach some 6,000 miles.

Nine towers are in use, the highest being 850 feet. Last year Nauen sent to the outside world almost $2,500,000 for the German government.

Recent Design of Hot-Wire Ammeter. Calibrated for Radio Frequency Measurements. It Possesses an Extremely Low Resistance, a Much Desired Quality in All Such Instruments. Fig. 1.
The Revolving Mirror and Spark Discharges

By PROF. LINDLEY PYLE, Professor of Physics, Washington University

It is a matter of historic interest, especially to wireless enthusiasts, that an American physicist, Joseph Henry, first secured, in 1842, indirect experimental evidence of the oscillatory discharge of a Leyden jar; that Lord Kelvin, in 1855, made the mathematical prediction that the time elapsing during an oscillation is given by the now familiar equation, \( T = 2 \pi \sqrt{\frac{C}{L}} \); that Feddersen, in 1857, obtained direct experimental evidence of the oscillations by examining the spark in a rotating mirror; and that Hertz, in 1887, showed experimentally that there is an accompanying electromagnetic wave propagated outward into space, thereby explaining certain puzzling experiments performed by earlier experimenters, and inaugurating the marvelous development of wireless telegraphy.

The amateur electrical experimenter may easily repeat Feddersen's classic experiment and measure to his own intense satisfaction the number of to and fro surgings per second in the discharge of a condenser thru an inductance and low resistance. This number is, of course, the number of waves thrown off into space per second. Since in one second the wave motion travels out into space 186,000 miles, the wave length in miles is immediately found by dividing 186,000 by the rate per second at which the waves are produced.

Figure 1 shows the arrangement of the required apparatus. A small transformer, \( T \), is used to charge a capacity (condenser), \( C \), arranged so that discharges take place thru the inductance, \( L \), across the spark gap, \( g \). The spark gap device consists of two zinc rods thrust thru holes bored in the sides of a wooden box, the box completely enclosing the spark except on one side where a hole is cut (see dotted outline of box in Fig. 1). The box may be about six inches along its edges and the gap should be about one-eighth of an inch long. Light from the spark passes out thru the hole in the box, thence thru a lens, \( l \), to a piece of good plate-glass mirror, \( m \), from which it is reflected back thru the lens to a focus on a photographic plate at \( P \). The mirror is fastened upon the projecting shaft of a small high-speed motor in the manner indicated in Fig. 2. (In fact, there are two mirrors.) Referring to figure 2, \( w \) is a piece of wood bored to fit tightly upon the motor shaft; \( m \) and \( M \) are two pieces of good quality plate-glass mirror fastened securely to the wood by red sealing wax. The lens should be bought at an optician's shop. Ask for a spectacle lens of one diopter focal power, i.e., one whose focal length is one meter, or 39.4 inches. It should not cost more than fifty cents when bought with the unfinished edges. The lens should be held in a stationary support facing the spark gap at a distance therefrom of 39.4 inches, with the motor driven mirrors as close as possible behind the lens (see Fig. 1). The faces of the mirrors should be as large as the face of the lens.

With the spark discharge in action (switch \( K \) closed) and the motor at rest, one should then be able to obtain a bright and sharp image of the spark upon a piece of white paper held at point \( P \) at the side of, and close to, the spark-enclosing box. (It will be necessary to shift the position of the motor armature by hand until the beam of light reflected from a mirror falls in the right direction.) More the armature slowly by hand and a number of separate images of spark discharges appear upon the white paper. Each separate image corresponds to a separate crash of noise coming from the spark gap and corresponds to the discharge phenomenon following each charging of the capacitance \( C \). We now proceed to show that when the armature rotates at a high speed each of these separate patches of light will itself be found to be broken up into separate discharges, meaning that the discharging of the capacity \( C \) really consists of a to and fro surging of electricity across the spark gap—each to and fro surging corresponding to an electromagnetic wave "shaken off" into surrounding space. The appearance of the discharge is then reproduced in Fig. 3. It can be seen directly on the white paper screen when the motor is at high speed but it is better to register the effect upon a photographic plate.

DARKEN the room or work at night in an unlighted room. Place a fresh and extra-rapid photographic plate in the position \( P \), with the sensitive face pointed toward the lens. It is most convenient to put the plate into a regular plate holder, if one be available, and to draw the slide just previous to the exposure. Start the motor and when it has attained its highest speed close the switch in the primary circuit. Now watch the face of the exposed photographic plate to see when the light of the spark falls upon it,—for it is obvious that only when the spinning mirrors happen to be in a certain position will they throw the light to the plate. Several records may be obtained upon the same plate provided it be moved slowly sideways to avoid having a spark image fall upon the same part of the plate twice.

It is now plain that the box is placed around the spark gap so that there may be no fogging of the plate by stray light while exposure is being made. Shut off the spark and the motor, develop the plate, and, if careful, you will have succeeded in taking a picture like that illustrated in figure 3.

The photographic reproduced in figure 3 was obtained by using 6 one-gallon Leyden jars connected in parallel to give the capacity \( C \) and 8 turns of a helix of 12 inches diameter whose turns were one inch apart furnished the inductance \( L \). In this case the photo plate was 58.7 inches from the lens and the motor was revolving at the rate of 3,764 revolutions per minute, as measured by a speed counter. The speed at which the spot of light crossed the photo plate may be easily calculated if it be recalled that when a reflected beam of light comes from a revolving mirror the beam turns twice as fast as the mirror. (For example if a looking glass receiving a sunbeam is turned thru 45° the reflected beam is turned thru 90°.) In the present case the beam of light coming from the lens is turning at the rate of twice 3,764 revolutions per minute, or 125.5 revolutions per second. Hence that part of the beam at a distance of 58.7 inches from the lens has a speed of 2 x 3.1416 x 38.7 x 125.5 = inches per second, or 40,280 inches per second, or 3,857 feet per second.

In other words, the spot of light from the spark crosses the plate at a speed much greater than that of a rifle bullet. Furthermore careful measurements on the photographic showed that there were 483 complete and three surges in oscillographs recorded.

The author will be happy to supply copies of this photographic device and an instruction book for the cost of materials, which is about forty cents, and for the cost of workmanship, which is about twenty-five cents. The necessary apparatus may be purchased at the cost of fifty cents. The time of exposure is about a minute. The author will be pleased to answer any questions that may be sent to him regarding this photographic device.

223,500 oscillographs per second. The photographic reproductions took place before the energy of this particular discharge was dissipated, but meanwhile 20 wireless waves were thrown
The Einthoven Galvanometer

By SAMUEL D. COHEN

PART II.

The next important thing is the tele-
scopic apparatus, Figs. 13, 14. The frame
for this is shown in Fig. 18. It is
made of brass, and in this job it
will be necessary to use a lathe and
turn it down very accurately to the diame-
ters given. The lens opening, which
is three-quarters of an inch in diameter, will
have to be bored out in order to produce
a fine fit. The opposite end of a three-
eighths inch shank is turned and threaded
with a No. 40 thread, and this is done on
the lathe, as it is very difficult to obtain a
die with this pitch, unless made to order.
A double-concave lens three-quarters of
an inch in diameter is inserted in each tube.
These are firmly held in the seat by means
of a brass washer, made as shown in Fig.
19. A flannel ring with dimensions equal
to the metal washer should be inserted be-
tween the lens and telescope tube. Precau-
tion must be taken in securing the lens.
The lens can be procured at any opticians' shop at a nominal price. In purchasing the
lens it is advisable to obtain those having
a focal length of two inches, as this is the
proper size for the tube. One of these tubes is used for viewing, while the second
is used for admitting light to strike the
wire.

The wire or string is one of the most
difficult parts that the constructor will have
to obtain. This is a .002 mm. quartz fiber,
the surface of which is silver-plated. This
may be obtained from manufacturers of
scientific measuring instruments. They are
worth about $5.00 per string. However, if
the amateur finds it difficult in obtaining the
quartz, the writer has found that a No. 50
copper wire will give fairly good results.
The difficulty with this wire is that its tem-
perature coefficient is high in comparison
with the quartz, and it requires constant
adjustment with temperature changes. A
piece of No. 18 wire is soldered to each
end of the fine wires, so as to support it
between the stationary and movable holders
on the instrument. The tension is derived
by turning the top tension knob.

As soon as the constructor has made all
of the required parts, he should carefully
assemble them as indicated in Fig. 4. Great
care should be exercised to see that all parts
fit properly, as the sensitivity of the whole
device depends upon how accurately it is
made. Three binding posts are placed in
the rear of the base, those at the end are
connected to each of the electro-magnets,
while the central post is used to connect
the series terminals of the coils. Two
binding posts are stationed in the front
two holes of the base and these are used
to terminate the ends of the fine quartz or
copper wire. This is done by connecting
one terminal with the wire support,
while the second is brought from the Bakelite
insulating block screw, which has the lug with the
solid flexible con-
ductor. All of the
wires should be sol-
dered at all termin-
als so as to avoid
excess resistances,
as the currents travel-
 ing thru the quartz
or copper wire are
extremely minute in
magnitude, and a
slight increase in
contact resistance
would cause a sud-
den drop in ampli-
tude, which would
destroy the desired
effect.

Great care must be
taken in adjusting
and the following
points will be found to give excellent
results in adjusting the instrument as
found by the author from actual experi-
ence. First, the in-
strument should be
connected as indi-
cated in Fig. 20 for
adjustment. The two
cells are connected
in series with a six-
olt storage battery, B, an ammeter, A,
and a variable re-
sistance, R. The
string circuit has its
terminals 2, 2, con-
ected to a variable
high resistance R, with a maximum
range of 10,000

oms and a very sensitive milliamper-
eter M.A. A key, K, is inserted in the

Circuit and the maximum resistance is
inserted at the beginning of the test. Hav-
ing done this, the next thing is to see
whether the string will be displaced when
the current from the battery, B, is sent
thru it, and maximum exciting current
traveling thru the electro-magnet. This is
noted by viewing thru one of the tele-
scopes, while the other one is placed in
the path of a strong ray of light and intermit-
tently closing the key with a light tension
on the string. If the string does not de-
fect the trouble lies with the improper
connections of the electro-magnets giving
two like polarities at their pole piece, poor
electrical connections, or an open-circuit.
This should be remedied by carefully trac-
ing out the circuits. The former trouble
can be overcome by testing the polarity of
the pole pieces with the aid of a magnetic
compass. If the trouble lies with the pol-
arity, then reverse the leads from one of the
electro-magnets.

To adjust to maximum sensitivity, pro-
ceed as follows: Close the string circuit
key and adjust its resistance controller R,
until the milliamperemeter reads nine-hun-
dredths of a milliampere. Then obtain a
projector lens and place it in such a posi-
tion that if a beam of light from an in-
candescent lamp is placed before one of the
telescopic tubes, that the string will be
projected upon a white screen placed one
meter away from the instrument. Adjust
the lens so as to obtain a sharp image of
the string on the screen. At the point of
the string image, place thereon a metric
system rule with its millimeter scale facing
the string, and place so that the unit mark
shall accurately coincide with the string
image. Having all this performed, the next
step is to slightly tighten the tension of the
string, and with a minimum excitation cur-
rent in the magnet field, close and open the
key rapidly, and note the amount of de-
flection of the string image on the scale.

In order to detect when the gal-
vanometer is most sensitive, the string
must be displaced one millimeter on the
scale with the original predetermined cur-

(Continued on page 425)
Spectroscopic Methods and Spectra

A SEQUEL TO "HOW TO BUILD A SPECTROSCOPE."

By D. S. BINNINGTON

BEFORE taking up the production of Spectra, it will be necessary to refer back to the previous article on this subject—"How to Build a Spectroscope," which appeared in the August issue. The instrument described will perform a considerable amount of this work, but if this work is taken up systematically, as this kind of work should be, a few small additions to the instrument already described will be found convenient.

The chief of these is connected with the observation of the spectrum, namely the Telescope. The Spectrum can be observed by placing a reading glass against the spy-hole, which will magnify the spectrum sufficiently for general purposes, but for thorough work and good results a small telescope is a decided improvement. This need not be elaborate or expensive, and does not need to be very powerful, one magnifying about 5 to 7 diameters and costing about one dollar, is very satisfactory.

The mounting of this telescope is shown in Fig. 1. The block of wood is adjusted so as to bring the lens of the telescope on a level with the spy-hole, which must be enlarged sideways to allow of the telescope being moved. The telescope is fastened to this block by means of a strip of tin or copper, and the end of the telescope placed just inside the box which covers the prism, and exactly horizontal with the prism.

The exact angle between the prism and the collimator and telescope can only be secured by moving the prism till the maximum spectrum is obtained. The block to which the telescope is fastened should be fastened to the base by one screw only, so as to allow it to be moved sideways as all the spectrum cannot be seen at once. If this addition of a telescope to the instrument is made, the instrument will need to be adjusted.

This is done as follows: Place a small mirror in place of the prism, so that any light past into the collimator is reflected into the telescope. Having previously focussed the telescope on some distant object, place a white light in front of the slit, and slide the tube containing the slit (either in or out) till a distinct and clear image of the slit is seen in the telescope. Both the collimator and the telescope tubes should be marked with a line so that the instrument can be placed at these points when necessary. It should be noticed here that the collimator should not be moved from this position, but the telescope will need to be re-focused for each individual test in order to make the spectrum distinct and clear. If these directions have been followed carefully the instrument will be ready for use.

It would not be out of place here now to consider a little of the theory of the instrument, as this, if intelligently studied, will give the operator much more confidence in himself and a better understanding of the principles which underly the instrument. To do this, it will be necessary to go back to one of the first principles of Optics, which is that light of any description, when passing from a rarer to a denser medium, does not travel in a straight line but is bent at an angle out of its path, i.e., it is said to be "REFRACTED." This is easily seen from Fig. 2.

Now, light (by this is meant a primary color) has a definite wave length, by which is meant the length of the vibration of the ether which corresponds to the sensation of a definite color. In this respect, Red has the shortest wave length, and the other colors gradually increasing in wave length till violet is reached, which possesses the longest wave length of the visible spectrum. Beyond this, rays of still higher wave length, invisible to the eye, are known to exist. These are the ULTRA-VIOLET RAYS. The same is also true of the red end of the spectrum, in which waves of still shorter wave length than the red are known to exist. These are the INFRA-RED RAYS.

It will be useful to note here that the red rays are the heat-carrying rays, while the violet rays are the rays which produce chemical action, photography being due to the violet or Actinic rays.

From the fact that these colors which make up white light each have a definite wave length, it can easily be seen that they are not all refracted alike. This is actually the case, and can be readily demonstrated by holding a reading glass outside its focus on a sheet of white paper. A colored halo will be seen around the edge. This is due to the varying refraction of the light, which is partially split up. When a prism is used in this fashion, the effect is intensified and a spectrum results.

SPECTRA are divided into two classes, (1) Spectra in which the colors form a continuous blend. This is a CONTINUOUS SPECTRUM, and is produced by incandescent solids such as the particles of carbon in oil or gas flames, or the filament of electric light. See Fig. 1-A. (2) Spectra in which the colors are isolated bands. This is BAND-SPECTRA, and is produced by an incandescent VAPOR OR GAS. In the following material, whenever a white light, or a continuous spectrum is needed, either gas (an ordinary burner or Welsbach), oil or electric light may be used. When a colorless flame is mentioned, a Bunsen burner is preferable, but an alcohol lamp with a clean wick can be used.

The methods of producing spectra: Class 1. Methods in which gas, alcohol or gasoline is used to produce the spectra. Class 2. Methods in which electricity is used to produce the spectra.
ELECTRICAL EXPERIMENTER

Class 1 being the simplest will be taken up first. When using this method, however, it must be borne in mind that only those metals whose salts can be volatilized at the temperature of the Bunsen flame can be used for this method. The exceptions are Sodium, Potassium, Barium, Strontium and Calcium, and the rarer metals, Rubidium and Caesium, and the extremely rare metals, Thallium, Indium and Gallium.

The wires used in this method are preferably of platinum, but a pure grade of iron wire (piano wire) can be used satisfactorily if platinum is used, about 2 inches of No. 28 B. & S. gage is sufficient for each wire, but if iron is used about 3 to 4 inches of a slightly thicker wire should be used. The wires are mounted as shown in Fig. 3. A piece of glass tubing about 4 inches long and 3/16 diameter is drawn out to a jet, which, when heated off and the wire inserted, the glass tube is now heated around the wire till it fuses onto it. The other end of the tube is heated in a flame till it closes. The free end of the wire is bent into a loop about 1/4 inch diameter. If platinum wire is used, two wires will be sufficient, but if iron is used about six should be made. Platinum wires are kept in a small bottle containing chemically pure hydrochloric acid. The glass handle of the wire should be pushed thru a hole in the cork. They are cleaned by first wiping off any loose matter with a piece of cloth and then dip in hydrochloric acid and heated in the flame. This is repeated till no color is given to the flame.

If much work is planned, a stand to hold these wires when in use is desirable. This can be made easily as follows: Make a base of wood, about 2 inches square and 1/2 inch thick. Thru the center bore a small hole, the width of which is about a stiff pointed piece of steel wire (a hatpin with the head removed is just the thing). Then take a cork about 1 inch long, and push it on to the pin so that it can be moved but fits tightly. Bore a small hole in it to take the glass handle of the wire at right angles to the upright pin. The wire can then be moved up and down or around, and adjusted and held in the flame for any required length of time without any trouble. The finished stand is shown in Fig. 4.

The Spectrum is taken by this method as follows: First take a white light, and place it in front of the slit and about 12 inches away. Observe the spectrum and gradually move the lamp closer till a point is found at which the maximum intensity of the spectrum is obtained. This point is noted and always used in practice. It would be as well, however, to note that lamps of different electrical methods vary in intensity of illumination and the writer advises determining experimentally the most efficient working distance for each method. When this distance has been obtained, the thoroly cleaned wire is moistened with hydrochloric acid, dipped in the powdered salt, placed into the holder and heated in the flame. If much work is being done, it is advisable to darken the room, as this is easier on the eye.

When a spectrum is wanted for a considerable length of time, the following procedure can be adopted:—A small piece of asbestos wool is placed in a large test tube, covered with hydrochloric acid, and boiled; the acid is then decanted off, water added, shaken up well, the asbestos allowed to settle, and the water decanted off. The asbestos is then shaken out onto a piece of cheese-cloth, squeezed till dry, placed in the tube again, fresh acid added, and the process repeated. It should then be held in a twist of wire and heated in the flame for about 5 to 10 minutes. If it colors it at the end of this time, it should be again washed with acid and water. When clean it is twisted onto a clean wire about 5 to 6 inches long.

The material desired for the spectrum is dissolved in water to make a strong solution. The asbestos is dipped into this, and then gently heated till dry, and then again dipped into the solution and re-dried. Two drops of hydrochloric acid are dropped onto it and it is heated in the flame. The spectrum thus produced will last a considerable time.

This method has one objection, however, and that is, when the asbestos becomes red hot, it gives a continuous spectrum, but if the slit has been made narrow enough this will not cause any trouble.

Occasionally, a yellow sodium light is required. This can easiest be made by using an alcohol lamp and placing a little salt, or borax, into it. This will give a yellow light indefinitely.

The best salts to use in taking flame spectra are the chlorides or chlorates. If these cannot be obtained, however, the available salt is mixt to a thick paste with hydrochloric acid. This subject, however, will be examined in further detail. This about covers the field of one method of spectra-production. The next section to be taken up is:

ELECTRICAL METHODS

Electrical methods can be sub-divided into three general classes:—

(1) Production of spectra of and in gases.

(2) Production of spectra of liquids or solutions.

(3) Production of spectra of solids.

Class No. 2 being the one most widely applied, will be considered first. In this method the materials in the form of a solution is vaporized in the electric spark.

The apparatus requires an induction coil, giving not less than 1/2 inch spark. Indeed the larger the spark the better will the results obtained. The apparatus is shown in detail in Fig. 5. The glass cup "A" should be about 1 diameter and about 3 inches long. Test tubes can be purchased about 8" x 1", which when treated as before, make two excellent cups. The tube is cut out about 3/4 down. This gives one good cup about 3" long and a piece of tube about 5" long. It is heated in the flame and worked with a large nail till the bottom is closed. This will eventually bring it to about the same length as the other.

Of course as will be seen later on, a small jet 1/2" or 1/4" is correct. This will be used, but the author would not advise this as the thickness of the glass will cut off some of the violet rays, besides distorting the image, which the apparatus made with a test tube is easier to make and will give far more satisfactory results.

A hole about 3/16" in one end now be made into the bottom of the tube. This is done as follows:—Plug up the tube with a cork thru which passes a piece of glass tubing connected to the side arrangement with a piece of rubber tubing. Heat about 3/4" in the center of the bottom of the cup with a small flame, to bright redness, and then blow thru it, so that it will then blow out. It should be carefully trimmed with a file till it is flush with the tube. The edges of this hole should now be heated in a small mouth-blowlip flame till they fuse and assume a smooth appearance.

The next step requires about 3" of platinum wire. This can be obtained from any laboratory supply house. A six-inch piece of No. 28 is about right. Add about 75c and will make various pieces of apparatus, No. 32 B. & S. can be used and comes a little cheaper, but No. 28 is more satisfactory and will give better service.

The tube "B" is about 5 inches long and 3/16" internal bore. One end has sealed into it, about 1 inch of platinum wire, so that about 1/4" projects into tube. The tube "C" is the most important part of the apparatus, and the directions should be carefully followed. A piece of glass tubing about 1/2" internal diameter is drawn out to a jet and cut off to about 1 inch over-all length. The large open end of the tube is pointed in the flame, and the jet end is ground on a piece of moist emery cloth till it has an aperture not larger than 3/64" (between No. 28 and 30). The bottom of this tube is corked with a small piece of rubber thru which a small hole has been made. Thru this hole, the platinum wire (about two inches) is worked, so that when the rubber stopper is in place, the platinum wire is just in the end of the jet. The position of this wire can always be adjusted by moving the rubber stopper slightly. About 1/4 inch or more of wire should project beyond the lower end of the valve, and the bottom of the tube is then drawn into the tube "A" by a cork in the lower hole. The tube "B" is fastened into the tube by a large cork, which should have a slit cut in one side to allow gases to escape. The distance between the spark (Continued on page 427)
Ohm’s Law and A. C. Circuits

By ARNO A. KLUGE, Instructor in Radio, University of Nebraska

A SUBJECT that is usually rather hazy in the mind of the practical electrical man who has never had the opportunity of engineering training, is the application of Ohm’s law to alternating current circuits. This may be traced to a total lack of literature of a concise nature on the matter, for in most text-books it is necessary to digest several chapters of non-essentials before the point is reached.

In alternating current practise we encounter three different kinds of paths or conductors of the current, and it is the method of computing their effective resistances in various combinations that this article has to deal with. The first kind is the simple straight wire, whose resistance, for low frequencies, at least, depends wholly upon its length, cross-section, and material. It must be clearly understood that this applies only to currents of audio frequencies, as from 25 to 500 cycles, since any conductor at audio frequencies possesses appreciable capacity and inductance.

The second and third cases of paths are the condenser and the inductance coil, designated as capacity and inductance, respectively. Seldom if ever do we find these cases in a circuit alone, but usually in combination with one or both of the other two. For example, an inductance coil always has resistance associated with it, since it is impossible to obtain a perfect conductor.

We can then make a table for the equivalent ohmic resistance of each of these types, from the data we find in text-books, as follows:

<table>
<thead>
<tr>
<th>Type</th>
<th>Equivalent Ohmic Resistance</th>
<th>Simple</th>
<th>Resistance of conductor</th>
<th>[ \frac{1}{C} ]</th>
</tr>
</thead>
<tbody>
<tr>
<td>R</td>
<td>(Resistance of conductor)</td>
<td>[ \frac{1}{R} ]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>(Capacity in farads)</td>
<td>[ \frac{1}{C} ]</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Inductance, \( L \), (\( L = \) inductance in henries) in the above \( P \) represents the reactance factor of the current applied, being \( P = 2\pi f \) (where \( f \) = frequency in cycles).

The difference in the value of these resistances is due to the differing effect which they have upon the voltage and current of our power supply. A condenser in the circuit, and by use of the formulae attached the student is enabled to calculate the current which will flow in any possible circuit. It should be borne in mind, however, that while these formulae will give the actual value of the current flowing in the circuit, we cannot then multiply this amperage by the impressed E.M.F. and obtain the power consumption of the circuit in watts. The latter is wholly dependent upon the power factor, i.e., the per cent lag or lead of the current, and it will be necessary to multiply the product by this factor to obtain the true wattage consumption of our circuit.

The power factor of an A. C. circuit is found by dividing the true watts as read off from a compensated indicating watt-meter by the apparent watts, which latter term is the voltage resultant from multiplying the effective or indicated volts by the effective or indicated (or calculated) amperes. Some A. C. installations are fitted with a direct reading power factor meter.

WOMEN INSTRUCT IN RADIO WORK.

Miss Baruch, daughter of Bernard Baruch of Glen Cove, Miss Chanler of Stony Brook and Miss Ferrine of New York are instructing the men of the air service at Mitchel Field in radio work. There are twenty-five other women who are volunteering their services in instructing the men in both the English and French language. Special attention is given to the men who are not familiar with the English language, with especial reference to military terms.

At one period no mail reached the miners of Spitzbergen for eight months, but they are now able to get the world’s news twice a day by wireless telegraph.
The Manipulation of Glass Tubing in the Experimental Laboratory

By Prof. HERBERT E. METCALF

Part II

It is often necessary to fuse a small tube to a large one or to make other end-to-end fusions. Fusions are the hardest part of glass-blowing and must be done carefully in order to produce satisfactory results. Many experimenters heat the ends of two pieces of glass in a flame and then stick them together only to find out that they will break apart upon the least provocation. A real fusion, properly done, will prove as strong as any other portion of the tubing. Heating the ends and sticking them together is the first part of the process, it is true, but the procedure extends beyond that. After the ends are stuck together they must never be allowed to cool. A cork is stuck in one of the ends and then a sharp needle-like flame from the bunsen lamp is directed at one side at the place where the two tubes join. This point will soon become white hot, the glass will run together and will bend in under the force of the flame. Removing the flame, blow very gently into the open end of the tube, thus bringing back the bent portion into its proper shape. At this point the glass is properly fused. This same procedure must be repeated all around the circumference of the fusion. When finished all points will be perfectly fused, with the two ends of each melted off smoothly one into the other. All this time the tube must not be allowed to cool. Therefore the work must be done rapidly and the joint must not be laid down until entirely finished. When the fusion is completed it must be gradually cooled in a yellow flame until sooted. It may then be laid on the asbestos mat to cool.

Making "T’s" and "Y’s"

T’s and Y’s are only variations of the end-to-end fusion process. The principal difference, however, is in making the hole in the side of the glass tube, and the order of procedure in the more complicated pieces.

To make a hole in the side of a piece of glass tubing is a simple matter, but to make a hole of the proper size is much more difficult. First select the top bar of the "T" and direct a sharp, very fine needle-pointed flame, at the place where the hole is to be, see Fig. 5. A cork has been placed in one end of the tube will enable the manipulator to blow out a small bubble on the side of the tube at the point which the blow pipe is heating white hot. Now the size of the resultant bubble will depend upon the area which is white hot and also upon the force with which the bubble is blown out. A few trials will soon give the knack of obtaining various sizes of holes. This bubble may then be broken with a file and the edges trimmed down, taking extreme care to leave a small lip to aid in fusion. The hole is now ready for the fusion. Heat the edges of the hole until they are sticky; heat the end of the piece to be fused on until it also is sticky, then stick them together with a slight rotary motion, being sure that no small air leak exists. If a leak is present it will prevent the effect of blowing in the tube.

As there are now two open ends, one of them must be plugged with a cork, leaving only one to blow into. The needle pointed flame is again brought into use and the joint fused by alternately melting in and blowing out the glass all around the circumference of the weld. The "T" must then be sooted thoroughly and laid away to cool.

A few words about this all important blowing operation which forms a part of all glass tubing manipulation. It is so important it must be thoroughly understood. Upon directing the needle-pointed flame on a portion of the circumference of two tubes at the point where fusion is to take place, the flame, depending on the size of the flame, will become white hot and the edges will fuse or run together. But, at the same time the tube at this point will bend inward, and must be gotten back into shape. This is done by blowing gently into the open end of the tube just hard enough to get the hot por-

Duplicating a Commercial Glass Vacuum Pump (left) by Simple Home-Made Design (right). Former cost $2.50—"Made in Germany." Latter cost 25 cents and works just as well.

Having made a "T" it is a very simple matter to make a "Y". After the "T" has been fused, direct a larger flame so as to heat the entire tube in the neighborhood of the joint and then bend into the shape of a "Y".

Tubes with any number of side openings may be made: A cross may be made with one precaution. Proceed to make a "T" and then immediately start working on the other side without allowing the first joint to cool. This is to avoid re-heating and re-cooling a joint once made, as they are apt to crack.

Making Constructions in Glass Tubing

The ordinary way of making a constriction in a glass tube is to merely heat a portion of the tube and then draw the two ends apart until the required result is obtained.

(Continued on page 422)
An electric furnace is an apparatus for the production of high temperature by electricity. The advantages of such an apparatus are—the direct application of heat to the material, thus eliminating excessive losses by conduction thru the walls of a containing vessel; the production of high temperature, usually above those obtainable from fuel in common uses; simple and accurate regulation, giving absolute control of a process and an economical use of power; and finally, with sources of water-power, a low operating cost.

There are several types of electric furnaces in use. The general division are—the Induction type, and the Resistance type. The purpose of this article is to give the experimenter the simple construction details and operating principles of these furnaces.

Before going further, it is well to inform the operator of any of these devices to watch his fuses, as many will be blown without the proper regulation of the rheostat in Fig. 1. The experimenter will find that a transformer is not necessary for a small arc furnace, but in the case of the resistance or induction types a higher voltage than the ordinary lighting current is required for good results.

The author has found the simplest rheostat to be of the water-barrel type. A wooden spool is first filled with strong salt water. A metal plate in the bottom is attached to one lead, which is well insulated; a piece of rubber hose over the wire is excellent. To this other lead is soldered a metal electrode of any sort. The distance between the plate and the electrode regulates the current; the closer they are the less the resistance. The experimenter may fit up a support for his adjustable electrode to suit his convenience. Fig. 2.

The arc furnace is by far the best for the amateur. It is the simplest and cheapest in construction, the easiest of operation and regulation, the most economical and is productive of higher temperature than the other types.

A furnace which will give practical results can be made from two blocks of slaked lime, hollowed out and grooved for two carbon electrodes, as shown. This apparatus, with proper lighting current, is the same as an arc-light. To start the arc in operation the carbons are touched together and then drawn a small distance apart, giving a steady arc. The material to be melted is placed in the hollow beneath the arc. To stop the arc, the carbons are drawn far apart, thus breaking the arc. The use of a rheostat or "ballast" improves the steadiness of the arc. A transformer is not necessary as was stated before.

As an electric arc between carbon wears down the positive electrode, adjustment is frequently necessary in order to maintain the flow of current. One carbon...
furnace, the amperage varying with the resistance offered by the material. The carbonodeum furnace at Niagara Falls runs on potentials as high as 22,000 volts.

The induction furnace (Fig. 8) is not a practical one for the experimenter. It requires some of the circuit material to start it, and due to the high reactance resulting from the distance between the primary and


secondary is uneconomical for a laboratory device. The induction furnace operates as a transformer, the secondary winding in this case being the "charge," which is contained in the circular channel A, and is heated by the secondary current. The amount of energy put into the secondary can be varied by varying the applied primary voltage.

It is hoped that these few notes will prove useful to the electrical experimenter. There is a large number of unsolved problems connected with the behavior of various substances at high temperatures yet to be worked out, and the results of some experimenter's research may be, for all we can tell, of great commercial or scientific value.

TRICKS IN 3- AND 4-WAY LIGHT SWITCHING.

By Y. R. MANN

In the experimenter's laboratory it is often desirable to control the flow of current from two or more points. To accomplish this easily and at a low cost, battery type, porcelain base, knife switches may be substituted for the 3-way and 4-way push button switches. It must be remembered, however, that when the current is turned off by opening one of these switches (see Fig. 1) the blade must be thrown over to the opposite contact, so that the throwing of another blade will close the circuit again. In the standard snap and flush switches this operation is accomplished automatically by means of the spring.

The solid lines from switch to switch (Fig. 1) show the circuit as arranged for control from three points, using one double-pole and two single-pole, double-throw switches. The connections for control from two points are made by using only the single-pole switches, connected to the line and load as shown, and connected together as shown by the dotted lines.

Making a D. P. Switch from a 3-Way.—Any standard 3-way flush push-button switch may be changed to a double-pole switch by removing the contacts from one side (not one end) of the shell and transposing them. As in a 3-way push-button switch, the contacts are arranged so that there is a high and a low one in each end of the shell, this change gives two high contacts in one end and two low ones in the other, making the switch either all on or all off at each consecutive push.

The strip of metal which bridges the "live" contact of the 3-way must be removed or permanently disconnected. Line connection may be made to the point which has no screw by soldering the wire to it or by simply hooking the wire firmly and tightly in the unthreaded hole.

To change a double-pole flush push-button switch to a 3-way, reverse the above operation, bridging one end by a piece of wire and removing one screw from that end so that the "live" end can be readily distinguished.

3-Way Hook-Ups.—Fig. 2 shows two S. P. D. T. knife switches connected up to control two lamps in two rooms from two different locations. Fig. 3 illustrates two 3-way (or two S. P. D. T. knife switches) controlling two or more lamps, A, B, etc., in a group, the switches being placed in such positions as at the top and bottom of a stairway, etc.

FILING SMALL HOLES.

It is often necessary to enlarge a hole thru a thick piece of metal by filing. If a very thin file is used, that will pass right thru the hole, there will be no risk of its getting jammed and snapping off with the end firmly imbedded in the work, as might happen if a stouter file were used that would only enter the hole for a portion of its length. On the other hand, only a limited amount of force can be exercised with safety when using a thin and delicate file, which makes the operation rather tedious.

The best way is to select as strong as file as possible for the job, marking the safe limit to which it may enter the hole, and preventing it from going any farther by slipping a small clinch or circlip at the end. The file can then be used vigorously without any risk of striking.

Contributed by H. J. GRAY.

AN EXTENSION GONG FOR A CLOCK.

In the sketch, A is a carbon cup holding mercury; B, a piece of No. 10 gage wire; C, a weak spring to raise B from cup; D, stop to prevent apparatus from turning out of position; E, piece of tin cut in triangular shape; F, pivot for tin triangle; G, cord or catgut connecting hammer with triangle; H, hammer, and I, the clock gong, as might happen if a stouter file were used that would only enter the hole for a portion of its length. On the other hand, only a limited amount of force can be exercised with safety when using a thin and delicate file, which makes the operation rather tedious.

The best way is to select as strong as file as possible for the job, marking the safe limit to which it may enter the hole, and preventing it from going any farther by slipping a small clinch or circlip at the end. The file can then be used vigorously without any risk of striking.

Contributed by H. J. GRAY.

A "Mercury Switch" Rigged Up to Ring Extension Bells Whenever a Clock Strikes the Hour and Intermediate Periods.

I recently made an extension electric gong for a clock, so that it would strike whenever the clock struck, but I experienced trouble in getting good contacts in the clock. At first the contact was made by the hammer striking the gong, but this did not give satisfaction, so I devised an apparatus which is shown in diagrams, that worked with excellent success.

The carbon cup, A—which is mentioned in the diagrams—is easily made from a piece of a round carbon from an old battery. The holes are easily made in it with the use of an old pocket knife.

Contributed by CHAS. J. EDWARDS.

TITLING BOOKS

Many readers desire to title bound volumes of the Electrical Experimenter, or other magazines, or books which have been re-covered, etc. The usual method is to mark it in either black or white ink, according to the color of the covering. This method may be improved upon by applying a coat of transparent shellac over the lettering, and thus prevent the wording from becoming obliterated from hard usage or by being rubbed off with the fingers. When the lettering his dried, the shellac is applied, and allowed to dry thoroughly before being used. It is advisable to apply one or more coats to the cover.

Contributed by ALBERT W. WILSDON.
Chlorin was first prepared by Scheele in 1774 while he was experimenting with "black magnesia" (an ore consisting largely of manganese dioxide) and hydrochloric acid, but it was not until 1801 that Davy first established its elementary character. Scheele called it "Dephlogistic Muriatic Acid". Berthollet named it "Chlorated Muriatic Acid", supposing it to be a compound, because he observed that its solution in water yielded muriatic (hydrochloric) acid and oxygen, when placed in sunlight. Davy applied the present name, chlorin, on account of its greenish-yellow color.

Gay-Lussac and Thenard demonstrated that one volume of it united with one volume of hydrogen to form hydrochloric acid.

OCCURRENCE.

Chlorin does not occur in the free state in nature as its affinities are too great. It is found abundantly in combination with sodium in the form of sodium chlorid, which is found in sea waters, inland lakes, and beds of deposite, from which it is dug like coal. It is also found combined with magnesium, which is a much smaller constituent of sea water than sodium, and which is also found in some mineral springs.

Preparation.—(1) In the laboratory it is usually prepared by removing the hydrogen from hydrochloric acid with the aid of manganese dioxide. In this reaction the hydrogen taken from the acid unites with the oxygen of the manganese dioxide, according to the equation:

\[ 4\text{HCl} + \text{MnO}_2 = \text{MnCl}_2 + 2\text{H}_2\text{O} + \text{Cl}_2 \]

Chlorin has affinity for metals, and so half of it unites with the manganese present to form the compound manganous chlorid (MnCl). It might be expected that MnCl + 2H₂O would be the products, but one atom of manganese cannot hold more than two atoms of chlorine, and half the chlorin is thus set free, having nothing with which to combine, while all the oxygen goes to form water. You will observe that the valence of the manganese in the factors (to the left of the above equation) is 4, while in the products (to the right of the above equation), it is 2; or in other words, towards oxygen, manganese has a valence of 4, while towards chlorin its valence is 2. This is a reduction and oxidation, hydrochloric acid being the reducing agent, manganous chlorid the reduction product, and chlorin the oxidation product.

(2) It may be prepared by the electrolysis of hydrochloric acid or the chlorides by utilizing the electrolytic generator shown by Fig. 130 of this series, in the September issue of this journal. The principle involved is the decomposition of the acid, or chlorides, by means of an electric current, in which the chlorin is liberated and collected at the anode, and the hydrogen or sodium (if sodium chlorid is used) collected at the cathode. In the various processes, many mechanical difficulties have been encountered in the form of secondary reactions taking place with the formation of sodium hypochlorit, chlorat and chlorid, due to the diffusion of the chlorin thru the solution, the reactions being:

\[ 2\text{NaCl} = \text{Na}_2 + \text{Cl}_2 \]

\[ 2\text{NaCl} + \text{Cl}_2 = \text{NaClO} + \text{NaCl} + \text{H}_2 \]

\[ 3\text{NaClO} = \text{NaClO}_3 + 2\text{NaCl} \]

\[ \text{Na}_3 + \text{H}_2\text{O} = 2\text{NaOH} + \text{H}_2 \]

Numerous devices have been invented to overcome this difficulty. Probably the most successful has been the Castner-Kelner process, described in the November, 1917, issue and illustrated by Fig. 88 of the same issue.

(3) On the large scale chlorin is made by a method known as the Weldon process. The only difference between this method and the one first described above, namely that of acting on manganese dioxide with hydrochloric acid, consists in transforming the manganous chlorid into a compound that can be again treated with hydrochloric acid. The manganous chlorid was formerly wasted, and thus the cost of chlorin, when made into bleaching powders, etc., was considerable, caused by the necessity of using new manganese dioxide each time. By Weldon's method the manganous chlorid obtained is treated with calcium hydroxid (slaked lime, Ca(OH)₂), converting it into manganese dioxide, thus:

\[ \text{MnCl}_2 + \text{Ca(OH)}_2 = \text{CaCl}_2 + \text{Mn(OH)}_2 \]

(Continued on page 411)
A SIMPLE BATTERY MOTOR FOR THE BOYS.
I am sending you a plan of an electric motor which I designed. The rotor is made of an old spool such as magnet wire comes on. On its circumference are set eight nails or screws on either side of the spool and these spaced evenly apart. One set of screws or nails is used for the commutator as shown in Fig. 2. This set of screws is connected to the shaft by wires as shown. When the screw D comes to brush E, F is drawn to the coil and on. The connections are as follows: One terminal of battery is connected to the shaft by means of a brush, or by connecting a wire to the frame. The other terminal is connected to one side of coils, and the other terminal of coils is connected to brush E, Fig. 2.
Contributed by C. P. WALKER.

HOW TO OIL KNIFE SWITCHES.
As oil is an insulator, it cannot be successfully used to make switches work easily of the ordinary blade and clip type, as the oil forms a film between the switch-post and switch-blade, thereby insulating one from the other. This may be overcome in the following manner:
To the switch-post solder one end of a flexible conductor about two or three inches long. Solder the other end to the switch-blade. For this conductor drop-cord for electric lights will serve very efficiently.
Contributed by RICHARD J. ANDERSON.

AN ELECTRIC “COMBINATION” DOOR LOCK.
The sketch shows a simple electric door lock attachment which any amateur electrician can make. It has been in use on my door for several months and has proven entirely satisfactory.
The solenoid “S,” armature “A,” and hook “B” are mounted on the casing of the door; inside the house of course. The row of push buttons “H” is placed outside of the door. The buttons 3, 4, and 6 are connected in series with the relay switch “I,” which is normally closed, and the solenoid coil “S.” Buttons, 1, 2, 5, and 7 are connected in multiple and the group in series with the relay switch magnet “D.”
If buttons 3, 4 and 6 are prest, coil “S” is energized, raising the hook “B” which allows the door to be opened. However, if any other buttons are prest at the same time, then coil “D” opens the solenoid circuit at “P,” and the door remains fastened. “C” is a switch placed inside the room to open the door when leaving or to admit anyone.
Contributed by RAE GALUSHA.

BURGLAR ALARM FOR A SLIDING DOOR.
This alarm has worked with success and I thought that someone else might wish to use it. The material consists of a strip of brass, a screen door spring, a long nail, an electric bell, switch and batteries. Fasten the strip of brass at one end on wall and bend it to shape shown in diagram. Drive nail in ceiling so that strip of brass will hit it when the door is open. Then fasten screen door spring so it will pull the brass strip against the nail “A,” when the door is shut the brass strip is held away from the nail, but when it is open the brass strip touches the nail and closes the circuit, causing the bell to ring.
Contributed by VIRGIL McELROY.

A MAFNET-LESS BUZZER.
To make this buzzer, a piece of resistance wire, X, about 18 inches long is sus-

A Simple Form of Battery Motor Which Experimenters Will Find Interesting.

To Make a Good Contact Thru Knife Switch Joints, Especially When Oiled, Solder a Flexible Lead to Both Hinge and Blade.
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BOILING WATER WITH ICE.

This is an old, the very curious and interesting experiment, calculated to mystify the uninitiated.

Obtain a Florence flask or glass distilling retort and fill it half full of water. Boil the water, and immediately on removing the flame, cork the flask tightly, and turn it upside down. As soon as the steam condenses it will form a partial vacuum over the water. It is well known that water boils in a vacuum at a much lower temperature than is required in the open air, and consequently, if the vacuum could be kept up, the water would boil long after it was removed from the source of heat. But as soon as steam is formed, it exerts a pressure on the water and stops the boiling.

If now we place a piece of ice on the top of the flask, the vapor or steam will be condensed, a vacuum will be formed and the water will commence to boil violently and will continue to do so until the temperature of the water in the flask falls below that at which water boils in a vacuum.

If the ice be removed before this occurs, the vapor will again form, press on the water and stop the boiling; but the boiling may be renewed by replacing the ice.

In performing this experiment, it is well to wrap the ice in flannel to avoid the dripping of the melted ice.

Contributed by V. H. TODD.

A FEW USEFUL INK FORMULAS.

Blue ink:

3 parts Prussian blue.
1 part Oxalic acid.
30 parts water.

When dissolved add 1 part of gum arabic.

Green ink:
Sap green dissolved in very weak alum water.

A good ink eraser:

A. Oxalic acid mixed with citric acid may be used.
B. Equal parts of cream of tartar and citric acid in solution with water.

Inks that appear thru heat:

A. A weak solution of nitrat of copper; when heated it becomes (Red).
B. With a solution of sulfuric acid (Black).
C. With lemon, onion, leek, cabbage or milk and will be visible when paper is heated.

D. With a weak solution of nitrat of mercury (Black).

Invisible ink:

A. Write with pure dilute tincture of iron and develop with a blotter moistened with tar.
B. Linseed oil, 1 part
Ammonia, 20 parts
Water, 100 parts
Mix well before using.

Vanishing ink:
To make an ink black at the time but that will disappear in 24 hours: Boil nutgalls in alcohol, add copper sulfate and sal ammoniac, let cool and then dissolve a little gum in it.
Contributed by GEORGE JOHNSON.

HOW TO MAKE, USE, AND TEST COAL GAS.

A test tube is half filled with ground soft coal, packed loosely. The tube is heated and the gas allowed to pass thru a bottle filled with air. Anything left in this bottle will be coal tar. The gas is then past thru lime water. If any carbon dioxide is present, the lime water will become milky. The gas is then past thru the last jar containing red litmus solution. This will turn blue in the presence of ammonia. From the last bottle, the gas may be allowed to flow thru a rubber tube in the end of which is a burner. The gas will burn with a yellow flame. Using a 6" x 3/4" test tube, this flame will give about 1 candle-power.

Contributed by MORTON BERMANN.

"CHEMICAL SNOW."

Two parts Strontium Nitrat are first dissolved in 20 parts of water. Dissolve 2 parts Sodium Carbonat in 10 parts of water (heat may have to be used to dissolve it). Pour the second solution into the first. The result resembles a miniature snow storm. Sodium Carbonat and Strontium Nitrat react, forming Sodium Nitrat and Strontium Carbonat. The latter is not soluble in water.

"Pouring Red, White and Blue from the Same Pitcher": Fill 3 glasses 2/3 full of water. In the first dissolve 1 measure of Ammonium Sulfocyanat. In the second 1 measure of Strontium Nitrat and in the third 1/2 measure of Sodium Ferrocyanat. In the pitcher dissolve 3 measures of Ferric Ammonium Sulfat in 1/3 glassful of water. Pour a little of this into each glass. The first will turn red, the second white and the third blue.
Contributed by DUNBAR L. SHANKLIN.

SILVER-PLATING GLASS.

To silver-plated glass first have the glass clean. To clean it well wash it first with an alkali and then with distilled water.

Now dissolve 7.8 grammes of silver nitrat in 6 c.c. of water and divide the solution in two equal portions. Dissolve also 3.11 grammes of Rochelle salt in 1180 c.c. of water and heat the solution to the boiling point. Add to it gradually, so as not to stop the boiling, one of the portions of the silver solution, boil 10 minutes longer, cool and decant the clear liquid. To the other half of the silver solution add just sufficient ammonia water to dissolve the precipitat which is formed, or only leave a faint cloudiness; then add 350 c.c. of water and filter. Equal portions of these two solutions, when mixed and poured on glass, will deposit a brilliant coating of silver in about 10 minutes, depending on the temperature of the room.

The coating of silver should then be well washed, dried and varnished.
Contributed by WALTER SWANSON.

A SIMPLE RENEWABLE FUSE.

Amateurs utilizing large amounts of current usually have trouble with their fuses blowing out. A method that makes this occurrence less expensive is to make use of the so-called renewable fuses.

Cartridge fuses may easily be arranged so that new pieces of fuse wire may be put in very easily. A fuse of the proper size as regards the clips is obtained and the brass caps slit with a saw as shown in the illustration, thus cutting the ends of the caps into four pieces. The pointed ends are bent in and in this manner the caps are fastened permanently to the fiber tube. The asbestos filling is removed and the tube cleaned out.

To renew such a fuse it is only necessary to run a length of wire of the proper size thru the tube and bend the ends of the wire around the ends of the tube, thus making connection to the brass caps. When the fuse blows the melted metal will not spatter, since it is confined by the tube. Corks may be placed in the ends of the tube to prevent undue splashing of the hot metal, but one of them should have a V-shaped slot cut in the side to act as a vent for the gases.
Contributed by THOS. W. BENSON.
Electric Figure Toy
(No. 1,722,304, issued to Eisen. C. Owens.)

This invention refers to an improvement in that class of inventions known as games and toys, and particularly to moving figure toys and advertising display features. The inventor makes use of two or more doll figures, arranged so that the electric motor drive within the cabinet will actuate the figures and cause them to take on life-like movements, the limbs being suitably jointed for the purpose. Some of the features incorporated in this patent are a means for supporting and guiding the reciprocating rods in the dolls and other figures, and cushioning means for preventing noise while the device is in operation.

Electro-Agricultural Scheme
(No. 1,268,994, issued to Reginald A. Smith.)

Prof. Passenbenk provides an elevated wire rack above the plaited as shown, and these are charged with a high potential current thru a rectifier and step-up transformer. An A.C. dynamo excites the transformer, the field of the alternator being connected to a rheostat the resistance of which is rotated by a motor. Thus the resistance of the dynamo field circuit is periodically increased and diminished during each revolution, and it is designed so as to give a strongly peaked wave form. He has found that a low frequency for such a current is preferable, even as low as one in five seconds, or even lower.

Electric Fog Horn
(No. 1,270,355, issued to Jesse A. Wright.)

An electric signaling horn useful for fog signaling and other requirements, and providing a means whereby the horn may be mounted upon the pilot house so that it can be rotated within the latter and locked in any of its adjusted positions. An electric fan such as used on autos but of larger size is mounted in the smaller end of the fog horn, and means are provided for maintaining the electrical connections to the siren motor as the fog horn is elevated or rotated thru different positions.

Electrical Percussion
(No. 1,266,945, issued to John Hickey.)

Physicians and surgeons make extensive use of the art of percussion in determining whether the body is sound and healthy, and also for diagnosing bone locations and dislocations, etc. Percussion is generally performed by striking the fingers on the portion of the body under examination, but a much more satisfactory means of establishing percussory sound waves is by means of the electrical percussion apparatus here illustrated. The vibrations created by the vibrating breaker are transmitted thru a rod and cup to the body.

Sound Reproducing Device
(No. 1,266,937, issued to Herman G. Pape.)

This invention provides a new form of ear cap for telephone receivers having a number of grooves or kears molded in the side facing against the ear, so as to allow free air circulation, so that when the cap is held snugly against the ear, it maintains communication between the outside air and the otherwise closed sound chamber within the cap. These kears prevent or dissipate pressure waves, due to the vibration of the diaphragm, where waves otherwise would be focused on the ear drum and cause the sound to be muffled or indistinct, besides causing great strain on the ear drum. An adjustment screw with spring connection permits of modulating the vibration of the diaphragm. The cap also carries molded extensions around its periphery to prevent the receiver rolling off flat surfaces.

Ventilating Apparatus
(No. 1,270,355, issued to James A. Williams.)

This patent covers a unique ventilating, cooling and humifying apparatus intended for use in theaters, restaurants and the household, and which will effectively circulate, cool and humidify the atmosphere at a small expense. The object of the invention here presented is to provide means for cooling the air which will so distribute the same thru the room, so as to avoid the injurious effects of direct blasts of draughts of air usually caused by the ordinary electric fan. The inventor provides means for holding ice in a air tunnel, thru which an electric fan blows a draft of air, and the ice water is caught in a drip pan at the base of the apparatus, which is provided with an overflow outlet.

Combined Telegraph and Telephone Receiver
(No. 1,270,861, issued to Herman G. Pape.)

This is a clever combination of telephone and telephone receiver which may be used with an acoustic amplifier described by the inventor, and which should prove of considerable efficacy in telegraph offices where the sounders now in use make a bedlam of noises. For telegraphy the person using the new telephone is the only one that receives the dots and dash signals. The electro-magnet actuating the device for telegraphy operates an armature attached to a sound anvil, which latter strikes the diaphragm, resulting in a tap or click resembling that given by the standard Morse sounder. An adjustable buffer is set against the diaphragm and is to prevent continued vibration of the diaphragm and which permits only an instantaneous sound or vibration to be heard.

Dry Storage Battery
(No. 1,268,162, issued to Walter A. Crowell.)

An improved form of dry storage battery in which the electrolyte employed is non-drying, and comprises suitable absorbent inert solid matter holding the electrolyte in the cells, and the latter is distributed thru the solid mass. A specially devidied gas vent and baffle is provided so that any gas produced by the battery can escape. A series of porous tubes are placed in the battery together with the plates, these tubes serving to hold any surplus of the liquid electrolyte which may seep thru their porous walls.

Electrical Phonograph Sound Recorder
(No. 1,271,684, issued to Victor Hugo Emerson.)

A scheme for producing phonograph sound records of the disc type and providing improved means for accomplishing this purpose by utilizing an electric heating coil applied to the needle of the master record machine on which the records are made. A source of electricity and a rheostat may be used so as to control the heat applied to the needle very accurately. In applying this arrangement, the inventor uses a high degree of heat applied to the so-called "cutting stylius" while the stylus is in contact with the revolving record, making a continuous record on the record blank, and causes the stylus to be heated effectively in the air, which is a better method than the so-called induction heating.

Dental Soldering Iron
(No. 1,266,877, issued to Harry A. Orme.)

Wire solder is used in the form of a rod, which can be snapped into place quickly, and this solder feeds thru the hollow handle and carried thru the tip of the iron itself. A wrapping of asbestos is placed around the iron just ahead of the tip to prevent too much heat reaching the solder at this point and melting it. An ingenious feed lever, which can be worked by the thumb, is mounted on the front of the handle, this lever being spring actuated. The bottom of the lever bears against the solder and is toothed so as to grip it forward a given amount with each movement of the lever.
“Amateur Electrical Laboratory” Contest

In this issue we publish some interesting facts with excellent photos, describing one Amateur Electrician’s experimental laboratory. Now “Bugs” want to publish a snappy one like it each month. Here’s our proposition: Why not write up your “Electrical Lab., in not more than 500 words. Dress it up with several good, clear photographs. If we think it good enough we will publish the article in display style and pay you well for it. The prize awarded to such articles will range from $3.00 to $10.00. And “Bugs” don’t forget to make your article interesting. Typewritten articles preferred. Address the Editor of this Department.

THIS MONTH’S $3.00 PRIZE WINNER—LAWRENCE C. ARMANTROUT, MATTOON, ILLINOIS

The accompanying photos are views of my laboratory and (now extinct) Radio Station. My laboratory is combination, chemical and electrical, and the photos show most of the apparatus. I have about twenty-five pieces of electrical apparatus, such as Tesla and Oudin coils, 110-volt motors, spark coils, Leyden jars, generators, electrolyticinterrupter, step-down transformer, rheostats, tin foil condensers to 5 M.F. capacity, experimental arc, condensers for the spark coils, and 1 K.W. transformer, also condenser and rotary gap, which excite the 1 K.W. Tesla coil. The Chemical Laboratory consists of test tubes, thistle tubes, retort, delivery tubes, desiccator, hydrometer, Florence and Erlenmeyer flasks, crucible, chemist’s scale, and sufficient other apparatus and chemicals for carrying on extensive experiments. I have carried on interesting experiments with home-made Tesla tubes, the construction of which was explained in the experimenter sometime ago. I also have a couple of storage batteries and a short line telephone; and a drawing-board and drafting outfit for making structural designs, hook-ups and other drawings.

One of the photos shows my former radio station, with which I obtained excellent results, Albany, N. Y., being my record sending distance (about 900 miles). I think that the equipment needs no other description than that it is a 1 K.W. sending outfit and there are two regenerative, vacuum bulb detection receivers for receiving, as well as auxiliary Crystal and crystal detectors.

Last but not least, is the workshop in one end of my laboratory, “all dolled up” for a picture, in which I have a good stock of binding posts, contacts, machine screws, wood screws, bolts, nuts, magnet wire, spindles, strip brass and copper and other “junk” that is usually found about a “mucker’s” laboratory. The tools are coping saws, key saws, twist drills, hand drill, pliers and punches of different sizes, etc.
Phoney Patents

Under this heading are published electrical or mechanical ideas which our clever inventors, for reasons best known to themselves, have as yet not patented. We furthermore call attention to our celebrated Phoney Patent Office for the relief of all suffering daffy inventors in this country as well as for the entire universe.

We are revolutionizing the Patent business and OFFER YOU THREE DOLLARS ($3.00) FOR THE BEST PATENT. If you take your Phoney Patent to Washington, they charge you $20.00 for the initial fee and then you haven’t a smell of a Patent yet. After they have allowed the Patent, you must pay another $20.00 as a final fee. That’s $40.00! We PAY YOU $3.00 and grant you a Phoney Patent in the bargain, so you save $37.00! When sending in your Phoney Patent application, be sure that it is as daffy as a lovesick bat. The daffier, the better. Simple sketches and short descriptions will help our staff of Phoney Patent Examiners to issue a Phoney Patent on your invention in a jiffy.

Prize Winner. Solarmobile. Joy rides now being forbidden on Sundays in gasoline buzz wagons, and Doc Garfield not having clamped the lid as yet on the sun, your petitioner prays for letters Patent on a sun-fliverette. This afore-mentioned solarmobile by means of its reflector (which also shades the driver) collects free of charge the sun’s rays, which striking the thermo-cells generate juice, thence trickling into storage battery, drive fliverette motors. Compressor operates ice plant to cool driver when he gets his tire bill. The fan blows away his perspiration when he tries escaping the speed-cop. Inventor Kenneth Strickfaden, Paoli, Pa.

Trolley Regenarrative System. With blushing modesty I announce my revolutionizing inverted scenic-trolleyroad. Once trolley pole goes joyriding along the ups-and-downs track which is but a camou-full-flaged trolley wire. Due to its sinuous road it affects a 2-and-fro motion of the trolley pole. This is utilized to rotate wheel W which in turn turns one good turn into another, thus turning the pulley of dynamo which in turn intern the resultant juice into storage batteries A, B, C, D for the duration of the war. The juice runs the trolley car, surplus current going into line to run other cars. Inventor Leslie E. Neville, Leonia, N. J.
The “Oracle” is for the sole benefit of all electrical experimenters. Questions will be answered here for the benefit of all, but only matter of sufficient interest will be published. Rules under which questions will be answered:

1. Only three questions can be submitted to be answered.
2. Only one side of sheet to be written on: matter must be typewritten or else written in ink, not penciled or otherwise.
3. Sketches, diagrams, etc., must be on separate sheets. Questions addressed to this department cannot be answered by mail free of charge.
4. If a quick answer is desired by mail, a nominal charge of 25 cents is made for each question. If the questions entail considerable research work or intricate calculations a special rate will be charged. Correspondents will be informed as to the fee before such questions are answered.

BOOKS ON THE “ELECTRON.”
(953) Oscar W. Ehram, Portsmouth, Ohio, inquires:
Q. 1. For a good book treating on the “electron.”
A. 1. With further reference to the editorial in the March number of the Electrical Experimenter, entitled “Dormant Forces,” you will undoubtedly find very interesting reading, in the new work by Professor Millikan entitled “The Electron. Its Isolation and Measurement.” Our Book Department can supply it at $1.60 prepaid. Also you will find some very interesting reading along this line in the April, 1918, issue of the Electrical Experimenter.

DIFFERENTIAL BATTERY CURRENTS.
(954) A. Hering, Brooklyn, N. Y., wishes to know:
Q. 1. How to detect differential battery currents in circuits where cells are connected in opposition.

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Now is the time to make your Kodak pay for itself in a real practical way. There are after interesting photographs of out-of-the-ordinary electrical, radio and scientific subjects and are willing to pay $1.00 cash for every one we can use. Please bear in mind that for half-tone reproduction in a magazine, a photograph should be particularly sharp and clear. Of course, if a subject happens to interest us particularly well, we can have the photo retouched. For the general run of subjects, however, it does not pay to go to such expense. Therefore, please take pains to properly focus and expose your pictures. If it often happens that a really mediocre subject poorly photographed. And don’t send us plate or print “negatives”; send unmounted or mounted “prints,” preferably a light and dark one.

As to what to photograph: Well, that’s hard for us to say. We leave that up to you, and every reader now has the opportunity to become a reporter of the latest things in the realm of Electricity, Radio and Science. But, please remember—it’s the “odd, novel or practical subjects” that we are interested in. Every photo submitted should be accompanied by a brief description of 100 to 150 words. Give the facts—don’t worry about the style. We’ll attend to that. Enclose stamps if photos are to be returned and place a piece of cellophane on the envelope with them to prevent mutilation. Look around your town and see what you can find that’s interesting.

Address photos to—Editor “Odd Photos,” Electrical Experimenter, 233 Fulton Street, New York City.

CAN SELENIUM CELLS OF DEFINITE RESISTANCE BE MADE?
(956) Ray N. Coffman, Newark, Ohio, asks among other questions concerning selenium cells, if it is possible to build them with a definite, known resistance.
A. 1. Relative to the least intensity of light which will cause the resistance of a selenium cell of the Fritts or Hammer type to be lowered to its smallest value, we would say that when either of these types of cells are subjected to light rays, their resistance is decreased considerably. In making a selenium cell it is very hard to ascertain what this ratio of resistance will be. An idea of the degrees of the resistance of some of these cells can be gotten from the fact that several cells have been constructed having a ratio of 200 to 1. The amount of current that will pass when a pressure of 12 volts is subjected to the cell can be computed from Ohm’s Law in the usual manner.

Suppose the resistance of a cell in the dark is 10,000 ohms and 500 in the light, then by Ohm’s Law the current in the dark is equal to

$$E = \frac{I}{R}$$

$$E = \frac{12}{10,000} = .0012 \text{ Ampere}.$$  

The amount of current flowing in a circuit when the light is on is equal to

$$E = \frac{I}{R}$$

$$E = \frac{12}{500} = .024 \text{ Ampere}.$$  

The resistance of the relay, if used, must, of course, be added to the cell resistance, in making this calculation. Yet an electrical current can be successfully broken 4,050 times per second, in fact Dr. Nikola Tesla has invented a machine for successfully making 50,000 breaks per second. A description of this machine has been given in the February, 1917, issue of the Electrical Experimenter.

ST. ELMO’S FIRE.
(957) Gordon Jones, Jr., Cordele, Ga., inquires of the Oracle:
Q. 1. What is St. Elmo’s Fire?
A. 1. “St. Elmo’s Fire” is the phenomenon which takes place when the atmosphere is abundantly charged with electricity. It usually appears as a brilliant light on the top of ships’ masts, the points of metallic objects and other conductors from which a silent discharge usually passes. The phenomenon is most common during thunder storms and in some instances, the appearance resembles jets of flame extending several feet in length.

We would refer your particularly to an interesting article on atmospheric electricity in the July and August, 1917, issues of this Journal.

WHAT IS “LAUGHING GAS”?
(958) Patrick MacCourt, Medicine Hat, (Continued on page 408)
Free Test Lesson in Draftsmanship

Send for this free lesson which explains the Chicago "Tech" method of teaching Draftsmanship by mail. Positions at big salaries are now waiting for competent men. The call of men to the war has left vacancies everywhere. Even draftsmen of limited training and experience are snapped up and paid good salaries. You have the opportunity, learn Draftsmanship. Chicago "Tech" will train you in the most practical way in the shortest time. Mail the coupon today and let us tell you about the Chicago "Tech" method. This free lesson will show you how well equipped you are to follow Draftsmanship. Enroll in the course only if you decide that you can take it up to advantage. No cost, no obligation on you to make this investigation.

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THE ORACLE.

(Continued from page 406)

Q. 1. What is "laughing gas"?

A. 1. Nitrous Oxide is commonly called "laughing gas." It is a colorless gas with a slightly sweet taste and produces unconsciousness. It is produced in the following manner: Ammonium nitrate is heated and as the nitrate melts it soon begins to decompose with effervescence. Great care must be taken in regulating the heat, otherwise an explosion may occur.

Q. 2. What is the meaning of Analgesia?

A. 2. Relative to the statement appearing in a certain weekly paper, we believe that said statement is in error because the word analgesia is defined as "the insensibility to pain in any part of the body." However, as to the method of removing hair so that no pain at all is felt, we would say that such methods are dealt with under the subject of cataphoresis. This subject of cataphoresis has been described in "The Experimenter" by W. J. Morton, which can be procured from our Book Department for $2.50. We do not know of any case where X-rays have been used for removing superficial hair.

MOVIE TRICKS EXPOSED.

(Continued from page 371)

as clear and simple as the result is mystifying and complex. The action is obtained by the process illustrated in Fig. 7. In scenes Nos. 4, 2, 3 and 4, the usual process of motion picture photography is followed. When the director determines that it is time for His Satanic Majesty to dissolve into space, he calls "Stop" at the call between scenes 4 and 5, marked X. The camera man stops the camera, Monsieur Satan leaves the scene; Jack, the stage hand, gets a small blow for his pains, and in scene 5, on the place where Satan stood and lights the fuse. The camera immediately is started again and the ensuing explosion is filmed. After this film has been developed the printer, who makes the thousands of duplicates or positive films from the negative or negative film for general distribution to show houses throughout the States, cuts out scene No. 5, and places scenes Nos. 6, 7 and 8 over scenes 2, 3 and 4 and prints them in position. The result attained is to have Satan gesticulate and instantly a smoke screen starts from his hat and envelops him entirely. When this smoke has cleared away, lo! and behold, you find that the Kaiser's Ally has also "cleared out!"

Figure 8 shows how it was possible by using the Bray system of animated drawings, to show the action of a commercial adding machine. This operation would normally be impossible to visualize with the naked eye. Therefore it can be readily seen that with the new process it is possible to photograph and understand thoroughly the operation of the heretofore unphotographable.

The production of an animated cartoon is made by a very tedious method, extending over a considerable period of time. The artist makes a pencil sketch of the cartoon that he wishes to have photographed and this is placed under a very thin sheet of celluloid having a thickness of about 1/5000 of an inch; and possessing a marked degree of transparency. The second operation is to trace this pencil sketch onto the celluloid sheet permanently with drawing ink. One drawing is made showing the background, which in Fig. 6 is a room, showing chairs, pictures and two doors. Upon this background sheet is

(Continued on page 411)
THE wonders of electricity and chemistry —
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Revolution

The name of Marat will forever be associated with the Reign of Terror during the French Revolution. He fell at last by the hand of Charlotte Corday to avenge the loss of her lover. This period contains more of dramatic interest than any other in the world's history. It is out of this period that the Empire was born, dominated and ruled by Napoleon. Again throughout the world thrones tremble and empires totter in the great war now in progress. Shall the new Russian Republican survive? Will red-handed terrorists again force the people to institute a monarchy to insure stable government is only one of the many great questions of the hour. How else are we to judge of the momentous questions confronting the whole world except from the lessons of the past?

The Rise and Fall of Nations

Ridpath, the historian, takes the reader back to the very beginning of civilization and traces man's career down through the long highway of time, through the rise and fall of empires and nations. Other men have written histories of one nation or period; Gibbon of Rome, Macaulay of England, Guizot of France, but it remained for Dr. Ridpath to write a History of the entire World from the earliest civilization down to the present day. It is endorsed by Presidents of the United States, practically all university and college presidents, and by a quarter of a million Americans who own and love it. If you would know the history of mankind, every sacrifice for principle, every struggle for liberty; every conflict and every achievement, then embrace this opportunity to place in your home the world-famed publication—

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St. Louis schools, said: "I unhesitatingly commend Dr. Ridpath’s History of the World as the ablest work on that subject which I have ever examined."

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for Dr. Ridpath's enviable position as an historian is his wonderfully beautiful style, a style no other historian in any generation has ever equaled. He pictures the great historical events as though they were happening before your eyes; he carries you with him to see the battles of old; to meet kings and queens and warriors; to sail in the Roman senate; to march against Saladin and his dark-skinned followers to aid the southern seas of Drake, to circumnavigate the globe with Magellan. He combines absorbing interest with supreme reliability and makes the heroes of history real, living men and women, and all the rich and red-handed phantoms of empire in such a fascinating style that history becomes as absorbingly interesting as the greatest of novels.

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Here you read of the rise and fall of nations, the splendor that was Greece and the glory that was Rome. You discern the causes which have led to the overthrow of monarchies and kingdoms, peoples and races, and see how it is that the rich and defenseless nation must sooner or later fall beneath the heel of the more warlike and aggressive power. If you would know the fate of the rich and defenseless nation then read the story of ancient Assyria or Chaldea or Persia or Babylon, whose glory now is but a memory. They have been so obliterated that even the location of their splendid cities is unknown. Any person who reads History, who has red blood, who loves home and country must favor adequate self defense against the aggression of warlike powers. Dr. Ridpath gives the complete history of every race, every nation, every time and holds you spellbound by his wonderful eloquence.
ELECTRICAL EXPERIMENTER

October, 1918

MOVIE TRICKS EXPOSED
(Continued from page 408)
placed the drawing of the subject on a separate piece of celluloid; then it is photographed. Each succeeding action of the figure is accomplished by making a separate celluloid showing the figure that is to move placed in a new position. In this way, progressive action is eventually accomplished. Each new move is photographed by the camera man. In the case where a figure remains passive but where a part of the figure moves, such as an arm, the figure is drawn on a celluloid sheet and is made armless. Each successive move that it is desired to have the arm make, is then drawn on another piece and placed upon the armless figure in its proper position.

EXPERIMENTAL CHEMISTRY.
(Continued from page 396)

Upon introducing a blast of air into the heated mixture the oxygen present gives Calcium Manganit (CaMnO₄)
Ca(OH)₂ + Mn(OH)₂ + O = Ca MnO₄ + 2H₂O
This manganit is acted upon by hydrochloric acid.
CaMnO₄ + 6HCl = CaCl₂ + MnCl₂ + 3H₂O + 2Cl⁻
By this process, the manganite is the respond ingredient, can be used again and again. The oxygen of the air together with steam, is forced into the mixture of hydrochloric acid and water.

(4) By heating a mixture of 5 parts of manganese dioxide, 4 parts of sodium chlorate, and a mixture of 12 parts of subluric acid with 6 parts water;
MnO₂ + 2NaCl + 2H₂SO₄ = MnSO₄ + Na₂SO₄ + 2H₂O + Cl₂
Manganese Sulfate

(5) By heating a mixture of potassium bichromate and concentrated hydrochloric acid,
K₂Cr₂O₇ + 14HCl = 3CrCl₃ + 2KCl + 7H₂O + Cl₂
Potassium Bichromate Chloride

(6) By adding hydrochloric acid to bleaching powder or hypochlorites,
Ca(OCl)₂ + 2HCl = 2CaCl₂ + H₂O + Cl₂
Bleaching Powder Chloride

(7) The Deacon Process is based upon the oxidation of hydrochloric acid gas by the oxygen of the air, over pieces of brick which have been saturated with copper chloride and heated to about 440 degrees Centigrade. In outline, the reaction is:
2HCl + O = H₂O + Cl₂
This is supposed that the copper chloride acts as a catalytic agent in the liberation of a portion of its chlorine, and withdrawal of it from the hydrochloric acid, thus the influence of the oxygen of the air.

Properties: Physical:
1. Chlorin is a yellowish-green gas, of a suffocating and stifling odor, and when inhaled, exerts a corrosive action on the mucous membranes of the air passages. It is irritating and intensely poisonous, death resulting from inhaling it in quantity. The "Huns" are reported as using this fiendish gas to check the advancing drives of the "Allies" in the present World War, and it is a foregone conclusion that no other civilized nation would stoop to such a vile means of not only killing, but severely impairing the respiratory organs of their opponents.

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Learning electricity as you would in the actual PRACTICE — in accordance with the methods employed by the highest paid electrical experts in America. The New McGraw-Hill Library of Practical Electricity contains the actual working facts which you need in order to succeed in the electrical field. Terrell Croft, formerly with the Westinghouse Company, makes the conquest easy for you. Read the course at home or slip a volume in your pocket for use on the job.

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Be guided by a Practical Man

Be guided in your study of electricity by an experienced Electrical Engineer of high professional standing. Terrell Croft, author of 7 of these volumes, climbed from the ranks to the top of his profession with the Westinghouse Company. He gained his knowledge with his elbows rolled up, and has met your problems in advance. He tells in plain, understandable language how to proceed by the best and most practical methods.

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makes your phonograph or talking machine truly delightful. It is the "missing link" that overcomes all faults of ordinary reproductions. It does away with that harsh, metallic, ringing sound that is common to all machines using ordinary records. It makes that disagreeable, nasal, "phonograph voice" a thing of the past. It reproduces faithfully and in true tone values, every note that is on the record. It gives you the sensation of hearing most delicate trills of accompaniments that are lost with ordinary reproducers. The Ellis "Music Master" is made for all machines using disc records and will give you renewed delight in hearing your favorite music. It makes possible absolutely perfect reproduction of the music. The cost is little, but the pleasure is great.

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Drying Tube Which May Be Inserted Between Generator and Receiving Bottle, as Described in Experiment No. 145.

EXPERIMENT NO. 145

Preparation from Hydrochloric Acid and Manganese Dioxid.

CAUTION!!! Chlorine is a poisonous gas, and great care should be exercised in handling it. Avoid inhaling it. Inhaling ammonia or alcohol will counteract some of its effects.

Put 10 grams of manganese dioxide (the granular is preferable to the powder in this experiment) into a Florence or Winslow flask and make the connections as shown in Fig. 133. Run the thistle tube thru a two-hole rubber stopper thru a short right-angle connector to the receiving bottle as shown. A drying tube of the form shown in Fig. 134 may be inserted between the angle connector and the flask to the delivery in the receiving bottle. If this dryer is used it should be filled with calcium chloride, which was added by tying the end of it with a rubber tube. Set the flask on the ring stand or tripod over gauze or asbestos, and apply only a moderate heat, first pouring in thru the thistle 25 or 30 cc. of hydrochloric acid and rotating the flask so as to mix the solid and liquid. As the experiment progresses it may be necessary to add more of the reagents, especially the acid (the gas escaping becomes white), shaking the contents of the flask in each case. Watch the action in the generator and flask and have other bottles to replace the first as soon as it is full, or a little before, which can be told by the color. Collect three or four
bottles, covering each with a glass plate. Test the action of the gas towards combustion, by thrusting a lighted splint into the flask.

EXPERIMENT NO. 146.
Prepare a hydrogen generator and cause the hydrogen to be liberated by permitting hydrochloric acid to act upon zinc. Use only a small quantity of zinc and have some water in the flask to condense the acid in steam, which may pass through the tube.

Instead of collecting it under water as we did in our experiments with hydrogen (Demonstration No. 139), bend a small glass tube as shown in Fig. 135, with a small opening at the end and reaching nearly to the bottom of a large bottle. When the hydrogen escapes quite freely, test it for air by applying a lighted splint, and when all the air is expelled, ignite the hydrogen at the capillary.

(To be continued)

WHY NOT ELECTRICITY FROM THE OCEAN?

(Continued from page 377)

To those who have not experimented with a float mounted on such a body of water as to give it appreciable power whenever waves of the proper size break on it, such as on rivers, lakes, or perhaps on the ocean shore, it is probably a little difficult to perceive that such water power could provide any appreciable amount of energy. The reader may form a good idea as to just how much power even a small wave will give by an instance which the author noted not long ago. In this case, the float (on the shore) measured about ten by twenty feet and was used as a launch landing on a river a mile wide. More than once the steamboats plying this river past a distance of half a mile, i.e., in midstream, the waves created by the passage of these boats was sufficient, when they reached the shore, to oscillate the float (on which rested one end of a fairly long and heavy gang plank) with surprising power, and to give an idea of just how powerful this action was, it can be stated that with four people, weighing about six hundred pounds in the aggregate, the float was thrown rapidly up and down on its guide poles a distance of about four feet, much as if it had been merely an arm attached to the gang plank. By comparison it is easy to see that the ocean waves, which are much more powerful on the average, would exert an infinitely greater power on the water. Thus, if constructed, the work expended by the waves amounted to 2,400 foot-pounds or considerably more in the aggregate. The float was thus capable of lifting a much greater weight than that mentioned, but this will serve as a practical example to show the great power possessed by a moving body of water.


AN ELECTRIC SPEED AND DIRECTION INDICATOR FOR TRANS-ATLANTIC PLANES.

(Continued from page 375)

Though the floating log being pulled thru the water would have to be periodically handled aboard to prevent it from rolling over as to reduce the friction of the dials. Several minutes would be consumed undoubtedly in hauling up the log and taking the indication from place to place, so some authorities have mentioned that this might cause an error as great as two per cent, owing to the time during which the log was out of the water, and the increase in weight down over the board, not then be recorded by the mechanism.

The drawing herewith shows the simple arrangement of electrical apparatus in studying the successes of any of our big money makers.

Interesting and inspiring are several cases that have come to my personal attention, because the same methods are open to us all. A good example is the story of a boy of twelve who was a great success. He started out in life with only a few dollars, yet he made good use of them. He bought a newspaper and circulated it, and by the time he was a dozen years old he had a large circulation and was making money. Another example is the story of a young man who worked in a big factory. One day he met Mr. W. M. Taylor, the noted efficiency expert, who read him the following:

"Power of Will." He did so, applied himself to the training of his will, and in less than one year his salary was increased to more than eight times what he had been earning.

Then there is the case of C. D. Wrenchen, General Agent of the Northwestern Life Insurance Company, who came to my office a week ago and told me that he had made $200,000 without speculating and today is earning $500,000. He is only thirty-five years old and he frankly credit his good fortune to Prof. Frank Chapman Haddock and his very re- markable methods in the matter of teaching. Another is the story of a young man who worked in a big factory. One day he met Mr. W. M. Taylor, the noted efficiency expert, who read him the following:

"Power of Will." He did so, applied himself to the training of his will, and in less than one year his salary was increased to more than eight times what he had been earning.

In this new book Prof. Haddock, whose name ranks with Bergson, James, and Royce in the scientific world, has for the first time a practical, simple system of rules and exercises that has completely revolutionized the lives of thousands of people.

It is a practical, simple, rule of life, and it is just the thing for anyone planning to be a master of the mind and training as any muscle of the body. "Power of Will," is being distributed free by the Pelton Publishing Co. of Meriden, Conn. Any reader who cares to examine the book may do so without sending any money. It is free, and after five days, you do not feel that this book is worth the 50 cents for it, return it and you will owe nothing. Some few doubtfuls will scold at the idea of will power being the key to wealth and achievement. But intelligent men and women will investigate for themselves by sending for the book at the publisher’s risk.

Among the 250,000 owners who have read, used, and praised "Power of Will" are such prominent men as Supreme Court Justice Parker, Wu Ting Fang, ex-U. S. Chinese Ambassador; Lieut. Gov. McNevile of Nebraska; Assistant Postmaster-General Brit; General Manager Christenson of Wells Fargo Express Co.; R. St. Louis Lewis; General Arthur Capper of Kansas and thousands of others equally prominent. As a first step in training, act on your present impulse to write a letter or address a man, or to hold a conversation. Then send a copy of "Power of Will" immediately. It will be sent on receipt of a card, postpaid.

P. S. It is recommended that you get a new impression on your money by making it a habit to write a letter or address a man, or hold a conversation whenever you are uncertain which of your two hands to use. The "Power of Will" is the key to success.

How a Failure at Sixty Won Sudden Success
From Poverty to $40,000 a Year.
A Lesson for Old and Young Alike.

By R. D. RAINES

The old-time millionaire "made his pile" by speculation, overwork and self-denial. A much bigger army of men today are piling up millions without denying themselves the comforts and little luxuries of life—by giving up poor jobs for better ones, by preserving their health and strength, and by retaining their manhood and independence all through. The secret of success is a new secret among the well working.

Our story is about one who learned it—an old man who got hold of some of these young ideas. If you could have met him in the summer of 1915 you would have pitied him. For forty years he had been true to the old creed—hard work, long hours, patience, faithfulness and economy. By dint of scrimping and scraping he would save a few dollars only to have them swept away by a season of illness in his family. And his reward? It came at sixty. When he was thrown out of employment onto the scrap-heap. His old-fashioned rules for winning success had failed to work. "What was wrong with them, said he to himself?"

He reviewed, one by one, the careers of some of his old business associates who had prospered, and suspected everyone of being him. He turned his attention to several young men who were forging rapidly to the front. Suspicion became conviction. In one respect all those men were identically alike. The climbing youngsters and the prosperous oldsters were strong-willed fellows of determined purpose.

It was almost amusing the way he be and others of his kind scurried to get out of the way of these men whenever they set out to accomplish any purpose. Slowly the full truth came to him. Success was not a matter of age. It was not luck. It was not even a matter of opportunity. It was simply a question of dominating the idea of success, of laughing at the brooks, the barriers, the obstacles. It is only a question of time. If you ever hesitate, it is because you have not set your mind on the result."

For a long time he had believed he could make a success in a certain line of manufacture. He had some new ideas about it. But he had never been bold enough to even mention his thoughts to others. Now he was sought out by some business friends. Instead of begging a small loan with which to pay his rent, he presented and explained his plans for launching a business of his own. His friends’ first response was to smile. But as they listened they were struck by a new note in the old man’s voice. He insisted that he possess it in his hearing; his tone was magnetic, compelling; his argument sound and convincing. This gentleman was not afraid to spend every penny of the loan and at the end of one year his books showed profits of $2,000, and his second year’s operations promised $35,000 to $40,000, a fortune.

A better understanding of the tremendous power of the human will as a force in business and in fortune building may be had by
NEW DEVELOPMENTS IN TELE-PHOTOGRAPHY.

(Continued from page 387)

A drum of non-conducting material, preferably on the same shaft as the sending and receiving brushes. These drums, in longitudinal alignment, are a very thin strip of copper or other conducting material and two resistance elements. All of these are electrically connected to the shaft. The current to these resistance strips is supplied from opposite sides, the purpose of which will be obvious later. Three brushes—one for the copper strip, and the other two for the resistance elements—are arranged so as to make contact with these as the drum revolves.

When sending a picture, the thin copper strip is connected thru the shaft to one outgoing wire; and the brush is connected in series with certain certain angle of the "log line" with his craft, altho the relative position of the log could be determined in this way at any time, even at night when it is dark, and the log appears as a point. A small calliope is blown, and a bull's-eye attached to the front of the log, as here shown. In practice the long line is simply attached to a lever mounted on the aeroplane so as to cause an indicator needle to move in the cockpit.

The synchronizing impulse is necessarily heavy to distinguish it from the picture transmitting current. This being the case, it is imperative to provide some means to keep the heavy synchronizing impulse from reaching the circuit that receives the picture, as it would burn out the magnets. The seams of the picture are arranged to come in line with the synchronizing strips on the non-conducting drum, so that the heavy impulse is never received when the picture itself is being transmitted, but while the seam is passing. It is, of course, necessary to have the synchronizing impulse received when the brushes at the receiving machine are passing the log, and so the log must be remembered for the sake of clearness this will be explained later and must be taken for granted for the present. It will be obvious that the current always comes when the brushes and synchronizing strips make contact, it is easy to arrange other contacts and brushes so that the current will pass thru the synchronizing circuit while this part of the cylinder is passing, and so that the current at all other times passes into the circuit that receives the picture proper. So long as the cylinders are revolving in synchronism, this means can be relied upon to distribute the two currents with perfect equality; but until synchronism is established, at the beginning of a transmission, another arrangement accomplishes the purpose.

The system operates strictly as before, except with the means for getting the resistance strips to pass beneath the brushes when the synchronizing impulse is received.

The principal part of the mechanism is another gravity relay. In its first position, this serves to connect the motor with its source of current through a circuit containing considerable resistance. This causes the motor to run slower than the one on the transmitting instrument. This being the case, the heavy current is reduced (and it takes only a few seconds—seldom more than ten revolutions) when the resistance elements are under the brushes. The motor is then permitted to pass the brush thru the coils of the relay, which throws the gravity arm, causing the resistance in the motor connections to be short-circuited, so that the motor then runs at the approximate speed of the motor of the transmitting machine.

Until the relay is operated, by the presence of a current in the synchronizing circuit, the circuit that sends the picture remains open. This is necessary to keep the coils from the light being burnt out, as the currents cannot be distributed until the brushes and resistance elements are in contact when the synchronizing impulse comes. This relationship is established, the relay, which operates only under the heavy impulse, is thus in the picture circuit to be closed. This relay performs the two-fold purpose of closing this circuit and of short-circuiting the resistance that is in series with the motor.

It has already been explained that the current is equal in the two brushes that touch the resistance strips providing the current is received when they are at center...
Thousands of skilled Electricians are needed. The demand is becoming more urgent every day. The Government is employing every one they can get which is causing a great scarcity throughout the country and big salaries are being paid everywhere. Right now is your big opportunity. Make up your mind now to prepare for one of these big jobs and then get here as quick as you can for your training.

**Earn $100.00 To $300.00 A Month**

In the Electrical business. Come here where you will be trained in these great $100,000 shops. Experts show you everything and you learn right on the actual apparatus. You work on everything from the simple bell to the mighty motors, generators, electric locomotives, dynamos, switchboards, power plants, everything to make you a master electrician. We have thousands of successful graduates. Just as soon as you have finished we assist you to a good position. We now have more positions than we can fill. Think of it.

**Drafted Men Read This**

It will only be a short time until you are called into service. This is a war of skill, brains, and machinery. Uncle Sam must win this war and must have tens of thousands of men skilled in modern trades and professions such as Electricity, Drafting, Plumbing, and Sanitation. Such men will be quickly recognized and given an opportunity to rise. It is not too late for you if you act at once.

In most cases those of our students in the draft, who have been called before completing their course, have been given an extension of time by their board sufficient to finish their course, owing to the great need of trained men in these lines in the Government Service.

**Prepare to Serve Your Country**

**Learn Drafting**

Skilled Draftsmen are always in demand. Our courses are thorough—short—practical, preparing a man fully to hold a position of responsibility. We have more positions than we can fill. We also have thorough practical courses in Plumbing and Heating and Motion Picture Operating.

**Earn Your Way**

Many students earn a large part of their living expenses by doing a little work in their spare time. Our employment dept. furnishes these positions without charge.

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**Skin Diseases**

**Falling Hair**

**Etc. Etc.**

Treatment Chart furnished showing use for over 100 ailments.

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**BOOK REVIEW**


This exhaustive Cyclopedia of Applied Electricity covers a very wide field of electrical engineering as the reader will perceive by glancing at the contents of the various volumes as outlined below. The general style of the treatment is such that anyone with an understanding of the English language and with ordinary common school education can readily learn from these books the successive problems and the application of electricity to telegraphy, telephones, electric lights and power distributors, wireless telegraphy, electric welding, etc., etc.

Volume one covers the elements of electrical study and starts off with the principles of the magnet and magnetic induction. The style of treatment by the authors of these books, all of whom are well-known instructors in well-known universities and colleges, is very clear, and the illustrations are particularly well arranged so that the layman or young student can gain a true idea in every case of just how a certain experiment or test is to be properly made. With the possible photographs or diagrams to show the commercial instruments and apparatus, and some blurring of the lines between the necessary diagrams with photographs of actual commercial apparatus the student or general reader cannot fail to gain a thorough idea of each instrument described and how it operates. Volume one continues with the study of electricity, primary cells, the principles of the telegraph and telephones, the principle of the electric current, the application of Ohm's law to both series and parallel circuits, etc. Considerable space is devoted to the requirements of the Fire Underwriters in installing electrical apparatus, and the various approved types of installation of this nature are well illustrated by means of photographs and diagrams where necessary. Another section deals with electrical measurements and coverage, the principle of the galvanometers, electrometers, Kelvin balance, wattameters, kilowatt meters, power-factor meters, Wheatstone bridge for measuring resistance, the Megger, the potentiometer, etc. The following chapter takes up the method of measuring tests on D. C. as well as A. C. circuits, and also in polyphase circuits. The mercury motor watt-hour meter and ammeter are described and illustrated, also the testing of watt-hour meters and the method of testing integrating watt-hour meters. At the end of the volume there appears a number of review questions which will give the student a good idea of how the various problems are worked out.

Volume two takes up dynamo-electric machinery. The first part of this volume deals with the laws of electro-magnetism, especially as they are related to dynamos and motors, and gradually the student is educated by easy stages to the well-known laws of the magnetic circuit. The elements of armature winding are clearly explained with many excellent illustrations. The principles of commutation are made particularly clear by means of numerous special drawings. A very complete study of the design of a continuous current generator of one hundred kilowatt output is given, together with every detail and calculation for the propounding of the mechanical and electrical parts of the machine down to the last bolt. This section will appeal particularly to those interested in dynamo and motor work and includes numerous tables giving data on various designs of dynamos from one kilowatt output up to several hundred kilowatts. Another chapter deals with the various types of generators and motors, and this chapter is illustrated with numerous photographs of all the standard types of dynamos and all well-known commercial makes, so that the student will quickly recognize each respective type of motor or generator when he sees it for the first time after studying the text. The latter part deals with alternating current generators and motors and a number of questions are appended at the end of the volume for the student to work out, which cover the text matter studied in the various chapters.

Volume three takes up the study of the direct current motor in detail, also the management of dynamos and motors including their installation and maintenance as well as the testing out of motor and dynamo troubles on the job. This volume also takes up the principles of electric lighting.

(Continued on page 418)
New Way to Master Electricity

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ELECTRICAL EXPERIMENTER
October, 1918

BOOK REVIEW.
(Continued from page 416)

The opening section on direct current motors is up to date, and is very clearly illustrated by numerous diagrams showing boxes and other components. Speed controllers are connected up to series, shunt and compound wound types. Numerous excellent illustrations are inserted throughout the work, showing both large and small commercial applications of the equipment, and these tend to broaden the mind of the student and to thoroughly familiarize him with the technical arrangement of belts, chains, etc., in industrial plants. One of the latest in the self-driven motor-driven machines, and shows how motors are applied to various types of machines, and some excellent tables are given of the horsepower required for driving these various sizes and types of machinery. Open-end dynamo trouble is well systematized and arranged so that the reader can turn to the remedies for any certain trouble. The section on electric lighting is very complete and open with circuits, and of the electric light head light systems, with complete wiring diagrams. The measurement of candellum is well explained and a very interesting final chapter covers isolated lighting plants such as those found in suburban homes.

Volume four covers alternating current machinery, and in this one of the most interesting principles of alternating currents are combined, as well as the arrangements of various types of alternating current machinery. The manner of expressing this principle is important: The various devices of alternating current machinery; and clearly and also completely explained. Without the aid of advanced mathematics, and therefore the student of electrical matters will find this one volume particularly readable and instructive, should be the one to be of great assistance to the student who has never heard of alternating currents. It is also the best and the most complete method of changing the direct current dynamo into a rotary dynamo, and the method of changing the operation of the various relations between the operation of the induction motor and the synchronous motor.

Volume five treats on power transmission, and it includes the theoretical and practical considerations in connection with the transmission current transmission circuits. The section on the design and calculation of transmission lines is very clear, and numerous tables containing the necessary data to be used in the formulas applying to the work are included in the text. Such practical and theoretical background consideration are taken up, and various arrangements of the transformers are described in detail, also the advantages and disadvantages of different arrangements. The section on electrical railways is written on the subject as a guide for the engineer, and is very well illustrated. Detail drawings are given of the various types of electric railway cars, and motors of the latest type are included in this treatise. Other features treated on are lighting and heating systems for electric railways, electric railway power plants and their operating characteristics, electrical transmission systems for railways, track construction, electric locomotives, etc. At the close of this volume a full-page free form description is given together with detail drawings of the latest electrically controlled two-coupled wheel and a section is also devoted to self-propelled railroad car type.

Volume six. Power stations and applied chemistry are here discussed. This book deals with electric power stations and the elementary principles of power station design are given in a simple manner. This volume can quickly progress. Various applications leading to the design of a various type. The first chapter takes up in detail the various factors governing the most desirable location of a power station, and shows the attention this is calculated so that the station will be as near as possible, the factors. The design and of the electrical load. The test then proceeds with the design of power stations, arrangement of boilers, etc., and also the installation of water tanks where water supply is required. Part of this volume is devoted to various types of electric sub-stations and switchboards, and the necessary instruments to be used on these boards for various sizes of plants. It is regrettable that the power is not larger, as hydro-electric plants are the coming thing and are being developed more and more every day. Considerable space is devoted to the study of storage batteries including their relation to the various types of power stations and the necessary instruments to be used on these boards for various sizes of plants. It is regrettable that the power is not larger, as hydro-electric plants are the coming thing and are being developed more and more every day. Considerable space is devoted to the study of storage batteries including their relation to the central station, where they are used.

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to carry the peak of the day's load, etc. The complete manner in which the storage battery is explained and illustrated is very good indeed. The electrode and battery are described in detail. Storage battery charging systems are covered very completely. The section on storage batteries described in detail. Volume seven, Telephony and wireless, both wire and wireless, electrical elevators, electrical heating and welding are the subjects treated in the seventh and concluding volume of the Cyclopedia. This volume treats the first chapter on modern land and submarine telegraphy, and the subject is very well handled indeed. The various types of telegraph circuits are discussed in a clear manner, and all of the different instruments used on the circuits are illustrated both by diagrammatic illustrations and half-tone cuts of the actual instruments. The various forms of telegraph signals are given, and a section is devoted to the latest developments in telegraphy, the typewriter key-board printing telegraph, such as the "Markram system." The various types of multiple printing telegraphs including the well-known Bokor system are illustrated and described as well as automatic and high speed telegraph transmitting and receiving systems. The section on cable telegraphy is well written, although it is somewhatbrief in scope. The next section deals with wireless telegraphy and the basic principles on which this branch of science rests are clearly explained. This section is the student a good idea of the general principles of wireless telegraphy, but it is more historical in its treatment than anything else. The concluding chapter of the wireless section treats on wireless telephony, and explains the principle of the telephoto, as well as the earlier systems used by Ernst Ruhmer and A. F. Collins, including the arc system of Poulsen. The section on elevators is made of extreme practical value.

THE REVOLVING MIRROR AND SPARK DISCHARGES.
(Continued from page 390) off into space. Had the oscillations continued for one second, 223,500 waves would have been produced and they would have been spaced 6,000,000 miles apart. In other words each of the 20 waves actually produced was 186,000 + 223,500 = length in miles or 0.832 mile, or 1,465 yards. A wave of this kind the helix would read 1,465 yards wave length if correctly calibrated.

NEW DEVELOPMENTS IN TELEPHOTOGRAPHY.
(Continued from page 414) and that the differential effect increases the further they are from center, one brush having the greater current above center, and the other brush the greater when below center. Each brush is connected to a solenoid, into the centers of which protrude the horn-shaped arms of a rocker that pivots on a friction bearing. A hand on this rocker forms the contact on the sliding contact rheostat in series with the coil. As long as the machines are running in synchronism, the current in the solenoids halts the arm so that the current to the motor is 60% in its normal position. This is a slight deviation in the synchronism, there is a change of current in the solenoids which pulls the arm to one side and this however moving the rheostat contact so as to increase the motor current if it is too slow, or less current if it is too fast. This system of synchronizing is positive, and because of the resistance of the rheostatic circuits, a very slight change causes the apparatus to respond.

When the picture has been received, the cylinders continue to revolve until they have advanced far enough to strike the arm of the starting relay and thus put it in its original position, breaking the motor circuit and stopping the machine.

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Loose Leaf Device.

(261) L. Mac Neil, Mansfield, Mass., writes us as follows: "As you know there are many styles of loose leaf books on the market, and most of them have to have a special paper that is supplied by the same people that put out the books. Because of the rings in the book, this paper has to be punched before it leaves the factory. A man could buy a paper punch for each kind of loose leaf book he has in his office, but it would not keep its punch, and take up too much time to punch all the pages for the book.

My idea is to have an adjustable paper punch. It could be about twelve inches long, and at least six dials, that could be spaced any distance apart, according to the needs of the man. A man could have as much paper as he wanted cut to the desired size, and have his book sheets cut to the size and type he desired them to be used them. Will you kindly give me your advice in this matter?

A device of this kind is not patentable. Unless there were entirely new features connected with this device, you could not obtain a patent on the same. Just by making a punch die adjustable does not make it patentable.

Projector.

(262) C. Reginald Wilson, Louisville, Pa., has an idea which concerns a twelve-inch shell to be used in a cannon. It contains a central cylinder shape, which he proposes to fill with nitro-glycerin, while another ring-shaped partition contains poison gas. The idea is that when the shell explodes the nitro-glycerin would force the gas out. Our advice on this is asked.

A. The idea is entirely impossible. Nitro-glycerin, one of those explosives which detonate violently under concussion, consequently, before the shell would leave the cannon, it would most certainly explode from the shock and incendiary effects of the explosion. The chemical, gas-poison shells, which are now being used at the front, make use of a certain explosive which opens up the shell, forcing the gas out. Usually, a very small amount of explosive is used for this purpose. There is, of course, nothing new in an idea of this kind.

Rubber Stamp.

(263) Dan Coller, Mountain Grove, Mo., says, "Noticing some Boy Scouts with a blackens emblem and merit badge after their signature, I thought of having a stamp with movable figures like the dating hand rubber stamps used in offices, but instead of having the figures or numbers, I propose using the Scout Emblems and merit badges. Is such an idea patentable?"

A. This is decidedly not patentable; just because you are the Boy Scouts' insignia instead of figures or letters does not make an idea patentable. Otherwise, it is a good idea. There are many good ideas on which people have made a lot of money which cannot be patented. It is only unusual that the patent that counts.

Richmond Collier,

"Hawthorn Estate,"

Collier, Grove, Mo.,

Spun Silk - 25c
down.

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Richmond Collier,

"Hawthorn Estate,"

Collier, Grove, Mo.,

Spun Silk - 25c
down.
H. GERNSBACK  

Testing Device.  
(264) Clarence N. George, Portsmouth, N. H., has developed a very ingenious scheme for testing our telephone wires. 

It has been found that many times it was necessary to run a number of circuits between two points where it was not practical to run a lead cable. These wires are all of the same color and it becomes necessary to test each pair before they can be connected to the proper lines and a branch exchange switchboard. The method usually practiced is to station a man at one end of the wire with a test telephone and have another man at the opposite end with a test phone and dry cells. In this way the right pairs are picked out. 

A. The idea which our correspondent advances is a very ingenious one and more or less simple. We are sorry we have not available space to show the entire device, but we are certain that our correspondent's apparatus can be patented. We advise him to get into touch with a patent attorney. 

Combination Device. 
(265) W. R. Charles, Knob Noater, Ma., shows a sketch which embodies a combination tool for pocket use, comprising a gas tank key, a small screwdriver, a bottle opener, owner's name and a hole which serves to put on the key ring. Our advice is asked. 

A. We see nothing fundamentally new in this device. It seems to us we have seen something similar before. 

Telephone Receiver. 
(266) Benson Freeman, Jr., Atlanta, Ga., submits a telephone receiver working on the principle of a suction cup, as the illustration shows. Instead of having an electric magnet in the shell of the receiver, this receiver takes the form of a tube 1 1/2" long, 1" in thickness, the inside being hollow, wound in the usual manner. The diaphragm is the ordinary one except for the fact that in the center a piece of soft iron or steel 1/16 of an inch thick and 3/4 of an inch in length fits into the hollow space in the rubber tube. We think that a patent might be secured on this receiver. 

A. This is a very old idea and has been described over twenty years ago. This is the principle of the so-called "soft cylinder" on one end. This cylinder has a cup-shaped depression as shown. As the door is pressed against this piece of rubber, it forces the air out of the cup and, therefore, makes a partial vacuum, holding the door firmly. The device can be fastened on the floor or against the wall. The door can be disengaged with a quick jerking pull. Is the idea patentable? 

A. This is indeed a very good idea and we are certain that a good patent can be secured. We should think there would be a good demand for a device of this sort, providing the article can be made to function surely in every instance. 

We have found, however, that the one trouble with suction cups of this kind is, that unless they are large they will not function well unless they are weighted, but perhaps by a weight corresponding to the cup-shaped rubber piece about two inches in diameter this could be overcome. Very pure soft rubber would have to be used also as otherwise age and constant use will deteriorate it too quickly. 

Dynamometer. 
(268) Isaac Weiss, Brooklyn, N. Y., says: "I have an idea of a Dynamometer and Efficiency Instrument, which I know will work and believe it practical. It would like to know thru the columns of your magazine whether or not there is any demand or field for such an instrument." 

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I have met the requirements of such instruments in a portable, direct-reading dynamometer of the capacity which occupies very little room on the shaft to be tested, takes a small amount of time to set in position for testing, and does not require the shutdown of any machine for testing.

A. If our correspondent has really produced such an instrument, we should think that the device would be of great value. Not knowing the full details we, of course, cannot give an intelligent answer. We would refer our correspondent to one of the patent attorneys.

Tail Lamp.

(267) John Hore, Sheridan, Ind., writes; "Would an automobile tail-light made in the form of a cored red-glass tube, be a good selling Auto Novelty? The light to be about three inches in width and length and one and three-quarters inches in thickness."

A. We are afraid that while this is a good idea, the authorities would not sanction the use of a Red Cross emblem of this kind on private vehicles. The cored glass would be too small to make for confusion, but this is merely our idea. Otherwise, we have no reason to doubt that it would be a patent that can be obtained.

THE MANIPULATION OF GLASS TUBING.

(Continued from page 395)

This may be all right and may give the required result functionally, but not mechanically, as any one who has handled a tube will such a construction knows, a break breaks very easily. The problem is to make such a constriction and have it strong as the original tube. This may be done very simply. Put the length of glass in a blow-pipe flame so that a portion about one inch wide is heated. Rotate the tube constantly to obtain a distribution of heat and while rotating gently push the tube TOGETHER instead of drawing it apart. This will cause the walls at this point to thicken. When the walls are quite thick, much thicker than the original walls, gently and firmly draw the tube out, and the resulting constriction will be as full as thick, or even thicker than the original tube.

ENLARGING THE DIAMETER OF A TUBE.

It is not so easy to enlarge a tube and keep the walls heavy at the same time. It is better to use heavy tubing and not make the enlargement too big. The entire success of blowing the glass in the heating of the tube. If one side of the tube is hotter than the other, naturally the enlargement will be one side. Also the enlarging of an argon pipe is sometimes too thin to support the operation. With only one blow pipe it is impossible to heat both sides at once so that if an enlargement is put on after once made, one side is sure to melt before the rest of it is heated, thus spoiling the symmetry of the bulb.

Heat the tube as for a construction, then when white hot remove from the flame and blow with a steady pressure on the open end, rotating the tube all the while. If you do not rotate the tube while blowing the force of gravity alone will make the resultant enlargement lose the shape of the bulb.


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**Electrical Experimenter**

Cut a series of tubes slightly longer than the length desired. After they are cut end should be sealed in a flame and put aside. Next draw out the other end of each so that a tube with an opening of about one to two millimeters in diameter is on the end of each ampoule. Each ampoule will now be composed of the main portion which is to form the finished container, a narrow tube, and then a short untouched piece of tubing, which was used to hang on to while drawing out the tube. (See illustrations in Part L)

The ampoules may now be filled with the desired liquid. This may be done by using a fine hypodermic needle and syringe and inserting the needle point all the way down into the ampoule. But most experimenters do not happen to have a long needle hypodermic around their laboratory. So one is quickly made by drawing out a piece of tubing which will be small enough to reach into the ampoule and then fitting a rubber pipette bulb on the other end.

After the ampoules have been filled about three-quarters full they are sealed off by rapidly passing the narrow tube thru a very hot flame. The sides of this tube are very thin and will melt together almost instantly, and even when filled with an inflammable or volatile liquid, the sealing will take place so quickly that there will be no trouble in sealing the tube without heating the contents. One thing which must be observed, however, is that the ampoules must be kept in an upright position until the seal is cool, otherwise the cold liquid coming in contact with the hot glass will surely crack it. When cool the ampoules may be scratched with a file near the seal and put away in a drawer. When it is wished to open one of them the tip may be broken at the file mark, and its contents extracted.

**Uses of Sealing Wax in Glass Tubing Manipulation.**

Sealing wax is very valuable in working with glass tubing, as if applied correctly it will stick to glass firmly. In case of pieces of apparatus where one tube is to be sealed inside another, it is especially valuable as it is almost impossible for anyone but an experienced glass blower to seal one tube inside another. So it is necessary to use sealing wax to accomplish the same result. (See Fig. 6.) It has many disadvantages for chemical laboratories as there are numerous liquids which would dissolve it and render it useless. But for many purposes it is invaluable and should always be on the glass blowing bench.

**Duplication of Commercial Articles.**

When the need for a certain article made from glass comes up in the laboratory, do not buy it until you have carefully studied it and decide that you cannot possibly duplicate its itself. Commercial catalogs are invaluable for the purpose of giving the construction of many of these pieces of apparatus. With a little study you will find that most of the articles illustrated may be home-made with very little trouble. To illustrate the point, I made a $2500 Meinke wet plate de-calcifier, a jet vacuum pump, adapting the design to fit my raw materials, using the illustration in a catalog of a more expensive house as a guide. There were a number of changes, it is true, and it did not look as pretty, but when I came to calibrate the vacuum in terms of millimeters of mercury I found that I could exceed the vacuum claimed by the supply house. (See Fig. 7.) I now have both, and the Meinke pump besides costing less than 25 cents is stronger and works better than the "made in Germany" product, which cost $2.50. Try it.

(Continued on page 425)

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<td>Nickel Sulphate</td>
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<td>Antimony</td>
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<td>Zinc Carbonate</td>
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(Continued from page 423)
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THE EINTHOVEN GALVANOMETER.
(Continued from page 391)
current flowing thru it. In order to obtain this deflection it is necessary to carefully regulate the tension of the string and the intensity of the field flux, which is controlled by the current flow in the galvanometer circuit with the aid of the rheostat, R. This requires a great deal of patience and care until the instrument is finally adjusted to this sensitivity. It is found that the string will be deflected a maximum at a given magnetic flux intensity, and if the current is further increased until the magnetic saturation of the cores takes place, the sensitivity of the instrument is decreased greatly; so it is advisable to take precaution in adjusting the current flow to the electric-magnets. It was also found that as soon as the tension of the string was altered at a given magnetic flux adjustment, that its sensitivity was impaired. Therefore, every time the tension of the string is varied, a corresponding change of the magnetic flux intensity in order to keep the instrument at a maximum sensitivity point.

The Einthoven galvanometer was utilizing great success in conjunction with radio-communication for recording received signals. It is the only instrument ever devised for receiving directly telegraphic messages sent by radio at speeds ranging from sixty to one hundred words per minute. This is accomplished by photographing the impulses received by the galvanometer string, which are projected upon a moving photographic film. The arrangement shown in Fig. 21 is used to accomplish this. This standard radio receiving circuit for the reception of continuous long wave lengths is used, since the undamped transmitters with high speed automatic keys are utilized for the purpose. A is the antenna connected to the primary of the induction coupler L C, and back thru the ground, G. The secondary S, of the inductive coupling is shunted with a variable condenser, V C, and linked to a vacuum tube detector A, the grid and wing circuits being electro-magnetically coupled to each other by means of the feed-back circuit, F. This is done to make the tube regenerative, thus increasing the undamped oscillations from the distant transmitter by beat reception. The audio-frequency circuit contains the telephone receivers, T, and the Einthoven galvanometer, each of which may be used merely by throwing switch, S W, in the respective contacts.

To record or photograph the incoming signals, the operator has but to listen to the telephone receiver, and as soon as he receives the proper transmitting station, he switches S W to the galvanometer terminal, which causes the string W to be displaced in accordance with the signals. Thus the string images are projected thru the magnifying and projecting telescope, T, to the moving film contained in a perfectly light-proof box. The light is derived from an incandescent lamp L, with reflector, R. This light is then condensed to a single beam by means of a condensing lens, L, and then permitted to fall on the string, W. The developing and fixing mixture are placed in the lower compartment of the photographic container, and as the film is moved at a constant and definite speed (Continued on page 427)

ELECTRICAL EXPERIMENTER 425

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THE EINTHOVEN GALVANOMETER.

(Continued from page 425)

velocity by two rollers driven by a motor, the photographer portion of the film is developed and fixed, and its message transmitted at the moment of its leaving the fixing tank. The process is very rapid and it is the only means utilized by the large radio companies, especially those having a great deal of traffic.

Not only is this instrument utilized in radio telegraphy, but it has assumed the most important role in the art of transmitting photographs over electrical circuits. It may be mentioned that whenever a very sensitive galvanometer is used, especially for recording high periodicity impulses, the Einthoven galvanometer is the only one that will meet the requirements.

(Continued from page 403)

SPECTROSCOPIC METHODS AND THE PRODUCTION OF SPECTRA.

points should be as large as the spark will permit.

The apparatus can be easily and hand-somely mounted as the arrangement shown in Fig. 2. The four small screws are screwed on underneath the tube. The tube is held by two bands of tin or copper. These are clamped to the tube by means of two small bolts and the ends screwed to the uprights. The electrical connections are made by pouring some mercury into the tube "P," and filling the tube "X," which is glass, bent and fastened to the board by a strip of metal. Into one end leads the platinum wire from "C," and into the other lead the wires from "D.

If the apparatus is intended to be connected direct to the spark coil, the wires from the coil may be directly inserted into the mercury in the two tubes, but it is better to fix two binding posts in the base and connect the coil to these. In this case the wires are fastened in the binding posts to the mercury should be iron, as copper will amalgamate with the mercury and cause trouble.

The apparatus is now ready for use. A solution of the substance to be examined is placed into "A," preferably with a pipette, till it just reaches the top of the glass tube "C." The current is now turned on. The liquid is drawn by the capillary attraction of the glass to the jet, and each spark vaporizes a tiny portion.

Both the level of the solution, the hole in the jet, and the position of the platinum wire may have to be adjusted before the apparatus will work satisfactorily. The chief advantages of this method are:-(1) Ease of working. (2) Small amounts of material can be used. Many materials that will not vaporize in the Bunsen flame will vaporize in the spark, and also many materials that give a spectrum in the Bunsen, but not in the spark, will give many more lines. (4) The supply is practically inexhaustible.

ELECTRICAL PHYSICS.

(Continued from page 386)

EXPERIMENTAL PHYSICS.

ever, the coil is held stationary over the magnetic field, no motion will be observed. i.e., no current flows. If the coil is driven up past the pole the needle will deflect in the opposite direction. If we alternately thrust down and draw up the coil it is obvious that an alternating current will result. By use of a commutator this current can be converted into direct current (the commutator is a device for reversing the current alternately when each change in direction occurs; the two reversals being equivalent to no reversal at all). We may now add to the theoretical discussion by the obvious principle that when a conductor moves in a magnetic field so as to cut the lines of force of the field, a current is induced in the conductor. The right-hand rule is an excellent guide for determining the direction of the induced current. Bend the thumb and the index finger of the right hand at right angles to each other. Point the thumb in the direction of the motion of the conductor, the first finger in the direction of the lines of force of the magnetic field; the central finger indicates the direction of the current. In the modern dynamo, of course, instead of hand power, steam or water power is used. The induced current and also the necessary rotation is usually much simpler and requiring less work, the advantage of other advantages, the coil is turned by the water. (These rules are also called the dynamo and motor rules respectively.)

EXPERIMENT 96-—Wind about 500 turns of number 28 insulated copper wire around the end of a 14-inch iron core and connect to a galvanometer such as shown in experiment 96. Wrap about the same number of turns about another portion of the core and connect to several cells. When the circuit is closed the deflection of the galvanometer will indicate the passage of a current thru the coil a in spite of the fact that the alternations are not in the metron of a. When the circuit is opened, an equal but opposite deflection will indicate the flowing of an equal current in the opposite direction. This experiment illustrates the principle of the induction coil and the transformer. The coil b is called the primary and coil a the secondary. Counting the lines of force to appear inside of a (magnetising the space inside of a) caused an induced current to flow thru the coil. Deflection of the galvanometer shows the current. Stated more compactly and correctly, any change in the lines of force of which thread a coil produces an induced current in the coil. In the alternating current transformer, the number of lines of force changes because the magnetising force is always changing. In the direct current transformer (induction coil) the number of lines of force changes because of the position of the core, and therefore of the interrupter of the form described in experiment 94.

In figure 88-B, c denotes a soft iron core composed of a bundle of soft iron wires; p is a primary coil wrapped around this core and consists of about 200 turns of number 16 insulated copper wire; connected to the

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battery circuit by contact point on the end of screw d, a secondary coil 1 is wrapped around the primary and consisting of about 50,000 turns of number 36 insulated copper wire connected to the terminal point (spark gap) i, and a spring hammer f for making and breaking the primary circuit. Just as in the case of the bell an intermittent current passes thru the primary, hence inducing a current in the secondary. The rate at which the lines of force are cut determines the voltage of the current; also since the number of turns of the secondary is so much greater than that of the primary, the effect is similar to having the same number of turns but more lines of force cut, and hence the induced voltage is tremendously greater than that passing in the primary circuit.

The subject of electricity is a vast one and because of its great commercial value is by far the most important division of Physics. In devoting only three lessons to it the author had to omit details and discuss only the fundamentals of the fundamentals. His hope is that a desire for further light on the subject has been awakened in the reader.

TO BE CONTINUED.

POPULAR ASTRONOMY.
(Continued from page 383)

...to be considerably less than our own, is familiar to every one. A second theory upheld convincingly by Prof. W. H. Pickering is the one of aerial deposition. The more prominent canals, according to this theory, are marshy strips of vegetation, lying in the path of water-laden air currents blowing from the vicinity of the melting polar cap toward the equatorial regions and depositing moisture along their paths during the Martian night. The absence of dense clouds in the planet's atmosphere and the amount of detail visible in the surface markings at a distance that is never less than thirty-five million miles show that the atmosphere of Mars is very rare. The daily range of temperature must therefore be very great, the days being extremely hot and the nights extremely cold. Much moisture would, therefore, be deposited at night.

In regard to the appearance of the broader and more conspicuous canals, that are comparatively few in number, Prof. Lowell stated that ninety per cent of them were either straight lines or followed the arcs of great circles, while Prof. Pickering declares that many of them are quite distinctly curved and attributes this curvature to the deflection of the air currents that feed the canals or marshes, due partly to friction with the atmosphere and partly to the effect of the rotation of the planet on its axis. He computes from the radius of curvature of several of these canals at a recent opposition the velocity of the storms that feed them and arrives at a value for the minimum pressure of the atmosphere of 7.5 inches of mercury or less than one-quarter of a terrestrial atmosphere. The corresponding temperature of boiling water on Mars he, therefore, finds to be 150°F.

It has also been noted in past oppositions of Mars that certain canals occasionally shift their positions noticeably both in latitude and longitude by the amount of several hundred miles.

A number of observers of the broader canals have criticized their representation as fine, straight lines, artificial in appearance, claiming that they appear rather—to use the words of one observer—as "soft streams of dusky material with frequent condensations."

(Continued on page 430)
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Little from the circle of the Earth. The Inclina-
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Mean Distances of the Planets from the
Sun as Radii. Mars is in OPPOSITION When the Sun S.
Earth E, and Projected Position of Mars M.
Are in a Straight Line in the Position SEM, the Earth Being Between the Sun and Mars.
The Planet is then Visible Throughout
the Night and is on the Meridian at Midnight.
When Mars is At M, and the Three Are in
the Position ESM, with the Sun Between the
Earth and Mars, the Planet is in CON-
JUNCTION with the Sun and Invisible Be-
cause it is on the Side of the Earth and
Lost in the Sun's Rays.
When Mars is at M, the Lines SE and
M:E Make a Right Angle at E, and Mars
is in QUADRATURE with the Sun. There Are
Two Positions in its Orbit in Which it is
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THE ARTILLERY BARRAGE— HOW IT WORKS (Continued from page 368)

rage is lifted another fifty yards out, and so it advances as the illustrated time-

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"Treat 'Em Ruff Boys" is the only line that fits in stage five, when the Yanks come to grips with the Huns in their own trenches. Here the standing and creeping barrages combine and advance to the rear, and finally, if the Huns do not surrender, a counter battery is planted to prevent their retreat, and also the bringing up of reserve troops and supplies, as much as possible, in stage six, for enemy counter-barrage. This is in a good luck with a counter barrage and this is liable to happen at any point in the previous stages, all depending on the strength of the enemy, tackled by the German commander (the counter barrage is indicated by the curved line of iron crosses) but, of course, the shells fired by the German guns are not quite so elaborate in shape; ask "Sammy"—he knows. The effect of the counter barrage is sometimes quite disastrous, unless the troops are able to dig in and make use of the underground galleries and dug-outs which they have captured until their own guns can silence the counter-barrage artillery, which may be several miles in the rear in some cases and well camouflaged. Another effect of the counter barrage is seen as the digging up of more than one or two waves of attacking infantry.

It was found, however, that even as effect as the barrage proved, there were still loop-holes by which the "Boche" could make his escape. For instance, he awakened to the fact that if he could withstand the shell-fire until the barrage had reached and past his own front trench, that he could then scamper around the "side" ends of the barrage "fire-curtain," out of the barrage to another escape to his second or third line trenches and dug-outs. But the Allied artillery experts soon got on to this cunning maneuver, and now they make use of what is termed by an artilleryman a "box barrage." This is shown in the accompanying illustration, and as will be seen, a number of the barrage-cannon are employed at certain intervals to create a cut-off wall of shell fire, as at A, A.

Some of the wonders and mysteries of modern artillery barrage fire are unmasked in a very excellent lecture recently given before the Washington Academy of Sciences by Major General John Headlam in charge of the British Artillery Mission in this country. General Headlam in his lecture, which was entitled "Developments in Artillery During the War," pointed out many important and highly interesting features of present day artillery practice, and in line with the foregoing discussion he has considerable to say concerning the how and why of barrage fire, particularly as related to regular artillery bombardments and the general factors related thereto, such as the methods of observation, the manner of allowing for loss in range due to multifarious factors such as wind velocity, humidity, air pressure, gun erosion, etc., etc.

The accompanying battle-field panorama shows in a vivid manner the general arrangement for carrying out an artillery barrage and the outstanding features of such an offensive, notably the numerous and highly diversified means of gathering the important information essential to insure the hair-line accuracy demanded in such an artillery operation.

In the first place it is interesting to note that the artillery, even for carrying out a barrage offensive, is not always situated as far back from the front line trenches as we are wont to imagine, for as General Headlam says,—"But, as a matter of fact, just as this war has seen the revival of hand-to-hand fighting with the bayonet and the rifle butt, so it has seen guns pushed into closer ranges. On many occasions I have known individual field guns put within two hundred yards of the enemy's trenches."
With time, ingenuity and courage, a gun can be gotten almost anywhere, and the effect of its fire at such ranges is very marked while its presence affords immense discouragement. One case in which I may mention, where a gun had to be brought up over the open, and it was moved at night by stages and carried by the church in high festivities. The gunners who carried the gun, would be trained to drop it on the gun when a "flare" went up, and the gun was supposed to be sighted at a range of seventy yards in nine minutes; completely destroying its objective, and then they returned to the gun. If the gun was not in the hands of a trained gunner, and the cartridge was of a different kind than that used in the gun, the shot would be fired and the gun destroyed.

General Headlam covers a number of interesting points, and then comes to the problem of the "flame" gun, which is said to be a success, and next we must make to keep lots together. One of the things that must be observed by the artilleryman is the weight of the shell, and the various lots of shells are carefully examined, checked, and marked for weight. The next thing the artilleryman has to think of is the hand of his gun, or rather how hard it has lived, for as a gun wears, its accuracy and its range fall off. The former cannot be calculated, but the latter cannot be calculated; and the loss of muzzle velocity in each gun must be found and allowed for. This is what we call "calibration," and the gun must be re-calibrated and re-checked every time it is used, and in a howitzer with each charge. These problems are usually carried out on the front, because we prefer whenever possible, that every shell should have at any rate a chance of killing a German. To enable it to be done the topographical sections provide the gun batteries with maps, carefully mounted, so as to avoid errors due to shrinkage or warping, and showing accurately not only the positions of the guns and their ammunition positions, but also such datum points as may be desired inside the enemy's lines.

Then we have the error of the day. "Having written on the known to artillery science, the errors of the guns, a battery commander has next to think of the error of the day, or rather, of the moment," says General Headlam. "He must ascertain and allow for the height of the barometer, the temperature of the air, the temperature of the gun, and the force and direction of the wind for a given time of flight, and here he must depend on his scientific friend "Meteor" in the nearest meteorological station, and the files of the steamships, which sends to him every few hours cryptic telegrams giving all essential facts. Then when we know the hand of the gun, the correction of the deflection and the calculation to be performed and carried out by artillery officers seem quite methodical and well settled, yet they are not always so easy to apply in the field by any means, and also they are sometimes fraught with considerable danger, especially where tests are being made with actual shell and blank cartridges, and with the observers located in shell holes or front line trenches. General Headlam mentions that the best battery commanders were killed by a shell from his own battery while he was conducting the fire from a trench and from which he had cleared the enemy, and then for the reason that the artillery officer or gunner has misjudged his fire.

(Continued on page 435)
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The Artillery Barrage — How It Works.

(Continued from page 433)

zone for all of the shells from a series of rounds fired at the same time and elevation will not fall on the same spot, but will cover a rectangle varying in size with the gun and the rounds.

Not only is the artillery officer confronted with an amazing amount of mathematical calculations to be performed almost instantaneously, as well as very accurately, but he must see to it that his arrangements for the observation of shell fire is composed of a large number of observers, as shown in the accompanying illustration, or where the observers are in aeroplanes — for the enemy, especially in a heavy counter-offensive, has an irritating habit of “dropping” these observation planes and balloons (blimps, as they are called) with a well directed shell on a large number of objectives.

In most cases artillery observation officers are sent forward with advancing infantry, and batteries are stationed near the front line trenches in shell holes or other advantageous points. The aeroplane observers communicate their findings by wireless telephonic lines handled under the supervision of the Signal Corps, and these lines of communication must be maintained in constant working order. An observer, for example, specially trained in the use of aerial navigation, will be registered the position of any gun that is foolish enough to open fire from an insufficiently masked position when the clouds are dark behind it. Then comes the sound-ranger, who, with his delicate instruments, registers the discharge of the enemy’s gun.

One of the latest developments in artillery is the “aerial barrage,” which comes within the realm of anti-aircraft gunnery. This is one of the most remarkable and as yet not very well-known branches of gunnery, and one in which there is a great opportunity for students of such work. It has often been said that it takes approximately a thousand shells to bring down or “bag” an enemy plane, even at a fairly low height, and then in most cases, the plane does not come down at all. As General Headlam says, “If you think that the results obtained have been small, that with all the expenditure of time and material devoted to the present enormous operation of aeroplane observation to bring ‘bag’ is insignificant, you must remember the difficulties of the task. An aeroplane has a life of only about 30 to 40 minutes, even if the weather is clear, while the shell is in the air, and I leave it to the sportsmen among you to say how many ducks they would pick up under such conditions.”

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W E have pointed out on various occasions in these columns the criminal waste that daily occurs when we convert coal into electric light. We have shown that when coal is burned only one-half of 1 per cent of the actual energy stored up in the coal is converted into radiant light—the other 99½ per cent goes up out of it where no heat is actually wanted or required. The great problem of the century is heatless light, or at least an approach toward it.

All our efforts in developing incandescent lamps or arc lamps are in the wrong direction. While we have made trifling progress from the old carbon filament lamp to the up-to-date Tungsten lamp, the progress as far as wasted energy is concerned is more than trifling; it only amounts to a very small fraction of one per cent.

The arc lamp which is very much more efficient, giving infinitely more light in proportion to the Tungsten lamp, can not, of course, be used in a small room, as it gives more light than wanted, and for that reason is impractical. The other electrical devices which are still more economical, such as for instance the Cooper Hewitt mercury lamp, which may be worn around a modern photographic studio, or the Moore lamp, which is a sort of Geissler tube giving a soft, pink light, are excellent for their purpose, but neither of these are flexible enough where only 30 to 50 candle-power are required.

What we need is something similar to our present-day electric light globes, but such a device must not have an incandescent filament. What this future invention, which is surely coming, will be, we do not know and the best we can do is to make a fair guess.

In Nature we find several light sources that may be termed “cold,” aloha in reality most of them are not. Take, for instance, the Firefly (Luciola), whose light at one time was thought to be of an electrical nature. Recent investigations have shown that the light is produced by the burning of the oxygen in a certain peculiar manner inherent in the firefly’s photogenic cells. While, of course, not actually cold light, it comes as close to cold illumination as is imaginable.

Then there is a certain species of deep-sea fish—Lantern Fish—who attract the prey by a brilliant light shift from their photophores. In this case, the luminosity is known to be of a phosphorescent origin, which, strictly speaking, is not cold either, but for practical purposes comes close to it. Then will o’ the Wisp, as well as the luminous mushroom fall in the same category, their light simply being due to burning of oxygen.

Electricity at high pressures is also known to give out certain light effects, as, for instance, a highly charged Tesla coil; but this light, if anything, is more expensive than that obtained by means of an incandescent lamp. The next following, we have the high tension Tesla vacuum lamp, which gives forth a brilliant and also cold light. Due to the very high potential currents that are necessary to produce this light, it has so far not been exploited commercially, although it deserves it.

Perhaps some inventor will devise a sort of combination Cooper Hewitt-Moore gas lamp, which, instead of a filament, have only hundreds of feet of very fine glass tubing all coiled up inside of our present day lamp bulb. Then by introducing a suitable gas into this fine tubing, which, of course, must be of a fair conductivity, we may produce some sort of an economic lamp bulb, and, while this light will not be absolutely cold, it might serve for practical purposes. But perhaps the final solution will be found in some device which operates by electronic bombardment of some sort of screen or substance, which thru this bombardment will become intensely luminous. In other words, a device working on the principle of the well-known spurious light.

Such a device would consume an extraordinarily small amount of current, and would constitute an ideal source of cold light.

H. Gernsback

EDITORIAL

COLD LIGHT

The ELECTRICAL EXPERIMENTER is published on the 15th of each month at 223 Fulton Street, New York. There are 12 numbers per year. Subscription price is $2.00 a year in the United States, $2.50 per year to all other countries. Those in Canada, $2.00 a year. Single copies will be sold at 15 cents, or $1.50 per copy. No copies for sale to subscribers. Copyright, 1918, by E. P. Gernsback, Inc., New York. The contents of this magazine are copyrighted and must not be reproduced without giving full credit to the publication.

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City of Ham Fired With Electric Bombs

The City of Ham was fired instantaneously by the crafty Germans after they had evacuated it, by means of electric incendiary bombs ignited by an electric current sent thru a network of wires from a point several miles away. The insert diagram at the left shows how the dastardly and wanton trick was accomplished by the throw of a switch.

The City of Ham—The French city of that name recently recaptured from the Germans, was set on fire by an elaborate system of electric incendiary bombs, all of which were placed throughout the various buildings with proverbial Hun thoroughness, which, when the psychological moment had arrived, were ablaze in an apparently natural manner; just as if the Allied shell fire had done the awful work. But the trick was not pulled off so smoothly—for we have the evidence in this case of some of the populace who managed to hide in cellars and other places of shelter of just what happened to Ham, once peaceful and happy, and birth-place of a well-known French electrician—Athanase Peltier—who discovered the remarkable electrical fact, that if a current is past thru a junction formed between bismuth and antimony, then the junction is either heated or cooled, depending upon the direction of flow of current thru the junction. This phenomenon is called in his honor, the "Peltier Effect".

Humanity is thankful for this additional information in the already mountainous pile of evidence against the boche, to one—Walter Duranty, a New York war correspondent of the New York Times, who was with the French army when they captured the still burning city. Mr. Duranty reports:

"For pure wantonness of destruction, Ham offers an example that even the Germans will find it hard to beat. It was a non-

all exploded simultaneously by an enemy officer located several miles away. Perhaps the crafty boche engineers thought that by wiring up the town in this way, and by driving out the inhabitants when the troops retreated, they could set the buildings..."
FRENCH ALPINE TROOPS CARRY BATTERY SEARCHLIGHT.

The electric searchlight has found more extensive use in the present war than in any previous conflict, owing to the fact that it has been improved and developed so that it has become a truly invaluable adjunct to all military and naval maneuvers, both for the purpose of illumination as well as for signaling. Small but powerful electric searchlights have been used successfully by the Allied armies for signaling in broad daylight, as was described some time ago in the Electrical Experimenter.

The present photograph shows a group of French soldiers—Chasseurs d’Alplne—sensing signals with a portable electric searchlight which can be held by one man. As those who have anything to do with automobiles will at once perceive, such a searchlight does not require a very large or extremely high candle-power lamp bulb, providing the lamp itself is fitted with a high grade parabolic silvered-glass reflector. Thus it is we find, that this member of the renowned “Blue Devils” is carrying the battery for operating the searchlight on his back, while he holds the searchlight projector itself on his breast.

Each of the mouths of a simple shutter arrangement fitted on these searchlights, when they are

military act of vandalism. Chauny street, leading to the market place, was piled high with the wreckage of fallen walls, and at the entrance to the square a group of pollux were risking their lives in clearing the outlook. A couple of houses whose glowing beams still crackled into flame at each gust of wind and whose side walls were bound to fall at any minute.

And my thought turned to that French woman who had lived in Ham before the Germans fired it, and who had hidden in a cellar while the cannon balls fell from the sky.

“Ham,” said a woman, “was destroyed methodically by fires simultaneously started in every quarter by electric devices. Nearly a month ago we noticed the hobs had begun fixing up wires in all directions, and we commented on the strangeness of such installation at a time when everything else pointed to a German retreat. It did our heart good to see the streams of guns, the material, and the shattered, dispirited troops that fled, pouring backward through Ham for the last few weeks.

“As time past the hobs steadily continued their preparations for departure, removing everything of furniture, and, indeed, everything of any value. But the wiring parties continued their work all the more busily.

“Last Wednesday we had the key to the enigma. That morning the French guns were very near and a few shells fell close. At noon, the officials issued orders to all civilians to evacuate the town. There were only about fifty inhabitants here, and perhaps twice that number of French and Allied soldiers in the boche press gangs. Some fifteen of us and six boys managed to hide in the cellars. I believe all save one or two are now safely accounted for.

“The next, at night, on Wednesday to Thursday we heard a sudden outbreak of small explosions all around. At first we thought there was grenade fighting in the street, as the noise was not loud enough for shells or air bombs. Before dawn my father stole cautiously out. The whole town was ablaze above our heads, but our house did not catch fire until we were able to leave it.

“The boche wires had been connected with incendiary bombs which were fired simultaneously from a central electric control. Ham burned furiously all Thursday and Friday. On Saturday morning the fire was dangerously close, and we left the cellar, to meet French soldiers, who had advanced and taken the town, shortly afterward.

“Our illustration herewith shows the scheme of carrying out such a dastardly deed. The incendiary bombs are connected up in series in circuit groups as here outlined, these groups being finally all connected to a single circuit leading to a central switch-board several miles away. At the closing of a switch the boche thus blasted out the only hope the peaceful inhabitants might have entertained of saving at least their homes and furniture.

GERMANS USE NEW AIRPLANE PARACHUTES FOR AViators

American Headquarters in France, Sept. 20. (Reuter)—Patrols report having encountered an entirely new type of enemy airplane, designed especially to make it easy to maneuver. They also report that the Germans are adopting the parachute as a means of escape from damaged planes.

Did you note the full purport of the last statement? Also, do you remember reading the timely article, “Is the airplane practice actual?” in the October number of the Electrical Experimenter? If you do, at least, we hope those who should be interested in such a life-saving device digested the logic the logic the logic in the paragraph who is a “flier” and, therefore, knows whereof he speaks. Yes, the report above cited looks good.

But, asks the reader, why do we not have such safety attachments provided for America’s birds? As usual the Germans have taken this idea, which had been tried out several years ago in France and the United States, and developed it to the stage of practicability. The reports from correspondents at the front have mentioned the Germans’ set forth by a man who is a “flier” and, therefore, knows whereof he speaks.

Finally, friends, listen to the clarion voice of the official bulletin, the “Anber of Aeroplane Improvement,” issued by the Naval Consulting Board. On airplane parachutes it says, “Those, considered as a safety device, ARE NOT DESIRED as a factor in the equipment of military airplanes. No entirely satisfactory disengaging device has yet been devised. To date, parachutes may presumably play some part in civil aeronautics and under peace conditions, but under existing military conditions they are not considered a necessary or desirable encumbrance.”

AMERICAN SPUN GLASS NOW IN ENDLESS LENGTHS.

In Venice, for many years, the art of glass spinning was fostered, till city became known for the great beauty of the ornamental objects which it put on the market. There have always been shortcomings in the work, due to the fact that glass thread could be spun only to the length of the circumference of the wheel on which it was wound, and this was never more than eighteen feet.

This difficulty has been overcome by an American Manufacturer, who can make spun glass thread in any lengths, and put it on spools as is done with ordinary threads. This enables manufacturers to make products to be made, that could not be made before. The spun glass can be made in all colors, giving a world of brilliancy.

Probably the largest field of use will be in the technical and engineering fields, where it already has a foothold. As absolute non-conductors, glass plates for storage batteries will give longer life than present-day plates. For insulation, the use of spun glass thread can be used. As an example of its non-conductivity, power house workers have had their shoes bottomed with spun glass plates, to avoid shock. For the filtration of acids, glass plates are excellent.
Why Airplanes Don’t Fear Anti-Aircraft Guns

Contrary to general opinion the enemy’s aircraft when they come to view, are not really to be considered as one of the arms of the enemy artillery, but rather as one of its eyes. In fighting the enemy aircraft, our guns fight the artillery of the enemy in its most vital part. When the artilleryman succeeds in landing a hit on an enemy airplane, he performs a most important service for his fellow fighting men, for not only does he bring down the ‘plane which may be loaded with bombs, or else fitted with machine guns for attacking ‘planes and troops at close range, but further, he is helping to render the artillery of the enemy practically useless by “blinding” it. The artillery airplane, first and last, is to a large extent, an agent of aerial observation. Without this wonderful far-seeing arm of the artillery, neither side can ever hope to accomplish any of the remarkable long range big gun hits that have been accomplished. An American army officer, recently returned from France, stated that on one occasion he saw a very remarkable long range artillery fire in which three eight-inch shells landed squarely on the target eight miles away, thanks to the range corrections transmitted via wireless, from the observation airplane. The first shot fell a little past the bridge, the second shot fell a little short of the bridge, while the third one fell squarely on the target. Such work as this is being duplicated every day on the Western Front by the remarkable means of communication and observation now mustered together by the able Allied commanders.

This gives at least a slight idea of the great importance of bringing down enemy aircraft whenever possible. One way of course, is to send aloft other battle ‘planes to destroy the enemy aircraft if possible. The problem of anti-aircraft firing has always been with us, and Lieut. Colonel X. Reille of the French army recently gave an interesting discussion on this highly important problem, before the Washington Academy of Sciences. What a difficult job it is to hit a ‘plane while in flight can best be judged by those who have tried to shoot a bird on the wing, especially when the object of your sight is a considerable distance away. Also the birdmen of today have an unkind habit of looping the loop, taking a nose dive, or executing some other rapidly changing figure in the air, just about the time you get ready to plant your second or third anti-aircraft shell squarely on them. As Colonel Reille points out—‘Anti-aircraft firing does not consist merely in firing at an aerial target, but in firing at an aerial target in motion. Moreover, this target moves with a speed which cannot be regarded as negligible with reference to the speed of the projectile designed to strike it. An observation airplane with an average wind will attain a speed of 35 meters, or 3813 yards per second.” These observation machines invariably fly at an altitude of fifteen thousand to eighteen thousand feet, and it is common for excellent photographs to be taken at this altitude also. At ordinary firing ranges, the time of flight of the projectile shooting skyward amounts to about twenty seconds. Hence, under normal conditions, the distance covered by the enemy ‘plane between the moment at which the projectile is fired at it, and the moment at which it bursts in the vicinity of the target, is about seven (Continued on page 494)
How Submarines Cut Thru Nets

W e often hear heated discussions among the pro-war enthusiasts as to how a submarine war vessel can cut its way thru one or a series of steel nets. We have had ample evidence in the past few years that it is possible for such an under-water craft to borrow its way thru steel nets, no matter how fine the mesh may be, or how heavy the cables of which the nets are constructed. You will hear some people argue about "submarine net-cutters," and when they are asked to just how the "sub" manages to cut thru the net, especially when running blind, you will invariably hear a reply something like—"I do not know the exact details, but it is very easy." But is it?

Oscar A. Youngren, of New York City, has recently taken out a patent on a submarine net and cable-cutting attachment which is illustrated in action herewith. It is simple and rugged in design, and is operated by means of an electric motor placed either inside or outside of the submarine hull.

How can we locate the nets? By observations in the vicinity of such nets before totally submerging; by sinking to the bed of the harbor or channel, if it is not too deep, and liberating a diver from a special chamber provided for the purpose, who can explore the water in the vicinity of the submarine; also the proximity of nets will be made known when the submarine bumps against one, for they are usually strong enough to prevent the submarine from getting any headway once it runs into them, by clever maneuvering of the sub-sea craft and by starting up the net-cutter motors, when this condition arises, the under-sea demon can shortly hack its way thru the net.

The net-cutters themselves are made on the principle of the well-known mowing machine, which carries a long fixed toothed blade over which a second movable toothed blade of similar pitch slides back and forth rapidly. In the design here shown, an electric motor drives a reciprocating cutting rod thru a set of gears, this cutting rod being joined to a vertical reciprocating shaft which slides up and down in a water-tight tube. The upper end of this shaft connects thru a link with a horizontal rod as shown, which in turn connects with a second link fastened to the moving toothed blade. The stationary toothed blade is secured to the hull of the submarine. The horizontal connecting rod is pivoted on the point indicated in the diagram, so that as the motor-driven piston moves up and down, the movable teeth are caused to rapidly oscillate up and down. These teeth are made of tempered steel and of considerable thickness, and not only this, but they are driven with considerable force owing to the manner in which movement is communicated to them thru the pivoted connecting rod and motor gear.

GROWTHS COVER PORTO RICO WIRES.

Some years ago the telephone and power companies operating down in the southwestern part of the United States and in Mexico found that they had to replace all their wooden poles by steel ones. All for the very good reason that in that part of the country there was a very busy little bird that persisted in picking the wooden poles full of holes, honeycomb them in fact. Now we have a photo of what happens to the aerial telegraph and telephone lines in the tropical land of Porto Rico. Here aerial plant life insists in living on the wires.
Americal birdmen will soon be able to fly across the United States, thanks to the recent announcement authorized by the War Department that a chain of landing fields for air pilots is being built across the continent. In a few states they already wait the flyers, being established at intervals of 100 miles.

When completed, these well-marked, safe landing places will be to air pilots like water tanks to locomotive engineers or harbors to mariners. Besides oil and gas, the majority of the fields will supply to the pilots shelter and limited machine shop facilities, maps, charts, and barometer and thermometer ratings. New York, Pennsylvania, Ohio, Illinois, the District of Columbia, Georgia, Texas, and California already have established lines of such landing fields. Arkansas, Mississippi, Alabama, New Mexico, and Nebraska will soon be equipped.

The value of permanent landing fields, sufficiently close together to establish well-defined air routes across country, was emphasized early in the training of American flyers. Flying by compass has now become an established practice, but landing fields, like beacon lights, help the pilot to pick out his course, even tho he has a compass. Most of the landings today are on army fields.

Reports to the Division of Military Aeronautics from field officers say that this movement, like that which started good roads, is rapidly gaining momentum. It is predicted that before another year an aviator with a plane of moderate power will be able to make a transcontinental flight without difficulty or inconvenience.

A typical aerial landing field of a type already successfully used in England is illustrated herewith. This layout includes four powerful electric searchlight markers, (Mineola) having, say, two red identification beams, Philadelphia, two blue beams, etc. Another scheme would be to use a searchlight signal shutter on all the markers and to periodically blink the shafts of light on and off to give the telegraphic dots and dashes of the landing field's initials—such as N.Y. for New York, etc. This could be done by automatic switching means actuated by a time-clock at periods of 5 or 10 minutes. It would also be possible in this way to signal by short and long flashes, corresponding to the dots and dashes of the telegraph code, the condition of the field, such as dry, muddy, wet, etc. This information is of distinct importance to the aviator intending to land on the field, as the airplane is handled differently for each condition of the field. The landing dive angle varies for wet, muddy, and dry fields, as does also the position of the plane just before it lands on the field. All army and navy birdmen have to know the telegraph and radio codes so no difficulty is encountered on this score. The electric lantern atop the Metropolitan Tower in New York City has been seen to beat the time at night at a distance of 30 miles easily, with the naked eye, and at much greater distance with binoculars or field glasses.

For night flying airplanes now carry a powerful electric headlight for use in landing, and have out-board marking lights, as well as a tail light, all of which are especially needed in formation flying, where as many as 15 to 20 planes, or more, often fly in a "V" or other formation. As the airplane heads down toward the field it is supposed, in this layout of signal lights, to light on the illuminated "Potts Arrow", then taxi along until the illuminated crescent is reached. From here the plane is run off to the right or left to the hangars. A red "limit" light marks the end of the field. A meteorological observatory will be erected at certain fields. The "Potts Arrow" and other marker lights are illuminated by electric lights sunk in pits in the ground. These are covered with wired glass about two inches thick, over which the "planes can run. The arrow is red, the crescent blue.

**GERMAN "CARRY-ON MAGNET" IS TEN POUNDS OF BACON.**

A "carry-on magnet, efficacy guaranteed," was advertised recently in German newspapers by its "inventor." The magnet was declared to have mystic powers enabling its possessor more easily to endure the food privations of the country.

The price was 300 marks and the buyer was privileged to inspect the magnet before paying. Those who sent in orders received a package bearing the inscription: "Contents: One Carry-On Magnet."

It is not on record that any one refused to pay for it, for the "magnet" proved to be ten pounds of Thuringian bacon. The ingenious "inventor" now is being sought by the police.
MANY years ago, when our forefathers were fighting hard to settle the country we are now living in, their enemies, the Indians, made use of many clever schemes for communicating intelligence from one tribe to another, even over considerable distances. It is said that the Indians transmitted intelligence over distances of fifteen to twenty miles when necessary, and one of the systems by which they communicated with one another when on the war-path, was to approach of men on horseback by placing the ear to the ground and listening for the sounds of the horses' hoofs, even when many miles away.

Acting on this very idea, it has remained for an American inventor, Professor Reginald A. Fessenden, to invent a system of transmitting and receiving powerful sound waves thru the earth or water. Professor Fessenden, as generally known, is the inventor of a system of submarine telegraphy which employs sound waves for the trans-

For telegraphy, use is made of an alternating current dynamo, D, which may be switched on to the powerful vibrator or oscillator immersed in the liquid-filled tank, buried in the ground, or mounted in the hull of a ship. Whenever the telegraph key is depressed, powerful sound waves will be set up and propagated thru the intervening medium. The sound waves are picked up by means of the same oscillator, or else by a sensitive microphone, placed in a tank containing liquid, in the same way as at the

Employ sonorous or sound wave vibrations transmitted thru the ground, and thus we know that the ground, and also water, are good sound conductors. The Indians used to hit two rocks together, one of which was partly buried in the ground, or else hit a rock with a tomahawk or hammer, and by various other means, transmission of powerful sound waves was effected. The "code" message was picked up by another Indian located some distance away, who placed his ear close to the ground. Not only this, but the Indians, not to mention the early pioneers, were experts in detecting the

mission and reception of intelligence. This system is in use on submarines and steamships as well as war vessels at the present time, and has saved many lives.

The present invention deals with a new and more sensitive method of mounting powerful electro-magnetic vibrators (or "oscillators," as their inventor calls them) in sunken pits which are filled with a liquid, such as water, oil, etc. The electric circuits for either telegraphing or telephoning by sound waves thru the earth or water, will be readily understood by referring to figures 1 and 2.

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By Means of the New Fessenden System for Considerable Distances. Also, the New Here Illustrated It is Possible to Actually Talk Without Wires Thru the Earth Or Sea "Sound Direction Detector" Will Render the Accurate Locating of Enemy Mining or Sapping Operations a Simple and Positive Task.

(Continued on page 505)
Magnetic and Other Fool War Dreams

AS TOLD BY THE "ELECTROMAGNET"—HIMSELF

YES, I am the much maligned and all-powerful "Electromagnet," bone of contention among patent liars, inspiring engineers, and heaven-inspired inventors of all ages, from twelve to a hundred and twelve. Recently I paid a visit to the Editorial Sanction of the Electrical Experimenter, and some of the inspired contributions and ideas I saw there, reposing gracefully in the waste baskets of the editorial and consulting staff, were from my more or less uniformed Over-Lords, who would have me perform some of the

tended rather for the Naval Insulting Board, address Chillingmycoat, Greenland, conveniently situated so that these precious ideas could be placed in cold storage and thus prevent their being lost to an ever waiting world.

One of the first would-be patents marked for the attention of the Naval Consulting Board was remarkable idea No. 1. This invention proposes to do nothing less than utilize my all-powerful magnetic attractive force at the ends of long booms, spaced liberally around the "dread-naught," so that of steel plates when they were bank up against me, or at most not over an inch or so away from me and lying perfectly inert, that I could not lift a fraction of a ton or even a few pounds ten feet away!

And so the merry patent war goes on—_inventors may come, and inventors may go_, but the "magnet fiend" will live on forever.

While browsing around thru other more or less startling inventions, I ran across the masterpiece—No. 2—there illustrated by the editor. The "inventor" was no low-brow or cheap-skate by any means. He proposed

when the naughty torpedoes come skipping along so joyfully thru the water, the chief electrician can throw in the main switch and feed me 110 volts and God-knows-how-many-amperes, so that I will instantaneously, according to his idea, proceed to exert an all-pervading magnetic power of presumably several thousand tons thru a radius of several hundred feet. Maybe that bird would like to know that if I had a diameter of six feet, and could lift twenty tons taking my co-ally, "High Potential," and injecting several billion kilowatts so as to boost the corona or efflux of my old friend "H. P." so that he could hurl himself thru space to any convenient distance, say several hundred miles, so as to thoroughly electrify all harboors, bays, inlets, and whatever enemy war vessels are wont to congregate, and even the ocean itself. Talk about your "Flying Dutchman." Gosh! but that's a

(Continued on page 496)
Why Is a "Blimp"?

By W. EDOUARD HAEUSSLER

KITE or observation balloons as they are termed, are used extensively in all of the theaters of the present war. Together with the innumerable airplanes employed by both sides, they constitute the most important means of observation and artillery fire control. Where there occurs a practical immobility of the lines for long periods of time, a case that is especially true in trench warfare, the observation balloons are particularly useful. It does not necessarily follow that these balloons cannot be used to advantage on marches. They can and are used even then, tho only under most favorable conditions.

Kite balloons are big and awkward to handle, and the manner of letting out and hauling in the balloons is interesting. The arrangement, for in case of attack or due to sudden high winds, the winch truck can travel along in the proper direction while the balloon is being hauled in. These winches are arranged with a separate engine to wind up the cable, but the drum may be operated from the auto engine when necessary, or both engines can be used for either the auto mechanism or the cable winch. The Germans are said to have used railroad locomotives in one case to haul down their observation balloons when a particularly rapid advance by the Allies threatened to envelop them, balloons and all. "Blimp" crews operate at altitudes of five thousand to six thousand feet usually, altho a twenty-five hundred to three thousand foot level is common, all depending upon the aerial activity of the enemy, and the extent of territory over which they have to observe.

Locomotives are also brought into play by the Allies in this interesting arm of the military activities, a very important branch when it is considered that the observation balloons are the eyes of the army. On a flat car there is mounted a motor-driven winch of the modern reciprocating, automatic adjustment, cable drum type, of extremely positive action. This car is trailed behind the locomotive in conjunction with an additional box car and another flat car. The box car is used to convey the gas stored under enormous pressure in steel "bottles," and the second flat car has the important service of carrying the balloon, bag and basket complete. The locomotive is of the armored type, and we therefore have a formidable "spy" in the shape of this aerial observation train and its equipment.

Beside carrying the gas on the flat cars, motor trucks or "camions" as they are now called throughout the Allied army, there are also generating stations situated behind the lines. Here the hydrogen gas is electrolytically produced on an enormous scale. The gas is generated in fairly large cement tanks that have been built into the ground, the tops of these tanks being placed flush with the level of the surrounding earth. These entire apparatus are camouflaged covers, hiding the plants from the eyes of the "boche" aviators. The cells are likewise made of cement, and are sixteen in number to a unit. The hydrogen gas is gathered by collector pipes that lead the gas to the gasometers or measuring instruments. It is then allowed to pass into the intake end of a force pump, compressed and forced out of the exhaust side, into the steel containing "gas bottles" as they are popularly termed "Over There". The oxygen that is generated simultaneously with the production of the hydrogen gas, is stored...
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and used by the “Gas and Flame” Squads. The oxygen is combined with acetylene, thereby creating an intensely hot flame upon ignition.

In the construction of the balloon bag, almost without exception, the panel system of manufacturing is adopted, i.e., rectangular panels of fabric cemented and sewn together in the same form as bricks are laid. There are at least twelve of fabric in the ordinary balloon; in places there are three. This refers to the gas-holding envelope. The rudder and the interior ballonet is generally only one ply thick. Where two or three ply material is used, it is cemented on the bias, thus gaining enormously in resistance to tears. As a matter of fact, it is almost impossible to tear three-ply balloon fabric with one’s hands.

The U.S. Navy “blimps” are of the French type, measuring ninety feet long by thirty-five feet in diameter. The greatest beam, to speak naively, is about one-third of the length from the bow to the stern. From here it tapers off somewhat toward the stern, thereby gaining a streamline effect.

The “blimps” have air filled rudders which resemble a large “earth worm,” extending clear around the center belt at the back of the gas bag, and also down and under the rear section. One side or the other of this air-rudder compartment is filled or emptied as required, thus presenting more or less head resistance to the wind and causing the ‘blimp’ to swing around to the right or left as desired. The observer’s basket is slung well below the gas bag so as to ride easily, and also to enable the pilot to cut loose with his parachute, in case the balloon is hit by an incendiary bullet or shell and set on fire.

The appendages attached to the rear of the balloon, are technically known as the air-rudders. Their principle involved in the operation of this air-rudder is extremely simple; it is nevertheless rather difficult to describe in mere words. The action of the ballonet can be better understood by referring to the illustration where the observation balloon is shown in section, looking at it from the bow at the point where the automatic valve cord runs transversely across the balloon. The reader, I trust, can understand from this illustration just how the valve works.

The automatic valves, H, are connected by a cord, X, to a stop immediately opposite to itself. Riding on this cord is an aluminum thimble, C; the thimble is fastened to a series of spider-legged cords, K, with this gas. Due to the expansion and contraction of gas in direct ratio to atmospheric conditions, some means necessarily had to be adopted in order that the shape of the balloon would remain the same at all times. In other words, the internal pressure had to be maintained at a certain constant. To accomplish this, the air-filled ballonet was adopted.

The ballonet is located in the interior of the balloon proper, and it runs diagonally from the forward end to the upper surface at the rear end, or stern of the observation balloon.

The physical action of the automatic valve comes into play when the gas in the upper portion of the envelope expands. This expansion of the gas forces the upper wall of the ballonet downward, thereby keeping the internal pressure constant. As the ballonet is forced down, it takes with it the spider legs, K, which in turn draw the aluminum thimble with them. The thimble, riding downward on the automatic valve cord, X, pulls it, and the increased tension opens the valve, allowing the gas to escape.

As the gas escapes, the internal pressure tends to become less, and the pressure of the air in the balloon, which is equal to that of the wind, entering it indirectly from the air-rudder, forces the ballonet, A, upward, and as the tension is removed from the thimble, the valves, H, due to their self-contained spring loading, automatically close. The hand valve produces the same action, and the gas can be made to escape by the pilot pulling this rope at his discretion.

While the shape of the rudder will not be amiss here, and it will serve to show how the air in the balloon is put under pressure by its action. This rudder is situated on the outside of the main bag, toward the stern and underneath. It is a sausage-like arrangement running toward the stern and ending in two small pipes which are communicative with the fins. These fins approximate the shape of the rudder, and are placed toward the stern of the bag and at its ‘equator’. An aperture of about one inch in diameter is located at the forward (Continued on page 492)
NOVEL X-RAYS

AN INTERVIEW WITH THE "ED"
By "Fips", Office Boy

AFTER several sleepless nights, I finally made up my mind to interview the Chief, even tho it would cost me my job. A certain matter disturbed me and I simply had to get it off my chest. So I cautiously pussyfooted in to his sanctum, climbed on a chair, and ambushed him by way of an open transom. The prospect did not look very promising. Our Editor-in-Chief was very, very busy. With his left hindmost foot he was O.K.ing "E. E." press proofs, by means of a rubber stamp attached to his heel. He glanced at the proofs thru an inverted periscope. To his left ear was strapped a telephone receiver over which the latest electrical and scientific news came trickling in. Of these he made notes using his left hand to write them down in Morse code on a constantly moving paper tape. He was just discussing the next "E. E." cover with the cover artist, and that poor mortal was perspiring freely trying to devise some brand new color scheme that would—in the Chief's language—"knock 'em dead"!
The Chief wanted an ultra-violet-skies, tinged with a carbuncle-heliotrope shade. The war machine—which was sure to win the war this trip—and which was to form the hair-raising subject of the cover—was to be a deep Hun-blooded red-vermilion, with garlic colored reflexes, while the wheels were to be of a deep-frozen helium-argon shaded gray, with canary-colored aigrettes on the hubs. Our soldiers were to be camouflage in chameleon (changeable) colored uniforms, with lilac scented colthoppers! The dead Hun's piled sky high around the machine were to be attired in "Frankfurter"-colored lingerie, while the Hun officers were to appear in Sauerkraut-colored pajamas, with X-Ray green complexes—indicating death by concentrated Sauerkraut-gas.

"War sure is hell," muttered the poor artist as he walked unsteadily from the sanctum as if in a trance, trying to memorize all those colors. Trembling I entered the sanctum, altho I knew from experience that the Chief, having delivered himself of his monthly "atrocity", would be in a fair humor. Indeed he was. With his right hand he kept throwing rejected manuscripts into the waste-basket, while with his disengaged right foot he shaved hundreds of rejected "Phoney Patents" into a trap door in the floor. Down they went right into the automatic paper baling machine located in the cellar. The Chief, for once smiled. Why shouldn't he. Business was good—injected M.S.S. For if there was no money in the magazine bus-ness, due to preposterous paper prices—he always sold $50.00 worth of baled manuscript paper a day! And that didn't cost him one cent. Besides most contributors use good paper, too, which commands a higher price! After discreetly coughing a couple hundred times to attract his attention, I finally caught the Chief's eye.

"Well, what is it?" thun-dered he, working right ahead with his four extremities.

"Anointed Chief," I said, "there have been millions of requests recently from your worshipping readers, who are begging you on their knees to publish your august countenance."

"Withering inexact," yelled the Chief, "fool, knave, wouldst thou deprive me of mine daily bread? Yon letters mean 50 simoleons in baled paper to mine income a day, at present market prices."

"I thought of all that, Chief. But suppose I know of a way to publish your picture, and still get the letters?"

Instantly the Chief was all attention and I explained my plan to him minutely.

Next morning I walked into his sanctum with the proof of the adjoining X-Ray photo of his head, and after he had snorted his approval of it, I began:

"Illustrious Mumbo-jumbo! Your ecle-mosny servant would fain address several questions to his august master—"

"Why August?" exploded he, "this is September, is it not? But proceed and be short!"

"Chief," I began, "it is of paramount importance to your readers, just where all those classical ideas of yours originate? Do they find their birth in these white, blank spaces, of which there are so many scattered through your revered dome?"

The Chief grew pensive: "Not all of them," he said, "only strictly ethereal ones."

"What accounts for the extraordinary emptiness of the upper, back section of your skull, Chief?" I continued.

"Very simply explained. At the time the exposure was taken, I thought of you. Naturally my mind was blank!"

(Continued on page 488)
Electricity Aids Hun "Movie" Spies

By GEORGE HOLMES

AGAIN we have the unfailing "Movie" to supply the thrill which all must experience to get away from the humdrum of every day life. This time our reportorial eye was glued to see the "writing on the wall," as it were, and with a little sleuthing on our part we

Lertz gives him money to carry out the plot.
Dr. Wolf prepares germ cultures and from it a paste impregnated with the living germs. Thru this paste he permits common house flies to walk, thus transferring the germs to them. Then the flies are re-

This instrument gained the first information which the Secret Service received in regard to the plan of the Imperial German Government's spies and plots in America to destroy the Du Pont de Nemours munitions plant at Hopewell, Va. A woman suspected of being in sympathy and in the con-

came back with some more scenes from that truly dramatic photo-play masterpiece—"The Eagle's Eye"—which is doing much to show our stay-at-homes what the vigilance of the eternal Secret Service has protected us against.

First is the plot to spread the dread epidemic of infantile paralysis throughout the land. Dr. Wolf is a chemist, German born and trained, who has a small laboratory in a tenement section of New York. (See Fig. 1.) In a medical journal he learns that it is possible to isolate the poliomyelitis germ, the cause of infantile paralysis. A scheme for causing an epidemic occurs to him. He goes to Heinric von Lertz and explains that the number of deaths which will result will so weaken the morale of Americans, that the possibility of the United States joining in the war against Imperial Germany would be removed forever. Von

leased to scatter the germs to the food of the city.
He next begins drinking, in an excess of enthusiasm over the success of his plot. He falls, in a drunken condition on the table of his laboratory, cutting his hand on a broken culture tube. He is infected with the dread disease he has caused in so many helpless children, and dies in agony.

Petty jealousies on the part of women have caused some of the greatest catastrophes of history. Yet this trait on the part of the eternal feminine has often been turned to good advantage, and in one instance it was the direct cause of the Secret Service gaining the first information of one of the most gigantic plots planned by the Imperial German Government's spies and plotters in America. In this case resort was made to the use of a dictograph to listen in on the conversation of the plotters.

The suspicion of Ambassador von Bernstorff, Captains Boy-ed and von Papen, and Dr. Heinrich Albert, the four leaders of the Kaiser's spy army in America was shadowed to a hotel. The operative who had followed them had no trouble in obtaining the room next to the one assigned to the suspect. The microphone was then attached to the door between the two rooms and the operative affixed the head-phones. (See Fig. 2.) Information was not long in coming. The suspect had a caller, also a woman. A quarrel ensued in which the suspect accused the other woman of attempting to usurp her place in the confidence of the Imperial German spy leaders in America. The quarrel exposed the fact that the accusation was based upon some plot suggested by the caller in regard to the munitions plant at Hopewell.

(Continued on page 504)
Electrified Barriers Stop Fish in Streams

On many occasions, particularly where large irrigating ditches are in use, and also in many large fisheries where fish are hatched and often are guided through different water channels from one lake to another, composed of heavy iron or other metallic wire, which may extend nearly to the bed of the stream or ditch. The different strength currents are applied, as the illustration clearly shows, to the successive barriers, so that the weakest current of all sizes at such places will be turned back without fear of killing the smaller fish, by subjecting them to a sudden charge of excessively heavy current, which might easily be the case if but one electrode charged at a fairly high potential were employed. As will be seen, one side of each of the transformer secondary coils is connected to a common conductor which is grounded, i.e., connected to earth. Thus, the current will pass thru the earth, thence thru the water to the respective metal wire barriers hanging in the stream. The metal wire barriers or rods do not need to be very close together, and yet they will protect as efficiently as a small mesh net.

According to a French electrician, the temperature of the carbon filament in an incandescent lamp approached 2,000 degrees.

These Spectacles Carry Their Own Light.

By Frank C. Perkins

The accompanying illustration shows an electric spectacle lamp and frame developed by an Idaho inventor, Mr. Ladislaus Zacharia. This electric spectacle lamp and frame provides means of bringing powerful electric lighting on a spectacle lamp and frame around the eye or eyes in the forehead, in order to exclude shadow from the side of the object where it is desired to see it clearly and yet leave both hands of the user free. It has an electric wiring system inside of the spectacle frame. For instance, a hollow socket and a passage thru the center of the lamps may be provided and a dark sleeve inside the passage of the lamp will enable the user to see the object clearer.

There is provided a cylindrical passage in the lamp which curves out on the point of the lamp and this curving can be shaped to any desired design. It is intended to give the eyes protection from overstraining by virtue of limiting the view thru openings in which dark tubings are mounted, thus protecting the eyes from too powerful light rays, the wide protecting frame catching the rays and throwing them back from the direction of the face. The bulb can be equipped with small reflectors if desired.

The Mystic Trio—Who are they? Ah! The secret is out, they are wearing the very latest in "spectacles." Each pair of glasses carries its own electric light between the lenses, current being supplied from a small pocket battery.
How Can We Tell “Real” Death?

By H. WINFIELD SECOR

CONSIDERABLE research in the realm of that branch of medical science dealing with real and apparent death shows that medical men practically agree that in view of the facts available on the matter, and also in view of their various experiences, that it is possible to determine to apparently die, and yet be in such a perfect trance or state of syncope that they can deny practically every ordinary test which the physician might apply, to determine if life had entirely left the body. Briefly, the facts in a number of such cases show that the respiration or breathing function may drop to such a low point that it is imperceptible and will not show on any ordinary indicating apparatus, as for instance the well-known mirror test. Also the person may be in a trance state with the heart functioning at such a low state of activity that it is impossible by any ordinary means employed by the physician, to determine whether the person is actually dead for all time or only in a temporary trance. These facts are of vital importance to all of us and of supreme interest to be sure, for we have all heard or read of persons being buried alive or while in a trance state.

Many people probably have scoffed at such statements or stories, but there are a sufficient number of cases on record to prove the point we are making. We know all concerning human life, and as to what the real germ of life is. For instance, if one will go down to the New York Academy of Medicine, and there consult the records of a number of eminent British physicians and scientists who visited India some years ago, they will find the official records of many of which are sworn to, covering the wonderful performances of the so-called Hindu fakirs. These exponents of advanced science can place themselves in a state of suspended animation, or syncope, for long periods; even for two hours, but this is not true. The patient, however, did present a remarkable case, and a short syncope did occur. Dr. Overton recalled two cases in his experience where a syncope, or state of "suspended animation," occurred for a period of about five minutes. The patients were pronounced dead to all intents and purposes, after all tests, including those of respiration and heart action had been thoroughly carried out. A very remarkable and little known experiment was carried out in these two cases, that of injecting adrenalin into the heart proper with a long needle syringe, a quantity of the substance sufficient to cause death, as indicated by the heart rate of the stethoscope being sufficient. These patients were brought back to life in this way (these experiments having been conducted at a well-known New York hospital) after all bodily processes and organic functions had ceased, in a period of suspended animation lasting about five minutes. One of these patients, a woman, was successfully resuscitated in this way and died eventually of contracting pneumonia. As Dr. Overton explained, "We cannot boost the heart or cause it to work beyond its limit, once the critical period in its life has been reached." But in this case the patient was an alcoholic and had been under severe exposure to the cold when received at the hospital. The second case was that of a man, and at last account he was still alive. The writer knows of a case where a woman thirty years of age passed into a state of suspended animation, due undoubtedly to a severe sickness thru which she had passed and who resuscitated herself after a syncope of twenty-four hours; this lady is alive and well today at the age of sixty-five years. The patient in this case had been pronounced dead by the attending physician, and came back to a regular state of life and activity when in her coffin. Hence when all is said and done, we are vitally interested beyond the peradventure of a doubt.

... in knowing what medical science has found out today in order to determine surely and accurately when life has past from the body, and below are given the principal tests which are used, as well as a number of newly suggested tests for this all important determination. Before proceeding further, it is well to remember that all undertakers today embalm the body, and the embalming fluid, (Continued on page 498)
Searchlights With Aircraft Sound Detectors

The accompanying photograph shows one of the large Austrian searchlights used on the Italian Front in the recent offensive by that country. As will be noted this search-light is equipped with special sound detectors comprising a series of large megaphones mounted in circular fashion about the searchlight frame, so that when the operators quickly move the searchlight and adjust the mechanism, an approaching aeroplane, or fleet of enemy aeroplanes, will produce the maximum sound in the acoustic receivers attached to the megaphones. Thus the searchlight beam will automatically and simultaneously be focussed in the same direction to that in which the megaphones are pointing.

This unique arrangement for locating and revealing the enemy aircraft is used most efficaciously and effectively. It is quite surprising to learn that a simple megaphone of even small size, such as that here shown, will indicate the approach of an aeroplane, owing to the great volume of sound given off by the gasoline motor propelling the plane. The French Aerial Observation Corps have made very extensive use of these megaphone aircraft detectors. They have been much employed in the larger cities of France, including Paris, for detecting the approach of hostile aeroplane squadrons or even a single enemy plane, even when they are several miles away.

The object of using these megaphone horns is that they will respond with the maximum sound when they are pointed to within even a few degrees of the source from which the sound is emanating, which is in this case, of course, the enemy aeroplane motor. The photograph, as aforementioned, shows Austrian observers listening for the approach of Italian aircraft. With such devices available it is possible for the military intelligence department to ascertain the approach of enemy bombing planes when they are at a considerable distance, and when thus armed with this advance information, it is a simple matter to bring up the anti-aircraft artillery, many of the guns of which are mounted on high-powered automobile chassis, and provide a very warm reception for the enemy intruder when they arrive on the proposed scene of action.

HEAT AND LIGHT TREATMENT LAMP

The illustration shows a new and improved thermo light, which has been designed along scientific lines for the proper infusion of electric light and heat. This unique reflector so directs the heat rays of the special lamp that they produce the best results with minimum current consumption and without the rapid deterioration of the filament.

The heat rays are effective over an area of approximately 50 square inches and not focussed in a small burning spot.

The outside shell and inside reflector are constructed of aluminum, making the device very light in weight, which permits prolonged treatment without fatigue.

It comes complete with lamp, to operate on any direct or alternating circuit not exceeding 125 volts, 3 feet cable and attachment plug.

A group of European electricians decided, after experimenting, that better results were obtained by placing the carbons in arc lamps horizontally and one slightly above the other, suitable gearing, so as to cause the two sets of wooden or other rollers to travel on endless chains. By means of the two handles shown on the right and left hand sides of the machine, the two uprights carrying the moving roller belts, can be moved toward or away from the "patient's" body, until they are adjusted accurately for each particular case. Also the upper rollers carrying the drums over which the roller belts travel, are adjustable and can be moved up and down vertically, so as to permit the belts of the top rollers to conform accurately to the shape of the body.
New Westinghouse Research Laboratory

The research work of the great Westinghouse electrical concern has always been carried on under the direction of the engineering department. In 1900, the research division was organized as one of the several divisions of the engineering department, and it now has under its control seven laboratories.

The work of the division includes activities which are not usually class as research work in other organizations. For example, it has charge of the preparation of all specifications for the purchase of the materials used by the company, together with the experimental and development work leading up to the writing of these specifications, says Mr. C. E. Skinner, the chief engineer and Mr. R. W. E. Moore, in a recent article describing these interesting laboratories. Mr. Skinner's photo is reproduced herewith. First there is a process section, which has technical control of all the various processes used by the company in the manufacture of its product. It has charge of the routine chemical and physical testing for all departments, including the inspection departments. It has technical control of the various metallurgical processes, such as those involved in the brass foundry.

Fair Telephone Operators Join Uncle Sam Overseas

HURRAH for the fourth unit of telephone operators, already taking its place in France beside the other three, and making things hum "over there!" The cable "Arrived safely," is brief, to be sure, but what it really means to say is, "Sixty more French-speaking American girls have arrived in France to operate war switchboards for Uncle Sam and our boys." They have volunteered to do this as their contribution toward winning the war, because they feel that it is the thing that they can do best. As one of them put it, if they didn't go they would feel like slackers, and would be slackers just as much as any man who shirked his duty. More are ready to go, but they are not needed at present, and are continuing their training over here.

With minds filled with the end to be attained, these girls and those who preceded them, together with those who are to follow, have traveled from the four corners of the United States.
A Gyro Electric “Movie” Camera for the Battlefield

PHOTOGRAPHY fills a most important niche in this business of Kanning the Kaiser! There is hardly a branch of the service that is lacking a camera- man, whose business it is to bring back an indestructible, true, and vivid record of what is going on “Over There” in the fight for democracy. And thus will our children’s children be able to see the struggle that was made to preserve the liberty of the good old U. S. A.

The strides made in the art of recent years reflect what an advance has been made over the now seemingly antique methods of photography used in the Civil War.

In the days of ’61 no great interest was evinced in the hazardous task of taking pictures under battle-front conditions and on the march. The very few men interested enough to undertake the task were mostly “free lances,” doing things on their own hook. Considering everything we are to-day indeed fortunate in still having a number of these photographs, whose value shall increase in the years to come of that memorable struggle between the North and South.

All this is now changed. On every battle-front you will find the photographer. Whether on land, up in the air or on the sea, you will find him turning his crank or clicking his Graflex.

To overcome some of the difficulties experienced with the standard movie camera one large camera concern has devised a new type of machine adapted for use under the most adverse conditions.

It is constructed on much the same lines as the usual motion-picture camera, but more substantially, so that it will outlast the wear and tear of service on the battle-field. The film magazines, shutter, take-up arrangement, lenses, etc., are located on one side of the camera and identical with the usual machine.

On the opposite side may be seen the electrical drive for the film. See cut above. The motor is self-contained and fitted with ball-bearings to ride the friction and make the driving almost noiseless. The motor is geared up so that at its maximum speed the machine takes about 24 pictures per second; its speed of the motor as well as the starting is controlled by a small lever on the side of the case which, when pressed, causes resistance to be put out of the circuit and the motor gains speed. Two dials are set in the top of the camera to show the speed of the film.

The all important feature is the small stabilizing gyroscope placed on the front end of the camera and driven by a separate electric motor. After the gyroscope has attained its maximum speed of 5,000 r.p.m. (it takes about five minutes to do this) it becomes possible for the photographer to move about, run, walk, ride and do numerous other things, while he simply holds the camera by the two handles (on each side). The camera will always maintain its horizontal plane and take distinct and clear pictures, without resort to a tripod or similar steadying device which would otherwise be necessary and always in the way.

The battery is set in a separate cabinet and consists of a set of twelve storage cells, the casings of which are made of light celluloid and fast into one solid unit. It delivers a maximum of twenty-four volts and about ten amperes.

The cells are so arranged that the acid cannot spill should the battery be overturned or upset.

The Latest Gyroscopic Electric “Movie” Camera for Use in Photographing Battlefield and Aerial Views. The Gyroscope Holds the Camera Steady at All Times.

Extremely Compact Electric “Movie” Projector for War Camp Work. Y. M. C. A. “Huts,” etc. etc.

Next after taking our pictures and developing and printing them comes the need of seeing what we have taken. The regulation (Continued on page 504.)

IMPROVED LOUD-SPEAKING TELEPHONES.

The loud-speaking telephone has come to stay—only a few years ago it was practically unknown outside the laboratory. It finds manifold applications daily and you are apt to meet it most anywhere nowadays.

A new type of duplex voice-transmitter is illustrated here. It is a very sturdy instrument manufactured for severe usage.

On quite a few installations of this apparatus as many as a thousand calls are made in twenty-four hours, day after day.

Generally it is the telephone operator who uses this equipment. A telephone operator is always in a hurry and a transmitter designed for the operator to take up and lay down every time she uses it, does not stand up as well as a transmitter mounted on an extension telephone arm, one type of which is here shown. This improved type of transmitter is made without any movable joints and in as few pieces as possible.

The reproducer horns are located in the walls in flush type containing cabinets when possible, as this makes an unobtrusive installation.

Since the reproducer horns are up out of the way where they are not subjected to wear, and because they have no moving parts to wear out, their life is practically unlimited.

The reproducer itself is mounted in a dust-proof case, and is fully protected against rusting.

Ordinarily there is but one switch used on these loud-talking systems and that is used for turning the current on and off. Standard switches are used.

The latest type of reproducer has as nearly permanent adjustment as possible. The reproducers are “seasoned” before shipment, so as to take care of any settling of parts.

The duplex voice-transmitter is designed for use on installations of from ten to twenty loud-speaking reproducer horns. It is approximately twice as powerful as the single-voice transmitter, because each transmitter energizes its own individual circuit of reproducer horns. Approximately half of the reproducer horns being energized by each transmitter, there is no electrical connection between these transmitters, except that they are energized by the same current supply.

The concealed type horn and cabinet shown has been designed particularly for use in hospitals. The horn is white enameled and the cabinet is given a final coat of paint after being mounted in place, of the same color used on the walls. The hinged door gives ready access to the interior when it is desired to clean or dust inside.

Loud-speaking 'Phone Cabinet of the Flush Wall Type. Sound Emerges Thru Grill at Base. Duplex Voice Transmitter for Loud-speaker at Left.
Electric Trucks Aid War Work

Along with the great increase in woman labor in "the army behind the army," much has come the use of a number of devices which make possible a much wider application of this labor than was originally thought of. Today women are making practically all of the great quantity of munitions that is being used by the British army.

One of the pictures herewith shows women workers loading shells on one of the trains of miniature railway cars, used for moving these shells about in one of the great British munition plants. Electricity is used wherever possible to expedite handling and delivery. Overhead cranes lift and carry the heavy shells and place them at their designated places in the shell warehouses. Women operators work the overhead cranes, direct the loading of the shells on the cars, as shown by the picture, and also drive the little storage battery tractor which transports these cars from building to building. It will be seen from the photograph that the girl in the foreground, driving the storage battery tractor, is quite youthful for the responsibility of this job. However, these tractors have been so simplified and safeguarded that their operation now can be performed by practically any person.

It is interesting to note that whereas the cars of the railroad trains run on tracks, the tractor which pushes these cars about does not do so. It can haul a string of cars in and then run past this string of cars, along the aisle, and do work elsewhere while this first string is being loaded. One of the desirable features of this storage battery tractor is that there is no overhead trolley and that all danger by reason of electric arcing, etc., is eliminated.

As our participation in the war assumes greater and greater proportions we may expect to see large numbers of these little tractors in use in our own munition plants.

The other photo shows how the electric storage-battery equipped truck is "doing its bit" in our own country. During the present congested and shortage of locomotives and electrical perfection of the storage battery, insure that money-making result—most days in service per year.

Plan to combine electric plants.

Combination of electric generating systems and eliminating of hundreds of isolated and uneconomical plants is under consideration by the Fuel Administration as a means of saving fuel supplies. Representatives of the Fuel Administration left New York recently to attend hearings before the Public Service Commission at Washington, D.C., at which the subject will be taken up as affecting New York City.

Millions of tons of coal would be saved, officials say, by centralization. The plan, too, if executed, they say, would go far toward relieving terminal congestion and lightening the loads carried by rail and barge lines.

The coal administration is conducting a general investigation to determine how centralization best could be accomplished without working undue hardships on the owners of plants which might be closed.

"It already has been demonstrated," said a recent Fuel Administration order, "that in many localities centralization may be effected without hardship and with a considerable saving. England and France long ago have taken steps in this general direction. In fact, a commission appointed in England to investigate the subject has described centralization as an economic necessity. It is estimated in this report that an economic saving of $600,000,000 would be effected and the fuel requirements of the industries now supplied with electrical power cut in half."

An Electric Truck "Doing Its Bit" Somewhere in New Jersey. This Truck Equipped with Edison Storage Batteries, is Hauling Three Tank Cars Without a Whimper.
The mystery of the spiral nebulae is still unsolved. These peculiar structures exist in the heavens by hundreds of thousands. They range in size from The Great Andromeda Nebula, which covers a space about one and one-half degrees in length by half a degree in width and is faintly visible without the aid of a telescope, down to the tiny flecks of light that are invisible to the human eye directly but appear on the photographic plates attached to our most powerful telescopes after an exposure of several hours duration.

Counts have been made of the number of spiral nebulae upon photographic plates within selected areas evenly distributed over the sky with a view to determining the probable number of these objects within the reach of great telescopes. It has been estimated as a result of these counts that there are at least seven hundred thousand small spirals photographically in reach of the largest reflectors, while the total number may easily exceed one million.

In some regions these spirals are crowded together in the greatest profusion. In a most wonderful region in the constellation Coma Berenices three hundred and four faint spiral nebulae have been counted upon a single photographic plate covering an area of about three-fourths of a square degree, the a region of equal size only a few degrees distant contains but two spirals. Aside from a marked avoidance of the plane of the Galaxy and a noticeable clustering near the north pole of this plane and to a somewhat less degree near its south pole the distribution of the spirals is quite general throughout the heavens.

The reason that spiral nebulae should lie within the neighborhood of the Milky Way, which is the region favored by the gaseous nebulae, the planetary nebulae, and the vast majority of the stars is not yet satisfactorily explained. The fact is most significant and must be considered in all theories dealing with the origin and nature of the spiral nebulae. The very fact that the spirals avoid the Milky Way shows that they are in some way affected by it.

A second most marked characteristic of the spiral nebulae is their extremely high velocity of motion thru space, the greatest for any class of celestial objects. Twenty miles per second. A few stars spoken of as "runaway stars" have a velocity of one hundred or two hundred miles per second, but these are quite exceptional and they are sometimes referred to as visitors to our galactic regions from regions beyond. In fact celestial objects other than the spiral nebulae that have unusually high velocities of motion thru space such as the globular star clusters and a few isolated types of stars show the same avoidance of the plane of the Milky Way that is shown by the spiral nebulae. According to one explanation this is due to the fact that a strong gravitational field exists in this plane with its hosts of star clouds, and its vast tracts of nebulous matter, both luminous and non-luminous. Globular star clusters or spiral nebulae entering this field would not be able to remain intact but would be disrupted and scattered.

The spiral nebulae do not possess the "bright-line" spectrum characteristic of the strictly gaseous irregular and planetary nebulae that are found in the vicinity of the Milky Way but have the continuous type of spectrum such as comes from our own sun and such as would emanate from star-like bodies. The spiral nebulae are for this reason not considered to be strictly gaseous objects but a conglomeration of stars and nebulous matter. Dark streaks visible in a number of spirals that lie edgewise to the earth seem to show that these nebulae are surrounded by some dark gaseous matter.

No. 3.—The Spiral Nebula in Centaurus (N. Q. C. 5236) Photographed With the 40-inch Reflector of the Lowell Observatory By C. D. Lampland. View of a Spiral Nebula Lying Across the Line of Sight.

No. 4.—The Whirlpool Nebula (N. Q. C. 5184) in Canes Venatici. One of the Most Beautiful of the Spiral Nebulae. Its Spiral Structure Was First Detected By Lord Rosse in 1845. Photographed With the 40-inch Reflector of the Lowell Observatory By C. D. Lampland. This Nebula Also Lies At Right Angles to the Line of Sight and Therefore the Spiral Formation Is Very Noticeable.
that absorbs the light from the inner portions.

Believers in the island universe theory of the spiral nebulae consider that our stellar system is also a spiral nebula and that its form is essentially that depicted in the accompanying photographs of characteristic spiral nebulae. The spiral arms are represented in our system by the star clouds of the Milky Way. The well-known star streaming tendencies of the stars represent motions in and out along those spiral arms toward and away from the nucleus of the spiral. According to this theory dark nebulous matter may exist in outlying portions of the Milky Way similar to the nebulous matter producing the dark streaks in the accompanying photographs (Nos. 1 and 2). Such nebulous matter would hide from our view spiral nebulae lying in the neighborhood of the galactic plane and this would explain why the spirals apparently avoid the plane of the Milky Way. It has long been known that the vast majority of all the stars and the great irregular gaseous nebulae constituting what is known as our "stellar system," crowd toward one plane, that of the Milky Way; for all we know to the contrary all these stars and nebulae may form one vast spiral structure. The distance of the spiral nebulae is now known to be very great. At a distance of several hundred thousand light-years our whole system of hundreds of millions of stars would fade away into a small blurred speck in which no individual stars except the giants of the system would be distinguishable and we would appear as a faint spiral nebula appear to us. So reason those who believe that the spiral nebulae are external universes separated from our Galaxy by distances so great that a ray of light travelling with the velocity of 186,000 miles per second would take not tens of thousands but hundreds of thousands of years to span the abyss.

Until a year or so ago there appeared to be no way of arriving at a reliable estimate of the average distance of the spiral nebulae. Up to July, 1917, thirty two Novae or Temporary stars had been discovered. Of this number thirty were in the Milky Way, two were in spiral nebulae. No particular attention had been paid to the two exceptions. In July, however, Ritchey, at Mt. Wilson, found a faint star in a spiral nebula that had not appeared on earlier photographic plates. Now one or possibly two Novae might chance to be in line with spirals but hardly three. The discovery started astronomers examining past photographs of spiral nebulae for Novae with the result that eight additional Novae were found to be connected with spiral nebulae.

The facts were then that all known Novae to date had appeared either in the Milky Way or in spiral nebulae. The appearance of Novae in the Milky Way is usually explained as due to the encounter of a star with nebulous matter. The Novae of the Galaxy are suns suddenly raised to abnormal brightness thru the friction arising from the encounter of star with nebula. How then should the newly noted Novae in spirals be explained since the spiral nebulae conspicuously avoid the neighborhood of the Milky Way? It was a point in favor of the island universe theory, for if the spirals are similar in structure to the Milky Way and are great aggregations of stars and vast gaseous nebulae the appearance of Novae in spirals is not so strange. This theory was further borne out by the fact that the Novae of the Milky Way average eight magnitudes or nearly sixteen hundred times brighter than the Novae appearing in spirals. Since the apparent brightness of stars of equal magnitude varies as the squares of their distances the Novae in spirals must be on the average forty times more distant than the Novae of the Milky Way, which are members of our own system of stars. We do not know the distance of the Novae of the Milky Way, but if we assume they are at an average distance of five thousand light years the average distance of the spiral nebulae comes out two hundred thousand light years.

There is another class of celestial objects, the globular star clusters, that are now known to be at distances ranging from twenty thousand to more than two hundred thousand light years from the earth. Each
POWERSFUL LIGHT RELIEVES PAIN.

It is rapidly becoming the practise, both in private and professional circles, to apply the rays of a powerful electric lamp to various affected parts of the body. They will conquer and banish pain and other symptoms of most diseases, thereby giving Nature a better opportunity to overcome the underlying condition and lessen the amount of medicine required, it is said.

For instance, they will overcome the pain of wounded or strained muscles or pressure upon nerves, and help poor circulation, numbness and stiffness of any part following cold or injury. Nothing penetrates, heals and soothes sore areas and so promptly re-establishes the vim and vigor of the patient as the timely application of heat and light therapy.

When applied early after a bruise, as of the eye or face, they prevent swelling and discoloration of the skin. The light here shown is claimed to decrease the pain of a carbuncle, boil or abscess. In the early stages it may prevent the formation of pus; in the later stages it helps to ripen the abscess. The illustration shows a 400 candle-power cornucopia shape lamp, which consists of an aluminum hood, globe, handle, seven feet of cord, plug and adjusting ball for raising and lowering lamp over patient. There are also available colored, adjustable reflectors, ruby amber and green screens.

230,000,000 K.W. WATER PER YEAR AVAILABLE, SAYS STEINMETZ.

Dr. Steinmetz, in a recent paper presented before the American Institute of Electrical Engineers, warned his hearers, that water power can never be expected to do anything more than supplement the use of coal. He estimated the possible hydraulic energy of all American water courses as 230,000,000 kilowatts a year, a little more than the total energy now produced in the United States, thru the medium of coal. “This means,” he said, “that the theory by which we hope to use the water power of the country when coal begins to fail as an endless supply of energy is now a dream and must remain a dream. If all the potential powers of the land were now developed, and every raindrop used, it would not supply our present demand for energy.

ANNOUNCEMENT

With this issue the price of the ELECTRICAL EXPERIMENTER advances to 20 cents a copy. We have delayed this move as long as we dared, but economical conditions made the change necessary if the publication was to survive. We are forced to pay 10½ cents a pound for text paper now—an increase of 11½% SING. 1916. Our cover paper now costs 11 cents a pound—AN INCREASE OF 91%. Printing, art work, engravings—all have advanced 50% to 90% and the end is not yet. Take only one item—the two carloads of paper that go into making a single edition of this EXPerimenter, they now cost us $2,200.00 MORE than a year ago. The paper alone in a single copy of the EXPERimenter costs 55 cents! Advancing the price of a publication never benefits a publisher. He loses a certain percentage of circulation, and his subscriptions fall off. New readers at the higher price are hard to find. We therefore can but hope that our old readers will bear with us, and support their EXPERimenter until such time when we return from a war, to a peace condition, and its accompanying recession of prices. In return for the higher price, we have already added a certain number of pages to this issue, and will continue to do so if we have the full support of our readers.

It is our belief that we offer more actual instruction and information than any kindred publication, and having the confidence of our readers we trust that they will support us as enthusiastically. Uniting times of stress, as they have during normal times, Subscription from 1 up to 5 years at the old rate of $1.50 (foreign $2.00) will be accepted up to and October 31st inclusive. After that date the new rate of $2.00 a year, ($2.50 foreign) will be in effect.

THE PUBLISHERS

A PORTABLE NITROGEN RADIATOR.

The latest offering to the public is the portable electric nitrogen radiator shown in the accompanying illustration. This radiator is said to be the only auxiliary electric heating apparatus filled with nitrogen gas which is built on scientific principles adopted by heating engineers of standing—i.e., the radiator.

It maintains an average temperature of 350 deg. Fahr. (176.7 deg. C.), it is said. The radiator contains an electric heating element surrounded by nitrogen gas. The gas fills the entire inside of the radiator, which is hermetically sealed. The gas serves to carry the heat from the heating element to the radiating surfaces at a temperature higher than that of a steam radiator. One feature pointed out for this device is that there is no way by which clothing, drapery or anything else can catch fire, as it has no exposed red-hot open wires. The cost of operation of this radiator is very low. The stock radiators are made in four, six, eight and ten sections.

STAND BACK! HERE COME THE ELECTRIC TANKS!

The very latest addition to toyland is the miniature electric tank here shown. The tank is a miniature model of the famous British Tanks which are playing such an important part in the Great World War at the present time, and it works to perfection. There is no end to the fun boys can have with this small war model and it will climb over anything that is in its path. No matter what is in front, it keeps right on forcing its way ahead.

The tank is driven by a powerful battery motor and can be supplied with current from battery developing 8 volts, or thru an A. C. step-down transformer on 12 volts.

The Electric Tanks Threaten to Invade Toyland in New York and all Other U. S. Cities and Towns on Xmas.
The Gyro Electric Destroyer

By H. Gernsback

We reprint below a few paragraphs relative to the Gyro Electric Destroyer, originally described by the author in the February 1918 issue of the Electrical Experimenter. This article was widely reprinted all over the country, from the New York World to the San Francisco Chronicle. We re-publish part of the article for the benefit of those readers who did not see the original.

The great trouble with the Tank is quite a sensitive trait. If hit, even the bullet of a small gun will generally cripple the Tank. The tank is the most vital part of the machine, and if damaged in one spot, it will be helpless to move or to attack. The weight of the tank is very enormous, and this makes it quite a good deal of trouble.

Attention is called to the fact that the movable belt tread of the Tank is quite a sensitive trait. If hit, the bullet of a small gun will generally cripple the Tank. The tank is the most vital part of the machine, and if damaged in one spot, it will be helpless to move or to attack. The weight of the tank is very enormous, and this makes it quite a good deal of trouble.

The present gyro electric destroyer is a single steel wheel, as clearly shown in our accompanying illustration. It is 10 feet high. The top of the wheel is not flat, but is in the shape of an arch. The weight is somewhat lighter, and it is nearly as much as the weight of the tank. The wheel itself looks like a huge ferris wheel, and is constructed of channel steel steal; in order to make it as light as possible, it has no continuous track around it, but rather the steel pieces at the circumference are spaced about one foot apart, leaving room for two inches. The weight is cut down. Second, much better purchase is had on the ground, the machine not being apt to slip as was the case of the Tank. If the top of the wheel was solid.

The wheel has one large shaft passing thru the center and extending at each side, as shown in the cross-section in our illustration. This shaft is hollow and need not weigh very much. It is constructed of very heavy steel bolts and at the ends of the shaft the latter is provided with armored projection. So as not to be damaged in case of shell fire. In the center of the wheel is suspended the engine car which comprises a gasoline engine of some fifteen hundred to five hundred horsepower. The energy is fed to a generator as shown. The result of the strange manner of using the engine is that it may be used for purposes of the wheel only; they are attached by means of a choral shaft shown.

Inasmuch as the wheel of the destroyer is not solid but contains steel, it may very well be understood that even a large size wheel will easily pass thru the machine without doing much damage, and here is where this machine shows its superiority over the tank. It will be almost impossible to damage this destroyer by means of shell shot. Even a "dead hit" from a medium caliber gun will cause much damage, and even a good sized shot hitting the gyroscopic will not hurt it very much, for the reason that the latter spins at enormous speed, which will certainly deflect the shot unless, of course, if it is a dead hit at right angles to the face of the wheel. The external drive shafts are encased and protected, and it should be as safe as possible to prevent the machine being done out of action, and this can be readily done in case of need. Another point is that this machine, the most vital part of the machine, presents but little surface to an opposing shell, contrast thereto you will have to make a large and very large moving pieces, then send along your contribution, using the accompanying blank. You might read the letter from the people who believe in the idea, reprinted herewith:

**EVERY LITTLE HELPS.**

"I sure would like to give more, as I think it will work out all right."

-- Hays, Kans.

**CALL AGAIN!**

"Enclosed find Money Order for $1.00 to go as part payment in the Gyro Electric Destroyer. I am sorry that I cannot at the present time give more, but if not enough is raised to build a fair sized model please call again."

I am very glad you gave me the opportunity to do, something of this sort before I am drafted, which I soon will be. When this Destroyer is completed, I should like to have a part in the crew when it is completed. May I suggest that you submit the plans to Henry Ford. I would not be surprised if he could be induced to build it; this would save a lot of money for the Government."

"I was not in the 'E. E.' and so did not see the Destroyer in the February issue, but am going to buy them from now on until the Destroyer is finished."

-- Walter Holey, Norwich, N. Y.

**I HEARTILY BELIEVE IN THIS MONSTER.**

"I heartily believe in this monster, and I hope that your experiment succeeds and that every reader of the 'E. E.' contributes as much as possible. I do not mean the 'E. E.' and so did not see the Destroyer in the February issue, but am going to buy them from now on until the Destroyer is finished."

-- Fred Van Dyke, 52, Gibson Ave., Detroit, Mich.

**HE SAW THE 'POW-WOW'!**

"I saw the 'pow-wow' in the 'E. E.' and agree with you. While it never occurred to me, I am contributing to the construction of that Gyro Electric Destroyer, now that it has been proposed. Enclosed you will find $1.00. Since you have it up, get your battle-scarred brain to work and make it possible. Here's hoping that you will have the best of luck and the 'Bugs' all cooperate with you."

-- Neil W. Beeson, 9 S. 3rd St., Marshalltown, Ia.

**A GENUINE BELIEVER.**

"Please see my letter of August 19, in which I enclosed $1.00 as my share in building a model of our Gyro Electric Destroyer. In that letter I mentioned the..."
A ion is a pretty small particle of matter to be made visible. It may consist of several electrically charged molecules grouped together, a thousand times too small to be visible in the strongest microscope, or it may be an electron or free atom of electricity which would be more than one thousand times smaller still. As has been previously stated these almost infinitely small particles can never be seen by the human eye which has such a limited range of vision. However, they may never be directly visible but they have already been made indirectly visible by the experiments of C. T. R. Wilson. These experiments not only are very striking in their nature but they have told us things about electricity and matter which we could have known in no other way. Electrons, and alpha and beta rays from radium may pass directly through ordinary molecules, and molecules themselves are not solid discrete particles as they were once thought to be, but are in every case points of electric energy far, far apart in relation to their size.

C. T. R. Wilson in 1912 made ions visible indirectly by photographing their path in the following remarkable manner: The principle made use of was the fact that an ion of high velocity forms other ions by collision with the ordinary molecules in its path, as mentioned in a previous article by the author. So he used a chamber of the form shown in Fig. 1, in which an expansion of the air could be obtained thru the opening P, connected with a pump. The space above the water W was first cleared of ions by an Electric Field; then an Alpha or Beta Particle was allowed to pass thru the Chamber in the direction A-A. The Air was Expanded and the Water Vapor thus formed, at Once Condensed about the ions. Fig. 2 represents the paths of alpha particles as photographed in the manner explained above. Fig. 3 represents the paths of beta particles and Fig. 4 represents the paths of X-rays. It will be noticed that these paths are strikingly different. The alpha particle travels in a straight line and the ions produced by it are so close together that it makes the line look continuous. The beta particle travels in a fairly straight line but it produces fewer

**LAST CALL**

On November 1st the subscription price of the "Electrical Experimenter" advances to $2.00 (U. S. Canada and Foreign, $2.50). This is the last chance to subscribe at the old rates ($1.50 in U. S., Canada and Foreign $2.00). No subscription for more than five years at the old rate accepted.—THE PUBLISHERS

This Chart Shows the Paths of "Beta Particles"—After Photograph by Wilson. Note the Difference Between Path Routes of Alpha Particles Depicted in Fig. 2. The Alpha Particles Travel in Nearly Straight Lines, whereas the Beta Particles Travel in Curved Paths. The Alpha Particles May Travel 7 Centimeters in Air. The Paths Taken by "Alpha Particles" in Air—After Photograph Taken by Wilson with the Arrangement Described and Illustrated at Fig. 3. Alpha Particles May Travel 12 Centimeters Thru Air. The Paths Taken by "Alpha Particles" in Water. After Photograph Taken by Wilson. The Alpha Particles Travel 6 Centimeters Thru Water.

This Chart Shows the Paths of X-rays. The Study of X-rays is the Most Recent Field of Electrical Experiments. The X-rays are Electrons, Photographic Plates are Used to Detect Their Presence. X-rays were First Obtained by Paschen in 1895. They are the rays of which X-rays consist of is mostly made up of "betweens." Which is the "between"? Is it Wood or Stone? The Electron Theory and Structure Makes It Perfectly Clear.

The Path shown by an X-ray is entirely independent of the material it pierces. When X-rays fall on a piece of wood or bone, they pass freely through the material, and the image is not very much altered. This is because the X-rays are not absorbed by the wood or bone. When X-rays fall on a piece of iron or steel, the image is much altered because the X-rays are absorbed by the iron or steel. The X-rays are not absorbed by all materials, but only by materials that have a high density. The density of a material is a measure of how much mass is packed into a given volume. The higher the density of a material, the more X-rays are absorbed by it. This is why X-rays are so useful in medicine, where they are used to see through bones and other dense materials.

The distance of alpha particles in air is very short, and they are easily deflected by the lightest particles. The distance of beta particles in air is considerably longer, and they are less easily deflected. The distance of gamma rays in air is very long, and they are not easily deflected at all. This is because gamma rays have a very high energy, and they are not affected by the electromagnetic field of the air.

The distance of X-rays in air is variable, and depends on the energy of the X-rays. The higher the energy of the X-rays, the longer the distance they travel in air. This is because the higher energy X-rays have more momentum, and they are less affected by the electromagnetic field of the air.

The distance of electrons in air is very long, and they are not easily deflected. This is because electrons have a very high energy, and they are not affected by the electromagnetic field of the air.

The distance of protons in air is very short, and they are easily deflected by the lightest particles. The distance of neutrons in air is very long, and they are not easily deflected at all. This is because neutrons have a very high energy, and they are not affected by the electromagnetic field of the air.

The distance of alpha particles in water is very short, and they are easily deflected by the lightest particles. The distance of beta particles in water is considerably longer, and they are less easily deflected. The distance of gamma rays in water is very long, and they are not easily deflected at all. This is because gamma rays have a very high energy, and they are not affected by the electromagnetic field of the water.

The distance of X-rays in water is variable, and depends on the energy of the X-rays. The higher the energy of the X-rays, the longer the distance they travel in water. This is because the higher energy X-rays have more momentum, and they are less affected by the electromagnetic field of the water.

The distance of electrons in water is very long, and they are not easily deflected. This is because electrons have a very high energy, and they are not affected by the electromagnetic field of the water.

The distance of protons in water is very short, and they are easily deflected by the lightest particles. The distance of neutrons in water is very long, and they are not easily deflected at all. This is because neutrons have a very high energy, and they are not affected by the electromagnetic field of the water.

The distance of alpha particles in air is very short, and they are easily deflected by the lightest particles. The distance of beta particles in air is considerably longer, and they are less easily deflected. The distance of gamma rays in air is very long, and they are not easily deflected at all. This is because gamma rays have a very high energy, and they are not affected by the electromagnetic field of the air.

The distance of X-rays in air is variable, and depends on the energy of the X-rays. The higher the energy of the X-rays, the longer the distance they travel in air. This is because the higher energy X-rays have more momentum, and they are less affected by the electromagnetic field of the air.

The distance of electrons in air is very long, and they are not easily deflected. This is because electrons have a very high energy, and they are not affected by the electromagnetic field of the air.

The distance of protons in air is very short, and they are easily deflected by the lightest particles. The distance of neutrons in air is very long, and they are not easily deflected at all. This is because neutrons have a very high energy, and they are not affected by the electromagnetic field of the air.

The distance of alpha particles in water is very short, and they are easily deflected by the lightest particles. The distance of beta particles in water is considerably longer, and they are less easily deflected. The distance of gamma rays in water is very long, and they are not easily deflected at all. This is because gamma rays have a very high energy, and they are not affected by the electromagnetic field of the water.

The distance of X-rays in water is variable, and depends on the energy of the X-rays. The higher the energy of the X-rays, the longer the distance they travel in water. This is because the higher energy X-rays have more momentum, and they are less affected by the electromagnetic field of the water.

The distance of electrons in water is very long, and they are not easily deflected. This is because electrons have a very high energy, and they are not affected by the electromagnetic field of the water.

The distance of protons in water is very short, and they are easily deflected by the lightest particles. The distance of neutrons in water is very long, and they are not easily deflected at all. This is because neutrons have a very high energy, and they are not affected by the electromagnetic field of the water.
THE present article which closes our contest on Burnt-Out Lamps illustrates that the idea has not been entirely exhausted. Since we published the results of our last contest in our June, 1918, issue, we have received over two thousand more suggestions from contestants located practically all over the world. Most of these of course were duplicates, and were along the lines of the ideas which we had published in former issues or otherwise were variations of them. There were all kinds of fantastic ideas, and we give below a few of the suggestions which came to the editor's desk but which were not of sufficient importance to warrant publishing separately. Among these were the following: Gold fish globes, a sort of steam turbine, stocking darning, cord (ball) holder, a swimming device, an apparatus to catch fish, and last but not least, a transparency representing the Kaiser to be shot at with a gun.

Perhaps the most original one which we publish here comes from France from M. G. Mohr-Desforges, Roulet, France. M. Desforges, who serves in the French army, has evolved a really good battery which we are pleased to illustrate and describe in full herewith. While it cannot be used for lighting or similar work, forty of them would certainly make a very fine battery for audition circuits, while it is for measuring work, etc., the Meiding battery can hardly be surpassed. Of course, all copper sulfate batteries must be used on a closed circuit, they cannot be left on open circuit.

MEIDINGER BATTERY

This idea is submitted by M. G. Mohr-Desforges, Sapeur Télégraphe, 8e Génie, 8e, D/T Détachement, Armée d'Orient, Roulet (Charentes), France. It is a very clever design of a Meidinger type battery with two solutions. This battery is well-known in Europe and America. It works automatically. It must be used on a closed circuit, open circuit work not being permissible. M. Desforges constructs his battery as follows:

A large burn-out lamp globe is cut in the top to accommodate another similar globe as shown in our illustration. After removing the glass stem of the lower globe, a small copper tube is soldered to the former filament; connections as shown. This forms the positive pole of the battery. From the stationary globe is suspended a zinc cylinder made of sheet zinc of suitable thickness and about in proportion as shown, which is suspended from the globe by means of wires. These wires may be copper, but in order to safeguard against local action, they must be well painted with asphaltum before being inserted in the solution. One wire forms the negative pole.

The other globe is filled with copper sulfate crystals and the open end is closed by means of a paraffined cork thru which a short piece of glass tubing passes. M. Desforges continues as follows: (French translation). "This is how I accomplish it:

I first fill one-third of the lower globe with a 10% solution of sulfate of zinc. Then by means of a glass funnel which must go all the way down, I pour a concentrated solution of sulfate of copper, which being of a heavier specific gravity stays at the bottom and raises the sulfate of zinc solution. A sharp dark blue markantion shows the line separating the two liquids. The lower globe will now be found to be about three-quarters full. I now insert the upper globe carefully, taking care not to shake the liquids which would otherwise mix. The battery is now ready for work. It gives approximately 1.07 volts.

"As the battery works, the copper sulfate at the bottom is used up, but a new supply is always at hand on account of the upper globe being filled with crystals that dissolve very slowly, the resultant solution descending by gravity to the bottom."

A SIMPLE HOT-WIRE AMMETER.

An efficient yet simple hot-wire ammeter can be constructed at small cost from a 100 watt Type "C" lamp. First break off the tip of the bulb, leaving a hole about ½ of an inch in diameter. Insert a forked wire with which to remove the spiral filament, and carefully bend the supporting ribs "B", back so as not to short-circuit the main leads. Next get a piece of No. 32 Manganin wire about two inches long, and solder each end firmly to a six-inch piece of iron wire for a handle. Having first arranged the ends of the lead wires so they are about an inch apart, insert the fine wire and wrap a half inch of each end about each lead, and break off the iron wire. Solder the joints by using a piece of resin core solder as one electrode of a storage battery circuit, the joint as the other, and the current will pass between them. It may be necessary to spread the leads (A) slightly after this operation to tighten the hot-wire. A short piece of No. 14 aluminum wire "D" is hung over the center of "C" and the ammeter is complete. Hang in an inverted position, and a current passing thru "C" allows it to sag, increasing the length of "D" protruding at the tip of the wire.

A useful Hand Grenade Fire Extinguisher.

Make up two solutions, one of part of sulfuric acid and ten parts of water, and a second solution of fifty parts sodium bicarbonate and five parts of water. Break off the tip of one of the show case bulbs under the acid solution and break off the tip of the other under the sodium bicarbonate solution. Close the fine holes with sealing wax. Bind the two bulbs tightly together and when a fire breaks out in the laboratory or elsewhere, just hurl the two bulbs at the flaming place, the two bulbs will burst, their contents unite in mortol contest, liberating much carbon dioxide gas, which will extinguish the flame.

Benson Freeman, Atlanta, Ga.

BATTERY TESTER.

Take a burn-out lamp, it does not matter what kind, and cut the top off with a three-cornered file as shown at left. Also pull out the lead wires. Just above the base of the lamp wind 15 to 20 feet of No. 22 wire. Then take a ½-inch nail and a small bit of cork. File off the nail as shown and cut the cork so that there is just enough cork (Continued on page 471)
Notice to All Radio Readers

As most of our radio readers are undoubtedly aware, the U. S. Government has decided that all Amateur Wireless Stations, whether licensed or unlicensed, or equipped for receiving or transmitting, shall be closed.

It is of the utmost importance that this decision be carried into effect immediately, for the reason that we desire to continue to publish valuable articles on the wireless art from time to time, and which may treat on both transmitting and receiving apparatus. In the first place, there are a great many students among our readers who will demand and expect a continuation of the usual class of Radio subjects, which we have published in the past four years, and secondly, there will be hundreds and even thousands of new radio pupils in the various naval and civilian schools throughout the country who will be benefited by up-to-date wireless articles treating on both the transmitting as well as receiving equipment. Remember that you must not connect up radio apparatus to any form of antenna.—The Editors.

Senatore Marconi Head of Italy’s Banking System

We have not heard a great deal of Senatore Guglielmo Marconi of late, due no doubt to the enormous weight of the several large enterprises and governmental positions of which he is the dominant figure. The recent reports of his activities state that he has been busy to the United States as the President of the American Radio Manufacturing Company, representing Italy. However, his country’s need of him was so urgent as to cause a cancellation of this particular mission. We, in a way, regret this decision as men of Marconi’s caliber are a valuable asset to any nation, locality or city which they may honor with their presence.

Senatore Marconi has rendered a very great service to Italy, and the nations of the world in general, by his abolition of all traces of the Teutonic financial supremacy, which, up to the time that his revision became effective, had been paramount, and the Germans had wielded a very powerful persuasive, namely the capitalization of very nearly all of the large enterprises in Italy. Dr. Marconi originated and organized the new banking system now in vogue in that country, and with him as the “moving spirit” of the undertaking, its future success is amply assured. As an irresistible worker, Dr. Marconi possesses animation, vigor and vivacity, and corrals all prices. He is ever “on the job” whether it be day or night.

He last visited this country as a member of the Italian Mission to the United States, and the photograph which accompanies this note, was taken at that time, when he received fifty young ladies from the Wireless Club of Hunter College, New York. He spoke to these women on their work as an aid to the Government. The highest title Guglielmo Marconi has had bestowed upon him is the one of Senator. He is one of the youngest Italian Senators. A title second in importance is that of Chief of Communications of the Italian Navy. Dr. Marconi is a member of the Institution of Electrical Engineers and numerous other well-known electrical and scientific societies throughout the world. His work has been recognized by many governments and seats of learning; he has been decorated by the King of Italy and the late Czar of Russia; he is an honorary doctor (LL.D. D. Sc.) of many universities, including Oxford, Glasgow, Aberdeen, Liverpool and Pennsylvania, besides having received the freedom of the principal Italian cities. He was awarded the Nobel Prize for Physics, which is perhaps the highest distinction that can be obtained by any scientist. He has also been the recipient of scientific rewards granted by many and various societies and other institutions throughout the world.

RADIO FLASHES 12,000 MILES.

Direct communication with Australia is the latest development of radio-communication.

Connection was established on October 1st, when Commonwealth Premier Hughes and Sir Joseph Cook, Minister for the English Navy, sent two messages to the Amalgamated Wireless Company of Australia at Sydney from the new Marconi station at Carnarvon, Wales, and the distance of direct transmission was 12,000 miles the messages were received with perfect clearness. The Hertzian waves of wireless message move equally in all directions. If, therefore, the messages between Wales and Australia should pass round the globe in one direction, they did so in all other directions, and these messages may be said to have enveloped the globe.

U. S. MAGNETIC SURVEY.

The Magnetic Survey Vessel, Carnegie, arrived safely at her home port, Washington, D. C. on June 10, where she will be put out of commission probably during the period of the war. During her cruise from Buenos Aires, Argentina, round the Horn to Valparaiso, Chile, Callao, Peru, thence thru the Panama Canal to Newport News, she was in command of Dr. N. W. Edmonds; the other members of the scientific staff aboard were: Messrs. A. D. Power, Bradley Jones, L. L. Tanguy, J. M. McFadden, and Walter E. Scott.

DO YOU KNOW?

That hydrogen and ozone play the most important part in your make-up. Your body is more than three-quarters water, the water is two-thirds hydrogen and one-third oxygen.
NEW CUTTER USEFUL IN QUENCHED GAP MAKING

The new adjustable cutter consists of a steel casting, on which are mounted two cutting tools, which may be adjusted to various diameters. This part of the device is rotated by means of a ratchet wrench. Pressure is applied to the cutting tools by means of a heavy coil spring. The device is held in place by a round stud, which is placed thru a ¾” pilot hole in the metal to be cut (in the case of iron conduit boxes) and fastened on the back of this metal by means of a flange nut.

It is obvious that this cutter can be operated in positions that would otherwise be inaccessible.

The old method of drilling a large number of small holes and then punching out the metal makes a crude job at the best and is slow, costly and very laborious. Not only can this device be applied to cutting holes and grooves in steel cabinets, boilers, tanks, etc., but also can be used for cutting metal, such as slate, marble and fibre. It is used for cutting holes or grooves ½” to 3”. The larger size cuts holes from 1¾” to 6”. A still larger size cutter will cut holes or grooves up to 12” in diameter.

A New Cutter which Lends Itself Well to the Making of Amateur Quenched Spark Gaps.

GERMAN RADIO APPARATUS ON AIRPLANES.

Lieutenant Jean-Abel Lefranc, writing in a recent issue of *Nature* on the evolution of German Aviation, states that for some little time the enemy machines have been occasionally equipped with continuous wave receivers of the valve type. Regarding the transmitting apparatus, Lieut. Lefranc says that the generator produces alternating current (270 volts 3 amps.) and continuous current (50 volts 4 amps.) The machine is driven either by a small airscrew rotating at 4,500 revolutions per minute, or by the motor. The alternating current produced by this generator is utilised by the oscillating circuit which gives rise to the oscillations creating the Hertzian waves. The Telefunken sender consists of a rectangular box containing a transformer, a condenser, a plate discharger and a wave-meter. Special arrangements permit of variation of wave length and intensity of transmission.

Radio Outfit on a German Airplane.

The aerial consists of a copper wire approximately 35 to 40 meters in length. On the ground this wire is rolled up on a bobbin. During flight it is suspended from the machine.

The range of these sets is about 35 km. (21 miles) and their weight in all 26 kg. (about 60 lbs.) The latest giant airplanes guide themselves at night by radio-oscillographs, as the Zeppelins do.

It will be noticed from the diagram reproduced herewith that the generator supplies current for several purposes. Thus the leads A go to the electric warming apparatus in the pilot’s clothes; B to the lamps on the instrument board; C to the observer’s clothes; D and E to heating apparatus on the camera and machine gun respectively. F is the searchlight for night landings. All G is therefore concerned with lighting. The generator, while K is obviously the transmitting key. L contains the Telefunken transmitters; M and N and O are the aerial ammeter, the aerial reel and the antenna itself. All Q is the purely wireless apparatus.

NEW METERS FOR RADIO AND HIGH-FREQUENCY WORK.

A high grade hot wire measuring instrument designed particularly for wireless and other high-frequency work, depending for its operation upon the expansion of a metal strip which is heated by the current to be measured has recently been developed. The slight sag in this conducting strip is magnified several hundred times on the scale by means of a combination of wires and a deflecting spring.

The conducting strip is made of special non-corrosive material. The operating posts have the same temperature coefficient of expansion as the conducting strip, so that the changes in room temperature do not cause an error in the reading of the instrument.

The scale plate is made of metal, and the scale subtends an arc of 90 degrees, being 2½ inches long.

The flush-mounting type meters have a guaranteed accuracy of 2 per cent, while the portable type, which can be expected to show an accuracy within 1 per cent of full scale. Standard meters are for 1, 2 and 5 amperes. Care must be used not to subject the instrument to more than 200 per cent load.—Photos courtesy Westinghouse Electric & Mfg. Co.

New High-Power Radio Station at Annapolis, Md.

The new high-power radio station at Annapolis, Md., the most powerful in America, was formally opened recently, Secretary Daniels signalizing the occasion by sending messages to the first lord of the British Admiralty, London; the French minister of marine, in Paris; and the Italian minister of marine, in Rome.

The station completed cost about $1,500,000, and is capable of maintaining uninterrupted communication over a distance of at least 4,000 miles.

There are four steel towers, each 650 feet high supporting the antennae which, with the ground system, required 100 miles of wire for their completion. The power installations is in duplicate, so that it will always be possible to maintain communication. The operation of the station requires the services of 100 men, all of whom are drawn from the enlisted force of the Navy. Suitable provision has been made for the protection of the station.

These messages were transmitted to London, Paris, and Rome with the utmost success, which is especially gratifying to Navy officials, since this powerful plant was erected and equipt by the Navy in the short space of 10 months. Under conditions that prevailed before our entry into the war its erection would have taken two years.
ELECTRICAL EXPerimenter

Bunque

By ALAN C. ROCKWOOD

I recently saw the advertisement of a Chronic Plunge Battery. I don’t know about Chronic Plunge batteries but I’ve certainly had plenty of experience with Chronically Discharged Batteries. A prominent radio experimenter who has wanderings may appear again. The compiler, however, needs some help on the job. If you have any electrical or radio quips send them along. Further decisions will be given or withheld as desired. Address “Bunque” care of the publishers of Electrical Experimenter.

Thank you.

A RADIO ECHO FROM THE PAST.

Mr. Godfrey Isaacs, in the course of a recent address in London referred to the achievements of wireless telegraphy and the progress that had been made in the twenty odd years of Mr. Marconi’s labors. This reference on the part of the Managing Director of the Marconi International Company brought forth a reminiscence from a Member of Parliament which appeared in the pages of Town Topics and is worth reading again.

“It is just twenty years ago since Mr. Marconi, now Senator Marconi, gave an exhibition of his wireless invention to members of the House of Commons.

He wanted to prove that a wireless message could be sent from the Terra...
A Sensitive Wireless Recorder

By ARNO A. KLUGE

NOW that the radio experimenter is taking an enforced "vacation" which may continue for some time to come, altho we hope not too long, perhaps it would not be amiss to attempt the construction of a more difficult piece of apparatus than the ordinary instrument, and yet one which has great possibilities for the operator.

With this thought in mind, I present here, with the details for making an ultra-sensitive relay, one which can be used for amplifying weak radio signals, so that they actuate a tape recorder or an audible buzzer. At first thought this device may seem rather complicated, but with a little skill, patience, and the expenditure of very little money, a suitable relay can be constructed that will rival any in existence.

The principle of this device is that of the capillary electrometer, which was first discussed by Prof. Lipmann several years ago. A "U"-shaped glass tube, A, Fig. 1, about \( \frac{1}{2} \) inch inside diameter, is filled with chemically pure mercury, so that it comes within \( \frac{1}{2} \) inch of the top of the shorter arm. A small quantity of 20 per cent sulfuric acid is then poured in on the top, at B. A plunger, C, carrying an electrode, is inserted in the long arm for varying the height of the mercury, and the whole apparatus is supported by a laboratory standard or a board.

Next we take a small glass tube that will fit inside the large one, and draw one end out into a fine capillary tube, by heating in a Bunsen flame. The bore of this tube at the capillary end should be about the size of a human hair, but it is best to make several different sizes to find the right diameter. This tube should be about two inches long, and is supported directly above the short arm of the large tube, so that it just dips into the sulfuric acid. A small quantity of mercury is then poured into it, connections are brought out at C and D, and the apparatus is ready to adjust.

This is done by blowing in the tube D until a small stream of mercury is forced thru the capillary tube into the acid. The pressure is then released, and, due to the capillary action, the mercury will recede a trifle, and will draw a quantity of the sulfuric acid up with it. The separation between the two mercury columns is now regulated by the plunger C, until the instrument works best.

To test the instrument, it is only necessary to place the moistened fingers across the binding posts, and the difference of potential between the two masses of mercury will affect the surface tension, and cause the point at the junction of the liquids to move up and down. The movement from such a slight potential is very small, visible only with a magnifying glass, but with strong wireless signals it becomes more pronounced, and is visible even to the naked eye.

To apply the instrument in operating a relay or recorder, it is necessary to use a beam of light, as shown by Fig. 2, playing upon a selenium cell, the construction of which will be evident to the experimenter. The same beam of light could also be used in giving a screen demonstration of radio or a photo-recorder could be built, and the signals recorded upon sensitive paper, as the operator chooses.

And while it is not possible to use this device in wireless at present, it has many other interesting uses which will suggest themselves to the experimenter, such as recording the fluctuations of the voice upon the screen, recording the sine wave of an alternating current by means of a revolving mirror, etc.

**BURNED-OUT LAMP CONTEST**

(Continued from page 407)

Nove. 1918.

The Capillary Electrometer Used in Building the Radio Recorder Here Described. It Em-

ployed Fine Liquid Mercury Which Con- 

tracts with the Column of Mercury in Large Tube 

"U" at Junction Between Them Rising and 

Falling as Radio Currents Are Applied to It.

capillary action, the mercury will recede a trifle, and will draw a quantity of the sulfuric acid up with it. The separation between the two mercury columns is now regulated by the plunger C, until the instrument works best.

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**BURNED-OUT LAMP CONTEST**

(Continued from page 407)

to float the nail. Now fill the lamp with water and drop the cork with the nail in the water. By connecting the two leads of the magnet coil to a battery the cork will go down and rise again as soon as the current is shut off. The harder and faster the cork goes down the more current the battery contains.

EDWARD N. HEURNER,
New York, N. Y.

**Connecting Plug.**

First break away the glass globe down to the brass base of a burned-out lamp bulb, leaving the glass part which holds the two wires. Next solder on the two ends of a flexible lamp cord to the two wires projecting from the glass.

Then take a brace and 1" bit and bore a hole thru a short piece of 2" x 2" wood. Into one end of the hole start the brass base


A French system of rapid telegraphy, by which 40,000 words an hour can be transmitted, has worked successfully for distances up to 900 miles in that country.
Radio amplifiers of many kinds have been tried but in the twenty years that wireless telegraphy has been with us, the more prominent types of current intensifying devices will be discussed here, reference being made to some of the novel or interesting ones. An amplifier is usually considered to be a device acting by electro-magnetic or other law, so as to boost the strength of a received radio signal. Such apparatus is of the greatest importance in radio work, not only for the improvement of weak signals at the receiving end, but also for the control or modulation of heavy radio-telephonic transmitter currents.

The electro-magnetic amplifier illustrated in Fig. 1, known as the “Multi-Audiophone,” is claimed to boost incoming wireless messages fifteen hundred times their original strength into radio signals. The amplifier consists of a special chemical placed between two electrodes, which arrangement changes the resistance by virtue of a diafram attracted to an electro-magnet. This will be more clearly understood by referring to a cross-section view of this instrument, Fig. 1. It consists of a permanent magnet A, supporting a metallic case N, having a threaded screw cap M. The case contains the amplification parts, comprising a condenser set B, a small iron core E connected to a very fine steel diafram D, carrying a cup F upon its surface. Another cup G is placed on the opposite side and connected to it, the chemical is placed at I. A tube H is provided so that the material is retained within the cups. The cup G is connected to a threaded rod J and lever K, supported by a rubber standard L on the steel magnet A. The diafram D is gold-plated in order that the chemical will not affect the steel. The electro-magnet B is connected by means of the wires O, while diafram D is joined to wire P. Rod J connects to terminal Q.

In order to regulate the pressure on the chemical mixture between the cups and electrodes, adjustment is made by nut K.

The action of this amplifier is somewhat microphonic, and as the diafram is caused to vibrate by the current in the condenser, it varies the distance between the electrodes, consequently varying the resistance of the chemical and accords a corresponding current. A 5-ohm ‘phone is used in connection with this amplifier, so it is evident that a large current is used in this secondary circuit. A horn is connected so that the messages can be heard about the room without using a pair of head ‘phones. If two or more of these units are used in cascade, it is possible to such an extent of loudness that one can hardly stay in the room on account of the loudness of the signals. The “Brown” Radio and Telegraph Relay.—The electro-magnetic telephone and telegraph relay designed by Brown, of England, is widely used for telephone current intensifying, and has been successfully employed for boosting radio signals.

Its make-up will be gleaned from Fig. 2, where N S is a permanent steel magnet furnished with one magnetizing coils K, and two, 4,400-ohm coils H (same size pole-pieces, etc., as used in a telephone receiver). A light spring or reed P carries a small armature Q magnetized by the pole-pieces. Attached to the moving reed is a rod joined to a delicate microphone M, filled with polished carbon grains.

The reference to connections in radio circuits we see that terminals A are joined in place of the regular telephone. The magnet coils K are energized by current from a battery of six volts thru the primary (17 ohms) of an auto-transformer P. S. Across the transformer acts or controls the battery thru a second "tuned" reed microphone M, etc. Three microphones are commonly used. Two of these "tuned" amplifiers can receive two different musical messages simultaneously without interference, if they and the incoming waves have a tune frequency differing by 20 per cent or over, it is claimed. Such a telephone receiver is delicate and must be very carefully adjusted and supported on elastic bands or otherwise supported in a shock-proof manner by employing a rubber. The third microphone circuit may control a "loud talker" or Morse tape recorder as desired. These microphones are extremely well built to permit of the most exact adjustment. The resistance of each microphone circuit, as well as the potential applied, is made finely adjustable. The "Detectiphone" and "Detectophone" receive set give a most interesting application of the "Detectophone" or dictograph, in the form of an amplifier for feeble or weak electric currents, as Fig. 4 there is outlined a system which has been tried out and which, when carefully and properly made, will yield good results.

Considering first the regular radio receiving instruments, with aerial A, ground G, loose coupler L (or tuning coil), we see that the regular sensitive and "tuned" receiver R 1, is mounted close up to a "Detectiphone" transmitter. An ordinary detector, finely adjusted, is connected at D, while C is the usual blocking condenser. The detector may be a crystal type or a Radium, which requires no adjustment. This circuit, shown schematically at Fig. 4, is for a 2-stage amplifier, but a 3rd "Detectophone" set gives better results of course. The batteries A and B are the regular ones supplied with the instruments, or they be ordinary 4½ volt flash-light batteries. At T 1 is the first transmitter of a "Detectophone" and its receiver at R 2, T 2 is the second transmitter and its receiver R 3. The only high resistance wireless type receiver is that indicated at R 1. This should be a "phone" and have at least 1,000 ohms resistance, and better, yet 2,000 to 2,000 ohms; so as to be as sensitive to the rectified detector currents as possible. This is a demonstration of the fundamental principle that if a faint sound, such as a radiotelegraphic signal, be reproduced close to the ultra-sensitive transmitter of the "Detectophone," then that faint sound will cause the diafram of the transmitter to vibrate, and thus cause variations in its resistance; which in turn are manifested in the receiver of the first "Detectophone." These signals actuate the second "phone," and this in turn controls the third, and the "Detectophone" receiver R 3, is well to place a 10-ohm adjustable rheostat in series with each amplifying circuit, to enable the battery current to be regulated to any desired strength. This device may be applied in any case to these "Detectophone" circuits.

Several different arrangements and modifications of the apparatus may be made, and thus the experimenter and student is left a good chance for research work along these lines. Stopocks or tuned transformers are probably the most successful, as they may be employed, as well as telephone induction coils, etc.

In making up such an amplifying set, care should be exercised to ensure that the receivers and transmitters very close to each other, each unit mounted in a sound-proof, air-tight wooden box, packed with felt, or other sound-deadening material. This may be done by carefully removing the front threaded.
THE HOW AND WHY OF RADIO APPARATUS—RADIO AMPLIFIERS

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"Multi-Audi-Phone" Amplifier

The Brown Relay

"Telefunken" tuned Reed Relay

"Detectophone" Amplifier

The Helmholtz' Acoustic Resonance Amplifier

Compressed air Amplifier

Lowestem Magnetic Relay — 1 micro amp sensitivity

The Selenium Relay

"Lieben-Riez" Gas Relay

The 'Pilotron' Vacuum Tube Amplifier

(Authorization See Opposite Page)
The Oscillograph—How It Works
By PROF. LINDLEY PYLE, Professor of Physics, Washington University

The oscillograph is one of the simplest yet one of the most marvelous of our electrical instruments,—simple because it consists of a single loop of wire hanging in the air-gap of an electromagnet, and marvelous in that it takes a moving picture of the behavior of an electrical current showing variations occurring in a time interval of one-thousandth of a second or less.

The principle of the oscillograph is made clear by reference to figures 1 and 2. Figure 1 shows an incandescent lamp burning on a 110 volt, 60 cycle A. C. circuit. The carbon filament in this lamp takes the form of a long single loop (hair-pin type). The tip of the lamp is toward the observer and the incandescent filament is clearly observable, along with some bright reflections in the glass globe. The horse-shoe magnet in the illustration is drawn away so that it has no appreciable influence. Now note in Fig. 2 the behavior of the loop filament when the magnet is brought close:—the filament is thrown into a violent twisting vibration. When one leg of the loop moves toward the magnet the other leg moves away, and when the first mentioned leg starts back the second starts forward. It is only necessary to recall that a current-carrying conductor extending across the lines of force of a magnetic field is urged sideways by a force PROPORTIONAL TO the strength of the traversing current. In the case of a loop the current at any instant is in opposite directions in the two legs; the two forces are therefore opposite and the filament is twisted. If the current is reversed the electromagnetic forces change direction and the loop is twisted the other way. The amount of twist depends upon the strength of current in the loop. Since the lamp in the illustration carries a current alternating in direction at the rate of 60 complete to-and-fro oscillations per second, the lamp filament is thereby forced to make 60 to-and-fro twists per second, or 120 single vibrations per second. Now this motion is too rapid for the eye to follow and the incandescent filament spreads out into an apparent ribbon of light as illustrated. So much for the illustration of the principle.

Fig. 1, and 2—Showing the Effect Produced by Bringing a Steel Magnet Close to a Carbon Filament Lamp Operated by 60 Cycle A. C. Magnet Away—Filament Still; Magnet Close—Filament Twisted Back and Forth 60 Times Per Second. This is the Fundamental Principle of the Oscillograph.

Fig. 3. Remarkable Oscillogram Taken by the Author. The Large Curve Shows 1 Cycle of a 60 Cycle A. C. The Small Ripples Show the Record Made by a “Howler”—a Microphone Held in Front of a Receiver—the Ripple Frequency Being 1380 Oscillations Per Second.

Now what is the mirror trying to tell us? Imagine the whole apparatus to be in a darkened room and allow a beam of light from the sun or an arc light to enter the room thru a small hole and to fall upon the moving mirror. The reflected beam of light will sway to and fro in accordance with the movement of the mirror. Take an unexposed photographic plate, hold its face toward the mirror, and chop it down across the reflected beam. Develop and fix the plate and a wavy line will be shown on the plate representing the displacement of the mirror at every instant. This method of registration is easy to understand if one takes a pencil and draws on a sheet of paper a line parallel to the top edge of the sheet. Now while running the pencil to and fro across this line, take hold of the top of the sheet and pull it out from under the moving pencil. The result is a wavy line drawn on the sheet of paper. If the (Continued on page 488)
A Thermostatic Time Switch

By ALBERT H. BEILER

I'll admit right at the start that this thermostatic time switch might better be placed in the E. E. category of "phony patents." If you ask me what real use it has, I can't tell you, but if you are the sort of "bug" who occasionally wants something novel—the commercial use of a thermostat. Also if you try to arrange to cool it, then when R contracts what is to keep the circuit from being opened at C?

Our problem, then, is this: Let a circuit be closed at C after a minute or so by the expansion of R, but as soon as this is done let the heating coil circuit become opened.

When you close the circuit containing this "Thermostatic Time Switch," the lamps connected in it flash up about two minutes later—why? Read the article. It explains just how to make this mystic apparatus.

Further, when R contracts on cooling let it have no effect on the continuity of the lamp circuit.

To accomplish this we will use our old friend the stick relay which the writer described in his article on "Burglar Alarms" in the July, 1917, issue of the Electrical Experimenter. Fig. 3 illustrates the circuit, and the mode of operation is as follows:

M is an electromagnet, one end of whose coil is attached to the core R. is the rod with the heating coil wound on it, W is a water rheostat to regulate the current of the heating coil. T is the time switch, S the main switch and L the lamps. C is the thermostat contact and C' is a rear contact for magnet M.

When S is closed but T open all circuits are open. When T is closed current travels from the + main thru switch S, armature A, contact C', heating coil, rheostat, switch T and back to the negative main. Soon the coil heats up enough so that R touches C.

This off cycle is just what is desired on a sign in order to attract attention. But suppose it were required to light lamps L by the thermostat and keep it lit permanently? That is quite another problem. At first thought it seems that an arrangement as seen in Fig. 2 will solve the difficulty. Here when the switch is closed the coil heats up and after a while R touches C and the lamp lights. Very fine, but meanwhile what about our friend the heating coil? If it is kept on for any length of time it will soon burn itself out and no more
A Water-Jet Blast Apparatus
By Professor HERBERT E. METCALF

O NE of the handiest articles around the laboratory is a blast lamp. Usually it is not extensively used because of the fact that most laboratories are not fortunate enough to be equipped with compressed air, and are obliged to make use of a foot blower to obtain the necessary air pressure. The foot blower has a number of disadvantages, such as giving an unsteady pressure, awkwardness in handling, and deterioration of the rubber back. Also its first cost is considerable. The water-jet blast apparatus to be described costs only a fraction as much as a foot blower, will deliver a steady stream of air, and can be made in a very short time with a little knowledge of glass blowing.

In general the water-jet blast apparatus consists of two injectors, a baffle plate, and a large collecting tube. The injectors are the essentials of the outfit, and, upon their efficiency depends the amount of air finally obtained. A piece of heavy walled glass tubing, about 12 inches long is drawn out in the flame making a constriction about one inch and a half from one end. This constriction should be made so that its walls are as thick or thicker than the original wall of the tube, as otherwise they will break in handling. This is done by thickening the glass tube at the point of the constriction by heating it and pinching it together, heating and drawing out very slowly. The lumen of the constricted portion should be straight and about 2 - 3 millimeters in diameter.

Next plug one end with a cork. Center a very fine flame on the short part of the tube just above the constriction until that portion of the wall is white hot and bending in under the flame. Then blow gently into the open end. A bubble will blow out from the heated portion which may be chipped off. Thus a hole is formed in the air inlet. Another tube is now made exactly like the first.

A piece of tubing which will fit inside the injector tube loosely, should be drawn out into a constriction so that the final lumen of this smaller tube will be slightly smaller than the diameter in the flange of the injector tube. This, if cut in the middle of the constriction, will furnish jets for both injector tubes.

The two tubes are then sealed firmly in the short end of the injector tubes by means of sealing wax. The point of the jet should be as near the construction as possible, leaving only enough distance to allow sufficient air to be carried by the end of the jet.

The large collecting tube should be as long as possible and may be made out of tubing, a bottle or a broken graduate. If a bottle is used the bottom may be cut out by winding a wire around it, saturating the string with alcohol, burning and plunging into cold water. The two large rubber cocks which are used in each end, should be of a size to fit very tightly when forced into the tube. The upper cock is perforated with three holes, two for the injectors, and one for the air outlet tube. The lower cock should have a large hole for the water outlet. This outlet tube should be large enough to allow all of the water to escape. In the apparatus as made, the lower tube consisted of a cut-off test tube.

The two injectors are now put thru their holes and adjusted in their final positions. A large cork will do for the baffle plate. This is to break the force of the water, and to allow the air bubbles to rise in the collecting tube. This cork should have two holes bored partway thru to receive the ends of the injectors, and then a series of small holes around the outside so as to allow the water and air to come out at right angles to the injectors.

The air delivery tube is then put in the top rubber cork, the baffle plate cork adjusted and put on, and the top cork prest firmly into place. The bottom cork with its outlet tube in place is then forced in also. In order that both jets function, a double delivery tube is made from the air delivery connection made with the faucet with heavy-walled pressure tubing. All joints should be wired because of the high pressure caused by the small size of the jets.

On the water delivery tube, and on the air delivery tube, there should be placed adjustable pinch-cocks over rubber tubing. These are very important because without their proper regulation the apparatus will not function. Turn on the water full force. If water rises rapidly and threatens to come out the air delivery tube, the air pinch-cock must be tightened. The back pressure will cause the water to go down. If too much air escapes out (Continued on page 504)

TESTING THREE-PHASE MOTORS FOR CONNECTIONS
By HERBERT J. MALONEY, Engineer.
(Australia.)

Many times electricians working among alternating current machinery are called upon to ascertain whether a three-phase motor is star or mesh connected. Little difficulty is experienced when the motor is of open type, where the wires can be easily traced, but the difficulty arises when they are confronted with a totally enclosed motor with only three connections leads projecting. The method here described is a simple way of tackling the situation by means of a megger and bridge. Wheatstone bridge or volt and ammeters. Between the stator leads is taken; after that is obtained bridge two of the leads and measure the resistance between the two bridged leads. The resulting resistance is half of that obtained by the first reading, it is a mesh connected motor, but if it is more than half or near the result obtained in the first reading, the motor is star connected.

The author used for tests for this article two Siemens 3 H.P. induction motors, one mesh and the other star connected. Fig. 2 shows the motor of star connection with two of the leads bridged. Fig. 3 is Fig. 2 in simpler form; as seen, we have phases A and B in parallel and C in series with them, with a resulting resistance of 1.27 ohms, according to the motor used, which is more than half of 1.72 (see Fig. 1) the resistance before the bridge was placed proving that it is a star connected motor. Fig. 6 shows the mesh wiring with two leads bridged. Fig. 7 is Fig. 6 simplified—phase A is shorted or bridged with phases B and C in parallel. The resistance of which is equal to .44 ohms, which is half of 88 ohms, the resistance minus the bridge. Fig. 5 proves that the motor is of mesh connection. Fig. 4 and Fig. 8 show star and mesh motors respectively, with two leads bridged with volt and ammeters, using Ohm's laws to find resistance (R equals —) and either D. C. or A. C. can be used. A study of the diagrams shows the simplicity of the method.
Experimental Mechanics

By SAMUEL D. COHEN

LESSON VII.

LATHE CHUCKS

The next exercise of importance which the novice should try, is to locate the cutting of shoulders on a piece of work. One way is to mark the actual position and then proceed to cut down the material to the mark and to the required diameter as indicated in A, Fig. 1. To accomplish the same result with better accuracy and speed, the use of the cutting-off tool is employed as indicated at B of the same figure, which shows a typical job with proper dimensions to be turned out on the lathe.

To proceed with the job it is first necessary to obtain a piece-of material one inch in diameter and eleven inches long. Square up both ends by placing the material in the live chuck and using a side cutting tool. Drill a counter-sink hole on the square faces and set stock between live and dead centers, securing material to live center with a lathe dog. Adjust the tail stock center so that the shaft plays slightly on the centers. Fasten the tail stock spindle by binding clamp, and keep dead center well oiled. Mark cutting position on work, starting from dead center towards live center. The cutting-off tool is started about 1/32 of an inch from the finishing line of the shoulder, and kept in position until the required diameter is reached, plus 1/32 of an inch more so as to allow for clean finishing. In this case it will be necessary at first to set the outside measuring calipers to read 17/32 inch. Then with the aid of a diamond-point tool, the remaining stock is cut off. To finish the face of the shoulder, use a side cutting tool. The final step is to measure nine inches from the dead center and set the tool to cut off the stock to its proper length, in this particular case nine inches.

Altho this job seems to be quite simple at first glance, yet ninety-five per cent of the beginners will find it difficult to produce the work with the required dimensions. A great deal can be learned from this job. First and foremost is the use of the cutting-tool, which gives most trouble to the novice; and secondly, accuracy in laying out work to rigid specifications.

While preparing this lesson the writer thought it well to omit giving exercises at this early period and consider that further details on the use of the lathe and other tools should supersede everything else. This was found to be essential in that it is important to know practically everything about tools and their use before it is possible to proceed with building a machined article or work-

Owing to lack of space and the great number of new feature articles we have had to postpone publishing the following articles this month: "Spectroscopy, Methods and Spectra"—Part II—by D. S. Binnigton. "The Secret of the Magnet Poles," by Walter E. Kettering. "A Practical Electrical Photo Printer," by Dr. E. Bade. But these, as well as a host of other "brand-new" features, will all be in the DECEMBER number.

In order that various shapes of work may be held on the lathe, special tools called "chucks" are used. There are many different forms of chucks on the market, depending upon their use. The chuck is one of the handiest tools that can be attached to the lathe, increasing its usefulness many times.

One of the commonest and most used chucks is the so-called self-centering chuck, which is shown in photograph, Fig. 2. This particular chuck has three jaws. However, there are chucks equipped with four jaws. The jaws are usually opened and closed simultaneously by turning the handle which is attached to a screw, the screw being geared to a worm connecting all of the jaws. As each jaw moves thru exactly the same distance toward or away from the center, it is obvious that a drill or any piece of work placed in the jaws will be held directly in the center. For holding twist drills, metal rods, bolts and small castings, these chucks are particularly useful and great time savers. Another type of chuck is shown in Fig. 3. This is called an independent chuck, and each jaw is moved in or out by its own screw, which works independently of the other jaws. In this device the work is chucked by moving the step (knurled) jaws in or out by the screws with which they are controlled, the jaws sliding in the block grooves. The jaw blocks are bolted against the face plate of the lathe, as shown in the figure. A single jaw is shown in Fig. 4. These jaws are adaptable for face plates, also for a great variety of work, and are rapidly taking the place of the larger sized chucks for several reasons. They are better adapted for use, being easily attached to the machine, and may be connected to or taken off the plate by one man alone without the use of tackle.

These jaws are reversible, facing them in or out. The sliding jaw may be quickly run out and turned end for end, also the blocks may be reversed if necessary. The last, but not least, item is their cost, and in this case they are much cheaper than other jaws, as they can be secured to the face plate furnished with the lathe. The independent chuck is very handy, especially in working with irregular shaped articles, and is used for jobs which the self-centering chuck cannot accomplish.

(Continued on page 488)
THE HALOGENS.

BROMIN, FLUORIN, AND IODIN

BROMIN: History.

This element was discovered in 1826 by Balard, who obtained and isolated it from the bitter or mother liquor of common salt. It was the last non-metal discovered previous to fluorin and argon.

Occurrence.

It occurs chiefly as magnesium bromid in sea water, and as the magnesium, calcium, and sodium salt in many rock-salt deposits and salt wells. It never occurs in the uncombined state in Nature. Large quantities of this element are produced at Stassfurt, and a considerable quantity is manufactured from the residues after the preparation of iodin from kelp, but the larger portion of our supply is derived from "bittern," the mother liquor of the salt industry. Bromides and chlorides of sodium, potassium, calcium and magnesium are contained in the natural salt brine.

Preparation.

1. For preparation in the laboratory, it is liberated from its most common compound, potassium bromid, by the action of man- ganese dioxid and sulfuric acid, analogous to the preparation of chlorin from sodium chlorid.

2. Br + MnO₂ + 2H₂SO₄ = K₂SO₄ + MnSO₄ + 2H₂O + 2 Br

Uses.—In the free state it is employed in the manufacture of bromides and of many bromin derivatives of the coal-tar compounds. It is also used somewhat in the manufacture of anilin colors. Potassium bromid is employed in medicine, and in the basis of other bromin compounds. Silver bromid is employed extensively in photography, especially for the negative.

FLUORIN: History.

The art of etching glass by means of a mixture of flor spar and sulfuric acid was known as far back as 1670. Many attempts have been made in recent years to isolate this element. In 1886, Moissan, by passing a current of 50 volts and 15 amperes through anhydrous hydro-fluoric acid, cooled to —23 degs., and contained in a U-shaped platinum tube, succeeded in obtaining the free element fluorin, as a colorless gas which has since been obtained in solid liquid form. Fluorin was liquefied by Moissan and Dewar, by utilizing liquid air as a refrigerant, at the temperature of —187 degrees.

Occurrence.

It occurs chiefly as calcium fluoride—Florspar—CaF₂, which is widely distributed over the globe, and as sodium and aluminum fluoride—Cryolite—(Na₃AlF₆) which is found in deposits in Greenland. It has been found in small quantity in sea water, in many mineral waters, in the bones and teeth of man, and in milk.

Properties.

1. It is a thin, volatile, deep red liquid.
2. It possesses a very pungent, stifling odor as a gas.
3. Its specific gravity is 2.99 at 15 degrees.
4. It is intensely poisonous, attacking the membranes, especially the eyes. It burns into the flesh and makes sores difficult to heal.
5. It is soluble in 28 parts of water. Its water solution being commercially known as Bromin Water. It is more soluble in carbon disulfid, alcohol or ether.
6. It freezes at —7 degrees, but rapidly evaporates at all temperatures above that.
7. At 1200 degrees the bromin molecule splits into its atoms. This makes one atom per molecule.

CHEMICAL. 1. Its chemical properties are very much like those of chlorin.
2. It has great affinity for hydrogen, and for metals, with which it forms bromides.
3. When dissolved in water it gradually combines with hydrogen and frees oxygen.
4. Antimony powder burns in bromin as in chlorin.
5. Bromin will not unite with oxygen, and no oxid of bromin is known.

IODIN: History.

In 1811 or 1812, Courtois, a soap-boiler of Paris, observed a peculiar corrosion of his copper kettle during the evaporation of kelp liquor, after crystallizing the sodium carbonat from it. Subsequently he obtained (Continued on page 491)
This department will award the following monthly prizes: First Prize, $3.00; Second Prize, $2.00; Third Prize, $1.00.

The purpose of this department is to stimulate experimenters towards accomplishing new things with old apparatus or old material, and for the most useful, practical and original idea submitted to the Editors of this department, a monthly series of prizes will be awarded. For the best idea submitted a price of $3.00 is awarded; for the second best idea a $2.00 prize, and for the third best prize of $1.00. The article need not be very elaborate, and rough sketches are sufficient. We will make the mechanical drawings. Use only one side of sheet.

FIRST PRIZE, $3.00

AN ELECTRIC POULTRY WATERER.
When the family is gone for a long while an electric waterer will come in very handy. A lump of ice may be added in the summer time to keep the water cool. C, is a waterproof box made by putting on about two coats of waterproof varnish. B, is a board 1 inch wide. This is nailed at the sides of the box so that it will extend across the box. The box can be of any width and height.

An electro-magnet is screwed to the bottom of the board B. On the top of this door is soldered a clamp attached to the solenoid. The water pressure will hold the door tight against the hole in the box to prevent leakage. The pan G should be right under the door L.

A piece of heavy wire 7, should be sharpened at one end and stuck into a cork. The rod F, is put in the pan G, with the cork at the bottom. At the other end is fastened a piece of brass an inch long.

A piece of brass D, is mounted as shown so the bottom will be as far below the contact on the rod F, as the pan is deep. The wiring is shown clearly. The pan G, is filled with water; so is the box C. As the water is drunk by the poultry the float F, goes down with the water. Finally when the pan is empty the contact on the rod F touches the fixt contact D—this closes the circuit and the solenoid draws the door L, up, the water in the box C rushes out of the hole in the side of the box which was closed by tin door L and starts to fill pan G. The float F goes up and the contact on the upper end breaks the circuit; the door drops down and the water stops flowing.

One battery is sufficient to run this waterer for a long time.

Contributed by WILBUR BRITTON.

PHENOLPHTHALEIN POLARITY INDICATOR.
The accompanying illustration shows a very simple and accurate way to make a polarity indicator. Altho there have been many articles on a simple way to make polarity indicators many of them have failed, because they did not prove accurate when a small current was past thru it.

For this indicator, make a 25% solution of phenolphthalein, which can be bought at any drug store or chemical supply house. Then take a carbon filament bulb and file the tip off; pass a wire into the bulb and break the filament as in illustration, and fill the bulb about full of phenolphthalein solution, and seal the tip of the bulb with sealing wax. By passing a current thru the indicator, the wire leading to the positive filament, will give off red bubbles, while the negative filament will give off white bubbles. After the current is shut off shake bulb so

...to the positive filament, will give off red bubbles, while the negative filament will give off white bubbles. After the current is shut off shake bulb so

as to make the coloration about the positive filament disappear. It is then ready to be

SECOND PRIZE, $2.00

USE A "MAGNETIC" TACK HAMMER.
1 ? & 1 ?? that "blankety-blank" hammer! That's the third time!
For the benefit of the reader I will say that the above is not a new form of writ-

ing or sign language, but merely a pleasant way any man has of expressing his candid opinion of the common indoor sport of lay-

ing carpets. For some reason or other, when one tries to indulge in this pastime the hammer has a cute and exasperating prac-
tise of colliding with the thumb or fore-
finger, and the result is far from agreeable.

But here's a little idea that will not make triviality of his ears in horror and bid him better half to "remember that the chil-
dren are around." As intimated by the title, it consists merely in having the hammer head magnetic, which may be done by bring-
ing it in contact with a permanent or elec-
to-magnet, in the usual method of magnet-
ing. The tack will then be held in the prop-
er position, as shown by the sketch, withou-

t the necessity of using either the thumb or forefinger, as heretofore.

Contributed by JOHN T. DWYER.

HOME-MADE POLISHING HEAD.
The sketch above shows a practical "Polishing Head" made of ordinary pipe and pipe fittings. First secure from a plumber the following pipe and fittings:— 3 tees, 2 male-female elbows, 2 nipples 1 inch long, 1 flange and one piece of pipe 5 inches long.

Fit them together according to the accom-
panying diagram, and thread a shaft of the right size 2 inches on each end. A pulley, either flat or grooved is fastened in the middle of the shaft by a set screw. This can be used as a polishing head or a grindstone.

Contributed by L. H. DECKER, JR.

THIRD PRIZE, $1.00

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On November 1st the subscrip-
tion price of the "Electrical Experi-
ter" advances to $2.00 in U. S. (Canada and Foreign, $2.50). This is the last chance to subscribe at the old rates ($1.50 in U. S., Canada and Foreign, $2.00).

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L. L. COOKE, Chief Engineer.
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ELECTRICAL OPERATED TOY STEAM ENGINE.

The accompanying sketch shows how to operate a model steam engine by electricity.

PROCURE a firm rubber plug the size of the water hole in the boiler. Bore two small holes thru it, then force two pieces of copper wire thru the holes—No. 20 B. & S. will do. Fill the boiler about half full of water, then insert the plug in the water hole so that the ends of the wires will be about one-half inch in the water. Have the wires as close together as possible without letting them touch.

Connect the protruding ends of the copper wires to a transformer that gives 25-30 volts, switch on the current and the engine will run as good as if a spirit lamp was used to heat it. The resistance of the water between the two wires will, of course, cause the water to boil and therefore generate steam.

By using this method and starting with cold water I have had steam up and the engine running in two minutes.

Contributed by A. E. WOODHOUSE.

A "PUSH-BUTTON" LAMP SOCKET.

Secure an ordinary wooden push-button and remove the button, inside contacts, etc. Enlarge the hole in the front so as to admit the socket part (base) of the lamp and fasten it in place with a little sealing wax.

Next pass the wires thru the base of the push-button and screw it to wall. Solder the wires to the base of the lamp, and fasten the two parts together by screwing on to the base.

Contributed by HORACE C. LEEDS.

ELECTRIC DOOR ALARM.

This device can be made of material found in every amateur's junk box. The materials needed are: 2 switch jaws (one drilled), 2 binding posts, and a right-angle triangle of any material. Size is left to the maker. This door alarm will ring if the door is moved, even if only one inch, and won't stop its noise until the proper concealed switch is thrown off.

Contributed by H. PIERRIS.

EXPERIMENTAL ARC LAMP FROM SPARK GAN.

Wishing to pass on a little idea to fellow experimenters I respectfully submit the following:

Any one possessing a spark gap such as in Fig. 1 can make a good experimental essentially of an ebonite rod A which, while being pushed down by means of the button B, is rubbed against cloth placed at E, in a frame of polystyrene disks. During the subsequent rotation the charge thus produced is collected on the brass tube D, insulated by the ebonite collar E. This tube remains, on the other hand, in permanent connection with the piece FF, consisting of two coaxial cylinders and moved together with A. When the rod is at the end of its path a small finger G lightly touches the support of the leaf to be charged. By repressing the pressure on B the spring H brings the rod to its original position, simultaneously connecting F with the brass disk I, and consequently with the electroscope case. The discharge being done consistent with the capacity of the leaf support, things are easily adjusted so as to produce a convenient deflection of the leaf with a single push of the button. A good plan is to overcharge the leaf a little and to keep the button down until the system has discharged itself to the desired point.

HANDY QUICK THROW SWITCH.

Here is a switch of novel design allowing quick changes and at the same time is well constructed, besides being very easy to insulate. As will be noticed it works on the UP and DOWN-ward movement, the blade revolving near the handle on a shaft secured to two wooden or other posts. Two blades or even three could be used.

Contributed by E. T. J.
A PRACTICAL HYDROGEN SULFID GENERATOR FOR THE CHEMIST.

BY K. BURNETT

Hydrogen Sulfid is an absolute necessity in every laboratory where analysis is carried out, but, as this gas is quite poisonous and, furthermore, possesses a characteristic, disagreeable odor, it is essential that it be generated at the time of using.

Below is described a simple generator of my own design, which, from my experience, has proved a complete success. As will be seen, the action is essentially the same as in the well-known "Kipp", but, as the construction of this differs somewhat from my own design, I have found it necessary to add certain additional parts.

The materials needed are:
1. Wide mouth glass bottle G.
2. Gas cylinder.
3. Tube (6" x 1" diameter) made from narrow bottle.
4. Atomizer bulb.
5. Glass tapers, or pinch cocks.
6. Rubber corks to fit tube, cylinder and bottle.
7. Thin one-holed cork (to hold FeS in tube).

Rubber connections and glass tubing.

Chemicals:—Ferrous sulfid.
Hydrochloric acid.

The essential working of the generator is as follows:

When tap A is turned (see figure) the acid rises in tube B, coming in contact with the ferrous sulfid, thus generating hydrogen sulfid gas, which, passing thru the wash bottle C is purified and escapes at D.

Use of the Bulb.—The pressure in tube B required to overcome the counter pressure exerted by the water in the wash bottle is often strong enough to force down the acid in tube B, and thus from further contact with the ferrous sulfid. The result is "no gas". Upon squeezing the bulb, however, the pressure is overcome and the acid rises in tube B, thus forcing out the gas. I have proved this in practise. It is essential that a bulb having an air inlet is employed, otherwise it is useless.

Use of the Pinch Cock F.—In order that the acid may rise in tube B it is necessary to open the pinch cock F to admit air. This is also necessary, when shutting off the generator, in order to expel air, but it should be kept closed when the acid has reached "low level", to prevent rise in case of leakage or lessening of pressure, due to the hydrogen sulfid dissolving in the acid.

Any amateur chemist may set up this apparatus without much expense and I am confident, that, if constructed upon this plan, it will give no trouble and the result is an odorless and convenient generator which makes a fine looking piece of apparatus for any laboratory.

HOME-MADE DISTILLING APPARATUS.

The accompanying sketch illustrates a home-made Distilling Apparatus. The condenser is made from a student lamp chimney. Insert a cork at both ends and bore them for glass tubing. Tube A should extend straight thru the condenser; tube D should extend about an inch below the cork. I found that if tube D is cut off about four inches below the bend and a long piece of rubber tubing used instead of a long glass one it would cost less and be more serviceable. Tube C should extend about 1 inch above the bottom cork. The condenser is held in place by a piece of wood, shaped as in Fig. 2, fastened on a shelf above the bench.

The boiler K is an empty coffee can. A hole is cut in the cover and the neck of an empty maple syrup can is soldered over it. The cover is then soldered on the can so that the steam cannot escape. Three pieces of tin are next soldered on to form a support.

Another can L is fitted with a small faucet which can be obtained off an old gas jet. This can is supported on legs like the boiler. Care should be taken that the bottom of the can L is on a level or higher than the top of the condenser.

When the water boils in can K, the steam passes thru tube A. The faucet on can L is turned on; cold water flows thru tube C and circulates thru the condenser and flows out thru tube D into a sink or a large pan. The distillate is caught at E.

If, when the water is turned on, the lower cork leaks some melted paraffin should be poured slowly into the tube and allowed to harden. This may be done on both sides of the lower cork.

If anything besides water is to be distilled a glass flask must be used instead of can K.

Contributed by FREDERICK REYNOLDS.
"Amateur Electrical Laboratory" Contest
THIS MONTH'S $3.00 PRIZE WINNER—ELLIOTT C. WOODFORD

I PRESENT herewith three pictures of the chemical laboratory that Eugene Cortright and myself are using at the present time. One of the photos (top center) shows the chemical cabinet containing over two hundred and fifty chemicals, all labeled and arranged in alphabetical order. This photo shows Eugene Cortright standing at the left of the cabinet, and yours truly at the right. Another photo, figure 1, shows the shelves of chemical apparatus, including burettes, crucibles, evaporating dishes, Florence flasks, Erlenmeyer flasks, funnels, graduates, mortars and pestles, retorts, wash bottles, condensers, hydrometers, beakers, U-tubes, and chemical thermometers. To the right of these shelves is the medicine cabinet, and below the medicine cabinet is a soapstone sink with hot and cold water. Another table contains a ring stand, gas tap, Bunsen burner, rack of test tubes, gas mask, and electric tap. Also a compound microscope. One of the tables contains a chemical balance, a ½ K.W. transformer, condenser, and spark gap (part of the wireless station that we had at one time, but which is dismantled now), and which material we intend to use in building an X-ray apparatus. Our stock cabinet contains extra test tubes of different sizes, pipettes, glass tubing, rubber tubing, electrical supplies such as switches, fuses, bulbs, sockets, and adapters, ad lib, ad infinitum.

ELLIOTT C. WOODFORD, Owego, N. Y.

HONORABLE MENTION—MILFORD H. COHEN

ABOUT four years ago, being interested in Electricity, I started a small experimental shop, which I have by the dint of hard work built up to quite an efficient electrical and chemical laboratory. I have an arc light which throws a beam from a mile to a mile and a half. I have constructed many, but this has been my most successful one. A choke coil is used for its resistance which has proven very satisfactory. When battery current is necessary I have a one-eighth horse-power motor, which drives a small fifteen-volt D. C. generator, and this supplies ample current. I also have an old-style graphophone, which plays the cylinder style records; with this graphophone I secured a recorder, and a few blank Dictaphone records. This outfit is excellent in receiving wireless messages coming at a fast rate of speed, for as soon as the message is completed, the reproducer may be changed, instead of the recorder, and in this manner the message may be repeated at a slow rate of speed. This was before the wireless stations were dismantled by our Government, of course. On the side wall of one of the photos (lower group) you will see a very efficient electric furnace, from which a very high degree of heat may be obtained. I am now engaged in making an auto, which is to be driven by a Smith Motor Wheel. My shop is very handy in many other ways, as it allows me to construct various models described in The Electrical Experimenter. In my chemical laboratory I am also doing some very interesting experiments.

MILFORD H. COHEN, Charleston, W. Va.
Under this heading are published electrical or mechanical ideas which our clever inventors, for reasons best known to themselves, have as yet not patented. We furthermore call attention to our celebrated Phoney Patent Office for the relief of all suffering daft inventors in this country as well as for the entire universe.

We are revolutionizing the Patent business and OFFER YOU THREE DOLLARS ($3.00) FOR THE BEST PATENT. If you take your Phoney Patent to Washington, they charge you $20.00 for the initial fee and then you haven't a smell of a Patent yet. After they have allowed the Patent, you must pay another $30.00 as a final fee. That's $40.00! We PAY YOU $3.00 and grant you a Phoney Patent in the bargain, so you save $43,001! When sending in your Phoney Patent application, be sure that it is as daffy as a lovesick bat. The daffier, the better. Simple sketches and short descriptions will help our staff of Phoney Patent Examiners to issue a Phoney Patent on your invention in a jiffy.

Prize Winner: THE MOTORMAT BURGLAR EJECTOR. Herewith witness my idea for an electric motormat burglar ejector, guaranteed to work without a hitch in 101 per cent of all cases. Mr. Burglar approaches the stoop and on his first attempt depresses the electric alarm bell button indicated in the S.E. corner of the map. You've got me, Steve! The knight of the black-jack hits the button—the bell rings—the householder (he, she, or it) arises and sneaks up to the front door—beholds intruder on motormat and does his duty by throwing the motor switch. The result is illustrated at the right. I said it was 101 per cent efficient—the extra 1 per cent is the time it 'gets' you, when wife sees you first as you rise up the front stoop about 3 Q. M. in the morning after the night before. Take a tip, Brother Yelps, wear a shock absorber—you know where! Inventor, Wm. A. Fritsch, Brooklyn, N. Y.

Theater-Chair Power-Plant. Did you ever stop to think just how many million horsepower of free energy are dissipated every single night by the thousands of theater-goers in such a large city as New York, when they sit down and get up? It amounts to something like 49,580,666 3/4 H. P. per evening for New York City alone, according to my figures. So, hence and thus, I collected my brains together and eventually devised the astonishingly simple chair pump and dynamo plant here shown. Each chair is connected by a lever with a water pump under the floor. The pump sucks water up from the tank below the water-wheel, forces it out thru another pipe back to the supply tank above the water-wheel, etc. The same water is thus used over and over again. The water-wheel drives the dynamo, which charges a storage battery. Thus the electricity required for lighting up the theater, "movie" machine, etc., is all provided by the unsuspecting audience. The manager gets his money's worth and the Public is pleased!! Inventor, Paul Austin, Phoenixville, Pa.
The "Oracle" is for the sole benefit of all electrical experimenters. Questions will be answered here for the benefit of all, but only matter of sufficient interest will be publish. Rules under which questions will be answered:
1. Only three questions can be submitted to be answered.
2. Only one side of sheets to be written on; matter must be typewritten or else written in ink, no penciled matter considered.
3. Sketches, diagrams, etc., must be on separate sheets. Questions addres to this department cannot be answered by mail free of charge.
4. If a quick answer is desired by mail, a nominal charge of 25 cents is made for each question. If the questions entail considerable research work or intricate calculations a special rate will be charged. Correspondents will be informed as to the fee before such questions are answered.

MAKING SOLENOID MOVE ALONG IRON BAR.

(969) W. Doherty, New York, N. Y., sends us a proposed scheme for creating axial movement of a solenoid along an iron bar and wishes our advice on it.

A. 1. To our best knowledge, there is no practical way of getting motion on traveling of the solenoid along a straight iron bar in the way you show in your diagram,

![Diagram of solenoid moving along iron bar]

(see sketch "A"), but it is possible to accomplish this by simply having the iron bar slightly tapered (sketch "B") and you will find a very long treatise on this very subject given in U. S. Patent No. 1,248,273, copy of which we can supply at 10 cents. The Electrical Experimenter for February, 1918, page 90, contains a brief digest on this interesting patent.

CAN HIGH VOLTAGE ALONE KILL?

(960) W. A. J., New York, asks:
Q. 1. We ask you to kindly answer the following question, in order to settle a dispute between two friends:

A says that a wire charged with 75,000 volts of electricity, without a fraction of an ammeter in it, would kill a person touching it. B says that aloft the wire is charged with 50,000 volts and there is no ammeter in it, and that the least part of an ammeter in it, in that a person touching it would not be killed.

We have asked several persons about this matter but in view of the fact of their varied answers we have decided to let yours be the last word. We would appreciate it very much, therefore, if you would kindly inform us what the effect would be on a person touching the wire. In case it would kill him we would also like to know if the killing would be instantly, gradually, or finally.

A. 1. In the first place it is impossible to have a wire charged to 75,000 volts without a fraction of an ammeter in it. You cannot have voltage without amperage and vice versa. In order to kill a person a good many conditions are necessary. It has happened repeatedly that people who touched wires charged to 100,000 volts were not killed, while others took only a 110 volt current and were killed instantly. The point in contact with the human body makes all the difference. For instance, when the hands are wet, the effect will be much more pronounced than if the hands were dry. Also various people have various thicknesses of skin, and the thicker the skin the more it protects. Thus, workmen using pick and shovel after a while acquire a very thick skin on the inside of their hands which forms a protection against the electrical current. Therefore, you will see that just touching a highly charged wire without knowing all the other surrounding conditions itself is meaningless.

Speaking generally, it is not volts that kill, it is the amperage. High voltage by itself is not dangerous as you can take several hundred thousand volts thru the body by means of the so-called Tesla high frequency currents without feeling anything whatsoever. Take an ordinary violet ray machine—it gives a voltage usually above 50,000.

Nor is it necessary to use high frequency currents. Large spark coils which give a tremendous amount of voltage while dangerous are not often fatal to the human system unless a charge is taken into a vital part of the body. The editor has seen a man get a fairly good charge in both hands from an eight-inch spark coil giving somewhat over 300,000 volts (maximum or peak value). While it threw the man down, the effect was not fatal. He recovered in a few minutes without ill effects.

AUTOMATIC AIR PRESSURE REGULATION.

(961) M. B. Pedersen, Tooele City, Utah, writes:
Q. 1. How can I rig up an automatic air compressor regulator so that the electric motor driving the compressor will start and stop at low and high pressure.

A. 1. In the diagram a front view is shown of your air pressure gage. It will be noted that there are two adjustable arms, A and C, which can be regulated for any pressure by means of an adjustable finger, also shown in diagram. These arms, A and C, should be fitted with suitable contact points. They should be insulated from each other, and should be properly connected to external relays for starting and stopping the motor. The point of relieving pressure also have a contact point on it and a connection to an external circuit, as shown in diagram. This scheme has been used successfully for more than two years.

IN THE DECEMBER "E. E."

How ships are "are welded" instead of riveted—resulting in better ships and faster production. The latest advance in ship-building science.

Turning Air Into Bread—The Electrical Fixation of Atmospheric Nitrogen, by Robert H. Mouton.

Electrical Testing Engineers Made to Order, by C. M. Ripley, of the General Electric Co.

Flying Across the Atlantic on a 10,000 H.P. Aerial Liner, by W. Edouard Haeussler, aviator.

Carbon Lamps versus Tungsten Lamps—the A. B. C. of the economy of Tungsten filaments.

How to Use Electric Fans in the Winter, by Pauline Gsingberg.

How to Make a Seven-inch Reflecting Telescope—for astronomical observations. Details for grinding lenses, etc., by Lattimer G. Wilson.

A Practical and Useful Laboratory Switch-board, by H. Danner.

The Edison Storage Battery—Its Operation and Maintenance, by J. F. Springer.

New Wireless Ideas, Rules, Wrecks and Follies, Including Description and Drawings for a new vertical type cabinet coupler; also a Rotary Quenched Spark Gap Unit and another Burney.

Popular Astronomy—Sixth Paper "The Total Solar Eclipse of June 8, 1918", with some wonderful photos, by Isabel M. Lewis.

SPONGY PLATINUM.

(963) Sylvan D. Rolfe, Philadelphia, Pa., writes:
Q. 1. Questions on spongy platinum.
A. 1. You are right relative to the matter of spongy platinum. It will only in-
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ELECTRICAL EXPERIMENTER

THE ORACLE.
(Continued from page 486)

The patient's faith in the presence of two or more gases, which rapidly combine, and the incandescence is due to the liberation of heat thru the combination of the gases, in which case the action is accelerated due to the presence of the atomic platinum, which acts as a catalytic agent.

EXPERIMENTAL MECHANICS.
(Continued from page 477)

where it is necessary to obtain a central point, irrespective of work. A dog-chuck is one containing independent jaws. Many lathes are supplied by the makers with a four-jaw chuck of this kind.

NOVEL X-RAYS.
(Continued from page 454)

"What are these branch-like marks at the upper and lower side of the skull?"
"Evidently something 'flashed' thru my mind just then—perhaps the birth of an idea. The plate recording the flash, which is just like a flash of lightning."
"How is it that your brain does not show at all?"
"As you know the X-ray picture was taken immediately after I concocted next month's cover design. All my brains went into making that, which explains the discrepancy!"

X-RAYS IN TUBERCULOSIS.

In the finished positive photographic print, the lungs of a normal person show white—this represents air contained in the cells of the lungs. If the lung is diseased—as in pneumonia—it will show dark, i.e., the cells being occupied with matter. Tuberculosis is diagnosed by the spotted, motiled appearance of the affected lungs.

In our illustration here shows clear case of incipient tuberculosis, the arrow's point to the seat of the disease. In this print the patient's right is left, and right is left. The right lung, which is quite dark, except for some free filtration shows traces of tuberculosis as well. In this lung, beginning right under the last lower arrow, we note a semi-circular bulge: this is the lower part of the heart. Underneath the heart is the diafragm—the part dividing the chest from the abdomen.

Photo courtesy Dr. B. Fidler, N. Y. C.

THE OSCILLOGRAPH—HOW IT WORKS.
(Continued from page 474)

paper be pulled at a known rate (say one inch per second) one can study the history of the movement as recorded on the motion in time. Similarly if the photographic plate in our imagined experiment be moved at a known speed, we can then study variation from instant to instant of the current traversing the loop. If the plate be chot thru the beam when no current passes thru the loop and then, with the test current on, chot thru again and in the same place as before (using guides to make the plate follow the same path) then upon development of the plate we will have from the first operation a straight line (the so-called zero line) and from the second operation the current, and thus the variations occurring in the test current. Where the curved line crosses the straight line the current is zero and is changing direction.

Figure 3 represents a record taken by the writer with a modern type of Dudell oscillograph. The prominent wavy line shows the variations occurring in a complete cycle alternating current. Figure 3 is a print from the film negative, the film having moving at the rate of 111 inches per second. The curve takes from the smooth sine curve usually used to represent the alternating current. Just one cycle is represented. What happened in figure 2 took place in one-sixteenth of a second. Certain kinks in the curve do not last longer than 1/2500 of a second. No zero line is recorded. If it were it would be practically impossible to have the time between the upper and lower peaks of the curve. The other smaller curve or ripple of Fig. 3 represents the current fluctuations in the higher order of a sine wave which when the receiver is held against the mouth-piece of the transmitter and is thereby made to emit the familiar high-pitched note gives the device its name the—holer. Note the broad zero line recorded in this curve. This, too, is an alternating current, tho of very different shape from the 60-cycle one. Further, it has a much higher frequency. Reference to the figure shows that 23 cycles of the high frequency current take place during one cycle of the primary current. In other words this howling telephone receiver was traversed by an alternating current of 1360 oscillations per second.

THE GYRO ELECTRIC DESTROYER.
(Continued from page 465)

fact that some of my friends here in the office would like to subscribe to this fund. I am, therefore, enclosing $1.00 to be used in this great idea of you understanding this dollar is not to be credited to me, but to O. H. King, 1422 Hunt Blvd., Atlanta, Ga., that will enable him to work the Destroyer until I go to the Navy, which I am expecting to do in November." . "A. L. Terry.

"1422 Hunt Blvd., Atlanta, Ga."

"INVENTORIALS" AND A "HUMDINGER."

"I have long been a reader of the E. E. and have always maintained a state of mental equilibrium and persuading you sometimes far-fetched 'inventorials' but I must admit that the September number contained a humdinger in the developments of the Gyro-Electric Destroyer. And in some instances it is felt privileged to put up and say "Shake!" to the originators of the idea and the editor who projected it. Why not a Gyro-Electric Destroyer more practical than the first airplane seemed to us, or the first airplane to the last steamboat? So, I say, for it, write some of those advertisements. Like you do! What else? 'Humdinger!' or like your August editorial, which, by the way, was a masterpiece. Keep it up for 18 months if necessary, appeal to the American idea of patriotism, and also of taking a chance, and every man who sees it will send in his dollar. Then you have the winter to build it, and in the spring we will see, what, if any, results. Here's to the success of the Gyro-Electric Teufel-wagen," and 'hoping with a dollar bill."

"Arno A. Kluge."

"12137 St., Lincoln, Neb."

FROM "TOM" REED.

"Good luck, old top!"
"19 Congress St., Boston, Mass."

MORE DOLLARS COMING.

"I will try to interest my friends in this 'Kaiser Killer' and send you some more dollars soon."
"Milton Ward."

"GIVE THEM HELL."

"I am enclosing one dollar as my part of the subscription for the big Gyro-Electric Destroyer. I am not a subscriber to the Electrical Engineering but I purchase my copy as soon as it appears on the newsstands and have read with the greatest interest your article on the Gyro-Electric Destroyer. I am sure this is an interesting and promising idea. Surely subscribers to an "Electrical Engineering" like yourselves will be interested in the Gyro-Electric Destroyer and will with confidence enough to finance one of its experiments. I send away for the Gyro-Electric Destroyer. The Top with the best luck and give them Hell."

"Karl F. Meyers, "Littlestown, Pa."

(Continued on page 490)
U. S. AIRPLANE Mail Service  

Started May 15, 1918

marks the real beginning of commercial aviation. Uncle Sam is carrying mail every day between New York, Washington and Philadelphia and the end of the war will make possible the extension of airplane mail delivery to all parts of the country. As fast as machines can be built they will be put to work carrying freight and passengers. But the demands of commerce must wait. Every man who knows, not merely how to make one small part of an airplane, but who has studied and learned the scientific principles of design and construction is needed RIGHT NOW to help win the war.

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November, 1918

THE GYRO ELECTRIC DESTROYER.

(Continued from page 488)

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ELECTRICAL EXPERIMENTER

November, 1918

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<p>|</p>
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<th>Paragon Shorthand</th>
</tr>
</thead>
<tbody>
<tr>
<td>75</td>
</tr>
</tbody>
</table>

Take the ordinary long-hand letter A, eliminate the long stroke, and there will remain —

This is the Paragon symbol for D. If it is always written downward.

From the long-hand letter C, rob out everything except the upper part of the circle — and you will have the Paragon E.

Write this circle at the beginning of every line and you will have Ed.

By letting the circle remain open it will be A. Thus $ will be Ad. Add another A at the end thus $ and you will have a's.

From O — eliminate the usual final strokes and O will remain which is the Paragon symbol for O.

For the long-hand 75c which is made of 7 strokes, you use this one horizontal stroke —

Therefore, 75c would be Me.

Now continue the E across the M, so as to add D — thus Me and you will have Med. Now add the large circle O and you will have Med, which is meadow, with the silent A and W omitted.

The long-hand letter N which has 5 strokes, is written in Paragon with one stroke, thus — same as the letter M, but shorter.

You may send the Complete Course of PARAGON Shorthand with the directions under which it is established that I have 7 days after the receipt of the Paragon Shorthand to either remail the Course to you of send you $5.

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Address

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Mond

May

Moan

Ada

Amen

And

No

Nod

Nome

Ed

End

Ode

Demon

Doom

Dont

Dox

Known

EXPERIMENTAL CHEMISTRY.

(Continued from page 475)

violet vapors on the addition of sulfuric acid to some of the waste liquor. Davy and Gay-Lussac both investigated this new element a year or so later, and Gay-Lussac gave it the name iodin from the color of its vapors.

Occurrence.

Iodin does not occur free. Its compounds are widely distributed but are not abundant, being found chiefly in combination with sodium, potassium, calcium, and magnesium, in the sea water, salt lakes, and in the sodium nitrate—Chile Salt peter—deposits of Chile and Peru. Until a short time ago the main source of this element, which was seaweed, but now the nitrat deposits of Chile furnish by far the largest proportion.

Preparation.

The seaweeds are collected and burned, the ash forming what has been known for a long time as "Seaweed Ash." These seaweed are fused to a mass of carbon and as, this mass being then lixiviated with water, the solution evaporated to remove the excess of chlorides, sulfates and carbonates, and the concentrated mother liquor treated with sulfuric acid, which causes a separation of sulfur due to the sulfides and sulfates present. This sulfur and the crystals of sulfate formed are removed and the remaining acid liquor contained in an iron retort, is poured with manganese dioxid, which, with the free sulfuric acid previously added, liberates iodin according to the reaction:

$$2\text{NaI} + \text{MnO}_2 + 2\text{H}_2\text{SO}_4 = \text{Na}_2\text{SO}_4 + \text{MnSO}_4 + 2\text{H}_2\text{O} + \text{I}_2$$

The temperature is kept at 60 degrees, which causes the iodin to pass off in vapor and condense in a series of carbenware receivers adapted to the retort for that purpose. Fig. 137 depicts such vessels which are known as Aludels. Any excess of manganese is avoided in order to prevent bromin and chlorin, which are present in the liquor as salts, from passing over and combining with the iodin.

Preparation of BROMIN from Potassium Bromid, Manganese Dioxid, and Sulfuric Acid.

Experiment No. 147.

Pulverize in a mortar about 5 grams of Potassium Bromide, or 10 grams of 2 grams of powdered manganese dioxid, then pour over it the potassium bromid from which they were mixed and set aside, and, crossing the paper, pour them into a flask of about 125 cc. capacity. Have a one-hole stopper for a thistle, which should extend slightly below the bottom of the flask. If there is no side neck to the flask, a two-holed stopper must be employed, containing the thistle tube and a delivery tube, right-angle or straight, the delivery tube, either directly from the side neck of the flask, if one is used, or from (Continued on page 498)
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November, 1918

WHY IS A BLIMP? (Continued from page 453)

end of the horizontal "wings". The fins and rudder lie flat against the sides of the balloon when it is not in the air. Upon ascent the wind blows into the rudder thru wooden scoops, inflates it, and passing upward thru two small pipes, inflates the fins in turn. The time that it takes for this inflation depends entirely upon the strength of the wind.

There is an opening between the balloon and the air-rudder, and consequently, when the wind blows into this rudder, it flows thru it and into the balloon. This air not being able to escape, it is put under a pressure equivalent to the pressure of the wind that is forcing it into the balloon, and which is directly governed by the wind velocity in miles per hour on the outside of the bag.

The pressure of this air in the balloon causes it to expand upward, and this upward expansion in turn presses on the gas above until the balloon strikes a state of equilibrium with that of the gas. Upon the occurrence of any atmospheric change, the balloon takes place as previously and causes the balloon proper to retain its original shape. This maintenance of shape is a very necessary element, for upon its remaining constant depends the ability of the balloon to fly accurately and safely.

The basket is made of rattan, which has been interwoven by following the over and under-lapping method which insures rigidity and strength. Its capacity is two observers. One of these acts as a pilot and is responsible for the action of the balloon, while the other-is known as the observer, and he is especially trained for this very important post. Instruments contained in the basket are of highest sensitivity for determining height, direction of wind, speed, and temperature at different hours, etc. A telescope is mounted on the cross-arms of the heads of the occupants, and due to its unique and patented swivel, it has a range of 360 degrees in any plane. Two parachutes also frame as normal activities of the equipment, as also do a telephone, consisting of transmitter and receiver, instrumenation, a camera, and a pair of binoculars, and last, but not least, a means of protection against enemy air attack in the shape of a modern light-weight machine gun.

Of especial interest is the way in which the basket is attached to the balloon. This method of cross-lacing preserves the swing of the basket to nil, and gives an increased stability, beside absolutely preventing rotary motion of any sort by the basket.

The "Blimp", in reality a dirigible balloon, navigating under its own power, is shown in cross-section for the benefit of the reader. By referring to the symbols in the picture, and then finding their corresponding definition in the caption below it, the writer hopes for a thorough understanding of the actions of the various means and methods employed to conquer the air in this particular type of machine.

The chances of enemy artillery making a direct hit and destroying one of these blimps or even observation balloons, is remote. One would casually think that hitting a balloon by shell fire would be the easiest thing in the world. Exactly the contrary is the case. The main difficulty is caused by the fact that there is nothing to judge the burst of the shell by. From its position where the enemy artillery is firing, nothing can be judged except whether the shells are going straight toward the balloon or not, and nothing is known as to whether these shells burst in front or behind the balloon. Observation from the enemy's flank will tell this, but flank observation will not tell the truth about the accuracy of the line. Cross-observation is the only method by which it can be made an easy target, but as this type of artillery observing takes probably about twenty minutes, the balloon can be brought to the vicinity of the automobile or locomotive on the ground below, and thereby causing the enemy to take another observation, and just about the time that they are ready to fire a shot at the balloon, it is again moved, and thus plays a game of hide and seek with the enemy artillerists.

The most dangerous position of the kite balloon, is at the period of time when it is just leaving the earth, and until it arrives at a height of about twenty-four hundred feet. After once attaining this altitude, it is comparatively safe from attack from any source upon the ground. But this immunity is not perfect once an enemy air-plane arrives upon the scene of action.

At the base where the cable and the wires from the balloon reach the ground, are stationed twelve men, constantly sweeping the sky with powerful glasses. Enemy airplanes are sighted, an alarm is immediately sounded, the locomotive or locomotive winch begins to wind up the cable, which moors the balloon to the earth, and powerful anti-aircraft guns spurt out their fire at the balloons that are trying to swoop down upon their prey. The guns crash, nearer and nearer comes the balloon to the ground, the automobile or locomotive to which it is moored, starts to move, and gently draws the balloon to its nest, where it is concealed until another and better opportunity for attacking arrives.

The duty of the observers when they are up above the shell-torn lands "somewhere in France," along the American sectors, is to be ever watchful and detecting suspicious activities behind the enemy's lines, to take carefully note of the positions of guns, trenches and men, likewise to carefully check up reports of cavalry reconnaissance, to be watchful for the bringing up of reserves, and spot field works.
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it was found that the angular velocity of a flying machine moving with a uniform linear velocity, changes value every minute in practically all cases, and is expected that the angular velocity measured at the very moment of the shot could be applied to extrapolate for the point in the air which the projectile occupied, and this is questionable owing to the relatively long duration of the flight, any measurement taken at a moment somewhat prior to the firing of the shot is especially valuable and has no value whatever regarding the extrapolation desired.

This is the reason why, after the trials made with instruments capable of giving from time to time discontinuous measurements of angular velocities, it has been felt necessary to substitute instruments capable of giving continuous measurements, and this instrument is illustrated herewith. It is called a galvanometric cinemometer.

The instrument works on an ingenious electrical principle as follows: A steel armature, turning in a solenoid (coil of wire) develops a current of induction, the intensity of which is a measure of the velocity of rotation. If the steel armature is set in motion, a sighting telescope pointed at the airplane, a galvanometer properly graduated will enable the range-finding officer to read constantly and independently the linear velocity of the moving target. As the illustration of the measuring instrument shows, there are two steel angles and two solenoids provided; one measures the angular velocity when the telescope is moved across the horizon, the other solenoid and armature indicating the angular velocity when the telescope is moved up or down vertically. A mean value is obtained from both instruments when the telescope is moved diagonally or up and sideways, for instance. The problem of aiming and firing an anti-aircraft gun is thus a considerable one, and moreover highly scientific in its solution, for among other things, the officers having to do with the range-finding, have to determine the altitude or height of the enemy plane, its direction and its velocity, either angular or linear; the extrapolation or prediction of the point to be aimed at, from where the knowledge of the azimuths is determined is then measured by triangulation from a large observation base. In all these calculations and estimations, and particularly suggested, the use of the well-known plotting board, familiar to all artillersists, is recommended.

In determining the azimuth when the angular velocity of the target is determined by the aid of the instrument here shown, the extrapolated azimuth is obtained by the plotting of the horizontal angular velocity and this is in starting from the last azimuth in which the target has been observed, prior to the firing of the shell, the angle of sight is extrapolated or plotted from the angular velocity taken in the plane of sight where the target has been observed. prior to the firing of the shell.

Consider once more the fact, as aforementioned, that an enemy aircraft may traverse a distance of about seven hundred meters or 434 mile during the flight of the projectile thru the air. The shell proceeds on its way and clings helplessly to its trajectory, and if the case be so, the combustion of its fuse has come to an end. In the words of Colonel Reille—"During this period the race is surely most important, for it is during this time that the guidance of a quick-witted aviator, has maintained the full power of her free will,
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WHY AIRPLANES DON'T FEAR ANTI-AIRCRAFT GUNS.

(Continued from page 494)

AERIAL PROJECTILE FROM THE GROUND BURST ANYWHERE NEAR THE 'PLANES, AND AT ONCE SHE IS IN A POSITION TO THOROUGHLY BATTLE ALL THE CALCULATIONS THAT HAVE BEEN WASTED ON THE AIMING AND FIRING OF THIS PROJECTILE. DUE TO THE CORRESPONDING FACTS, IT IS CLEARLY EVIDENT THAT THE SYSTEMS OF ANTI-AIRCRAFT FIRING BASED SOLELY ON RANGE MUST BE CONSIDERED AS BEING INEFFECTIVE AND EXCESSIVELY EXPENSIVE.

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(Continued from page 475)

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and place them in the mine. In another compartment of the mine place a ton or so of gun-cotton or T. N. T. "Now," sez he, "when all is ready, and the compasses duly fitted with an electrical contact, it will swing around and close the spark coil circuit, thus detonating the high explosive as soon as a steel ship draws near; but how in blazes am I going to tell enemy ships from my own?! I should worry!"

GADZOOKS!!! Lads, but look at war dream No. 4! What do our eyes behold, my Lords? Nothing less than the evil eye and titanic grin of the terrible Electro-magnetic torpedo! Why should mighty torpedoes be wasted by missing the mark, when such an invisible and omnipotent force as that of magnetism is available, writes this "also-ran" inventor. No sooner said than done, and down he sat and penned this drawing and specification. I would assure you friends that if I were as big as the biggest torpedo, with a girth of twenty feet and a length of ten yards, and just bubbling over with magnetic molecules, I would not be unable to do any job, which you ever saw at a distance exceeding a few inches at most. If you do not believe it, just go down to the nearest steel foundry where they have an electro-magnetic capable of lifting several tons, and see for yourself how far my magnetic influence extends.

The "electrification" experts had been at it again when I ran across Phoney Patent No. 5. "Take some ten thousand of your electrical experts" sed this inventor in his specification, "and let them in their most industry and address to no less a personage than General Pershing himself—send them down to the sunny shores of the Meditteranean, and let them improve each shining hour by gathering thousands of No. 1 electric eels. Ship said eels to the Western Front in plate-glass trunks, so that they cannot break while in transit, and note at the psychological moment, liberate fifty thousand for luck from airplanes flying along the Rhine into that German holy of holies, and the war will be ended." I commission that budding genius with the rank—I sure think it's rank—Brigadier-General of the Electric Eel Division, and he can have full charge of that Department any time he wants it!

I momentarily lost my equilibrium and nearly fell to hold my magnetic molecules in line, while old "H. P." nearly fainted, when my gaze fell on the Patents No. 6. CARABBA!!! What do you think of this magnificence? I say, a chap that promulgated and otherwise foisted this brainy (?) idea on a long-suffering War Board was a Colonel— Colonel, my good friend. Patented it, he wrote—"Why not build a VERY POWERFUL ELECTRO-MAGNET and submerge it in the shal low waters about the North Sea, so that the enemy battleships will be attracted from the deep channels into the shoals, where our sea forces can knock them to smithereens." Well, boys, I am all for this scheme for myself; I'd take a tip from father, that if that bird could build an iron core large enough for me to slip around it with my body, a couple of copper wire, big enough to use all the kilowatts developed in Europe, well then I could not cause any of the mighty steam battleships of the British Navy to move one-thousandth of a millionth part of an inch from their chosen path. Of course, if a noisy submarine tried to interpose itself, I might get a few 'em, but with the help I provided I had several thousand kilowatts of magnetized molecules tuned up to a state of shock to hold him in his place. But none of that five-mile or ten-mile stuff, or quarter mile either.

I have often wondered how it would feel to have several million of my body's transferred molecules concentrated on the nose of a
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November, 1918

fast-traveling bullet, so that when approaching the steel helmets of the Kaiser's finest, they would immediately yank the bullet out of its wonted course, and cause it to slam mightily against Fritz's steel sky-piece, and by this sudden concussion cause the bullet to spurt into the air. You can imagine the results.

A budding genius from Whitewater, H. R., propels the Naval engineers shall equip all sea-going vessels with a series of (always) "large and powerful" magnetic coils, placed in belt lines entirely around the hull of the ship, and exerting magnetizing coils with several hundred kilowatts of alternating current. Now, aloha you might not know it, when an alternating current is past through an iron mass, I can repel certain bodies with extreme speed, but not for any great distance, usually not exceeding a few inches. You can imagine then what chance I would have of repelling a modern automobile thunderbolt traveling at the rate of fifty miles an hour, and with a momentum of many thousand foot-pounds.

Boys, Howdy! Take off your hat to war, spasm No. 9, specially invented to hasten peace, so to speak, to make my bones weary, for I'll be dinged if he doesn't pack up a bunch of my best trained Maxwellian molecules into an iron lifting magnet and meagre me in a thousand feet in diameter, and whirl it along until the molecules suspended from an airplane. You must hear that boy rave. I can see the boche on a dead run for Berlin, can't you? Yes, you can't! Not the Sun was such a pleasant smile in Fig. 9—it must be a warm day in July—lie right is right!

How Can We Tell "Real" Death?

(Continued from page 457)

which is usually injected into the jugular vein in the neck after the blood is withdrawn, is composed of a certain chemical solution which tends to prevent rapid decay of the tissue. When the body is embalmed, it is impossible for a person to come to life again (as far as we know) from a state of suspended animation). So it becomes all the more important to know an exact test for determining absolutely cases to exist, even before embalming as becomes obvious.

USUAL TESTS FOR CESSION OF LIFE

1. Pulse and Heart Beat: The pulse, as the pulse of life, appalls we, and this is felt by grasping the wrist so that the heart and inferior border of the rib are compressed against the heart, and this definite pulse is felt. As the life approaches the end, the heart rate decreases and may decrease to 10 per minute. It is usual for the physician to listen to the heart beat with the stethoscope. There is also available what is known as the microphone stethoscope, which is supposed to be extra sensitive, for the better appreciation of the slightest heart beat. Some physicians, however, state that the most sensitive method of listening to the heart beat is to rest the ear against the breast, upon which a piece of gauze has been placed for chilling reasons and which does not interfere with the transmission of sound from the heart to the ear. The stethoscope in such cases is liable to amplify or localize other sounds, such as the movement of the breasts, which tend to movements of the heart in the lungs, or due to congestion in the lung passages, especially where the patient has been affected with what is known as death rattle. If the heart has to all appearances and purposes ceased to beat at the breast over a period of five minutes and then for another period of five minutes is alive, to assume that the patient is actually dead, for in practically all ordinary cases of suspended animation, the persons so affected have come to life after a period not exceeding three minutes. Finally, the radial artery may be opened at the wrist. If blood flows when pressure is made, it indicates that the heart is still alive, and the patient therefore not actually dead. In the case of suspended animation, it is the opinion among medical men that the pulse is not really departure from the body, and no authentic case is on record where such a condition has occurred, as Dr. John B. Hulber has pointed out.

2. The Respiration Test: Respiration normally occurs at the rate of sixteen to eighteen per minute, but this may drop to as low as three or four per minute as life approaches its finality. An old fashioned test which is a fairly good one and extensively used at the present time is that of putting the hand upon the breast of the mouth. In the case of syncope, any slight action of the muscles may cause the breath, which forms a mist on the mirror, This test, however, may be put to the advantage of the physician in cases of severe shock, as any movement of the breath provides an indication of life. The only ordinary test will indicate this condition by stopping the action of the breath at the wrist.

Even the slightest breathing can be heard by the ear applied to the breast, especially by the trained ear of the experienced physician. The death rattle is one phase of it, and finally rises with water.

3. Body Temperature: When life ceases to exist the temperature of the human body invariably drops rapidly, or at the rate of approximately 1.6 degrees Fahrenheit per hour. The living body has a temperature of 98.6 degrees, but may die down to 58 degrees, and have a temperature as high as 106 to 108 degrees. The living body temperature is, however, not constant, but varies degrees temporarily, in some serious cases of cholera or yellow fever, about 95 degrees is usually considered the minimum temperature at which life can exist. Sometimes the temperature will rise above 100 degrees both before and after death, but this is purely a chemical reaction in the different parts of the body. The body is at a higher cooling, and room temperature may fall in from three to twenty hours after death of the body has been noted after a period of as long as three years.

4. Color of Skin: To all intents and purposes, if the skin has been freshly dead and has practically ceased, the skin of the body becomes deathly white, and there is absence of the pink color when examined. The tissues of the body lose their elasticity, and finally the body becomes in a state of rigor mortis.

Skin Signs: Scarification of the skin and use of a cupping glass fails to draw blood. Injection of the skin with a fluid, as a rule, followed only in life by a port wine colored congealed blood, and finally myoglobin when approached toward a light if there is circulating blood.

EXPERIMENTAL CHEMISTRY.

(Continued from page 491)

the right angle bend, is connected to a medium size test tube, which is immersed in a vessel filled with water. Pour in 5 or 6 drops of sulfuric acid thru the thistle tube, and again place the vessel in the water. If the vessel is a small amount of antimony sulfide, or other substance, the tube will be seen to be filled with water. A drop of the fluid is placed on a piece of glass, and the dish is observed for the presence of any distinct color. In the case of antimony sulfide, a greenish color appears. In the case of antimony trichloride, a yellow color appears.
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ELECTRICAL EXPERIMENTER

November, 1918

PATENT ADVICE

Edited by H. GERNSBACK

In this Department we publish whatever as is of interest to inventors and particularly to those who are in doubt as to certain Patent Phases. Regular inquiries addressed to "Patent Advice" cannot be answered by mail free of charge. Such inquiries are published here for the benefit of all readers. If the idea is thought to be of importance, we make it a rule not to divulge details, in order to protect the inventor as far as it is possible to do so.

Should advice be desired by mail a nominal charge of $1.00 is made for each question. Sketches and descriptions must be clear and explicit. Only one side of sheet should be written on.

Readers' attention is called to the fact that due to the great amount of letters to this department it is quite impossible to answer them all thru these columns. The inquiries answered in this issue date as far back as May, and if readers with speedy service they should carefully note the announcement appearing in the preceding paragraph.

Spring Handle.

(270) Fred A. Shearer, Centralia, Wash., has an idea to prevent handles attached to tool chests, etc., from being broken in transit. They are often broken when thrown off trains. His idea is to place a small wire spring in the handle to keep it closed, thus preventing damage. Our advice is asked.

A. Spring handles are not new, and there have been a great many styles on the market. Any first class hardware store carries such handles.

Stereoscopic X-Ray.

(271) Robert J. McGill, Washington, D. C., submits a plan of X-ray work for quickly locating a foreign object in a body. He has two simple shadows upon fluorescent screens which are at right angles to each other and at a stereoscopic angle to each other, so that the observer, (see illustration) can get an idea of the depth of the object as well as the location laterally. By using a stereoscope, the observer may combine the two views so as to give the appearance of solidity to the subject, and the operator in the "mind's eye." This principle may be used for observation and diagnosis of cases other than those where foreign bodies are located in the patient's body. Our advice is asked.

A. This seems to be a particularly clever idea, and also stereoscopic X-ray pictures have been taken before, we do not think that we have come across a scheme whereby the object can be seen stereoscopically direct by means of a fluorescent. Hereafter pictures were taken on regular photographic plates, and these pictures were then in turn viewed by means of a stereoscope. We think this idea is patentable but as a precautionary measure, we would ask our correspondent to get in touch with a patent attorney to have him make a search.

Sub-Aquatic Wireless.

(272) H. K. Skinner, Oxford, Ohio, wishes to know if he could get a patent on underground wireless by applying same to a submarine. Our advice is asked.

A. The sketch which our correspondent submits outlines the idea, but he evidently forgets that salt water being a fairly good conductor will transmit wireless waves from being propagated under water for any appreciable distance. For this reason the idea can hardly be called practical.

Double Caliper.

(273) Lawrence Byrne, La Salle, III., submits a double caliper as shown by attached diagram. As will be noted points A A are used for calipersing the inside, and points B B are used for measuring the outside of the work. Our advice is asked.

A. This is a particularly clever idea, and we are quite certain that a patent can be obtained upon it. We do not think a caliper of this sort exists at the present time. We advise our correspondent to get in touch with a patent attorney.

Miscellaneous Patent Questions.

(274) M. A. Levin, Pueblo, Colo., submits several ideas. We answer them as follows:

1. The use of selenium in connection with measuring the candle power of various light courses is not new, having been often described in text books. The idea of having a swinging record on a moving picture film, so as to make so-called speaking pictures in not new. This idea was described a long while back by us and is the so-called Hartmann process. It is patented.

3. The use of selenium as resistance in connection with moving pictures is not practical as outlined by our correspondent.

Aerial Torpedo.

(275) H. Reichart, Edmonton, Alta., Can., has invented an aerial torpedo propelled by the escaping gases, on the principle of the sky rocket, with a small explosive charge in the war head. The torpedo is supposed to be used from aeroplanes.
only, and weighs a few pounds, but is destructive enough to damage an enemy plane or dirigible balloon. The torpedo could be started from a sort of small motor which would ignite the powder and propel it until it was traveling under its own power. The distance it would travel could not be far and a small angle for firing would be necessary, it probably would have a destructive effect.

A. An idea of this kind, while it is good and while it makes practical sense, has the great drawback that, like all other devices to combat airplanes, it will be ineffective, for the reason that airplanes travel too fast, and even if it were possible to make the flying machine self-propelling and self-steering, how could it overtake an airplane manned with a thinking pilot who changes his course at will. A mechanical device, of course, could do nothing of the sort, as you could not make it follow an airplane. Mechanisms of this kind, while interesting, are not very practical, even if they should be controlled by wireless.

CODE PRACTISE INSTRUMENT

(276) A. E. Kopp, New Middletown, Ind., sends in a drawing and description of a code prac-
tise set, and the illustration which we reproduce below shows it is practically self-explanatory. As will be noted the bulb D is mounted on the cross piece, while the key C makes contact with the bottom of the bulb thru battery B. It will, therefore, flash every time the current is made. A. This is a very clever idea, but there is one thing we do not like about it, and that is the current is broken on the downward stroke. As a rule such outfits are not liked very much, and if our correspondent could devise an instrument where-by the current is made on the downward stroke, we believe he would have a much better apparatus. However, even in its present state we believe a patent can be obtained.

Expansion Toggle.

(277) D. W. Booth, Montreal, Que., Can., submits an idea on an Expansion Toggle which illustrate. Our advice is asked as to patentability and practicality of the design.

Novel Form of Expansion Toggle Proposed

By Inventor

(278) Paul B. Kingley, Cheyenne Wells, Colo., submits the following: "Just recently I purchased a bottle of Le Page's glue. After removing the metal body and screw cap, I was immediately confronted with the problem: How shall I remove the cork? I finally succeeded in prying the cork out with a knife, and sat down and thought. An idea came to me. I secured a screw of the rounded-headed variety, and...

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after punching a hole thru the metal cap I thrust it thru and turned it into the cork. Then I could remove the cork easily and re-place the two when operation. See illustration. Why not make corks along similar lines, to be used on such bottles as Manufacturing Varieties. Various modifications of this idea may be made from a mechanical standpoint. Particularly keep the screw (or swivel pin) from pulling out the cork. Would fly your opinion on this subject? A. While the idea is clever and no doubt practicable, we are often in a hurry to once opened—no need for cork. When in use they are at no time in my possession being kept in the bottle, and for that reason the metal cap as a rule is used, which presenting little surface does not stick as strongly as the large cork would. Opinion is that from a practical standpoint, an invention of this kind would not be very satisfactory.

THE DUNWOODY INSTITUTE.

The William Hood Dunwoody Industrial Institute, at the endowment of five and one-half million dollars "for training in industrial and mechanical arts," is now training a large number of men under contract with the government for both Army and Navy. One of the interesting departments in connection with this training is the Radio Department, in which are under training over 200 Navy radio students and fifty Army radio students.

The men are in the Navy or indented into the Army or Navy are sent to the Institute for an eight to ten weeks' course of instruction in both operating and theory. The Institute has shown an increase in the quota of radio students under training and needs additional instructors for class work in theory and laboratory operating. Any men having proper qualifications, if interested, should write to The Dunwoody Institute, Minneapolis, Minn., for further particulars.

HOLDING DEATH

(Continued from page 498)

Muscle Signs: In death the muscles show an ACID in lieu of an ALKALINE reaction during life. Nerves throw into action muscles become oxidized. A living muscle responds by contraction to a factor which is applied to it. The response diminishes after death and is lost in 3 hours. If 20 minutes have elapsed after presumable death and the muscular contractility is unaltered—the subject is NOT dead. (electro-histo) A woman who lay for 32 hours deprived of apparent vitality was saved from burial.

Icaria's Fluorescent Sign: This is probably one of the most interesting signs of death, reliable, and the drug is innocuous. A solution of 15 drops of Fluorescein, 15 grains of Sodium carbonate and 120 grains of water is injected under the skin. As long as the eye does not close, the injected fluid spreads rapidly, and in this case the sign is effective within 2 or 3 minutes. The eyes simultaneously become emerald green. With a slow circulation its coloration may continue 2 or 3 minutes. NO COLORATION shows that life is extinct.

Eyeball Signs: In death the eyes are invariably open, but they may appear to be closed for the reason that the upper and lower lids both droop, the upper lid drooping about half way over the pupil and the lower lid as high as the papilla; the sipping of the lower lid causes the white of the eye to be noticed and hence it is generally thought that the eyeballs are pointed upward, but invariably point straight ahead. Closed by skillful manipulation on the part of the undertaker. In real death the eyeballs lose their extreme tenacity which in cases of syncope or suspended animation. A flash-light thrown in the eye may reflect this test known as the light test.

The central test is made by scratching the cornea of the eyeball with the finger nail — in real death no movement of the eyeball or reflex should occur. With regards to the face, the mouth involuntary closure and reflex should be noted. This must be closed by the undertaker, preferably before the body has become cold and the muscles set.

6. Rigidity: The arched muscles of the limbs and the rest of the body do not always indicate real death, and that in this condition can also occur in cases of syncope or suspended animation. A flash-light passed through the eye, or reflected from the test being known as the light test.

NEW AND PROPOSED TESTS FOR CESSATION OF LIFE

1. The Litmus Paper Test: As is well known, litmus paper changes color upon whether a solution or secretion is alkaline or acid, the paper changing color accordingly. In applying this test for the purpose in question, a small piece of paper is employed, one end of which is placed

The Dunwoody Institute's Radio Department is training over 200 Navy radio students and fifty Army radio students. Any men interested in pursuing a career in radio technology, if they have proper qualifications, are encouraged to write to The Dunwoody Institute for further details.

Icaria's Fluorescent Sign is another method of detecting death. A solution of 15 drops of Fluorescein, 15 grains of Sodium carbonate and 120 grains of water is injected under the skin. The eyes simultaneously become emerald green. This is a reliable sign if the eye remains open and able to respond to light.

In real death, the eyes lose their extreme tenacity and may not respond to manipulation by an undertaker. However, in cases of syncope or suspended animation, the eyes may still show movement.

The Central Test involves scratching the cornea of the eyeball with the finger nail. In real death, no movement of the eyeball or reflex should occur. This test should be performed by the undertaker, preferably before the body has become cold and the muscles set.

The Litmus Paper Test is another method for detecting cessation of life. A small piece of litmus paper is placed near the body, and its color change can indicate whether the body is still alive or not.

In summary, the Dunwoody Institute is providing valuable training for men interested in the field of radio technology, and various methods are being used to detect death accurately.
on the eyeball or on the under side of the lid, and if it does not change color it may indicate a syncope condition. This is the reason: In the skin and eyelid exudations are alkaline, while when death occurs bodily decomposition and its various chemical reactions set in, therefore these exudations become acid. Hence we obtain the acid reaction on the limbus paper in this test, if the person is really dead. This is one of the best and newest tests available, says Dr. Sinclair Tousay. A simple method of obtaining a solution (ether or chloroform), a few drops of which are placed on the eyeball, and the solution, due to the actions just mentioned, will cause the eyeball to turn red and slightly swell, if life still exists in the body, even though all other tests indicate differently. If no coloration or movement of the eyeball occurs, then death can be considered to have taken place, says Dr. Albert C. Sums.

2. The Electrocardiograph Test (proposed by the writer): The writer has employed the very minute electric currents produced by the pulsations of the human heart, as explained in an article on the Electrocardiograph which appeared in the May 1917, issue of this Journal, it would seem that by applying the electrocardiograph to sensitive Einchoven arcing galvanometer or an equally sensitive instrument to the body, then the slightest changes in the heart would produce a measurable electric current, which would register on the photographic recorder of the apparatus. It would also seem possible for every place in the body to be equipped with a special portable instrument of this type for the purpose in question.

3. X-Ray Test (proposed by Mr. H. Gernback): Suggested on the strength of the fact that with the improved high-power X-ray apparatus available today various parts of the body can be photographed, including lungs, which owing to the absence of air in the diseased lung, photograph black.

4. Abrams' Test: This is based on the fact that a beating heart produces radioactivity and yields a characteristic reflection. As long as the heart beats, this reflection can be elicited. A detailed description of this test is given in the technical for the average layman.

5. Weighing the "Soul": This is probably a rather far-fetched and mythical proposition, but according to reports current some time ago, it was claimed that tests were made with a specially sensitive balance, on which a glass of water was placed and later died. The physicians claim that after making every conceivable precaution for bodily decomposition, both organic and gaseous, there was still a discrepancy of about four and one-half ounces, higher than all other methods could account for in the case of Mr. F. Bach, and they attributed it to the soul departing from the body.

We print this statement for what it is worth.—Editor.

Conclusion: "The danger of premature burial has no longer been exaggerated, for the diagnosis of death by a competent physician should be made obligatory by civil law," says Mr. Abrams, the well-known medical authority. "A period that may elapse before burial should be fixed by law. In France, it is 24 hours; in Germany, 48 hours; and in England, it is customary to await putrefaction, which in such countries of Greece and Rome, where 6 to 11 days were allowed between death and the funeral."

WESTINGHOUSE ENGINEERS GET NEW RESEARCH LABORATORY. (Continued from page 459)

materials laboratory, the ceramic laboratory and the research laboratory. The latter is housed in what is known as "the new research building." The growing demands for more fundamental work made it desirable to provide a special building where advanced science and research problems could be better separated from the more insistently problems. A location about a mile distance from the works was selected, partly on account of the excellent condition in the vicinity of the works, but more especially to secure a site relatively free from vibration and noise which would afford a certain amount of isolation.

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A WATER-JET BLAST APPARATUS

(Continued from page 476)

the water outlet, it should be stopped by tightening the water outlet pinch-cock. By regulating both pinch cocks a place is reached where the water reaches a constant level, all air going out to the air delivery tube, and all water going out the water outlet tube.

An apparatus such as just described was made by the writer and has been in constant use in his laboratory. It supplies sufficient air for two blast lamps, and will give at least five pounds of air pressure for injection purposes, etc. If more air is needed then three injectors may be used, or if not as much is required, only one injector is necessary.

If a combination blast and vacuum apparatus is wanted then one, or both of the injectors may be made into a water-jet vacuum pump by the addition of a "F" fused on to the air inlet hole. If both are thus equipped, a blast and suction cannot be obtained at the same time unless one air opening is left free. One injector may be left open for the air supply and the other used for suction. But in doing this the supply of air is cut in half. Usually there fore it is better to leave both air inlets open and make a vacuum pump separately, then both may be used at the same time without loss of air.

In this way, and with a minimum of expense, and with a very little knowledge of glass blowing, an efficient suction and airblast apparatus run by water pressure may be constructed so that they will be in every way as satisfactory as the factory-made product.

ELECTRICITY AIDS HUN MOVIES

(Continued from page 455)

The final episode of this series is brought to a dramatic climax by showing the final efforts of the Kaiser’s spies to weaken their hatred on America up to the very moment war was declared.

Harrison Grant and Dixie Mason know that Ambassador von Bernstorff will not leave the country without making a supreme effort to cause damage to American resources. Ceaseless vigilance directs their
TALKING THRU LAND AND WATER.

In Fig. 1, as the operator speaks, changes in the microphone resistance will occur, corresponding to the fluctuations of the voice. These variations will cause differences of battery current to reach the electro-magnetic oscillator, which in turn will radiate powerful sonic vibrations or sound waves corresponding to the spoken voice. These electric sound waves transmitted thru the earth or water, are picked up by a microphone (or by a receiver and antenna) and caused to affect the telephone receiver in the same way as the telegraphic dot-and-dash signals do. The recorded sound signals have been transmitted to a distance of twenty miles by this method, and telephonic speech has been transmitted and received over distances of more than ten miles.

One of the most interesting phases of this recently patented invention (U. S. Pat. 1,270,998) is that by means of a compound microphone arrangement (mounted in one of these liquid tanks or ground pits so as to be revolved thru any desired angle) it becomes possible to very accurately determine to the fraction of a degree, from just what direction a sound wave is propagated! A combination of this principle in the new Fessenden sound-transmitting and receiving apparatus, is shown in Fig. 3, where, by means of two oblong tanks arranged with the special "sound direction detecting apparatus," it is possible to quickly and accurately locate any activities on the part of enemy "sappers," who may be engaged in digging a mine.

The principal feature of the whole arrangement here outlined, is that the signal-producing or receiving instrument is not in direct contact with the earth, and does not vibrate with the same phase or amplitude as the ground itself. Hence the transmitting or receiving point, thereby avoiding losses from refraction, bending, or irregular travel of the sound waves, and enabling the true direction of the sound to be rapidly ascertained, and permitting amplification by mechanical resonance, etcetera; as will become evident.

Referring to Fig. 3 and the detail illustrations, the right showing a close-up view of one of these "sound direction" detectors, we see that a large pail-shaped tank of water is sunk in the ground to start with. The ground around the pail is preferably wetted so as to make good physical contact between the pail and the ground. A three-legged metal spider rests at the bottom of the pail, and this is surrounded by a sound-insulating pedestal made of lead. In this sound-insulator is placed a vertical and revolving metallic rod which carries a pivoted cross-arm supporting a sensitive microphone.

(Continued on page 507)
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- Magnesia Carbonate
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- Sodium Bicarbonate
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- Sodium Chloride
- Calcium Sulphate
- Barium Chloride
- Lead Acetate
- Ferrous Sulphate
- Nickel Sulphate
- Sodium Phosphide
- Zinc Carbonate
- Ammonium Sulphate
- Ammonium Carbonate
- Ammonium Aqua
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TALKING TIRU LAND AND WATER

(Continued from page 505)

at either end. The two microphones face each other and are connected in series-parallel with a battery and a differentially wound telephone speaker. Suitable to the angles are fitted to the apparatus, which instantly indicate the angle, both vertical and horizontal. A nebulometric bubble happens to rest when a certain measurement is being taken.

Considering that the two differential windings of the telephone receiver are connected so as to oppose each other, any sound waves traveling thru the ground and reaching the gear exactly at the same instant, will cause a total cessation of sound in the receiver, when the 2 bar carry the two microphones is exactly at right-angles to the direction from which the sound proceeds. The position in which the microphone bar indicator points toward the enemy’s trench will be the one to be attacked, either by counter-mining or by a direct raid on the enemy trenches. This measurement gives the horizontal direction or angle from which the sound is emanating.

To determine the vertical angle or the dip of the direction from which the sound emanates, the central vertical rod is rotated thru 90 degrees of the pivoted microphone bar, and is tilted until the sound on the ground is such at which the angle or dip is indicated on the vertical index dial of the instrument. By taking another reading every thirty feet down the trench, the location from which the sound proceeds may be determined in the same manner, and its point of origin will be that point which the two lines of direction, so determined, meet, and its distance can then be instantly calculated (or computed on the rule) by trigonomical means, with which all military men are thoroughly familiar.

POPULAR ASTRONOMY.

(Continued from page 463)

globular cluster is composed of thousands if not hundreds of thousands of individual suns, sun in size, sun in brilliancy. They appear to be systems that have reached the height of development in which they are comparatively settled and there is as yet no sign of an alteration. They resemble the spirals in having exceptionally high velocities of translation thru space, but they do not show in number about seventy being catalogued up to the present time as thousands of the spiral nebulae. Now these globular systems show a symmetrical distribution with reference to the plane of the Milky Way which appears to form an equatorial belt that the globular clusters and the spiral nebulae avoid. The width of this equatorial belt wherein lie the vast majority of all the stars, including our own sun, and the great majority of the nebulae is ten thousand light years, while its diameter appears to be fully three hundred thousand light years. Symmetrically distributed with reference to this belt seems to be evidence that they are units in one great universe in which the Milky Way occupies the equatorial position. This has a direct bearing on both the age of the universe and the theory of the spiral nebulae. The spirals as well as the globular star clusters lie at great distances outside the equatorial belt, and we can see the evidence of being affected by it since they tend to cluster in greatest profusion in the vicinity of its poles as if avoiding the strong gravitative attractions existing in the equatorial region.

It would appear then that the spiral nebulae are not "island universes" in the sense that they are Galaxies similar to and independent of our own Galaxy, but are rather secondary formations in a universe in which the Milky Way occupies the position of an equatorial belt. The spiral nebulae are possibly conglomerations of stars and nebulae that have at some time broken away from or past thru the equatorial region of dense star clouds and gaseous nebulae and are moving rapidly away from the central plane since the antapex of their radial velocities is the center of the equatorial area.

According to Dr. Shapley of the Mt. Wilson Observatory, who has recently made extended investigations of the globular clusters, the spiral nebulae will have penetrated this equatorial region from the Milky Way the Great Cluster in Hercules, one of the nearest, will reach the plane in less than thirty million years. These intervals of time are very short in the general universe and he concludes that the central region has been penetrated by the globular star clusters many times in the past and that the moving star groups that are found within this equatorial region such as the Hyades and the Ursa Major star group may be remnants of clusters that attempted to cross the plane of the Milky Way.

The most acceptable theory advanced up to the present time in explanation of the spiral nebulae therefore assumes that they are "island universes" that resemble our Galaxy in size and extent but rather subordinate units in one vast universe in which the majority of all the stars, the planetary nebulae, and the great irregular nebulae from which the stars are formed, occupy the central belt. At great distances beyond this region lie the globular star clusters and the spiral nebulae.

The origin of the spiral nebulae and the cause of their peculiar structure is still under investigation, but it is generally believed to be enormous conglomerations of stars and nebulous bodies having a motion of rotation as well as a velocity of translation thru space that is tremendously high.

(Next installment will appear in November issue)

THE HOW AND WHY OF RADIO APPARATUS.

(Continued from page 472)

metal cover on the transmitter, and placing the wireless receiver diafragma (with its cap removed, of course) up against the "Detect- phone" transmitter diafragma. In fact the two may be glued together so as to have a practically single period of vibration, similar to the method utilized in building tele-developers. By this means, and taking care not to spill the carbon granules out of the microphone, the receiver and transmitter should be bound together firmly with minute and exactitude. The effect, of course, will be seen for the second receiver and transmitter, stage D. At Fig. 4 there is shown a simple method of supporting the ground-proof diafragma of the detector of stage C; by suspending them on 4½ inch rubber bands from an arm. This prevents extraneous vibrations from affecting the ultra-sensitive

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transmitters. This system has been applied commercially, and an amplification value of 15 times the initial received strength of signal has been obtained.

The "Helmholtz" acoustic resonator has been successfully used to boost the strength of signals as heard in the radio receiver, the glass bell of the resonator being placed close up to the receiver opening as shown in Fig. 3A. It is particularly suited to use on regenerative valve sets, where a variable capacity is employed to vary the number of beats. The receiver used is preferably a standard 1,000 or 1,500 ohm type.

The large opening of the resonator should fit over the opening in the telephone receiver cup. The pure acoustic resonator responds only to a certain frequency for each size of bulb; therefore the resonator used should approximate the beat frequency used. Also the variable capacity in the audion circuit should be varied until the beat frequency created permits the Helmholtz resonator to be in resonance with the receiver. On spark signals and a crystal detector a resonator corresponding to the pitch of the incoming signals should be selected in each case.

Fig. 5-2 illustrates an adjustable resonance amplifier which has been used with beneficial results, it is said. The resonance tube comprises two tight-fitting brass tubes, one for sliding within the other and the complete tube member joining a microphone and receiver, for example. The resonant frequency to which the tube will respond may be changed by sliding the inner tube in or out. The law of frequency for these tubes can be found in any good text-book on physics. Various sizes of tubes should be tried.

The "compest air" amplifier. A new and extremely simple form of intensifier for telephonic, telegraphic, and photographic signals or sounds in the Parson's compressor air valve, shown in Fig. 6. A radio or telephone receiver, R, is conected by a rod, as shown, to an air piston or other form of valve. Whenever the receiver diaphragm moves, or signals are being received, it actuates or moves the air valve controlling the flow of compressed air to a loud talking diaphragm, I, connected to a suitably large horn. This is only a general description of this interesting amplifier, and further information can be gained from the phonograph companies using it, also by consulting the records of the Patent Office or back files of the Electrical Experimenter (October, 1915, issue, page 265).

The "Lowenstein" Electro-magnetic Amplifier. This apparatus as designed by F. L. Lowenstein, of New York, will operate on any receiving detector and is recognized as the most sensitive detecting device for electric current of this particular type ever constructed for commercial use, as it will be deflected by a current of 1 microampere (1 millionth of an ampere).

This super-sensitive relay is illustrated in Fig. 7. The moving element $C$ is wound with a coil of extremely fine wire and carries a contact D which makes connection with a small pool of mercury E, when the armature is deflected. The moving part is supported on two jewel bearings to eliminate friction and the connections to the moving coil consist of two very fine helical copper springs at both ends. Two small discs, F, F, are provided to regulate the swing of the coil, which is mounted between the pole-pieces, E, that are energized by the magnets shown at A, A, A. The coils are so connected that the two pole-pieces will have different polarities, thus forming an X, and the current for these magnets is obtained from a 110 volt direct current supply and is led in thru the wires G.

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The operation of this remarkably sensitive relay is as follows: The powerful electro-magnets are first excited and the moving coil is connected to the receiving circuit. The place of the regular ‘phonograph terminals H’ and a calling device, such as a bell, at the terminals I. When the coil C is excited by the feeble current produced by a recorder, which, of course, is received by the other instruments from the radio transmitting station, it will turn, and its lever D will make contact with the coil of mercury E, thereby completing the circuit which causes the calling device to operate. The bell can be replaced with a tape recorder by which messages can be rapidly copied. This, of course, must be operated at a slow speed, as the moving coil has an oscillation period of 1/2 of a second. The oscillating frequency period can be changed by varying the distance of the levers F, F, and the coil. The ivory or bone cup in which the mercury is kept can be moved either forward or backward by operating a small thumb screw located at the end of the container.

The complete relay is supported on a table which can be rotated to offset any detrimental effects of the earth’s magnetic field. A suitable cover with a glass top is placed over the instrument to prevent any dust settling on the delicate moving parts. This device is capable of withstanding shocks and will work even when slightly jarred. For, it has been tested on moving vessels and the results were entirely satisfactory.

Altho the relay is adopted for radio work, it will be very useful in a laboratory where it is necessary to detect very minute or feeble currents. By mounting a sensitive microphone to make connection with the winding on the moving element of this apparatus it might then be used as a telephone relay, second only to the Audion in sensitivity.

The “Selenium” Relay. Until recently the most sensitive relay was the Siemens polarized relay, which would close its contacts when a current of less than 0.0001 amperes was carried. The new selenium relay invented by Mr. G. Allstrom is said to respond to less than 0.00000000001 (one hundred billionth) amperes of current. This would make it more sensitive than a telephone receiver, and experiments have shown that for wireless work it is well adapted for signalings and calling purposes. The instrument has been used in connection with electrolytic detectors, which were always thought to be too feeble for connection with telephone receivers. Loud, audible signals were never obtained so far with such detectors, but the Allstrom selenium relay makes it possible to use a sounder or tape register with any kind of detector, no matter how sensitive.

An extremely light piece of sheet iron, A, is hung between two platinum wires of the minute diameter of 0.0001 inch, etc. In the center of the iron sheet a small, very light mirror is cemented. An electro-magnet, B, when a current of high as 10,000 ohms, is placed instead behind the iron foil, so that the magnet core almost touches the iron.

Some distance away a sensitive selenium cell, S, is stationed. The cell itself is enclosed in a box, which at the front has a narrow slot. A source of light, Q, is placed behind the cell, and the room must, of course, be dark. By means of a parabolic mirror a beam of light is reflected upon the small suspended mirror on A.

This beam is reflected towards S, but as long as the foil A is motionless, the beam of light does not cross the slot.

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I am writing this letter as a last resort to see if we cannot secure more men willing to qualify for traffic positions paying $2,500 to $10,000 a year.

How important is the trained traffic man's work can be seen by these few cases out of thousands which occur every day. A concern in South Chicago had been shipping about 200 cars of coke from Connellsville to their smelters. Some time ago a traffic expert succeeded in getting a rate adjustment which resulted in a saving of about $5,000 on each car. Thus on this one item alone a saving of over $360,000 a year was effected.

In St. Louis, through mis-routing of freight, errors in reconsigning cars and undercharges on shipments, a railroad lost over $27,000.

A traffic expert discovered that freight rates paid by the Meeker Coal Co. were legal, but exorbitant. A ruling secured from the Interstate Commission resulted in a refund of $120,000.

There are about 50,000 large business corporations and about 400,000 small shippers which must be protected by competent traffic men. These concerns have freight expenses running from a few thousand dollars to many thousands of dollars monthly. Yet in the entire country there are only a few hundred men actually competent to save the money now being wasted through lack of efficiency in applying the Government Freight Rate System.

Realizing the crying demand for trained traffic experts, and seeking relief, the American Commerce Association—a national organization OF traffic men, FOR traffic men, BY traffic men—offers to give men the training required to make them competent to handle the problems of most economical distribution. This instruction is given by mail and can be studied in spare time at home. The most complete and thorough training is given, and, through the Association, costs but a few cents a day.

Through its Advisory Council, every member of the American Commerce Association receives the help of the most prominent traffic men in America.

It is impossible to go into details in this letter, but the Association has published a remarkable book for free distribution which explains everything in detail and tells how any one may quickly learn the new profession of traffic management. If you are at all interested in getting into this highly profitable field, paying salaries of $2,500 to $10,000 and more, write for the remarkable free book. Please state whether you are a beginner or whether you have had previous traffic experience, and give your present age and occupation, also your telephone number. Address American Commerce Association, Dept. 5011, 206 S. Wabash Avenue, Chicago, Ill. (American Commerce Bldg.)
the frequency of the radio current to that of the controlling current. For telephone control the amplification ratio varies from 100 to 1 up to 350 to 1. It has been successful in control of the output of a 75 kilowatt radio frequency alternator.

With this amplifier it has been possible to effect a variation in the antenna energy from 5.8 to 24.7 kilowatts with a variation of control current of but 0.2 amper. Think of effecting such a control—namely 37 kilowatts variation—by means of a telephone transmitter.

This covers the important types of radio amplifiers. Radio investigators and experimenters generally will, however, undoubtedly find of interest the following articles which have appeared in this journal. If you cannot obtain a copy of the desired issue from the publisher you can see them at your local library in most cases.

Compressed air amplifier applied to phonograph. Oct., 1913, issue.


A new Magnetic Radio Relay—How to build one and close a long circuit for tape recorder or other apparatus. By Ralph A. Mead. May, 1916, issue, page 162. (Note—the magnet coil mentioned gives no indication of the size; each magnet coil contains 11 ounces of Ne. 36 R & S. 6.4 gauge enamelled copper magnet wire, giving a resistance of 7,650 ohms for the two spools in series.)

Selencium, Relay. See present number of ELECTRICAL EXPERIMENTER, page 471.

Audio Amplifier Action—Exhaustive discussion of electronic movements, etc. Most complete article on this phase of the vacuum valve available. August, 1916, issue.


THE PHENOMENA OF ELECTRICAL CONDUCTION IN GASES. Continued from page 465.

graphic paths it can be seen that they have encountered no force strong enough nor any mass great enough to turn them aside in their passage thru many thousand molecules until the particle had slowed down a great deal. Another interesting point is evident here in the fact which can be obtained from the photographic path that the slower the ion is traveling the slower ions it will produce, and the faster it travels the more likely it is to pass completely thru a molecule without bringing anything to a rest in the way in which an electron may pass thru a molecule has been illustrated in a previous paper by the way in which a pebble may be slowed down by the circle described by a rapidly revolving ball on a string without either touching the ball or the string. Similarly two molecules consisting, as in Fig. 5, of electrons rotating about nuclei, may pass thru each other without either of the two nuclei or the two electrons coming to a rest. The faster electron is moving in the directions of the arrows the less likely it is that the rotating particles will collide.

The fact that the paths of the ions in Fig. 4 is quite different from the others shows that ionization may be of several different kinds, and in no way is this shown and explained more clearly by these phonographic paths. This brings up the question as to just what the mechanism of ionization is. There is little doubt but that the beta particle produces ions in passing through molecules of air by ejecting an electron from each molecule, either by collision or by the force of its field. As the electron remains inert along the path of the ionizing particle it seems to have been suddenly loosed rather than forcibly ejected as by collision. The action of the

(Continued on Page 515)
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E. E. 11-18
THE PHENOMENA OF ELECTRICAL CONDUCTION IN GASES.

(Continued from page 513)

alpha particle is just like, and it also seems that an electron is lost from each molecule through which the alpha particle travels, and in some cases several may be lost, which might be expected from the greater size of the alpha particle.

In the case of the short ether waves, say X-rays, the electrons seemed to be very forcibly ejected, for they break off from the main path and every branch indicates the point where a collision took place and a new ion was produced. Hence the path of a ray of X-rays thru air is an intricate network.

Just why ether waves produce this violent ejection in contrast to the passive ionization left by the path of alpha or beta particles remains a mystery.

In connection with the older molecular theory molecules were considered to be perfectly plastic so that on colliding with each other they bounced back with exactly as much energy as before. This assumption was necessary because if it were not true the molecules of any gas would slowly lose their energy and would fall to the bottom of their containing vessel as inert particles.

If the energy at each collision energy would be lost and the pressure would gradually decrease to zero. If we investigate the conditions of collisions it is apparent that reflections do not always occur. The molecules might pass thru each other under proper conditions, or the reaction of the gases so that all the energy of one is used in producing ionization and that one becomes inert, or they might be reflected. If the gas particles are reflected it may be from one or both of two causes:—The electric fields of the particles within the atom may oppose and repel each other, or some imperceptible centers more solid and material than electricity, if there be such, may collide and rebound. The fact bears repeating that an alpha particle may pass thru a million molecules before experiencing such a force or such a material center. The faster the molecules travel of course the more chance it has of going completely thru another molecule. Ordinary gas molecules move at such relatively low speeds that they do not really produce reflection. The fact that the collision seems perfectly elastic is still difficult to explain unless as explained above, this reflection is due to the repulsion of electric fields; then the only loss of energy would be due to the ether and the other is considered frictionless.

The field of the ionization of gases is one of the most promising in all science. In these papers the most important phenomena have been considered relative to electricity in gases and besides adding to our practical scientific knowledge and intellectual resources which it throws on the real electrical nature of matter and electricity is invaluable.

(Conclusion.)
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ELECTRICAL EXPERIMENTER

November, 1918

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But if the waves traveled 12,000 miles around the earth, they probably traveled just as high above it, and perhaps very much further. We already know from experience that atmospheric conditions are the bane of the radio operator. Ionization of the air and barometric as well as electric disturbances of the atmosphere often make radio-communication impossible. Experiments and our present day knowledge of physics, on the other hand, convince us that if there were no atmosphere at all, radio transmission would not be only infinitely better, but the distance covered with a certain amount of power, could be increased very considerably. Radio waves, the same as light waves, belong to the same family. Both are electromagnetic manifestations of the ether. Both are equally hampered by the terrestrial atmosphere. Thus the best astronomical observatories are located on the highest mountain peaks. In such a position the astronomer can see much better, tho only one or two miles nearer his object, which, as for instance the planet Mars, may be 50 million miles distant. But the astronomer must thru only about 30 to 40 miles of air—this being the estimated thickness of the terrestrial atmosphere. On the other hand, our radio waves traveling around the globe, must speed thru 12,000 miles of atmosphere. Naturally, there is an enormous amount of absorption of energy, while the waves travel thru such a wide blanket of air; hence our suspicion, that as there is no such obstruction skywardly, the waves will travel infinitely farther into the free space where there is no atmosphere, once the paltry 30 to 40 mile air layer at Carnarvon is traversed. That these radio waves therefore, reach the moon, altho the latter is 238,850 miles distant, seems probable after these deductions.

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At Last the Super-Tank!

HERE at last we have the super-tank. It was recently thought out and patented by one Anton Krzan of Chicago. This military device has considerable possibilities, and its field of activities is a wide one. It may be mounted on a powerful automobile truck or chassis, so as to be kept rolling over the country at high speed, and the while hurling forth streams of machine gun bullets, not to mention liquid fire and gas. This armored telescopic tank may carry searchlights for use at night. It can also be used as an observation post for the Signal Corps.

Of course, this armored tower could be well camouflaged so as to be hardly discernible even a few hundred yards away. The inventor describes one way of elevating the steel tower, whenever so desired, by the use of compressed air. He states that one man can elevate the tower section by simply turning the handle on a small air pump which compresses air at atmospheric pressure and forces it into a flexible chamber, which, as more and more air is pumped into it, naturally causes the tower sections to rise correspondingly. Where the super-tank is mounted on an automobile chassis, several other methods at once become available for elevating the tank as often as required. One of these is to connect it mechanically with the automobile engine thru suitable clutch mechanism and gearing. Another method is to have a separate gasoline engine unit,
Electrical Experimenter

December, 1918

New York's Novel $6,000,000,000 Liberty Loan Sign.

One of the most spectacular features of the Fourth Liberty Loan campaign was the moving picture of the big Wrigley Gum Electric Sign in Longacre Square, which occupied an enormous scale giving the total figures subscribed each day. This sign, the largest electric sign in the world, occupies the roof of a building on the west side of Broadway from 43rd to 44th Street. The sign is 200 feet long by 50 feet high, and is an artistic design, comprising more than 15,000 electric globes.

Mr. Wrigley donated the sign for the use of the Liberty Loan during the campaign and the concern who built the design and donated the Electric Scale which recorded the total subscriptions until the six billion was reached. The scale occupied the center of the sign and is 66 feet in length. In fact, it is a small section of an enormous dial which, if completed would be 332 feet in diameter. The arrow is 14 feet long, and the letters "BUY LIBERTY BONDS" are 5 feet high. The arrow was set electrically several times during the day, according to figures received on the long distance phone from Washington, and busy New Yorkers found it of great convenience to watch the progress of the subscriptions to the Fourth Liberty Loan by simply glancing at this huge sign.

There was a sign at the bottom of the big display stating that the space was donated by Wm. Wrigley, Jr., Company, and this

dynamo, and the dynamo to operate the electric motor. This corresponds to the steam-driven prime mover fitted to many of our new ships, and there is also at the present time an automobile on the market having this form of drive. One of its principal features and characteristics is greater flexibility owing to the wide range of speed available wherever an electric motor is used. This cannot be said of any steam or gasoline engine power unit, where the power is taken direct thru gears, or other more or less jerky mechanical means.

Not only does this super-tank have a steel tower, but it can be raised and lowered as it speeds along, and the tower may be rotated as desired. For this purpose the upper section containing the machine gun or other ordnance is mounted on roller bearings, so as to turn easily and quickly. A portable wireless outfit may also be carried and at any time often times would be of invaluable assistance in carrying out difficult maneuvers and battle formations, owing to the fact that the observer is elevated above the ground and thus has a clear view of the enemy lines. At first thought it might seem that considerable power might be required to raise a telescopic steel mast such as this, especially when it might be expedient to raise and lower it quickly for the purpose of keeping the enemy gunners guessing. If they should happen to get a "bead" on the moving, highly camouflaged super-tank, but such is not necessary. For the telescopic steel mast can be properly arranged with suitable balance weights in the same manner that our apartment house and office building elevators are, so that very little power would

\[ \text{supply regiment, 1 quarry regiment, 1 minin} \]
\[ \text{regiment, 1 electrical and mechanical} \]
\[ \text{regiment, 2 crane operating companies,} \]
\[ \text{1 camouflage battalion, 5}
\]
\[ \text{army companies, and 44 depot detachment-} \]
\[ \text{of floor space are required to store 90}
\]
\[ \text{days' supplies for 1,000,000 soldiers}
\]
\[ \text{and double that amount of open space. At}
\]
\[ \text{one point of embarkation, he said, 375,000}
\]
\[ \text{square feet of wharf space had been pro-}
\]
\[ \text{vided to accommodate incoming troops and} \]
\[ \text{supplies, and he estimated that the transpor-}
\]
\[ \text{tation services which had to be constructed}
\]
\[ \text{and must be able to handle the front 25 pounds per man per day.} \]

Army Engineers' Corps a Giant of Efficiency.

The wartime organization of the Army Engineer Corps was revealed for the first time on June 27, by Major General William M. Black, chief of the corps, in an address before the American Institute of Electrical Engineers. General Black outlined the extent to which modern warfare is an engineering problem and illustrated his address with screen views of the activities of the Corps in France.

General Black said the present corps organization is composed of 8,000 commissioned and 200,000 enlisted personnel. New units created, he said, most of which are now in France, included: Five corps regiments, consisting of sapper, searchlight and sound-ranging troops; 43 sapper regiments and trains; 2 mounted battalions and trains, 5 pontoon trains, 4 inland waterway companies, 40 railway regiments and battalions for construction and operation of standard and light railways, 1 railway transportation corps, 1 highway regiment, 1 gas and flame regiment, 1 gas training service, 5 forestry and auxiliary forestry regiments, 1 surveying and printing battalion, 1 military mapping service, 2 supply and shop regiments, 1 water supply regiment, 1 quarry regiment, 1 mining regiment, 1 electrical and mechanical regiment, 2 crane operating companies, 1 camouflage battalion, 5 army companies, and 44 depot detachments.

General Black, who accompanied Secretary Baker to France, personally inspected army engineering projects there, said the majority of these units were serving with American troops, although some were attached to the French and British forces. He pointed out that 20,000,000 square feet of floor space are required to store 90 days' supplies for 1,000,000 soldiers and double that amount of open space. At one point of embarkation, he said, 375,000 square feet of wharf space had been provided to accommodate incoming troops and supplies, and he estimated that the transportation services which had to be constructed and must be able to handle the front 25 pounds per man per day.

Radium in Mexico.

A concession has been granted by the secretary of industry and commerce in Mexico for the exploitation of a deposit of gold, uranium and radium at Guada- lupe, in the mountains of the state of Chihuahua. All the machinery necessary for thor and extensive operation will be introduced. The government will receive 5 per cent of the gross output for the permission granted. This is the only deposit of these minerals so far discovered in the republic.

Almost automatic in its operations is a new cabinet for quickly developing X-ray photographs for dentists' use.
A Deadly Spiral Course Torpedo

DROPPING a missile from an airplane with sufficient accuracy such that it will hit a moving ship or other target is a very difficult matter at all times, and as may be readily supposed the number of "hits" registered under marine conditions is but a very small proportion of the missiles dropped. Therefore, a Yankee genius, Edward D. Priest, of Schenectady, N. Y., has taken out a patent on a clever spiralling course once it starts moving under its own power, to follow a spiral path of ever increasing radius. As the accompanying illustrations will make clear, it is only a matter of time when such a torpedo is bound to "get" you. Of course, if the torpedo should be near the end of its range, such as on an outside lap of the spiral and traveling somewhat slower in speed, the argument might be raised that the vessel could easily side-step with a disengaging striker which hits the water just before the nose of the torpedo, releasing the parachute, and in the next instant two specially devised rudders strike the water, and these are pushed upward; this action causes the propelling motor circuit to be actuated, and the propeller starts spinning. At the same time an electrical device begins functioning, which causes the rudder to slowly turn, which then forces the torpedo to follow a spiral path of gradually increasing radius. It is evident that if this were not done, and the rudders set at a given fixed angle, then the torpedo would proceed to follow a circular path of the same or constant diameter.

The torpedo is preferably propelled by compressed air, actuating a compressed air motor, the same as in the standard naval type of automobile torpedo of the Bliss-Leavitt pattern. The inventor provides for causing the torpedo to travel either partially submerged or on the surface, as desired.
3,000,000 Fish an Hour Without a Hook

ANY luck?” asks the habitual human machine gun. You can only answer him and say, “Yes, several thousand bites from our mutual friends the mosquitoes, but not a bite from the wily fish.” It is the same old story, but not so with the new Giant at the rate of ten miles an hour, this forward motion causes fish to be carried into the scoop and thence thru the throat of the scoop onto the electric conveyor, which carries the fish to the electrically operated sorting machine, where the different varieties and sizes are sorted, separated and sent on fish are absolutely fresh when they are placed into the ice-making machine and frozen, then they necessarily must be absolutely fresh when the boat is landed and the fish unloaded for consumption by the public. All fish that are of desirable qualities but are too small for use are allowed to pass

Fishing Machine, designed and originated by one Captain N. A. Lybeck, a sturdy follower of the sea from coast to coast. While on one of his numerous adventures of the deep, he was thrown into close relationship with an unknown specie of deep sea fish that had a searchlight eye with the properties of “mesmeristic” influence. After his safe extrication from this catastrophe he evolved the idea that this fish must exercise a hypnotic influence over its prey and here was the birth of his great idea,—namely, a giant fishing machine which would “hypnotize” the fish with powerful electric searchlights and a scooping device, which would run in the fish to the sorting tables; in other words, an electro-mechanical fisherman on an enormous scale.

How successful he has been can be judged from the illustration of his monster Fisherman. In action its operation can be described as follows:—When the engines are working and forging the boat ahead to the different respective packing bins.

The best of the selected fresh food fish are immediately, while still fully alive, frozen into solid blocks of ice in an electric refrigerating machine. The Government Bulletin that has been issued on this subject of cold storage lays stress on the fact that either the packing of a perishable article in ice or the refrigerating of the same by a cold producing machine will positively preserve the article in its exact condition at the time of refrigeration. Therefore if the uninjured back into their native element, where they may increase in size and numbers. This is made possible by the construction of the fishing machine and its scoop. The fish are caught and carried forward without any sort of injury; therefore if they are not of the kind that are wanted or are diminutive in size they can be returned and none the worse for their experience.

The hulls of the boat are tunnelled and streamlined so as to eliminate any disturbance of the water, which in some way or another gives notice to the sixth sense of the fish, if they have such a sense, that danger is lurking nearby. For that very reason you could have killed Tower when you brought him on that last fishing trip and while comfortably smoking our favorite mer- schaum he started to bark and run up and down the bank of the stream, scaring all of the fish away from your
How Ships Are Welded by Electricity

It is reported that Charles M. Schwab, Director General of the Emergency Fleet Corporation, is considering the construction of a totally electrically welded ship at an early date. It is undecided whether to make the initial experiment with a five thousand ton vessel or a barge. But in any event, the Emergency Fleet Corporation, which is now building vessels by the hundred for Uncle Sam, thus placing the American flag in every port of the world after the war, will undoubtedly adopt this form of building ships, if not altogether, at least to a large extent. For many years, and in fact as long as steel ships have been built, the plates on the hulls that the boats have been lapt over one another, and then held permanently together by passing red hot iron rivets thru perforations near the edges of the plates, the heads of these rivets being swaged over with either a barbed hand with a sledge hammer or else with a pneumatic riveting tool while hot. Some idea of what a tremendous job this riveting problem is may be gained from the fact that a typical day's record in riveting at Hog Island, America's newest and greatest shipyard, is 110,000 rivets per day.

The Emergency Fleet Corporation has thought so well of electric welding of steel ships, as followed by the English shipbuilders in a small way, that they have appointed an

Electric Welding Committee, which board has looked into the technical details and problems connected with the application of electric welding on such a gigantic scale as is required in welding the plates together on a five thousand to ten thousand-ton ocean greyhound, measuring five hundred feet long and standing sixty feet high on the ways—from keel to deck.

Briefly, there are two forms of electric welding which are being experimented with, and these are arc welding and spot welding. Arc welding gives great promise in the shipbuilding field, and has been largely used abroad and also to some extent in America, especially in railroad repair shops where a heavy direct current was easily obtainable. It was thus discovered that the process of arc welding was much cheaper and could be performed more rapidly than by any of the gas welding methods. Spot welding is now used extensively in many different industries, and has been employed considerably for the welding of bonds on street car rails. "It is interesting to note here the difference in practice between Great Britain and the United States," says Mr. H. A. Hornor, in a recent paper presented before the American Institute of Electrical Engineers on the subject of electric welding of ships. Mr. Hornor is a member of the Electric Welding Committee appointed by the Emergency Fleet Corporation. As he has pointed out—"Great Britain, knowing little or nothing about spot welding, had the practise and application of arc welding well under way, while conversely American engineers, on the other hand, had highly developed spot welding, even to the point where elaborate welding machines for this class of work performed their task automatically day after day, making successful new, very little having been publish in connection with it. The accompanying diagrams, figures one and two, show the two different processes of electric ship welding in a clear manner. To produce a spot weld, two heavy copper electrodes, water cooled in the heaviest machines, are placed on opposite sides of the material to be welded together, such as two steel plates. The joint is a lap joint, and machines are now available that will make two and more spot welds at one time. The details of the operation, which requires but a few seconds for each weld, are as follows:

The electrodes are brought into contact with the material to be joined, and current is supplied sufficient to give the required heat. Pressure is then applied; the current and pressure are then removed—the spot weld is then complete, and is usually as strong as the base metal which has been welded. The spot weld operator has a perfect indication of making a good spot weld by the use of a button placed under the electrode, and by observing it he knows exactly the proper timing of the operation. There is therefore no question as to a good, poor or indifferent spot weld.

Arc welding, which gives much promise of being rapidly adopted in steel shipbuilding at an early date, is carried out in the following manner: One side of the electric circuit is connected, as Fig. 2 shows, to the material to be welded, the shank material (Continued on page 572)
New Yankee War Inventions

By H. WINFIELD SECOR

WARTIME inventing has become more or less a profitable game in the past few years, and of late the electrical world of America has busied themselves in perfecting new schemes with which to overcome the Teutonic armament of the modern war. No less interesting of these patents which have been taken out are herewith described and illustrated.

The first invention is that of an electrically operated machine gun. This is a very interesting scheme indeed. Where a source of electric current is available, such as from a storage battery or from feed wires carried up to the front line trenches, this electric machine gun should prove of considerable utility. It has a detachable drive for the belt containing the cartridges and the firing pin mechanism is also positively controlled by the electric motor actuating the spring belt. The machine gun is fitted with a safety switch, which is connected in series with another switch mounted within the rear hand-grip as described. An illustration shows the cartridge belt is provided on its underside with a series of teeth adapted to mesh with the teeth of the gear wheel driving the lower wall of the chamber, and projecting upward into the same, so as to fit into the teeth formed in the belt. The belt is designed to be made in a number of sections, or it may be made in one continuous length with its ends detachably connected together when not in use. A bucket or other storage vessel to accommodate the tubular containers secured to the belt.

In operating this electrically machine gun the gunner simply grasps the hand-grip, after having closed the safety switch. The electric motor then starts up, causing the cartridge belt to move, and the cartridges are brought one at a time into the firing chamber. During the adjusting of the cartridge in the chamber the firing pin is thrown back, and the next instant a powerful spring throws the firing pin forward, striking the closed end of the cartridge, exploding it. This action is rapidly repeated, and a thousand or more cartridges fired per minute. A patent on this machine gun was issued to Louis M. McManus of Houston, Texas.

A second electrical military scheme was recently patented by Colonel Willis P. Coleman of the United States Army, and appertains to improvements for use in connection with the instruction of recruits, and particularly rifle marksmen, especially with regard to the proper method of holding the rifle and pulling the trigger without distorting the line of fire. As Coleman states the case—"It is necessary to hold the rifle in a vise-like grip during the operation of squeezing the trigger. The same time is to shoot a military rifle with any degree of accuracy." To bring the recruit to the realization of the necessity for the "hold and squeeze" is the most difficult part of the instruction, says the inventor. Here-tofore there has been no satisfactory method of concentrating on this particular part of the recruit's instruction.

The invention here illustrated provides a very simple scheme for overcoming this difficulty quite effectively. The recruit is nothing more than a dry battery or two, a small electric bell of the common garden variety, and a metal contact mounted on an adjustable board. The invention also supports a miniature target, all of which is arranged in the manner depicted by our artist. In practise the rifleman has to hold the piece so that the electrode-pin projects a short way inside the barrel and which will abrade him while he goes through the movement of loading and pulling the trigger. He must be able to pull the trigger without strain on the receiver or the instrument without moving the gun barrel sufficiently to bring it in contact with the central axis of the ring. No bullets are used in this maneuver of course. The invention is of wide application and extremely simple to adopt, and is, moreover, well-suited to training riflemen for shooting in any position, either prone, kneeling or standing.

A third invention on which Mr. George Fleming of Princeton, Texas, has taken out a patent, is that of an electrical shot-gun. The object of the invention, so states the patent, is to use a piece of wire which will close an electric circuit and immediately upon contact with the shell, to create a spark for igniting a combustible fluid or material which is mixed with the stock of the gun. By means of an insulated trigger and the necessary contact plates an electrical circuit is closed thru the cartridge or shell whenever the trigger is pulled. The shell is preferably adapted to contain powder, gas, or any other suitable combustible fluid. A spring-loaded projectile is to be shot from a barrel of the gun. The shell has a spark-plug mounted therein, so that contact of the trigger with this spark-plug will close the electrical circuit, and cause the contents of the shell to be ignited, and thus project the bullet out thru the barrel. Normally, a spring holds the trigger out of engagement and out of contact. For certain classes of shells, particularly small gas shells and the like, this idea is well adapted.

An Electro-Gasoline Cannon is illustrated in the fourth figure. This cannon or gun is intended to hurl forth projectiles by means of the same force as that employed in the automobile engine cylinder, i.e., by the explosive force produced when a gaseous vapor, such as that composed of gaseous line and air, is suddenly exploded by an electric spark. Thus no powder is necessary with such a gun. As the diagram and illustration show, the cannon is loaded thru a sliding breech-block in which the shell is placed. The gasoline and air mixture is obtained by means of a vaporizer, built on the principle of a carburetor, and this mixture is injected into the chamber back of the shell by means of a force pump. This is necessary to compress the mixture, and it is ignited by means of an electric spark produced by means of a spark coil and battery. The inventors, John Anthony and W. S. Bradford of Haynes, Arkansas, claim that perfect control of the fire is readily attained by the use of their gun, simply by variation of the force pump. They also point out that a crew can fire such a gun with little danger from explosions and that the cost of operating a gun of this type is said to be much less than the cost of operating a gun from which the projectiles are fired chemically. It may be interesting to our readers to know that a similar gun has, to our best knowledge, been used successfully in France, and also there has recently been developed a machine gun of this type which can fire three thousand shots per minute.

When the birdmen soar to lofty altitudes in the comparatively cold weather of mid-winter, or when the shooting season is over, the aviator is thrown upon the resources created by the cold. As a particularly effectual, electrically warmed aviator's shoe has been invented by William L. Lillard of Irvington, N. J. Mr. Lillard makes use of storage battery or other source of electric current, and his shoe is particularly useful for all those who may be exposed to extremely cold weather, including aviators, drivers of street cars, automobilists, etc. His scheme is particularly interesting in that the inner sole containing the heating element or grid may be adapted to any footwear, whenever desired.

An electric insole is used in both shoes, and electric conductors extend thru the heel of the shoe and thru the leather pocket attached to the outside of the shoe at the rear, connect with a storage battery or other source of electric current. It is thus evident that the electrical contacts in the heel and the sleeve covering the conductors leading up from the heel, may be quickly attached to any regular footwear, whether they be shoes or boots. Electrically heated helmets and gloves have also been very successfully by the Allied forces.

The sixth idea is a suggestion for naval and marine engineers, in the form of a quickly collapsible net to be used as a protection on ships against torpedo attacks. As the illustration herewith shows, the inventor, Mr. John Wosinski of Detroit, Mich., provides for a series of telescopic tubular superstructures which can be rigidly supported about the vessel when necessary. These arms may be quickly extended by the means of compresst air, by a hand-operated gear, or, better yet, by means of an electric motor. Each telescopic boom is supported by cables from the masthead and is able to sustain the weight of the net and floats. It is just possible that this idea may work out and be made available for the purposes for which it is intended. The net protector for ships, you know, is taboo in all naval discussions on torpedo defense, notwithstanding the fact that English warships have used them with success many times. Therefore, it is possible that Mr. Wosinski's invention may find acceptance in shipping circles in the event of the general objection to these torpedo nets heretofore having been that they reduced the speed of the ship and otherwise handicapped the movements of the vessel.

One of these fine nights "Kaiser Billiam" and the "Clown Prince" will be highly surprised when their headquarters and perhaps the rest of the family castles are bombarded by a gigantic flock of aerial torpedo bombers, of the type invented by a Neb-ras-ca genius, S. H. Benson. This aerial torpedo is devised so simply that the men on the ground can automatically drop a shower of bombs or other explosive missiles at predetermined points. By the use of a clever arrangement of trap doors in the shell of the torpedo and their releasing mechanism, the doors may be caused to open one after the other, as desired.

Continued on page 584
UNCLE SAM'S WAR INVENTORS ARE BUSY

ELECTRIC MACHINE GUN

ELECTRIC RIFLE OR SHOT GUN

ELECTRIC TARGET TEST

ELECTRO-GASOLINE CANNON

ELECTRICALLY WARmed AVIATOR'S SHOEs

EXTENSIBLE TORPEDO-Net

AERIAL TORPEDO BOMBER

THE ONE-MAN TANK

(For Description See Opposite Page)
Tanks Uproot Wire Entanglements

By H. Gernsback

O NE of the most formidable barriers to the advance of the modern tank is the modern barbed wire entanglement. As is well known, it is almost impossible to charging infantry to move over the interminable entanglement once the latter is equipped with barbed wire. First of all, the advancing men are ready targets for the enemy, and once they come up close to the barbed wire, there is no way of getting over without the enemy spotting the men, when they can be easily picked off by means of the enemy’s rifle fire. In the past, many schemes have been suggested and are in operation, to either clear the barbed wire or else to destroy it. Perhaps the most efficient is the modern barage which levels and shatters to the ground all entanglements, blowing them to atoms, and the cable. The basic method is that the enemy’s entangled forces are sent out holding the ground to be emplaced, if any. After our steel wire has been shot over the barbed wire, all that is necessary for our men to do is to pull the wire to where they need it. Depicting in illustration, which tank may be some considerable distance behind our lines at any point which is best suited for the requirements at the moment. When all lines are made fast, it is necessary for the tank to start moving backward, when a considerable section of the barbed wire entanglement will be blown uprooted and pulled out of the way. The entire tangled mass of poles and barbed wire wreckage can then be pulled somewhere to the rear, where it is one of the most baffling problems of modern warfare. The writer wishes to advance an idea which has none of the objections cited above, while at the same time no new ma-

vance thru the open gap. The enemy will at most have a few minutes notification, which will not be sufficient to call in his reserves. One way to see that the advantage of this idea lies in the fact that a wide breach can be made at extreme expense to human life, for it is obvious that no human being need be near the barbed wire, unless, of course, volunteers should elect to place the grapple cables into the barbed wire by hand during the night, thus even dispelling with trench mortars. This can be done by sending out the men in no-man’s-land during the night to fasten the lines to the barbed wires. There are, of course, many other variations to this scheme which will immediately suggest themselves to the men in charge of this work at the front and who are best qualified to handle such matters.

Three Views Depicting a Novel Idea How to Uproot Barbed Wire Entanglements. Fig. 1 Shows Thin Wire Cables to the End of which Any Number of Hooks or Grapples, the Cables Being Shot Over the Entanglement by Trench Mortars as Shown. Fig. 2 Shows the Other End of the Wire Cable Attached to a Tank By Our Men. Fig. 3 Shows the Tank Uprooting the Barbed Wire Entanglements, the Hooks or Grapples at the Other End Holding the Cables Fast to Entanglement.

centrate reserves of infantry behind the attacked area, thus defeating the object gained by destroying the entanglements. Another favorite method originated by the Allies to shoot tanks run over the entanglements, crushing poles and wire to the ground, but again this method gives notice to the enemy, and while not as much as if the harrage were used, still notice is given. Also one tank or even fifty tanks cannot break down a large area of wire, for it stands to reason that each tank can only crush down an area equal to the width of the tank itself, which usually is not more than ten to fifteen feet wide.

Recently a Yankee colonel devised an original method whereby use was made of ordinary chicken netting interspersed with thin steel rods. A number of such wire rolls are arranged over the entanglement and the soldiers found little trouble in walking over this improvised bridge, but, of course, many casualties resulted by the Huns picking off the Americans with gun or rifle shot. All the methods cited above have one great objection, and that is that they leave the barbed wire on the ground in some form or other, and even if the poles and barbed wire have been crushed down, they still make very unpleasant walking as may be readily understood.

After a number of wires, spaced a foot a part, have thus been shot over the entanglement, not leave their trenches and attack the free end of the wire, as shown in our illustration, which tank may be some considerable distance behind our lines at any point which is best suited for the requirements at the moment. When all lines are made fast, it is necessary for the tank to start moving backward, when a considerable section of the barbed wire entanglement will be blown uprooted and pulled out of the way. The entire tangled mass of poles and barbed wire wreckage can then be pulled somewhere to the rear, where it is out of the way and will not harm our advancing infantry. It goes without saying that by using a number of tanks and by shooting over a sufficient amount of lines, almost any section of barbed wire can be cleared in this manner. This system would work, of course, where there is a double, triple, or even quadruple line of barbed wire entanglements, one behind the other. In this case, all our men have to do is to grapple the nearest line facing the enemy, and once our tanks begin pulling, the first line of entanglements will invariably become enmeshed with the second, third and fourth line, and uproot them all. It is merely a problem of having a big enough tank or tanks with heavy enough wire cable and grapples.

It also goes without saying that the tank which we have illustrated can be replaced by either heavy railroad track, or other wise compound hand tackles (chain blocks), if it is not advisable to use either tanks or automobiles.

In order to so not to give the enemy any information as to what is coming, the trench mortars can be fired in the evening or early morning, and the object can be successfully camouflaged by sending over ordinary trench bombs at intervals. Thus the enemy will have no notice of what is happening, and will take the firing from the trench mortars to be nothing more than the usual daily trench bomb bombardment. Then at dawn, about half an hour preceding the attack, the tanks can get busy uprooting the barbed wire entanglements, making a wide breach in the defensive system, and within a few minutes after thus clearing an opening, our infantry can ad-

President’s reply to German flashed by radio from Arlington.

President Wilson’s reply to Germany on October 22nd was sent broadcast to the world from the Arlington naval radio towers on the night of October 24th, after the official text had been put on the cables. It was picked up directly by the German station at Nauen, it was undoubtedly relayed from other points in Europe in time to reach Berlin in the morning.
Preserving Organic Substances by the Use of X-Rays

The apparatus here illustrated was recently developed for the purpose of utterly destroying insects or other animal life that would tend to destroy perishable articles, such as tobacco, certain foods, etc., or else to sterilize and prevent further propagation of the species, and also to destroy any eggs that the insects have already laid.

In certain instances, such as in the treatment of furs, woolen articles or feathers, it is desirable to destroy the moths or other destructive insects before they can do the damage. With other perishable articles, such as grains, the few weevils or other insects that may be found initially in the grain will do little damage to the grain, provided their powers of reproduction are annihilated or destroyed, and further that the eggs already laid be sterilized.

Again it is well known that tripe, which is infected raw pork, are in themselves harmless to human life; but that the second generation, when bred in the human system after eating raw pork, becomes very dangerous to human life. Therefore, in the case of the raw pork or of the grain, it is only necessary to destroy the fertility of the original insect, to a large measure prevent any material injury from the presence of such insect. Therefore, a Florida inventor, Mr. David Collins Gillett, devised the special X-ray "oven" here shown.

Mr. Gillett has provided a number of novel electrical features in working out this idea to the best advantage, and for one thing he greatly reduces the length of time required to thoroughly sterilize such articles, by providing a battery of powerful Coolidge type X-ray bulbs on either side of the oven. The compartment into which the cars containing the materials are rolled is partitioned off with wood or non-metallic sheeting. The outer wall of the X-ray cabinet is composed of wood or other suitable material, and the entire inside surface of the outer wall, including roof and doors, are lined with sheet lead, about one-eighth inch thick, to prevent the X-rays from passing thru the walls and exerting deleterious effects on the attendants. Special connecting racks are provided, so that the batteries of X-ray bulbs can be quickly replaced or reconnected and exchanged at any time. A milliamperemeter is provided for each battery of bulbs which registers the amount of high tension current passing thru them.

An electric motor connected to a high efficiency air blower on top of the cabinet craters a strong draft of air, which passes thru the two air compartments placed against the outer walls and inside of each X-ray tube compartment in the manner shown. Opposite each X-ray tube there is a shunt switchboard, with the usual ammeter and voltmeter, necessary switches, circuit-breaker, etc. Two safety switches are provided on the door frames, so that as the door is closed, as shown, the shunt circuit connected to the circuit-breaker on the switchboard will be automatically broken. A time switch, which may be set for any given length of time, or for any given number of applications, will open the circuit of the appliances, thus preventing overheating of the apparatus.

New "X-Ray Oven" for Treating Tobacco, Meats, Besides Other Foods and Substances Liable to Contain Animal Life or the Eggs Laid by Insects, thus Sterilizing Them and Effectually Preventing their Propagation.

A motor provided a pair of nozzles thru which this air can escape in a direct stream on to the tubes, thus helping to keep them cool. The X-raying compartment is made with a high-potential, high-tension transformer for operating the bulbs, and develops a potential of about one-hundred-thousand volts at the secondary. The low-potential, filament heating current for the bulbs is provided by two step-down transformers. All of the apparatus is readily controlled from the switchboard on the exterior of the cabinet.

SAW "SPY" SIGNALS IN THE HUDSON.

Following the military order forbidding "suspicious lights and signaling" along the Hudson, the first observed instance of signaling was reported recently by Captain Franic Crossman of the Hastings-on-the-Hudson Home Guards. Captain Crossman said that his men reported seeing signaling between a motor launch and a post on the top of Hook Mountain, back at 9:30 p.m. one evening, again at 11:30, and the last time at 3 o'clock in the morning. Capt. Crossman said that at 3 o'clock one of his guards observed a low-built launch, of the racer type, slow down off Hook Mountain and, using a light hung at the masthead, flash a code message. The blinking of the lantern was kept up for about five minutes, and then three short flashes winked from the mountain top.

The guardsmen, warned by the two earlier visitations, had a launch ready to go out to the suspicious craft. Before the guard boat could get within halting distance of the stranger, however, the latter sped downstream toward New York.

Members of the Home Guard pointed out that it is from the top of Hiethoven, in the Ramapo's, back of Hook Mountain, Revolutionary officers thru spy-glasses used to watch the movements of the British in Long Island Sound as far west as Nantucket. Guardsmen said that a powerful signal on Hiethoven could be caught by a U-boat lying off Nantucket. Home Guardsmen said that from Hook Mountain spies armed with strong fieldglasses could sweep Camp Meritt, near Cresskill, N. J.

It is Reported that "Spy" Flash Signals Were Observed at Hastings-on-the-Hudson, the Signals Being Flashed from a Launch in the River Up to Hook Mountain. How Easily these Signals Could be Relayed to Mount Hiethoven, and Thence to a U-Boat in Long Island Sound is Made Evident.
Huge Electric Toys

These photographs show the unique electrical display of toys made by a Seattle, Wash., toy concern. The immensity of the toy figures made the public gasp for breath. fantastically colored in typical "monkey pose," so familiar to everyone. The huge moving figure is mounted in a shadow box, which produces a most spectacular lighting effect at night. Behind the black background is concealed the intricate electrical mechanism which makes the monkey's head, arms and leg move, and the contented smile on the monkey's face shows his satisfaction at creating such a disturbance among the children as well as the grown-ups of the city. The idea is an original conception, nothing of its kind ever having been attempted before, and the oddity, immensity and originality of the huge moving figure caused widespread notice and created a petulant grin to be seen on the scores of faces which continually watched the fantastic movements of the clever monkey.

The electrically lighted jumping jack was 15 feet high. The daily uniformed General was 22 feet, while the Private stood 19 feet in height. Looks like "Papa Billiard" abiding to the "Clown Prince."

THE AERIAL MONOFLIER IN THE AUGUST "E. E." WORKS!

Our readers will undoubtedly remember with interest the proposed "Aerial Monoflier of the Future," illustrated and described in color and diagram in the August, 1918, issue of this journal. Many letters of criticism were received, saying that this apparently wild dream was a real impossibility and would not work. Some of the writers objected to the support of such a large car on top of a cable by means of a stabilizing gyroscope, claiming that a gyroscope capable of doing this would have to be larger than the car itself, etc., etc.

So, all hail the advent of a real monoflier, shown in the accompanying photograph! We just recently came across this toy monoflier, and purchased one to try it out. It worked admirably and would run along a cable or string in fine shape. A small, lead wheel gyro, about two and one-half inches in diameter, by one-quarter inch thick, is geared to one of the two traction wheels under the car, so that when this wheel is spun by drawing the car across the floor, the gyro spins at high speed and the car takes on all the features of the gyroscope itself, i.e., it manifests a remarkable stabilizing power in the vertical plane. To give an idea of the powerful stabilizing effect of this small but rapidly spinning gyro, it may be mentioned that the metal car measures nine and one-half inches over all, stands four inches from top to bottom and measures two and one-quarter inches in width.

Of course, it is a simple matter to arrange a car of this type with an electric motor, supplying the necessary current to the motor thru a trolley arrangement on top of the car. Also a similar sized car was tried out with an electric motor fitted into it and driving two propellers, in exactly the same manner as that proposed for the aerial monoflier described in the August issue, and the car rode up an inclined cable very successfully. "Truly, it may be said that "science moves in mysterious ways, its wonders to perform"—to paraphrase the famous biblical passage."

NEXT! WOMEN ELECTRIC WELDERS.

Women electric welders are the latest in shipyard news. Hog Island won the honors on the one hand and three girls who are making good at their new work, on the other. There's riveting, rigging, bossing, and a lot of others, and we'll see how much longer men will hold out against willing women.

Several weeks ago Miss Sarah A. Erwin applied at Hog Island for a job, and they told her they had a chance for her in the electric welding department. The novelty of it was pictured so alluringly that Miss Erwin became the first electric welder of her sex in the world, so far as is known. Not long afterward Miss Anna Kennewie applied for a try at the new work, and she and Miss Erwin both developed skill so rapidly in the training school that they were soon turned over to the production department. Number three is Miss Mary Dunn, also of Philadelphia, who is still in training.

JAPAN TO HAVE ATMOSPHERIC NITROGEN.

According to a bill past by the last diet the government of Japan has decided to establish a laboratory for the study of the fixation of atmospheric nitrogen. The demand of ammonia for fertilizer amounts to nearly 20,000,000 yen each year, and up to now this has been supplied solely by import. It is hoped to make this a local industry in the near future.
ELECTRIC XMAS SUGGESTIONS

Submarine Chaser Model. It is Available in Electric or Spring Motor Drive. A Present That Will Tickle the Sides Chasing Rheumatic Pains Away.


Experimental Chemistry for the Boys. This Complete Outfit Gives a Good Education in Chemistry. Instruction Book of 100 Experiments and Tables Tells How.

And Here’s the Submarine—Available With Electric or Spring Motor Drive. It Submerges, Speeds Along and Fires a Torpedo.

For Your Soldier and Sailor Friends. The Electric Shave-Light.

The Wireless Pup! Call Him by Name, and Out He Pops, Delighted!

The Electric Windmill Pump. Works Just Like the Big Power Windmills. Operates on Battery.

Beautiful Colored Electric Lamps for Decorative and Xmas Tree Lighting. Tungsten Filament, 2 Candle-power, 1/4 Volt Type.

New Electric Decorative Lamp in Form of a Cross.

The Electric Questioner—It Answers Your Questions by a Signal From a Buzzer, Whenever Fortune Causes the Right Connection.
A Trans-Atlantic 10,000 Horsepower Aerial Liner

By W. EDUARD HAEUSLLER

The Palace Trans-Atlantic Aerial Liner "Etheric" Nearing New York Harbor. Sandy Hook Lies to the Right of the Picture. Equipped with a Powerful 10,000 Horsepower Engine Plant, Radio-telegraphy, Aerial Sounding Signals and Sleeping and Eating Accommodations, This Wonderful Craft Makes the Trip from London to New York, a distance of 3,456 Miles, in the Remarkably Short Time of 31 Hours. Steamships Cannot Much Improve on a Four-day Trip Across the Atlantic, No Matter How Powerful the Engines with Which the Vessel Might Be Fitted. A Speed of 100 Miles Per Hour Is Common Nowadays for Airplanes.

In the very near future one may expect to see such a placard posted in a conspicuous place and past with only casual interest, as it will have become commonplace. Likewise the daily appearance of a monstrous aerial flier such as the "Etheric" would not cause excitement—perhaps just a slight interest as to her passenger list.

"All aboard for London!"—Then amid the roar of the big siren and that of the six gigantic motors, aggregating in all some ten thousand horsepower, the noise of which is deafening, the last passenger steps aboard, the small wooden stairs are removed, and the gigantic machine starts to rise rapidly into the air, bound from New York to Harbor Grace, Newfoundland—one thousand one hundred and forty miles distant, the first lap of her trans-Atlantic journey.

The city beneath appears to be dropping away from under you, the buildings and tall skyscrapers become a mere jumble of varicolored squares, interwoven by a mass of threads resembling a net, which in reality, are streets, and the "flies" that you perceive moving about in them are the rushing masses of New York's busy people. Your attention is drawn to a small winding thread, and when you follow it with your eye, you notice that it extends and disappears into the horizon. This, you are informed, is the Hudson River. After the flier has gone several thousand feet higher, you become interested in the apparent widening of the circle of land and water within the horizon. This is due to the height, for as our altitude becomes greater, so also does the area of land beneath you increase in size. This holds true to a certain altitude, above this limit of height the expanse of the horizon again decreases in diameter. You chat for a few moments with a fellow passenger, when of a sudden, you notice the lack of turmoil and the noise of the city, which has been replaced by a noticeable and complete calm.

Looking over the rail you are surprised to find that the flier has made remarkable progress and is over the restless waves of the sea. The next to attract your attention is the announcement that a landing at Newfoundland is to be made in a short while, and that a period of twenty minutes will be allowed, during which time you can again become accustomed to walking on "terra firma." This time is utilized by the crew to provide ample fuel and provisions for the flight over the 1,940 mile stretch of ocean. The landing station at Newfoundland is an imposing structure rising some five hundred feet in the air. There are two large express elevators for conveying the passengers to and from the aerial liners and the streets below. Use is made of the new magnetic landing scheme and a "whirling disc" starting device, which appeared in a previous issue of this magazine.

After the necessary fuel and provisions have been carefully stowed aboard, the engines are started again and the plane rapidly rises into the air; the sensation and observations are identical with the ones experienced upon leaving New York. The pilot of the "Etheric" heads her straight up into a strata of air about 2,000 feet above the surface of the sea. A noticeable decrease in temperature is the result and a very light-headed feeling ensues. Looking off to the east, that is, straight ahead, a very dark and menacing bank of clouds is observed. Apprehension is felt, as this black appearance will shortly prove to be a severe electrical storm. But the passengers may feel reassured, as their safety has
been provided for by the equipment of the "Etheric" in the form of lightening rods. These rods extend on all four corners of the ship and ground is obtained by the dropping of a copper wire to a distance of about 150 feet from the bottom of the plane. Upon the extremity of this wire is placed a torpedo-shaped steel "fish." Should the misfortune occur that the "Etheric" were to be struck by lightning, the lightning would be extinguished, but still from the protruding rods down thru the insulated wire and dissipated into the air below the machine by means of the "discharge在外的".

Our pilot, with expert skill, starts the gigantic airplane on a rather sharp angle and the powerful motors respond quickly, carrying it to a height of 12,000 feet. At this height we are absolutely safe from any danger whatever that might have been in store for us from the approaching thunderstorm. The speed of the plane heading directly into the tempestuous area carries us above it in a very few minutes. The roll of the thunder is ear-splitting; we fail, however, to see any lightning discharges as we are above the storm; and therein our feeling of insecurity soon passes off.

By referring to the chart that is placed amidship on either side of the cabin deck, we discover that we have traveled some 600 miles since leaving Harbor Grace. A fellow passenger is heard to remark, "I feel the beginning to feel rather chilly. A plane-hand, over-hearing the remark, informs me that the heat in the cabin has been turned on and he will find comfort below. We are skeptical — for who ever heard of heat in an airplane? Being Americans, we are naturally inquisitive and our curiosity got the better of us, so we descend the stairs in order to find out for ourselves if what we were told is true or was mentioned to give us a "psychological cushion." Going downstairs we notice a perceptible increase in temperature and a feeling of well being once more. After climbing to the upper floor, we are conducted to the kitchenette, where we are offered aperitifs. From the corners of our stomachs, an electric gong starts to ring vigorously and as we have heretofore learned, it is the evening signal that "dinner is served."

The food is very good, and the fare is wholesome and satisfying. It consists mostly of canned goods, due to the lack of room and the ever-present need for lightening the cargo. However, it suffices to allay our appetites until we shall make a landing at Queenston and then we can partake of good old Irish "spuds." Soon night falls and we retire in our tiny cabins, where we are soon lulled asleep by the musical vibration of the "Etheric's" motors. Our sleep is untroubled.

About noon next day the summer sun brings out the highlands of Ireland in bold relief, and as we drop lower, altitude in order to affect a landing, we begin to realize that the populace in the cities of the country which we are to visit must necessarily be perceiving in this sweltering heat. We are made very comfortable by the thoughtfulness of the steward, who in the evening, in the lounge time, have put out for our comfort, even to the turning on of the four electric fans in the lounging room.

Despite the intense heat (note rapid change in temperature), we are all crowding to the rail in order to see where and how we are going to again come back to Mother Earth. Only an experienced question is very quickly answered when the machine comes to rest on a landing stage, an exact duplicate of the one we left at Newfoundland.

There are two things that attract our attention and in which this place differs from the Harbor Grace terminus—one of which is a slightly smaller size airship, built practically on the same lines as our ocean-going planes which is marked in very large letters designating that it will carry us to London if such is our intention and destination. The second object of interest is a large observation balloon suspended at an elevation of 1,000 feet above us; in which we can faintly see two men waving their periscopes. This special equipment is to show what type of balloon is for, we are given the information that this is the "meteorological station," operated by the Trans-Atlantic Airplane Company and by means of which the various nautical and air observations are determined and reported. Under this heading we are told that the temperature, visibility, time, tide and kindred other computations are made.

Upon this we are overhauled by a crowd of curious peasants, hucksters and market people. After finally disengaging ourselves from this human net, we arrive at a small town. One of the squares consists of an Irish jaunting cart drawn by a one-mule-power animal, "Mike" by name, who looks at us in his lazy way and seems to say, "You come over, up in the air, and you will again go up in the air trying to make me pull you and all of your infernal luggage." Climbing into the cart, with some feeling of insecurity, we finally arrange ourselves comfortably and our hackman starts to bawl out at his "hony" mule, and once more we are off on our way and about to visit the splendors and beauties of the picturesque Irish landscapes.

This story of a trans-Atlantic trip is not an idle fancy, but a logical forecast of the remarkable progress in aviation, the materialization of which will be found not many years hence.

The proposed mammoth Aeriel Liner here pictured will be constructed along the following specifications, according to logical figures which have been past upon by competent authorities. It will have a wing span of four hundred and twenty feet, a fuselage length of two hundred and ten feet, and a height of ninety feet from upper to lower planes. The planes, three in number, will extend horizontally from the hull of the ship to a width of two hundred and ten feet on either side.

The hull, containing the passenger compartments, is built on a stream-line basis, resembling that of a sulfur-bottomed whale, and is arranged to accommodate eighty-five persons, besides a crew of fifteen men, a total of fifteen thousand pounds of cargo, and carrying seven thousand pounds for support, he will be able to fly for the 18 hours' run; seventeen hundred pounds of the service capacity would be available for baggage.

The motive power is derived from six high-powered gasoline motors. The three motors situated on the upper deck and the two on the lower tier of the planes are of sixty-five hundred horsepower each. The central motor situated in the forward section of the hull is of two thousand horsepower; all the stupendous total of ten thousand horsepower, weighing in the neighborhood of twenty thousand pounds.* The horizontal and vertical stabilizers are of a design that takes advantage of the updraft of the machine, as are the rudder and elevator.

The upper side of the wings will be designed to take advantage of the upward suction. It might be well to state that 66 per cent of the lifting power is due to the suction on the upper surface of the wing panel, while only 33 per cent is credited to an actual pressure of air on the under surface. The lifting capacity of these three planes will be 1,000 per cent for the upper, 20 per cent for the middle, and 35 per cent for the lower plane. Figuring their angles to be 4°, the lifters will be capable of 1,400 pounds to

(Continued on page 594)

*The total gross weight will be 120,000 lbs., or 60 tons, and a useful load of 22,000 lbs., or 11 tons.
Electrical Testing Engineers Made to Order

By C. M. RIPLEY, of the General Electric Co.

CAN you imagine the delight in the heart of a young man when he goes to his post of duty on a battleship, cruiser, destroyer or submarine, in Uncle Sam's navy, and finds that he has charge of some machines, similar to those which he himself tested and adjusted in his student days? 100 men in a factory—in all of these activities—he must be a 100 per cent man.

But work in the Navy and in the Army is not the only kind of work that Electrical Engineers are doing and will continue to do for centuries to come—for electricity is useful in peace as well as in war. In fact electricity is necessary to American industry, and the wider and wider America uses electricity in the future, just so much more efficient will she be in battling for the markets of the world.

Men from all over the world meet on common ground in the Testing Department of this electrical concern—a department which occupies 72,000 sq. ft. of space. This area in downtown New York would cover nearly 15 city blocks, each the size of that occupied by the Equitable Bldg., which is bounded by Broadway, Nassau, Cedar and Pine streets. This space is 29 per cent greater than the entire rentable area of the Woolworth Bldg.

One reason why the Testing Department is the best department for a young man to start his career in, is because it takes him into so many different buildings and permits him to handle so many different types of apparatus. Hence, it is ideal for developing his knowledge of all types of electrical machinery.

The apparatus is tested where it is manufactured. The rough castings are received at one end of the building, machined, assembled at about the middle of the building, are then tested, and at the farther end of the building they are painted, boxed and loaded on the railroad cars to be carried later on mule back into the Andes mountains, on dog sleds into the heart of the Yukon, hauled by mules or by human carriers in China or by elephants in India.

Would you believe it possible that this concern has set aside and reserved merely for testing purposes, 250,000 k.v.a. of electrical apparatus? This statement is the result of a careful census and a conservative one, since it does not include any of the power stations—a certain portion of which are used for testing purposes.

At one of the plants the power station has only 1/10 the capacity of the Testing Department equipment. The total capacity of apparatus reserved for testing in each factory is greater than the capacity of its power supply. This situation is largely due to the "feeding back" method by which two motors, both under test, are used for testing each other—one running as a generator and the other as a motor. This saves floor space, saves power and lessens the generating capacity. The feeding back method permits testing to be done on an enormous scale with the use of a comparatively small amount of coal, as the machines being (Continued on page 590)
A NEW GAS-FILLED LAMP AND SHADE IN ONE.

The accompanying illustration shows a unique ornamental gas-filled lamp recently developed by a large lamp concern.

It is claimed that this lamp produces an indirect non-glare light which will not injure the eyes. The lamp is interesting in that it combines an ordinary gas-filled bulb with an ornamental lamp shade. The lamp, known as the "Liberty," is made of plain white glass with ornamental decorations in green, gold, blue and other shades that will harmonize with chandeliers or room decorations.

A NOVEL ELECTRIC WINDSHIELD CLEANER.

Altho simple in construction and easily attached the new electric windshield cleaner illustrated, manufactured by a Philadelphia concern, is attracting considerable attention in scientific circles, having been exhibited for the first time only recently.

A plate-glass disc, set in the windshield of any make of motor car or truck, is whirled at 2,000 r.p.m. on fine ball bearings by a tiny electric motor, the centrifugal force throwing off rain, snow, sleet, mist or dust, thereby keeping the vision area clear in every kind of weather.

ELECTRICAL EXPERIMENTER

The small motor is driven by current from the car's regular motor, the makers claiming that its operation costs less than that of a single headlight. Perfect balance and scientific precision of the instrument, it is explained, makes the high speed possible with minimum power consumption, there being no frictional wear and tear. A push button, installed in a convenient place on the regular instrument board, controls the current.

No repairs are necessary, it is claimed, the entire device requiring no cleaning or polishing. The motor is weather and rust-proof while the bearings are of a special type of fine alloy steel.

The diameter of the standard size plate-glass disc is seven inches. All parts, except the glass, are of white metal, heavily plated with nickel or black gloss.

Altho made especially for use on motor cars and trucks, the device also is adaptable for use on battleships, submarines and aeroplanes. While the standard size is seven inches, larger diameters are obtainable.

LACING SHOES BY ELECTRICITY.

By Frank C. Perkins.

The accompanying illustration shows a machine which performs with remarkable rapidity and perfect accuracy the operation of shoe lacing which, prior to its introduction, was purely a hand one and inaccurate. It is absolutely required wherever fine shoemaking is attempted to lace the shoes at the throat with thread prior to the lasting process. The demand for lacing with this machine has long been limited only by the number of operators who could be trained for this work, requiring as it does exceptional skill and experience to do even passable work.

It is pointed out that lacing with thread is practically the one method by which the eyelets and uppers of shoes can be protected from injury and which allows the upper to be drawn closely down to the last—considerations which are of the utmost importance in fine shoe making. The operation of the machine is very simple, all that is required of the operator being the bringing of the two sides of the shoe tops into position, so that the corresponding eyelets are back to back, and placing them over spindles on the machine.

A slight pressure of the foot lever starts the machine in operation and the thread is quickly past thru the eyelets and tied in a hard, unyielding knot, after which the properly laced upper is removed from the spindles, when the machine is ready to repeat the operation. A simple adjustment makes it possible to vary the location of the knot, so that uppers may be tied to allow any desired spread at the throat.

It is stated that as the stretch or the thread used is uniform, one or two simple tests are all that are necessary in regulating the placing of the knot to secure the desired result; and, once this is determined, the ma-
Turning Air Into Bread—Nitrates from the Air

By ROBERT H. MOULTON

If anyone came along and remarked offhand that air could be turned into bread, he would at once be considered a bit subject to confusion in lunacy. Nevertheless, this very thing is being done today, and what is more, Nature has been doing it very well for millions of years. The explanation is this: Nitrogen is drawn from the air and then converted into nitrates. Nitrate of lime is a rich plant food and when it is incorporated into the soil makes a wonderful fertilizer. The other natural deposits of nitrates are in Chili, South America, from which, up to the time of the present war, 1,800,000 tons were exported annually to fertilize the farms of the other parts of the world. But the Chilean nitrate deposits cannot be depended upon with certainty, even after peace shall have come. It has been calculated that the Chilean deposits will be dangerously reduced by 1923, and inside of a score of years the supply will be exhausted.

For these reasons the discovery of a practical method by which the inexhaustible supply of nitrogen in the atmosphere can be utilized, is of the greatest possible moment to the entire world.

To two Norwegian scientists, Professor Birkeland, of the University of Christiania, and Samuel Eyde, an engineer of the same city, is due the credit for discovering this method. They are now taking nitrogen from the air, solidifying it and preparing it for application to the soil. And, whereas the method of Nature requires an entire season to do this, the method of the two Norwegian scientists requires only a few days.

The plan in a nutshell is as follows: The air is drawn thru oxidation towers and is then forced thru electric arcs, where a terrific heat is maintained. The oxygen and carbon dioxide in the air are consumed, leaving the nitrogen. This is precipitated in the form of nitrous oxide. This nitrous oxide is then conveyed to immense porcelain towers 75 feet in height, where it is condensed and allowed to settle in vats of limestone. The chemical action then results in the production of nitrate of lime.

For several years a nitrogen making plant has been in operation near Rjukan, Norway, where 250,000 horsepower are drawn from the falls. Working day and night these quarter of a million water horses manufacture, out of the air, 200,000 tons of nitrat of lime per annum. But this describes the electric flames consisting of powerful arcs of light, which are used in the electric furnaces.

The formation of the flame occurs by an arc of the electric flame being formed between the points of the electrodes, which are close to each other. By this means a movable and flexible current is established in a highly magnetic field. The electric arc that has been formed moves on account of the magnetic field with great velocity parallel to the lines of force, and the electric arc's feet draw back from the points of the electrodes.

To regulate the current, an inductive resistance is used in series with the flame. With alternating current all the arcs are formed alternating in opposite directions and appear to the eye to be circular discs. This flame provides the powerful technical means for the oxidation of the nitrogen of the air.

The electrodes are thick copper tubing, thru which water is passed for cooling purposes. See photograph herewith. The chamber in which the flame burns is circular, of only a few centimeters width, and about three meters in height.

The interior of the furnaces is lined with fire-clay brick, thru the walls of which the air is admitted to the flame. The nitrogen formed in the flame escapes thru a channel made along the casing of the furnace, which, like the flame chamber, is furnished with fireproof bricks.

In order to supply the furnace with the amount of power desired, each coil is furnished with an induction coil, by means of which the power is regulated as required. The inductance coil serves, moreover, to keep the flame in the furnace steady and even while working.

The temperature in the flames is at the Rjukan plant 3,000 degrees Centigrade. The temperature of the escaping gases varies between 800 and 1,000 degrees. The furnaces are made of cast steel and iron, the middle of the furnace being in the form of a circular flame chamber. The electrodes are led radially into this flame chamber. By the aid of
centrifugal fans the air is brought into each furnace thru tubes from the basement. When the air in the flame chambers has been acted upon by the electric flame the nitrous gases formed pass out thru pipes, which convey the gas to steam boilers, in which the temperature, which was approximately 1,000 degrees Centigrade, is reduced. The gases pass on from the steam boilers thru an iron pipe into a cooling house, and complete the cooling begun in the steam boilers. Each cooler consists of a large number of aluminum tubes, over which cold water runs, while the hot gases pass thru them. In these tubes the temperature of the gas is considerably reduced. From the cooling chambers the gases pass to the oxidation tanks. See diagram in continuation.

The towers are vertical cylinders, lined with acid-proof stone. The object is to give the cooled gases a sufficient period of repose, in which time the oxidation of the nitrogen oxide may occur. The necessary amount of oxygen is present in ample quantity in the air which accompanies the gases from the furnaces. From the oxidation tanks the gases are led by blast engines into the absorption towers.

The towers are filled with broken quartz, which is affected neither by nitrous gases nor nitric acid, and thru them there is a continual trickle of water. The water absorbs the nitrous gas and when the liquid has become nitric acid of sufficient strength (30 per cent.) it is collected in cisterns, and from them again into vats filled with limestone.

There is considerable noise then, as the nitric acid displaces the carbonic acid of the limestone. The result of this is a watery solution of nitrat of lime. It is pumped into the vacuum evaporating apparatus, heated by steam from the boilers which are kept hot by drafts of fresh gas from the furnace. When evaporation is completed the solution contains 13 per cent. of nitrogen and it is passed into chambers where it is solidified into a hard crystalline mass. Later this is taken thru crushing machines, reduced to a coarse powder, and put into casks holding 100 kilos each. This powder is the finished nitrat of lime. The air has now been converted into fertilizer ready for application to the hungry soil. The U.S. Government is now preparing to erect powerful nitrogen fixation plants.

(Continued on page 502)

LADIES! WOULD YOU LIKE TO VISIT YOUR NEAR-BY ZOOLOGICAL PARK? PERHAPS YOU TIRE OF WALKING AROUND TO SEE THE VARIOUS LIONS, TIGERS AND POLAR BEARS, IN WHICH CASE, YOU CAN, IF VISITING THE BRONX ZOO IN NEW YORK CITY, FOLLOW THESE TWO LADIES IN ONE OF THE NEW ELECTRIC CHAIRS AVAILABLE FOR VISITORS AT THIS PARK.

LADIES! SEE THE ZOO FROM AN ELECTRIC ROLLING CHAIR.

Pleasure can now be mixt with knowledge at the New York Zoo by those who go there to study the animals. No more will it be necessary to walk miles upon miles to study all the exhibits on display in the greatest menagerie in America. Just get your electric roller chair—make believe you are the board-walk at Atlantic City—and see all that is worth seeing in Bronx Park. A twist of the hand lever and away you spin on your trip to see the lions, polar bears, giraffes, and monkeys. A storage battery concealed within the car body furnishes the electric current to actuate the motor which propels the vehicle. Electric headlights are provided for night travel, as well as an electric siren to warn pedestrians traffic.

WOMEN AS ELECTRICAL ENGINEERS.

The Rolin Chemical Company, with a plant at Charleston, W. Va., is hiring women to serve as electrical engineers because of their inability to secure men. Fifty-two will be employed.

A Belgian machine for digging canals will eat its way thru the ground at a rate of 100 yards an hour.

NAVAL CONSULTING BOARD CHANGES ADDRESS

Suitable space having been provided for the Naval Consulting Board in the new building of the Navy Department, at Washington, D. C., the preliminary examination of inventions, which heretofore has been conducted in the New York office, has been transferred to Washington, where it will be directed by Mr. David W. Brunton. All correspondences relating to inventions should be addressed as follows:

NAVAL CONSULTING BOARD
NAVY DEPARTMENT
WASHINGTON, D. C.
Poplar Astronomy
THE TOTAL SOLAR ECLIPSE OF JUNE 8, 1918
By ISABEL M. LEWIS
Of the U. S. Naval Observatory

TOTAL eclipses of the sun and the advent of comets are two celestial happenings that have always been observed by mankind with the liveliest interest. If the advance of astronomical knowledge had accomplished nothing more than to free the nations of the world from the hysterical fear formerly aroused by these two phenomena, it would be worth all that it has cost.

Only two hundred years ago a total solar eclipse in England was predicted in a pamphlet, entitled "The Black Day or a Prospect of Doomday." Exemplified in the great and terrible Eclipse, which will happen on the 22nd of April, 1915! Predictions of total eclipses of the sun still continue to be issued in the form of pamphlets, but instead of direful prophecies they now contain carefully prepared information and enlarged maps of the region traversed by the path of totality to facilitate the successful observation of a phenomenon that is now considered to be of such scientific importance that expeditions from many nations have at times been sent thousands of miles to observe it.

It is now a matter of universal knowledge that eclipses of the sun occur when the moon passes directly between the sun and earth and temporarily conceals the sun from our view. Since it is only at the time of new moon that the moon can pass between the earth and sun, eclipses of the sun must always occur at new moon and when the earth can come between the sun and moon and cast its shadow over the moon. Since the earth is much larger than the moon its shadow is much larger than the moon's shadow and as a result the moon becomes entirely emersed in the earth's shadow during a total eclipse of the moon, while during a total eclipse of the sun, the moon's shadow just about reaches to the earth. In fact the apex of the moon's shadow cone comes between the earth's surface and its center in a total solar eclipse. There are times when the apex of the moon's shadow falls short of the earth's surface. Then an annular eclipse of the sun occurs. That is, the moon's disk just fails to cover the sun's bright disk, giving the effect of a bright ring or annulus of light surrounding the dark body of the moon, whence the name annular eclipse of the sun. So near is the apex of the moon's shadow to the earth's surface during eclipses of the sun that occasionally an eclipse may be annular in one part of its course and total in another, the apex just grazing portions of the earth's surface and totally falling on the earth at the most. The width of the shadow path then shrinks almost to zero. The average width of the path of total eclipse is about sixty miles and its length something like eight thousand miles. The greatest width attainable by any shadow path of the moon is one hundred and seventy miles and this can only occur under a most exceptional and favorable combination of circumstances.

The moon's shadow trails over the earth's surface in the form of a narrow band of great length. If earth and moon were stationary the shadow would appear as a small dark ellipse on the earth's surface, but owing to the motion of both bodies and chiefly to the earth's rotation on its axis the shadow sweeps over the earth in a long narrow strip bringing successively for a few brief moments the phenomenon of a total solar eclipse to all located within its path. The average duration of the total phase of an eclipse at any one point in the path is only three or four minutes. Under the most favorable combination of circumstances totality may last seven minutes and fifty-eight seconds and it varies in length from this value down to zero, according to the circumstances of the eclipse. When the apex of the shadow fails to touch the earth's surface, passing either above or below it, there may still be visible a small portion of the eclipsed sun, the magnitude depending upon the distance of the sun.

Can occur at no other time. On the other hand eclipses of the moon occur only at the time of full moon, for this is the only time

Diagram to Show Positions of Sun, S; Moon, M, and Earth, E, at the Time of Total Eclipses of the Sun and Moon. Every Year There Must Be at Least Two Eclipses of the Sun and There May Be as Many as Five. There Can Never Be More Than Three Eclipses of the Moon in a Year and Some Years There May Be None. The Greatest Number of Eclipses Solar and Lunar Combined That Can Occur in One Year Is Seven. Some of These Are Only Partial Eclipses.
central line of the shadow cone from the earth. Also whenever there is a total eclipse of the sun upon the earth's surface the partial phase is visible for hundreds of miles on either side of the central line of the shadow, the magnitude of the partial phase decreasing as the distance from the path of totality increases. Partial solar eclipses are quite common occurrences, but so narrow is the path of total eclipse that hundreds of years sometimes elapse before a certain town or district is visited by a total eclipse of the sun. Every total eclipse of the moon on the other hand is observable from the entire night side of the earth since the earth's shadow is so extensive that the moon passes entirely into it during the total phase. So it is that all of us have seen total eclipses of the moon, which unfortunately have little scientific value, while very few of us have had the good fortune to observe one of the most impressive scenes that nature affords, a total solar eclipse.

On the eighth of last June a narrow strip of territory within the United States lay in the path of the moon's shadow cone while the partial phase of the eclipse was visible to a greater or less extent over the entire North American Continent. The central path of the shadow cone first touched the earth near Japan. After crossing the Pacific Ocean in less than two and one-half hours, it reached the western coast of the United States at the mouth of the Columbia River in the afternoon, crossed diagonally across the country reaching Florida forty-seven minutes later and two minutes afterwards past the earth at sunset near the Bahamas. The frightful velocity with which the moon's shadow travels over the earth can be judged from the fact that it journeyed from Japan to Florida in a little over three hours. The longest duration of the total phase for any one point in its path was two minutes and twenty-three seconds. Within the United States the duration was even less, averaging about one and a half minutes. The width of the path in the United States averaged fifty miles. Short as was the duration of the totality of June 8th the eclipse was observed with great success by expeditions sent out from the leading observatories of the United States and, if the World War had not prevented, expeditions from many European nations would doubtless have traveled to the Western States to observe the phenomenon. As it was, many astronomers in our own country who had planned to observe the eclipse were unable to do so owing to the urgency of war work.

The Corona, from a Negative by Edison Pettit. Top Is North, Left East. The Two Large Prominences on the Eastern and Western Limbs Are 35,000 and 45,000 Miles High Respectively. The Corona Streamers Themselves Reach Hundreds of Thousands of Miles Above the Surface of the Sun. The Little White Circle on the Right Under the Head of the Sun Represents the Actual Size of the Earth. It Gives a Good Idea of the Immensity of the Prominences.

The Lick, Yerkes, Lowell, U. S. Naval and Mt. Wilson Solar Observatories sent expeditions to favorable locations near the central line, as well as a number of college observatories; nearly all of these expeditions obtained photographic and spectroscopic results of great value to science. Clouds brought suspense to practically all expeditions and to observers stationed at Denver, the largest of which is a shadow path, they brought a completely overcast sky and the keenest disappointment. At Goldendale, Washington, the Lick observers were kept in uncertainty until the last moment, but were rewarded by a surprising break in the clouds, perfect seeing, at the critical time and a number of valuable photographic plates. A number of eclipse parties at Matheson, Colo., met with exceptional success as did also the U. S. Naval Observatory expedition to Baker, Oregon. The Yerkes and Mt. Wilson Solar Observatory expeditions at Green River, Wyoming and the Lowell Observatory expedition near Syracuse, Kansas, were hampered, but by no means defeated, by clouds and some remarkably fine views of the eclipse were secured at these stations.

The most important feature of a total eclipse of the sun is, of course, the corona. It can be seen at no other time. It is now possible to study with the aid of suitable instruments, such as the coronagraph and spectrophotograph, all the complex features of the solar atmosphere with the exception of the coronal gas. However, if the outermost solar envelope. Its light is excessively faint and so is invisible to the human eye except when the moon acts as a screen for our eyes and permits us to glimpse the exquisite beauty and intricate form of the coronal rays and streamers for a few valuable moments. At such times photographs of the corona are obtained and records of its spectrum as well, for use in later careful investigation of the nature of the light and the causes for the peculiar changes or form of this strange appendage of the sun.

It has been found from studying and comparing a long series of photographs taken during different total solar eclipses that the form of the corona is extremely intricate and that it undergoes periodic changes that are associated in some unknown way with the period of sun spot frequency. When sun spots appear in greatest numbers on the solar surface the corona is very brilliant and its streamers are widely developed in all latitudes. It is then a sun spot maximum type of corona. As the sun spots decrease in frequency the corona gradually changes to the form which it assumes when they are at a minimum. It becomes less brilliant and more (Continued on page 590)
Experimental Physics

By JOHN J. FURIA, A. B., M. A., (Columbia University)

LESSON SEVENTEEN

PERATURE FALLS. Newton's law adds the quantitative statement that the rate of cooling of the water body is proportional to the difference in temperature of the two bodies, i.e., the greater the difference in temperature, the greater the rate of exchange. These laws are very important in quantitative heat experiments, since they enable us to make corrections for the loss or gain in heat during the progress of the experiment and thus not necessitating tedious and difficult methods of controlling the temperature of the apparatus.

Experiment 100.

On photographing a spectrum such as was discussed in the lesson on light, we find that the photographic plate is affected beyond the limits of the shortest visible violet ray. These are known as the ultra-violet rays (meaning beyond the violet); they have been photographed and measured, having wave lengths as small as .000005 of an inch. The longest of the rays visible in the extreme red has a wave length about ten times as large. Delicate instruments however reveal infra-red (heat) rays five hundred times longer than the longest visible red ray. Heat and light differ only in the length of measuring radiations, can be bought reasonably, and can be easily made by those having access to a vacuum pump. It consists of four delicate, very light vanes fastened to the ends of a delicate cross arm of aluminum wire, mounted so as to rotate easily about the vertical axis inside of a glass bulb which has the air mostly pumped out. The vanes are blackened on one side and highly polished on the other side. When the instrument is brought into a beam of sunshine, near a gas flame or electric bulb, the vanes rotate rapidly. The writer has found it good sport to make a radiometer (see Fig. 90B) using an Erlenmeyer flask for the glass bulb and tin foil blackened on one side for the vanes. We require aluminum wire for the cross and upright, cork stopper, glass tubing, pinch cock, and rubber tubing, and DeKotinsky cement for making the connections airtight. (It is found necessary, because of leaks, to evacuate the flask from time to time.) The action is simple. We notice that the direction of rotation is such that the black side moves away from the heat source. The black surface absorbs practically all the heat radiations it receives. Hence the black sides become slightly warmer. A freely flying molecule striking the black side according to Prevost acquires some heat, and its vibrations are strengthened. On leaving the vane the reaction on the vane, according to Newton's third law of motion, is equal to the action of the leaving particle. A freely moving particle striking a shining side (colder) vane has its strength of vibrations lessened, hence its reaction on the vane is less than the reaction of the particle on the blackened side. There being more force on the blackened side than on the shining side, the set of vanes move in the direction—from the blackened side to the shining side—away from the source of heat.

Experiment 101.

Transfer the insides of a can of your favorite peach to your own inside. Punch a hole thru the can A and insert a thermometer T. Solder a circular piece of tin B at the open end of the can, and blacken it with soot. Fill with water thru the thermometer hole, and place on a wooden

(Continued on page 588)
Radio Around the World

On October first, a radio message was transmitted and received over a distance of twelve thousand miles. The message had been flashed from the powerful Marconi wireless station at Carnarvon, Wales, to a receiving station located at Sydney, Australia. While wireless experts were not surprised at learning that wireless messages had been received in Sydney, Australia, from Carnarvon, Wales, a distance of 12,000 miles, they pointed out that this was nearly double the distance that messages had been previously sent. It was on Tuesday, October 1, that Premier Hughes and Sir Joseph Cook of Australia, who were then in England, sent two messages from the new Marconi station at Carnarvon, Wales, to the Amalgamated Wireless Company's plant at Sydney; thus these messages enveloped the earth, for Hertzian waves move equally in all directions, as the accompanying illustration shows. This may or may not have been a freak radio transmission, said a Marconi engineer, but in any event it marks a new era in long distance radio-telegraphy. In fact, it actually brings true the dream of Nikola Tesla and many other great scientific minds, who some years ago predicted that the day would come when wireless waves would encircle our globe. As we know that wireless waves spread out equally in all directions just like the ripples in a pond of water when a stone is dropped into it, thus these powerful radio oscillations emanating from the antenna at the Carnarvon radio station, radiated in all directions, east-west-north and south; and eventually, at a point approximately halfway around the globe, or at Sydney, Australia, where a suitable apparatus had been erected, these same etheric wave vibrations were again picked up and interpreted.

Many interesting and revolutionizing developments have been and are taking place in the realm of high-speed long-distance radio-telegraphy. Among other interesting happenings in the field of commercial and government radio-telegraphy, we find that one thing that the forms of transmitters for this work have been changed in a number of cases with very gratifying results. For instance, it has been found that the Goldschmidt (German) type of radio-frequency reflecting alternator which was formerly used at Tuckerton, N. J., was so sensitive that it practically required an operator to stand alongside of it all the time in order to constantly adjust the various electric circuits and to keep the speed of the machine constant. Besides, it had a number of delicate mechanical features which required the utmost skill in the operating personnel.

Another form of transmitter which has accomplished some really remarkable work in long-distance radio transmission in the hands of skilled engineers and operators, is the high-power oscillating Poulson Arc, such as supplied by the Federal Telegraph Company and other concerns. The United States Government has used a large number of these Arc transmitters, and is now utilizing for a number of them at the present time in both large and small sizes for various requirements. A number of the larger wireless stations, including the transatlantic station at Sayville, L. I., have used a high-power Arc for transmitting. Both the Goldschmidt Alternator and the Poulson Arc are foreign inventions, and while they have shown some very excellent results in many ways, it is gratifying to note that they have both developed undesirable characteristics in operating, which have given way to an American form of high power radio transmitter of the radio-frequency alternator type, and upon which many thousands of dollars have been spent in research by one of the largest electric companies in America. Some of the best transmitting records ever made, both with regards to the clearness of telephone signals received and also their strength, have been transmitted across the Atlantic Ocean from one of the large American trans-Atlantic radio stations by means of the Alexander radio-frequency alternator.

A few years ago the radio-frequency alternator was considered more of a laboratory device than anything else by electrical engineers, and even by the radio engineers themselves. But at the present time the high frequency alternator in question has been developed to such a perfection that it really represents a remarkable stride in engineering design and technique. At present there are being used two large units of this type, one rated at 50 k.w. and the other at 200 k.w. Once upon a time these machines, in order to produce a frequency of 50,000 cycles a second, had to revolve at the tremendous and very dangerous speed of 20,000 r.p.m. (revolutions per minute) and up to 30,000 r.p.m. or more, but at the present time they have been so perfected in design as to require a rotation speed of but 5,000 r.p.m. Therefore, one of these machines can be operated without any greater attention than is required in the operation of any commercial dynamo or motor. It is possible to instruct radio operators in the handling of a plant of this type, it is said, within a few days. These machines are under perfect control at all times, and their regulation and operation either for telephone or telegraph wireless transmission is beautifully and accurately effected by means of a novel magnetic amplifier, which keeps the load on the driving motor constant, and also the frequency of the output current constant. The windings and magnetic sections are water-cooled.

For trans-Atlantic or trans-oceanic transmission, it has generally been thought that nothing else would do than a high steel mast with which to support the antenna, or else the employment of a series of tall steel masts extending over a distance of a mile or so, such as one finds at New Brunswick, N. J., or Honolulu. Nothing entirely new in the wireless field is the fact (Continued on page 588)
Harvard Hails the Naval Radio Man

HARVARD, scion of American college and university life—renowned for its classic halls and dormitories, from where thousands of America's greatest engineers, lawyers and captains of industry have been educated for generation upon generation—has capitulated to Uncle Sam's naval radio men, whom we see busily at work mastering the intricacies of wireless telegraphy in the three accompanying views recently taken at the Harvard Radio School, where several thousands of the Nation's finest are being given intensive training in Radio.

Once these classic halls resounded to the why and wherefore of the gerund and gerundive and why Nero burnt Rome. Now all one hears is the steady all-day drone of the five-hundred cycle buzzers as the keys tap-tap and the sailor boys learn how to take down a message at the rate of forty words per minute, more or less—usually less, at least for the first few weeks.

Fig. 1 of the accompanying view shows a portable radio field set equiped with manually driven dynamo and tripod, being demonstrated before a squad of junior naval operators. It is an unwritten law that the Navy is out to beat the Army when it comes to radio matters, and judging by the great interest evinced by all of the students present at the various classes, it seems that the lackies will at least give the Doughboys a hard tussle, when it comes to solving the various phases of angular impedance and the logarithmic decrement. The portable field radio set, shown at Fig. 1, has a range of about forty to fifty miles, and is intended for use with a collapsible aerial, which is supported when in use from a telescopic steel or wooden mast, about seventy-five feet high. The receiving instruments and transmitting apparatus are all contained in a cleverly designed water-proof case resembling a large dress-suit case. It is surprising how quickly the boys are trained to set up and dismantle one of these sets, and as a matter of fact, they have often set up such as frequency and power factor meters. The hot wire radiation ammeter is mounted just over the spark gap in the center of the photograph. The receiving set in front of the student seated at the table with the head "phones on, is of the de Forest type, with calibrated dials which indicate the

Fig. 2.—In the Receiving and Transmitting Apparatus Laboratory Where the Future Naval Radio Men Are Thoroughly Instructed in the Handling of Modern Apparatus.

Fig. 3.—One of Harvard's Radio Classes in "Theory."—The Exact Relation Between Radio Theory and the Apparatus Itself is Taught by the Aid of Blackboard and Instruments.

wave length being received directly in meters. Three electrode vacuum valves are used practically all together in both the Army and Navy sets, and the receiving set here shown employs vacuum valves. A naval officer is seen in the foreground instructing the operator seated at the instrument table. In the background may be seen the large-sized oscillation transformers of the spiral copper ribbon type, while at the left the copper plated Leyden jars condensers may be observed. In the extreme rear corner of this laboratory there is mounted a complete, magnetic type, automatic starter for the motor-generator set.

If you want to see an interested class of radio students, just glance at Fig. 3, which shows a class in "Radio Theory" at the Harvard Radio School. A Naval petty officer is acting as the instructor to this class, and we are glad to say that the Navy Department has succeeded in enlisting some of the best radio men in the country for this purpose. Some of the classes are very large and contain several hundred students. Unlike the average collegiate course in radio or electrical engineering theory, these future naval operators are taught theory hand-in-hand with actual practise. This is proven by the fact that wherever there is a blackboard at this school there is also invariably a more or less complete set of apparatus such as used in practise. Note the close interest manifested.
ADJUTANT-GENERAL McCAIN, in discussing the publication of war-
casualty lists, makes this statement in
regard to the transmission of numerals by
telegraph: "More mistakes are made by
telegram companies in transmitting fig-
ures than in transmitting anything else."

Groaning business men everywhere
crowd forward to testify that
statement is only too true.

For many of the errors in telegrams
there exists efficient first-aid. The over-
speeded telegrapher, losing a word, re-
places it with a neat fresh one from his
own vocabulary, fully as long as yours,
and as stout and serviceable in every way.
And this honest practice an-
wers very well, the context usually en-
abling you to restore your correspondent's
original word, if for some reason you like
it better.

For streamlining out proper names, you
rely on the wonder-
ful insight of the elevator man, who
after years of prac-
tice is able to rec-
ognize a patronymic
even when severely disfigured—such as
"Oake" for "Oakam".

But for the poor hard-working numerals
there is no "timely succor" anywhere in the
community. Every little figure has a mean-
ing of its own; and, loyal as the digits may
be to their corps, it is impossible for one
of them to "take another's place and do the
best he can." Remember what happened to
the porter who put out at Buffalo the man
in lower six, instead of the one in lower five, who'd requested the favor?!

A wounded numeral is a "dead" numeral.
But because he's the most vulnerable does-

n't explain why he's the oftener hit.

Hush now, hush! for me purpose is to
invade the guarded enclosure, and attack
the sacred cow. Is it possible that the com-
plex numerals of code-signs themselves are
partly to blame?

What, as a matter of fact, is the objec-
tion to using simply:

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—a scheme which would have occurred to
Father Adam, if he'd received a telegraph-
set along with his animals?

I assure you I'm trying to handle this
subject with tender circumspection, a mother
accords her child, or a bomber his bomb;
for it's a "commonsense" sugges-
tion, and nothing infuriates people like one
of these. I've found.

I'll never forget my experience with a
worthy lady, a neighbor of mine, who was
troubled with the rain soaking in around
her window-frames. She had carpenters
on the problem, and plumbers, and masons,
and guess most every profession but
undertakers, and they applied shingles, and

See how pretty! All of them different
from the letter-signals, and with such a
natural progression—prefixed dots in regu-
lar order, then knocking them off till you're
out of dots again.

Some cantanker-
ous old pipefitters
consider them just near
enough alike to be con-
fused. But that isn't all; plumb in
the middle of this
dream of complex
symmetry, what
meets the eye? Hor-
ors! As I live, five
dots for the figure
"1"! Forthwith arise
the voices of the
Babe and Suckling,
inquiring in plaintive
tones, "If five dots is
good for 5, why
aren't there six
telegraph isn't six
good for 6?"

As usual, the Babe
and Suckling, like
the fewest, are
easier spanked than
answered. The simple
series of taps, or any
short sounds, represen-
t numbers so naturally
that anyone, telegrapher or
not, can read them,
read them right.

Whatever else a
numeral does, it surely
ought to "nume"; and
the simple ones
do, while the code-
man's intricacies sig-
nals don't. He
seems to have drest up his cook till she's
spilled the beans.

Some say you couldn't count nine quick
dots with accuracy. But you can count
the quickest-striking clock up to 9, and even to
12. As a closer comparison, take the fire-
alarm tappers in the engine-houses and
street-boxes. They're quicker than any
clock, and furthermore, a shorter line of
numbers, forming tens and hundreds, as
"2-6; 3-8-5"; but I never heard that the
fremen often drove half a mile to box
375, for example, miscounting it for box
351, just around the corner. The dot sys-
tem's good enough for them, and they
sometime betray a regard for holding their jobs
at that.

Others say the dots would be mistaken
for letters.

 would be "E" as well as "1".
 "1" also "A".

Oh, yes, serious confusion would result:
an operator copying "EISH dollars," for
instance, might mistake the "Eish" for an
accidental sneeze, and furthermore (as
etiquette requires) and inform Jones that
Smith "will give you dollars"; and Jones
would think his message was the words to
a song, a companion-piece to "In the morn
I bring thee violets," and perhaps get mad
—because some folks don't like music.

But talk about mistakes. How about
the abbreviated form" of code-
numerals actually in use, where

(Continued on page 585)
A Rotary Quenched Spark Gap
By FRANCIS R. PRAY

THERE are a great many Radio amateurs who find it impossible to join the Service for some reason or other, and realize that the present is an excellent time to make that "perfect" set if for no other reason than the quite obvious fact that raw material will not be cheaper than it is now. Of course you exclaim; "Cheap! Why, it costs more now than it ever did." Well, yes, that may be so, but did you ever stop to think what it will cost after the war?

No doubt your next transmitter will employ a rotary quenched gap, as that is the most efficient type up to date. Should you be undecided as to the design, allow me to submit the following, as it combines the best features of the gaps on the market, besides several original ones. It is easily made with no other tools than a small bench lathe and slide-rest and the usual experimenters' hand tools. It is so designed as to combine the utmost in ruggedness with the easiest accessibility and the minimum not too much.

Parts "A" and "B" should be of brass or copper, or possibly aluminum, the sparking surfaces "C" should be heavily silver-plated in order to insure the utmost efficiency, and you know aluminum cannot be plated. Part "A" may be cast solid and the cooling flanges cut in later with a parting tool. Much care should be taken to see that the sparking surfaces are cut at exactly 45 degrees and perfectly smooth before silver-plating. The ring "D" may be made of any tough metal, since it carries no current. It is held onto the Bakelite tube "E" by eight machine screws. Tube "E" need not have a wall thicker than \( \frac{1}{4}\) inch. Disc "F" is of Bakelite also, and should be accurately fitted to "E" so as to exclude air. Eight machine screws tapped into its periphery should be sufficient to hold it in place firmly. A whole piece of Bakelite with a cross-section like "G" should be turned in the lathe and fitted into a recess in "B." This hole should be cut first and the 45-degree sparking surface turned last, because this surface should not vary the slightest in its orbit. "G" is held in place by metal washer "H." Four machine screws be all right to take a little off the motor bearings to make some, as the gap's adjustment depends on this feature. "P" and "Q" are large washers. On the right end of part "M" a small recess is drilled just large enough to hold a single ball bearing. Axle grease or vaseline is put in the hole to make the bearing run easily. By turning knob "K", the sparking electrode "B" is moved to and from the electrode "A." When a satisfactory distance is found by experiment, the lock-nut "K1" is screwed up tight. In assembling the gap, turn "K2" as far up as possible and unscrew the machine screws slightly at "R." The holes for these machine screws in the rim around part "A" should be somewhat larger than usual so that when part "A" is fitted to part "B," "A" may be moved around until it fits cone "P" snugly. Then the screws "R" are tightened and gap is ready for use. If desired, a hole may be bored at "S" and a small tube tap in thru which gases may be forced for experimental purposes. An outlet may be made at "T." Holes should be bored to ventilate the motor at points "U" and "V" all around the tube.

A Detail View of Rotary Quenched Gap, End-Play Shaft Regulator.

AIRMEN USE FALL AS RUSE TO FIND HIDDEN WIRELESS.

Residents of Glen Cove, L. I., who a short time ago had been wondering and complaining about the continual flying over their homes of airplanes from Mitchell Field, Mineola, were amazed when it became known that Department of Justice agents have been searching the city for an alleged hidden German wireless plant, said to have been discovered thru efforts of the airmen. The wireless plant is declared to have been located in the attic of a house in the exclusive Red Springs section of Glen-Cove.

For days airplanes have been hovering over the city. Two machines came to grief, and the pilots were taken into nearby houses. Now it is said that the accidents were deliberate, with the intention of gaining admittance to the suspected house. After being picked up, presumably unconscious, and carried into a certain house, one of the airmen, while left alone, is said to have fired the concealed wireless.

HOW TO MAKE BUZZER GIVE HIGH TONE.

Being in need of a buzzer giving a high pitched tone I took an ordinary call buzzer, removed the armature and \( \frac{1}{2}\)-inch from the end of the contact spring I wound two turns of No. 22, B. & S. bare copper wire around the armature under the contact spring, and two turn around the armature and over the spring. Then I twisted the ends of the wires together tightly. When I replaced the armature and adjusted it I had a high tone buzzer, which made hardly any noise to the ear, but using a telephone receiver it almost "raised the dead.

Contribute by GEO. F. HARRINGTON

A Simple Trick For Making Any Buzzer High Tone.
DETECTOR BUILT ON ATTACHMENT PLUG.

Herewith is a drawing of a "receptacle detector." Any number of detectors can be made and different ones screwed in as needed.

The base is made from an old wall type receptacle or other kind of receptacle. The detector container is made from the bottom of an old attachment plug. The plug screws into the receptacle and the detector is then ready for use.

Contributed by E. T. J.

A CLEVER WIRELESS PRACTISE SET.

Take an old tuning coil, remove the sliders or slider and on each corner of the top of the end support tack on two thin wooden sticks, such as kite sticks, and let them project over about 4" at one end. If a tuning coil is used, bring out each end of the winding as shown in coil No. 1. Connect telephone receivers as shown in diagram.

To make coil number 2, take an old curtain pole or a piece of broom handle. Saw off a piece about one inch in length. Now to make the end, take an old piece of heavy cardboard and cut out two circular pieces about two inches in diameter. After finding the exact center of your cardboard, take the round piece one inch in length, and attach the two cardboard discs, one at each end. After completing, wind full of No. 16 or 18 insulated magnet wire and hook up as shown.

By depressing the key the battery is connected with coil No. 2; the magnetic lines of force travel from coil No. 2 to coil No. 1. By operating the key according to the coil, the sound will be heard in the receiver, the same as in long distance wireless receiving. This method is fine for learning the wireless code, as the sound produced in the receiver can be varied in strength by shifting the coil No. 2 along the slide strips on top of the coil.

Contributed by T. G. GRANTHAM.

ELECTRICAL EXPERIMENTER

A PERFORATED TAPE CODE TEACHER.

After reading the description of various contrivances for teaching the code, I thought I would try to make one of my own design. Here is a description of it. Referring to the illustrations, A is a tin can cover, the one represented in the figure being 7" in diameter. This will take a record 22" long, or long enough to hold the entire alphabet, minus the figures. It has a grooved pulley about 2" in diameter fastened under it on the center by 4 screws. A hole is drilled centrally thru both pulley and can cover. This had better be done before fastening them together. Procure a base of suitable size, and on each end tack a piece of tin 2" square with a column in the center. Fasten an insulated wire over one tack and run this to one binding post.

The can cover should have a small piece cut out of its edge 1/16 of an inch wide, as at B. Two springs shaped as at C are soldered to the can cover inside at D. The record is a strip of paper about 24" long, with the dots and dashes cut out with a ticket punch. The ends are past thru the cut in cover edge and fastened under the ends of the springs. The cover can now be mounted on the base, over the piece of tin. Put a couple of washers under it, and fasten it down with a screw. Put a washer under the screw head too. The brush is made of spring brass shaped like E. Cut slits in the end so it will be turned to make contact with the can cover thru the dents as shown in the tape record. A driving pulley is now mounted on the other end of the base. Put washers under this too. Screw a handle on to turn it by and have a hole in the handle large enough to turn freely on screw holding it. Connect this pulley with the small one with a strong belt. Put a piece of rubber hand in it so it will always be tight. The pulleys need not run exactly true. Connect the brush with the other binding post and the code teacher is finished. In making the record repeat the same letter three or four times in some of them, as it is necessary to hear them over and over again to remember them. It is to be remembered that the instrument is connected in series with a buzzer or sounding battery.

Contributed by A. E. HERSEE.

AN Imitation "STAGE" RADIO.

Having need of an imitation wireless sending station for use on the stage that was to operate in semi-darkness, I hooked up a buzzer and electric light globe (paint ed blue), so that when a contact was closed it would connect both of them as shown in the diagram. The buzzer represents the noise of the spark discharge and the globe, represents the light that the spark throws off. The contact is to be closed by the operator (actor) pressing the key on the stage. The buzzer and the light, of course, are not to be seen by the audience. They may be placed behind a box or some other object on the stage. The buzzer should make the loudest noise possible. When this apparatus is used in the semi-darkness it will prove very satisfactory.

Contributed by G. B. PENNBAKER.

HARD RUBBER PANELS.

Go to the storage battery station in your town and ask for some large size battery jars that have been discarded. These can be procured for little or nothing. Set these in hot water until they are pliant and then with a hack-saw cut so that the jar cuts two sides at once. If the rubber becomes stiff while sawing, immerse it in the hot water again. After it is washed it can be polished with linseed oil and shellac. It can be drilled with a metal drill. If one piece is not of sufficient thickness, two pieces may be fastened together, rough sides touching, by means of the screws of the apparatus.

Contributed by DONALD HUCKE.

ROUND TRANSFORMER CORES.

In cutting the sheet iron laminations for the "legs" of transformer cores, make them of different widths, i.e., cut them narrower as they get farther from the middle. The legs will then be round, rendering the transformer much more efficient and also easier to wind on the coils.

Contributed by H. G. ASCHBRENNER.
How to Make a Seven-Inch Reflecting Telescope

By LATIMER J. WILSON

The desire to see the planets thru a telescope of greater power than the one which came within the writer's limited means financially is responsible for his accomplishing the task of making a telescope of considerable efficiency. The grinding, polishing and figuring of a glass speculum is not beyond the average ability, and such an accomplishment is far more satisfactory than the purchase of a refracting telescope of small size. Indeed the service rendered by a home-made 11-inch reflecting telescope has compared favorably with that rendered thru several months' experience with an 11-inch refractor of the best construction.

A seven-inch speculum is less difficult to construct than a ten or an eleven-inch, tho it is powerful enough to disclose details on the discs of Mars and Jupiter, Saturn and the moon, and will present splendid views of the wonders of the milky way. But if one wishes to attempt a larger size he may do so by following the methods described here, increasing in proportion the length of stroke in working and the quantities of material.

The concave mirror, or speculum of a reflector performs the same service as the lens of the refractor, it brings the rays to a point in the focal plane thus forming a real image of an object. This image in both telescopes is magnified by the eyepiece, various eyepieces being used to furnish different magnifying powers. It is obvious that the quality of the image must be perfect to permit of magnification.

The materials for a seven-inch mirror in 1910 cost about $5, including the glass discs.

There will be needed two discs of common plate glass, seven inches in diameter, one-inch and one-half an inch in thickness respectively. The thicker disc becomes the speculum, the other the "tool." The thickness of a glass speculum should be in proportion to its diameter about as 1:8.

Two or three pounds of borundum No. 80, one or two pounds of No. 120 and two pounds of Grade E FF will be needed for the grinding. One half a pound of Jeweller's Rouge (iron oxid) and about three pounds of Burgundy pitch, two cakes of beeswax, four ounces of turpentine and a pound of resin are required for polishing. These, with a few chemicals needed for silvering the finished mirror, complete the list of ingredients which one must purchase.

The one-half inch glass disc, edges ground smooth and top edge of the rim slightly bevelled, is cemented with pitch to a wooden block ten inches in diameter. The block is then made fast to a rigid support, a post or a barrel that has been firmly fastened to the floor. The worker must be able to walk freely around the support and must have plenty of room for the necessary arm movements in grinding and polishing. The one-inch thick disc, the future speculum, is cemented with pitch to the center of a circular wooden block six inches in diameter on the top of which is screwed a handle. In manipulating the speculum over the glass tool the hand must at no time come in contact with the glass of the speculum. The heat from the hands is sufficient to produce a perceptible effect in the final curve.

The No. 80 borundum (or emery) is made damp with a little water and is spread thinly over the tool. The speculum is held by the handle in such a manner that a very slight pressure from the side of the hands is upon the wooden block; it is then moved forward and backward across the tool, the worker rotating the speculum all the time by means of the block and the handle. As the grinding proceeds the worker walks around the support in a direction contrary to the direction in which the speculum is rotated. The speculum should be moved forward and backward a space slightly greater than one-half the diameter of the disc. This motion tends rapidly to cut away the center of the upper disc, at the same time cutting away the edge of the tool, making the latter convex and the former concave.

The amount of concavity necessary for a focus of sixty inches is equal to the arc subtended by a radius of 120 inches. Roughly it can be determined by frequently examining the surface of the speculum in sunlight during the stages of rough grinding. Wet the disc and hold it so the sun's light will be brought to the position of best definition, indicated by the smallest disc of the solar image. When the distance from glass to image measures about sixty inches, the rough grinding is complete.

The successive stages of the grinding are devoted to refining the curve and eliminating the pits and scratches caused by the coarser particles of borundum. It will be well to subject the No. 120 grade to a series of two washings. Mix the whole of it into a receptacle holding two gallons of water and...
water, stir well and immediately pour off all the sediment. This will be used for the first stage of fine grinding. The portion that was poured off should be allowed to settle for ten seconds and then all but the water and sediment contained in the lower part of the vessel again poured off. These sediments labelled 1, 2 and 3 are to be used in the first, second and third stages of the fine grinding.

The stroke in grinding with the finer grinds is progressively shortened. Moving the specimen forward and drawing it backward a space of one-third or one-fourth the diameter tends to keep the curve concave, and gradually to produce a spherical form. Shorter strokes tend to flatten the curve and during the final two or three hours of fine grinding the strokes may be no longer than one and one-half inches.

The FFF Grade of the flour of carborundum is subjected to several washings as follows: (a) the coarsest 8 seconds; (b) 20 seconds; (c) 1 minute; (d) 10 minutes; and (e) 30 minutes. The particles held in suspension in the washing that is left after standing 30 minutes are so fine that the liquid seems almost to be pure water. Great care should be taken not to permit coarser particles from getting mixed with the finer grinds when they are placed upon the convex surface of the tool. Plenty of water must be used during the fine grinding to prevent the binding of the surface as it is manipulated over the glass tool.

The final surface when the fine grinding is complete will present an appearance of a thin film of dried milk spread upon a piece of transparent glass. Black type well spaced and lighted one-quarter of an inch in size should be easily distinguishable as viewed through the ground surface, if the back surface is of polished plate.

Next the Burgundy Pitch is melted and strained. It is then thickened with resin or thinned with turpentine until when cool (at the room temperature) it permits a slight impression to be made with the thumbnail when pressed into it. The grinding tool is cleaned and a strip of surgeon's tape, or lantern-slide tape (paper) is stuck to the glass circumference so that it will protrude about one-quarter of an inch all around above the surface. The melted pitch is then poured on the tool and allowed to set an instant.

The speculum is painted with the rouge, which has been mixed with water and only the thin portion of which has been removed for use, thus assuring only the finest portion, avoiding coarse particles. It is very important that the speculum be kept thoroly wet with rouge and water when it is placed upon the warm pitch and gradually permitted to rest upon it until the surface of the pitch has assumed the curve of the speculum. The pitch is then reheated by passing a gas flame across it rapidly until it is soft enough to permit squares to be pressed into it. These squares must be spaced one-quarter of an inch apart by pressing a wooden foot-rule in lines at right angles, the lines being one inch apart. A reflected light from the center of the tool but should be sufficiently eccentric to allow only one corner to be in the exact center. When the squares are formed the grooves can be cut out very clean with a sharp knife, after which every particle of the debris must be washed off the polisher which is again heated by the gas flame and coated with a mopping of melted beeswax. The speculum is again painted with the rouge and is gently pressed upon the square surface for a short while it will shape the surface into perfect contact. Then the polishing can begin, the purpose of the squares being to distribute the rouge and to assure even polishing. Frequent application of rouge is necessary.

The strokes are at first as long as in the coarse grinding. When a sufficient polish appears the mirror can be subjected to the well-known Foucault Knife-edge Test. Always before testing the mirror should be permitted to rest for fifteen minutes in order to cool all the heat from the friction of polishing has subsided, otherwise a true test of the surface cannot be made. In a darkened room the speculum is placed in an upright position and directly in front of it at a distance equal to the radius of curvature (in this case 120 inches) is placed a lamp having a bright flame hidden entirely by a metal chimney. Opposite the brightest part of the flame is a needle hole so directed toward the mirror that the light from it will be reflected back to a point within ten inches of the lamp at its side. The brighter the light and the smaller the needle hole the better will be the result. The writer has used satisfactorily a small arc projection lantern having a prism in the path of rays and the light from the lamp is directed through a needle hole in a piece of tinfoil glued to the side of the prism. This enables the worker to make the test at a distance of only a few inches. The light from the needle-hole illuminates the mirror as seen at the principal focus. Inside this focal point the image of the lamp will be seen upright; beyond the point it will be seen inverted, but at the focal point the light from the bright needle-hole will illuminate the disc so that no image will appear except the mirror's bright disc. An opaque object such as the straight edge of a knife blade mounted upright can be passed across the cone of rays before the eye. If the shadow advances as a straight line in the same direction as that of the moving knife-blade the mirror is too near the mirror; if it comes from the opposite direction it is too far, but if the mirror gradually darkens the blade is in the best focus and the test can be made.

Imagine the surface of the mirror illuminated from a direction opposite to that from which the blade is moved. If the surface then presents the aspect of a ridge around the edge and a hill in the center, the polishing strokes should be lengthened to cut away the elevations. If the mirror shows slight depression the strokes should be shortened. If a deep depression is seen and the outer portions of the disc seem turned back, the figure is that of a hyperbola and to correct it go back to the grinding, using very short strokes. A perfect sphere is indicated when the surface darkens evenly. Work first for this effect. Then to produce an approximate curve that will satisfy all demands polish for a very few moments at one time, until the surface looks like a shallow dinner plate, a very faint trace of a depression in the center. This will probably approach the parallel curve, and if not carried too far will result in a perfect speculum.

(Continued on page 586)
A Simple Study of Currents and Magnets

By Prof. E. H. JOHNSON, Dept. Physics, Kenyon College

ONE of the first facts that the investigator in the field of electromagnetism comes to recognize is that there is a "directedness" to the interactions between magnets and current-bearing conductors. The mystery is partly dispelled, however, when he learns that a magnet, whether permanent or due to a current in a coil of wire, can be attracted or repelled only by another magnet—that is, it is acted upon only by a magnetic field.

Now the "field" in the sense here used means the entire region throughout which the magnetic force can be detected by any means whatever. Therefore the various portions of the field can be considered to have direction, because a force has a direction. And if we try to map out a field of magnetic or any other kind of force on a sheet of paper, we will get a series of lines or arrows, not necessarily having any uniform direction. Such a map is naturally limited to two dimensions, and so will represent only some one plane arbitrarily chosen in the three-dimensional space field of force we may be studying. These direction lines in the field have been called the "lines of force," and it must be remembered that they are directions only and probably do not exist in any much more real manner, nor do they serve to enable us to form a comprehensive idea of the possible causes of the reactions we may actually observe.

To grasp the ideas involved in a clear manner, many simple experiments can be performed, but we will content ourselves with several of the simplest ones, which, tho not new, are well worth close observation by the student.

To begin with, we have the fundamental law that LIKE magnetic poles repel one another, while UNLIKE magnetic poles attract one another. Hence, according to our previous statement that the magnetic force of a magnet, as ordinarily observed in its natural North-and-South position hold directly, above it and parallel to it, a single wire in which a small direct current is flowing. It will be found that if the current is flowing from South to North above the needle, the North pole of the needle will be deflected toward the West, as shown at —a—, Fig. 1. If the current is reversed, the needle will swing to the East, as shown at —b—. Now if the wire is slpt under the compass and the preceding two steps are repeated, the deflections will be changed correspondingly, as indicated by —c— and —d—, Fig. 1.

From this simple experiment we can see that there is a definite relation between the direction of the current and that in which a magnetic pole will move if free to do so. If one imagines that he can look along the wire, of which the shaded portions in Fig. 2, represent sections, the arrow-like direction in which a North magnetic pole will move when the current is flowing out from or into the plane of the paper, Mercury.

Another simple rule covering all of the above cases, is that known as the right-hand rule, which states that if the current-bearing wire is grasped in the right hand, with the thumb pointing along the wire in the direction in which the current is flowing, the fingers will encircle the wire in the direction in which a North magnetic pole would be deflected. See Fig. 3. This rule is perhaps the easiest to remember of the many which can be given, but it should be clearly seen that they all lead to the same conclusion and that the law they seek to illustrate is perfectly definite and invariable.

So numerous are the experimental possibilities for demonstrating this principle that it is in fact difficult to escape its application in any branch of electrical science. Without it electromechanical machinery would be impossible. For the present, a few simple constructions will suffice to show how repeated or continuous motion may be obtained with the use of simple deflection as in the case of the compass needle, and also the examples here given are in the nature of toys long known to anyone familiar with the subject, they will be highly instructive and well worth the time and effort involved in their construction by anyone who is not thoroly acquainted with them.

Secure a glass tube or slender lamp chimney (A, Fig. 4) about 6 inches long and about an inch or so in diameter. Into its ends fit two corks, B and C. Thru the lower cork, C, thrust an iron rod, D, about ¾ inch in diameter and 3 inches long. Around the lower half of it wind a couple of layers of insulated wire (any size from No. 18 to No. 24) and carry one end of the wire up thru the cork, shown in Fig. 4, so that it may be surrounded by a layer of mercury, F, which, in turn, should not quite cover the upper end of the iron rod. Thru the upper cork, B, pass a short length of bare copper wire G, and then hang it from a loosely a sufficiently long piece of similar wire, H, to just encircle the mercury. This device can be mounted in an upright position on a block in any convenient manner.

(To be continued)
Spectroscopic Methods and Spectra

A SEQUEL TO "HOW TO BUILD A SPECTROSCOPE"

By D. S. BINNINGTON

PART II—Conclusion

Method No. 1.

THIS method of obtaining the spectrum of a gas, is the only one that can be used, and has several difficulties in the way of home-made apparatus. The principle of the method is, that the required gas is sealed up in a tube in an exceedingly dilute condition, and by means of platinum electrodes, the tube is connected to a spark coil. The tubes are of the shape shown in Fig. 7, and the narrow portion is placed in front of the slit for inspection. These tubes cannot be home-made without special apparatus, etc., but can be purchased from dealers in laboratory apparatus with various gases, such as oxygen, hydrogen, carbon dioxide, etc. The price of these varies somewhat, but the lowest is about $1.50 per tube. They can also be obtained filled with the rare gases, argon, helium, neon, krypton and xenon, but these will not interest the average experimenter as they are only for use with delicate apparatus, besides ranging in cost from $5.00 to $15.00.

To those who are interested in this branch of the work, however, a tube can be purchased that, coupled with the fittings of a stop-cock is then closed and the tube is ready for use. This tube possesses the advantage that it can be filled with any desired gas for one outfit. But care must be taken to exhaust it thoroughly, else complications will ensue. It should be noted, too, that all the materials used to prepare the gas must be as pure as obtainable. The gas should be washed with a proper wash liquid, and dried over concentrated sulfuric acid, Calcium chloride or any drying agent. These details, however, can best be obtained from

good laboratory, will give excellent results.

Method No. 3.

This method is really the simplest of all three, but has some disadvantages, however, which eliminate it from certain classes of investigation. It consists, essentially, in vaporizing the material in the electrical arc.

A quantity of carbons about ¾" diameter should be cut by means of a small saw into pieces 6" long. One end should then be roughly rounded off with coarse sandpaper or a file. It should then be clamped in a vise or between two boards, and a hole drilled in the center of the end about as large as a pencil lead, and about 3/16" to ¾" deep. A mixture of the material to be used and its own bulk of charcoal is then powdered, well mixed and packed into the hole. It is then placed opposite a plain carbon in a horizontal position, and an arc struck between the two. A small amount of the material is vaporized into the arc, the temperature of which is sufficient to vaporize any known material. As, if this method is used, fresh carbons must be prepared, it is convenient to make a small stand to hold them in use and so that they are easily interchangeable.

An apparatus for this purpose has been designed by the writer and is shown in Fig. 9. One carbon is fixed, while a clip is made into which the prepared carbons can be inserted. A water rheostat is used in series with the arc on 110 volts. A standard spectrometer as used in the laboratory, note how the prism is clamped to a rotatable table. The telescope and collimator are adjustable and the base has three leveling screws.

The finished electric arc for producing various spectra. A water rheostat is used in series with the arc on 110 volts.

A text-book on Chemistry. This covers the field of work on gaseous spectra for amateurs, but, however, hardly touches it from the scientist's point of view, as the subject of gaseous spectra has probably the widest field of all spectroscopic work, and merges to a considerable extent into X-rays, radioactivity and similar fields of electrical work connected with vacuum tubes, and basing their theories on electrons, etc. Indeed this subject belongs really to Physical Chemistry, which correlates all that is known from the chemical, electrical and physical standpoints, and places it on a common foundation.

(Continued on page 594)
An Electrical Photo Printer

By DR. E. BADE

The electrical photo printer is made from a wood or metal box eight inches in length, nine inches in breadth, and twelve inches in height. The cover, one inch thick, extends two inches on each side. It is made in two parts but it differs from those usually employed in that an iron flange, E, is attached to it, which hooks the presser block and holds it in place at E. The same piece of iron also presses the rod G, which, by means of levers, pulls H downward. H fits into another pair of levers within the box which lift the red cloth screen, J. The lever is held in place by the brace. The screen is made from a framework of wood and covered with suitable cloth. The screen is in its normal position when it is down. The negative and the paper are placed upon the glass plate and the mask is adjusted. As soon as the press is brought down to hold the picture in place, the rod is pushed down by the flange, the screen lifted by the system of levers, and the light from the bulb will print the sensitive paper. This forty watt bulb, which is constantly lit, is

AUTOMATIC GASOLINE ENGINE "STOP."

This device is used to stop a gasoline engine that drives an air compressor automatically, when the pressure has reached the desired point.

We found it impossible to get a safety valve that would not leak air, so I designed this device and have found it entirely satisfactory. All that is necessary to do is to start the engine and "forget it." When the pressure gets high enough the engine stops.

The circuit breaker, A, is made from an old bell. The two springs, B and B, were taken from an automobile tire valve. The switch handle, C, is made of fiber (wood or hard rubber). The armature, D, is riveted to the steel strip E (old hack saw blade). F and F are merely stops to prevent springs from pulling levers too far. G is a pivot connecting H to I. The hook J is of steel (case hardened) and catches in the steel hook (which is hardened) on the end of E. E is pivoted on the steel pivot K (piece of hack saw blade). The pivot K has a projection which goes thru in E to keep E from slipping out of place.

In regard to the pressure gage it must be placed between pump and check valve. At each impulse of the pump the hand jumps slightly. One of these jumps is enough to close the circuit for an instant. Then the hand falls back a little and prevents start. A small hole must be drilled thru the dial at the desired mark, a corresponding hole is drilled thru back of gage (shown in drawing). The bolt A has a wire soldered to its head. This wire extends thru dial of gage and has platinum point soldered on its side. Bolt A must be insulated from gage by means of fiber washers at B. The hand C has a platinum point soldered to it so it will make contact with the point on A. When the point on hand C touches point on A the circuit is closed. The magnets in the circuit-breaker pull armature D down, allowing arm C to fall back, thereby breaking the ignition circuit and stops the engine. To start the engine again the arm C is pushed in again.

Contribution by L. E. PARSONS.

TRAIN REVERSING SWITCH.

If you have an electric train with a permanent magnet field then reversing the current would reverse the motor. I have designed this reverser, which is combined with a variable resistance unit.

The switch handle is made of fiber or hard wood and the contacts on it are made of copper. The resistance coils can be old shade-roller springs.

Contributed by BURTON McKIM.
LATHE CHUCKS.

A OTHER form of independent jaw chuck is found useful in chucking irregular work. This has four screw clamps or dogs of the form indicated in Fig. 5, which are bolted by means of a nut to the chuck or face plate. By tightening the large threaded screw against the work, it will be securely fastened for operation.

A very useful form of chuck which depends upon adjustable screws for holding the work, is the bell chuck, and this is shown in Fig. 6. It consists of casting or forging made in the shape of a bell, C, which is bored and threaded at the back to fit the lathe spindle. The work, W, is held between the screws S.S.S., which are placed at regularly spaced intervals around the bell portion of the casting. In the side view of this chuck, two sets of screws are shown, one set behind the other, which enables the work of considerable length to be adjusted centrally, while the work is more securely held than by one set of screws.

At times when the work is heavy at one side, or when an angle plate is used in chucking, it is necessary to bolt a counter-balance on the face plate opposite the heavy part. The distance from the center of the lathe to the heaviest part of the work should be the same distance to the center of the counter balance; otherwise the work will run out of center or out of true, and thus will not be round when machined, owing to unbalance.

A drill chuck is usually very handy, and is made much smaller than those described above. It generally contains three jaws. A most common form of drill chuck is shown in Fig. 7. The drill is secured between the jaws by turning the knurled outer shell of the chuck. This operation automatically tightens up all the jaws.

For especially accurate or precision work, another form of chuck is used, which is called a split- or draw-in chuck. The chuck and method of securing is shown on precision head stock, Fig. 8. The draw-in chuck, I, consists of a cylindrical tube with a hole in the center of proper diameter. One end of this tube is turned conically, and its face split in three equal parts, by three slots. This tube is threaded on the opposite end and fits into a rod, R, protruding thru the spindle, and its end secured to a handle, H. Looking at the construction of the head of the spindle, it will be noticed that by drawing the split cylinder towards the rod, R, and turning the handle, H, that the conical end will be drawn in, thus making the hole of the cylinder smaller. If a rod of the proper diameter were secured in this hole, it would be tightened up and clamped in it. This cylinder with the conical end and split face is called the chuck, and the rod, R, is called the draw-in attachment of the chuck.

There are a great many sizes of split-face chucks. Each and every one has a definite size hole, and can be used only with work having its diameter approximately equal to the diameter of its chucking hole. This, of course, gives a standard hole, and for this reason is used for precise model and other work, where accuracy and speed in centering is necessary.

In order that the amateur may not be confused with the terms, it may be stated that the word "precision," as applied to the lathe, has several meanings. One of these concerns a lathe, no matter on what principle it is built, which if carefully constructed, is capable of producing precise work within the limits of one type. The real meaning of the word, however, is technically applied to a particular type of tool, which, in addition to the first-class workmanship, is also constructed on a definite plan, so that precise results are attained mainly from the method in which the machine is set up. A true precision lathe is generally a tool for lighter work. The mandrel is so designed that the bulk of the precision accessories are attached to it by means of a draw-in spindle or rod, and not at all by means of a threaded nose.

It is well to remember, and it is a proven fact, that the screw-on principle of attaching chucks to a lathe is far from desirable from the point of accuracy. However carefully the nose may be screw-cut and the chuck fitted, sooner or later, due to dirt accumulations in the chucks and wear on the thread by continually screwing in and unscrewing it, and on the faces of the chuck adapter, the attachments work out of alignment. In addition, the method by which so-called self-centering is accomplished and which was described at the beginning of limited wearing area of their jaws, only serves to make matters worse. For most purposes, in small power engineering, at any rate, the usual method of screwing on chucks is quite accurate enough, in view of the fact that it is the usual thing in heavier machine-tool practice. In some classes of work, notably in watch, clock and instrument making, this matter becomes particularly important, and it is here that the want of a true precision lathe results in its production on the line just mentioned. Also in heavier machine work where large quantities of interchangeable parts have to be made on repetition lathes of the turret-head kind, the split-chuck principle is used. Practically all model shops, especially those turning out instrument parts are equipped with precision lathes of this type. (Continued on page 594)
SULFUR: History.

Sulfur was known to the ancients, the alchemists attaching a great deal of importance to it. They thought it was one of two or three primary substances. The Greeks and Romans utilized it as a medicine.

Preparation.

The crude sulfur earth and masses of ore are piled with a small amount of fuel in heaps over depressions in the ground. These heaps are then ignited, the Sulfur melts, runs down, and is collected from the hollow beneath. The liquid solidifies and this product is exported.

So that the reader will not be confused by the names Brimstone or Roll Sulfur, and Flowers of Sulfur, it will not be out of place to distinguish between them at this time. Sulfur, on the contrary, is the crude unmoulded sulfur, which is used for technical purposes only. Flowers of Sulfur, is the so-called sublimed sulfur, which consists of a mixture of the rhombic and amorphous varieties (to be described later).

Sulfur is refined and made into Flowers of Sulfur by the process of sublimation. The crude Sulfur is contained and melted in a vat, which leads to retorts, thru which the sulfur is diverted (see Fig. 152). All the air is excluded during this passage, and after reaching the retorts, then vaporized by heat situated directly under the retorts. In this state it is then past into a chamber, on the cold walls of which it sublimes. As the walls of these chambers become heated, the sublimate melts and the liquid is drawn off by means of an outlet situated at the bottom of the chamber, into cylindrical moulds. It is in this form that it is called Brimstone.

Sulfur can be obtained from the Calcium Sulfid which is obtained as a waste product in the LeBlanc soda process. This waste product, before removing from the leaching vats, is subjected to a current of air, by which the sulfid is partly converted into sulphur and thiosulfate. The calcium thiosulfate may be used for the preparation of Sodium Thiosulfate ("Hypo") which is used in considerable quantities in photography, or the mixture may then be treated with Hydrochloric acid,

2CaS + CaSO₃ + 6HCl = 3CaCl₂ + 4S + 3H₂O

The recovery of sulfur from the purifiers in the gas works is practised to a large extent in England. The gas, of which Hydrogen Sulfid is a constituent, is past over moist ferric oxide, thus,

2Fe₂S + 3H₂O + 3O = Fe₂O₃H₃O + S

The recovered iron oxide, mixed with Sulfur, is then exposed to another quantity of the gas, and repeatedly regenerated until the mass contains about 50 per cent of Sulfur, the latter being recovered by heating the mixture.

Allotropic Forms.

Octahedral or Rhombic Sulfur. This is the form in which it occurs in nature as well as that form in which it crystallizes from Carbon Disulfid.

Prismatic or Monoclinic Sulfur. This form is obtained from the cooling of fused Sulfur. On heating Sulfur in a Hessian crucible until melted, allowing to cool until a crust forms on the surface, then quickly pouring out the liquid portion, the crucible will be lined with long, brilliant transparent crystals, having the form of monochine prisms, these becoming opaque after twenty-four hours at ordinary temperature. If these crystals are examined under a microscope, they will be found to be made up of minute rhombic crystals. This form has a specific gravity of 1.96 and melts at 120 degrees, and is soluble in Carbon Disulfid.

Plastic or Amorphous Sulfur. This may be prepared by carefully heating Sulfur to 330 degrees, and then pouring, in a thin steam, into water. The product in this case being an amber-colored, plastic mass, which may be drawn out into threads or kneaded between the fingers. This is called the Plastic variety. The specific gravity of this form in 1.95, which is insoluble in Carbon Disulfid. Due to the fact that it quickly reverts to the rhombic variety with the evolution of heat, no melting point can be assigned to it.

(Continued on page 577)
SECOND PRIZE, $2.00

NIFTY SLOT-CUTTING WRINKLE.
To cut slots (which is quite difficult to do neatly with a thin file), hook into your hack-saw frame, instead of the usual single blade, two, three or four blades, according to the width of the slot desired. Be sure to have the teeth of all blades point the same way. A beautiful even slot is the result.

Contributed by THOMAS REED.

MAKING A SWITCH FROM AN OLD FUSE BLOCK.
To make a switch from an old fuse block is an easy matter. All the material that is necessary is the fuse block, a piece of brass rod the right length, and a wooden handle. I used the handle of an old shocking machine. A hole is bored in the handle so as to hold the brass rod snugly. The clips that originally held the fuse are now used to hold the brass rod. Connections are made by running the brass rod in the clips in place of the fuse. When the switch is not in use the rod may be taken off and taken with you, so no one can tamper with the switch while you are away.

Contributed by RUSSEL MAC COMISKEY.

FIRST PRIZE, $3.00

A HOME-MADE "LOCK-SWITCH." Having need for a lock-switch, I made one as shown in diagram. On a base, B, I mounted a padlock, C, with screws. A wire was soldered at C and connected to binding post D. A block of wood was mounted at A and a strip of brass, F, was fastened to it. The brass spring was connected to post E. The strip of brass was bent until a good contact was made when the padlock was open.

To make this switch more effective, a cover should be put over it, with an opening where the key otherwise fits. A little extra work is expended on this, but the result is more than sufficient to build a neat lock-switch at a low expense.

Contributed by E. D. PAPKEE.

A SIMPLE PADLOCK SWITCH FOR CLOSING ALARM BELL CIRCUIT WHENEVER LOCK HASP IS OPENED. A simple padlock switch for closing alarm bell circuit whenever lock hasp is opened. Inserting the key and a pin, H, should project thru the cover so that the lock can be shut.

Contributed by E. D. PAPKEE.

A CENTRALIZED BUZZER TELEGRAPH AND TELEPHONE LINE.
This scheme comprises one buzzer, 2 dry batteries, 2-75 ohm 'phones 1 m.f., connected at either end but at the center of the system preferably. Only one of each is necessary to work both ways. Where two Amateurs reside in the same house or on the same side of the street this will go a great way towards keeping them in trim until after the war. Now, brother experimenters don't wear long faces because you can't use your radio outfit. Hook this up and forget your grouches.

Contributed by JOSEPH C. HANHAUSER.

TRY THIS STUNT ON YOUR PIANO.
A very unique and entertaining (also sometimes exasperating) attachment may be easily installed by musically inclined experimenters, for their own amusement.

Procure a telegraph sounder and a few dry cells. Consult the accompanying diagram, and the soft pedal will do the rest.

Contributed by J. J. COPeland.

HOW TO REMEMBER OHM'S LAW.
I present herewith a simplified method for figuring Ohm's law which I have never seen in print. It might appropriately be termed 'Ohm's Law in a Nutshell.' In the formula E represents voltage, A amperes, and R the resistance in ohms. To find any term, cover it with the finger. Thus to find the amperes we have the fraction E over R, or volts divided by ohms; to find voltage we have A times "Ohm's Law in a Nutshell."
Never before has there been such a big demand for trained graduate electricians, and never at such splendid pay. There are not enough trained men in the country. More men must be trained to meet this urgent need. Here is your opportunity!

You — yes you — are wanted, but as a TRAINED ELECTRICAL MAN. In these days there is no place for idlers, and there is no place for the untrained man. In civil or military life he is not only useless, but he is a burden. It is now up to every one of us to prepare to be just as useful to the country as possible. And after the war the untrained man will be up against it still worse, because he will be unable to compete with the skilled men now being trained. How does this hit you?

BE A CERTIFICATED ELECTRICIAN
Earn $45 to $100 a Week

There is only one thing to it; you simply have to prepare for a real business if you expect to ever get ahead; and I can easily train you so you will soon be ready for a fine Electrical position, if you will only follow my advice and instruction. My system of Instruction at Home, without interfering with your work, is simple and clear yet thorough and complete. A few months snappy training of the right kind will prepare you to earn a good salary and start you on the way to a big success.

I have trained thousands of men and I know what I can do for you. In fact, I know so well that I will Guarantee under Bond to return every cent of your tuition if you are not entirely satisfied when you receive your Electric Certificate as a graduate of my school.

How have other successful men gotten ahead? Not by idly drifting along, but by preparing for bigger things. They have no more brains than you, but they have trained them. You can do the same and soon be earning a fine income.

L. L. COOKE, CHICAGO ENGINEER
DEPT. 20Y
441 Cass St.
YOU'RE WANTED!

CATED ELECTRICIAN

You Men of Draft Age  Don't delay taking up this course because you may be drafted. That's the very reason you should begin immediately. It is your patriotic duty to make yourself worth the most possible to your country—and to yourself—and of course the trained man with technical education is the one who rises in rank and pay. If you begin at once you may finish the course before you are called, but if not the part you have covered will be a benefit to you. Write me about it today.

What Can You Do as a Trained Man? This is absolutely the day of the specialist. Success in any line depends upon training. What line will you take up? There is no field that offers such a wide range of application, such wonderful opportunities for financial advancement and such urgent need for more trained men as Electricity. I can very quickly train you so that you can handle your share of the business of the nation. But it is up to YOU. You must act for yourself. But if you will give me your confidence and your co-operation I will take you along the way to a real success. Fill out the coupon and send! Now.

The Only School In addition to the fact that I am Chief Engineer of Chicago Engineering Works and can help you better than anybody else, here we have large finely equipped shops where you can come at any time for special instruction without charge. No correspondence school has such equipment or can make you such an offer. You can't learn electricity from a set of books.

Special Offer Right now I am giving a big valuable surprise that I cannot explain here, to every student who answers this ad. Be sure to get this. Write today.

FREE LESSONS AND OUTFIT

Send me the Free Outfit coupon at once. Do it now! For a limited time I am making a slashing cut in the cost of tuition and giving each new student a fine Outfit of Electrical Tools, Materials and Instruments—Absolutely Free. I will also send you—free and fully prepaid—Proof Lessons to show you how easily you can be trained at home to enter this great profession, by means of my new, revised and original system of mail instruction which has proved so successful for my students.

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To everyone who answers this ad I will also send without charge my free book, "How to Become An Electrical Expert". Write for it today.

Tear Off and Mail The Coupon Now!
It will not cost you a nickel to find out all about this, and it may mean everything to your future life. Don't neglect it. Tear off the coupon right now. Fill in your name and address and send it to me. Then what I will send back to you will show you the wonderful opportunity I am offering you and how easily you can take advantage of it. Now tear off the coupon.

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CHIEF ENGINEER COOKE,
Chicago Engineering Works,
Dept. 20Y-441 Cass Street,
Chicago, Ill.

Please send me at once—fully prepaid and entirely free—complete particulars of your great offer for this month.

Name .................................................................
Address .............................................................
City ................................................................. State ..........................
BE A CERTIFICATED ELECTRICIAN

Never before has there been such a big demand for trained graduates in electrical engineering, and never at such splendid pay. There are not enough trained men in the country. More men must be trained to meet this urgent need. Here is your opportunity!

You — yes you — are wanted, but as a TRAINED ELECTRICAL MAN. In these days there is no place for idlers, and there is no place for the untrained man. In civil or military life he is not only useless, but he is a burden. It is now up to every one of us to prepare to be just as useful to the country as possible. And after the war the untrained man will be up against it still worse, because he will be unable to compete with the skilled men now being trained. How does this hit you?

**B E A CERTIFICATED ELECTRICIAN**

Earn $45 to $100 a Week

There is only one thing to it: you simply have to prepare for a real business if you expect to ever get ahead; and I can easily train you so you will soon be ready for a fine Electrical position. If you will only follow my advice and instruction. My System of Instruction at Home, without interfering with your work, is simple and clear yet thorough and complete. A few months snappy training of the right kind will prepare you to earn a good salary and start you on the way to a big success.

I have trained thousands of men and I know what I can do for you. In fact, I know so well that I will Guarantee under Bond to return every cent of your tuition if you are not entirely satisfied when you receive your Electric Certificate as a graduate of my school.

How have other successful men gotten ahead? Not by idly drifting along, but by preparing for bigger things. They have no more brains than you, but they have trained them. You can do the same and soon be earning a fine income.

L. L. COOKE, Chief Engineer

CHICAGO ENGINEERING WORKS

DEPT. 20Y

441 Cass Street

Chicago, Ill.
A SIMPL E KIPP GENERAT OR.
The Kipp generator shown in the accompanying drawing can be easily and cheaply constructed. The drawing explains itself, so far as construction is concerned. The test tube should be as large as possible, but picking over a block of wood until the wood is perfectly smooth, stain and finish up in any desired style. Use no color for oak. Rosewood Stain—Alcohol 1 gallon, camwood 2 ounces. Set in a warm place 24 hours. Add extract of logwood 3 ounces, aqua fortis 1 ounce. When dissolved it is ready for use.

India Ink—Grind fine lampblack and gelatine, scent with camphor or musk essence and mold in sticks. It can be improved by washing the lampblack with a solution of caustic soda and then straining off the solution or drying it out. Transparent for Tools—Best alcohol, 1 gal.; gum sandarac, 2 pounds; gum mastic, 1/2 pound. Place all in a tin can which admits of being corked; cork it tight, and shake it frequently, occasionally placing the can in hot water. When dissolved it is ready for use. This makes a very nice varnish for new tools which are exposed to dampness, etc.

Contributed by ERNEST E. MILLER.

A NOVEL CHEMICAL INDICATOR.
In chemistry an indicator is something which tells whether a substance is acid or basic. The following is a rather peculiar one:

Place some sulfate of quinin in a beaker and add some water. The sulfate of quinin will not dissolve. Now add dilute sulfuric acid drop by drop until the sulfate of quinin is all dissolved.

To test for a basic reaction add some of the above solution to the solution to be tested. If the solution is basic the sulfate of quinin will reappear as a flaky precipitate. To test for an acid make some of the test solution slightly basic and add solution to be tested. If the solution clears the substance is acid.

Contributed by J. C. MORRIS, Jr.

EXPERIMENT WITH CALCIUM CARBONAT.
Place some powdered calcium carbonate in a vessel containing some water. The carbonat is insoluble. Now blow the breath thru the water and the carbonat will dissolve due to the fact that the insoluble carbonat of calcium is transformed by the carbonic acid gas of the breath into the soluble bi-carbonat of calcium.

Powdered or precipitated chalk is a convenient form of calcium carbonate to use.

The reactions which take place are as follows:
First: The carbon dioxide of the breath unites with the water to form carbonic acid, according to the equation:
\[ \text{H}_2\text{O} + \text{CO}_2 \rightarrow \text{H}_2\text{CO}_3 \]

Second: The carbonic acid unites with the calcium carbonat, according to the equation:
\[ \text{CaCO}_3 + \text{H}_2\text{CO}_3 \rightarrow \text{Ca(HCO}_3\text{)}_2 \]

If the solution of the bi-carbonat is heated the carbonat of calcium will again appear as a precipitat because the bi-carbonat of calcium is broken up by the heat, according to the equation:
\[ \text{Ca(HCO}_3\text{)}_2 \rightarrow \text{CaCO}_3 + \text{H}_2\text{CO}_3 \]

This latter fact is made use of commercially in the purification of water.

Contributed by J. C. MORRIS, JR.
Electric Light for Pencils.
(No. 1,274,320, issued to Cristian Edmundson.)

This electric light attachment for pencils or pens is intended for use in conjunction with a small flash-light battery carried in the pocket.

The attachment as here designed is detachable from the point of the pencil, and is also provided with a switch for closing the lamp circuit. The switch is controlled by the movement of the fore-finger while writing and thus the position while writing is a natural one. The attachment may be adjusted at any position along the pencil to compensate for reshARPaning, etc. Two or more pen lamps can be used in the reflecTor.

Electric Cooking Vessel
(No. 1,274,021, issued to Howard C. Causten.)

This invention relates to a domestic kettle or cooking vessel adapted for use with an electric heating unit, the improvement being directed to the provision of a receptacle within which the heating unit properly may be removable placed so as to be below the bottom of the general volume of the vessel so as to insure entire immersion of the heating unit, with an amount of liquid which is relatively in proportion to the volume of the vessel. By the arrangement as shown, the liquid is delivered to the heating unit from a position in which soft India rubber is used. The inventor claims that the device is efficacious for the purpose of making cooking machine records, and reproducing them by means of this invention.

"Cold" Light
(No. 1,274,110, issued to William L. Barnard.)

On the order of the cold light of Dusaud, the Frenchman, this inventor provides an incandescent electric lamp having a multiplicity of filaments which are connected to a rotary switch in such a manner that when the switch is rotated by a motor, a continuous and uniform luminosity will be produced by the lamp. Each filament produces but an intermittent luminosity. In this way each filament is switched off before it produces any great heat, and thus the total heat radiation from such a lamp is greatly reduced.

Art of Illustrating Phenomena
(No. 1,270,369, issued to Charles F. Bishop.)

Ordinarily the flow of electrical current along a conductor is an invisible phenomena of course, but the inventor represents action in electrical circuits by using parallel lines to form each conductor, and then partly fills in the space between these lines with short black sections to represent the presence of a current. He also uses parallel lines of varying density to indicate different degrees of magnetization. When a large number of successive diagrams are constructed in this manner, it is evident that a very realistic effect will be produced upon the spectator, as he can visibly see the current flow around the circuit, the core becoming magnetized and the secondary discharge across the spark plug, etc.

Radio Signaling Scheme
(No. 1,271,431, issued to Roy Alexander.)

An improved method of radio signaling employing a receiving antenna designed to exclude interfering electric-magnetic waves having a frequency considerably higher than the frequency of the incoming waves. The usual arrangement of elevated antenna may be employed, but included therein at regular intervals, there is inserted a series of flat inducances, which may be of equal value, and of the form of closely wound coils. This antenna is connected in the usual manner to a tunable receiving set. Apparently a species of electrical inertia is thus imparted to the antenna system which resists the wide oscillations produced by shock.

Talking Motion Pictures
(No. 1,275,227, issued to Clyde J. Coleman.)

In this patent an arrangement is provided for establishing synchronism between a motion picture projector and a phonograph, such that this synchronism is attained by providing an escapement for one mechanism, controlled by the driving element of another, each mechanism having a separate source of power. The phonograph is placed behind the screen, and the sound passes thru openings in the same. A commutating disk controls the electrical impulses sent thru an electromagnet attached to the escapement mechanism or when attached to the picture projecting machine, so as to translate the "speed" and "register" of the film.

Direct Reading Ohm-Meter
(No. 1,275,980, issued to Harry Gould Stuart.)

The inventor provides a direct reading ohm-meter comprising two distinct elements, viz: an ammeter and a voltmeter. It operates on the principle of Ohm's law, familiar to all electricians. The movable element of the ammeter carries a calibrated scale or dial; the movable element of the voltmeter carries an indicator which extends in a direction approximately at right angles to the scale attached to the ammeter. Thus the scale and indicator overlap, and by noting the position of the indicator with respect to the scale, the total resistance of the conductor can be immediately deduced.

Telephone Transmitter or Receiver
(No. 1,270,920, issued to Konrad Bose.)

A telephonic device suitable for use in converting sound waves into electrical impulses, or electrical impulses into sound waves. The inventor provides a clever and simple arrangement of telephone transmitter or receiver of the diaphragm type, and which has operatively connected thereto the diaphragm oscillator, an auxiliary coil, and an oxidizing agent material, such as iron. This so influences the magnetic field when the diaphragm is actuated that current impulses will flow thru the circuit in which the oscillator is connected. Further, the passage of electrical impulses thru the magnetic oscillator influences a magnetic field that the diaphragm will be oscillated in such a manner as to emit the original sounds which set up the electrical impulses thru the magnetic oscillator in the telephonic circuit. The diaphragm used is of mica. The conical helix may be made of iron or steel.

A Liquid Rheostat
(No. 1,270,808, issued to Arthur J. Hall.)

In this improved form of liquid rheostat, means are provided for automatically changing the load due to the evaporation of the electrolyte within the rheostat and maintaining a substantially constant amount of electrolyte, which may be continuously circulated thru the liquid rheostat for the purpose of dissipating the heat developed therein. Another provision is an automatic means for maintaining the density of the electrolyte at a constant value. To accomplish this an auxiliary tank of fresh water is connected with the main electrolyte reservoir, so as to automatically replenish the electrolyte whenever the volume has decreased to the predetermined amount. A pump is provided for circulating the electrolyte continuously as shown.

COPIES OF ANY OF THE ABOVE PATENTS SUPPLIED AT 10C EACH
With the Amateurs

"Amateur Electrical Laboratory" Contest

THIS MONTH'S $3.00 PRIZE WINNER—HOWARD BUCKWALTER

HEREWITH I present three photos of my Electro-chemical "Lab." All together my Electrical "Lab" consists of about 45 pieces of apparatus, such as static machine, Leyden jars, induction coils, switches, spark coil, a lamp bank, a magneto, a small dynamo, several motors, all the parts of a radio outfit, several parts of a telephone, a variable arc, and a couple of flat condensers, A. C. bells, a resistance, German Silver, and copper wire, etc. The static machine is of the Toepler-Holitz type, from which I can coax a six-inch spark. With the above mentioned apparatus I have performed a considerable number of experiments, especially with the static machine. The Electro-chemical "Lab" consists of over one hundred and fifty reagents and about sixty pieces of apparatus, among which are ring stands and clamps, test tubes, Erlenmeyer and Florence flasks ranging from 25cc. to 200cc., graduate, delivery tubes, U-tubes, Hydrometer, lactometers, 2 balances, wash bottles, a nest of beakers, a retort, a mortar and pestle, etc. The apparatus set up in the right foreground is for the electrolytic production of lead carbonat. With the apparatus I have performed a number of experiments in inorganic chemistry. The other photo shows my library, which consists of 52 purely scientific books. Also a 200 diameter microscope, a skull, and several supplement photos from the "E. E." I have all of the "E. E." issues since November, 1913. HOWARD BUCKWALTER, Lancaster, Pa.

HONORABLE MENTION (1 year's subscription to the "ELECTRICAL EXPERIMENTER")—E. BERGQUIST

ONE of the photos (lower group) shows my wireless controlled boat that I made: it goes out and shoots four small cannons off, and has two speeds ahead and two speeds reverse. It is directed by a small spark coil on board. My shop is located away from the house, so I can make all the noise I want to without disturbing the folks. Two small storage batteries can be seen under the shelf and a transformer is below the switchboard, from which I can get any potential from 1 volt up to 220, and up to 50 amperes. At the right of the large ammeter is a magnetic rectifier of my own design, which is connected to an oil-immersed step-down transformer beneath the table and from which I can draw 20 amperes D. C. current for charging batteries, and I take in quite a few for charging. In front on the shelf is an electric soldering iron, which I find very handy. On the end of the shelf is a 60,000 volt, 54 K. W. transformer. When I connect this to my Tesla coil, I can get sparks about eight inches long. On the switchboard are various instruments for measuring resistance, volts and amperes. I can obtain from 2 to 12 volts A. C. or D. C., by simply turning the few switches on the switchboard. At the extreme right can be seen my telephone, which goes to 6 other electric "Bugs." one of whom resides a mile away. I also have "Experimenter" dating back to 1913 and a complete set of electrical books.

E. BERGQUIST, Spokane, Wash.
Phoney Patents

Under this heading are published electrical or mechanical ideas which our clever inventors, for reasons best known to themselves, have as yet not patented. We furthermore call attention to our celebrated Phoney Patent Office for the relief of all suffering daffy inventors in this country as well as for the entire universe.

We are revolutionizing the Patent business and OFFER YOU THREE DOLLARS ($3.00) FOR THE BEST PATENT. If you take your Phoney Patent to Washington, they charge you $20.00 for the initial fee and then you haven't a smell of a Patent yet. After they have allowed the Patent, you must pay another $20.00 as a final fee. That's $40.00! We PAY YOU $3.00 and grant you a Phoney Patent in the bargain, so you save $37.00!! When sending in your Phoney Patent application, be sure that it is as daffy as a lovesick bat. The daffier, the better. Simple sketches and short descriptions will help our staff of Phoney Patent Examiners to issue a Phoney Patent on your invention in a jiffy.

Prize Winner: AUTO WHEEL AIR COMPRESSOR. The source of the free fuel is all in the wheels, a sectional view of which is here shown. The rim of wheel is divided into sectors and each sector is connected with a piston moving up and down in each of the hollow spokes. As each sector comes against the ground, the weight of the car forces the piston inward, compressing the air in the spokes. Near the end of the piston stroke the spoke registers with an aperture in the hollow axle, thus forming a rotary valve. The hollow axle is flexibly connected to a suitable storage tank equipped with pressure gages, etc., mounted at any convenient point on the chassis. From this storage tank the compressed air is led to an "Air Motor" connected to the propeller shaft through gears engageable by means of a foot pedal. With this system you only need to run your gas motor until the air pressure in tank is high enough to start the air motor, and thereafter you travel on air with enough surplus to run such attachments as a signal siren, air brakes, self-commencer and all the other confounded contraptions so dear to the hearts of all "motor-bugs." Inventor, J. A. Weaver, Baltimore, Md.

GETUPQUICKBED. The failure of the ordinary garden-variety alarm clock to arouse the heavy sleeper is well known, even when the expedient of placing the clock on the family dish-pan is resorted to. Again, some of us are so absent-minded that we shut the clock off in our sleep, or else go off into Slumberland again after the clock has sounded its 6 A. M. warning. Be it known to the patriotic alarm-clock public that I, D. M. Halig, have this day invented an alarm clock "getupquickbed," and it sure lives up to its word. To use it, proceed thusly: The mattress is attached to the bedstead by means of two powerful springs at the foot of the bed, which when free hold the mattress in a vertical position. At night the mattress is depressed, and the pin A is engaged by the catch B, which retains it in a horizontal or sleeping position. The alarm hammer of the clock then, instead of beating viciously a murderous gong, as heretofore, releases the catch at 6, 7 or 8 A. M., and you will rise punctually, never fear! Inventor, D. M. Halig, New York, N. Y.
The "Oracle" is for the sole benefit of all electrical experimenters. Questions will be answered here for the benefit of all, but only matter of sufficient interest will be published. Rules under which questions will be answered:

1. Only three questions can be submitted to be answered.
2. Only one side of sheet to be written on; matter must be typewritten or else written in ink, no penciled matter considered.
3. Sketches, diagrams, etc., must be on separate sheets.
4. Questions addressed to this department cannot be answered by mail free of charge. If a quick answer is desired by mail, a nominal charge of 25 cents is made for each question. If the questions entail considerable research, work or intricate calculations a special rate will be charged. Correspondents will be informed as to the fee before such questions are answered.

### TRANSFORMER CONNECTION AND POWER FACTOR.

(964) W. B. Cain, Montreal, Quebec, Can., asks us:

#### Hook-Up for Multiple Winding Transformer.

The Primary Divisions Are All Connected on Parallel, as Well as the Secondary Units.

#### Q. 1. Why will the transformer connection I show not work?

A. 1. You have shown the transformer windings connected in series which is wrong. The transformer windings both primary and secondary should all be connected in parallel, as shown in the accompanying diagram. The transformer ought to operate with about the same efficiency as a 2 K. W. transformer.

The effect of connecting these in parallel will be that of using energy to the amount of 2 K. W. or using the normal lighting current (110 volts, 60 cycles), a current of about 18.2 amperes will be used, at 100% power factor. Such a transformer would only have a power factor of about 80%. Hence the apparent watts (volts X amperes) = 2400 watts; current then equals 22.7 amperes as indicated on an ammeter. Thus you will see that a special circuit will be necessary because the ordinary house circuit is only heavy enough to carry 6 amperes. By placing proper choke coils in the primary side, the effect of dimming the lights can be minimized.

#### DECREASE OF INDUCTANCE WITH INCREASE OF FREQUENCY.

(965) W. O. Powers, New York, writes "The Oracle":

Q. I. Re: the article on "Investigation of Inductance" in the July issue of the ELECTRICAL EXPERIMENTER, page 179:

You will note that as stated, the inductance of a coil is decreased with increasing frequency of current. According to my understanding of what takes place in the windings of such a coil this statement is not quite clear to me.

A. 1. The reason for the inductance increasing when high frequency is used, is that the high frequency current merely traverses the outside layer of the wire and produces only an outside magnetic effect; while if low frequency were used the current would traverse the whole cross-section of the wire, and all of the wire would produce magnetic effects. As the inductance is caused as a direct result of this magnetism, it consequently follows that a greater inductance value is therefore obtained with low frequency current. You are no doubt aware of the fact that a current is induced every time the magnetic lines of force vary in density, and thus you will see clearly the solution of the problem.

### TELEGRAPHING OVER TELEPHONE LINES.

(966) Everett Ziemer, Walhain, Minn., writes "The Oracle":

Q. 1. How can I telegraph over a telephone line without interfering with the talking currents?

A. 1. Regarding the connections of a telephone line to be used for the operation of telegraph instruments, see diagram. It is not a very good practise to use telephone lines for this purpose, but it is possible to use any Public Service Utilities for personal use. If the telephone line is a privately-owned affair it does not matter.

With reference to the ground connection, this can be made by using a metal plate about one foot square, and burying it about eighteen inches in a moist spot of ground. Should the ground prove to be dry, it would be advantageous to place some charcoal about the plate, and at periodic intervals pour water over it.

Another way is to connect a perforation of telephone key to the metal stand of the telephone. By manipulating the key of such an instrument the clicks of the code can be transmitted over any length of telephone line, without any batteries or other paraphernalia beyond that making up the telephone instruments. We will supply address of company supplying such a key on receipt of stamped envelope.

(Continued on page 568)
Free Test Lesson in Draftsmanship

Send this free lesson which explains the Chicago "Tech" method of teaching Draftsmanship by mail. Positions at big salaries are now wanted for competent men. The call of men to the war has left vacancies everywhere. Even draftsmen of limited training and experience are snapped up and paid good salaries. If you are dissatisfied with your opportunities, learn Draftsmanship. Chicago "Tech" will train you in the most practical way in the shortest time. Mail the coupon today and let us tell you about the Chicago "Tech" method. This free lesson will show you how well equipped you are to follow Draftsmanship. Enroll in the course only if you decide that you can take it up to advantage. No cost, no obligation on you to make this investigation.

Come to the College or Learn At Home

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ELECTRICAL

THE ORACLE.
(Continued from page 566)

HOW TO PRODUCE "INFRA-RED" RAYS.

Q. 1. Asking several questions regarding fluorescent mineral effects, infra-red rays, their production, etc.,

B. Burgess,

A. 1. Replying to your first query, the fluorescent pad you speak of is probably nothing more than some granulated carbonate or zinc sulfide or willogen, all of which can be procured from one of the companies advertising in these columns.

Relative to infra-red rays: these rays are developed by means of powerful searchlight lamps, which consume as high as 20 K. W. or more. They are focused by means of parabolic reflectors, and are of such a reflector of which is usually highly polished zinc or silver. The electrodes are of carbon and some barium chloride is usually added to increase the production of the infra-red rays. The visible rays can be screened off by the interposition of a suitable diaphragm screen which consists of black fluorite, a metallic solution of iodin in carbon disulfid. The rays may be detected by the aid of a thermopile or a bolometer, the expansion of liquids, etc. We do not know anything about them. We are not aware of anyone who has done any useful work in developing them for use on powerful war machines. For most interesting information on the use of powerful, invisible infra-red rays, for radio control we refer you to the book "Radiodynamics," supplied thru our Book Department at $2.15, postpaid.

MAKING STEAM DIRECT FROM ELECTRICITY.

Karl A. Loeven, Bismarck, N. D., writes:

Q. 1. Can I produce steam from electrolytic action in water directly at a reasonable efficiency?

A. 1. Your particular idea of using electricity for the production of steam is indeed very good, because experiments of 1898 have been reached by some investigators along these lines. By referring to the March, 1918, issue, pages 360 and 361, and U. S. Patent No. 1,251,116, we believe you will obtain the desired information.

PHOTO-ELECTRICITY.

Albert S. Osgood, Ames, la., writes: "The following:

Q. 1. Refers to several queries concerning photo-electricity.

A. 1. Photo-electricity is the development of electricity by certain cells when exposed to light. They bear no relation to wireless in the common sense. There are no examples at present of P. E. C. being used in wireless apparatus. Extensive articles pertaining to electricity developed direct from sunlight, which deal with P. E. C. are given in the September, 1916, issue of the Electrical Experimenter, page 316, and March, 1918, issue, page 798.

SIGHT OF WOUNDED TO BE RESTORED BY ELECTRICITY.

An invention is being perfected in France, which, it is claimed, will restore sight to men blinded by the most serious wounds and accidents. The experiments are being conducted at the University of Paris by a professor named Kann. Work upon the apparatus is being watched with the keenest interest by Allied officials.

The perfection of the apparatus would be unusually timely, following up the reports from German sources that the Huns are planning to use new kinds of gases which blind their victims.


This useful and out-of-the ordinary, hand-book is moderately priced and highly suited to the requirements of practical men. As we have already stated, the book electrical men have been expecting for some time, is not a "penny-a-liner" or a "hassle" about theoretical circuits and design figures. It tells you where to find dozens of excellent treated on these subjects. What Mr. Burgess has done is to give the practical electrical man, artisan and engineer alike a real, hold-downed and model-size volume, which he can always have with him and find therein just what he wants.

The treatise opens with some blue line drawings of practical hook-up for motor starting boxes and control, including a description of the device, as well as drum controllers, printing press controllers, "monitor " automatic starting, reversing controllers, float switches, elevator controllers, etc. Furthermore, and which might not be speed devices, mine locomotives, street car wiring diagrams, induction motor connections and automatic tuning.

Then comes a section of wiring diagrams for all sorts of lighting circuits and 4-way control, three wire systems, and numerous articles which can be used in the shop when he comes to install such circuits.

The author gives explanations of perplexing problems met with in everyday electrical installation and insulation, as, for instance, square root, etc.; the principal electrical units and their meaning and theoretical circuit diagrams to figure the resistance, voltage and current of various kinds of circuits; resistances and capacitance formulas and diagrams; methods of doing by actual tests what would otherwise be perplexing; the setting up of electrical machinery, testing out faults, etc.; the operation of the motor, etc.

Such we find a set of useful alternating current formula, including the various connections of transformers.

EVEHADY PHYSICS. A laboratory manual, by John C. Packard, A. M., publisher in Sun and snow experiments, and therefore begins with elementary mechanics. The author inserts such topics as horse power, gravity, etc.

He follows up the subject of air and water measurements and considers therein the measurement of density of air, thermal capacity, etc., then the study of light, its measurements and its uses. The author treats the subject partially and in an easily understood manner. The subject on mechanics is also well written. He considers the subject of the pendulum and measurements; under "generation" the siren and vibrating strings are treated. He shows in a good way the defects of the dyes of hearing and sound therefore.

Next we find the subject of the photometer and the study of the defects problems of refraction, diffusion, etc., also defects of vision and the teeth themselves. The author includes the bio-electrical study of electricity and magnetism, and in a short space are given laboratory exercises and instructive experiments for the beginner, so that he may fully grasp the subject of electricity and magnetism.

The author is to be congratulated on being clear and concise manner, in which he treats the subjects, and for the excellent illustrations he has provided. It makes an excellent manual for high schools and similar institutions. A small order is received.

(Continued on page 570)
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BOOK REVIEW.
(Continued from page 568)


The author starts the opening chapter with the characteristics of light and with the various types of incandescent lamps. Then follows the discussion of wiring diagrams and construction of each lamp. Then comes the chapter on the subject of arc lamps, both open arc and closed, and in the same chapter he considers mercurial arc lamps. Next follows the theoretical and practical aspects of principles of illumination, where he considers the advantages of equal light distribution, candle-power, curves, non-reflecting materials,午后 artificial light, etc. Good reasons are given for the use of various types of reflectors, and the frequent use of lighting fixtures are presented in a very complete manner. The author presents practical methods of calculating interior illumination is commendable, and the author gives examples of various methods of illumination, including outdoor lighting.

In the second part of the book, the author gives the wiring of motors, and connections for direct and alternating current motors. The author gives the wiring diagrams for interpole motors, squirrel cage induction motors, and rotating motors, as well as the single-phase induction motors, self-starting synchronous motors, and synchronous motors. The chapter on selecting motors for industrial purposes is important, and the author shows how a specific type of motor is necessary to properly operate each style of machine. In this chapter the author also gives a clear description of the different types of motors as used for various industrial purposes.

Section three is devoted to the system of wiring for D.C. and A.C. and the subjects of insulation and wiring are taken up in detail. Calculations and uses of different types of wires and cables, switches, circuit-breakers and fuses are well presented. The author takes up in the same chapter the subject of switchboard installations, and in this chapter, he shows the layout of the wiring for an office, and the other a simple wiring chart for direct current circuits. By means of this chart, the author is able to solve quickly the problem of the conductor necessary to carry a particular load. An appendix contains a number of tables which are very good for the general electrician, and which facilitates the calculation of electric circuits and allied problems.

RADIO COMMUNICATION, by John Mills, 5 x 7 5/16 inches. Price, $1.75 net, published by McGraw-Hill Book Co. 206 pages, 126 illustrations, including diagrams. Imitation red, flexileather. This book was written for the purpose of instructing army and navy men, especially officers who are being prepared for the Signal Corps of the United States Army. The author has written the subject of radio communication in a very peculiar manner. The beginning of the book gives us some elementary considerations of electricity, treated in such a way as to bring the subject into the subject of alternating currents and therem-in, certain applications. It seems rather unusual that at the very beginning he should delve immediately into the subject of imaginary quantities, which very few engineers utilize, as such a subject of imaginary quantities is used mostly in the advanced study of alternating currents.

It would certainly be of greater ease to the average student of Radio Communication if the author had treated the subject of alternating currents in a more simple manner than he has done, the author believes. The book contains a double set of subjects which he has handled at the beginning of his book, and are of great value to the electronics and to radio engineers in general.

In the second part of the book, the author treats on a very important subject—the transmission of sound. The author has at least done himself justice in treating the telephone receiver in a really excellent manner. Here he gives a complete theory and explanation of the various types of receivers that have been invented. In a lucid manner he describes the various functions of the parts of the telephone receiver, including "impedance." A very good chapter on the vacuum tube is also given. In this chapter the author begins with the elementary consideration of the electron, and from there proceeds up the subject of vacuum tubes, and he then takes on the two electrode-vacuum tube and treats on the characteristics of the plate with respect to the filament. The three-element tube is ably discussed and a short description of the characteristics of this tube are given, but none of high
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in this case being two steel plates. The joint is usually prepared by beveling the edges of the pieces to be welded together. The other side of the electric circuit is connected to the hand electrode which is provided with a ground lead. This welding tool connects with a heavy flexible cable leading to the current supply circuit. By touching the electrode to the metal, and material a heavy arc is drawn, and to reduce the blinding glare from the arc the operator wears a head shield fitted with special glasses. The slotted arc welder draws an arc at several points along the seam to be welded, and then establishes several distinct tack welds, which serve to hold the plates firmly in line. He then proceeds to weld the entire seam, moving the electrode from side to side of the groove and giving it a semi-circular motion, while at the same time he slowly moves the electrode along the groove.

The accompanying illustration shows an excellent sample of arc welding between two plates, done by a practically new process, whereby such a weld is formed of the basic metal composing the plates; thus the weld is invariably as strong as the plates themselves.

It is important that the arc shall "bite" into the shank metal, creating a perfect fusion along the edges, while the movement of the electrode is necessary for the removal of any mechanical impurities which may be deposited. In the coated electrode it is further necessary that the slag which forms for the protection of the pure metal be blown up to the surface, and it is extremely important in the event of a second or third layer that the slag or impurities be carefully scoured away before the virgin metal is again laid on. The operation in arc welding is protected, with a screen covering his face with special glass thru which to observe his work. The electric arc emits dangerous invisible rays in both the upper and lower spectrum scale and it is quite evident that both the infra-red and ultra-violet are dangerous in their effect; the former is pathological, the latter actinic.

The operator further uses gloves for his hands and for the very difficult work of overhead welding, it is necessary for him to use a helmet which covers his breast. Without entering into an elaborate analysis of the relative costs of electric welding, it may be broadly stated that there is hardly any question that the electric process is cheaper than any other. The same may be said as regards reduction of labor and also reduction of man power. In a recent discussion of this subject by an authority it was stated that at one of the most important plants, the total number of parts on the welding program of the standard riveted ships now building at that yard amounted to 225,000. The labor cost for riveting the pieces is about $245,000, and for welding about $99,000, thus making a saving of $146,000. But this is only a mere drop in the bucket when compared to what might be profitably done in this line. The expert stated further that in certain particular instances the saving is as great as 50 per cent. The electric arc requires a reduced voltage and this is difficult to attain with direct current, without relatively expensive machinery for a useless expenditure of energy. The practise in this country in manufacturing establishments of any size has been toward an increase in the supply voltage so that very few large manufacturing plants use less than 220 volts direct current. With this voltage the only economical method of transformation is in the use of a motor-generator set. The efficiency in this case is in the neighborhood of fifty to sixty per cent. It is possible to use a supply voltage of 110 volts with a variable resistance which cuts down the voltage to the arc volts. This gives a very poor efficiency. In the case of creating current the supply voltage can be reduced by a transformer which will supply, as in the case of direct current, a sufficient voltage for striking the arc and a satisfactory reduction when the arc has been struck. On the other hand, if a low voltage alternating current is provided, a small reactance may be introduced which has a few of the same wasteful characteristics of the resistance used with the direct current. The average apparatus will permit of electric arc welding consuming about six to eight kilowatts per welder, but if low voltage is provided, these are certain outfits which will reduce the consumption to as low as three and one-half kilowatts per welder, or even less.

Regarding the spot welding of fabricated steel ships, it may be said that experiments were conducted by the Electric Welding Committee, which showed that it was difficult to weld one-half and three-quarter inch steel plates as well as one-inch steel plates; and in fact experiments were successful in welding three thicknesses of one inch steel plate. Lately, large sized spot welders, having jaws five to six feet long have been designed, and these will be used in building a spot welded steel vessel at the New York Shipbuilding Corporation, located at Kearny, N. J., which represents the largest portable spot welder ever completed. The spot welder has five feet and, considering the five foot jaw spot welder with multiple contacts spaced at a distance corresponding to the oldtime rivet, one is actually astonished when stopping to consider...
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HOW SHIPS ARE WELDED BY ELECTRICITY.

(Continued from page 572)

Consider how much time and labor of efficiency is occasioned by the old method of riveting steel plates and girders, where but one rivet can be handled at a time. Think of a six foot gap electric spot welder which can then accomplish a seam in the construction of radio apparatus. Here are found the need and importance of this method, and in each case the author works out an example for the student, so that he can familiarize himself with the method of working such a problem.

BOOK REVIEW.

(Continued from page 570)

Frequency currents, and as an amplifier. In the next chapter we find various types of detectors of high frequency currents, and detectors. As a practical application of undamped high frequency oscillations is also commendable. A short discussion follows on the chapter on Radio-telephony. In the eighth chapter the book gives several devices for the construction of radio apparatus. Here are found the need and importance of this method, and in each case the author works out an example for the student, so that he can familiarize himself with the method of working such a problem.

PRACTICAL ELECTRICITY. by Terrel Croft. Cloth bound, 560 pages, numerous illustrations, size 5½ x 8½ inches. Price $2.50.

Another excellent work from the author of mechanical books on the subject, it has been arranged in 53 elaborately illustrated chapters, with all the matter arranged in proper sequence.

The author states that the object of the book is to present the fundamental facts and theories relating to electricity and its present-day applications, Isaacs and Smith's W. H. New York, 1917. Price $2.50.

Another excellent work from the author of mechanical books on the subject, it has been arranged in 53 elaborately illustrated chapters, with all the matter arranged in proper sequence.

No higher mathematics have been indulged in, with no loss to the value of the work; the numerous and readily visualized analogies, which the author is adept in supplying, are a great help.

A study of the book will find it a valuable aid to all, whether teacher, student, practical worker or layman. It is invaluable to the boys who have been working the coals from the mind and to reform and recondition in line with modern electrical theory and practice.


The author has endeavored to put forth in a clear and concise manner the theory and operation of Direct Current Machinery, without aid of higher mathematics, although some mathematics of elementary nature has been used here and there. Magnets, and electromagnets, and the unit of suggested work, have been especially dealt with in order that the student should obtain a clear understanding of the principles of dynamos and motors. The book further shows that whenever energy is transformed by a man-made mechanism to electrical or vice versa, that a loss is made, and it is true in this regard giving the efficiency of a motor or a generator.

The various types of motors, dynamos, including direct-current, alternating, and d-c motors, are all given. Armatures of the drum, disc, lap, wave, and other types are fully explained, including the various capabilities of each, accompanied by numerous red and black line charts which serve to corollary clearly the various methods of wiring armatures. The uses of electrical energy, or the advantages of the three-wire system, types of dynamos and motors—INCLUDING their operating characteristics—is of course, a chapter on the "Selection and Installation of Dynamos," are additional features of this book. In general, this book is designed to assist to students, engineers and electricians, and all those who have occasion to deal with Continuous Current Machinery and its allied problems.

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An excellent treatise on the subject of direct current motors and the practical applications there of, with numerous illustrations of up-to-date machinery.

This book is intended for the student, the owner of D.C. machines, the consulting engineer, the motor inspector, and supervising engineer, for the man who will subsequently have charge of the machine and for the civil or mechanical engineer who desires to have some knowledge of the subject.

There are several chapters in this book which divide the subject into many parts, such as the elementary theory underlying the action of motors, the starting of motors that have once been started and stopped; the variation of speed and the reversal of the direction of the motor, etc. Still further on the book treats to some extent with the theory of D.C. motors, especially matters so that more speed and power, and several types of central station apparatus, including automatic and semi-automatic appliances. The efficiency of motors and the various methods of determining the amount of power of the various kinds of motors and central station apparatus, are also fully described.

For each chapter there is given a set of examples and answers which should prove of immense interest to all. The appendix shows how to determine the resistance step for use in starting a motor, how to use Logarithms, and how to connect a motor on higher or lower voltage than that for which it is rated. In short, the book is a complete treatise on D.C. motors, the various appliances used therewith, the practical application of the subject and a textbook for the library of those who have occasion to use or install Continuous Current Motors.


Part II of this work proves to be a useful handbook and one that will be popular as a reference book. The editor and his contributors have been瓶子 generally in this special branch of electrical science. Still further on the book treats to some extent with the theory of D.C. motors, especially matters so that more speed and power, and several types of central station apparatus, are also fully described.

The following list of contents should prove of interest: Curves, diagrams and their meaning—the logarithmic, parabolic and hyperbolic curves, the sine curve, etc.; the theory of direct current systems; direct current dynamics—the pressure and its adjustment and measurement; the eddy currents and their effects—how they are overcome; the A.C. transformer, the action of the windings, the electrical analog of the transformer, inductance of transformers, and the relations between the current and voltage in tuned circuits, with mechanical analogs of various A.C. circuit relations, such as effect of capacity on phase relation; the effect of inductance on phase relation; effect of resonance; etc. The logarithmic over and under excitation of transformers are well written and of great benefit to all radio workers. Spark discharges are treated in detail. A very thorough chapter is devoted to "cancellation valves"—governing, "best and erection of undamped wave signals, reception of weak signals, etc. This section on valves is quite complete and treats on the theory of the Fleming two- and three-pole valves. De Forest, Armstrong and Langmuir are unknown quantities to this author apparently.

A valuable book to all interested in the art, and dealing with the subject of Radio in a simple and clear cut manner. This book takes us into the inner technical problems involved. It treats the problems more interesting and more important in less books dealing with the subject.

DO MAGNETS MAKE PHOTOGRAPHS?

The 1917 Year Book of the Carnegie Institution of Washington, D. C., has the following interesting "magnetophotography" experiments conducted by L. A. Bauer and W. F. G. Swann:

A large number of experiments have been performed and some are practicable to give more than a general survey of the work. In all of the experiments in which articles with a metallic field, a subsidiary plate was set up and the experiment performed to some influence of a magnetic field.

December, 1918

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If you ever thought of building a spark coil, transformer, or similar apparatus, now is the chance to get the right material for it. As far as we know this is the only lot of iron Norway Core Wire in the hands of any dealer at the present time, and none can be gotten until after the war.

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If either of these sizes should be too long we advise cutting the wire down yourself by means of shears. It will pay you to do so as real Norway Iron Wire, sold by a few dealers last year, brought from 50c to $1 a pound. American core wire now sells for from 35c upwards per pound.

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Important Announcement from Washington, D. C.

The Government of the United States has found it necessary to ask every householder in the Nation's Capital to offer their spare rooms to those brought here for war service. Thousands of young women from the best American families will in this way find suitable homes.

In order to meet war conditions the DEWEY HOTEL, situated in that exclusive residential section, at 14th and L Streets (5 minutes' walk from the White House), has opened its doors to transient guests. For many years the Dewey has been the official residence of Senators and those prominent in official life of the Capital. The accommodations are limited, and only those whose presence will be compatible with its clientele will be accepted. It will be best to make reservations by letter. Room tariffs, illustrated brochure, restaurant charges and other information may be secured by writing.

FRANK P. FENWICK

with a similar set of articles, but beyond the influence of the magnetic field. In the earlier experiments, this subsidiary plate was placed in an ordinary plate-box at atmospheric pressure, the box being bound around with dark cloth; but in the later experiments it was placed in the same vacuum as the main plate, and shielded from the magnet by an iron disk. All experiments except the last two were performed with limited darkness, the photographic red light only being turned on after the articles had been mounted in the bell-jar, and the latter had been bound around with dark cloth.*

In order to test whether the effects observed could be attributed to radio-active material, two experiments were made with permanent magnets, but in the case of one of them the bell-jar was washed out with a weak solution of uranium nitrate and allowed to dry. After an exposure of 21 days, the articles showed up equally strongly on both plates.

A plate was exposed for 6 days over an electromagnet, the articles being pieces of wood, iron, copper, amber, and cork; also, in addition, a piece of wood resting on a piece of metal which was in contact with the plate, and a piece of lead resting on a piece of wood which was in contact with the plate. Both pieces of wood in contact with the plate showed up dark on a lighter ground, the grain of the wood being very clear, and the cork showed up slightly darker than the ground. The metals in contact with the plate came out lighter than the ground. In the case of the subsidiary plate which was set up at atmospheric pressure, only the amber showed up, and this appeared dark on a light ground.

Several experiments made with the articles slightly separated from the plate showed that their images fell off rapidly within a distance of 1 or 2 mm.

The effect of resin in acting upon a photographic plate, especially when the resin has been previously stimulated by light, is well known, and at once suggests the assumption that the resin wood, cork, etc., produce a radiation of some kind, or a gaseous emanation, the latter being produced either directly or as a result of the radiation, and that this gas diffuses over the body of the plate and darkens it. In this case the metal articles would simply act as shields to the plate. Experiments made with stimulated resin and metallic articles showed that distinct impressions of the objects could result only provided the resin was in this way without a magnetic field or a vacuum. At atmospheric pressure the darkness of the plate falls off with the distance from the resin, but on evacuating the space around the resin the "range" of the action is increased and the impressions are much more uniform.

A large number of experiments were made with stimulated resin, and it appeared that the action was propagated roughly in a linear manner for a distance of about such as a centimeter or more, and after traversing this distance was still capable of passing thru aluminum leaf.

The apparent action of the magnetic field in the experiment with wood and metal articles suggests that a similar action should be produced in the case of the resin. If the action of the resin is ultimately attributable to the ejection of charged particles, the possibility of producing deviation by a magnetic field at once suggests itself. New marked influence of this kind was, however, found in the case of the pure resin.

* Those interested in magnet photography should refer to the original articles on this work written by Mr. Noyes, and which were set up in the October and November, 1917 issues of the Electrical Experimenter.
One of the most remarkable features of the photographic action produced in the case of wood and metal articles is that it is approximately uniform over the plate, altho the magnetic field varies both in magnitude and direction. If the action of the magnetic field were one of controlling the direction of propagation of a radiation or gaseous effusion emitted by the substances, one would expect it to vary over the surface of the plate. The absence of such variation practically limits the nature of the effect to one in which there is direct or indirect stimulation of the activity of emission or production of active gas, diffusion being subsequently relied upon for the uniform distribution of the effect over the plate.

The effect of very slight temperature changes in modifying the action of metallic articles upon a photographic plate is well known, and one has to remember that an electromagnet becomes appreciably warmed during its existence.

The presence of resinous articles does not seem wholly necessary for the production of the apparent magnetic effect. Thus, for example, a number of metal articles, namely, lead, iron, nickel, copper, and brass, were set up over an electromagnet in a vacuum for 14 days, and a similar group was set up in the same vacuum, but in a region shielded from the magnetic field. The first set produced strong impressions, light on a dark ground, while the second set produced no appreciable effect. The experiment was repeated with a permanent magnet and an exposure of 21 days, with similar but less pronounced results.

At the stage of the work recorded in the paper here abstracted, the preliminary conclusion was reached that while a magnetic field or vacuum was not essential to the production of effects of the kind recorded by Mace, the magnetic field appeared to have an effect in intensifying the action in certain cases. The experiments are being continued with the object of ascertaining whether the primary agency producing the effect, in the case of the electromagnets, for example, is really the magnetic field itself or some other influence accompanying the production of the magnetic field.

EXPERIMENTAL CHEMISTRY.

(Continued from page 538)

Properties of Sulfur (Physical).

1. It is a yellow solid, without odor or taste. 
2. It has three allotropic forms, two crystalline, and one amorphous.
3. Its color is usually lemon-yellow when solid, when finely divided it is white. It gradually becomes dark red and viscous on gradually raising the temperature from 200 to 280 degrees, when it is too thick to pour, and becomes almost black in color.
4. It is non-poisonous, and may be taken internally, as is frequently the case in the spring, when the so-called sulfur and salt licks makes its appearance as a blood purifier.
5. The so-called "sulfur odors" do not come from the element, but rather from the compounds, as Sulfur Dioxide, Hydrogen Sulfide, Carbon Disulfide.
6. It is insoluble in water, the best solvent being one of its compounds, Carbon Disulfide, in which it dissolves unchanged, tho the amorphous variety does not dissolve and flowers of sulfur only slightly.
7. It is negatively electrified by friction.
8. Sulfur melts at 115 degrees to a thin, amber-colored liquid. At 200 degrees it becomes thick and dark colored and can hardly be poured, while at 300 degrees it again liquifies. If poured into water at the amber stage, it crystallizes, but if at the latter stage, it is amorphous and elastic.

(Continued on page 579)
CHEMISTRY!

We present herewith to our friends our new E. I. Co. Chemical Laboratory which contains real chemicals and apparatus to perform real chemical experiments. This outfit is not a toy, but put up merely to amuse, but a practical laboratory set, with all the chemicals, apparatus and reagents necessary to perform real work and to teach the beginner all the secrets of inorganic chemistry. With this outfit we give free a book containing a Treatise in Elementary Chemistry, useful data and recipes, and 100 instructive and amusing experiments.

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<th>Brimstone</th>
<th>Ferrous Sulphate</th>
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<tr>
<td>Alum</td>
<td>Iron Oxide</td>
<td>Nickel Sulphate</td>
</tr>
<tr>
<td>Antimony</td>
<td>Sulphate of Zinc</td>
<td>Sodium Phosphate</td>
</tr>
<tr>
<td>Boracic Acid</td>
<td>Magnesia Carbonate</td>
<td>Zinc Carbonate</td>
</tr>
<tr>
<td>Charcoal</td>
<td>Zinc, Metallic</td>
<td>Ammonium Sulphate</td>
</tr>
<tr>
<td>Sodium Nitrates</td>
<td>Sodium Bicarbonate</td>
<td>Ammonium Carbonate</td>
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<td>Sodium Carbonate</td>
<td>Sodium Sulphate</td>
<td>Ammonium Aqual</td>
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<tr>
<td>Sodium Berate</td>
<td>Sodium Chloride</td>
<td>Calcium Chloride</td>
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<tr>
<td>Sodium Sulphite</td>
<td>Calcium Sulphate</td>
<td>Chloride of Zinc</td>
</tr>
<tr>
<td>Manganese Dioxide</td>
<td>Barium Chloride</td>
<td>Copper Sulphate</td>
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<tr>
<td>Oxalic Acid</td>
<td>Lead Acetate</td>
<td>Glycerol</td>
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The following apparatus are furnished:

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<tr>
<th>Glass Tube</th>
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<tr>
<td>Glass Tubing</td>
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PATENT ADVICE

In this Department we publish such matter as is of interest to inventors and particularly to those who are in doubt as to certain Patent Phases. Regular inquiries addressed to "Patent Advice" cannot be answered by mail free of charge. Such inquiries are publish here for the benefit of all readers. If the idea is thought of be of importance, we make it a rule not to divulge all details, in order to protect the inventor as far as it is possible to do so. Should advice be desired the mail charge of $1.00 is made for each question. Sketches and descriptions must be clear and explicit. Only one side of sheet should be written on.

Readers' attention is called to the fact that due to the great amount of letters to this department it is quite impossible to answer them all through these columns. The inquiries answered in this issue date as far back as June, and if readers wish speedy service they should carefully, fully note the announcement appearing in the preceding paragraph.

Arc Lamp.

(279) William Woodward, of Wilmette, Ill., submits an idea of a self-regulating arc for moving pictures which he would like to have our opinion on. He says "let us presume that the operator strikes the arc and adjust it. In a few minutes the carbons would be too far apart, but for the feeder which pushes carbon up as follows: When the current diminishes, that is, the carbons draw apart, the brass rod C becomes cool and contracts, which by a lever of the first class pulls the carbon up. When there is a demand for current, the action is vice versa. Of course, about half an hour it would be necessary for the operator to screw the carbons up for continued use. The horizontal adjustment would be adjusted as on a modern machine."

A. An extremely clever idea as well as capital idea. It is doubtless the most economical and light regulating scheme ever to be used. If it works out as promised, it will save the expense of the horizontal adjustment.

B. If this idea is in practice as well as it looks on paper, we think that our correspondent has a very valuable patent. Our advice is to get busy at once and build a model and apply for patents in the meantime.

Swaying Screen Door.

(260) C. L. Emmons, St. Joseph, Mo., submitted a very clever device on a screen door which will swing open when pushed in either direction or on either side. A number of metal strips are used in order to effect this and our advice is asked.

A. This is indeed a remarkably clever idea, and the only fault we have to find with it is that the hinges would sag because the special hinges used seem to be too long, and sooner or later would cause trouble. With these, there might be found ways to overcome this objection, and we are certain that a patent can be obtained on the invention.

B. Another idea by the same writer relates to making distilled water, or drinking water from salt water. The apparatus consists of a pump to which heat is applied and a coiled metal tube, cooled in water through which the distilled water is discharged. A. There is nothing fundamentally new contained in this idea, and a patent cannot be obtained on it.

Edited by H. Gernsback

Power Jack.

(281) Cleo Maddy, Utica, Kan., sends an idea of a power jack for an automobile to be permanently secured to the rear bumper, made of copper and a small band of cold-rolled steel. The jack is operated by the starter by means of two small red and black wire. Our correspondent wishes to know if the idea has been patented, and if it is practical.

A. We are afraid that while the idea is not impossible, of course, it would be impractical for a number of technical reasons, unless simplifying improvements were made on the device. We think it has always been founded on the idea—of how much value it will be, we do not pretend to know.

Changing D. C. to A. C.

(282) Edward Huesher, New York City, encloses a diagram of a device for changing 110 D. C. current into 110 A. C. to any number of cycles desired. The idea is to have a metal spider wound with wire operated from an 110 D. C. motor, the ends of the spider cutting thru an electromagnetic field. A. This device could be taken from the spider and from the wire ends.

A. This is a clever idea, and we believe it is feasible, but we doubt if a patent can be obtained on it as very similar types are in use.

Rifle Improvement.

(283) Wilford Dooler, San Francisco, Cal., sends in a device whereby it becomes possible to equip or to have a small gun or rifle fire any size cartridge desired. A. We believe, present guns can always fire a small cartridge.

A. This is a clever idea as well as ingenious, and we think a patent may be obtained upon it. We doubt, however, that it has any practical value, as too many special inserts would be necessary in order to equip rifles that this is other than the inventions that seem very good, but have practical objections which are entirely unanswerable.


(284) We publish in full an interesting letter by one of our readers, J. B. Warren, Kearney, N. Y.,

"I notice in the July issue of the Electrical Experimenter that you have inaugurated a new feature in one of your most valuable departments, the 'Patent Advice' department, whereby you will disclose the invention freely to the public, sent to you, and publish it in the department. I have just read this, and I think it is an excellent idea. I have been experimenting with an invention of my own for a long time, and I think it is worth while to get a patent on it. I would like to have you publish this invention, and I would like to have you write me a letter telling me how to do it."

Our facilities for securing patents enable us to give prompt and efficient service at reasonable rates. Inventors are invited to write to the following questions appearing in this department protecting all matters receive prompt attention. Send for blank form of disclosure to prevent your idea from going lost. It will pay to place your patent in the Patents Office. Book of Instructions and blank forms are free on request.

A. M. Buck & Co.

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ELECTRICAL EXPERIMENTER

100 Tenth Avenue, New York City

December, 1918

Knob K. Our advice is asked on this arrangement. A. This strikes us as an excellent idea and certainly a patent can be obtained on the idea. We suggest that our correspondent get in touch with patent attorney at once.

This correspondent also submits a diagram on an electrical horse for cars operating on the vibrating diaphragm principle. Our advice is asked.

A. There is nothing new about this device, there being on the market several automobiles built working on this principle.

Phonograph Motor.

(287) Floyd Hoskins, Fine Bluff, Ark., submits an idea on an electric motor concealed in the inside of a phonograph, driven by dry cells, thus driving the phonograph disc. Our advice is asked on the arrangement.

A. This is quite an old idea and nothing of this sort can be patented, many motors being used accomplishing exactly what our correspondent describes.

Sound Electric Shutter.

(288) Emison Furrell, Higgivsville, Mo., wishes to have our advice as to patentability of a sound electric shutter operating device for a camera. When the person standing in front of this camera says "Hello," the sound waves strike a microphone which in turn allows a current to pass thru a highly sensitive relay. An armature is then pulled over, making contact, while the current from the battery passes thru an electromagnet and the magnetism induced therein pulls over an armature which in turn snaps a shutter or finger. One does not have to be a photographer to active this device. The entire device, of course, has to be made up and a camera placed in it. Not alone could this be accomplished, but the film could be utilized for taking close up pictures of explosions, for secret service work, and for novelty use taking of unexpected pictures of friends.

A. This is a really capital idea, and while the idea itself is not fundamentally new, we are certain a patent can be obtained on it in the combination with a phonographic camera. While, of course, such a sound operated device is not new, there being on the market at present a toy dog which comes out of his house when a whistle is blown, the combination of a sound operated camera shutter presents great possibilities. We would advise our correspondent to obtain a patent on this idea.

Naval Consulting Board.

(289) Percy F. Walsh, Keyser, W. Va., claims to have invented a device which by means of a few big guns he claims he could not have to patent it; he would rather give it to the government for free. We refer our correspondent to the Navy Department and the Patent Office. Our advice is asked.

A. It is not practical to address an individual of government department or office and ask them to turn over any patent. He wished to address it to a certain individual of such a department. Our advice is asked.

Detectors.

(286) Homer Surbeck, Rapid City, S. D., submits a wireless detector which consists of a metal wheel with a number of cat whiskers mounted on the periphery of the wheel. We refer our correspondent to the Patent Office and the Patent Examiner. Our advice is asked.

A. It is not practical to address a government department or office and ask them to turn over any patent. He wished to address it to a certain individual of such a department. Our advice is asked.

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These samples have been forwarded mainly in connection with the several inves
tigations undertaken in South America by P. S. Smith, and in Australia, New Zealand, Japan, and eastern Siberia by R. A. Lundquist, special agents of the Bureau. Complete data accompany each article on exhibit, giving country of origin, where, when, and how they are selling price, etc. There are several hundred items in the exhibit.

There is a wide field abroad for standard American electrical goods, as well as for adaptations of American designs to foreign requirements, and when our electrical manufacturers study the types of goods now in use in each market, they may obtain a grasp of the standards and of the conditions existing that can be secured in no other way, as the industrial visit, to the field, and this knowledge will enable them to push the sale of their goods with the best possible efficiency.

EXPERIMENTAL CHEMISTRY.

(Continued from page 599)

Uses.

It is used mainly in making sulfuric acid. Bleachers of silks, woollens, and straw goods employ it, but it is not used on cotton goods.

It is sometimes used as a disinfectant. Sulfur being burned in a room occupied by persons having an infectious disease, the room being tightly closed, the sulfur dioxide from the burning sulfur will kill all disease germs. Formaldehyde (Formalin) is, however, becoming quite generally used in place of the sulfur dioxide for this purpose.

Experiment No. 140

Forms of Sulfur.

Fill a test tube one-third full of pieces of brimstone and heat slowly. Note the fluidity of the liquid formed. Continue the heating until it becomes almost solid, then note any further change on more heating. Notice color changes at each stage. Finally pour some of the contents of the tube into a dish of cold water. Pull that portion and observe its elasticity and amorphic nature. Let it cool, stand and see whether it remains its original state. Be on the alert for crystallization.

Experiment No. 141

Compounds of Sulfur. Hydrogen Sulfide.

Prepare a generator of about 125 or 250 cc. capacity and fit with a two-hole stopper. Into this put about 5 grams of Ferrous Sulfide (FeS), about 20 cc. of water, and at first about 1 cc. of hydrochloric acid, which amount may be increased from time to time as necessary.

First collect some of this gas by downward displacement in a wide-mouthed bottle (See Fig. 149). Note the color, and apply the splint test for combustion. Test the solubility of the gas by passing some into and over litmus paper (See Fig. 150).

This test with (a) Litmus paper.
(b) By putting a drop of silver nitrate, or (c) By pouring a little into a solution of Lead Nitrate.
(d) By holding over the mouth of the tube a paper wet with a drop of lead acetate solution, and warming the tube while making
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3,000,000 FISH AN HOUR WITHOUT A HOOK

(Continued from page 528)

sacred angling grounds. That was the time that you were angry, if you ever were in your life. The same principle seems to apply. If you add a little carbon disulphide to the dish, and if the sulfur dissolves, either eat the dish in a draft of air or blow across the liquid, and look for the formation of crystals. This is a very common and should be carefully described. What evaporates, the carbon disulphide or the sulfur, or both? Is it then apparently a physical phenomenon? Or is the sulfur in the liquid, when is it thrown out, does it occur in the crystalline or the amorphous state? Of what other element have you found carbon dissolving a solvent? What is the natural state of these two elements of which this compound is composed?

(To be concluded)

3,000,000 FISH AN HOUR WITHOUT A HOOK

(New Yankee Inventions. Continued from page 530)

interval, so as to scatter the bombs over a wide area. The torpedo is propelled by compressed air or other form of energy, and the equilibrium is modified by a swinging pendulum hung within the shell, and which is connected by suitable cables to the rudder and elevating planes.

The inventor claims that the machine is capable of traveling at a high rate of speed over a considerable distance—much farther than is possible to fire ordinary projectiles —and it is intended that a very large number of the torpedoes be launched simultaneously, the entire array being cleared on a broad front and to a considerable depth for infantry charges, etc. By electrical or other means the mechanism inside is arrested in the event of the machine to maintain the balance, and as soon as they are dropped the equilibrium of the machine is destroyed, the nose or front end becomes heavy causing the machine downward. The shell contains an explosive charge so that when it strikes the ground the charge, in being detonated, will blow the machine to atoms, preventing it from being used by the enemy—destroy-

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The final patent here illustrated is that awarded to John B. Felicetti, a Philadelphian, and an inventor with true Italian ingenuity and originality. We have had one-man tanks and one-man submarines, but this one-man self-propelled tank is about the best device in this branch of military inventions that we have come across for some time. As the illustration indicates, the operator lies prone inside the tank, and the whole body is protected by the steel armor. When desired he can also sit up in the tank. The inventor claims that this tank is sufficiently light so that it may be carried when necessary over short distances by the operator. The Signal Corps should find a device of this kind very useful, for an observer could safely advance quite a distance beyond the front line observation points, with a well camouflaged steel tank of this description. It is propelled by the operator pulling on the two handles shown, which actuate two steel spades on the rear of the machine and which dig into the ground alternately. The steering is accomplished by means of the feet. The inventor ambitiously points out that his tank can travel over land, sea, snow and sand, or thru water and mud. In order to be able to negotiate ponds, brooks, and the like, the vehicle is provided with broad flanged wheels, and the axles are not brought out on a line with the wheel hubs, but extended upward behind the wheels before they enter the tank housing. The reciprocating levers actuating the two spades which propel the vehicle slide in water-tight stuffing boxes. When operated thru water, the steel spades at the rear act as oars or paddles. Imagine what a flock of these one-man tanks, all decked out in their camouflage war-paint would look like as they swept up over a hill on a charge.

THE CODE-NUMERALS GET THEIRS.

(Continued from page 549)

... = "N"  
... = "D"  
... = "Y"  
... = "V"  
... = "3"  

Imagine writing: "Would not consider offering 925:3 to a man if not satisfied," and having it delivered "Would not consider offering you nut; may go to Dav-ll. if not satisfied." Some business has to be declined, of course; but a declination in a form like that would be considered abrupt, if not actually rude. Well, then, if the "abbreviated" numerals can avoid such pitfalls, why need our little dots shake in their little shoes?

Finally, brethren (as you reach for your hat under the pew), behold the number 128,035, expressed in the four different ways we have considered:

1. with the digits spelled out:
   
2. in the official numerals:
   
3. in the abbreviated numerals:
   
4. in plain dots:
   
Try it on your "buzzerola". And now, Human Nature, let the blow fall!
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### HOW TO MAKE A SEVEN-INCH REFLECTING TELESCOPE.

(Continued from page 553)

There are numerous formulae for sil-\vering the concave surface. The so-called sugar-loaf method has been satisfac-\tory used by the writer at all times. Solution (A) Silver Nitrate crystals 100 grs.; Water (distilled) 4 oz. (B) Set aside one-tenth of “A” for future use. (C) Caustic Stick Potash (pure, by alcohol) 100 grs.; dis-\tilled water 4 oz. (D) Aqua Ammonia strong. (E) Reducing Solution: Loaf su-\gar 40 grs.; nitric acid, 39 grs.; alcohol.

Pour the mixture into an enamel dish of distilled water. Drop (D) ammonia into (A) Silver Nitrate until the solution darkens and clears. Add (C) the caustic potash and drop in enough ammonia again to clear. Then add enough of the solution (B) to change the froth color without becoming muddy. Add then 8 drs. of the reducing solution (E) and pour the mixture into a porcelain or enamel dish large enough to accommod-\ate the mirror and to allow the fluid to extend about one-half an inch over the concave surface. Agitate gently and note the change of color in the fluid. When it be-\"comes a muddy pink pour off quickly and wash the silvered film of the spec-\ulum in running water. When dry the film can be dipt into fine dry rouge. The polished surface will reflect about 90 per cent of the light used. When mounted the diagram will serve both as an astronomic-\al and a terrestrial telescope. The flat mir-\ror necessary to bring the cone of light into the eyepiece tube can be a piece of se-\lected plate one-quarter of an inch thick. It can be silvered at the same time with the concave mirror.

It may be interesting to know about how much time will be required for the grinding, polishing and figuring the spec-\ulum. Of course this will vary with the particular kind of glass and the degree of one's energy, but the processes should require approximately the following: 5 hours for the rough grinding, 10 hours for the fine grinding, and 35 hours for the polishing and figuring. During the latter stage of figuring the work becomes tedious, because only a few moments of polishing can be done before the speculum is tested.

The mounting can be that of an alt-\azimuth as shown in the photograph, or a sim-\ple equatorial as shown in the diagram. The eyepiece can be of one-inch or one-half inch and one-quarter inch equivalent focus and are cheaper purchased than to attempt to make them. The ordinary microscope eyepiece (Huyghenian or negative) is rec-\ommended.

Having used both the altazimuth and the equatorial form of mounting, the writer can recommend the latter as the simpler to construct and the more generally service-\able. As the tube can be pointed at the celestial object and then clamped on and the motion around the polar axis need be con-\sidered in following the diurnal movement of the planet or the stars.

From a plank one-inch thick cut two cir-\cular discs, eight inches in diameter and seven inches respectively. Center them and screw them together with four screws. The mirror will be held flat with its back sup-\ported by a circular piece of Brussels car-

---

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when the amount of your bill will be had. For example, if six 40-watt lamps (carbon or tungsten) burn 60 hours per month, then: $60 \times 6 = 40 = 14,400$ watt-hours, or divided by 1,000, $14.4$ K.W.H. At 10 cents per K.W.H. the bill would be $14.4 \times 10 = $1.44.

Data on Carbon and Tungsten Lamps

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<th>Actual in</th>
<th>Position in</th>
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RADIO AROUND THE WORLD.

(Continued from page 547)

that trans-Atlantic communication has been successfully carried on for some time with
any such kind of the aerial being placed in the ground. Details of the exact arrangement of such ground antenna cannot be given, of course, at the present time, but the fact can be found that messages from England and other countries have been and are regularly received on this form of aerial, and also some of the high towers erected some years ago have been taken down. Another interesting point connected with long distance radio transmission and reception is the fact that an American radio engineer succeeded in picking up messages from England and other European stations in a laboratory situated on the southeast coast of the United States without any elevated aerial wires, ground antenna or anything excepting a coil of wire placed in the laboratory, the coil measuring about eight feet long and eight feet in diameter. This coil comprised about five thousand feet of insulated bell wire; by tilting the coil in various directions, by sitting at the interesting and valuable scientific measurements were taken. As might be suspected, the tuning was not quite as sharp as with this arrangement as when elongated rectangular ones were used, but the very fact that messages were received by such a small coil inside a laboratory, in comparison to the gigantic antenna erected for the purpose, is in every case a few years ago, speaks for itself.

Some very interesting work has been done in the direction of high speed wireless transmission and reception. Up to a few hundreds words per minute have been experimented with, and up to one hundred words per minute, the radio messages have been transmitted and received very successfully, fully, the received signals being amplified by means of two-stage vacuum valve amplifiers, and recorded on a meter representing the record of the cylindrical wax record type. In connection with the experiments with the ground aerials, it can be stated that no appreciable success has had the great aeronauts for transmitting with such aerials, it having been found in this case that in order to radiate the energy without too much loss, that an elevation of at least one hundred feet above the ground is usually desirable and necessary.

Long distance wireless has developed tremendously since the outbreak of the war. The great German station at Nauen, which at the outbreak of the war, included a single tower 300 feet high, has an array of towers, ranging in height from 360 to 890 feet and messages have been transmitted 3,200 miles. It is from these towers that South America has received messages in the past.

Japan is fast developing communication with the United States and altho Japanese high power stations located with Hawaii, it is planned to build stations in Japan and on the Pacific coast, a distance of over 4,000 miles, that will of commercial use.

The development of wireless between Scandinavia and the United States is making rapid strides. In Stavanger, Norway, has communicated with the Marconi station at Belmar, N. J., with good results.

Japan is to have one of the greatest wireless stations in the world. It will be built in Fukushima prefecture, says the Department of Communications, and will cost 800,-000 yen (430,000). The station will be at Hibiya, near Haraizumi, and the receiving station will be at Hosoya-cho.

Survey work has been started by engineers of the department.

EXPERIMENTAL PHYSICS.

(Continued from page 544)

stand S so that the blackened surface gets the direct rays of the sun. With this crude apparatus we are in a positive measure of the amount of energy received from the sun on each square inch in a certain definite period of time, such as second, minute, or hour. The second and the minute are almost perfect absorption qualities it possesses, and consequently its poor radiating or reflecting qualities. The heat striking the black surface is absorbed, and then conducted by the metal can to the water. The weight of the water multiplied by its change in temperature gives the heat absorbed (in calories, if weight is measured in grams and temperature in degrees Centigrade). Dividing this result by the time elapsed from the initial and final readings of the thermometer, gives us the heat received per unit of time. Dividing this result by the area of the heat units received per second, on each square inch surface. By careful determination and necessary corrections according to Newton’s law, stated in Experiment No. 99, we find that each square inch of surface on the earth receives about 10 calories of heat per minute from the sun.

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while in the path of the vertical rays. From this may be calculated the total heat energy received from the sun by the whole earth. This is calculated to be equivalent to about 350,000,000,000,000 horse-power or about 250,000 horsepower for each inhabitant.

Experiment 102.

If we continue our observations (by the aid of proper instruments) of waves still longer than the heat waves we come to the electrical waves, the short,—of which are about 1/2 of an inch, running over a wide range of lengths. Waves of hundreds and even thousands of feet in length.

The following analogy between sound and electricity will serve to strengthen the wave nature of electricity. With the so-called loud pedal of the piano on, strike middle C. Placing a finger gently on the string middle C (the front panel of the piano being removed) the vibrations are felt. Since middle C is the only note that has been struck one would expect that only that string would be vibrating. Placing the finger gently on C, above or below middle C, we find those strings also vibrating. The explanation is simple: The string middle C on being struck begins to vibrate at a certain rate, setting up waves of a certain frequency the sound of which we interpret as middle C. These waves on striking the other C’s of the piano,—since the rate of vibration is similar to middle C, in fact a multiple of middle C’s rate,—start them vibrating neither faintly but sufficiently to be felt.

Let the inner and outer coats of a Leyden jar be connected to a loop of heavy wire composed of two segments D and E and a movable cross-piece F, so that the length of the loop can be altered to suit. Let jar B be connected with a loop C of fixed length. A space of about 1/2 of an inch should exist between the loops and the knobs of each of the jars respectively. On charging and discharging the jar B, a spark will jump from the knob of jar A to the loop of jar A provided the loop of jar A is adjusted so as to have the same area as the loop of jar B. On moving wire F to any other position, no spark is observed at jar A. This electrical case is similar to the sound example given above. When the electrical system of A and B is such that they have the same vibration rate, just as the C’s of the piano having the same vibration rate, then vibrations of the one cause the second to vibrate. We therefore conclude that electrical discharges are vibratory. Moving the sliding wire F is called tuning, and when the two systems are tuned they are said to be in resonance. Just as heat can be transmitted by radiation, so electrical energy can be transmitted. Electricity differing from light only insofar as its waves have a tremendously greater length and the speed of transmission being independent of the wave length. We should notice that the speed of electrical transmission equals that of light or 186,000 miles per second.

Electro-Magnetic Theory.

An intensive study of electrical radiations shows us that they not only have the speed of light but that they are reflected and refracted, etc., just as light is. Hence in modern Physics, light is considered an electro-magnetic radiation. Light waves are considered to be generated by the vibrations of electrically charged parts of the atoms. James Clerk Maxwell, as far back as 1862, showed that it ought to be possible to create waves in the ether by the use of electrical disturbances. Hertz’s experiments in 1887 confirmed Maxwell’s theory; these two events and dates really marking the beginning of Radio telegraphy. (To be continued)


Electrical Testing Engineers Made to Order.

(Continued from page 538)

tested supply most of the electricity required for testing them, only the losses being supplied from the power station.

The test men operate the machinery being tested on the machine used for testing the apparatus which has been manufactured for shipment.

With this operating experience, the graduate of the "Test course" can manage almost any main station, sub-station or switch house and take charge of its electrical operation.

This feature was probably one of the main reasons of the test men were all appointed for officers in the Army and Navy.

The fact is not as generally understood as it should be, that the students engineers are continually shifted from one kind of work to another, and are consulted regarding the sort of work they desire to specialize in and also class of testing they desire to take up month after month.

For example, if a student engineer has experience in a turbine work, he can spend 50 per cent or more of his time testing large and small turbo-generator sets. Turbines are tested non-condensing and also with water washed. For, student becomes familiar with the properties of steam, ranging from 200° super-heat down to 20 per cent moisture. One of the students is a student engineer who enters the Test Course, is the vast amount of information which he secures in rapidity.

An indication of the scale on which this mechanical electrical phase of the Company's testing has been developed, is shown by the fact that one of the test equipment was installed at an expense of $300,000 and a steam equipment is being installed at $250,000—both solely for "testing purposes." Such is practical turbine testing today on a great scale.

In comparison with this work the little jet and barometric condensers in the old power plants, 15 years ago, were but cunning little toys.

This wide variety of apparatus for steam and vacuum condensers, motors, both mill, mine and crane, motor generator sets, etc., illustrates the breadth and scope of this heavy work. It contains the latest, and hence the most interesting electrical mechanical devices that are manufactured. When the Engineer of the General Testing Lab. electrical locomotive throws his controller handle one notch ahead, he duplicates what an electrical test man has previously done. When an operator of the great electric locks of the Panama Canal throws the switches which permit a $3,000 ton battleship to pass through the also, tremendously what the student engineer has previously tested and adjusted.

The theoretical phase of the training of a student engineer is taken care of by an extensive series of lectures, which are given to the students by prominent designing, research and production engineers, and working with the commercial managers of the Company.

Not only are these lectures free but the students are paid full time while attending them. Attendance is not compulsory and a student may attend one or two each week as desired. These lectures are given between the 4th and 35th of the month, P. M.—after the close of the working day.

The purpose of these lectures is to round out the student's knowledge of the Company's products, and it is very popular. The young men are encouraged in their desire to become specialists, but are given freedom to choose the field of knowledge that are opened up to them by these various lectures. Altogether there are 50 lectures given every year.

After six months or more have elapsed since the student entered the "Test Course," he has the opportunity to choose which of those who have made a good record. The Superintendent of the Testing Department selects three men for the various offices in the Engineering and Commercial Departments, at the end of which training they then return to the Testing Department.

Popular Astronomy.

(Continued from page 543)

and more asymmetrical in appearance. They are sometimes referred to as the equatorial regions of the sun while above the poles the rays are extremely short with pronounced dark rifts between them. The equatorial region sometimes extends to eight or nine million miles from the sun. This type of corona is called the sun-spot polar. The sun-spot activity was just past the maximum for this sun spot cycle which had been reached the year before. The decline toward minimum activity was also very gradual. 

Important of the solar declination of activity, that is, a sun-tropic type corona roughly triangular in shape. The evenly developed portions toward the edge of the sun spot maximum type forming the base of the triangle and the long equatorial streamers to the east of the sun spot minimum type forming the triangle. Their greatest extent was three solar diameters or two and one-half million miles. The corona was also a petal-formed corona, most beautiful type observed in certain eclipses of the past. The rays curved and interlaced to form enormous petals and Gothic arches, and the brilliant blood-red prominences of inconstant gases that were plainly visible to the naked eye and formed a most impressive and vivid spectacle. The prominence, the arching of the coronal streamers above the prominences, to a height of several thousand thousand miles from the surface of the sun in the typical corona, that causes the eruptive prominences is accountable for the arched coronal rays above them. The prominences, which are chiefly incandescent and bright and the helium and calcium often rise to heights of one hundred thousand miles or more and then rapidly fade away. The accompanying photograph taken at Green River, Wyoming, by the Yeke's eclipse expedition, shows a number of conspicuous prominences on June 8th, and also the inner corona. Unfortunately it is never possible to reproduce in prints the complex coronal rays, tho the negatives show a wealth of detail and detail is derived from the original negatives are necessary to show this complex structure.

Since it is possible to observe the prominences on any clear day with the spectrophotograph they possess little scientific interest during totality, tho they are a most impressive and beautiful feature of the eclipse, owing to the great height they attain and their conspicuous scarlet hue and variety of form. The chromosphere, the richly colored lover rays, tinged with pink and orange colored vapors of many elements, that appears as a narrow rim above the eclipsed solar surface is also extremely beautiful and indeed the celestial color.
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TURNING AIR INTO BREAD—NITRATES FROM THE AIR. (Continued from page 541)

Thus we see that the electrical engineers abroad have actually succeeded in transforming "air into bread" as we might say. At the present time, there is no plant such as here described in use in the United States, or in fact, in the two Americas so far as we know. It is safe to say that with the gradually changing conditions resulting from the present war, and also in view of the fact that the engineers of today are continuously striving to reduce the cost of all commodities, we of the present generation and our children will live to see gigantic electric-nitrogen power plants, such as here illustrated, sprinkled across the country. It may be of interest to some of our more technical readers to trace the steps followed in the manufacture of nitrate, etc. The schematic diagram here-illustrates the steps that are used in the disassociation of the nitrogen from the atmosphere in a procedure closely following the appended outline, viz.: After the sodium nitrate has been taken from the soil by the electric arc it is admitted into the soda absorption towers, which precipitate the soda and allow the nitrate to pass on into the acid absorption towers and simultaneously the free nitrate is conveyed by means of piping to the apparatus used for the manufacture of the nitric acid, etc. But at this stage of the operation the nitric acid is condensed in the condensation tower, according to specifications by Kestner, the renowned chemist and then run into the crystallization chamber where the mixture is crystalized. There is an outlet whereby the mother liquor is drawn off and collected in a vat especially constructed to retain the strong acid. Outlets from the filtering apparatus also lead into this container, and likewise a third outlet for the force of the liquid after the mixture has been separated from the paste by centrifugal action of the Centrifuge. The Nitrate is then carried to the Silo in powder form and stored there until it is to be placed into barrels. The second line leading from the absorption towers that are shown at the center and at the bottom of the illustration, carries the acid after it has been valenciated with an additional atom of oxygen from the ventilator, past thru an oven to eliminate the moisture, superheated in the steam boiler and chilled in the condensers. This oxygen then associates itself with the nitric acid as the first step of the manufacture of saltpeter (these apparatus are shown at the upper left hand portion of the diagram). The acidulated paste is neutralized and condensed; then it is stirred until it is evenly mixed and all the lumps are broken. The ball mill comes into action at this period and grinds the paste to a powder, after which it is run thru a sieve and conveyed by a bucket hoist to the Silo, where it is dried and stored for future consumption as the regenerator of the soil and to produce better, bigger and more wholesome crops for our consumption.

A $5,000 KW. TURBO-ALTERNATOR.

The first turbo-alternator of 60,000 kw. capacity has recently been completed in the A. E. G. (German) works, and the following description is abstracted from Elektrotechnische Zeitschrift. The output of the machine is 55,000 kw. at a speed of 1,600 revs. per min. It gives 7,000 volts, three-phase, with excitation at 220 volts. The turbines work at a super-heat of 326° C, and with cooling water at 27° C. The weight of the turbine is 250 tons, of which the turbine rotor is responsible for 49 tons; the total weight of the alternator is 225 tons and of its rotor 100 tons. The entire weight of the machine, turbine and alternator, is thus 475 tons.

This machine, together with a second one of similar size and output, designed by B. Goldenburg, will be installed in the Rheinisch-Westfälische Elektricitätswerke power station, located on the site of the coal fields at the foot of the hills near Cologne. The total installation at this station (named after the designer, the "Goldenburg-works") will consist ultimately of six turbo-alternators from 15,000 kw. each up to about 200,000 kw.
December, 1918

POPULAR ASTRONOMY. (Continued from page 590)

effect of the entire solar surround- ing during the total phase is gorgeous beyond de- scription.

The Sun's Prominences—Photographed by Yerkes Observatory. This is a particular Fine View of One of the Larger Prominences.

To astronomers the all important problem in conection with a total eclipse of the sun is—the corona, its composition, the nature and cause of its radiant energy. It con- tains an element so far unknown elsewhere and named "coronium." An important re- sult that has followed from observations of the June 8th eclipse is a line of knowledge of the wave length of the characteristic green line of this unknown element. The exist- ence of one or two additional distinct coronal elements is also suspected, inasmuch as a number of lines of unknown origin appeared in the spectrum of the corona photographed on June 8th, as well as in the coronas of several past eclipses. Determinations of the positions of these lines have also been made. Tho several of them may belong to coroniuns it is likely that some of them are lines of other un- known elements. It has also been found that the inner corona shines chiefly by its own inherent light instead of by reflected sun light. The outer corona on the other hand shines largely by reflected light from the sun. It is believed that the corona is composed partly of scattered particles of matter that reflect the rays of the sun, but electrical forces are probably the cause of its peculiar etherial radiance and magnetic lines of force may cause the complex and periodically changing form of the coronal rays and streamers. It is possible that the clue to the secret of the radiant energy of the sun may lie in the yet unsolved mystery of the solar corona. Every successful ob- servation of a total eclipse of the sun brings us nearer to the solution of this im- portant problem. By correlating a series of observations made by different eclipse ex- peditions at various total eclipses of the sun or by different observers of the same
eclipse the handicap of being granted only a few brief moments at long intervals for the solution of a perplexing problem is largely overcome.

(Watch for next Installment.)

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A TRANS-ATLANTIC 10,000 HORSE-POWER AERIAL LINER.

(Continued from page 537)

EACH motor, or a total of twenty-four blades to the machine. The general contour will be similar to the illustration of the "Etheric." The exhaust from the engines will be used for heating "muffler" stoves, upon which all of the food in the dining car can be cooked, water will be heated, and a general warmth provided in cold weather and while flying at unusual heights.

Quite an appreciable amount of reserve lifting power is used in order to provide comfort of the passengers in the way of cushions, hammocks, and periodicals.

The "Etheric" is equipped with a wireless outfit having a range of up to two thousand miles, and each passenger is taken care of in the event of accident by an individual combination parachute and life-belt, for he should drop from the altitude over which he was flying, all of his body would be brought beyond a trace of recognition. These parachutes are stowed at the back of the operator's compartment for the benefit of each state-room, all of the room-fronts facing the exterior of the ship.

It is then a very simple matter in the event of an unforeseen emergency, for the passenger to jump out of bed, open the door, slip on the life-belt and parachute hanging behind him, and forgetting all fear, make his exit quickly. The parachute will open, and he will float gently to the surface of the water, in which element he will again take care of himself.

Use will, of course, be made of the Radio Direction Finders, which will be in a synchronous tune with New Foundland and Irish stations. Messages from radio stations of other stations will be immediately recognized, as this is due to the close tuning between the line's station and the station for which we are listening.

We had all better buy Liberty Bonds, so that by the time they will mature, we will have money laid away in order to buy a ticket for the trip through the high thousand feet in the air, across the Atlantic, and at a speed of one hundred and ten miles an hour with all the advantages of comfort.

Note—The motors necessary to propel this gigantic machine would necessarily have to be of approximately 1.9 or 2 pounds weight per brake horsepower. At present we have motors that will develop a horsepower at a weight of 2.5 pounds per brake horsepower.

It is of interest to note that at the large aviation fields maintained by the government, the airplane are called "ships."

EXPERIMENTAL MECHANICS.

(Continued from page 557)

The main point of accuracy of split-chucks lies principally in the fact that the mandrel, made especially large and held in the first set of jaws, is not only accurately fitted to ground-in bearings of glass-hard steel, but is in itself, the chuck body for the receptacle of the Fractioned sets of jaws, of which one split-chuck may be regarded as a set. To bring this about, the mandrel is bored true through to as large a diameter as possible and is further coned out at the front end to an included angle of 45 degrees. It can be clearly seen that these forms are made of such accuracy of sledge hammer blow will put the running of this internally coned surface out of truth with the lathe axis. All the principal grips of the split-chucks for the makes of one size externally, to fix exactly into the mandrel bore. They are bored exactly to the size of the hole and are intended to grip, screwed at the back end, in friction form, but what is called a split-chuck. By placing within their grip around work of the size they are intended to hold, and drawing them in tightly to the mandrel end by means of a hollow draw pin, screwed to their back end, and working thru the bore of the mandrel, absolute precision is obtained within limits where .001 (one one-thousandth) of an inch would be regarded as a serious error.

In order to procure accuracy of the finished material or product, it is essential that the means of chucking the work plays a very important part. Where precision is desired, no other than the split-face chuck should or can logically be used.

(TO BE CONTINUED)

WORK OF BELGIAN COMMISSION AMERICAN RED CROSS.

The American Red Cross, thru its Belgian Commission, has authorized the installation of an electricity storage battery plant at the colony of 400 Belgian children which it is supporting at Recques. These children are refugees from the towns in which the fighting is going on today on the Belgian front.

SPECTROSCOPIC METHODS AND SPECTRA.

(Continued from page 555)

be slit. This clip is made of sheet brass, also the copper and may be used over the arc is struck by moving this carbon forward back they both touch, and then moving them back about 1/2 to 3/4. The current connections made to the holders or clips should be connected to binding posts on the base.

A sheet of white cardboard tacked to the back will show the form and color. The current is used is the 110-volt lighting current. A rickets is used in the circuit.

Their brightness has been, full of water and adding 3/4 to 1 oz. hydrochloric acid and then immersing the strips in it. The amount of current can be varied by lowering and raising one of these strips. The wiring connections are shown in the figure.

It is advisable, if this apparatus is used for the house fuse plugs have not less than 25 amperes capacity, as the usual house fuse is 15 amperes rating, which will burn out in a short time, especially if too much acid has been used in the water.

It will not be out of place here to refer to the advantages of a number of places in the article. These are mainly connected with the fact that the means to produce the spectre sometimes give a continu- ous spectrum of all the elements completely blots out the band spectrum. This can only be overcome by using very narrow slits, but if a very narrow slit is used, the illumination must be increased. It is really advisable to make about six slits, in which they vary in size from one large one, about 1/8 diameter, and five small ones, in which the smallest should be about as wide as the thickness of a sheet of writing paper. A set of these will greatly facilitate good work.

This covers briefly all the general fields of spectroscopic work, but several miscellaneous items still remain.

The instrument is pointed at the sun, a continuous spectrum will be seen, which, however, is most by a considerable number of blinks, and it is the theory that the sun is a white hot mass of solid matter, surrounded by a mantle of gaseous vapors. These vapors are then, ordinary circular with a background of incandescent matter, they are reversed, and appear as black lines on a colored background.

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It is obvious that by comparing these lines with ordinary spectra, we can tell what elements exist in the sun. This has been done, and the sun has been found to contain chiefly iron, sodium, magnesium, calcium, chromium, nickel, barium, copper, zinc and hydrogen. Hydrogen especially has been observed in enormous quantities.

One of the iron spectrum (which contains an enormous number of lines) has also been identified. It is also a fact that the sun contains quantities of certain metals not known on earth. One substance has since been discovered, namely, Helium, and it is a startling fact to confess that this element was discovered in an incandescent body millions of miles away in space before it was known on our own little globe.

An experiment to illustrate this reversal of the spectrum can be made by placing a sodium flame in front of the spectroscope, and behind it a small arc. The yellow band will disappear, and the continuous spectrum of the arc will be cast upon a black line where the yellow should be. The experiment can also be made with other elements, but the result is in every case the same.

A little consideration should now be given to the best materials, etc., used to obtain the spectra. As a general rule, it can be said that the halogen salts, that is, the chlorides, bromides or iodides, are the best to use. The chlorides being the cheapest and most easily procurable, are generally used.

The reason these salts are the best is because of their instability at the high temperatures used. They are decomposed (dis-associated is the more correct term) into the free metal and radical. Care must be taken, however, with these salts, for example calcium chloride, which yields a spectrum of its own which lasts until it is decomposed into calcium oxide; and, in fact, if possible, it is best to use the oxide instead of the chlorid.

The foregoing remarks apply equally alike to flame, spark and arc spectra, but in the case of the light being used, in which it is evident that the temperature is not nearly so high as the arc and spark methods, materials can be used that will materially aid in producing the spectrum. The salts referred to are the chlorides, which practically amount to a chlorid with a certain oxygen attached. When, for instance, calcium chlorid is introduced into a flame, the heat begins to drive off some of the oxygen, which, in proportion to the temperature of the flame, in which the residual chlorid is being volatilized. It will, therefore, be seen that the use of the chlorides where available, for flame spectra, is a decided improvement.

The nitrates can also be used in a similar capacity, but are not so efficient as the chlorides.

It will be well to again repeat the warning that nitrates or chlorides must never under any circumstances be used for arc spectra, as the combination between them and the carbon of the electrode, making practically gunpowder, at the temperature of the arc, may result in a dangerous explosion.

It is to be hoped that enough has been said in the preceding articles to give to the careful and earnest Experimenter some small glimpse of the wonders that can be revealed with a very little expense, a normal amount of ability and patience, opening up as this subject does, such a fascinating and entertaining field of work, and yet it is a strange but true anomaly that the more we learn and the farther we extend our knowledge the stranger becomes the conviction that we know less and less of it than ever before.

(Conclusion)
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SEND ALL ORDERS TO "CIRCULATION DEPARTMENT"

EXPERIMENTER PUBLISHING CO., Inc.
233 Fulton Street, New York City, N. Y.

SEND FOR OUR FREE SUBSCRIPTION CATALOG

Scores of Publishers are increasing their prices overnight. Protect yourself by subscribing NOW

You benefit by mentioning the "Electrical Experimenter" when writing to advertisers.
Opportunity Ai-lets

YOU will find many remarkable opportunities and real bargains in these columns. It will pay you to read and investigate the offerings made here, as many of the firms who advertise sell other than the items advertised. Here is the place where you will find the most attractive opportunities at the lowest prices.

Advertisements in these columns are accepted only as a service for the benefit of the reader. The publishers are not responsible for the truth or accuracy of the statements made in any of them. Cash must accompany all classified ad. It is advisable to have a list of the items you wish to buy before you_send money. A return of second-class postage stamps will be allowed on money paid for classified ad. It is the publisher's policy to make the best market for each item advertised. This policy cannot be changed to include or exclude any item. Cash should accompany all classified advertisements unless placed by an accredited advertising agency.

Write early to receive discount announcements and information on the lowest rates. Objectionable or misleading advertisements not accepted. Advertisements for the January issue must reach us not later than November 22.

The Circulation of the Experimenter is over 100,000 and climbing every month

EXPERIMENTER PUBLISHING CO., INC., 251 Fulton Street, New York, N. Y.
ELECTRICAL EXPERIMENTER

December, 1918

For Advertisers

20 Word Ad. in 100 Pulling magazines, $1.00. About 2000 copies. 30 Word Ad. in 100 Pulling magazines, $1.50. About 2500 copies. 50 Word Ad. in 100 Pulling magazines, $2.00. About 4000 copies. 100 Word Ad. in 100 Pulling magazines, $3.00. About 6000 copies. 200 Word Ad. in 100 Pulling magazines, $5.00. About 9000 copies. Give us your rates today. Douglas Wakefield Coute, 225 Massachusetts Ave., Cambridge, Mass.

For Inventors

Inventors—Mail your inventions, through National Institute of Inventors, World Bldg., New York City. Membership co-operative organization.

Thousands Government jobs open to men, women, girls, 55.00 month. Quick increase. Write immediately for free list of positions open.

Wanted—To buy American Toy Manufacturers, to make Toy Soldiers, Army, Navy and other toys. Home workers on small scale, manufacturers on large scale. Greatest chance for industry and consumers in America. Enormous demand in American Made Toys. Will buy your toys, dolls, or anything in good condition. Will pay largest prices. Complete outfit for manufacturers wanted. Write for free list of manufacturers. Many men—Who know what they want and who have the necessary capital to start huge lines. 

Patent Your Own Inventions. Save your attorney’s fees; prepare applications; furnish full information and quotations. Free information. Mr. C. L. Orton, 371 East 10th St., New York City.


Science and Industry—Patents—Without advance attorney’s fees. For full information and quotations, send 10c for free book, Books free. Frank Fuller, Washington, D. C.

Inventions Wanted! Manufacturers constantly writing us for patents. List of inventions accepted. Write for complete information. Mr. C. L. Orton, 371 East 10th St., New York City.

Complete Chemical Laboratory for sale or exchange for wireless goods. Rakosy, 331 East 80th St., New York City.

Strongest Force Courses, $100. Clay Hewes, 102 S. Lake Ave., Albany, N. Y.

Send for free booklet. $50.00 value. Speedily advancing. Contains practically unobtainable equipment. Pratts, 1050 W. Workman Ave., Los Angeles, Calif.

Wanted—Screw cutting bench lathe or high frequency apparatus. Have 20 Vol., Encyclopedia Britannica, complete leather edition, good as new. Address Nestor J. Saffoon, Buffalo, N. Y.

Electrical Laboratory For Sale—Send for list of everything in stock. Ray Wengel, 29 W. Dotty St., Madison, Wis.

Everywhere—Worth while samples 50c. Mention subjects preferred. Mutual Exchanges and New Inventions. Write to Mr. C. L. Orton, 371 East 10th St., New York City.

For Scientific Exchange Columns

LIE readers with something to "swap" or sell have found that the surest and quickest way to make the desired trade is thru ad in these columns.

The rates are:

Five cents per word (name and address to be counted.) Remittance must accompany all orders. No advertisement for less than three dollars accepted in Opportunity Ad. columns only.

OVER 100,000 CIRCULATION

Printed

100 Bond Noteads, 4 lines and 100 envelopes prepaid, $1.00. Southern, 149II Berendo, Los Angeles.

Beautiful Lithograph Stationary at Printer’s Wholesale Prices. Free Descriptive Lithograph Co., 708 E. Tenison, Milwaukee.


For Sale or Exchange—Rausch & Lemberg microscope, magnifies 24 times, Physics Laboratory equipment, florist's supplies, 36 lbs. wheatstone bridge, etc. Want Xela and spark coil, etc.

Will Exchange—New $1 #1 Meccano for Chemical Laboratory Outfit. Charles Blake, Fayette Street, Wolcott, Conn.


Sold—Small stamp collection cheap. Write, Granville Whittley, Jr., 120 E. 67th St., New York City.

For Sale or Trade—Weston D. C. 300 Amp. Anemeter with 300 Amp. shunt, 10s. galvanometer, slide wire bridge for cash or chemical supplies. John Cauthel, 191 Summit St., Toledo, O.

Wanted—Round Volume No. 4 Electrical Experimenter, state price. George Hawley, Hutchinson, Kansas.

Camaras, Suppl., Photo Developing

"Camera Kinks and Photo Fads" tells how to make prints from ordinary snapshots, flash lamps, colored slides, etc.—Chemical oil photo,—Photos on silk, fine paper, etc.—Send 10c for free booklet. C. E. Greenhll, The Lexington, Indianapolis.

Clean Neat Finishing—Payment both ways. No extra charge. Business card, picture, letterhead setting, etc. My Studio, Department Four, Sum- merset, Ind.

Mail us 1¢ with any size Film for development and 6 velvet prints: Or send 6 negatives any size on 6c. 25¢-enlargements 95c. Prompt, perfect service. Rosauke Picture Studio, 222 E. 34th St., New York City.

Tobacco or Snuff Habit Cured or 50¢. Very稿件速 (Signed) now on trial. Superiority Co., SA, Baltimore, Md.

Don't Throw it Away! If a pot lets leak $1 for a box of Menda's. Save money. Simply take a few lids from your pot, cover surface. Only 10c. agents wanted, The Wanted Agency, 34 Crystal St., Brooklyn, N. Y.


Don't throw it Away! If a pot leaves send $1 for a box of Mend’s. Save money. Simply take a few lids from your pot, cover surface. Only 10c. agents wanted, The Wanted Agency, 34 Crystal St., Brooklyn, N. Y.

Pyorrhea—Dr. H. E. Kelty, D. D. M., S. M., pyorrhea specialist, has developed a successful home treatment for pyorrhea, Puri- ty and Power —Natural Pyorrhea. Full monograph and booklet, 1c. Circle free, Dr. H. E. Kelty, 154 South Wabash Ave., Chicago, Ill.


Scientific Exchange Columns

THE rates are:

Five cents per word (name and address to be counted.) Remittance must accompany all orders. No advertisement for less than three dollars accepted in Opportunity Ad. columns only.

OBER 100,000 CIRCULATION


Song Poems Wanted

Write the Words! Original songs, music and guarantee publisher’s acceptance. Submit complete work. William T. Seeber Music Co., 158 S. Dearborn St., Suite 206, Chicago.

Stamper

St-stuff-tistering and Stampering at curled at 50c per hund. For sale—105 Potomac Bank Building, Washington, D. C.

Tricks, Puzzles and Games

Tribe stage tricks with 500 instructions, made from small absolute, $1.00. Hornman Magic Co., 816, 420 Eighth Avenue, New York.

New and Mystifying Hindo Magic Tricks, Tokio Trick 100c, Chinese Link L Link Mystery 25c. Send for free catalogue. Rising Card 35c. How to make Fireworks. Do it yourself, 50c. For a limited time only, including free trick and cata- logue. You can earn 55.50 in cash by reading these Scientific Advertisements and sending to your friends. Full particulars on request. Luckhurst Magic Shop, Dept. E, 1311 S. Louis, Mo.
$5.

EXPERIMENTERS!

A Sample of What You Can Do With This Outfit

This illustration, made from an actual photograph, shows only a very few in\\nstruments that can be performed with this wonderful outfit. The RADIONOE, a 'truly a

The "Electro" Radiophone

The "Electro" Radiophone is not a toy, but a practical, honestly built telephone outfit, which

No. EX2002

"The Boy's Electric Toys" contains enough material to make and complete over twenty-five
different electrical apparatus without any other tools, except a screw-driver furnished with the outfit. The box contains the following complete instruments and apparatus which are already assembled:

Student's chronic plunger battery, compass-galvanometer, solenoid, telephone
receiver, electric lamp. Enough various parts, wires, etc., are furnished to make the following apparatus:

- Electromagnet, electric camera, magnetic pictures, dancing spiral, electric
  hammer, galvanometer, voltmeter, hook for telephone receiver, condenser,
  sensitive microphone, short distance wireless telephone, test storage battery,
  shock coil, complete telegraph set, electric riveting machine, electric buzzer,
  dancing flames, singing telephone, mysterious dancing man, electric jumping
  jack, magnetic geometric figures, rhesus, erratic pendulum, electric butterfly,
  thermo electric motor, visual telegraph, etc.

This does not by any means exhaust the list, but a great many more apparatus can be built actually and effectively.

With the instruction book which we furnish, one hundred experiments that can be made with this outfit are listed, nearly all of which are illustrated with superb illustrations. No other materials, goods or supplies are necessary to perform any of the one hundred experiments or to make any of the 25 apparatus. Everything can be constructed and accomplished by means of this outfit, two hands, and a screw-driver.

The outfit contains 14 separate pieces of material and 24 pieces of finished articles ready to use at once.

Among the finished material the following parts are included: Chronic salts for battery, lamp socket, bottle of mercury, core wire (two different lengths), a bottle of iron filings, three spools of wire, carbons, quantity of machine screws, flexible cord, two wood bases, glass plate, paraffin paper, binding posts, screw-driver, etc. The instruction book is so clear that anyone can make the apparatus without trouble, and besides a section of the instruction book is taken up with the fundamentals of electricity to acquaint the layman with all important facts in electricity in a simple manner.

We guarantee satisfaction.

The size of all the outfit is 14 x 9 x 2 3/4. Shipping weight, 8 lbs.

No. EX2002 "The Boy's Electric Toys" outfit as described.

IMMEDIATE SHIPMENTS

ELECTRO IMPORTING CO.,
231 Fulton St.
NEW YORK

You benefit by mentioning "Electrical Experimenter" when writing to advertisers.
FIGHT or Join the Industrial Aircraft Service

You may not be free to get into the actual fighting, but you can still give valuable service to your country. Join the Industrial Aircraft Service and you’ll not only be serving where you’re most needed but you’ll be laying the foundation for your future success.

Here is both Duty and Opportunity.

Here is your chance to get into essential war work, serve your country and make a good connection in the industry that’s fast becoming one of the foremost in the world.

The Aircraft Industry is more than a wartime emergency. The Aerial Mail Service has established the definite commercial value of the Aeroplane. After the war there will be opportunities aplenty for men who make good in the Industrial Aircraft Service now.

An Opening for You in One of America’s Foremost Aircraft Plants

At present our plants in New Brunswick (N. J.) and Long Island City are engaged solely in the manufacture of Aeroplane Motors for the Government. To meet our ever increasing schedule of production we must have the man power to operate the machines in our various departments.

We want your help. We want skilled mechanics, machine operators, inspectors, draftsmen, etc.

We will pay good wages for the right men.

Our Offer to Men Not Technically Trained

You do not have to be a skilled mechanic to get started with us.

If you have the right spirit and the determination to learn, we will take you on and train you at our expense in our School of Instruction.

Not only will we give you, free of charge, a full course of practical instruction under the supervision of competent instructors, but we will pay you while you are learning.

When you have completed the course which takes about ten days, we will pay you full wages prevailing in the factory.

Living Conditions Good

Living conditions in New Brunswick and vicinity are being bettered every day. Every Wright-Martin man will be able to count on a comfortable and congenial place to live. Moreover, the Government is now building 200 houses especially for war workers at Wright-Martin and other factories.

The company provides for social and recreational activities for everyone. With baseball, football and track athletics, picnics, concerts and dances, there need be no dull times for you or your family in New Brunswick.

One Hour from New York City

New Brunswick is just about one hour out of New York on the Pennsylvania. It is within short commuting distance of Newark, Elizabeth, Trenton and Philadelphia.

Your Duty Is Here

In fairness to yourself you can’t afford to pass up this opportunity to advance yourself and serve your country, too.

Write, phone or apply in person to Employment and Welfare Department, Wright-Martin Aircraft Corporation, New Brunswick, N. J., and Long Island City, Starr and Borden Avenues.

Wright-Martin Aircraft Corporation

New Brunswick, N. J., U. S. A.
**The Baby Double Action Revolver**

A HANSONS AND MOST EFFECTIVE WEAPON

$5.50

Measures but 4 1/2 inches long.

**The Border Bandit Books**

Thrilling Adventures and Daring Deeds of Notorious Outlaws

Price 25 CENTS OR THE FULL 10 BOOKS $4.00 POST

ONCE AND FOR ALL

This series of books contains thrilling accounts of the adventures and doings of the most famous of the Border outlaws. They are written in a style that will appeal to all who enjoy stories of adventure, and are full of interest and excitement. The stories are well researched and are based on actual events. They are sold at the price of 25 cents each, or the full 10 books for $4.00 postpaid.

**The Conjurer's Casket**

Apparatus and Directions for a Number of Mysteries

Enough for an Entire Night's Amusement

ANYONE CAN DO THEM. PRICE 50c POSTPAID

**The Watch Camera**

The most wonderful and ingenious Camera made.

It is little larger than a Watch, which is clearly evident. You can carry the Watch in your pocket without any risk of damage. One Cent a Picture

The Eye leads in, and the camera automatically operates itself. It is safe and reliable.

Price $250

**Electric Insoles**

Comforting to the Feet and Healthful

You will never suffer from Cold Feet while you wear these Electric Insoles. They are filled with a special electrical element that provides warmth to the feet.

**Invisible Ink**

Writing can be read only in a dark room; writing is invisible at daytime. Very remarkable.

**New Vamping Card**

No Tear Nor Hold. Folds easily. Can be carried in your pocket. Packet of 20 cards for 50c.

**Serpent's Eggs Mystery Skeleton**

10c each.

**Mystic Skeleton**

10c each.

**Great Curiosity Midget Illustrated Bible**

The Smallest Bible in the World

Price 50c.

Price 50c.

**Cigarette Roller**

Very neat and handy. Works less than a quarter of an ounce. I make a roll cigarette and you can buy as many as you wish. You save money and get a better cigarette. Price 10c each.

**Latest Novelty: Aerial Balloon**

Flies easily and smoothly. With a little practice you can make your own. Price 10c each.
A Grand, New Opportunity for Young Men in America

Thousands of Wireless Operators Wanted—at Big Salaries

A few short years ago wireless telegraphy was only the dream of dreamers. Today it is one of the most important of modern industries. Its usages are widening with terrific rapidity, until it is now considered an essential to the progress of man. So great has been the growth of wireless that there are now over 30,000 unfilled openings for Radio Operators.

Master Wireless in Ten Weeks

The National Radio Institute, headed by authorities who are now closely allied with governmental training of students, has perfected an easily mastered course in wireless telegraphy whereby students are taught completely in ten weeks. Many of our students are ready to take up actual wireless work in much less time. The course is founded on actual practice, hence the rapidity of the progress of the student.

THE PRICE IS REASONABLE—EASY TERMS

Our unusual facilities enable us to teach thousands of students by mail, affording them the same efficient service as if they attended our big school here in Washington. Herein lies our ability to offer this course at a figure which everyone can afford. To those unable to pay the full amount on entering, we offer easy terms of payment.

America Takes Her Place on the Seas

America is spending billions of dollars on the mightiest navy and merchant marine in the world. Practically all vessels are being equipped with wireless apparatus of the most up to date type. Thousands of operators are needed now. Salaries are high, and constantly rising. The field affords a wonderful opportunity for the man who starts now to master wireless. He can enter the navy, the army, the aviation field, the merchant marine, or a land station. Operators are needed badly in all of these branches of governmental and private industries.

Be a Trained Man in 10 Weeks

In the short period of ten weeks we can make of you a wireless operator, a man with a profession, independent, and not subject to the rise and fall of wages in the labor market. Salaries are as high as $150 per month and expenses. The man who acts now is the lucky one. Such glowing opportunities do not present themselves often in a life time.

These are the instruments you work with—they are given FREE with your course.

FREE COUPON

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Dept. 65, Washington, D.C.

Send me, free of charge, your booklet "Wireless, the Opportunity of the Age," with full particulars regarding your famous 10 week Home Study Course, and your Special Free Instruments Offer. Name ____________________________

Address ____________________________________________________________

Town ____________________________ State ____________________________

YOU ARE NEEDED NOW—GET YOUR INSTRUCTION FROM THE NATION'S CAPITAL

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14th and U Streets, N.W., Washington, D.C.

Get this coupon in the mail today. It is a step you will never regret. This coupon brings to you full particulars as to the unusual possibilities in the wireless field, the high salaries paid, and other interesting facts.
SMOKE BARRAGE SAVES ESCAPING PLANE
SEE PAGE 612
FREE BE A CERTIFICATED ELECTRICIAN

YOU MEN LISTEN

The country needs more trained, graduate electricians. Thousands have gone into the Government service and there is such an unusual demand for competent electrical men that I am making a wonderful offer at this time. HERE IS YOUR OPPORTUNITY! I want to send you my splendid offer now.

Don't hesitate because of age or experience. Young men, boys and old men must now fill the gaps and keep business going. DO YOUR PART. Prepare yourself for a real position, by my Home Study Course in Practical Electricity. I am Chief Engineer of the Chicago Engineering Works. I have trained thousands of men and can help you better than anybody else. We also have large, splendidly-equipped shops where you can come at any time for special instruction without charge. No other correspondence school can give you this.

SPECIAL OFFER: Right now I am giving a big, valuable surprise that I cannot explain here, to every student who answers this ad. Write today!

$46.00 to $100.00 a Week

Go after some real money. Qualify for one of the thousands of splendid positions open. All you need to start is a few months snappy, practical instruction from a competent engineer. Come to me—NOW. I'll give you my personal care to ensure rapid and efficient progress. My course is intensely practical. It is highly condensed, simplified, up-to-date and complete. I am so sure you will make a splendid success in this study, that I will Guarantee Under Bond to return to you every cent paid for tuition, if you are not entirely satisfied when you receive your Electrician's Certificate granted you as a graduate of my school.

FREE—Lessons and Outfit—FREE

Send me the Free Outfit Coupon at once. Do it now! For a limited period I am making a slashing cut in the cost of tuition, and giving each new student a grand outfit of Electrical Tools, Material and Instruments—in addition—Absolutely Free. I will also send you—free and fully prepaid—Proof Lessons to show you how easily you can be trained at home to enter this great profession, by means of my new, revised and original system of mail instruction.

ACT PROMPTLY

Get the full benefit of this great offer. Send the Coupon or a postal for free information without delay. Do it now—before my free offers and guarantee are withdrawn.

CHIEF ENGINEER COOKE

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2100 illustrations

A letter that means something to every man in America who is interested in electricity

McGraw-Hill Book Company, Inc.,
239 West 39th Street, New York, N.Y.

Gentlemen: In an attempt to express myself about CROFT'S NEW LIBRARY OF PRACTICAL ELECTRICITY, I have never seen and do not believe there was ever printed in the English language, a more comprehensive set of books. It is a library that is just as valuable to the novice as to the expert, because it is all practice.

Respectfully,
GUY H. PEIFER,
Chief, Duplan Silk Corporation, Hazleton, Pa.

McGraw-Hill Book Co., Inc.
239 West 39th Street, New York, N.Y.
Here are many different ways of producing music, and as our culture advances the desire for better and still better music becomes a craving of civilization. From the ancient tom-tom to a Stradivarius violin is a long story, and the changes are that as our musical tastes become more refined, still better instruments will become necessary and highly desirable.

There are few instruments giving a more mellow and a more “human” sound and quality of tone than a fine violin, but we have no hesitancy in saying that it should be possible to obtain still better results by electrical means. The field of purely electrical music has hardly been touched. Some years ago an American inventor produced the Telharmonium. This was one of the earliest and best attempts at pure electrical music. The Telharmonium was invented by Dr. Thaddeus Cahill and he used alternating current generators, each of a certain frequency; if a telephone receiver were connected in the circuit, the latter would give forth a certain very pure note. By using a switchboard arranged in the form of an organ keyboard, wonderful musical effects were produced.

Another more recent attempt was the pure electrical music discovered thru researches of Dr. Lee de Forest. He used his audion bulbs in connection with a telephone receiver, and obtained beautiful flute-like tones of the greatest purity. The two devices just described necessitated the use of a telephone receiver to translate the electrical impulses into sonorous vibrations, and this is a great disadvantage, for it ties us to a thin diaphragm, which in itself cannot produce the very purest tones obtainable. As one can readily understand, the limitations of a diaphragm are very great and while it is possible to obtain a single pure note, it is a different matter where several pure notes in different octaves are to be reproduced simultaneously.

A way out is suggested by the writer by pressing into service the thermo-telephone which employs no diaphragm at all, but uses a very fine platinum wire of microscopic cross-section. This platinum wire, heating and cooling in unison with the electrical vibrations, impress upon it imparts these impulses to the surrounding air. With this device very pure electrical music can be obtained.

There should be of course many other ways to actually produce pure electrical music, and here is a wonderful opportunity for experimenters and inventors. To the writer’s mind, it seems not at all impossible that we should take a metallic wire stretched taut and by impressing the electrical current upon it, vary its heating and cooling effects so as to produce pure sounds in a suitable receiver such as a thermo-telephone.

Dr. de Forest has shown us that beautiful music can be produced in a vacuum tube. Paradoxical as it seems, this nevertheless is a fact. There must be many other ways of producing vibrations in a vacuum tube which can be translated into an electrical current, thus producing music.

There are also certain ways of making electromagnets produce music—this without the adjunct of telephone receivers,—by vibrating their entire structure. Many other means will undoubtedly suggest themselves to our students and scientists.

H. GERNSBACH.
Wireless in Ten Weeks

(We teach you in your own home during your spare time)

Thousands of operators needed for
America's Merchant Marine

The age of wireless is here. The experimental stage has passed. Wireless now equals in importance telegraphy, and telephony. It has assumed its place among the great commercial industries of the earth. So rapid has been the development and growth of wireless in recent years that there has been left in its wake a tremendous shortage of operators. Actually thousands upon thousands are now needed for permanent "peace time" positions offering wonderful opportunities for advancement.

Earn up to $200 per month

In the short period of ten weeks we can make of you a wireless operator, a man with a profession, independent, and not subject to the rise and fall of wages in the labor market. Salaries are as high as $200 per month. There is a position in the merchant marine, the army, the navy, or a land station, awaiting everyone completing our course. We give you this training at home, by mail, in your spare time. It is not necessary for you to lose any time from your work to take the course.

Free Instruments—

To every student enrolling with us we present a standard set of instruments with which wireless messages may be sent and received.

Travel the world over or locate at a land station in America.

America is spending billions of dollars on the mightiest navy and merchant marine in the world. Practically all vessels are being equipped with wireless apparatus of the most up to date type. Thousands of operators are needed now. The field affords a wonderful opportunity for the man who starts now to master wireless.

Our students actually pass the commercial examination in ten weeks or less.

Get your instruction from the Nation's Capitol. Our course is endorsed by officials of the U. S. Government.

NATIONAL RADIO INSTITUTE

Dept. 67

14th and U Streets, N. W.

Washington, D. C.

A Valuable Book Free

Our booklet, "WIRELESS, the Opportunity of the Age," gives you complete information in regard to our course, the quick and easy methods by which you can master wireless, and other important facts you should know. It is free. Just mail the coupon. No obligation whatever on your part.

FREE COUPON

NATIONAL RADIO INSTITUTE,

Dept. 67, Washington, D. C.

Send me, free of charge, your booklet, "Wireless, the Opportunity of the Age," with full particulars regarding your famous 10 weeks' Home Study Course, and your Special Free Instruments Offer.

Name

Address

Town

State

You benefit by mentioning the "Electrical Experimenter" when writing to advertisers.
Master Electricity By Actual Practice

The only way you can become an expert is by doing the very work under competent instructors, which you will be called upon to do later on. In other words, learn by doing. That is the method of the New York Electrical School.

Five minutes of actual practice properly directed is worth more to a man than years and years of book study. Indeed, Actual Practice is the only training of value, and graduates of New York Electrical School have proved themselves to be the only men that are fully qualified to satisfy EVERY demand of the Electrical Profession.

The Oldest and Only Institution of the Kind in America

At this “Learn by Doing” School a man acquires the art of Electrical Drafting; the best business method and experience in Electrical Contracting, together with the skill to install, operate and maintain all systems for producing, transmitting and using electricity. A school for Old and Young. Individual instruction.

Over 5,000 Students now holding Successful Positions in the Electrical World

5,000 of our students are today successful electricians.

No previous knowledge of electricity, mechanics or mathematics is necessary to take this electrical course. You can begin the course now and by steady application prepare yourself in a short time. You will be taught by practical electrical experts with actual apparatus, under actual conditions.

Let us explain this course to you in person. If you can't call, send now for 64-page book—it's FREE to you.

New York Electrical School
29 West 17th St., New York

New York Electrical School,
29 W. 17th St., New York, N. Y.
Please send FREE and without obligation to me your 64-page book.

Name

Address

You benefit by mentioning the "Electrical Experimenter" when writing to advertisers.
American Destroyers Throw "Depth Bomb Barrage"

A n American destroyer, with her depth bombs ready to be discharged, is a dangerous craft. Running without lights in the darkness she is a menace not only to the enemy but to herself and other ships should a collision occur.

The bombs are now released from every quarter of the destroyer. Two can be dropped from the bridge by pressure of a button; "Y" guns, amidships, with two barrels, can throw bombs to port or starboard; astern there are two long lines of bombs running on miniature railway tracks, so a complete barrage may be fired at any point where the subaqueous explosion occurs.

The detail view herewith of one of these depth bombs shows clearly the principle upon which they operate. The steel tank container is a simple affair, fitted with a sensitive water-pressure diafram. The pressure of the water increases .433 lb. per square inch for every foot of head or depth. Thus for 1 foot depth the hydrostatic pressure acting on the shell, and also the diafram, would be .433 lb. for every sq. in. of surface area. For a depth of 20 ft. the water-pressure per sq. in. would be 8.6 lb.; for 50 ft. depth, 21.6 lb., and for 100 ft. depth, 43.3 lb. per sq. in. Hence it is clear how it becomes possible to "set" the diafram of the detonating device, whether electrical or mechanical, to trip off the latter at any desired depth. The farther the contact pin, or trip finger, is set back or away from the diafram, the greater the water-pressure or depth required to press it in that far.
ELECTRICAL EXPERIMENTER

January, 1919

AND NOW THE ELECTRICIANNETTE!

We have conductedettes, female bartenders, police women, elevator operators, usherettes and farmerettes, but this is the first instance, so far as I know, of where we are having an electricianette.

Mrs. Ada B. Vail of the Atlantic City Electric Company, Atlantic City, New Jersey, has complete charge of an installation of sixty-five electric ranges in one apartment house, located at the above address. She is responsible for the proper maintenance and operation of the entire equipment of these stoves and handles her position capably. Beside, she takes care of some thirty-five odd city stoves, at the addresses where they are located. She supervises one hundred of these in the various electrical devices.

Her entire tool kit can be summed up in a testing lamp, screwdriver and two pairs of pliers, one large and one small. Compare this neat and compact equipment with most certainly reflects the characteristics of a woman as its owner, with the modest (?) tool chest of the male species of electrician and the carrying of a large assortment of unnecessary junk, approximating one-half ton in weight, and when he finds that the job will require a screwdriver one-sixteenth of an inch smaller in size! We would be asking too much if we should expect him to use one of the next size. Instead he takes an afternoon's vacation on your time, going to the nearest place to Coney Island, or Kalamazoo, as far as we know, and by the length of time that he consumes to get this tool.

Can you imagine upon arising from your warm bed on a cold Winter morning, making a quick dash to the electric stove in the sitting room, turning on the switch, and in anticipation of the warmth that you are to get, you find the electric stove is as cold as a chunk of ice. The heat of your indignations warms you thoroughly, and you make a great dive for the telephone. After you have stood there for about a half hour with your teeth chattering, waiting for the telephone boy in the hall below to answer your call, you are finally rewarded for your patience by being allowed the honor to speak with the janitor. After you have told him what you thought of him and his entire family, back to his great, great, great grandfather, he very sweetly answers with a roar like the Kaiser and tells you that your need will be attended to.

Within a few seconds you hear a short staccato knock upon the door, and upon opening it you are almost stricken speechless by the appearance of a very neat and chiselled young lady, in overalls. Taken back with this surprise, you ask her what she desires. "Oh, Sir," she says, "I am the electrician! You sent a call for me, and I am here to repair your heater."

The interior of the room is not very agreeable to you, and with military precision she brushes past you, takes off the top of the heater, yanks out the heating elements, moves a most inflammable, that sounds like "burnt out," inserts a new one, attaches another fuse, turns the switch, and the job is finished. It has taken her exactly ten minutes, and the most incredible part of it, is when you ask her the charges, and receive a reply, "Oh, that is received, sir. I am paid by the firm that owns the building. She goes out closing the door very gently, and without even looking for a tip.

Cheer up, fellows, it will be a great old world after the fair sex take our jobs. We will have nothing to worry about except washing the dishes and scrubbing the floor.

WORLD RADIO SYSTEM URGED FOR SOCIALISTS.

Active steps are being taken by the International Socialist movement to establish a private system of wireless throughout the world. Five installations are already indefinitely projected. Stations will be immediately set up in England, France, Belgium and ultimately in other countries, including America.

Three of the new stations will be linked up with the German and possibly the Russian Socialist wireless. They will be used to connect Socialist organs in various countries.

In collision there is no danger of the shock exploding the bomb, but some might be thrown into the water and explode when at the proper depth.

And this is not all of the Depth Bomb's story, either. Did you ever hear of the depth bomb gun? It shoots depth bombs accurately for a distance of half a mile or more. The merchant ships that dodged the U-boats were equiped with such guns, which operated with almost perfect air, similar to the well-known torpedo tube. The illustration shows how the depth bomb gun is sighted to drop the bomb just at the point where it will make a complete trajectory thru the water and explode near the enemy submarine, which has submerged and is sneaking off, or trying to.

In this also, the effect of a subaqueous barrage on the enemy subsea fighters. Talk about land barrage fire! The water transmits the noise and vibrations from the exploding depth bomb many times better than in the air. Cases have been known where a submarine's plates have been dented in and the seams started at a distance of nearly one-half mile. The concussive wave transmitted thru the water is exceedingly powerful, because, for one reason, water is practically incompressible.

Remembering that stores of munitions in the German naval ports first gave clear intimations that Germany's military machine was breaking down, it is not surprising that the revolutionary movement first should have assumed serious form among the sailors. And according to the current reports, the terrible hardships and the ghastly number of fatalities among the U-boat crews were what started the final fatal break in discipline and morale.

It can be said, therefore, with some approximation to truth, that not only did unrestricted undersea warfare hasten and make certain the defeat of Germany by bringing into the war the American land and water forces needed to turn the scale against her, but it was the thing which, working from the other side of our speed to the downfall of the Kaiser's hopes and his empire. The fears and the despair which the submarines could not create in the minds of the Allies did create in those of the men who had been ordered to commit the atrocious crimes by which the world was shocked.

They did what they were told to do, but the task proved too much for even their docility, and they rebelled against it at last, not, however, so far as any evidence yet presented has shown, because of indignation against the order, but because the execution of those orders so often meant for them the fate of drowning rats. Too many of the U-boats that went out did not return, and the mystery of their fate was intolerable to the survivors.

BACK NUMBERS.—Many readers desire to obtain back numbers of this Journal. We have a limited quantity of these back issues on hand and can supply them at the following rates—Back Numbers of The Electrical Experimenter not over three months old, 15 cents each; over three months old, 20 cents each; over one year old, 35 cents each.
Solar Engine Uses Sun's Energy

Six thousand degrees Centigrade is the computed temperature of the sun. Its light giving power is equal to 27,000,000,000,000 candlepower, a quarter of a mile away. Scientists tell us that only the 2,735-millionth part of the total energy radiated from the sun reaches our earth, but this was ever ceased to stop for any reason our planet would turn into a dead, rigid ball of rock; the present average annual temperature of 13° C., would change, without the heat of the sun, to 73° C., of frost, it is calculated.

Experiments show that the power of the atmosphere to trap heat is largely due to the water vapor that it contains. It is also due to some extent, to the carbon dioxide gas that is one of its minor constituents, points out Prof. Garrett P. Serviss. Carbon dioxide is a remarkable heat retainer, but there is only a very small quantity of it in the air compared with the vast bulk of the atmosphere. It only amounts to about 3/100 of 1 per cent. But there is this significant fact about it, viz., that its amount is variable, to a slight degree at the present time, while there is evidence from past geological history that once it was vastly more abundant than it is now.

Now, how much carbon dioxide must the air contain in order that a perceptible effect on the temperature may be produced? Arrhenius answers this question for us. He says that if all the carbon dioxide now in the air were removed, the average temperature would fall nearly 38 degrees Fahrenheit. On the other hand, if the present amount were doubled, the temperature would rise more than 7 degrees, and if it were quadrupled, the rise would amount to nearly 14 1/2 degrees which would be far more than enough to banish all the glacial suffering that we had to endure last winter. Even the smaller amount of increase (7 degrees) would probably suffice for that.

These facts are very interesting from a technical point of view, indeed. The practical aspect of solar energy lies at present in the hands of those who are endeavoring to perfect a solar motor—i.e., an engine or electric generating device which, when the sun's rays strike it, will develop steam to operate a steam engine, or electricity to charge electric accumulators or storage batteries. Those interested in this branch of science will find of great interest several articles which have appeared in back numbers of this journal.

Considering later developments of a practical nature in the line of solar engines and boilers, we may take up the work of Mr. Shuman, of Philadelphia, Pa., who later collaborated with a Mr. Boys, of England. They were able in their final developments to operate a 100 horsepower engine by means of solar energy. This plant was built at Meadi on the Nile, Egypt. Prior to this excellent work, however, we may consider briefly the early solar engines developed and tried out at Philadelphia, Pa., by Frank Shuman, upon which work he started in 1906. One of these solar engine plants installed in


Voltaic Electric Plant in Italy Develops 15,000 H.P., March, 1917, Issue: page 789.

Texas being illustrated herewith. The heat of the sun's rays strikes a large number of mirrors, which reflect the heat to special boilers. These produce steam to run an engine, the latter operating an electric dynamo. The current thus produced was capable of operating an electric motor pump which pumped water to a height of 60 feet above the ground.

Mr. Shuman had running at Tacoma, Pa., a practical plant of this type, which developed about 3 1/2 horsepower by using 1,200 square feet of sunshine that was allowed to fall on a 30 horizontal water box. This box was fitted with a glass top and a series of parallel horizontal black pipes were immersed in the water. These pipes, containing either exposed 900 square feet of surface to the solar radiation. The water also became heated and carried the heat to the underside of the pipes, thus realizing a greater efficiency. The ether boiled and its "steam" drove a small vertical, single cylinder engine. The exhaust ether vapor past into an air surface condenser and the liquid ether from this was pumped back into the tubes of the sun boiler. It was found that this plant worked well even with snow on the ground, which is explainable from the fact that the permeability of the atmosphere is about 20 per cent. greater in winter than in summer.

Further tests and refinements to the Tacoma plant by Mr. Shuman resulted in 1911 in an engine and boiler which showed considerable strides forward in their design, the ratio of 245 square feet of sunshine per one brake horsepower having been attained.

It may be mentioned here that the pipes constituting the sun boilers have invariably been blackened. For low temperatures, copper black has been used as the absorber, but where high temperatures were required platinum black was used.

(Continued on page 672)
Electric Death Traps in Hun's Retreat

By H. WINFIELD SECOR

January, 1919

DON'T MISS THESE ARTICLES IN FEBRUARY "E. E."
"My Inventions"—No. 1 of a series especially commissioned for the ELECTRICAL EXPERIMENTER by Dr. Nikola Tesla himself.
"Cold Light—What it is and is not," by Rogers D. Rush, B.S.C.
"Subways of New York"—A wonderfully complete panorama of the underground, surface and elevated systems, an interesting and instructive article.
"How Jimmy Saved the Bank"—A story that will surprise you, by F. W. Ransome.
"The Unknown Purple"—A 20th Century drama of Ultra-Science and Psychology.
New Electrical and Wireless "Movie" Stunts.
The "Alkaline" Storage Battery. Its operation and maintenance, by J. F. Springer.
Experiments in Radio-activity, Part II, by Ivan C. Croyce.
Producing Ball Lightning in the Laboratory. With excellent photos, by Samuel S. Weisiger, Jr.
Wood Finishing, for the Amateur, by Arno A. Kneze.
Besides the usual "Constructor," "Wireless," "Chemistry," and "Machine" articles, there are hundreds of other valuable, time-saving wrinkles, ideas and formulas.

Electric Death Traps in Hun's Retreat

I

If you have any doubt that the Teuton is possest of a cunning mind, then you have but to read the reports that have come out now and then from various reliable sources on the battle-fields of Europe, where the Allied troops have always had to contend with much deadlier and more sanguinary affairs, of deadly and inhuman offensive schemes, such as liquid fire and gas, which horribly mutilates and disfigures its victims in thousands of cases. The Allies were never sure of what they might expect when they advanced on enemy territory. The Huns resort to every possible underhand scheme their wily brains could think of in a desperate effort to spread terror among the Allied soldiers, and some of the despicable "traps" used, to make even the most seasoned of our men flinch from the sight of them which we have not the space here to describe, are illustrated herewith.

Fig. 1 shows how the Germans often mined the town pump, or any other pumps on which they could operate, so that when a thirsty Allied soldier endeavored to draw some water, he would be instantly killed by a charge of gas set off by an electric contact and battery inside the pump, the fuse circuit being closed on the first downwallowing of the handle. Of course, hundreds of mechanical traps were used, as well as electrical ones. The electrocuting has been extensively used in these operations, a simple affair, and comprises nothing more than a small dry battery or other battery, together with a pair of electric contacts arranged to be closed by the current of water running off a piece of fuse wire, and a piece of fine fuse wire which is placed in the explosive. When the water shorted the contacts, the electric current passed through the fuse wire, and through the fuse wire with the fuse wire, and destroying the fuse wire, the current would pass through the fuse wire, and through the fuse wire, and destroying the fuse wire, and destroying the fuse wire, and destroying the fuse wire, and destroying the fuse wire, and destroying the fuse wire, and destroying the fuse wire, and destroying the fuse wire, and destroying the fuse wire, and destroying the fuse wire, and destroying the fuse wire, and destroying the fuse wire, and destroying the fuse wire, and destroying the fuse wire, and destroying the fuse wire, and destroying the fuse wire, and destroying the fuse wire, and destroying the fuse wire, and destroying the fuse wire, and destroying the fuse wire, and destroying the fuse wire, and destroying the fuse wire, and destroying the fuse wire, and destroying the fuse wire, and destroying the fuse wire, and destroying the fuse wire, and 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ELECTRICAL EXPERIMENTER

ELECTRIC DEATH TRAPS IN HUN'S RETREAT

EXPLOSIVE SHELL HIDDEN IN FIREPLACE

THE TOWN PUMP IS OFTEN MINED — BEWARE!

THE DESERTED BOCHE CANNON WAS NOT AS HARMLESS AS IT LOOKED

CALL OUT YOUR BEST GIRL HEROIN — (DON'T TRY IT IF IT MAY BE PLANTED)

THE 'BOCHE' WATCH TRICK

THE BUDDY BOMB PLANTED UNDER DEAD 'HUN' — BEWARE, MC FANN!

AN 'EYE' IN THE COLD PERIODS DEVELOPED AND ALMOST KILLED BY BOCHE TIME FUSE AND GAS TANK

EVEN THE GOOD PRIEST IS NOT SAFE

When the rain fell in the tank, the mixing float closed a bomb circuit; the whole building blew up.

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(For Description See Opposite Page)
Submarines in Peace-time

Now that the great world cataclysm is practically over, we have to think of many reconstruction problems, and one of these will undoubtedly have to do with many of the marine as well as military apparatus which have been developed and built in unbelievable quantities. For one thing, the flotilla of submarines—especially surrendered U-boats. A New York inventor, Mr. George Wall, has proposed and here illustrated a novel use for these superfluous submarines, namely, to utilize them as freight carriers, and not only to perform this service in the ordinary sense, as has been done when the giant submarine "Deutschland" crossed the Atlantic Ocean with a cargo, but to arrange for these submarines to pass thru a submarine tunnel for example. Let us consider, as Mr. Wall points out, the freight-handling problem at Manhattan Island, New York, where incoming steamers are unloading their cargo and are老爷.

Telephoning To and From Moving Trains

Three Americans residing in Toronto, Canada, Messrs. Isidor, Abraham and Samuel Berliner, have invented a moving train telephone apparatus for telephoning to and from trains en route, as depicted in the illustration. This apparatus permits voice transmission to be made automatically and directly thru the ordinary car wheel and axle, without the assistance of any contributing medium, by a special instrument connected to the wheel. Thus electrical connection between the instrument and the rail is made thru the car wheels, and in combination with the ordinary rails properly bonded for the block-signal system, but it will work equally well on any track where the rails are similarly bonded, without regard to the absence or presence of a block-signal installation.

Telephonic speech or voice transmission is conducted thru the ordinary existing axle, thru the wheels and down to the rails, along which it runs and is picked up by other moving trains or any of its desired joined cars, train dispatcher's offices, signal towers, stations, city exchanges, towns, villages, hamlets, or with that of any regular telephone subscriber. This railroad telephone invention consists of an apparatus including standard equipment only comprising the well-known telephonic retardation or repeating coils, ordinary rolling stock of wheels and axle, requisite bearing instrument from which it is connected to the wheels, and the usual rails, properly bonded. This transmission and reception is carried on, it is claimed, without regard to the trains' speeds or of trains moving in the same direction, opposite directions, trains crossing over at right angles to another, or any other moving positions, whatever these be upon the same track as in the case of a fixed track line, or between any tracks.

The control of the system differs in no respect from ordinary telephone operation, and artificial amplifiers requiring delicate adjustment are not employed. The invention now makes it possible for a connection to be made between the train instrument and that of any regular telephone subscriber. Train speed is of no material consequence, for the same results are attained to travel at 60 miles an hour as when barely moving.

Telephoning Between a Moving Train, Irrespective of Its Speed, and Any First Station, Office, or Home, Is Now Possible—Thanks to a Recent Invention, Which Enables the Telephonic Currents to Travel Thru the Car Wheels and Along the Rails to the Nearest Telephone Exchange.
Submarines in Peace-time

loaded in some cases on the piers at the North River. This freight is frequently trans-shipped by auto-truck or otherwise to points directly across the city. In other words, the goods are often carried thrice to any point of the city. The conversation may be held as easily as from house to house. The word of the voice is just as clear as with the telephone on a city circuit. One cannot tell that the train is moving, as far as the sound in the instrument is concerned, it is claimed.

A working model of a new moving train telephone apparatus has been very successfully demonstrated by the Canadian Government Railways on their road by Mr. W. W. MacFarlane of New York, who conducted the tests of his invention, which was tested at Moncton, N. B., Canada, from July 16, 1917, to March 28, 1918, inclusive.

During these tests, which were very complete, the conversations were carried on between the train and the dispatcher’s office in a clear and distinct manner.

The engine was cut off from the car and proceeded a mile down the track by orders telephoned from the conductor to the engineer. The engine was then stopt by telephone orders from the conductor, who was on the car, and instructed to come back and couple up again. Then an order was given by the conductor to back up the train and take on the flagman, who had gone back to flag.

Before backing up, a telephonic message was sent to the dispatcher’s office, asking if it was safe to back up, and the answer by telephonic from the dispatcher was that this would be all right. After backing up to the flagman, the order was received from the dispatcher’s office to go ahead to Humphreys and cross over to the other track and come back to Moncton. Before reaching Humphreys a second telephonic message was received from the dispatcher countermanding the previous order to cross over, but return to Moncton on the same track, as the train was protected from the rear.

All these instructions were transmitted by telephone from the dispatcher’s office to the conductor on the car and by him transmitted to the engineer by telephone, while the car was running, showing that it is perfectly feasible to control a moving train by telephone from the dispatcher’s office at a distant point. The invention is patented in the United States and Canada as well as in foreign countries. This new railroad telephone system promises to completely revolutionize modern railroading.

INDIAN PRINCESS LEARNS WIRELESS.

The accompanying photograph shows an Indian princess learning wireless telegraphy—Miss Emily Moran, descendant of a famous Indian chief. She promptly offered her services to her country in this national crisis, and is rapidly learning the art of radio operating so that she can graduate from clerical work to the wireless room of an ocean liner or possibly a transport.

Many young women have taken up wireless operating, several of the leading schools having classes, at which young ladies attend. At the present time there has not been a very large opportunity to place these fair radio graduates, because the Navy Department controls all the wireless stations, and it is against their rules to have women in any government radio stations. However, there are many ways in which women trained as radio operators can help and have been helping. For one thing, they can be of considerable aid in helping to teach the soldier and sailor "cookies" the rudiments of radio operating—particularly the code, which is always a great stumbling block to most of them. Women should prove particularly efficient in teaching this part of the radio art, for they have proven themselves very adept and successful in imparting knowledge to students of all ages in our public schools without the country.
A New Aërial Smoke Barrage

The airplane has surely come into its own during the recent world war. Hundreds of planes were to be seen in the air on various sections of the great battlefield at many times during the day, their glistening wings sparkling in the bright sunshine. Pursuer and pursued hurtled thru the air at prodigious speeds. These airplane attacks looked all very tame from the ground until one of them closed in on his adversary, when many a spectacular battle was enacted. Perhaps one of the most spectacular of all aerial battles is that mentioned in a number of the interesting stories that have come to us from the iron-hearted flyers of the air, where an enemy plane has dropped out of the cloud, in order to pounce down and surprise an unsuspecting flier below. Some of the German aviators used to practise this trick regularly, sailing upward thousands of feet, only to suddenly disappear in the cloud or cloud bank. Then the crafty flier would suddenly dart out of the cloud at the side or at the bottom, and if a hostile plane happened to be anywhere in the vicinity, the factor of surprise would in practically all cases be on the side of the emerging warplane.

But clouds would not always be conveniently at hand for carrying on such maneuvers. There is not always a cloud to be found in the vicinity of the battlefield. In the case of the aerial warfare—the "airplane smoke producer"—the particular form of this invention here illustrated and described being due to John Koltsko, of Watertown, Connecticut.

As the front cover and accompanying views show, this invention enables an aviator to send out a large quantity of heavy smoke which will entirely envelop the plane and prevent, or at least make it extremely difficult for, an enemy plane to "plant" a good shot on him. This is more apparent when it is considered that the smoke would not simply have a dense cloud of smoke blown around it at one point in the air, but it would in a few minutes produce a long trailing cloud of black smoke, and it would indeed be quite difficult for an aviator to tell at exactly what point in this cloud the enemy plane was.

The technical details of this smoke-producing apparatus for aircraft are quite simple and it operates as follows: A steel tank is mounted in the body of the plane, from which there is connected a bypass pipe connecting with the exhaust of the engine. A suitable valve control is provided to pass smoke from the motor exhaust into the tank. The tank contains certain chemicals which when acted upon by the fumes from the motor exhaust, produce smoke rapidly in great volume.

As the illustration shows, the diffusing heads consist of conically-shaped drums with perforated faces on them, and are placed around various parts of the airplane, under the wings and along the fuselage.

THE MAGNETIC SURVEY VESSEL, "CARNEGIE." The Magnetic Survey Vessel, Carnegie, arrived safely at her home port, Washington, D. C., a short time ago, where she was put out of commission during the period of the winter famous cruise from Buenos Aires, Argentina, round the Horn of Valparaiso, Chile, Callao, Peru, thence thru the Panama Canal to Newport News, and in command of Dr. N. W. Edmonds and a number of other scientists of the Government staff.

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ACKED by an absorbing story enacted and assisted by elaborate scenic and stage effects, "The Long Dash" has proven one of New York's latest and greatest theatrical successes. The play was written by Robert Mears MacKay and Victor Mapes, co-author of "The Boomerang." It has a distinguished cast, including Robert Edeson, Henry E. Dixey, Violet Kemble Cooper, Milicent Evans, and others. The dramatic story revolves around the invention of a marvelous new "radio controlled" cannon. The secret of its operation is stolen by a spy. With the inventor of the gun dead and the radio code by which the gun is operated lost, many curious and exciting incidents result. Interspersed with all these affairs there is a delightful love story in which two brothers, Paul and John Hazelton, both impersonated by Robert Edeson, are concerned.

Now for the dirty work. Those who have seen this show have undoubtedly wondered just how the wireless controlled gun, a large sized and faithfully reproduced model of which is used on the stage, as the accompanying photographs show, is operated. For it surely does give one, no matter how sophisticated in scientific matters he may be, a genuine dramatic thrill. Robert Edeson, who endeavors to solve the mystery of the lost code, presses the key of the wireless transmitter located across the stage from the gun, and every time he presses the key a crashing blue-white spark several inches long leaps across the spark gap at the transmitting apparatus. A similar spark also appears simultaneously at the spark gap fitted on the gun pedestal. Being of a scientific turn of mind, he eventually gets down to the point where he can cause the gun to train around a circle, and also up and down vertically, besides firing. The controlling signals comprise a number of dots or short sparks, and after the proper number of these have been transmitted, a long dash or spark is required to cause the particular function in hand to take shape. Thus when the gun is to be fired, after being trained with a previous set of signals or sparks, a number of short flashes are rapidly transmitted, and then the "long dash" or spark is the signal that the gun will fire. A thirty-eight caliber Colt revolver is cleverly arranged inside of the model cannon and this, operated by a stage assistant, produces the explosion whenever the gun is fired.

But this is not all, for to lend still more enchantment to the seeming mystery of this pseudo-scientific drama, the target at the rear of the stage plays a very important role. For every time the gun operates another "bullet" goes thru the target. At least the audience thinks so, for does not a hole appear in the target each time the gun fires? Sure it does, and little Willie in the front row as well as his grand-dad probably wonders how in the dickens they can fire a small naval cannon right on the stage and cause a shell to pass thru the target without killing a few dozen actors standing off stage. The truth is, there "ain't no such animal" as a bullet used, but a trusty assistant stands ready with a string in his hand, and each time the gun fires he yanks another wad of paper out of a previously prepared hole in the bull's-eye of the target. "Ye gods!" little Willie remarks, Mr. Edeson is sure some sharp-shooter, and in truth he is, so far as the story of the drama is concerned.

As will be recollected, in the introduction it was mentioned that Mr. Edeson impersonates two roles—that of Paul Hazelton as well as John Hazelton. In another act a clever bit of stage work is carried out, and a few words describing it will undoubtedly prove of interest. In this scene one of the brothers sits down in a large high-backed, old-fashioned chair, and presently turns the chair with its back to the audience and starts eating at a table. The audience sees the actor's arms moving as he proceeds to eat his dinner, but the old saying that the "hand is quicker than the eye" still holds good to a dot, for right before your very eyes and while the good Mr. Hazelton No. 1 apparently is enjoying his meal an unseen transposition takes place in a few seconds. The seat of the chair is a spring-actuated affair and collapses when desired. The actor escapes down thru the bottom of the chair by means of an electrically operated dumb-waiter, or "trap," as it is called in stage parlance, and another actor rises on the trap, gets into the chair and carries on the arm movements and other embellishments that go with the assimilation of a hearty repast; and in the meantime the door of the room opens, and in walks the other brother, Mr. Hazelton No. 2, who is no other than our old friend, Mr. Robert Edeson.

An electrically controlled machine for sorting coffee beans has been invented by a native of Munich.

India has increased its annual coal production to 12,000,000 tons and is introducing electrical machinery into some mines.
Nikola Tesla and His Inventions
By H. Gernsback

AN ANNOUNCEMENT

Several years ago, in the course of a discussion, a well-known journalist asked me whom I considered at present the world's greatest inventor. I said: "If you mean the man who really invented, in other words, originated and discovered—not merely improved what had already been invented by others, then without a shade of doubt, Nikola Tesla is the world's greatest inventor, not only at present, but in all history."

My friend was much surprised and voiced his astonishment. "Surely," said he, "you do not mean to place Tesla ahead of such great men as Archimedes, Faraday or Edison?"

"That is exactly what I mean," I replied, "and before twenty-five years have elapsed the world at large will echo my opinion."

"But listen," persisted my friend, "who on earth is this man Tesla anyway? What are his wonderful inventions, what great thing has he ever done? How is it that the world at large does not know him?"

"To begin with, and the better to impress you," I replied, "Tesla has secured more than one hundred patents on inventions, many of which have proved revolutionary. Science accords to him over 75 original discoveries, not mere mechanical improvements. Tesla is an originator in the sense that Faraday was an originator. Like the latter he is a pioneer blazing the trail; aside from this he is a discoverer of the very highest order."

"Ninety percent of the entire electrical industry pays tribute to his genius. All electrical machinery using or generating alternating current is due to Tesla. High tension current transmission without which our long distance trolley cars, our electrified trolleys, our subways would be impossible, are due to the genius of Tesla. The Tesla Induction Motor, the Tesla Rotary Converter, the Tesla Phase System of Power Transmission, the Tesla Steam and Gas Turbine and the Tesla Coil and Oscillation Transformer are perhaps his better known inventions."

"As to your last question, namely, why the world at large does not know Tesla, it is answered best by stating that he has committed the unpardonable crime of not having a permanent press agent to shout his greatness from the housetops. Then, too, most of Tesla's inventions, at least to the public mind, are more or less intangible on account of the fact that they are very technical and, therefore, do not catch the popular imagination, as, for instance, wireless, the X-ray, the airplane, or the telephone."

The trouble with Nikola Tesla is that he lives a century ahead of his time. He has often been denounced as a dreamer even by well informed men. He has been called crazy by others who ought to know better. For Tesla talks in a language that most of us do not as yet understand. But as the years roll on Science more and more appreciates his greatness, and begins to pay him tribute more and more.

In 1893, three years prior to the earliest attempts in Hertz wave telegraphy, Tesla first described his wireless system and took out patents on a number of novel devices which were then but imperfectly understood. Even the electrical world at large laughed at these patents. But large wireless interests had to pay him tribute in the form of real money, because his "fool" patents were recognized to be fundamental. He actually antedated every important wireless invention.

A few weeks ago the world read thru news dispatches of a great wireless discovery—the static eliminator. But Tesla had not only patented systems overcoming this and other forms of interference but had actually constructed and successfully operated devices years ago in Colorado, under conditions where static interference was troublesome to an extraordinary degree. A photograph of one form of his apparatus is published with a note from him for the first time elsewhere in this issue of the Electrical Experimenter. And so it goes. The world smiles at an unbelievable smile, but Tesla's master mind invariably sets the world aright.

I first read about Tesla in a well-known German weekly publication when I was less than 15 years old. The Editor of that publication reproduced his picture on a full page and paid high tribute to Tesla, hailing him as the world's coming greatest electrician.

H. W. Buck, Chief Engineer, President of the American Institute of Electrical Engineers, among others, said: "The work of Nikola Tesla in his great conception of his rotary field seems to me one of the greatest feats of imagination which has ever been attained by human mind."

Lord Kelvin, before the British Association, commenting upon the Tesla Transformer exhibited, said: "This is a wonderful development of the induction coil destined to be of great importance."

Electrical Review, commenting upon the wireless: "Mr. Tesla's
researches in this field have attracted world-wide attention, and his is undoubtedly the master mind."

_Der Elektro-Technische Anzeiger, Berlin, and Elektrizität, Leipzig_, Germany, (commenting upon Tesla's work): "It is a combination of the grandest power of technical performance with the most vivid imagination, such as has never before manifested itself in the human mind."

Brigadier Allen, of the United States War Department (commenting upon Tesla's Turbine): "Something new in the world. Officers are greatly impressed with it."

While studying abroad I read every scrap of his work I could lay my hands on. I performed most of his high frequency experiments, and the more I saw of his work the more impart I became. Some years ago as Editor of _Modern Electrics_, I met him in a New York shop where his famous turbine models were first built. I was fascinated with the tall, gaunt man, then about 50 years old, but looking less than 30. His extraordinary face, with his deep set blue eyes, proclaimed the intense thinker—the philosopher. A few minutes' chat with him left me more than ever convinced of his greatness.

Further contacts during the past few years still enhanced my opinion of him. Tesla is a man of extraordinary knowledge. He is remarkably well read and has a photographic memory whereby it is possible for him to recite page after page of nearly every classical work, be it Goethe, Voltaire or Shakespeare. He speaks and writes twelve languages. He is an accomplished calculator, who has little use for tables and text-books and holds the sliding rule to contempt and has received numerous honors and distinctions of all kinds. He is a knight of several orders, holder of many titles and diplomas. Some time ago he was awarded the Elliott Cresson gold medal by the Franklin Institute and last year the Edison medal by the American Institute of Electrical Engineers. Many extraordinary distinctions have been offered to him which he has declined. As of timely interest one instance may be mentioned. At the announcement of Tesla's high frequency discoveries, while the former Emperor of Germany was all-powerful and great men were eager for his favors, Tesla received an invitation from him and the Empress to repeat his celebrated experiments at the Royal Palace in Berlin. He forgot all about it and did not answer for one year, when he politely apologized for his inability to avail himself of the honor. Later the invitation was renewed and nearly two years past before Tesla answered to the same effect. After a lapse of time, however, upon the announce-

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**Nikola Tesla**, in the opinion of authorities, today is conceded to be the greatest inventor of all times. Tesla has more original inventions to his credit than any other man in history. He is considered greater than Archimedes, Faraday, or Edison. His basic, as well as revolutionary, discoveries for sheer audacity have no equal in the annals of the world. His master mind is easily one of the seven wonders of the intellectual world.

_H. Gernsback._

"Dr. Tesla," I said to him, "you are aware of our great admiration for you, which may or may not be important. But the great public knows little of your mark. Even many of those technically educated—excuse the frankness—think that you are

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“Odd Photo” Contest

WELL, Readers, what do you think of this perfect galaxy of "Odd Photos"? Fit for a king, eh. That's what we thought and so decided to publish them. Have you ever tried to enter a photo in our "Odd Photo" contest? Now is the time. Just look over this collection, gathered from all parts of the country, and you will gain a clear idea of just what we are after in this direction. We want brainy pictures as well as freak photos. Electrical, Radio and Scientific subjects give you a wide field to choose from. See announcement of "Odd Photo" contest elsewhere in this issue.

WELDING CAR TRACKS AT NIGHT

Herewith is an interesting night picture of men welding car tracks in Buffalo. The welding, of course, is electric, the trolley wire being tapt and a wire fastened to a weight placed on the track, making the connections. The 350 volt current is reduced thru a bank of resistance grids carried on a cart. The men are equipped with a heavy glass mask of special design, to protect their eyes and ears.

Kenneth Strickfaden, New York City.

IS IT AN A. C. OSCILLOGRAM?

I here present a print which resembles an alternating current oscillogram. This, I am told, was caused by the film being wound too fast, thereby causing static electricity.

What caused the lines to be in double or in pairs? Can anyone explain this?

What causes the lines to have those peculiar peaks?

I hope that your readers can answer it.

Wm. P. Ullrich, Ansonia, Conn.

LIGHTNING AT THE SEASHORE

Here is an excellent photograph of an electrical storm at the seashore.

Last August, while at the seashore, I was awakened about 1 A.M. by the loud crashes of a storm. The flashes were very bright, so I got out my camera. Herewith is the best picture I obtained. In the foreground is a boys' camp and the board walls. The beach can be made out very clearly.

C. M. Fairbanks, Ocean City, N. J.

MYSTIC SHADOWS CAST BY SOLAR ECLIPSE

One of the many interesting phenomena occasioned by a partial eclipse of the sun is the shape of the shadows cast by the light filtering thru the trees. The present picture is one taken during the eclipse of June the eighth, at a spot where the eclipse was 89 per cent. The picture is of a sheet images of the sun on this particular occasion.

James L. Clifford, Evansville, Ind.

A 2-HEADED MAN

The photo herewith, altho it does not bear any relation to electricity or radio, you will admit is odd. It is prized especially because of its history. The photo itself is a duplicate of my homely physiognomy and was taken under several difficulties. In the first place I was home with the mumps and the measles and, being at a loss for something to do, I started to pester my peaceful camera. Secondly, I was alone and had to take the picture myself. Thirdly, my camera is a box type, and I had to rig up a series of wire rings, so

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New British 'Plane Can Coast 20 Miles to Safety

In a recent report from an aviation camp behind the British lines in France comes the news that while the absolute proof airplane has possibly not yet been invented, in the opinion of American pilots who are except for slight damages which may follow a landing. They are so balanced and the wings so arranged that when the engine stops, they glide gradually and easily to earth, without the pilot's attention.

The following test shows how remarkably stable these airplanes are: A pilot climbed to a sufficient height, stopped his engine and took his hands off the controls, merely keeping his feet on the rudder bar. He steered for an airdrome twenty miles away and, except for keeping it straight, let the airplane do what it liked. It traveled the whole twenty miles as steadily as a bicycle coasting down a long, straight and gentle hill.

The accompanying illustration shows just what such a performance means to the aviator, who has heretofore always been in danger of being forced to volplane down at a sharp angle as soon as the engine stopped. Thus the aviator had to make a landing while coming down at a fairly sharp angle, and in some cases the plane has practically "dropt out of the sky," killing the aviator and demolishing the machine.

Just think what it will mean to the bird-men when they can volplane down a distance of twenty miles, such as from Mineola, L. I., to Governor's Island, or vice versa. It's really a wonder our flying machine inventors have not perfected such a device before this, when we stop to think of the many military aviators who have had their engines stall when over the German lines, which invariably meant they had to descend in enemy territory, with subsequent capture. The cities and towns shown about New York City in the accompanying view are all situated approximately 20 miles distant.

Electrical apparatus taking current from a light socket has been invented by a French scientist to purify the air in a room by literally pumping it into a reservoir and washing it.

The One Great Problem Confronting the Flying World Has Always Been—"How Far Can I Glide or Coast, if My Engine Should Stop?" The Answer Is—Twenty Miles; that is, If You Have One of These Newest British Planes, One of Which Has Glided That Distance in an Actual Test.
New Flashlight Cuts Off After One Minute

The newly invented and extremely novel electrical flashlight here illustrated incorporates a feature not possess by any other flashlight so far developed, in that when the push button is depressed the lamp circuit is kept closed for a predetermined and specific length of time, such as one minute, and then opens the circuit automatically. This feature results in a great saving of battery energy, particularly in such forms of the dry battery electric lamp as those made in the form of an ordinary lantern, of which are provided with a switch instead of a push button, and which the owners thereof have a great habit of thinking that because it is an electric lantern, it will stand almost any abuse. It would make the heart of any good electrician with extreme anxiety to watch some users of these electric lanterns and see them close the switch and then forget it—as dry battery to them is a veritable electric dynamo; they never give a thought to the fact that the dry cells used in every one of these flashlights, will give several—several—times the life if open the switch or button periodically—say at intervals of one-quarter to one-half minute—in order to give the battery a chance to recuperate.

It is to guard against just such misuses of the electric flashlight that the inventor of the present automatic cut-off push button, Mr. G. H. Parsons of Stanmore, Conn., has evolved and patented the device here illustrated. One illustration shows the exterior of his new flashlight under the "Tempolight," while the second illustration shows a diagrammatic view of the interior arrangements. These are simple and comprise the usual lamp bulb, a dry cell, and a circuit-closer or push button, to which he attaches a small air bellows. When the button is depressed this bellows is also depressed, and the air exhausted within it. By means of a slow acting air valve or other suitable arrangement, the bellows after an appreciable length of time of one-half to one minute, depending upon the period for which the switch is set to expand and open the push button contact trigger. A spiral spring on the push button rod tends always to push it outward.

You Push the Button of This Flashlight—a Minute Later It Extinguishes Itself Automatically. Result—a Saving in Battery Power and Life.

FOOLING THE DRAFT BOARD?—IT CAN'T BE DONE.

The sad and distressing fact has been brought forth that to escape a righteous duty, one that every full-blooded American should be proud to fulfill, there are amongst us mor- tals in this free land, a new generation—small in numbers, to be sure—who deliberately seek to evade the greatest of all things—the protection of the Stars and Stripes and the preservation of the Union. Amongst the false claims is that of partial or total deafness.

The French military specialists have already established the difficulty in this direction. It appears that the malingerer most difficult to detect is the one claiming complete loss of hearing in one ear. A moment's thought will show why this should be. Were only partial deafness claimed it would not be difficult to trap him, as he could not possibly be consistent in all his statements through an extended series of tests; but, with complete unilateral deafness as the claim, he simply and uniformly fails in the negative to all tests applied to the alleged defective ear.

Dr. R. R. Brownfield has devised a test which not only definitely determines the acuity of hearing in either ear, but also quickly detects the unilateral malingerer.

The device as evolved by Dr. Brownfield batteries and make-and-break contacts are entirely dispensed with. The ordinary 110 volt alternating commercial lighting current is used. The variable current is produced by a potentiometer, and is variable from an absolute zero to maximum. No vibrating iron is used, and the maximum strength of current employed is dependent on no factor except the ratio of the electrical resistances employed. The circuit current produces 240 vibrations per second, equal to the average tone used in conversation.

The sound producer is similar to a telephone receiver except in one very important respect—the core is of soft iron and is not magnetized. This results in eliminating the variability due to demagnetization and doubles the pitch, so that the ordinary 240 vibrations per second are increased to 480 vibrations per second. This, it is claimed, makes the test more difficult to pass. The sound producer is to the usual telephone receiver as a telephone is to the usual radio receiver.

The sound producer is provided with three lugs to hold it away from the ear, so that the sound will be transmitted solely by air conduction. By simply turning the indicator from 100 to zero, one can cause the sound to increase from the point at which it is just perceptible to one of normal hearing, the threshold of audibility, or 100 per cent, acuity, to a degree of intensity at which failure to perceive it indicates that the subject has no practical hearing. In addition to the variable receiver, there is a sub-judicatory one that always operates at maximum intensity, irrespective of the loudness of the other.

In the usual test for the acuity of hearing, only the variable receiver is used. As the subject holds this to the ear, the pointer is gradually moved from zero to a point on the scale is reached, that would normally indicate very defective or almost no hearing for the good ear.

The very nature of the test, it will be noted facilitates the detection of fraud, because the better he can hear in the alleged defective ear, the less he will hear in the other—a condition just the opposite of what he is supposed to be; with the intensity of sound increasing, the less he will hear under these conditions the sound appears to come in some mysterious way from a point at the center of the head; and if the two ears are approximately equal in acuity, there is absolutely no possibility of identifying the gradually increasing sound in the supposedly good ear until a point is reached on the scale away beyond the reading that would be obtained when the loud receiver is disconnected. Hence in the case of the pretender, the physician has only to repeat the test with the loud receiver disconnected, and a totally different reading will be secured, thus proving the deceit.
Wintertime Uses for the Electric Fan

By PAULINE GINSBERG

As it ever occurred to you that the electric fan can be used to great advantage in the wintertime as a labor and time saver? Probably it has not. This is but natural on account of the popular idea that the fan has only one mission, that of cooling the air. What the fan really does is to circulate it. By impelling circulation, for instance, about the body, the displacement of the warm air for the cooler, as well as surface evaporation accordingly gives a cooling sensation, but in hot weather such as in July, the forced air from the fan does not change for the cooler, it being equally warm both indoors and out and the fan sometimes causes more discomfort than comfort. As many of us have entertained the idea that the fan brings the air, naturally the fan was invariably hustled to a secluded nook in the attic or down the cellar until the warm zephyrs of the next spring reminded us that it was "fan-time" again.

A few suggestions are here given for the wintertime utility of electric fans, and eventually you will find a number of other uses to which the electric fan can be employed with benefit.

When the master of the house (or was it the janitor?) goes down to the cellar, and after much ado about the furnace (no, not "nothing"), finally makes a heroic attempt at starting a fire on a sultry day and it won't work—what to do for a forced draft? Just apply a fan opposite the front or side ashpit door of the furnace as here illustrated, and the fire will soon be crackling away merrily. Along this same line of the heating problem it can often be placed behind or in front of the steam radiator to circulate the air around and thru it so that the room is heated more rapidly and evenly.

Something that many women will appreciate is the use of the fan in the laundry for drying clothes. You will notice, in the third photograph, how the fan is placed away from the clothes lines in order to give a freer circulation of air so that it passes over all the clothes, and has therefore almost the effect of a light wind were the clothes outdoors. If the windows are kept open both at the top and bottom, you will be surprised how nicely they will dry.

The fan in the kitchen window solves a problem that confronts every housewife—what to do to prevent cooking odors and smoke from spreading over the whole house? It is particularly annoying when friends pay a visit. Any handy piece of board the length of the window can be attached as a shelf. It should be about three-quarters of an inch thick and can be fastened in place with a pair of brackets and a few screws. On this the fan is placed so as to face the open window and create a strong suction. In a short time the smoke and odors will have vanished. Also to deodorize the kitchen a flower or two may adorn the other end of the shelf.

Something we all dislike is the unpleasant odor that is the result of a room or rooms having just been painted. With the window kept open a few inches at the top and bottom and with our friend, the electric fan, kept going, the paint will dry quickly and the odor will have vanished in a much shorter time than had it not been used. Incidentally dust will have been prevented from settling on the wet paint; also, if having dried more quickly, there will be no marked luster added on the painted surface. The fan can also be played on any small article that has been painted or enameled, such as a kitchen chair or table.

Gas heaters were never in such favor as they are last year and will be this year (the coal problem still being the chief reason). As a rule, with the oncoming of a substitute, some unfavorable feature is bound to spring up—in this case the reduction of humidity—the gas flame consuming a high percentage of the precious vapor which contains the oxygen, so necessary to our lungs. The electric fan again clears the situation.

Place a pan about three-quarters full of water anywhere convenient, so that the fan can play directly on it. Over the pan put a thin board or piece of heavy cardboard, which has been perforated a number of times, so that small wicks or pieces of cloth can be smeared into the perforations. They should be long enough to pass down into the water. The board or cardboard should be of the correct size so as to exactly suit the handles, and so be held in position; it should not be blown off by the fan. The arrangement need not necessarily be kept for a great length of time in one room, but it can be employed for a short period in every room, especially in bedrooms and sick rooms, to promote comfort and good respiration, which in turn produce sound healthful sleep.

A fan should invariably be kept in the sick room so as to insure good ventilation. It should of course be turned away, and at a considerable distance from the patient. It will greatly ease his suffering and discomfort which come from the difficulty of breathing and from the inability to sleep. The fan can be kept going at intervals near a slightly lowered window. As the impure air rises and escapes thru the upper opening of the window, and the pure air enters thru the lower section, a good plan would be to have a small funnel made to hold the fan near the upper opening, the suction pumping out the impure air. It should also

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THE most beautiful object in the midnight sky during these winter months is the planet Jupiter, which will continue to be in excellent position for observation far into the spring. Upon New Year's Day Jupiter will be in opposition to the sun and therefore directly on the meridian at midnight. It is then seen at its best and will be visible throughout the night, rising in the east as the sun sets and setting in the west at sunrise.

Jupiter shines by reflected sunlight with twice the brilliancy of the brightest of the stars, Sirius. When seen during the midnight hours the remarkable, unflinckering brightness of this largest and most distinguished member of the solar system at once serves to set it apart from the scintillating stars far beyond.

There is but one planet, Venus, that surpasses Jupiter in brilliancy, and as Venus never departs more than forty-eight degrees from the sun Jupiter always shines without a rival at midnight. To one who has observed the two planets together the silvery radiance and surpassing brilliancy of Venus, due not to its size, but to its comparative nearness to the earth, at once serves to distinguish it from the golden yellow glow of Jupiter.

Even the smallest telescopes of two or three inch aperture will show the four historic moons of Jupiter which were the first celestial objects to be discovered when Galileo turned his crude telescope to the heavens in the year 1610.

The fact that these tiny points of light were actually revolving around the great planet was soon detected by the famous astronomer and we can imagine with what breathless interest he observed these satellites of another world whose discovery dealt such a severe blow to the old Ptolemaic theory that the earth was the center of the universe. It was not until the great telescopes of modern times were invented that the five additional moons of Jupiter were discovered. The four satellites first observed by Galileo were fancifully named Io, Europa, Ganymede and Callisto, in the order of their distances outward from the planet, but these names are rarely used now, the satellites being designated for convenience I, II, III and IV, respectively. The first of the new satellites to be discovered was Satellite V, which is the nearest to Jupiter of all the nine moons. It is an extremely small body, not more than one hundred miles in diameter, and to discover this tiny body as it skirred rapidly around the great planet within sixty-seven thousand miles of its surface, nearly lost in the glaring rays, was a diffi-
cult feat even for an experienced observer. It was accomplished, however, by Prof. Barnard with the great Lick refractor in 1899. Saturn IV is hopelessly beyond the reach of any but the greatest telescopes, as are also the four satellites discovered since that date. In fact, most of these tiny moons are observed photographically. Satellites VI and VII were discovered photographically in 1905. They are both about seven million miles from the planet, their paths loop thru one another; they are, moreover, highly inclined to each other at an angle of nearly thirty degrees. When nearest together they are separated by a distance of two million miles. Two more extremely small bodies, known as Satellites VIII and IX, have been discovered quite recently, one at Greenwich, England, in 1908, the other at the Lick Observatory in 1914. These excessively faint bodies are the most remote satellites of Jupiter and they are of particular interest because they travel around the planet in a direction opposite to the direction of revolution prevailing in the solar system. The ninth and most distant satellite of Saturn also retrogrades; that is, it revolves in a clockwise rather than a counter-clockwise direction around the planet. One explanation given for this peculiarity of the outermost satellites of Jupiter and Saturn is that the backward revolution around the planet is more stable when the satellites are at great distances from the primary and the gravitational control that the planet exerts, therefore weak. The moons of the planets are, of course, subject to the attraction of the sun as well as to the attraction of the controlling planet, and the greater the distance of the satellite from the planet the stronger the pull exerted by the sun and the weaker the bonds that bind such a moon to the planet. Beyond a certain limit it would be impossible for the planet to hold the satellite against the sun’s greater attraction and it would leave the planet to revolve directly around the sun, thereby becoming a planet. It appears that in this manner it is not unusual for the satellite to “back” around the planet than to follow the usual “west to east” direction of revolution. The eighth satellite of Jupiter is the largest, and the ninth more than fifteen million miles from the parent planet and they require about two years and three years, respectively, to complete one trip around Jupiter. When we consider that Satellite V darts around the planet in less than twelve hours at a distance of only sixty-seven thousand miles from its surface we realize what tremendous differences exist in the distances and periods of revolution of the nine moons. There is also great disparity in the sizes of the various moons. The five moons discovered in modern times are all excessively faint and therefore extremely small. The diameter of the largest of these, Satellite V, is less than one hundred miles. On the other hand, the four historic moons of Jupiter are of planetary dimensions. The smallest, Satellite II, is slightly larger than our own moon, while the largest, Satellite III, has a diameter according to measurements made with the 40 in. Yerkes refractor in 1916, of three thousand nine hundred and eight miles, which is only four hundred miles less than the diameter of Mars. The periods of revolution of these four satellites range from one day and eighteen hours for the nearest, which is about two hundred and sixty-one thousand miles from the center of Jupiter, to six days and sixteen and one-half hours for the most distant, which is more than one million one hundred and sixty thousand miles from the planet. These four moons of Jupiter are most interesting members of the solar system. They are so near to the great planet that they are continually dipping into his huge shadow and experiencing an eclipse of the sun’s rays, which, owing to the nearness and great size of Jupiter, lasts for two or three hours. At times of eclipse the moon suddenly disappears from the observer’s view, tho it may be considerably to one side of the planet. Its reappearance later on is just as sudden, or it may pass out of the shadow while hidden from us behind the disc of the planet, in which case its reappearance is invisible from the earth. The occultations of the satellites, or, in other words, their disappearance behind the planet’s disc, are also interesting phenomena to observe, as are their “transits” across the disc of the planet as the satellite passes in front of the planet. Not only the satellite itself but its shadow as well can be seen, a small black dot passing over the surface of Jupiter. The satellite is totally eclipsing the sun for this small dark portion of the planet. Two satellites and their shadows are frequently seen crossing the face of the planet at the same time. It is possible to observe all the phenomena of the satellites’ transits and shadows, eclipses and occultations with very small telescopes. From observations of the eclipses of Jupiter’s satellites the important discovery of the finite velocity of light was first made as far back as the year 1675.

Faint surface markings have been made out at certain times on the largest of the four satellites, Satellite III, and also on Satellite I, or Io. Observations of the markings on the former seem to indicate that it always kept facing Jupiter. They turn toward Jupiter as does our own moon toward the earth.

There are also reasons for believing that the equatorial regions of Satellite I are light colored and the polar regions dark. (Continued on page 668)
An All-Electric Hot Air Balloon

The captive balloon as used by the Allied armies at the present time is invariably filled with hydrogen or other gas supplied from steel bottles containing this gas stored at a high pressure, or else it is obtained from manufacturing supply stations on the field. The first balloons ever used—the old "Montgolfières" of 1783—were made to rise by means of hot air, for, as we all know, and after a short time the heated air rising up into the balloon causes the envelope to become very light and it rises in the air. Some of these balloons will travel for miles, and years ago it was not an uncommon sight in Europe to see hot-air balloons ascend with several men.

There has always been, however, a serious objection to a hot-air balloon where the heater was of the flame or similar type, point to another. Either the automobile engine or a separate gasoline engine mounted on the balloon drives the propeller which supplies current for an electric heater in the balloon. By means of suitable clutches, the engine may be caused to drive the dynamo, or else a current may be connected up to rotate the electric winch drum. The dynamo makes connection to a duplex power cable ready available, and this leads up to the balloon basket.

Also the telephone circuit is carried up to the balloon thru the drum on the other side of the ground where the observer and the observer's balloon are in telephonic connection at all times with the observer's balloon basket, and under battle conditions he would also be in telephonic communication at all times with "field headquarters," so as to report the position of enemy guns, troops, etc.

Referring to the balloon in detail, we find that it is provided with an electric grid heater, and also a motor-driven blower and connecting tube, so that whenever the blower is operated air is pumped up into the balloon envelope, the air passing thru the electric grid heater. The balloon bag is fitted with a suitable damper in the lower opening and a relief valve at the top in the usual manner, the relief valve being connected to the observer's basket by means of a small rope. When it is desired to descend, the observer may open the motor blower switch in the basket, and thus aid the hauling in of the balloon, for as the temperature of the air within the balloon bag falls the balloon naturally tends to descend toward the earth.

8,700,000 American Homes Lighted by Electricity.

From the compilation made by the Society for Electrical Development it is shown that there are 20,689,000 families in this country, of which 17,000,000 have incomes of $500 or more. However, the yearly average family income before the war was under $300.

Over 13,000,000 families are too poor, too illiterate, or otherwise unfitted to buy electrical goods. Over 8,700,000 homes are electrically lighted and 120,000,000 sockets contain Mazda lamps. In over 30,000,000 homes carbon lamps are used. It is estimated that 9,000,000-10,000,000 of these are empty.

Homes lighted by other means, 15,000,000; some are wired but not connected up; electric service is available in 10,613 communities of the United States, compared with 3,545 communities that are being served with gas.

Electric Searchlight.

Ranges of electric searchlights vary from between one thousand to two thousand yards in foggy weather to ten thousand yards or more when the air is very clear. The average sea range is approximately six thousand yards, but there are cases on record where ships have been spotted at a distance of nine miles. These figures are based on a sixty-inch mirror and a twenty-thousand watt arc.
The City of Splendid Night

By AMOS STOTE

A 20th Century poet strolled at night en-raptrured thru the highways and byways of Manhattan, aglow in all her nocturnal glory—not one night, but many nights—some moonlit, others rainy, but always—the magic of millions of electric lights threw its spell over him. And as he walked along this street or that, or mayhap thru the park, or along the shimmering Hudson, the very soul of the city seemed to commune with him. The poet’s name was Amos Stote, and he has here set down three literary gems describing New York City at night as it appealed to him. We like Mr. Stote’s soulful word-pictures of the Greater City electrified—he gives us something to think of besides the lights themselves. Thought is the keystone of all intellectualism. Our poet has given us a new pair of soul spectacles thru which to view many splendid sights—which the everyday man never as much as suspects.

I have wandered down unfavored streets, idle channels from which the thinning traffic of the closing day has been diverted cause—because of a man named Edison. In the old days of shrunkled streets, when darkness threw a mantle of mourning over the city, good men went in groups for safety sake. Then only the brave and the brute cruised singly abroad, for of course we except the gallant, suffering from love’s fever. But now a million gleams of light insure the safety of the streets and give the night-bedecked city over to the amusing glances of those who have learned the beauty that lies in the silent battlements of commerce; and in the old homes and highways.

New York—“the City of Splendid Night.” A Wonderful View of the Theater Section from Times Square—the Hub of Manhattan’s Ever-Seeking Traffic. The Hotel Astor Appears in the Left Foreground.

And a “Night in the Park.” For Within the Sylvan Solitude the Voice of the City Speaks Faintly, and Its Sparkling Eyes Are Veiled with the Romance of Contrast.

(Continued on page 625)
Prussianizing the American Ether

By H. Gernsback

W

HEN, on April 6, 1917, the President of the United States, by executive order, closed all wireless stations, the order was carried out to the letter by all Radio amateurs willingly and cheerfully. No notice has come to our attention where an amateur disobeyed the President's wishes.

All amateurs stood solidly behind the President when war was declared because all realized that everyone had to bear great sacrifices willingly and cheerfully. When the armistice was finally signed, the whole world breathed a sigh of relief, including the American amateur who had been given to understand that as soon as peace was actually declared the ether would be free for all once more. The amateurs were satisfied to go back to pre-war conditions, to take up their studies in an art which has few parallels as far as instruction and ennobling of the mind is concerned.

Unfortunately, however, in certain quarters in Washington, a feeling seems to exist that the amateur at best is a nuisance and should be done away with entirely. On November 21st two identical bills were introduced, Senate 5036 and H. R. 1319, the former by Senator Fletcher, the latter by the Honorable Joshua W. Alexander. These bills are reproduced elsewhere in this issue, as well as a statement made out by the Navy Department. The Navy Department frankly admits that these bills are not a war measure and endorses these bills. The Navy Department also makes the extraordinary statement that "experimenters" and scientists will not be interfered with, to wit:

IT SHOULD BE NOTED THAT THIS BILL IS NOT TO CREATE A COMPLETE GOVERNMENT MONOPOLY. THE SCIENTIST, MANUFACTURER, AND SHIP OWNER ARE SPECIALLY PROVIDED FOR, AND NO CHANGE IS PROPOSED IN THEIR STATUS UNDER EXISTING LAW. STATIONS MAY BE LICENSED FOR SPECIAL COMMUNICATION, AND THESE ARE EXEMPTED FROM GOVERNMENT OPERATION.

Any intelligent person reading this paragraph must come to the conclusion that amateurs would revert to their ante bellum days the minute peace was declared by Presidential proclamation.

So far, so good. We now turn to the Alexander and Fletcher identical bills, and read them attentively. To our amazement not a word is mentioned about the amateur. This bill also contains the extraordinary statement that:

"experiment station means a radio station actually used for conducting experiments for the development of the science of radio communication or the apparatus appertaining thereto, and used for no other purpose except as a technical and training school station."

In other words, a technical training school station is an experiment station and vice versa. Of course, this statement alone, unless modified means that if the bill is actually passed by both Houses the amateur will be just as dead as that sensitive spot on a galena detector after it was hit by lightning.

A second reading of the Navy Department's statement also informs us that the President approved a similar bill: H.R. 2572.

We now turn our attention to this bill of Commerce as provided by the act to regulate radio, approved August 13, 1912.

Here the similarity ends. In all other respects the three bills read equally and almost entirely word for word the same. We heartily approve Mr. Padgett's bill, which also has the approval of the President as admitted by the Navy Department.

Now then, as Mr. Padgett's bill was introduced on April 9, 1917, and as Mr. Alexander's bill was introduced on November 21, 1918, one and one-half years later, and inasmuch as Mr. Alexander's bill reads exactly alike word for word all the way through the exception of the paragraphs mentioning amateurs, Mr. Alexander necessarily must have copied Mr. Padgett's bill. But when he came to the paragraph mentioning amateurs he ran his blue pencil right over them.

And that is the joker. President Wilson approves of Mr. Padgett's bill favoring amateurs. Mr. Alexander with the stroke of his pen,—or was it the blue pencil?—wants to shut out all amateurs from the ether forever.

Not that Mr. Alexander is not familiar with the amateurs. He knows them well. Mr. Alexander was the author of the original radio bill before it was a law. The writer in 1912, as will be remembered by amateurs, fought the Alexander bill for the reason that it did not make mention of the amateurs. Finally Mr. Alexander and his advisers were convinced that it would be an injustice to silence the amateurs, and in April of that year the Alexander Wireless Bill died appeared. As will also be remembered, Mr. Alexander and his advisers, accepted the writer's recommendation pertaining to the amateur's editorial in the February, 1912 issue of Modern Electrics, and this bill later in the year was signed by President Taft, thus making it the present wireless law.

It strikes us as remarkable that inasmuch as in 1912 Mr. Alexander could not see the amateurs with an ultra-microscope, his eyesight as far as the amateur is concerned has not grown better in 1918. As soon as we know that there was to be a less wireless measure, we got busy immediately and we found out that there will be a hearing of Mr. Alexander's bill on December 12th which will continue from day to day until about the 12th of the month, it would have been impossible to inform all amateurs of the impending measures, and for this reason we took it upon ourselves to mail out at once some 50,000 letters broadcast to all amateurs giving them the facts of the case.

Of course it is not too late even now for those who have not received our letter. Mr. Alexander's bill has not yet been
past, and we doubt very much if it will. What we want is Mr. Paddet's clauses reinstated—in other words, what we want as far as the amateurs are concerned is the passage of the R.A. This, however, has the full approval of the President, so admitted by the Navy Department; or, what amounts to the same thing we want the Attorney General to insert the same clauses inserted in Mr. Alexander's bill. One is exactly the same as the other. This is all that we want, and it is fair to all concerned. It simply means that the present wireless law is to remain the same, and this, we are certain, will satisfy every amateur in the country.

The licensing system whereby the amateur was licensed by the Department of Commerce for the five years during which the law was in force, proved satisfactory to all concerned. No amateur has ever complained and all the stations licensed the amateurs refrained from sending out false calls or otherwise making a nuisance of themselves, a condition which prevailed before the 1912 wireless law was past.

It has been proved time and again that radio apparatus enormously sharpen the senses of the whole world, no other invention has kept the man away from questionable company during his spare evenings, and this appliance, which few people would have thought could possibly be brought against the amateur. Any parent who has a growing son is thankful for being allowed to spend all his leisure can for radio apparatus, because he realizes more than anyone else that it keeps together the home ties between son and home.

It is not too late as yet to protest against Mr. Alexander's bill, and those who have not as yet done so should write or wire to Mr. Alexander's committee at once. When you write refer to H.R. 13159 and address your letter to the Honorable J. W. Alexander, House of Representatives, Washington, D. C.

A BILL TO FURTHER REGULATE RADIO COMMUNICATION.

Statement by the Navy Department. This has been sent by Lieut. W. H. Fletcher, Chairman of the Senate Committee on Commerce, and by Judge Alexander, Chairman of the House Committee on the Merchant Marine and Fisheries, on November 21, 1918 (S. 890 and H. R. 13159). A similar bill (H. R. 3273) has had the direction of the House Committee on the Marine and Fisheries and the Senate Committee on the Merchant Marine and Fisheries. In general, the bill provides for the acquisition and operation, by the Navy Department, of all radio stations on shore used for commercial purposes by private individuals, and to secure the maintenance and control of the radio service. The Senate Committee has preferred to the adoption of the House Committee.

Radio Law and Existing Restrictions

By William B. Duck

The following interesting article by an attorney well versed in the subject, should answer the thousands of letters with which we, as well as all amateur Radio Supply Houses have been bombarded since Nov. 11th of this year.—

Editor.

Any wireless amateurs never had it so good as now. The new wireless regulations of Congress upon wireless sets, and fewer yet grasped the legal effect of the existing restrictions upon the use of such apparatus.

The existing wireless law derives its authority and likewise its legality from the so-called “except clause” of our national constitution, giving to Congress the right to regulate commerce among the several states. By a simple provision in our constitution, Congress never would have had any authority to legislate upon any phase of this subject. Our national constitution embodies a wide variety of powers given up by the thirteen sovereign states when the constitution was adopted. All other powers and rights were reserved by the states. Consequently when Congress enacts any law purporting to give authority in some provision in the constitution. For instance Congress cannot pass any law regulating the rates of railroads both terminals of which are in the same state. The state only has such authority. Our supreme court has given a very wide interpretation to the word commerce, and the clause of our constitution. It has declared, for instance, that communication carried on by line wires extending from one state into another that is done for a fee, as wireless amateurs have ever bothered to go to the expense of having the courts pass upon the question as to whether Congress has the power to legislate in such a situation for exclusive use between two cities in the same state, if as an incident to this commerce, business is conducted beyond the borders of the state. It is better for the amateurs that Congress compels the higher power amateurs to submit their rights to its decrees in the regulation of their stations.

It is for this reason that the wireless law provides that no license is necessary for governmental operation of these stations. Trans-oceanic radiotelegraphy is not a serious competitor of cables. It will not yet receive from one another all day in all parts of the world, and while signals from radio stations are transmitted in all parts of the world, and the interference with the legitimate work of an installation under government control is most care-ful regulation of radio traffic, through international agreement, can the maximum good be obtained, and only by each nation having the operation of radio stations restricted to the extent of agreements be properly executed.

In spite of the claims of inventors, radio communication is still hampered by atmospheric disturbances commonly termed “static” and by interference. In congested districts, as in the case of important seaports, communication is limited and must be controlled by a central organisation, otherwise a serious situation ensues. In the case of high-power stations where there is a limit to the number of all or wave lengths which can be used, interference is encountered regardless of the control of national stations. For instance a station in Washington is liable to be interfered with by a station in San Francisco, while attempting to receive from France or Italy.

IT SHOULD BE NOTED THAT THIS BILL IS NOT THE MUTUAL RADIO COMMUNICATION GRANT BILL. IT IS ENACTED BY CONGRESS TO MAINTAIN A MONOPOLY. THE SCIENTIST, MANUFACTURER, AMATEUR AND CONSUMER WILL NOT HAVE THE SAME PRIVILEGES HAVING BEEN RESERVED FOR SPECIAL COMMUNICATION, AND THESE PRIVILEGES ARE THE EXCLUSION FROM GOVERNMENT OPERATION.

By agreement with the Department of Commerce, the licensing law, as is now, the licensing of ship stations and of commercial operators for them would be transferred to the Department of Commerce. In the United States, this is a serious monopoly, and although for special communication, these commercial stations would eliminate a number of other stations, the Department of Commerce.

This, however, is not a war measure. In accordance with the act of 1912, all radio stations in the United States, and the use of the submarine in the government's hands, were taken over by the Department in 1917. This now being operated by that Department, promptly in April, 1917. Many changes have occurred during the war, stations formerly operated commercially have been found to be unnecessary for certain purposes, and Section 2 of the act of 1917 is no longer necessary.

The part played by high-power stations in this war and the marked advantage to the Allies, were a party to it, shows very clearly the necessity for Governmental operation of these stations. Trans-oceanic radiotelegraphy is not a serious competitor of cables. It will not yet receive from one another all day in all parts of the world, and while signals from radio stations are transmitted in all parts of the world, and the interference with the legitimate work of an installation under government control is most careful regulation of radio traffic, through international agreement, can the maximum good be obtained, and only by each nation having the operation of radio stations restricted to the extent of agreements be properly executed.

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(Abridged on page 665)
Conduction of Electricity Thru Gases. Gases, the air included, under normal conditions will not conduct electricity. However, when a high potential is established between two points in a gas, as for example when a Wimshurst machine is excited or a spark coil operated, the gas offers less and hence form shadows when striking an obstruction. In figure 95A c is the cathode. A piece of metal hinged at its lower end stands in the path of the rays. A distinct shadow of the same shape as this obstructing metal is formed at the end of the tube. On dropping the metal down at the hinge by shaking the tube, the shadow disappears.

Experiment 106

In figure 95B the cathode is concave and spherical. The other electrode (anode) consists of a small piece of very thin sheet platinum. The cathode rays are converged, focus on the platinum and are therefore very concentrated. The platinum incandesces, showing the heating effect of the cathode rays. Of far greater importance than either the fluorescent, the shadow, or the heating effect is the magnetic effect, especially as this gives us an insight into the nature of the cathode rays.

Experiment 107

In figure 96 a-b is a fluorescent screen of zinc sulfid, or barium platino-cyanid; c is a mica strip with a narrow slit in it. The cathode rays emerging at d are absorbed by the mica c, except for a small part passing thru the slit. These travel straight thru for the full length of the tube and cause a narrow band of the screen a-b to fluoresce brilliantly. Hence, the path of the rays, which are themselves invisible, is readily seen. If now a horseshoe magnet is brought near the tube the rays are deflected toward it at right angles to the magnetic field. This is precisely what would happen if the cathode rays consisted of very fast electrons moving in a magnetic field.
The Effect of Statics on Wireless Transmission

By NIKOLA TESLA
Written for the ELECTRICAL EXPERIMENTER

A FEW statements regarding these phenomena, in response to a request of the ELECTRICAL EXPERIMENTER, may be useful at the present time in view of the increasing interest and importance of the subject.

The commercial application of the art has led to the construction of larger transmitters and multiplication of their number, greater distances had to be covered and it became imperative to employ receiving devices of ever increasing sensitiveness. All these and other changes have cooperated in emphasizing the trouble and seriously impairing the reliability and value of the plants. To such a degree has this been the case that conservative business men and financiers have come to look upon this method of conveying intelligence as one offering but very limited possibilities, and the Government has deemed it advisable to assume control. This unfortunate state of affairs, fatal to enlistment of capital and healthful competitive development, could have been avoided had electricians not remained to this day under the spell of a delusive theory and had the practical exploiters of this advance not permitted enterprise to outrun technical competence.

With the publication of Dr. Heinrich Hertz's classical researches it was an obvious inference that the dark rays investigated by him could be used for signalling purposes, as those of light in heliography, and the first steps in this direction were made with his apparatus which, in 1896, was found capable of actuating receivers at a distance of a few miles. Three years prior to this, however, in lectures before the Franklin Institute and National Electric Light Association, I had described a wireless system radically opposite to the Hertzian in principle inasmuch as it depended on currents conducted thru the earth instead of on radiations propagated thru the atmosphere, presumably in straight lines.

The apparatus then outlined by me consisted of a transmitter comprising a primary circuit excited from an alternator or equivalent source of electrical energy and a high potential secondary resonant circuit, the terminals of which were used to ground and to an elevated capacity, and a similar tuned receiving circuit including the operative device. On that occasion I express myself confidently on the feasibility of flashing in this manner not only signals to any terrestrial distance but transmitting power in unlimited amounts for all sorts of industrial purposes. The discoveries made and experimental results attained I made with a wireless power-plant erected in 1899, some of which were disclosed in the Century Magazine of June, 1900, and several U. S. patents subsequently granted to me have, I believe, borne out strikingly my foresight. In the meantime the Hertzian arrangements were gradually modified, one feature after another being abandoned, so that now not a vestige of them can be found and my system of four tuned circuits has been universally adopted, not only in its fundamentals but in every detail as the “quenched sparking”, “ticker”, “tone wheel”, high frequency and rotating field alternators, forms of discharges and mercury breaks, frequency chanter, coils, condensers, regulating methods and devices, etc. This fact would give me supreme satisfaction were it not that the engineers, misinterpreting the nature of the effects, are making installations so defective in construction and mode of operation as to preclude the possibility of the great realization which might be brought within easy reach by proper application of the underlying principles and one of which— the most desirable at present—is the complete elimination of all static and other interference.

During the past few years several emphatic announcements have been made that a perfect solution of this problem had been discovered, but it was manifest from a casual perusal of these publications that the experts were ignoring certain truths of vital bearing on the question, and so long as this was the case no such claim could be substantiated. I achieved early success by keeping thee steadily in mind and applying my efforts from the outset in the right and correct scientific direction. I may contribute to the clearness of the subject in answering a question which I have been asked by the Editors of the ELECTRICAL EXPERIMENTER with reference to the report contained in the last issue, that signals had been received around the globe, an achievement the practicability of which I have fully demonstrated by experiment eighteen years ago.

The question is, how can the Hertz waves be conveyed to a distance in view of the curvature of the earth? A few words will be sufficient to show the absurdity of the prevailing opinion propounded in text books.

We are living on a conducting globe surrounded by a thin layer of insulating air, above which is a rarefied and conducting atmosphere. If the earth is represented by a sphere of 1294 miles radius, then the layer which may be considered insulating for high frequency currents of great tension is less than 1/64 of an inch thick. It is held that the Hertz waves, emanating from a transmitter, get to the distant receiver by successive reflections. The utter impossibility of this will be evident when it is shown by a simple calculation that the amount of

(Continued on page 628)
GERMANS USE BICYCLE DYNAMO TO OPERATE RADIO SET.

The accompanying illustration shows an ingenious German method of generating the necessary electric current for operating a radio installation in the trenches, which was captured in a recent British advance. As the photograph shows, a tandem bicycle with its wheels removed has been fitted with a supporting frame so as to stand upright and the pedal wheels connect with a belt to a small dynamo.

Such an outfit will produce considerable electricity which can be used for radio or lighting purposes, etc. In fact, this scheme is not new to the American wireless amateur, for we published an article on such a device for producing current to operate a wireless transmitter several years ago. A person sitting on a bicycle fitted with proper gearing, exhibits a great deal more power than would be imagined off hand, and besides for warfare requirements the outfit is noiseless, albeit it is not quite so handy as the small gasoline engine outfits used by some of the other armies.

NEW TELESCOPING RADIO TOWER.

A device that promises to be of great importance to the field wireless service is a telescoping tower that can be raised almost instantly on the throwing of a lever. This tower, the invention of R. W. Dean, of Des Plaines, Illinois, has been presented to the Government.

The tower that carries the wireless aerial works on an extremely simple principle. A number of light steel pipes fit inside of another, the space between them being made air-tight by a series of washers at the top of each but the middle pipe. The base-pipe connects with a comprest-air reservoir which is always kept filled by an air-pump.

The operators turn on the comprest air lever. Air from the tank rushes to the top of the innermost pipe and pushes up on it with a force upward of twenty-five pounds for every square inch of its surface. The sections shoot upward, one after another.

Of the 8,000 girls who applied for service as military telephone operators with the American forces, abroad 650 were accepted.

Marconi Company Claims Famous "Static Preventer" Discovery

"With the conditions that pledged us to absolute secrecy no longer prevailing, the Marconi Wireless Telegraph Company of America is permitted to announce a discovery and invention in wireless telegraphy which will mark a new era in world communication," says a statement issued by Edward J. Nally, Vice-President and General Manager of the Marconi Wireless Telegraph Company of America.

"Ever since the genius of Marconi made wireless telegraphy a fact, the only limitation of this method of communication was the deadly phenomena of 'static conditions.'

"It remained for an American radio expert, Roy A. Weagant, Chief Engineer of the Marconi Wireless Telegraph Company of America, to discover the solution of the static problem.

"Among the revolutionary changes that the new system effected in wireless installations will be the immediate disappearance of the huge steel towers, heretofore built at great heights to catch the incoming wireless waves. Equip with the Weagant invention, the wireless receiving antennae are stretched merely a few feet above the ground.

"Herefore, also, the increasing number of high power stations that were being erected in every part of the world raised the difficult question of 'interference.' Crossing wireless messages that shot thru the ether sometimes made the wireless signals so indistinct that they could not be understood, or drowned the weaker transmission entirely. The Weagant system, based on a unique selective principle, eliminates 'interference' and permits absolutely clear communication, regardless of the operation of other stations even in the immediate vicinity.

"The notable contribution to wireless telegraphy opened by Mr. Weagant's discovery makes continuous wireless communication over the oceans and between continents an absolutely assured fact for twenty-four hours of the day and every season of the year, regardless of atmospheric conditions. All the Marconi high power stations are being equipped with the Weagant system, and the stations of the Pan-American Wireless Telegraph and Telephone Company, which are to link North and South America, will likewise be equipped.

"This invention sounds almost too good to be true. However, Mr. Weagant, in an interview with the ELECTRICAL EXPERIMENTER's representative, stated that by very careful study of the subject over a considerable period, discovery of an entirely new principle had been made, and by accident at that. It was, as expected, but while making investigations along other lines this particular effect became more and more noticeable until it developed into a full-fledged invention. "As soon as official 'Peace' is declared," said Mr. Weagant, "I will present a technical paper before the Institute of Radio Engineers describing the invention. Also a body of technical men will be invited to one of our stations to hear it work."

SHIPS PERMITTED TO USE RADIO AGAIN.

Announcement has been made by the Naval Communication Service that commercial wireless traffic between United States merchant vessels and naval radio shore stations would be resumed at once. This means that wireless messages may be sent to passengers on board steamships and that travelers at sea may communicate with shore.

During the war steamships were forbidden to use their wireless except to listen, the precaution being taken to prevent submarines and surface raiders from learning the positions of Allied vessels.

OCTOBER MEETING OF INSTITUTE OF RADIO ENGINEERS.

The Institute of Radio Engineers held a meeting on the evening of Wednesday, October 9, 1918, in the Engineering Societies Building, New York City.

A paper on "SPECIAL HEATING EFFECTS OF RADIO FREQUENCY CURRENTS" by PROP. EDWIN F. NORTHUP of Princeton University was given.
Squadrons of American airplanes fighting in France up to the moment of the armistice, were maneuvering under the vocal orders of the squadron commander that reached each pilot by radiotelephone.

News of the successful development of this device, hitherto a military secret, tho some inkling of it had reached the Germans just before hostilities ceased, was made public recently by John R. Ryan, Director of Aircraft Production.

There are some details concerning it which we cannot discuss yet," Mr. Ryan said, "but the radio devices worked out during months of experiment went into actual service some weeks ago. I have myself, standing on the ground, given orders to a squadron flying in the air and watched them maneuver accordingly.

"The transmission of the voice is clear enough to be heard distinctly thru the sound of the airplane motor. It is in every way the most satisfactory means of communicating between planes in the air and from the ground to planes."

The distance over which the radiotelephone talks from earth to plane is a matter of several miles.

"For some months," said William C. Potter, of the Equipment Division of the Bureau, "it has been possible in our offices in Washington to hear the planes flying miles over the city, talking to each other and to the ground as they worked out and perfected the device."

The accompanying views show several of the radiotelephone apparatus which can also be used for wireless telegraphic transmission when desired and utilizing the De Forest Oscillon bulb having a filament, grid and wing. The oscillon comprises an exhausted glass tube or bulb, the size of which depends upon the output in watts, and which greatly resembles an ordinary incandescent lamp. This bulb contains two additional elements besides the usual incandescent filament, which are known as the plate and grid respectively. In these oscillons, the grid consists of a spiral winding of very fine tungsten or other wire wound upon a glass frame, and so placed as to entirely surround but not touch the filament. The plates, of which there are two, are placed one on each side of the filament, outside of, but not in contact with, the grid. In operation, the oscillon or vacuum bulb, oscillation generator requires two sources of potential, one of low voltage for lighting the filament, and one of high potential for supplying current from plate to filament across the vacuous space within the tube.

A small motor-generator suitably wound to supply the proper voltage is generally employed as the most convenient source of current. Reception of radio-telephonic or telegraphic waves is accomplished by the use of a similar but smaller sized vacuum bulb, which is capable of generating oscillations by a re-action between two or more tuned circuits, so that either damped or undamped oscillations can be interpreted.

Fig. 1 of the accompanying views shows a complete airplane Radiophone oscillation transmitter, especially designed for military use. In this set the weight has been reduced to a minimum. A special "chopper" or calling key is fitted to the instrument as well as a special type of microphone for modulating the oscillations in the form of speech waves. At the left of the photograph will be observed a small dynamo resembling an airplane bomb, one end of which is fitted with a small size propeller. This dynamo is driven by the force of the air turning the propeller, as the airplane speeds along, and thus current is produced for the operation of the oscillon. The large oscillon bulb is enclosed in a wire cage to protect it from breakage, and the necessary measuring instruments are mounted on the front of the panel, viz: a hot wire ammeter in series with the antenna circuit to measure the radiation current, a milli-ammeter indicating the "B" battery current, and a filament battery ammeter. Suitable tuning inductances and capacity control knobs are mounted on the front of the panel. The connections between the various parts of the apparatus are accomplished with flexible twin conductors sewn in leather straps, the ends of which are provided with separable jack plugs.

The illustration in Fig. 2 shows a combination audion, ultra-audion and one-step amplifier. This combination is similar to the audion two-step amplifier outfit, with the exception that the apparatus is arranged for one-step amplification. This set will meet conditions perfectly, it is claimed, where the intensity of the normal signals does not.
The Manufacture of Vacuum Detectors

By O. B. MOOREHEAD

ALTHO the majority of radio engineers are familiar with the use and operation of vacuum tube detectors, a brief description of their manufacture may be interesting. In the early experimental work on this type of device, we strove to produce a detector by combining maximum operating power with inexpensive manufacture. The next point considered was that of desirable conditions, i.e., tubes that possessed oscillating characteristics, tubes that were exceptional detectors, and tubes that displayed both qualities, says O. B. Moorehead, in a paper recently presented before the Institute of Radio Engineers. The third consideration was the production of a device easily handled and assembled, without disturbing the adjustment of the elements and damaging the filament.

Tubes and bulbs of various shapes and sizes were tried, using a gaseous medium ranging from one millimeter to 0.025 millimeter of vacuum, many materials being employed as elements. Various exhausts were applied, but it was soon found that the employment of a gaseous medium introduced considerable difficulty in the matter of accurate reproduction of a desired result. Gases at pressures ranging from one millimeter to one-fifth of a millimeter were next experimented with.

I found that a tube containing a platinum filament in an atmosphere of hydrogen, at pressures comparable with one millimeter, gave fair results. Tungsten filaments were then tried in higher vacuas as well as at the so-called "gaseous medium" pressure. It was immediately noticed that conditions could be duplicated as soon as a vacuum above that which allowed a "gaseous medium" pressure was obtained. Moreover, tungsten was ideal as a filament not only because of its refractory qualities and low volatility but also because it acts as a purifying agent by dissolving any traces of residual gases that may remain in the tube and forming compounds which are then volatilized on the walls of the tube.

As the parts are small and complicated, the glass is worked before the blowpipe, after it has been brought into the form of tubes, and the blowpipe is then cleaned. The tubing is obtained by first blowing a bulb, then fusing an iron rod to a point diametrically opposite the blowpipe and rapidly separating the two points of attachment from each other. Various grades of glass were experimented with, and a mixture containing a high percentage of lead and a small quantity of siliconic acid was found to be the easiest to work and produced a detector of maximum sensitiveness when used in conjunction with the aluminum plate and copper grid. In the selection of the glass to be used, the devitrification of the glass had to be considered, as during exhaustion of the glass it is necessary to subject them to heat at temperatures near the point of softening and nearly all glasses, when maintained at this temperature for any length of time, have a tendency to separate out into the crystalline state.

There has been considerable discussion regarding the elements in this type of device and I may say that aluminum plates and copper grids were first selected on account of their electro-chemical relation to the tungsten filament. Later, numerous other metals were tried under the same and other conditions of exhaustion and showed widely different operating characteristics.

The selection of metals for the elements is very difficult, as a slight difference in either the copper or aluminum changes the whole system of exhaustion. For instance, copper and aluminum purchased from one factory lot will require a certain degree of applied temperature during the evacuation, while another factory lot of the same weight and size will require an entirely different exhaust.

I have eliminated this variation to some extent by subjecting the aluminum plates to a temperature of approximately 600 degrees Fahrenheit (315° C.), immersing them in a saturated solution of cyanide of potassium, and finally rinsing in alcohol. The copper is subjected to heat until it glows, while it combines with the oxygen of the air to form a black, brittle oxide which breaks off in scale and exposes the underlying metal which is of rose red color. It is then placed in a current of moist air and becomes covered with a layer of oxygen compounds, which remains very thin but heated to high temperatures.

The lead glass tubing, used as the container for the elements in the tubular type detector, is obtained from the manifolds in lengths of 6 feet (2 m.) with an inside diameter of 0.087 inch (2.2 cm.) and a wall of 0.003 inch (0.7 mm.), and one end is cut in lengths of about 6 inches (15 cm.) and one end is drawn down to a point. Two stems are made of glass tubing similar to those used in an incandescent lamp, one stem contains the grid and two filament leads, and the other contains the plate connection and the filament lead. After the wires are sealed into these stems, they must be annealed very carefully. The annealing consists in allowing the temperature to drop very slowly, since quickly cooled glass is subject to internal strains which arise in the following manner: In rapid cooling, a low temperature is soon established at the surface and the glass works layer solidifies while the interior tends to contract, thereby exerting a pressure on the outer layer which is directed inward. This may cause the stem to crack.

After the stems are annealed, the grid is wound to the proper diameter and the filament is clamped onto the plate by means of a device. The plate is mounted on the other stem and the two stems are then connected together by means of the filament. Final adjustment of the plate and grid spacing so the spacing between the elements is not very critical in this type of device, but it is best to wind the grid to a thickness such that it will strike the plate rather (Continued on page 671)
A Vertical Cabinet Type Coupler
By JOSEPH H. KRAUS, Jr.

CABINET couplers, altho handsome and efficient, are quite expensive, even if the amateur attempts to make one himself. In the following article is given a description of a large cabinet coupler which did remark-

able work and the cost was surprisingly low. An instrument such as this is an asset to any station and will well repay the ambitious Radio Amateur for the time and trouble involved.

THE PRIMARY (WINDING WITHOUT A LATHE)

Two cardboard tubes are first procured, eleven inches long by five and four and one-half inches in diameter, respectively.

The five inch diameter tube is first wound in the following manner: In the center of a rod of wood about two feet long and of a diameter that will easily pass into both the five and four and one-half inch tubes (a broomstick handle will do) drive several nails, in such a manner that their heads protrude about one-half inch from the wood. This wooden rod is then placed in the five inch primary tube and held as near to the central axis as possible while cotton waste is packed in around the axle. The friction of the cotton waste against the tube will prevent it from slipping when it is being wound and the nails will act as grips for the axle (Fig. 1). A crank is now fastened to one end of the axle and the whole is suspended from two "Y" shaped uprights nailed to the opposite ends of a small box (Fig. 2). By using this cotton-waste method there is no necessity of fitting a rod tightly into the tube and a lathe is not essential. The winding is now commenced three-fourths of an inch from one end of the tube and a tap eight inches long is taken off every turn for the first twenty turns. Number these starting with the first wire as No. 20, then 19, 18, 17 and so on down until we get No. 1, and then No. 0. These taps must not be taken off directly under each other, but they zig-zag or spiral one-third around the tube, so as not to allow the least chance for a short circuit between two turns. Each must be carefully insulated and No. 22 black enamel wire used.

The manner in which a tap is taken off doesn't make much difference and every Amateur has a method of his own. However, here are two "standard" methods. For the primary the preferred method is to solder a wire to the place where the tap is taken off and insulate it carefully. Another method is to twist a loop into the wire and then continue winding; this will constitute a double wire lead (see Fig. 3). (This method will save trouble in the secondary winding.)

After the twentieth tap has been taken off (No. 0) the wire is wound for twenty turns and then a tap taken off. In this way the tube is wound until one-half inch off every three-quarters of an inch of winding. These loops are made one inch long and are taken off spirally one-third way around the tube. As the winding proceeds and as each tap is taken off a hole is punched into the cardboard tube immediately under each tap and a match stick inserted into the opening; each respective tap is to be drawn thru its particular opening. When complete there should be fifteen taps. Now to each of these is soldered a piece of flexible cotton or silk covered wire about twenty inches long, a piece of rubber tubing slips over the joint and the wire drawn thru the center of the coil toward one end thru its respective opening. Number each tap in order, shellac and allow to dry.

Note: These wires are not soldered on until the tube has been fully wound and removed from the crank.

(Continued on page 671)
NEW "BUMBLE-BEE" HY-TONE CODE PRACTICE SET!

Here's the hy-tone code teaching outfit you have been looking for, Radiobugs!

[Diagram of a hy-tone code practice set]

The set works as follows: The sending key (A) closes the circuit thru the battery (B) and lamp (C). The light works the selenium cell (D), operating the relay (E), which closes the circuit of the specially quick-starting and stopping motor (M). A fan (F) on the shaft of this motor plays a breeze on the plant (I), waiting an Aroma de hyacinth to the unsuspecting bumble-bee (I), which is tuned to a clear hy-tone. The microphone picks up the bumble-bee's buzzes faithfully and reproduces them in the telephone receivers. Every time you press the key it buzzes. Voila!

Contributed by WM. E. R. MIDDLETON.

WIRELESS MESSAGES REACH ARCADIA CAL. FROM BROOKLYN YARD.

The wireless station at Arcadia, Cal., by using for an aerial the cable of a balloon, put aloft from the training field, has intercepted messages sent by the Brooklyn navy Yard wireless station, according to an announcement by the War Department. This balloon cable probably makes the highest aerial in the world.

This announcement was made by the Division of Military Aeronautics, indicating increasing efficiency in both the work of students and the equipment of the War Department's various balloon training fields.

The balloon school at Arcadia has 106 miles of wire in use for teaching military communication. For the purpose of demonstration it has a complete system of wiring, running as it would be in the front line trenches on the battlefield. Communication posts and stations for all kinds of messages are used by the students in the same as soldiers use them at the front.

A good part of the country southeast and southwest of Arcadia is laid out with lines of communication to this balloon school, similar to part of a sector at the front. All of the balloons, when aloft, are so wired that they can be lined together with any trench, doubled up for any work together, or they can be cut off from the trenches and talk only with their own chart room and winch or operating crew on the ground below.

It is reported that the U.S. Government purchased the Sayville, L.I., Radio Station shortly after the declaration of war.

SPAIN TO AMERICA BY AIR IS PROJECT IN MADRID

Captain Herrera, chief of the hundred Spanish military air forces, has had a number of interviews with King Alphonso on the subject of aerial postal and passenger service between Spain and the United States. The scheme also has been discussed at Cabinet meetings and it is said that a leading shipping company is willing to finance it.

The plan, it is understood, is to manufacture large airships capable of carrying forty passengers, besides the mail. The rate charged for a passenger, if the scheme is carried out will be $200, and letters will be charged for at the rate of $1 the 0.003 uf. line, weight (about three ounces and a half). It is estimated the journey would take two and a half days.

A BATTERY-LESS TELEGRAPH.

A simple telegraph set may be put up between two chums' houses by running a small wire from house to house about 20 feet above the ground and 50 feet from the lighting wires in the street; connecting a key and receiver as shown in the following diagram. No batteries will be needed. One wire is grounded to the gas or water pipe. It works by induction from the lighting circuit.

Contributed by RAY L. MILLER.

A Batteryless Telegraph System. It Operates by Induction in a Regularity A. C. Lighting Circuit.

Where so lighting line is in the neighborhood, bury a zinc plate in moist earth at G, and a copper plate at G'. This system was once used by the editor, and by using a 75 ohm receiver at each station, satisfactory results were had over 1/2 mile. This "ground battery" gives about .07 volts.

AN ENT THAT RADIO COMPUTATION GRAPH.


WTH regard to the article in your September issue, "A Graph for Solving Wave Length, Frequency, Inductance and Capacity," I would like to point out that all the commercial values of the quantities can be expressed by the graphs. Of the published diagram bounded by the lines representing one milli-henrey, 01 milli-henrey, 0.1 uf. and 10^-6 uf. (uf. = microfarad.) To do this two inductance scales are required as in the diagram herewith.

Each diagonal line represents two wave lengths, one being ten times the other, as shown for 600,6000, and 2000,20,000,000; giving directly a range of 600 to 20,000 meters, the left-hand inductance scale being used for the lower range of wave length, the right-hand for the upper range.

Only a part of the commercial waves below 600 m. are obtainable directly, but values not on the chart can easily be determined as follows: To find, say, the inductance required for 300 m. with 0.003 uf., note that the 0.003 uf. line intersects the 3,000 m. line at 0.000084 h. Divided by 100 we obtain 0.0000084 h., the required value. In general, using the line representing 10 times the wave length, divide the required value by the graph by 10 and vice versa. Values of inductance and capacity not shown directly may be determined as follows: Suppose we wish to find the 0.0001 uf. required with a wave of 8,000 m. and capacity of 1.7 uf., which are approximate values of the Glace Bay transmitter primary; divide the capacity by 1,000. The line for 1.7x10^-3 intersects the 8,000 m. line at about 1.06x10^-5 h. Dividing by the same number by which we divided the capacity (1,000) we obtain 1.06x10^-8 h., the required value.

The procedure would be exactly similar with a known inductance and wave length. By extension of the above procedure, which is simply based on the fact that wave length varies as the square of the capacity or of the inductance, as the case may be, and that the product of capacity and inductance is constant for any particular wave length, we can obtain any wave length, inductance and capacity, but if many values are required which are not on the chart, it would be better to construct another pair of squares of the original graph from which the values could be read off directly. The advantage of this graph over the original one is its increased scale, which is ten times that of the original one for the same size paper. It is also easier to construct the number of logarithmic lines required being but 5/17 of the number required for the original.
Building a 3-Inch Spark Static Machine

By DR. E. BADE

Friction is one of the commonest sources of static electrical excitation. Every one has noticed how the hair crackles under the comb in dry weather. The same sound is heard on stroking the back of a cat, and, if the room is dark, sparks may be drawn from pussy's fur. But for developing large quantities of electricity by friction a static machine is utilized. The simplest form of such a static machine which will develop sufficient electricity for all kinds of devices, as it gives a spark ranging from one to three inches in length, according to the neatness and exactness of the finished apparatus, altho one of excellent construction will give a larger spark, consists of a revolvable glass plate, a rubber and a conductor. The capacity of the conductor can be heightened with a well insulated iron ring capable of being attached or taken off from the conductor at will.

The wooden frame is to be made first. It is constructed from hard dry wood (walnut or mahogany); the base is 20 inches long, 12 inches wide, and 2 inches thick; the edges are beveled off. The two supporting arms can be made from thinner wood, but each should be 15 inches long, 4½ inches wide at the bottom, and 3 inches wide at the top. These arms, which are dovetailed to the base, are fastened with two screws countersunk; the holes being later plugged

rod one foot long and a half to ¾ of an inch in diameter is taken for an axle. Two small wooden rings serve to hold the cemented plate to the rod. One should be careful to see that the axle is perfectly horizontal and the plate exactly perpendicular. One end receives a handle and a wooden ring which prevent it from slipping from the supports.

Now a "rubber" is made from three pieces of wood. The lower part is made from a piece 5/8 inches wide and 4 inches long. The sides, which are made to slant slightly upward, are 4⅜ inches high. This frame is supported by a glass rod 4 inches long which is sunk into the wood. The other end is placed in a fork 4 inches long, 2 inches wide, and ¾ inch thick. With the aid of this fork the frame is fastened to the base board by winged screws. But before this is done a small brass knob or ball is attached to the frame which in turn is attached, by means of tinfoil, to the rubbers.

Each of the two rubbers consist of a board on which soft, thick felt is glued. A spring presses the rubbers lightly against the glass plate. In order to prevent the rubbers from falling out a short piece of wood is nailed to them so that it projects and catches against the frame. Each rubber is now covered with an amalgam consisting of two parts of mercury, one part of tin, and one part of zinc. This must be evenly distributed over the surface with the finger. If this will not adhere a little lard (fat) may be used.

The conductor with the metal comb is made next. The former consists of a four or five inch hollow brass ball fastened to a glass support. The ball receives two holes thru which a brass rod is placed carrying the comb. The top of the ball also receives a hole which will later carry the ring as well as other pieces of apparatus for experiments. The metal points of the comb are attached to two rings of tin, each of which is fastened to a wooden ring. The metal rings are each 3 inches in diameter.

The points consist of ordinary thumb tacks. When the rings are placed between the glass plate, the points should be at least ½ of an inch from the glass. Under no circumstances should they touch the plate.

A flap of silk is glued to the rubber which (Continued on page 673)
How I Built a Model Gyro-Electric Destroyer

By LeROY H. MAHONY

The illustration represents a 25-inch model of Mr. Gernsback’s “Gyro-Electric Destroyer.” The entire machine with the exception of the Gyroscope and the driving motors was built of “Meccano” parts.

I next turned my attention to the main axle and the gyroscope. The gyroscope I turned from two pieces of ¾ inch wood 8 inches in diameter. To the side of it I secured a small sprocket for the driving chain. The gyroscope must run FREE of the large quantity of silex in the substance require the tools to be extremely hard and even then they are subject to rapid wear. It also contains an oil which prevents nails driven into it from rusting.

EinTHOven GALV. STRING.

A commercial form of Einthoven galvanometer string is shown below. The case, F, contains the fine wire carrying the current to be measured. The figure shows schematically the detailed construction of the suspension for the fine wire E, which must be as fine as possible. Platinum, silver or aluminum can be used, but it was found that even a smaller diameter can be obtained by using quartz or glass fibers, these being platinized or silvered. The ends of the wire are soldered to T-shaped members, which are held by the set screws C and F at the ends. Adjusting the tension of the wire is a close operation and it is carried out by mounting the upper wire carrier upon a rod having the cam K at the upper end, the rod being normally pushed up by a spring L. The lever K’, presses the rod down, this lever being operated by the micrometred screw J. With this arrangement a very fine adjustment of the wire is secured.

Contributed by SAMUEL COHEN.

I first constructed each side of the big wheel. To a bush wheel I bolted eight 1½-inch strips equally divided into angles of 45 degrees. I then bolted together seven 1¾-inch strips overlapping two holes each. I bent this around the ends of the side braces and fastened it to them by means of angle brackets. In the same way I constructed the other side. I selected pairs of ½-inch strips and bolted each pair together, overlapping them one hole. Three center treads, the same in circumference as the sides, were then made of seven more 1½-inch strips, overlapping two holes. It now remained to connect the two sides and the center tread together by means of the preconstructed pairs of ¾-inch strips. One pair was bolted at right angles to each side brace and one equally placed between them. To preserve more stability, I connected the side braces with 3½-inch strips. This completed the main wheel.

The next part to consider was the engine cage. Three small plates fastened side by side with ¾-inch strips, composes each side, while each end comprises a large plate with the flanged edges flattened out. The sides and ends were fastened together by angle brackets. It is necessary to fasten inside the cage two motors (preferably electric), one to drive the gyroscope separately, and the other to propel the entire machine. As to the position in the cage for these motors—that is left to the discretion of the builder as his type and size of motors may differ from those of the writer. However, the motor driving the gyroscope must be placed in the center as the gyroscope must be driven in the center. The other motor must turn the axle of the wheel by means of chain and sprocket. On each side of the cage is fastened a ¾-inch strip so that the cage is suspended from the center axle.

Teak the Hardest of All Timbers.

People familiar with different kinds of wood are aware that African teak is the hardest timber known to the mechanical industries. So indestructible is this teak wood that vessels built of it have lasted over one hundred years. The peculiarity of this wood is its hardness and great weight, causing extraordinary durability. Its weight varies from 42 to 52 pounds per cubic foot. It works easily considering its hardness, but

The who are interested In building an Einthoven string galvanometer for measuring and recording radio signals, as described in the September and October issues, will find to the detail of the string suspension of value.

Here is a Fine Model of the “Gyro-Electric Destroyer.” It is Fitted with Electric Motors and All. It was Constructed by the Author from “Meccano” parts. It Stands 25 Inches High and Weighs 15 Pounds.

Fig. 2
A Simple Study of Currents and Magnets

By Prof. E. H. JOHNSON, Dept. Physics, Kenyon College

(Conclusion)

If now the wires J and K are joined to a direct current circuit of several volts, the wire, H, will rotate about the iron rod, D, which is now a magnet, and it will be found that the direction of this motion will depend on the direction of the current in the wires. It may take a little study to see how the action is in accordance with the principles previously defined, but it will be found to be no exception to the rule.

In this case the only difficulty will be to get it accurately balanced. It should have 10 or 12 spokes, which may be soldered to a heavier copper wire for a shaft to be laid across the finished ends of the supporting wires from the post, A. When the balancing is fair the wheel should turn as easily in one direction as the other, or remain stationary. To do this the mercury pool, with which the ends of the spokes make contact, is connected as before, by a wire to one end of the coils of the magnet, and their other end is joined to the other binding post, B, so that a current may pass thru the apparatus between A and B. In this case the effect will be continuous with the proper current, and we have a fair type of electromagnetic motor. Again, our right-hand rule should be applied, considering the current as flowing up or down, as the case may be, in the spoke touching the mercury, to see if the rotation is what should be expected.

Other experimental devices such as these will readily suggest themselves to the experimenter, and he should learn to look at all such arrangements with that keen appreciation which sees not only the wires and mechanism, but which recognizes at once the underlying principle of its operation. When this habit has been formed and some of the information which it will inevitably bring, has been acquired, the entire field of electromagnetism, including dynamo-electric machinery in all of its phases, will open up with a surprising simplicity and consequently with endless interest.

ELECTRIC FLASH-LIGHT IGNITER.

Having some difficulty when taking flash-light pictures with cartridges, with the fuse not igniting the powder, or putting the subject on guard, frequently catching him with his eyes closed, and being badly burnt by the powder once, I constructed the apparatus shown in the accompanying sketch. It will run nicely on four dry cells. The principle is that when the batteries are short-circuited, the wire gets red hot.

The wires leading from the powder box are the kind known as bell or annunciator wire. Inside the box, the wire wound between the tacks is about No. 40 gage. When the box is constructed, place some powder in the box, press the push button, and off goes the powder. To make the apparatus portable, put the batteries in a box, and mount the powder box on top of this. In this way the operator may appear in the picture himself, if the wires are concealed behind furniture and his person. This also catches the subject off his guard, giving him a natural pose; it enables the operator to be at a safe distance from the powder. If a spark coil is procurable, it can be used instead of batteries by running a pin thru each side of the box making a spark gap, connecting the wires to a handle and pressing the button. I have used this apparatus extensively and successfully myself.

Contributed by FRED C. DAVIS.

A "BATTERY-LESS" MAGNETO DOOR BELL.

A small magneto generator is placed in a box (properly stained and finished) on the back of the door. A turn of the knob rings the bell, which may be an ordinary vibrating bell. Best results are obtained by winding it to from 100 to 300 ohms. An old crank escutcheon plate from a magneto telephone may be placed on the front of the door. This device when properly made is neat in appearance and does away with all battery troubles.

Contributed by CHURCHILL GERRY.
Experiments in Radio-Activity

By IVAN CRAWFORD

PART 1—Ionization

Radio-activity is one of the greatest mysteries of today. The modern scientists, however, thru experiments have succeeded in throwing considerable light upon the subject. The term radio-active is generally employed in referring to such elements as uranium, thorium, radium and their compounds which possess the property of emitting radiations capable of penetrating many substances opaque to ordinary light. These radiations also have the power of affecting photographic plates, ionizing the gas thru which they pass and causing fluorescence on certain substances placed in their vicinity. It is deemed unnecessary to enter further into the explanation of radio-activity as it has been well described by Mr. Jerome Marcus in previous issues of this magazine. It is the purpose of this series of articles to merely outline some experiments on this extremely interesting subject.

The most important property possessed by the radiations of radio-active substances is the power of discharging electrified bodies. Hence, the discharge of an electroscope placed in the vicinity of the radio-active substance, furnishes an efficient means of measuring the intensity of the activity.

The construction of a super-sensitive electroscope suitable for these measurements is clearly depicted in Fig. 1. The metal shell consists of a large oil can with the bottom and spout removed. Two round holes are cut opposite each other about half-way up the side. As is clearly shown in the drawing the gold leaf is fastened to a brass strip which in turn is suspended from a sulfur lead. In to the other side of this lead is fastened a wire which passes thru the sulfur block at the top of the chamber. Another wire is then past thru the block and bent as shown. The sulfur block is made by pouring melted sulfur into the opening and allowing it to harden. In order to charge the electroscope the belt with a, is turned so that the lower portion makes a contact with the brass strip. A charged rod is then applied to the other end, b, until the desired charge is attained, when the wire may be turned back and back with the rod. The gold leaf is attached to the brass strip in units of a small drop of some adhesive. In order to observe the discharge, a small low power microscope having a scale on the eyepiece is used. This is mounted in one of the apertures by fastening a brass tube to the shell of sufficient size to allow the microscope to be easily adjusted. A similar brass tube with a ground glass window is mounted in the opposite aperture. This is to facilitate the illumination of the chamber. Using this instrument the rate of discharge may be accurately measured by noting the fall of the gold leaf on the scale. The substance to be measured is placed on a grounded plate and the electroscope placed over it. The radiations by means of their ionizing properties cause the charge of the gold leaf to be dissipated. In Fig. 2 is shown a photograph of such an instrument which was constructed by the author. Some very accurate measurements have been made using this instrument.

To determine the activity of an unknown substance the electroscope should first be charged until the gold leaf coincides with one of the markings on the scale. The time required for the leaf to pass over five divisions on the scale should then be noted with the electroscope empty. The reciprocal of this time is then the measure of the discharging current. The electroscope is then recharged to the same point and placed over the substance to be measured. The time required for the leaf to pass over the same five spaces is again noted. The difference between the reciprocals of these two time elements is then the measure of the discharging current due to the presence of ions produced by the radiations from the substance. It may be shown that the discharging current I, which is proportional to the radio-activity is proportional to \( I = \frac{1}{t} \) where \( t \) is the time of discharge in the presence of the substance, and \( I \) is the time when empty. Thus by comparing times the radio-activity of equal masses of various substances can be measured. Uranium oxide is taken as a unity and uranium nitrate, thorium nitrate and uanyl chloride were compared with this. The results are shown in the following table:

<table>
<thead>
<tr>
<th>Substance</th>
<th>Formula</th>
<th>Time (sec)</th>
<th>Relative radio-activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Uranium oxide</td>
<td>( \text{UO}_2 )</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>Uranium nitrate...</td>
<td>( \text{UO}_2(\text{NO}_3)\cdot 6\text{H}_2\text{O} )</td>
<td>0.25</td>
<td>0.25</td>
</tr>
<tr>
<td>Uranium chloride...</td>
<td>( \text{UO}_2(\text{NO}_3)\cdot 4\text{H}_2\text{O} )</td>
<td>0.45</td>
<td>0.45</td>
</tr>
<tr>
<td>Thorium nitrate...</td>
<td>( \text{ThO}_2(\text{NO}_3)\cdot 12\text{H}_2\text{O} )</td>
<td>0.38</td>
<td>0.38</td>
</tr>
</tbody>
</table>

It will readily be seen that the activity of a substance is proportional to the amount of uranium or thorium it contains. There are other considerations, however, which affect the experimental results, such as the state of the substance, whether powdered or in lumps. Every electroscope also is different, and all quantitative experiments should be conducted using the same instrument.

It will be found that the distance between the substance and the gold leaf affects the rate of discharge. For uranium compounds the most effective distance is about 3 cm., while for thorium compounds it is about 5 cm. Ionization by radio-active rays is by no means uniform along the path of the rays. In Fig. 3 is shown the ionization caused by a sheaf of parallel rays as determined by Geiger. The range is laid out horizontally in cm., the number of ions are laid out vertically. It will be seen from this graph that when the alpha-rays pass thru ordinary gases to lose some of its enormous speed it becomes a more effective ionizer; near the end of its path, however, its power suddenly decreases.

The experimenter will find innumerable other applications for this electroscope to

(Continued on page 672)
REMOTE CONTROL SWITCH FOR LIGHTING CIRCUITS.

After obtaining the necessary material listed below, remove the handle from the knife switch, and substitute a weight made from 2" length of conduit pipe and \( \frac{1}{4} \)" x 2\( \frac{1}{4} \)" stove bolt. The head of stove bolt is filed flat on one side so as to be properly engaged by the trip arm. The bolt is placed in one side of pipe, and pipe filled with melted lead and allowed to cool off. The threaded end of bolt is then inserted thru hole (in insulating bar across knife switch) formerly occupied by screw holding handle. If properly placed this weight does not come in contact with either of the switch blades.

Now place the fuse block in upper left-hand corner of the iron box as shown on sketch, then place knife switch in bottom, the one side of base being against back of iron box and the whole switch so mounted as to allow weight to swing down and close switch without hitting side of box. The rubber bumper is then placed on bottom of box either with small stove-bolt counter-sunk in the rubber or with a small wood screw from the under side.

The object of the bumper is to prevent the weight from snapping off the insulating cross piece of switch when switch drops.

The casting on base for holding gong should be obtained with a hack-saw just beyond the screw hole, and the ball hammer can be cut off with a pair of cutting pliers, leaving the hammer arm intact.

In placing the bell it will probably be necessary to build it out from the back of the box over two holes, so as to have weight on switch. This building out should be done with either a piece of fibre, porcelain or iron washers. No wood or combustible material should be used. Bend trip arm as shown in sketch, so as to engage the filed side of stove-bolt-head which protrudes thru the weight.

All mountings should be made with stove-bolts, drilling holes in iron box where necessary. If box is thick enough to allow threading machine screws may be used.

The rubber bushing to protect bell wires can be inserted in the box at any convenient place and a narrow piece of linen tape or wire twisted tightly around the inside will serve to hold it intact.

Place the attachment plug on one end of the lamp cord, knock out one of the punch run and the button and place the B. X. connector, insert the cord thru this and wind the cord with tape on the inner side of the connector so that the clamping device can be tightened thereby holding lamp cord, preventing pull on the connections at fuse block and at the same time serving as a bushing for the cord. Connect other end of cord to fuse block as shown.

Make all connections as shown using the No. 14 wire for the lighting circuit and ordinary bell wire for battery circuit.

Only one blade of the knife switch carries current for the ordinary two-wire lighting circuit. For the three-wire circuit the two blades are used and an additional lamp cord and attachment plug are required.

Installation: This apparatus should be mounted on wall close to house fuse box and not more than 6 or 6\( \frac{1}{4} \) ft. from floor. To connect to an installation one fuse is removed from the house fuse box and the attachment plug inserted in its place, the fuse can then be placed in the "fuse" socket of the apparatus. The bell circuit can easily be run and batteries installed at any convenient point.

Operation: By closing battery circuit, the hammer arm of bell, then close the door. Keep pivoted and contact clips of knife switch lubricated with vaseline. This switch can be used for distant cut-in control or in conjunction with burglar or fire alarm systems, cutting in the lights when alarm conditions, and doing away with the necessity of running heavy lighting wires. Where the law requires it, a ground wire can be attached to the iron box with a short stove-bolt, and the box grounded to the electric conduit system.

The following material is required to make this apparatus:
- One 7" x 8" iron cut-out or switch box
- One two-wire main line plug fuse cut-out block
- Two dry batteries
- One two-pole single-throw knife switch
- One iron box bell
- One rubber bumper
- One 4" B. X. box connector
- One rubber lamp socket bushing
- One attachment
- One liter 1/4" x 2\( \frac{1}{4} \)" stove bolt
- One rubber knob from old door bumper
- One 2\( \frac{1}{4} \)" length of 1" conduit pipe
- Two of double pole lamp switch, No. 14 reinforced flexible lamp cord
- Proper quantity of bell wire

Contributed by E. C. O'DONNELL.
Boring and Drilling.

Sometimes the lathe can be used with success for drilling purposes if the machined hole is of the desired diameter. In the case of the circular saw, a hole of this diameter is required in the disk for the guide of the blade. In drilling a metal stock, the hole is often of a greater diameter than that required in the finished work. In this case, it is advisable to use a hole of this diameter, as well as to drill the hole with a large ball. The tool should be run at a high speed, and the burr at the end of the drill should be removed. If this is done, the hole will be a true circle, and the edge of the work will be smooth. In boring, the hole is often made in a series of small holes, and the edges of these are removed by the burr. In order to make a hole of the desired size, the tool should be run at a low speed, and the burr removed by the burr. If the hole is made in a series of small holes, the edges of these should be removed by the burr. If not, the burr will be removed by the burr, and the edge of the work will be smooth. If the hole is made in a series of large holes, the edges of these should be removed by the burr. If not, the burr will be removed by the burr, and the edge of the work will be smooth. If the hole is made in a series of small holes, the edges of these should be removed by the burr. If not, the burr will be removed by the burr, and the edge of the work will be smooth.

In boring small holes, the drill should be held by the operator, and the burr removed by the burr. If not, the burr will be removed by the burr, and the edge of the work will be smooth. In boring small holes, it is advisable to use a tool of this size, as well as to drill the hole with a large ball. The tool should be run at a high speed, and the burr at the end of the drill should be removed. If this is done, the hole will be a true circle, and the edge of the work will be smooth.

Boring Out a Casting in the Lathe by Means of a Boring Bar "BR."
The Casting is Secured by Bolts "B" to the Saddle "CS."

Fig. 1

Holding a Twist Drill In the Lathe by Means of a Monkey Wrench. The Back of the Drill Is Placed on the Tail-stock Center.

Fig. 2

Proper Clearance on Boring Tool (Left) and Improperly Ground Tool at Right.

(Continued on page 670)
PHOSPHOROUS: History.

PHOSPHOROUS was discovered by Brandt, an alchemist, in 1669 at Hamburg. He gave it the name Phosphor [light bearer]. Gahn, in 1769, found it to be a constituent of boneash, and about 1775 Scheele first published his method of preparation from this source. Liebig in 1840 used phosphates as a fertilizer for plants, while Romer [about 1833] first applied it to matches, thus revolutionizing the means of obtaining fire and light.

Occurrence.

It never is found in the free state, but chiefly as calcium phosphate \([\text{Ca}_3(\text{PO}_4)_2]\), the principal constituent of bones. This occurs in certain minerals as Apatit \([3\text{Ca}_3(\text{PO}_4)_2]\) and Phosforite \([\text{Ca}_3(\text{PO}_4)_2]\). The latter being also known as Phosphate Rock, being extensively used for fertilizing purposes.

Phosphorous is always found in plant and animal tissues, in the soil, and in sea water.

Preparation and Manufacture.

It is obtained mainly from bones of vertebrate animals, which usually contain from 55 to 60% of calcium phosphate, the hard parts of invertebrates being mostly Calcium Carbonate, \(\text{CaCO}_3\). These bones are first burned or else distilled. In either case the ash is the same, but in the latter the carbon is retained as boneblack, which in the former gives rise to carbon dioxide. The volatile substances driven off are ammonia and other nitrogenous products, such as water, carbon dioxide, etc. The ash, mostly Calcium Phosphate with a little calcium carbonate, is reduced and phosphorous obtained by three steps.

First.—It is treated with Sulfuric Acid, which changes it to a soluble phosphate, \(\text{H}_3\text{Ca}[\text{PO}_4]\). \[
\text{Ca}_3(\text{PO}_4)_2 + 2\text{H}_2\text{SO}_4 = \text{H}_3\text{Ca}[\text{PO}_4] + 2\text{CaSO}_4
\]

It might be expected that the Sulfuric Acid would change the phosphate salt into phosphoric acid, but the Sulfuric acid used is not very strong and the reaction goes but half way, producing an acid salt. It, however, changes the insoluble phosphate to a soluble one and precipitates the Calcium Sulfate, which is then separated by filtration or settling.

Second.—The liquid is next evaporated, and the solid residue from the evaporation is strongly heated, a process which breaks it up into Calcium Metaphosphate \([\text{Ca}_3(\text{PO}_4)_2]\), \[
\text{H}_3\text{Ca}[\text{PO}_4] = \text{Ca}_3(\text{PO}_4)_2 + \text{H}_2\text{O}
\]

Third.—The reducing agent, carbon, is next added and thoroly mixed, and heat is again applied. When two-thirds of the Phosphorous distills over, the remainder again forms Calcium Phosphate.

\[
2\text{Ca}_3(\text{PO}_4)_2 + 10\text{C} = 3\text{Ca}_3(\text{PO}_4). + 10\text{CO} + 4\text{P}
\]

To obtain the whole of the Phosphorous, Silica \([\text{SiO}_2]\) in the form of sand is introduced, and the following reaction takes place:

\[
2\text{Ca}_3(\text{PO}_4)_2 + 25\text{SiO}_2 + 10\text{C} = 2\text{Ca}_3\text{SiO}_5 + 10\text{CO} + 4\text{P}
\]

Great care is taken not to have the hot Phosphorous in contact with air, and retorts are arranged so that the Phosphorous runs into cold water. See Fig. 153. The Phosphorous must be either redistilled or pre-tatt chamosin skinned to get rid of carbon particles, etc. It is then run into small mounds of copper or glass.

The manufacturing process is detrimental to the health of the workmen. Some of the fumes have to be inhaled, and the breath at night is often luminous. The element attacks the teeth and jawbones, especially the lower jaw, which is sometimes entirely eaten away through failure to cleanse the teeth.

The electrical process has practically replaced the old method. In an upright pear-shaped furnace, an intimate mixture of Carbon, phosphite, and flux is heated by means of carbon electrodes in the electric furnace, as shown in Fig. 154. The mixt is fed in thru the hopper \(H\), the carbon electrodes entering at \(G\). The phosphorous vapors pass off above to a condenser, being condensed under water, and the slag is tatt off below at \(C\).

\[
2\text{Ca}_3(\text{PO}_4)_2 + 25\text{SiO}_2 + 10\text{C} = 2\text{Ca}_3\text{SiO}_5 + 10\text{CO} + 4\text{P}
\]


1. It is found in several allotropic forms, the most important being the yellow and the red varieties.

2. Yellow phosphorous is a colorless, transparent to translucent, wax-like solid. At ordinary temperatures it is sufficiently soft to be cut with a knife, but at lower temperatures it becomes more brittle.

3. It burns the flesh when handled out of water, and these burns are slow to heal, on account of the poison absorbed. For this reason this element should always be manipulated with a pair of forceps.

4. It is insoluble in water. It is soluble in 350 parts of absolute alcohol at 15° C, and in 240 parts of boiling absolute alcohol. It is soluble in 85 parts of absolute ether, in 25 parts chloroform, and in about 50 parts of any fatty oil. Carbon-disulfid is probably its best solvent, dissolving from 18 to 20 times its weight without losing its fluidity. All solutions of phosphorous in carbon disulfid should be preserved with the greatest care. When spilled or otherwise exposed, the solvent rapidly evaporates, leaving the phosphorous in such a finely divided condition that it inflames spontaneously.

5. It possesses a garlic odor, and is very poisonous. This odor somewhat resembles Ozone.

6. The phosphorescence, visible in the dark, when exposed to the air appears to be due to the slow formation and spontaneous combustion of phosphin.

7. Phosphor is a very inflammable element, igniting spontaneously in air at 50° C. For this reason it is kept and cut under water. Phosphor, when kept under water and exposed to the light, undergoes slow oxidation, becoming covered first with a white, opaque film, which slowly turns red.

(Continued on page 666)
FIRST PRIZE, $3.00

SIMPLE ELECTRICAL ALARM CLOCK.

Herewith are submitted the details for an electrical alarm clock which I believe is the simplest one I have seen published in your valuable magazine. A brass spring (a) is supported on an insulating block (C). A piece of blotting paper is glued on to the end of the strip to insulate it from the alarm-winder. The operation of the alarm can be easily understood. When the clock alarm rings, winder key revolves which releases the spring. When the spring is released it strikes against the side of the clock, thus closing the circuit.

Contributed by CHAS. WALLER.

UNIQUE "HOOK-UP" FOR TELEGRAPH SETS.

Herewith is a hook-up used by myself and friend on our telegraph sets, the main object being to eliminate closed circuit cells and to use dry cells. When one fellow wishes to call the other he opens his key and throws his switch over to "receive" and closes his key. The apparatus used comprises two sets, i.e., sounders and keys; two D. F. D. T. switches, 2 sets dry cells (3 each). Our system works fine and the extra-switch throwing is worth the battery saving.

Contributed by G. E. MEARS.

SECOND PRIZE, $2.00

A "COLLAR BUTTON" COMPASS.

This compass is very easy to construct, and can be made with a needle, collar button, snap fastener, and a piece of thin steel, cut in the shape of a compass needle. After having cut the needle to the desired shape and size, punch a hole in the center. Over this solder the bottom part of a snap fastener. This completes the needle. Next, force a steel needle up through the collar button so that it protrudes out of the top about one-sixteenth of an inch. Solder it firmly from the under side. The needle is magnetized by rubbing it over a magnet. When it is thoroughly magnetized, place it on the needle point and adjust it so that it will balance and revolve freely. It can be mounted either in or out of a case as desired. I find that an old dollar watch back makes a good base as it does not affect the needle. This compass is very handy for performing experiments.

Contributed by J. H. ENGLAND.

KNOWS FOR ROTARY SWITCHES.

Knobs for rotary switches may be easily made from the stoppers on old storage batteries. This is done by cutting the part off which has threads on it and drilling a hole large enough to put a brass bolt thru, as shown in sketch. (Vent stoppers may be purchased from garages.) See cut below. Contributed by MARION HENSEL.

THIRD PRIZE, $1.00

FIXT CONDENSER IN A SHAVING STICK TUBE.

An efficient and neat fixt condenser can be made from a nickel-plated shaving stick can as a container. First cut some tinfoil to about 2 foot lengths and 1-3/4 inches wide, separated by 2-1/4 inch width paraffined paper. This can be made as large as desired, and by heavy pressure a large condenser can be placed in the tube. Solder all lugs and make connections with flexible conductor to binding posts. Bore holes in the cover and make washers as in (B). Fill the case with molten paraffin wax. Contributed by E. S. HAGEMANN.

A SERIES BUZZER TELEGRAPH SET.

Here is an efficient series buzzer telegraph system. When the set is not in use put switches on No. 2, then when you wish to call up your friend put your switch on No. 1, disconnect the key switch and start sending. As soon as your friend hears your signal, he puts his switch on No. 1, thus increasing the battery strength. Remember to reverse the batteries if it is positive at your switch on one end, make it negative at the other station.

Contributed by PRESCOTT OVERTON.
AN ELECTRIC FIRE DETECTOR.

Herewith is a plan of a fire detector which I made myself. It consists of two batteries, a cigar box, an electric bell, a scheme, and a rock crystal. A small reed relay is fastened to the lower contact block, thus ringing the bell.

In Case of Fire the Heat Expands the Copper Wire Spiral, Causing It to Touch the Lower Contact Block, Thus Ringing the Bell.

A piece of bare copper wire made into a spiral spring, two blocks of wood, four screws, and two binding posts. Normally the wire made into a spring does not touch the lower contact block, but when fire breaks out it expands the wire spiral and completes the contact, causing the bell to ring.

Contributed by JOSEPH WOHLPART.

SPARK PLUG TESTER MADE FROM SPARE PLUG.

Most autoists carry a spare spark plug in their tool chest which can be made to serve as a spark plug tester without destroying its usefulness.

The only thing necessary is to cut a piece of fiber or heavy cardboard to the shape shown in the illustration. The hole in the end is made large enough to pass the threaded end of the plug and serve as a holder.

To test the plug in the engine, hold the spare plug, sparking points up, by means of the fiber strip. Touch the post on the plug to the engine cylinder and bring the thread end of the plug in the plug against the binding posts of the plug in the engine.

A small spark or none at all will indicate a broken porcelain or carboned and short circuited plug. A heavy spark will show that the points of the plug in the engine are too far apart. In cases of emergency any means may be employed that will hold the test plug without giving the driver a shock.

Contributed by THOS. W. BENSON.

TWISTING CABLES IN THE SHOP.

In looking over your October, 1916, issue under the head of "How-to-make-it," I noticed a scheme for twisting telephone wires, contributed by Mr. Leach. While this is a good method, I would like to suggest one that will not ruffle or twist the insulation of the individual wires as other methods do.

Porcelain knobs may be used as swivels. Attach two knobs to shop wall, do not tighten up screws, knobs should turn freely. Attach No. 14 wire loops to receive ends of insulated wires. Have wires same length; turn brace five or six times, pulling on it to take up slack and keep knobs from turning. Now slack off slightly on brace and knobs will spin, thus relieving the twist in each individual wire. Almost any length of wire can be handled in this manner, equaling the factory product.

Contributed by J. ESHLIMAN.

A REVERSING SWITCH FOR SMALL MOTORS AND TOYS.

A small but thoroughly effective reversing switch for small battery motors and other apparatus can be made from scraps found about most any workshop.

First procure a base about 1/2" square and 1/4" thick. Next cut four strips, each 3/4" long and 1/4" wide out of a piece of brass about 1/16" thick. Then bore a hole in one end of each strip and fasten it to the base by means of small wood-screws as shown in Fig. 1.

Contributed by HENRY RHEIMS.

DRAFTING HINTS.

Tracings may be very readily cleaned and pencil marks removed by the use of benzine, applied with a cotton swab. It may be rubbed freely over the surface without fear of injury to the lines drawn in ink, or even water colors, but pencil marks and dirt will quickly disappear. The benzine evaporates almost immediately, leaving the tracing unharmed. The surface, however, will be somewhat softened, and should be rubbed down with a little powdered talc or chalk before drawing more ink lines. Always sprinkle chalk or talc on surface (dull side) of cloth, rub in with fingers, and wipe off before starting to draw ink lines.

SIMPLE HOME-MADE SNAP SWITCH.

This is a very durable but simply constructed snap switch. (A) is the screw from an old dry cell carbon, the head (E) being filed flat and inserted in a small block of wood (I) drilled as shown. The block (I) is fastened to wood base (G) with screw (B). A strip of spring bronze (D) inserted thru the slot in spindle (F) assures an excellent contact. (C) is a pin for handle and (H) the supporting screw holes. The spindle is held in the base by a small rivet at the bottom. This can be used either as a single or double-pole switch.

Contributed by WALTER SELLENEIT.

HOW TO MAKE A S.T.D.P. SWITCH OUT OF TWO S.P. KNIFE SWITCHES.

Nail a block of wood on to a base of proper size. Next procure two S. P. battery knife switches. It must be made certain that one opens to the right and the other to the left. The reason for this can be seen when they are mounted. If they are the same, just take off the knife and terminals and remount them in reverse or...
SPIRIT LAMP FROM FAN GREASE-CUP.
A novel but efficient spirit lamp can be made from a fan grease-cup when cleaned and filled with alcohol and a wick inserted.

Simply Fill a Fan Grease Cup with Wood Alcohol, Insert a Wick in the Hole, and You Have a Serviceable Little Spirit Lamp for Light Soldering.

It will burn for one hour. This lamp can be used for numerous purposes, such as removing enamel from enameled wires, et cetera. A small brass tube can be easily soldered to the cup for the purpose of providing a blast of air and a side-wise concentrated flame tip, by blowing thru the tube. The upper end of the tube must be closed, and a tiny hole drilled in it—about No. 64 drill.

Contributed by EDWIN WOLBER.

SOME INTERESTING CHEMICAL EXPERIMENTS.
When a very little dry powdered potassium permanganate is moistened with sulfuric acid, brownish-green oily drops of permanganic anhydride (MnO₂) are formed. This compound is volatile, giving a violet vapor and is apt to decompose explosively into oxygen and manganese dioxide. Its oxidizing power is such that combustibles like paper, ether and illuminating gases are set on fire by contact with it.

White phosphorous, when heated with sulfur unites with explosive violence. By using red phosphorous the action can be controlled. The product is phosphorous sulfid and the kind depends upon the proportions used.

If a small piece of sodium is placed on a piece of filter paper and placed on water, the water is decomposed and the heat liberated is sufficient to set fire to the sodium, which burns with a characteristic yellow flame.

Powdered magnesium and potassium chlorate in the proportions of 10:17 is used in making flashlights for use in photography. Cordite, a variety of smokeless powder, is made by dissolving guncotton (65 parts) nitro-glycerin (30 parts) and vaseline (5 parts) in acetone. The resulting paste is rolled out and cut into small pieces. When the acetone evaporates the horny cordite remains.

Javelle water (solution of sodium hypochlorite) is an ingredient of ink eradicators. The solution is first applied to the ink and a dilute solution of hydrochloric acid is rubbed over it. The chlorine which is liberated is responsible for the bleaching effect.

Contributed by ALBERT TOTHL.

TEST CLIP MADE FROM BINDING POST.
For making contact with insulated wires take an old binding post and file the thumb screw to a point. Also cut a portion of one side out with a hack-saw as shown in the drawing. To make contact with an insulated wire, simply slip the wire in the slit in the side and force the thumb screw point through it. This will save the time and bother of skinning the wire. It also may be used as a helix clip.

Contributed by MERLE E. NANTZ.

FITTING A MINIATURE BULB TO STANDARD SOCKET.
First we need a broken Edison bulb, a miniature lamp and some sealing wax or paraffin. Then break all the glass from the bulb, making it to the bottom of the large lamp base. Now solder the two wires from the Edison shell to the rim and center of the miniature bulb. Heat some sealing wax in the bottom of the shell and let it cool. This attachment will be useful to anyone who has a socket with a snap on the side or a pull-chain socket.

Contributed by STAN. DIRVIN.

At Left: Standard Lamp Base Fitted to Miniature Lamp. At Right: Handy Test Clip Made from Binding Post.

CHEMICAL EXPERIMENTS.

No. 1: Put on a clean white plate or saucer, a mixture of pulverized sugar and potassium chlorate. Upon adding a few drops of sulfuric acid a vivid combustion will ensue. By adding with the sugar a few iron and steel filings, and performing the experiment in a dark room, or out of doors at night, bright rosettes will flash thru a rose colored flame, and produce a fine effect.

No. 2: Mix a teaspoonful of nitric acid with a teaspoonful of sulfuric acid; place a little turpentine in a teacup out of doors, and pour the mixture upon it at arm’s length. The turpentine will burn with almost explosive violence.

No. 3: Make a saturated solution of sodium sulfate (Glauber Salt), in warm water; pour the mixture in a bottle, and let it stand. The salt will remain for months without crystallizing; but if taken up, and shaken a few times, the whole mass will instantly form into crystals, so filling the bottle that not a drop of water will escape. Should there be any hesitation at the moment of shaking, drop a small crystal of the salt into the bottle, and the effect will be instantly seen, by the depositing of new crystals in every direction.

No. 4: Heat a piece of tin until the coating begins to melt; then cool quickly in water and clean in aqua regia. The surface will be found covered with beautiful crystals of the metal.

No. 5: Pour dilute nitric acid upon bits of tin. Dense red fumes will pass off.

No. 6: Throw crystals of any nitrat on red hot coals; they will deflagrate with dense red smoke.

Contributed by GLENN HELWAGEN.

PERCENTAGE SOLUTIONS.
The difficulty about percentage solutions, says Studio Light, will disappear if the worker will always bear in mind that one ounce of water weighs 437½ grains, which is, of course, equivalent in weight to one ounce avoidius. It follows that if one-tenth that number of grains—i.e., 43.75 grains—are put into a graduated glass and water added to make up one fluid ounce, the result will be a 10% solution.

In the following table the figures are worked out for solutions of various strengths. If the number of grains indicated in the table are taken and sufficient water added to make up one fluid ounce, it will be found that the solution has the required strength.

No. a 1% solution take 4.37 grains
  5% "  21.82 "
 10% "  43.75 "
 20% "  87.50 "
 30% " 131.25 "
 40% "  175.00 "
 50% "  218.75 "

HOW TO FILE SOFT METALS.
The teeth of a file are soon filled when the file is used on lead, tin, soft solder or brass. It cannot be cleaned like the wood rasp by dipping it into hot water, but if the file and the work are kept wet with water, there will be no trouble as the already wet particles of lead, soft solder, etc., do not readily adhere to the file.

HANDY COMPUTER FOR MECHANICS.
Here’s the latest vest-pocket computer for electrical and mechanical men. By rotating the cap on end it shows at a glance the size of drill to use for taps for sizes from 1/4 to 2 inches. U. S. S. Pipe 3/4 to 3½ inches. A. L. A. M. to 1 inch. S. A. E. to 1½ inches also 15 small numbered sizes below 1½ inches. It has the advantage over blue-prints and chart that it can be easily carried in the vest-pocket.

A Useful Computer for Machinists and Experimenters. It Shows the Size of Drill for Any Tap Instantly.
Loose Coupler
(No. 1,276,618, issued to Carlyle B. Canyon)
This patent relates to an improvement in tuning transformers and particularly to a switching arrangement by which unused portions of the inductance or winding are completely cut off from the circuit, thereby eliminating undesired effects on the wave length. The arrangement shown provides for a plurality of separate coils in close inductive relation. The terminals are connected with solid and spring contacts, adapted to be separated by a revolving insulating disk in order to cut out certain coils when so desired. In other words, it incorporates a revolvable form of dead-ending switch.

Electrically Heated Radiator
(No. 1,276,637, issued to James J. Rohan)
An electrically heated steam radiator of novel design in which there is provided a radiator of the usual form, together with an electrically heating steam generator, this latter being very rapid and economical in operation, it is claimed. Simple and positive means are provided for automatically controlling the flow of electric current to the heater, and likewise for automatically controlling the flow of water of condensation from the radiator back to the heating device; this automatic control being effected through the medium of the steam pressure developed within the heating device.

Electric Shutter Trip for Cameras
(No. 1,277,592, issued to Gilbert R. Horton and John M. Miller)
By means of this electromagnetic actuating mechanism for camera shutters, photographs may be taken at a considerable distance from the operator, such as where animals are to be photographed. The length of circuit over which this shutter device may be operated is governed only by the strength of the battery used. A push button, which is located at the battery, the current completing a circuit thru the small electromagnet fitted to the shutter trip as shown. When the magnet is actuated the shutter is opened, continued pressure on the push button will hold the shutter open.

Electric Headlight
(No. 1,276,665, issued to Overton Campbell, Wisc.)
An improved electric headlight for automobiles and other machines and providing a special means for shifting the electric light bulb with respect to the reflector, whereby the bulb may be moved transversely toward and from the axis of the reflector. A soft iron or steel collar is secured to the rear end of the lamp base, which serves as an armature in cooperation with an upper and lower control electromagnet. These electromagnets are secured to and supported by an annular ring mounted in the lamp housing back of the reflector. Thus the lamp bulb proper may be thrown up or down, simply by actuating one or the other of the electromagnets, throwing the light beam either far ahead of the machine or else just in front of it on the ground, as may be desired.

Apparatus for Concentrating and Projecting Radiant Energy
(No. 1,278,028, issued to Salvatore Salto)
An apparatus for the concentration of light, heat and electric rays and for the projection of these rays in a certain desired manner. This apparatus for concentrating and directing light rays has for its purpose to illuminate objects by concentrating light rays thereon, by means of reflectors with elliptical curvature. The object to be examined or illuminated may be observed directly by placing it inside the hollow elliptical, or projected on a screen by means of a suitable device such as a microscope or a magnifying glass. Thus extremely high specific luminous or caloric intensities are obtainable by concentrating emanations from several sources of energy and causing them to be projected on a screen. Thus, for example, in the case of a light source, the light, or as a projector for motion picture machines, automobile head lights, etc. The apparatus can also be used for concentrating heat radiations.

A Sound Operated Dog
(No. 1,279,831, issued to Christian C. Grober)
When you clap your hands or whistle to this "pup" he jumps out of his kennel in great delight. All because of a clever arrangement of a simple microphonc and electromagnet which holds the trip retaining the dog within the kennel, until the sound produced by the clap of the hands or whistle strikes the microphone. At this instant the normal constant current thru the retaining electromagnet drops to a comparatively low value, thus releasing the powerful spring which kicks "Fido" out the door.

Primary Battery
(No. 1,276,74, issued to Walter Grothe)
A novel arrangement for supporting the electrode elements within a primary battery. The supporting member for the electrodes consists of a flanged yoke having depending ends, while a suspending bolt passes thru a hole in the yoke and is rivetted therein. A spool of porcelain is arranged to be clamped against the yoke as shown. The shank and heads are preferably of triangular shape. A perforated container closed on all sides excepting the top, is adapted to be clamped between the depending ends of the yoke and the ends of the clip.

Crystal Detector
(No. 1,277,637, issued to Thomas H. Miller)
A crystal detector for radio receivers which is claimed to be exceptionally rugged and reliable in design; also its operation is not likely to be interfered with by mechanical jars or concussions. This adjustable feature enables the contact member to be placed at any point upon the surface of the crystal desired, and the contact point and crystal are both enclosed.

Motor-Driven Revolving Door
(No. 1,276,145, issued to Edward C. Haviland)
Where a revolving door is continuously rotated, electric current is being continuously consumed regardless of the egress or ingress of people thru the door. The object of the present invention is to provide a means whereby a motor for revolving the door is only put in operation when a person is passing thru the door. These switches eliminate electrical circuits to the actuating motor, but only for such time as is necessary for the person to pass in or out of the door.

Radio-Telegraph Transmitter
(No. 1,279,500, issued to Oscar C. Boss)
A system in which the discharge of the oscillating circuit condenser may be readily controlled over a wide tune range. The operation is as follows: The high frequency generator A cannot break down a larger gap than S and the arresters, therefore prevent the discharge of the condenser C across the gap unless they are simultaneously broken down. They...
"Amateur Electrical Laboratory" Contest

THIS MONTH'S $3.00 PRIZE WINNER—ALFRED STACEY

HEREWITH are photographs of my laboratory. On the large table in the center of the room may be seen the radio outfit which was assembled in its original place to take this photograph. When set up it was used with an aerial one hundred and fifty feet high, one hundred feet long, with four stranded wires placed three feet apart. The transmitting set consists of a 15 K. W. transformer, condenser, rotary gap, oscillation transformer, aerial inductance, aerial condensers, and hot-wire meter, keys, etc., also a Polsen arc and transmitter for radiotelephony. For receiving, I have receiving transformers, variable condensers, flat condensers, audion, loading coils, Ferron, Galena, and Silicon detectors, two pairs of 'phones, etc. On the experimental table to the left of the radio table may be seen Tesla, audion, step-up and step-down transformers, meters, batteries of different types, motors, generators, telegraph and telephone instruments, condensers, measuring instruments and other electrical apparatus. To the right of this apparatus may be seen the two switch-boards containing circuit breakers, switches, and rheostats for controlling various instruments. To the right of the switch-board may be seen the work-bench for building and repairing instruments. To the right of work-bench, chemicals, elements, retorts, graduates, flasks, hydrometers, thermometers, ad infinitum. To the right of this bench will be seen another bench used for the manufacture of chemicals such as bromin, chlorin, etc. Next may be seen the stock-room and dark-room used for photo developing and printing. I have a book-shelf containing over one hundred and fifty chemicals and electrical books. This laboratory is the result of ten years' hard work assisted by the famous "Electrical Experimenter" and "Modern Electrics."—ALFRED STACEY, Hamilton, Ontario, Canada.

HONORABLE MENTION (1 Year's Subscription to the "ELECTRICAL EXPERIMENTER") GERALD DITTMAN

I PRESENT herewith photograph of myself and two of my laboratories. I am eighteen years old and have had my laboratory for about a year. I have a great number of chemicals which I use for testing foods and for mixing up different solutions to see what effect they have on electricity. I have made an arc light which furnishes all my illumination. I use an ammeter to show how much current I am drawing and in that way save fuses, because when the pointer approaches ten amperes, I know a fuse will blow and I can shut it off in time. I also have a number of motors, a transformer, spark coils, condensers, Leyden jars and other instruments which I use for various experimental purposes.—GERALD DITTMAN, Chicago, Ill.
Phoney Patents

Under this heading are published electrical or mechanical ideas which our clever inventors, for reasons best known to themselves, have as yet not patented. We furthermore call attention to our celebrated Phoney Patent Office for the relief of all suffering daffy inventors in this country as well as for the entire universe.

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Prize Winner: WEEWEEEPICORGAN. Take one gross pigs fresh and lusty, assort according to musical scale, put each in soundproof chamber, attach tails to electromagnetic claws operated by keyboard. Pigs run on endless belts furnishing power for organ. Depressing keys on keyboard pinches pigs' tails. Pig sings weee—weeee—wee, as long as key is pressed. Don't use old sows. They sow discord. French airs go well on this organ due to the oui, oui! Inventor: Paul Gaugewere, Bethlehem, Pa.
The "Oracle" is for the sole benefit of all electrical experimenters. Questions will be answered here for the benefit of all, but only matter of sufficient interest will be published. Rules under which questions will be answered:

1. Only three questions can be submitted to be answered.
2. Only one question may be written on each sheet; no penciled matter considered.
3. Drawings, diagrams, etc., must be on separate sheets. Questions addressed to this department cannot be answered by mail free of charge.
4. If a quick answer is desired by mail, a nominal fee of 105 cents is made for each question. If the questions entail considerable research work or intricate calculations a special rate will be charged. Correspondents will be informed as to the fee before such questions are answered.

FIRING TWO FLASH-LIGHT POWDER PANS SIMULTANEOUSLY.

(970) Fred Wheeler, Galt, Ont., Can., wants to know:
Q. 1. How to fire two or more flash-light pans simultaneously.
A. 1. For firing flash-light powder at two places simultaneously, we refer you to arrangement as per diagram. Use a spark coil and battery as indicated in diagram. Wire the two or more flash pans in series. Keep the spark gap in each pan small—1/16" gap is sufficient.

HOW TO TELL DYNAMO POLARITY.

(971) Paul Miles, Chicago, Ill., inquires:
Q. 1. How can the positive terminal of a small D. C. dynamo be determined?
A. 1. Off-hand we cannot tell you which is the positive brush. However, we advise you to make the following test: In a 50% solution of salt water put two wires connected to the dynamo, and note from which wire the most bubbles come off. This is the negative wire.

A 4-volt dynamo will give about 3 amperes. However, much depends upon the condition of the brushes (contact, pressure, etc.), and the condition of the batteries. We would advise you to refer to "Lessons in Practical Electricity and Magnetism," by Swope, which can be purchased thru our Book Department for $2.25, postpaid.

SPEED CONTROL OF A.C. MOTORS.

(972) Hugh McPherson, Borden, Sask., Can., asks:
Q. 1. How can I control the speed of a 30 H.P. A.C. 3-phase motor?
A. 1. The speed of the 30 H.P. A.C. 3-phase motor can be regulated in several ways, some of the best of which are as follows:

The voltage applied to the motor is varied by a transformer from which several taps are brought out to a controller, thereby varying the speed. Again, by means of an induction regulator which consists of a primary and secondary winding, having an iron core with one of the windings so arranged as to allow of being varied thru 180 magnetic degrees. The above methods are really best for single-phase service, while the following method is very good for the three-phase service: In this method the speed can be varied by changing the number of poles of the motor connected in the circuit by means of suitable switches or by varying the current by a suitable rheostat connected in the respective legs of the wound rotor circuits. This last method also applies to the single-phase system, wherein the current is varied by means of a rheostat.

LOOSE COUPLER AND DISTRIBUTED CAPACITY.

(973) C. W. Opert, Freeport, Ill., wishes to know:
Q. 1. Several points about making a loose coupler transformer for radio receiving circuits.
A. 1. In constructing a loose coupler, the best way to take the taps off is as follows: At the required part of the coil put a hole in the cardboard tube and soak about 18 inches of wire thru this hole by looping the wire, and then pushing it thru. All that remains to be done now is to continue winding the coil until all the taps have been made.
We provide coils with dead-end switches in order to get rid of the distributed capacity. Distributed capacity is the capacity which exists between the turns of a helical coil, and for your benefit we refer you to an extensive article on this subject which was printed in the May, 1917, issue of this journal.

TESLA COIL FOR 2-INCH SPARK COIL.

(974) R. Conover, New York, N. Y., inquires of "The Oracle":
Q. 1. For data on a Tesla coil suitable for use on a 2-inch spark coil as an exciter.
A. 1. The ordinary Tesla coil, especially designed to work with a spark up to 2 inches on the primary side will do, and is briefly described as follows. The primary should consist of 14 turns No. 10 solid, rubber-covered copper wire in one layer on a spool 4½ inches in diameter, while the secondary consists of a coil 2½ inches in diameter and 12 inches long, wound its full length with a layer No. 28 enamel wire.

This size of Tesla coil can be furnished by the leading companies who advertise in our magazine. It is best to use two one-pint Leyden jars connected in parallel or a one-quart Leyden jar.

The construction for a glass plate condenser for the above Tesla coil is as follows: Procure five glass plates 6x7x1/16" and four pieces of tin-foil 5x6 inches. The tin-foil should be placed between the five plates so that two ends of the tin-foil protrude from the sides of the glass. The size of the space remaining from the above Tesla coil will be about ¾ to 1 inch and can be taken thru the body without any harm.

(Continued on page 648)
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ELECTRICAL EXPERIMENTER

THE ORACLE.

(Continued from page 646)

RECORDING SPEECH ON A MOVING IRON WIRE.

(975) Miss Clara B. Griffin, Carthage, III., writes this Department:

Q. 1 Can an instrument known as the Telegraphophone record speech?

A. 1. Relative to your inquiry regarding the Telegraphophone, an instrument invented by Valdemar Poulsen of Denmark, we are pleased to state the following:

This instrument will record speech on a thin steel wire by recording the fluctuations of the magnetic lines of force set up by a set of magnet coils. A full description of this machine was given by Samuel Cohen in the June, 1915, issue of this Journal; an article describing iron wire type of Telegraphophone designed as a dictating machine for business offices.

CHARGING LEYDEN JARS.

(976) Mr. B. Brewer, Dedham, Mass., asks:

Q. 1. Different ways to charge Leyden jars.

A. 1. We are giving a sketch herewith to show how to charge the ordinary Leyden jar by means of a static machine.

The best way is to hold the jar in the hand and let sparks from one of the balls of the static machine jump over to the central ball of the Leyden jar. At first the sparks will jump fast, then as the jar becomes charged, they will grow smaller and smaller, finally being too small to discharge. The ordinary machine, as shown in Fig. 2.

The important part to remember is that not every glass can be used for Leyden jars. Here is where many an experimenter is disappointed. Only potash glass can be charged — all the other varieties, such as flint and lead glass, “leak” — it being impossible to sustain a charge for even one second if such glass is used in the Leyden jar. If no potash glass is procurable, an ordinary glass jar can be coated on both sides with tinfoil. The jar can be charged by means of the ordinary machine, as shown in Fig. 2.

Various Ways in Which to Charge Leyden Jar Condensers from Static Machines and Induction Coils.

In order to get the charge, it is necessary to hold the discharger as shown, and a continuous discharge will flow across the two knobs. The quality of the spark is the same whether charged by a static machine or Leyden jars, except that in the case of a static machine the spark will sometimes leap several inches, while the jar charged with a spark coil will only leap an eighth or one-quarter of an inch, and in extreme cases one-half inch.

DOES A PERSON WEIGH MORE AFTER EATING?

(977) Querist, New York City, inquires:

Q. 1. Does a person weigh more after drinking say, 25 glasses of beer, or eating 10 lbs. of beefsteak (as often happens at beefsteak eating contests), or will their weight remain the same? "A. says they will weigh the same; "B. says their weight will increase in exact accordance with the amount of food or drink taken into the stomach.

A. 1. This is an interesting question and one that has been asked hundreds, even thousands, of times. The Editor of this column collects the usual answer by the man in the street to the effect that he will weigh exactly the same. He will, eventually, but—well, listen to the learned

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The War is Over—Yes!

but the men “over there” will not be back for months—perhaps years, for their work “over there” isn’t over. And so you, and thousands more must fill up the gap now that the absence of these brave workers has made in the ranks of skilled labor. Trained Electricians are needed more, perhaps, than any other class of men. The sudden ending of the war has caused the big industries to start work sooner than any of us expected and in consequence the Manufacturers are Calling for Trained Men, and we are training men as fast as we can to meet these urgent calls. You are needed, Young Man, now! Don’t wait. Don’t put it off. Get in touch with us Today. Get ready to join the great “Peace Army” here at home. Your country calls. Again we say, prepare to serve your country! We’ll make a trained electrician of you in three months! Let’s go!

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THE ORACLE.  
(Continued from page 648)

pores of the skin, also from the lungs, this slight difference would occur immediately. But in two or three hours, due to the foregoing causes, also digestion, the weight will gradually decrease to normal.

Dr. William Benham Snow, of New York, one of the leading American electro-therapists and medical men, states: "The increase of weight in the human being after eating, say, one pound of meat varies greatly. In some instances there is no increase at all; while in others there is a slight (but never the full weight) increase, all depending upon an individual's respiratory and digestive organs. In the case of water, the full weight of the water is added to the person's weight, but within a very short time the weight will rapidly decrease to normal. It has been a widespread and popular idea that if a person were to lie on his back and hold his breath he could be lifted with two fingers. This has been done by hypnotism, but not otherwise.

ELECTROLYTIC RECTIFIER.  
Q. I. I have made a small Electrolytic Rectifier for charging storage batteries. This rectifier was built from instructions in the Scientific American Supplement No. 1544. According to the instructions, the liquid consists of one pound of crystallized sodium orthosilicate (per jar).

I am having trouble getting this chemical. Some drug houses I have been to do not seem to know what it is at all. Could you advise me where I can get it? Or what other chemicals I could use instead?

A. 1. Relative to your electrolytic rectifier, would advise that the majority of these rectifiers, even the larger sizes, are operated with a solution composed of sodium bicarbonate (baking soda) dissolved in water until the solution is saturated, i.e., until the water will not absorb any more of the bicarbonate. Another very good solution is composed of water in which there is mixed ammonium phosphate. A saturated solution of this is also electrolytic.

The matter of the solution used is not a very important one, it being more important that a good, pure grade of aluminum is employed. Water and air have been used in electrolytic rectifiers in emergency for that matter, and also wherever a solution seems to have a high a resistance or where a sufficient current is not obtained, a few drops of sulfuric acid may be added to the water to make it more conductive. If you have further trouble in getting the rectifier to operate, it is well to note that the aluminum plates have to be formed" and this has sometimes to be accomplished by running the rectifier for five or ten minutes or so connected to a lamp bank so that this or similar resistance in the line can put a fairly strong current thru the rectifier, and cause the necessary oxid to form on the aluminum electrodes.

2 K.W. "PIPE THAWING" TRANSFORMER.  
(1979) Mr. Wm. E. Newton, Ontario, Canada, writes the "Oracle" Dept.:

Q. I. I would like to make a transformer for Ordinary water pipes and want a secondary current of 150 amperes at 10 or 12 volts, as I would only need to thaw about 10 or 12 feet at a time. The primary winding will be operated by 110 volts, 5 cycle alternating current. I have plenty of soft pipe iron at hand from which I could make the core, which, I suppose, would be of the closed core type. Please give dimensions of core, size, number of turns, and weight of wire required for primary. What kind, size, number of turns of wire required for secondary core, etc. A. 1. We give below data for constructing the transformer in question:

Primary: 2 loops of No. 9 B. & S. gage D. C. copper magnet wire wound in layers on one of the long legs of the core. This will require about 2 pounds of wire.

Secondary: The secondary coil to deliver 150 Amp. and 13.3 volts at full load may comprise 31 turns of No. 0 B. & S. gage D. C. copper magnet wire, or if this is not convenient, owing to its large size, you may wind on simultaneously two No. 3 B. & S. gage D. C. conductors side by side, or four No. 6 B. & S. gage D. C. conductors. The terminals of the separate wires, if a multiple winding is used, are joined together so as to connect all the wires on parallel.

The efficiency of this size of transformer is about 95 per cent with respect to the watts input at the primary and the watts output at the secondary.

Knowing the size of the core you can readily compute the weight of wire for the windings by consulting any wire table. The circular mils area of the No. 9 B. & S. gage wire is 13,594 c.m., while the circular mils area of the No. 0 L. & S. gage conductor is 105,592 c.m.

A NEW TOGGLE SWITCH.  

The toggle surface switch illustrated differs from the ordinary snap switch in that manipulation is by the throw of a lever or toggle, instead of by the turning of a key or button. Throwing the lever up makes the circuit; throwing it down breaks the circuit. The movement is positive—the make-and-break quick and snappy. The toggle switch has been used in Europe for a number of years, but was slow to find favor in America. 

The advantages of the toggle movement in a surface switch are stated as three-fold—first, it permits making the switch more attractive and stronger than the ordinary switch; second, manipulation is much more convenient by means of a toggle, and third, the switch is self-indicating, the position of the lever showing at a glance whether the current is "on" or "off" without any marker or dial. It combines in unusual degree the best mechanical advantages of the features which make an appearance which makes quick appeal to those seeking the dignity of simplicity and richness.
RADIO-TELEPHONE GUIDED U. S. FLYERS MANY MILES AWAY.

(Continued from page 629)

require amplifying more than from ten to fifteen times.

Fig. 3 shows a new form of oxid filament tubular audion as supplied on U. S. Army and Navy sets. This bulb is provided with a special base, making it very convenient for attachment or replacement, and tests made with this bulb show the life to be about five thousand hours.

Fig. 4 shows an improved form of audion control panel. A number of new radio-engineering features are incorporated in this apparatus, including deeply grooved, insulating terminal blocks which carry the binding posts. Integrating condenser switches are employed for regulating the capacity of the bridge and stopping condensers. The ammeter at the right of the panel indicates the filament current at all times. A special form of graphite potentialmeter is mounted just below the filament ammeter to regulate the wing current.

Fig. 5 shows a large capacity oscillation bulb and control instruments mounted on a self-supporting panel for radio-telegraphic transmission. The bulb is mounted between upper and lower rings of heavy, rubber-covered wire. The loading coil switch for varying the antenna wave length is mounted in the upper left hand corner of the panel. Terminals for the Morse telegraph key are fitted at the bottom of the panel. A radiation hot-wire ammeter is seen at the left of the switchboard, while a three-pole switch controlling the filament and wing current appears at the right. The necessary condensers and auxiliary apparatus are compactly mounted on the back of the panel.

A $\frac{1}{2}$ K. W. oscillation is good for 150 miles radiophone transmission over water, or 250 miles radio-telegraph signaling over water. A 1 K. W. outfit has a range of 200 miles radiophone or 300 miles radio-telegraph over water. A 2 K. W. will talk 300 miles or telegraph 400 miles over water. These ranges can be greatly increased by the use of two to six stage audio amplifiers. The six stage audio amplifier has an amplifying factor of one million times.

Fig. 3. New Form of Oxid Filament Audion as Supplied on U. S. Army and Navy Radio Sets.
ELECTRICAL EXPERIMENTER

SALT FROM THE SEA BY ELECTRICITY.

A company is about to start the exploitation on a large scale of a method for extracting salt from sea water. The undertaking is being backed up by a number of men of exceptional standing. The process is due to Professor Helledan Hansen, and the venture is backed by $5,000,000. It will in all probability be found expedient to erect several works along the coast of Norway as way more electric energy becomes available.

The comparatively large capital is principally necessary on account of the large plant needed, preparing solutions, etc., absorbing the bulk of the power; the production of the salt itself only requires a small amount of energy and is consequently cheap. As to the location of the new factories, no definite decision has been arrived at, but Stavanger has been mentioned as a likely place for the first factory, and the Giamfjord for the second.

A MELODIOUS PHONOGRAPH REPRODUCER.

By Frank C. Perkins.

The accompanying illustrations show the details of construction of a new phonographic reproducer, developed at Milwaukee, Wis., which is said "Humanizes a Talking Machine." This machine is so arranged that the phonographic reproducer plays perfectly all disc record selections, even the subtle tones of the instrumental accompaniments and prevents clash and approaches the living voice, whether of soprano, contralto, tenor, baritone or bass, quite as natural as life. Even the resonator of the violin and the tone of the flute are marvelously perfect.

It is held that band records are reproduced with all the tone values of instruments, every overtone and undertone brought out harmoniously, without nerve-wracking tire, while orchestral combinations are greatly improved. The recordings of the great symphonies are revivified with all the original sublimity; intensified in just the right volume for home enjoyment. The violins, cellos, cellos, clarinet, bassoon, saxophones, flutes, piccolos, horns, the "brasses" including the great tuba, the "percussion" containing drums, cymbals, bells, special effects as the imitation of birds, church choirs, are all as real as the record is made.

Any talking machine can be equiped with this reproducer in a moment, without tools. Either steel or fiber needles will work perfectly with the reproducer, whose weight is less than four ounces, so that records wear indefinitely if care is used.

BOOK REVIEW


The student of electricity and magnetism will find many new, interesting, and valuable experiments described in this work. The author is well known for his scientific circles and of high standing. Furthermore, as it seems to the present reviewer, this presentation is of more than ordinary interest, as involving experiments in the laboratories and spark shadows are given with some new theories as to their meaning; causes of local magnetic storms; the effect of "wind" on magnetism; and something on the relation of sounds. These effects are indeed wonderful, and so new as to demand the attention of every earnest electrical student. Professor Nipher has performed some very interesting experiments in the laboratory and also in the field along these lines, and if you wish to read something refreshingly new in the realm of experimental electricity, you should by all means study this excellent and clearly written explanation of these little known scientific phenomena.


One of the well-known Horstmann and Tousley practical handbooks for electrical engineers giving the theory and practice of this branch of electrical engineering so that the nonspecialist can learn the exact meaning of the various terms used. The work starts with the generation of alternating currents and discusses induction, power, capacity and resistance and their effect on the voltage and current in alternating current; we find an interesting discussion on impedance, wattage current, and skin effect.

Other interesting chapters treat on the calculation of power in A. C. circuits; the theory and calculation of transformers and how they are connected in lighting and distribution circuits; alternating-current generators, their theory and construction; A. C. motors, including the synchronous motor and its characteristics; synchronous converters, their theoretical and practical operation; the generation of split-phase converters; A. C. to D. C. rectifiers of various types; including electrolytic and vacuum rectifiers, special regulators, measuring instruments for A. C. work, including synchroscopes and synchroscopes, and with numerous tables for the calculation of A. C. circuits for different frequencies and voltages. A clearly written handbook which explains in untechnical terms the principles of alternating currents for the practical electrical and student.

GERMAN ENVOYS TOLD TO SUR- RENDER, VIA RADIO.

A wireless message sent to the German delegates from German headquarters authorized them to sign the armistice.

The German commissioners remained up all night writing the final instructions. When the radio message arrived they hastened to a private train in which Marshal Foch was living and which formed his headquarters. Marshal Foch was asleep at the time. He was aroused. He received formal word that the Germans had come to terms.

The signatories affix their signature to the momentous document was Dr. Matthias Erzberger and Count von Galen. The German delegates followed. As they signed, one by one, they saluted, Marshal Foch and his aide-de-camp received considerable attention.

In the meantime, across the network of wires running from Marshal Foch's headquarters to Paris, the order for cessation of hostilities at 11 o'clock, Nov. 11th, began to be flashed up and down the far-flung western front, while from Paris and London the news started on its joyous trip around the world.
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**WINTERTIME USES FOR THE ELECTRIC FAN.**
(Continued from page 619) be screwed down so as not to fall over and injure anyone.

Another illustration shows a very effective aid in the drying of milady's silk stockings, gloves and hair. The funnel "B" can be easily constructed of ordinary cardboard to fit the protective guard, and attached with wire. Or, it can be made a bit larger so as to slip a few inches over the protector, perforated at two or four places and tied at the back with string. Of course the width of the other end should be much narrower in order to produce the conical shape, as the sketch illustrates. A small piece of cardboard formed into a cylinder, and down or pasted together so as to exactly fit the end of the cone, is also fastened to it with wire. This is done by perforating both and sewing the wire from one hole to the other. The stock is then slit on and can be clamped down. (The clamps that are used on jam jars to make them air-tight would serve very nicely here.) Also books made of wire (picture wire would do), invisible hairpins, etc., can be affixed to the end of the funnel, on which handkerchiefs, stockings and gloves can be fastened. In the latter case it is not necessary to make the small cardboard attachment. It is readily understood that the forced air thru this funnel dries the articles in no time. Should it be inconvenient for you to make this funnel, the handkerchiefs, stockings, etc., can be attached to the protector itself by pins or hairpins. With this method it will take slightly longer for them to dry. Care should be taken to attach the articles before you set the fan going. Take them off after you have cut off the current with the snap switch and the fan has fully stopped. This precaution should be taken whether the electric fan is handled in any way.

Figure 15 shows a handy device that can be easily made from ordinary cardboard. A circle of tin is cut in the manner illustrated, allowance being made for small projections which are bent over and formed into hooks. It can be affixed to the protector guard with the projecting tabs. If the tin is not handy, cardboard will do just as well, except that the hooks must be made of wire or old hairpins. A good way to make these hooks is to thrust the hairpin thru the perforation, the two ends first, twisting them around at the other side of the perforation and then spreading them apart. About four cardboard tubes are inserted and sewn with wire as aforesaid, and a piece of cardboard large enough to fit the wire cage pro-
What does it feel to earn $1000 a week? How do I feel to have earned $200,000 in four years? I don't think I know the answer to these questions. But these are questions I feel I should be able to answer. Is it such a difficult task to tell the truth? I should like to answer these questions, and I should like to tell the truth.

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ELECTRICAL EXPERIMENTER

January, 1919

THE GIFT OF GIFTS
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ELECTRICAL EXPERIMENTER

January, 1919

NIKOLA TESLA AND HIS INVENTIONS.

(Continued from page 615)

either a dreamer or, worse yet, crazy. The fact is the world does not understand you because you live in the next century. Moses was used with great power, but the Bible teaches us that he was "heavy of tongue" and could not make himself understood. His brother therefore always spoke in his stead, according to the mannerism Moses had to say. Why not let the EXPERIMENTER be your brother? Why not let us translate your work into a language that the man in the street can readily understand? We have the knowledge and the technical training to do your inventions justice by means of great illustrations and written explanations. The public does not want patent drawings or patent language. It wants pictures and plain English. You are a great inventor, but your 21st Century training prevents you from making yourself understood to a 20th Century public. My plan is to run one of your inventions a month, in full, in English fully illustrated. That means that it will probably take over two years to deal with all of your more important inventions. At the end of this period the articles can be published in book form, a thing that does not exist at present. The plan is twofold. Success on such a large scale will at last understand the highly important work you have accomplished and will fully recognize you. Second, it will be of greater benefit to Science, to whom your inventions will then not be the sealed book they are today.

Knowing that Tesla had in the past continuously refused similar offers of dozens of great publishers of this country as abroad, I was not at all sanguine of my own plan. Great was my surprise therefore, that he not only gave his consent, but he actually agreed to prepare each invention, personally with the Editors' collaboration.

Dr. Tesla wants it expressly understood that he is undertaking this great work chiefly to educate the young generation. He felt that he could not possibly reach such a large electrically trained young mankind, save thru the medium of the ELECTRICAL EXPERIMENTER. With its circulation of about 100,000, all enthusiastic experimenters, Tesla feels that his greatest mission in life, namely, to assist our rising generation, will come near fulfillment.

Nikola Tesla's articles will therefore run serially every month in the ELECTRICAL EXPERIMENTER. The articles will be entitled: "My Inventions"—by Nikola Tesla. Every article will be entirely original; each will be illustrated with our own new illustrations and with such wash drawings as have been this journall so successful. The first article will appear in our February number.

We wish to congratulate EXPERIMENTER readers for having obtained for them probably the greatest technical news feature of a generation. I caution you: Expect much!

FARMERS AND ELECTRICITY.

Within the past three years the farmers of the United States have purchased one million automobiles and 100,000 tractors and innumerable pumping engines, and other devices run by electricity, according to wise published estimates. Farmers everywhere are rapidly advancing in the same direction, progress in labor-saving contrivances being phenomenal in this country. A motor does the churning; a motor runs the sewing machine and the washing machine. The rural telephone is invading country districts at the rate of many miles per day, and all farm machinery is being operated by the aid of tractors, which now haul the wagon and work the hay loader in the hay field. Next year, it is said, reapers and mowers in great numbers will be driven by tractors.

DEVICE FOR PROTECTING ELECTRIC MOTORS.

A motor protection system which, if claimed, does away with the trouble and expense of cleaning motors, has been devised and marketed. The usual type of installation, it is pointed out, in working out this system consists of casings which enclose each end of the motor and make it dust proof. A fan is attached to the end of the motor and air is drawn thru it which carries away the heat as fast as generated. Motor casings are provided with large doors to permit of a ready inspection of brushes, commutators, bearings, and the like. The dust separator is also provided with doors so that the screens can be readily removed. The equipment can be applied to motors with moving parts and requires a short time to install. Besides reducing the temperature and increasing the efficiency, the maker points out that the protection provided allows the carrying of a large overload without shortening the life of the motor and eliminates fire hazards.

DANIELS TELLS OF Foe RADIOS SCOUTS FOUND.

A telegram from Secretary of the Navy Daniels received by the Boy Scouts of America characterized them as "chivalrous young crusaders" because of their work during the war. It also disclosed that the Scouts, working on behalf of the Government, had discovered hundreds of illegal wireless plants.

Twenty-six of these plants were found in one day. A German alien, operating an underground radio station with a small New England river supplying the motive power, was taken into custody and interned. This plan was soon being exchanged by German Government agents between America and Berlin. Details of these scout activities are expected to be made public later.

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When everything has been made easy for you—when one of our top-flight instructors PAYS YOU—your home will bring you a bigger income, more comforts, more pleasures, that success means—can you let a single priceless hour of spare time go waste? Make your start today. This is all we ask. Without cost, without obligating yourself in any way, put it up to us to prove how we can help you. Just mark and mail this coupon.

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energy received, even if it could be collected in its totality, is insufficent and would not actuate the most sensitive instrument known to be magnified many million times. The fact is that waves have no perceptible influence on a receiver if situated at a much smaller distance. It should be remembered, moreover, that since the first attempts the wave lengths have been increased until those advocated by me were adopted, in which this form of radiation has been reduced to one-billionth.

When a circuit, connected to ground and to an elevated capacity oscillates, two effects separate and distinct are produced; Hertz waves are radiated in a direction at right angles to the axis of symmetry of the conductor, and simultaneously a current is passed through the earth. The former propagates with the speed of light, the latter with a velocity proportional to the cosecant of an angle which from the origin to the opposite point of the globe varies from zero to the limit of 30°. Expressed in words, at the start the speed is infinite and diminishes, first rapidly and then slowly until a quadrant is traversed when the current proceeds with the speed of light. It is seen that region on the velocity gradually increases, becoming infinite at the opposite point of the globe. In a letter to me in April, 1905, I have summed up this law of propagation in the statement that the projections of all half waves on the axis of symmetry of movement are equal, which means that the successive half waves, though of different length, cover exactly the same area. In the near future many wonderful results will be obtained by taking advantage of this fact.

There is a vast difference between these two forms of waves as far as the bearing on the transmission. The Hertz waves represent energy which is radiated and unrecoverable. The current energy, on the other hand, is preserved and can be recovered theoretically, at least, in its entirety. If the experts will free themselves from the illusions under which they are laboring, they will find that to overcome static disturbances all that is needed is a properly constructed transmitter, and receiver without any additional devices or preventives. I have however devised schemes of apparatus eliminating statics even in the present defective wireless installations where they are not magnified and multiplied. Such a form of instrument which I have used successfully is shown in the annexed photograph. These phenomena have been studied by me for a number of years and I have found that there are a number of different causes tending to intensify them, and in due course I shall give a full description of the various improvements I have made, in the ELECTRICAL EXPERIMENTER. For the present I would only point out that in order to perfectly eliminate the static interference, it is indispensable to redesign the whole wireless apparatus as now employed. The sooner this is understood the better will be for the further evolution of the Art.

A means of making use of the electric magnet under water has been devised in Japan, and it promises to be of great assistance in locating submerged bodies of which salvage operations on a big scale are expected after the war.

With the aid of special oxygen masks airplane experts believe that air fighters will be able to carry on battles five miles above the earth.
NEW BATTERY CHARGER SIMPLICITY ITSELF.

For the Garage Man going into Battery or Service work on an ample scale, or for the Garage that has outgrown its present equipment, an Ohio concern has brought out a new 32 battery capacity Charging Outfit shown herewith.

With this outfit batteries in all stages of charge can be handled with the four charging lines provided, caring for eight batteries in each line. Batteries requiring different charging rates can be handled according to their individual needs, due to the ample output of the machine. Different voltage batteries can also be charged in the same line, due to the automatic voltage control of the Generator.

With this outfit, battery charging work is claimed to be very profitable, and the makers state they have designed the outfit wholly with the idea of bringing the Garage the largest profits possible from this class of work.

DO YOU ASSOCIATE COLORS WITH FIGURES?

The recent letter to Science from David St. Jordan led to my attention a fact which I did not know before, says Arthur Bessey Smith, the well-known telephone engineer, in that journal. On mentioning it to my laboratory assistant, Mr. Herbert Edward Clapham, he said that he, too, associated colors with the letters of the alphabet but not with all, and that figures were also associated with colors. At my request he wrote out the following list:

A gray  O black  1 white
B light red  P brown  2 red
C black  Q light red  3 light red
d  pink  R k  4 gray
E scarlet  S white  5 white
F pink  T red  6 white
G gold  U golden brown  7 golden
H yellow  V gray  8 brown
I white  W v  9 red
J white  X yellow  10 black
K  Y white  11 red
L  Z  12 red
M olive green
N olive green
O

Altho I have never associated colors with letters or figures from my earliest recollection I have always thought of letters and of figures arranged in certain relative positions. The origin of this I do not know. It might have been something in the presentation of these things by my first teacher, or the manner in which little wooden sticks were laid out on my desk in high school and college work. These little sticks, each about 3 mm. in diameter and 20 mm. long, had been split out of pine for me by my father.

Which Job Can You Fill?

Which one of them could you fill? If you haven't the knowledge necessary to break into the big-pay class, decide to get that knowledge NOW! Any of the books listed below will quickly fit you for a well-paid job—at home in your spare time.

These books were written by experts in plain, everyday language. They are free from puzzling technical terms. Numerous illustrations, diagrams and tables make difficult points as simple as A-B-C. They are handsomely bound in half or full leather (except Law and Practice, which is bound in law buckram) and stamped in gold. Fill out the coupon.

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Nine volumes, 2200 pages and 2200 illustrations, plates and diagrams. Prepares for Civil Engineer, Structural Engineer, Triangulation Engineer, Estimator, Design or Chief Draftsmen. Regular price, $46.00. Special price, $28.00.

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Ten volumes, 2200 pages and 2200 illustrations, plates and diagrams. Prepares for Certified Public Accountant, Assistant. Register price, $25.00. Special price, $23.00.

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In this Department we publish such matters as are of interest to inventors and particularly to those who wish to know as to certain Patent Phases cannot be answered by mail free of charge. Such inquiries are published here for the benefit of all readers. If the idea is thought to be of importance, we make it a rule not to divulge all details, in order to protect the inventor as far as it is possible to do so.

So far has been desired by mail a nominal charge of $1.00 is made for each question. Sketches and descriptions must be clear and explicit. Only one side of sheet should be written on.

Readers' attention is called to the fact that due to the great amount of letters to this department it is quite impossible to answer them all thru these columns. The inquiries answered in this way in large number each weekly, and if readers wish speedy service they should carefully note the announcement appearing in the preceding paragraphs.

**Code Practice Instrument.**

(289) Geo. R. Griffin, Troy, N. Y., writes: "I have noticed in the November number of the Electrical Engineer an article by A. L. Kopp, New Middletown, Ind., called 'Code Practice.' I have found it with me. I have an idea which might be of value to Mr. Kopp's instrument, and am enclosing a copy of same with the request to publish the device at your convenience."

Mr. Griffin suggests putting the lamp of the practice outfit right on the key lever as shown in our illustration. By this means the bulb is screwed in the socket made for that purpose on the lever of the key. This has a tendency to light the bulb on the downward stroke instead of the upward stroke.

A. This strikes us as a good solution of Mr. Kopp's problem, and of course it this case Mr. Griffin and Mr. Kopp should really be joint inventors in any further patent action. The solution seems satisfactory.

**Invisible Periscope.**

(292) Mr. Geo. Utz, Newark, N. J., submits an idea of what he calls "invisible periscope". The periscope tube is to be surrounded with a heavy glass tube, while the space between the periscope tube and glass tube is to be filled with sea water. The periscope tube is to be painted to match the sea water. Our advice is asked.

A. While an ingenious idea, this is not different from many other similar devices which have been suggested in the past. The trouble is that it is not the periscope itself which makes the trouble, but the V-shaped wave of curried water which is left behind as the submarine speeds thru the water. The periscope itself can be and has been camouflaged in the past in such a way as to render it almost invisible within a hundred yards. Of course, this is all right while the submarine is not moving, but once it starts moving, the periscope immediately leaves a tell-tale wake behind it.

**Ice-Cream Cone.**

(293) Gardner W. Wymond, Pittsburgh, Pa., says: "I would like to submit a plan for a paper ice-cream cone that is to take the place of cake cones now in use, as I understand there is a shortage of the latter; the plan is to make a cone of the same shape as cake cones out of fairly heavy wax paper, the latter to be formed like a paper pencil as the cone is eaten away." Our advice is asked on this point.

A. We are afraid that while it looks feasible on paper, it would not work out in practise for the reason that it would be too expensive to maintain the proper motion to thus unroll the wax paper, which surely would splash melted cream over the eater.

**Diving Mine.**

(290) W. F. Ash, Jacksonville, Fla., writes: "Has there been a patent issued for a 'diving mine'—power to be furnished by small motor or clockwork which will take in water in the surface of the sea, which will cause it to sink to the mine taken over by, and after it has gone down to about fifty feet, it will throw out water, and thus cause it to rise in time to blow a Liberty ship up."

A. To our knowledge there has never been anything of this kind invented, and we have never seen any reference to it. We think this device of this kind is more or less impossible.

**Safety Soap.**

(291) W. L. McGowan, Holdenville, Okla., writes: "To your knowledge has there been any device patented for preventing soap from being stolen or destroyed from public places? Furthermore, what do you know of such a device. The device which I speak of is composed of a flat steel utensil, runs kind of inverted before, and is fastened by chain at one end and small lock on the other. Any information that you can give me concerning this matter will be greatly appreciated."

A. This is a very old idea, and one which we have seen in actual use in hotel and public wash-rooms years and years ago. There is nothing novel about this, and nearly all of these devices have been superseded by automatic soap dispensing machines, such as liquid soap, where you only have to press a button to get a thimblefull of liquid soap in your band, or the other device whereby you have to handle which puts soap shavings into your hand.

**Improved Code Practice Instrument.**

**PATENTS**

**With a Sketch, Battle-stolen a Ship Kopp's Light**

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ELECTRICAL EXPERIMENTER

Electric Radiator.

(294) Earl F. Hobbs, St. Louis, Mo., has an idea of a hot water radiator, electrically heated with expression of the most resounding assurance that it could be moved from one location to another and from room to room could be made equal to 34 inch pipe with about a 500 watt element made of copper. The radiator has a medium and a low point.

A. There is nothing fundamentally new in electrically heated water radiators as our correspondent suggests in his letter. We have in the Electra-ised systems often described numerous electrically heated radiators of this sort.

Poison Shell.

(295) Joseph Vierthaler, Philadelphia, Pa., submits description and device of a poison shell which comprises an ordinary shell with a hollow center. Poisoned gas is enclosed in the shell, the trigger is put in the shell when manufactured. Our advice is asked.

A. There is nothing new at all about this, and the present gas shells as have been used by the Germans as well as all the Allies and the United States are made along precisely this plan.

Fan Guard.

(296) Ladimir H. Sybrock, Cleveland, Ohio, writes, "As editor of the 'Patent Advice' I would appreciate your advice on the following: Would it be advisable to employ a guard for a small special electric fan having blades but 3" long? The guard if employed must be disasutable. I have been advised to use a 'sand guard.' Could you give me details regarding this or any other disasutable guard?"

A. We see nothing fundamentally difficult in making a detachable guard fan to work in conjunction with a small fan. It seems that any material, shape, or a clever experimenter ought to be able to devise such a guard, which seems very satisfactory, and do not know, however, what you mean by sand guard. We do not know in what this refers.

Telephone Receiver.

(297) Frank M. Harrington, Fulton, Ill., sends in a sketch of a telephone receiver which we reproduce herewith. The device employs two lobes having a central opening which are to pull in two soft iron needles 1/16 inch in diameter attached to the diaphragm as shown. We are asked if this design is good, whether the telephone is sensitive and whether the device has ever been tried before.

A. This is similar to an idea described some time ago in these columns. Right here we want to send the telephone receiver as a rule — with very few exceptions — which has its diaphragm weighed so as to interfere with the free vibration of the latter, usually is less sensitive than the diaphragms which swing free. We are quite convinced that the construction shown by

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ONE READER'S EXPERIENCE
WITH DR. ABRAMS' THOUGHT TRANSFERENCE THEORY.

As our reader's will recollect, we suggested in the September issue in connection with the article therein entitled "Popular Demonstration of Thought Transference and Other Phenomena," by Dr. Albert Abrams, that they write to us as to what success they have attained in conducting any of the demonstrations outlined by Dr. Abrams in this little known field of science, and we are pleased to give herewith the views of Mr. J. W. White of Brooklyn, N. Y.
Mr. White having witnessed a number of these tests conducted by Dr. Abrams personally, and visiting San Francisco several years ago. Furthermore, Mr. White, who is in the electrical business in New York City, and a thorough worker, is a student of electrical and allied matters, had the satisfaction of taking part in some of the experiments in Dr. Abrams' laboratory, and his views are given below, those of an unprejudiced and unbiased student.

Many people undoubtedly who have read the article in question have tried, unsuccessfully perhaps, to obtain results by current methods, according to the theory of Dr. Abrams, such as for instance where the "perception" or person interpreting the thought transmitted or emitted, is connected to another person or body which forms the exciting point in the unipolar (single wire) circuit.

Here, for example, is what Mr. White experienced, and certainly it is well to remember that the high professional standing of Dr. Abrams in the medical and scientific fields precludes all doubt of any fake results. He, however, had reached a point where the phenomena, however little we may as yet know as to the exact mode in which such phenomena take place. First Dr. Abrams placed Mr. White in a separate laboratory room and gave him a permanent steel bar magnet, which as we all know has a North and a South pole. At the alternate ends the Doctor instructed Mr. White to present either magnet pole as he might elect to the steam radiator in the room, when he would be able to tell by a sensitive instrument laboratory just which end of the magnet he had presented. According to the theory of Dr. Abrams, the action here was as follows: That by charges from the magnet, even when held a short distance from the radiator, charged the metal piping system, and this particular discharge past along the radiator and metal piping to the laboratory where an instrument or a human subject for the instrument was connected by one wire to another radiator connected to the system. In this connection it is interesting to note that Dr. Abrams usually prefers to employ some delicate human reflex, such as the heart or stomach reflex, for indicating when one of these extremely minute electric currents arise, and which agents he, among many thousand times more sensitive to minute currents than are the most delicate scientific instruments such as galvanometers, etc. To sum up, as Mr. White was able to tell quickly just which magnet pole Mr. White had presented to the radiator, not making a single miss in twenty tests.

One of the most astounding phases of this particular excitement was when the Doctor informed Mr. White that it was not at all necessary that he present the magnet to the radiator, so as either to touch it or approach close up to it, but that he could determine which pole of the magnet the investigator was thinking of if he would but lay it on the floor and concentrate his mind as if he were to touch it directly.

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BROWNING GUN SUCCESSFUL IN AIRPLANE PROPELLER TEST.

The Browning machine gun has successfully undergone a test to determine its value for use with aircraft. This is one of the three types of machine guns with which the rate of fire can be synchronized, so that the gun can be fired by the pilot of a combat plane thru the revolving blades. It was found necessary to aim the machine gun by steaming the plane directly at the target. The direction of the plane gives direction to the fire and the pilot can control the machine gun while controlling the plane.

Airplane propellers revolve at 800 to 2,000 revolutions per minute. The machine gun is connected with the airplane engine by a mechanical, hydraulic or electrical device, and impulses from the crank shaft are transmitted to the machine gun. The rate of fire of the machine gun is constant, and its fire is synchronized with the revolving propeller blades by "wasting" or adjusting certain percentage of the impulses from the airplane and by having the remaining impulses trip the trigger. These impulses fire just at the fraction of a second when the propeller blades are clear of the line of fire.

The pilot operates the gun by means of a lever which allows the impulses to trip the trigger. It has occurred in practice that as many as 15 shots have hit the propeller without putting the plane out of commission.

FAKE ELECTRIC PISTOL TO SCARE THIEVES.

A new electric flashlight pistol of French invention is said to be in existence, not only displays a bright light when the trigger is pulled, but also makes a noise like a real weapon as well.
PHILA. TO BE BIGGEST ELECTRICAL CENTER.

Philadephia is to be made the largest electrical center in the world after the declaration of peace, according to plans now being perfected by the Westinghouse engineers.

Experimental Chemistry

(Continued from page 639)

Chemical Properties.

1. Yellow phosphorous possesses great affinity for many of the elements, uniting with all directly, except nitrogen and carbon. With Bromin and Sulfur it reacts violently. Characteristic is its affinity for Oxygen. When exposed to the air at 40° C. or at a lower temperature, if in a finely divided state, ignition takes place, burning to Phosphoric acid, according to the supply of oxygen present.

2. It is luminiscent in the dark, even the minute particles adhering to the fingers on handling matches.

3. Because of its great affinity for oxygen, phosphorous is an energetic reduc- ing agent. Sulfuric acid is reduced to Sul- fur diox. Nitric Acid is decolored with explosive force. The elements of the metals are reduced to their metals and phosphides, thus silver nitrat is reduced to Silver and AgP,

Red Phosphorous. Properties. 1. This is an allotropic modification, and possesses properties essentially different from the yellow variety. It forms a dark red to redish-brown powder, which is insoluble in carbon disulphide and all other solvents. It does not Phosphoresce, and is stable in the air. It does not ignite when quickly heated above 200° C. the vapors change to those of yellow phosphorous. This variety is prepared by heating the yellow phosphorous to 300° C. in closed, air-tight vessels, and after the conversion, the product is then treated with carbon disulphide to remove any of the unchanged phosphorous. If a little iodin be added, this change will take place below 200° C.

Scarcet Phosphorous. Properties. This is another modification, being obtained by boiling a solution of phosphorous in phosphorous tribromid. It resembles the red variety except that it is more active, reducing the copper, with the alcalies, it yields phosphin [PH₃] and a hyposulphite.

Metallic Phosphorous. Properties. This form is obtained by heating the yellow phosphorous at 600° to 700° C. from air to 530° C. It thus forms black metallic shining crystals, which are less active than the red variety.

Luminescence or Phosphorescence.

If a match is scratched in a dark room a faint line of light may be observed as the minute particles of phosphorous which are left glow and oxidize. The same thing occurs if an oxygen lamp is exposed in darkness, and the phenomenon is called PHOSPHORESCENCE. It is due to slow combustion (or oxidation). Substances rubbed with phosphorous give the same effect.

Many other minerals and chemical com- pounds have the same property; emit light in darkness, and some of these form the basis of the so-called luminous paints. The sul- fides of Barium, BaS, BaS₂, BaS₃, etc., are examples.

Some animals, as fireflies, glowworms, etc., cetera, emit a light from a certain part of the body, without heat above that of the rest of the body. In Cuba, a species of luminiscent insect is bottled up and used sometimes for lighting purposes, about the same manner as the glow-worm.

The light is apparently due to an oxidation of animal tissue which is under the control of the insect. To produce the same light by the oxidation of gas, it is necessary to have a temperature of about 2000° F. and 99% of the energy of the flame is lost, while these need but a 5% of the energy of oxidation, without any apparent rise in temperature. The animal supplies its own light.

Uses.

Phosphorous is used mostly in the manufac- ture of matches. A kilogram (2.2 lbs.) of it will tip about two million matches. It is also used to some extent for medicinal purposes.

Matches.

The making of matches after the splints are prepared includes two processes. First, one end is dipped into melted sulfur, some of which adheres to the wood. Second, it is dipped in a red mixture of phosphorous, an oxidizing agent, and glue. A little coloring matter is quite frequently added. The oxidizing agent may be Potas- sium chlorat [in which case the wood has a burn and burns vigorously on being scratched], potassium nitrat, Manganese dioxid, or red lead [Pb₃O₄]. This result is accomplished by pressing the end on a slate slab covered with the paste. Sulfur is necessary, as the heat liberated in the burning of phosphorous is not enough to set the wood on fire, and a coating of P₂O₅ forms over it. Sometimes paraffin is utilized in place of the sulfur. The well-known Swedish [or Safety] match head does not contain phos- phorous, but consists of a mixture of potas- sium chlorat and dichromat with red oxide lead and antimony sulfid. They are ignited by scratching them on the prepared surface of the box, which is essentially a mixture of red phosphorous, antimony sul- fid and powdered silica. A machine has been constructed to cut the splints, tip the matches, and dry and pack them in boxes, all four processes being automatic and con- tinuous, besides eliminating the poisonous fumes.

A Burning Match.

Whenever one ignites so simple and com- mon a thing as an ordinary match, little does he realize the miracle taking place. One of the most wonderful and complicated of chemical experiments. The mere fact that fire could be obtained by simply scratching the end of a stick was regarded less than three-quarters of a century ago, as a truly remarkable triumph of science.
chlorate, then potassium chloride is left. The heat of the burning phosphorus is enough to set fire to the sulfur, which unites with the oxygen of the air to form sulfur dioxide, and this in turn sets the wood on fire.

The reactions of a burning match are many. Try and complete the following and explain from what each comes. The next time you strike a match you will probably stop to think of the complicated change which takes place. This only goes to illustrate that many seemingly unimportant operations made during our daily routines may, if carefully analyzed, show the complicated changes which take place unobserved.

1. KClO₃ + S → 3ClO₂ + SO₂
2. K₂S + SO₂ → 2K₂SO₃
3. 2F₂ + 3Cl₂ → 2ClF₃ + FCl₃
4. K₂S + SO₃ → 2K₂SO₄
5. 2P + 3H₂O → P₂O₃ + 2H₂
6. P₂O₅ + 3H₂O → 2H₃PO₄
7. 6HCl + 6O₂ → 6HClO₃

Phosphates.

Wheat contains compounds of phosphorus, and most food plants in order to come to fruition must take phosphates from the soil in which they grow. The phosphates must be soluble, so that, as the rain dissolves it, it can be absorbed by the roots and circulated in the sap of the plant. Soils have to be renewed or fertilized, and fertilizers contain, among other things, the soluble phosphate H₂Ca₃[PO₄]₂, made according to the first step in reducing the element. This is absorbed, transformed, and assimilated by the plant, especially the fruit.

Animals eat the fruit, and thus the compounds of phosphorus are again transposed, circulated in the system, and deposited wherever needed, as in the bones and nervous tissues, and especially in the brain. Man feeds upon either plant or animal, and thus obtains phosphorus. From the human system it is excreted by means of the blood and kidneys, as phosphates and macroscopic salt (H₂Na₃PO₄). When the brain is hard worked, more usual is excreted;—in fact, there seems to be a direct ratio between the amount excreted and the vigor of brain action, as the intellectual effort was attended by the combustion of phosphorus. A simple test of the urine will demonstrate this. At the start of the day or at the end, or under normal conditions, appear clear yellow. Examine a sample of urine from the same subject taken after a hard day's brain work, and you will see bundles of very little white specks floating about. This represents the phosphates, and while the laboring brain is in search of a nerve impulse, if any, of these suspended phosphates in the urine at the end of a working day, the brain worker will invariably manifest this condition regularly. To clear the urine in order to test it for any solids or sediment, add a little nitric acid. It will clear up perfectly if the urine is normal.

Experiment No. 147.

Place about 12 heads of ordinary (not safety) matches in a flask, as shown in Fig. 155. Have this flask (1) about half filled with water. Proceed to distill the same by applying the Bunsen burner under the flask, taking care that the action does not become too violent.

If this experiment is performed in a darkened room a ring of greenish light appears at the level of the water in the condenser, where the sulfuric acid is. After a short time little colorless spheres of a waxy solid collect under the water in the second flask, which acts as a receiver for the drippings from the condenser. If the water is poured away, this solid begins to give off a white smoke, and is luminous in the dark.

(To be continued)

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ELECTRICAL EXPERIMENTER

January, 1919

POPULAR ASTRONOMY.
(Continued from page 621)

There is the question of life. From the habitability of the nearest satellites of Jupiter, if they may, on the other, hand, be barren, lifeless worlds, such as Mercury and the Moon. Their great distance from the highly heated interior and spread out into belts parallel to the equator and in the direction of the planet's rotation. From its nearest satellite all the interesting changes of color and form that constantly take place in the atmosphere of this great globe could be observed in great detail.

Diagram I.—Showing the Relative Sizes of the Four Moons of Jupiter, Io, Europa, Ganymede and Callisto, or Satellites I, II, III and IV respectively, and the Moon and Terrestrial Planets. Distance from C to S is the Distance from the Center to the Surface of Jupiter. So If All the Satellites of the Planet and the Terrestrial Planets and Their Combined Diameters Would Fall Short of the Surface of the Planet by a Distance About Equal to the Diameter of the Earth.

The high percentage of light and heat that Jupiter reflects from the sun to its nearer satellites would make it a secondary sun to them of tremendous size but feeble strength. As seen from the nearest moon the other three major moons of Jupiter present all the phases of our own moon in rapid succession, due to their constant changing positions with reference to the sun. The five small moons, discovered in modern times, are so minute that they are simply star-like points of light even when viewed from the other moons of Jupiter.

When nearest each other some of the moons appear even larger than our own moon does to us, but when approaching opposite sides of the planet their disks rapidly diminish in size so they never appear as small as the far distant sun nearly five hundred million miles away whose apparent diameter is less than one-fifth that of the full moon.

To keep track of the rapidly changing positions and various phases of the moons of Jupiter as seen from any one of them,

Diagram II.—Orbits of the Four Old Satellites of Jupiter, and Saturn V, Not First To Be Discovered of the New Moons. Satellites VI and VII Are Nearly Seven Times More Distant and Satellites VIII and IX Nearly Fourteen Times More Distant Than Satellite IV. The Period of Revolution of Satellite V Is 12 Hours and of Satellite IX 3 Years. Scale 6 Cm. = 200,000 Miles.

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as well as the rapid apparent motion of the planet thrush the sky due to the revolutions of the satellite itself, would be a troublesome task for an astronomer stationed on one of these far distant worlds. It would be a common sight to see in the sky at one time, however, the planet itself, and one, two, or three moons. Seen from the moons of Jupiter the constellation would appear as they do to us on earth for a slight change of five hundred million miles, more or less, is trivial when one is measuring the relative distances of the stars. Observations of the relative stars from the great moon of Jupiter would be attended with difficulties at times, however, since reflected sunlight from a body 120,000,000 miles distant would be extremely troublesome, especially were the phases of the planet near that of the full moon. Even from the fourth or most distant of the major satellites the planet would subtend an angle of nearly five degrees. Occultations of the stars would be many and frequent as the huge planet globes swiftly drift through the heavens. Many a moonlight night would appear almost as day owing to the presence of the enormous bodies reflected from the light of Jupiter and occasionally two or three moons in addition. Only the brightest stars would be seen under such circumstances. When, however, the small worlds passed in shadow of the great mother planet and not only the light of the sun but also the reflected light of Jupiter disappears for many minutes the stars shine forth in all their glory there as here. In the sky would appear, possibly, some of the larger moons feebly shining by the reflected light of the far distant sun. Saturn also might be visible, but beautiful Venus and ruddy Mars would fail to appear. Tiny bodies, mere specks of light at this distance, they are lost to view in the glare of the sun.

(The next installment will appear in an early issue.)

ELECTRIC DEATH TRAPS IN HUN'S RETREAT.

(Continued from page 608)

to blow the cave to pieces, and which was connected up with an electric device to the—well, to think of it! I reach toward the Rhine as the Boches not only hope to gas their victims, but to kill them as well, one way or the other.

The daily press had considered to say in the later month of December concerning the many devilish and ingenious delayed time-fuse bombs which were left behind in many of the towns and cities of northern France. Once as the Rhine army was being driven toward the Rhine by General Foch's victorious armies. One of the simple devices of this nature, which blow up buildings, etc., a considerable length of time after the Hun's had retreated from a certain locality, is shown in Fig. 10. It comprised nothing more than a tank similar to those used on all modern plumbing for flushing purposes. As soon as it started to rain, such weather being frequent in northern France, the tank filled up and caused the float to rise. When the float ball reached its uppermost permit it closed such an electric circuit which set off the fuses running inside the building, to a heavy charge of explosive, with results that can be better imagined than described. These cowardly and devilish tricks are not only blame and harmless when you read them "Over Here."—imagine what havoc and untold death that have spread. Of course, it often happened that troops had occupied a town for several days before some of these delayed time fuses functioned at unexpected moments!

INDEX TO

ELECTRICAL EXPERIMENTER

FOR VOLUME 1, 2, 3, 4, 5

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ELECTRICAL EXPERIMENTER

January, 1919

EXPERIMENTAL MECHANICS.
(Continued from page 638)

secured to the saddle. The circle should be marked with a sharp scriber where the boring is to be done, also its final diameter.

By bringing the work forward to the sharp point of the scriber which is attached to the boring rod, and revolving the boring rod, the scriber making the proper mark, this will aid in boring the hole to the proper diameter. At the same time you can see whether the hole is secured to the saddle with respect to the central line of the cutting tool, also live and dead centers. The cutting tool is held on block T. H., or tool holder, and is secured to the boring rod by a set screw. The boring rod is run between the centers and firmly attached to the line scribed by means of a lathe dog D to the face plate.

The novice can construct a very simple form of boring cutter, such as that shown in Fig. 4. A boxiron rod, B. R., which may be of any desired length, depending on the character of the work. The rod should be made of tool steel, having a diameter large enough to prevent its springing or bending when used in boring. The longer the rod, the greater the chance of sprunging, and, therefore, the longer the rod makes the rod as short as possible. A one-half inch hole is made in the center of the boring rod, which is used to secure the cutting tool. ATap and a set screw is a tool that the novice will need in his work.

Another hole is drilled at right angles to this one for the 1/4-inch drill shank, and tap for No. 18 1/2" inch thread. A headless set screw is threaded in, a saw cut being made on the outer end in order that it may be screwed in with a screw driver. The cutting tool should be made of the highest grade, self-hardening tool steel. Its length should not exceed one-half inch, the diameter of the boring rod. The tool

Fig. 45-B

A Simple Spark Discharge from an Induction Coil.

in a hole in the cast iron, will be found advisable to start with a heavy cut. It is done so that the sand or other silica particles that may have adhered to the cast iron when taken from the mould are immediately removed. In the following coming the subject of "Taper Cutting" will be considered.

(To be continued)

Madrid gets its electricity for lighting and power from a hydro-electric plant 120 miles from the city.

A company in Japan has begun the production of soda by an electrical process.

Electrically operated cash carriers for stores have been invented, the motors of which are supplied with current through the wires on which they run.

EXPERIMENTAL PHYSICS.
(Continued from page 620)

sisted of negatively charged particles, remembering that an electric current is an electric charge in motion, and that an electric current tends to move in an electric field in a direction given by the three-finger motor rule (see Lesson 16). Hence, the presence of a field tends to make the rays converge into negatively charged electrons. The fact that these rays give a negative charge to bodies on which they fall is probably just another way of expressing the theory. The deflection of the cathode rays in magnetic and electric fields furnishes us with the necessary data for computing the size and weight of the electron. The size and weight is extremely small, the speed tremendously large (about 100,000 miles per second).

Fig. 55-B. The Cathode is Concave and Spherical. The Anode Consists of a Small Plate. The Cathode Rays Are Converged, Focus on the Platinum and Are Therefore Very Concentrated. The Platinum Incandesce. Thus Showing the "Heating Effect" of the Cathode Rays.
flected or refracted as light can, but they are different in many important respects. X-rays penetrate many substances which cathode rays cannot (X-rays pass right through, cathode rays do not). X-rays cannot be deflected by electric or magnetic fields and hence cannot, like cathode rays, be stopped by electrically charged particles. The real nature of X-rays is still unknown. Lead seems to be the most difficult substance for X-rays to penetrate. When cut they are placed on top of each other and two one-eighth inch holes drilled about one and one-half inches apart and toward one end. They must of course, be in alignment, as they are for the slider rods. The center must also be free as in one of the four and one-half inch covers fifteen holes are to be drilled for the fifteen secondary taps. The respective taps of the secondary are drawn thru in order and the ends nailed to the coil with brass nails. Care must be taken to get the openings for the sliders directly under each other. The completed secondary is shown at Fig. 4, and also the sliders and their arrangement. The sliders are made from No. 8 copper wire which is stretched taut by screws at the top of the cabinet. A screw eye is inserted into the top for hanging. The coupling, as will be described presently, and the primary is screwed in place (see Fig. 4).

THE CABINET

Very little need be said about the material for the cabinet, perhaps, as the building of this depends entirely upon the ways and means of the maker. The measurements will be given. The cabinet is made like a box except that the top and back are not put into place until the apparatus is in. The front panel is one-half inch thick, twenty-six inches high and eight and one-half inches wide (3/4 inch Bakelite makes an excellent job); the sides are six inches wide.

SWITCHES, SWITCHPOINTS AND METHOD OF VARYING THE COUPLING

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Fig. 1. Made for use on a vacuum cleaner.
Fig. 2. Made for use on a fan.
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January, 1919

were purchased from a hardware store. These are glass drawer knobs and have a brass shell fitted into a glass place and is cemented; also a screw is fitted into the end. Five of these are needed. The switch blade is cut from a piece of springy brass or nickel. Cut two switches and taper one end and fit them into the base of the knob and taper down one end (see Fig. 5). The other end must be made to fit the knob. A hole is drilled into this end and the blade is soldered to the brass cup; bend the contact end as shown. Also cut two pieces one and one-half inches long for the secondary switches made in the same way and one to the fifth knob solder the hand of a clock.

The switch points are common upholsterer's nails with the brass tops and small washers to the under side. After the wire has been drawn thru a hole drilled in the cabinet for it, it is twisted around the nail and then thru a hole formed pushed thru and driven into the hollow of the cup of the nail. A small amount of flux and a piece of solder about one-quarter the size of a split pea is placed into the cup which is held hollow upward. A hot iron is now applied to the solder to the nail, and the solder will melt flush and make an excellent connection. The washer is now slip over the nail and the nail driven in place. The washer es not essential but makes the heads of the switch point protrude more. (Fig. 5).

The method of varying the coupling is by a cable and drum arrangement. Rack and pinion methods need accurate workmanship for them to operate correctly, so this novel home made coupling method was devised. After the clock hand has been soldered to No. 5 knob, a twenty-four inch (circumference) wooden wheel is fastened to the screw of this knob. This wheel is placed in such a position that one end is facing the bearing is made to fit the outer end of the screw, so that there will be a fairly good axle and bearings formed, one bearing being the other end of the screw. This is then the bearing that will answer for the other end. A piece of leather is fastened in such a way as to cause friction against one part of the wheel, a piece of cloth is nailed to the wheel and wound around the groove; the cord passing over a small pulley and secured to the screw-drive of the upper end of the secondary (see Fig. 4).

ASSEMBLY

Along the mid-line of the panel and four and eight inches up from the bottom, respectively, drill two holes to fit the screws of the switches. Above each of these two holes, two smaller holes are drilled so that the end of the screw of the switch will reach to the antenna and ground. Draw the flexible wires thru; solder to switch blade (Fig. 5) and put switch in place. Place a spring on the under side of the switch to keep it tight. Describe an arc with each switch and using about two-thirds of a complete circle for the arrangement of switch points, divide them equally around the area this allows for. Drill holes for the wires of the switch points, solder to switch points as already described and connect into place. Then seventeen inches from the bottom and two inches from the mid-line each way, drill holes for the switches of the secondary. Mount the switch plates in place as per diagram for connections.

Put the top on the cabinet with the bolts (eye-bolts) for slider rods and tighten the rods; finally put on back. The diagram of the assembled coil is shown in Fig. 7.

There are many advantages of the type cabinet, as it is both compact, inexpensive and neat. It does not allow dust to settle between the windings and prevents the entrance of other foreign matter. One complete turn of the coupling knob will change the coupling completely. Accurate tuning of the primary is worked out to a very fine extent and this novel arrangement of the secondary tuning will be seen to have many merits, as any portion of the coil may be used until the desired current may also be reversed. Often the coupling will not have to be changed in order to vary the secondary, as both switches may be moved and bring another portion of the coil into play.

With a galena detector stand and using a 'radiotone' crystal, this outfit cannot be beaten and other stations were brought in that never were heard before. This may have been due to the excellency of the crystal, but the coil has something to do with it, in my estimation.

SOLAR ENGINE USES SUN'S ENERGY.

(Continued from page 607)

Messrs. Shuman, Boye and Ackerman, engineers, and built a large solar energy plant at Mead on the Nile, Egypt. This plant developed 100 h.p. The total area of the sun's concentrate was 13,500 square feet. The maximum pounds of steam generated was 12 pounds per 100 square feet of sunshine, or the equivalent, or 10,3 square feet per brake horsepower. The best hour's run developed, at atmospheric pressure, 1,442 pounds of steam. Hence (allowing 22 pounds steam per brake horsepower) the maximum output for an hour was 55.5 horsepower (about ten times better than any previous results). This means 63 brake horsepower per acre of land occupied by the plant. Moreover, no marked reduction in the horsepower produced was noticeable in the early hours of the morning or in the late hours of the afternoon.

The temperature of the sun, as aforementioned, has been calculated to be about 6,000 degrees centigrade. Several authorities point out that this terrific heat there fore precludes any possibility of the sun being a molten mass in the process of combustion. It has been thought recently by many to be a great mass of matter possessing a remarkable degree of radioactivity akin to radium. Helmholz proposed that the sun could keep on producing energy at its present rate by accounting for same on the basis of a slight annual shrinkage in its size. From observations and measurements
ELECTRICAL EXPERIMENTS

(Continued from page 636)

BUILDING A 3-INCH SPARK STATIC MACHINE.

(Continued from page 633)

NOVEL PHOTO OF CITY AND LIGHTNING AT NIGHT.

The photo I submit is a picture of a city at night, taken from a high mountain nearby. The object of taking the picture was to "snap" the lightning.

Rob't Sullivan, Canon City, Colo.

AT LAST—A PHOTO OF "BALL LIGHTNING."

Speaking of "Odd Photos" or something for the "bang" to worry about, I think I have here, in the form of two actual photographs, either of which contain any kind of lightning one would want, i.e., chain, ribbon or ball.

These photos were taken about six months ago (Pardon the selfishness) on the same night and about five minutes apart, during a very damaging electrical disturbance in this locality.

I may be wrong in my conception of the impression on the right side of photo No. 1 (the upper one). It is a ball lightning, but would suppose it to be such. This picture is an exposure of 30 seconds. There was no artificial light of any kind in front of the lens of the camera, and the phenomenon was not perceptible to the eye—or at least was not observed.

If this be ball lightning we then know that ball lightning is of an oscillating or pulsating nature, as is evident from the path taken by the ball. Possibly this is a potential of one sign seeking its affinity or opposite potential sign, in order that it may neutralize. Following the path of the ball it comes in at the base of the ribbon discharge at the top, travels straight across, almost parallel to the wires in the background, then it comes to rest in the upper right hand corner. It now slowly follows this star path with a few stops and makes its exit into the heavens, no doubt to join its patienty waiting other half.

Photo No. 2 (lower center) is a 3 minute exposure, during which time the camera was moved once but very slightly, as you see from the double print of the chimneys in the background. In this picture will be seen innumerable paths of the light ball where it has traveled at various speeds.

L. E. Church, Barville, Okla.

THE CITY OF SPLENDID NIGHT.

(Continued from page 623)

footed torch-bearers led the way. None of them, proud souls, ever saw their doorways in full brilliancy; but the electric, that softens rude promenances while it throws a lustrous, enchanting glow over fine design and decoration. The "City Night" forever calls me to fresh delights. I go the way of a side street at the beckon of a light and, anon, find myself before the stately pile of a building. The sky is dark, the glare of the guardian pillar of radiance that stands before it. Later I come upon a green park bordered with electric jewels. Here I seat myself and watch the trees play tag with beams of electric brilliance.

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You may know the white lights of the night, so do I, but I also know where are to be found those more precious sights of the night, made possible by light and electricity. And so I wander lovingly through the "City of Splendid Night," and visit its shimmering shrines.

The Park at Night

WHEN next you walk abroad at night, choose Central Park, and preferably that part of it which ranges south of Seventeenth Street. Enter to the left of General Sherman Monument. Follow the friendly bypath that skirts the Japanese Lake, where the swan boats ride at anchor. I call it the "Japanese Lake" because it is the first of its kind in the park, certain trees bent and burred with weird charm, suggests a Japanese print, while the towering Plaza becomes Fuyumaya. The while you stand the lake gathers lustre from many sources, taking toll of light until its tiny, radiant body seems a great, luminous drop, drop from the eye of God.

You can't know Central Park until you see it at night, and then it is no more the park than the city surrounding it that is no more the city than its own particular charms; but it is best to consult your almanac prior to making the excursion, for no more has charged at such a time. The lights of Manhattan should not be disturbed, or marred, and a cloudy night, tho' with rain yet a long way off, is to be especially desired.

In truth some of the rarest charms of this great enclosure are the vantage points it offers for viewing the glowing city. From each hill and hollow and rustic bridge you see sights that make you whistle. New York has prepared a wonderful gallery in which you may stand and see the thousand pictures painted by the city. And the wonder of the lighting. Never have pictures been hung for exhibition with more rare understanding of the art of presentation. Never has favored critic at private view found color and arrangement, composition and subject, more effectively displayed than those he who will be guest of Central Park. The parks witness to the glory of Manhattan.

Off to the South and West flare great electric signs surmounting high buildings. Wages and laborful they hang in the sky: acrobatic, detached. As wonders of fantastic shape, winking at the night and rippling through darkness. Rows of lighted windows speak a thousand messages. From the summit of a tiny hill streaking traffic is visible in its shooting rays of warming speed.

Within the sylvan solitude the voice of the city speaks softly, and its sparkling eyes are veiled with the romance of contrast, that ever comes when Nature spreads her green mantle in the midst of man's activities.

Oh, the wonder of the city from the park; and then the wonder of the park within the city. Here Robin Hood might dwell of the colorful, the soaring, the thrilling as his finest scenes in Kensington Gardens. If you would really see all the spirits of the wood, you must dwell in the city, and then stand at the Northern limits of the Mall and, half closing your eyes and rising on tiptoe, look down its length. Fill yourself with its splendor in the every court. It is precisely lighted with soft, glowing globes. Here and there stand set pieces of statuary, grotesquely gigantic, forever trying to strike the spires in strange shadows for each competing light that falls on them from either side and from across the Mall's mile-way. From this vantage point, the whole illuminated city of New York seems as to an insomniac's point of view of the world, all the world, and that part which is the heart of the city.

As sure as you believe infancies, they are here. Some lurking behind these statues, snuggled in the robust curves of back and base. All waiting in thrilling expectancy their turns to dance and frolic in the silvery glow. The scene will surely ensnare you. Your five senses are eternally acute, you feel the pulse of Beauty, and the heart within you takes flight.

It lives the radiant poetry of Central Park. It is there for all of you who will go with vision for its picturing. It is the great gallery exhibiting the Light of Manhattan.

New York in the Rain

BLOOT out the stars. Draw a leaden mantle of cloud across the heavens. Let the skies open every pore, until earth and skies the sunlit surface of the fields are sodden, woods sullen, villages sordid, and all the open country a sticky mass of morbid moisture. But oh! Holland Amsterdam is glorious!

So fare you forth and witness the wonders of this city of cities in the rain. The perfect time is during the first silent hours of the morning. Then you may surprise it in the still splendor of its morning. The buildings stand stark, dripping, and in great masses rise triumphant thru the drenching.

The gullers are long panels of flowing mist, through which you can read in the million fractions in reflections, where treacherous corner grills suck them into roiling depths. About each light that punishes the air, you can read in the mist, there is a lazy glow. Here sparkles the jewel thrown overboard by the clouds in an effort to lighten their ballast.

As the hoisting themselves on the liquid ladder of the storm, the ascending mingled lights of the city burnish the grey vault above with golden copper, as the heartlanders picture scenes in the kettle swinging from the crane.

The romance of Masonry and Electricity is before you. It is a drama done in pour rain; in the air. The scenery is made of steel and stone, with all the city on the stage. Footlights and spotlights get their light from giant dynamos and turbines with my feet graver light than Nero made when sacrificing Rome.

Now pause, while the clouds are discharging their cargoes; if you will halt between tall houses in the rain for a full upward glance you will know somewhat of the feeling of the mountain traveller when he stands in the spray of some vast waterfall. Deep down in the calom he pauses while the rays of an unseen sun paint a rainbow on the struggling torrent at the spot where the unleashed waters hurl themselves from the cold embrace of the rocky heights.

Again you stand before great arches opening into the halls of commerce and mark the spirit mentioned. The city stands out of the night and rain and sending many-colored reflections into the shadowed recesses as fire-bearers to us in the darkness of some echoing cave.

So we see the many-sided city at its bath. The city that has been the sweetheart of an endless procession of goodly men. The city of which O. Henry sang so sweetly and of which he wrote so understandably. Great is Diana of the Madison Square Campground. Great is the Lady of Liberty Lite. But greater still is the city over which they reign.

When storm breaks at night Manhattan blossoms like a hothouse season in the downpour, and bathes majestically. And so, when drenching clouds cut off our view of the campfires of the guardsmen of the heavens, we feel an increased thrill in the shining of our faithful keepers of the curb, the stars of the street.
MAGAZINES GOING UP!

Further Increases Coming!

NOW IS YOUR CHANCE!

With this issue, the price of the EXPERIMENTER, as announced on another page, goes to $2.00 a year. With the paper market in chaos and soaring prices, printers demanding another large wage increase, engravings going up 50%, we feel sure that before spring ALL magazines will go much higher than now.

By subscribing now for from one to five years, YOU POSITIVELY WILL SAVE BIG MONEY.

The prices below are unquestionably the lowest for standard magazines that it is possible to obtain anywhere. Only by a special arrangement with the publishers are these prices possible and they are good only until December 15th, after which date all prices as given on this page are withdrawn. Make up your list at once--do not delay. If you are already a subscriber and your subscription to the EXPERIMENTER runs for a long time, you may subscribe for any other magazines by deducting the price of the EXPERIMENTER from the clubs at the rate of $1.85 (this special price allowed in clubbing with other magazines). Thus you can make up any club yourself of as many magazines as you wish from the list below.

All prices quoted are for subscribers in U. S. only. Canadian and foreign subscriptions require additional postage.

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Write for Special Prices on ANY Publication not listed here

We will save you money
SEND ALL ORDERS TO "CIRCULATION DEPARTMENT"

EXPERIMENTER PUBLISHING CO., Inc.
233 Fulton Street, New York City, N. Y.
SEND FOR OUR FREE SUBSCRIPTION CATALOG
Opportunity Ad-Lets

You will find many remarkable opportunities and real bargains in these columns. It will pay you to read and investigate the offerings made every month by reliable firms and dealers from all over the country. No matter what you may be seeking, whether supplies, automobiles, or anything else, you will find listed here the best and most attractive special offers and bargains that are not less than 50% accepted. Name and address of the advertiser should accompany all classified advertisements unless objectionable or misleading advertisements are noted.

Owing to the large increase in circulation the classified advertising rate beginning with the February issue will be 7c per word. However, all orders for December, January, and February will be accepted at the old rate of 6c per word.

ELECTRICAL EXPERIMENTER
PUBLISHING CO., INC., 233 Fulton St., New York, N. Y.

Automotive Accessories


Ford Starts Easy in Cold Weather with our new carburetors. 34 miles per gallon. Use cheapest gasoline or half kerosene. Increased Styles for any motor. Very slow on high. Attach it yourself. Big profits to agents. Money back guarantee. Thirty days. Price $1.00. Send to Cable, Ohio.

Lubricant Carbon Remover Solves the Carbon Problem. When your motor loses power, when it is hard to start, don’t waste your time with the carburetor. Send for a can of Lubricant Carbon Remover. Every can guaranteed. Price $1.00. Send to Cable, Ohio.


Agents Wanted

Insey Tyree, inner armor for automobile engines, double your gasoline mileage and engine life. Available now. Q. good. TYREE CO., 1111 Oak St., Minneap. Minn.

Hei-Met The Kaiser Pin—Latest war novelty. Biggest hit out, every patriotic citizen wants one. Write for free catalogue. W. Wedge, Box 140, Hampton, N. Y.

$10 daily refreshing chandeliers, brass beds, automatic lights, or any method, without capital or experience. Free particulars and proofs. Write today.


Help Wanted

Men Wanted to make Toy Soldiers, Army, Navy and other toys. Home workers on a small scale, manufacturers on a large scale. Greatest chance for industrious people for independent business. Enormous demand and future in "American-made toys." This new American market stands entirely ready. Factories have been established, people trained, machinery made with energy and success. Dealers don’t want to handle any others except “American-made.” We buy all toys now paying fair price. Experience or tools not necessary. Hundred per cent profit. Can be done on one square foot. Booklet and information free. Toy Soldier Manufacturing Co., 32 Union Square, New York.

To Ascertain the Vocation for which you are best fitted, and gain valuable information about the scope, send date of your birth and 2c. Prof. Zangl, 105 West 6th St., New York.

Monthly income paid to those who send lists of names for us at home, spare time; no supplies to purchase, no investment, expense or work required; postal bills particular. National Exchange, Box 300, New York.

Phonographs—Continued

Build Your Phonograph—"Perfection" high-quality spring and electric Motors. Reproducers, Wonderful results. Big saving since every batch is mailed for ten cents, Indiana Phonograph Supply Co., Indianapolis, Indiana.

Charlotte, N. C., Oct. 4, 1918.


Dear Sirs:

It certainly was some RESULTS. I’ve almost worn out a good typewriter just about exhaust myself writing. Well, I will have to answer it. And about “Gone Busted” buying postage stamps.

Now, I’m a-going quit, and will never do it again, and I will write to the Patent Office to answer all the letters I received from an Ad that I placed.

The letters are still coming in.—The apparatus advertised has long since been sold. Every inch of this letter is from all over the United States, AND CHINA. AND JAPAN, AND SHANGHAI, China. Can you beat that. I’m completely satisfied with it.

It’s a great life, if you don’t weaken. I THANK THE E.—Some circulation.

Very Respectfully,

402 N. Brevard St., Charlotte, N. C.

Miscellaneous

Tobacco or Snuff Habit Cured or no pay. hon. No cash ever sent on trial. Superb Co., S.A., Baltimore, Md.

Catch Fish. Descriptive folder containing valuable information, $0.10. C. S. Craig Co., 1937 East Pershing St., Chicago, Ill.


Your Technical Troubles can be solved. We handle all technical problems pertaining to design, calculation, installation, etc., promptly and correctly for 5c and up. We invite your correspondence.


Fountain Pen Free with a $1.75 order of ink. Eighteen packages each contains enough material to make twenty cents’ worth of blue-black ink. Trial package ten cts., three for 25 cts. Kravole & Co., 2344 Altgelt St., Chicago, Ill.


Pyrotheta—H. E. Keely, D. S. M., pyrotheria specialist for 15 years, has developed a success in the treatment of all Purity, healing, preventive. Full month’s treatment and board free. Address H. E. Keely, Glenwood & Woodland Aves., Leonia, N. J.

Our most limited, number of beautiful artistic pictures on hand. Write for Free Descriptive circular. Dr. Lee De Forest. These make a handsome decoration for any living room or office. Should be prominently displayed. Price for both, prepaid, loc.$3.50.

Phonograph—”Perfection” new model. Ten cents each. Write H. E. Keely, 282 E. 52nd St., New York.

Opportunity Ad-Lets bring quick results. Over 100,000 circulation, net. Other firms are making money—so can you. For proof address Classified Department, Electrical Experimenter, 233 Fulton St., New York, N. Y.

Business Opportunities

I made $20,000 here past four years making burial vaults. Will start in same permanent business without capital. Absolutely no selling details. Charles Murphy, Dept. 3, Bloomingtion, Ind.

Enter a New Business. Earn $5,000 to $10,000 yearly in professional fees making and fitting a federal register, operated only. Inquire for a free booklet. Can be traded you can attend to; easily learned by any one. Write for free booklet. If you want a business, no further capital required; no goods to buy; job hunting soliciting of agencies. Address Stephenson Laboratory, 82 Back Bay, Boston, Mass.


Make Die-Castings, Sketch, Sample, Booklet, and Proposition, 10c. R. Byr, Box 227, Erie, Pa.

"Quick-Action Advertising—How it is Building Business for Progressive Advertisers of America." A little story of RESULTS, told by the advertisers themselves—not the publisher. You will be interested in reading this little booklet, which we have prepared for progressive advertisers. Simply mail 10 cents to the address given on your request. You may have the money to buy it. Write for magnificent and Douglas Wakefield, Coute, 225 West 30th St., New York.

Build up an Income in Oil—Others are doing it—Why not you? Today is the opportunity, join our easy monthly payment plan. NOW it may mean hundreds in profits. Write for booklet. Our Oil Drilling Co., Dept. R, Houston, Texas.

WANTED—Specialties for mail order house. Write for offer. Stone Specialty Co., 11 Broadway, N. Y.


You can letter Automobiles, Windows, Trunks, etc., without previous experience, by Transfer Process. Make $2.50 on 5c output. Auto Mono-gram Supply Co., 87 Niagara Building, Newark, N. J.

Incorporate your business under the common law. No organization tax; no franchise tax; no federal or state taxes or certificate tax; no personal or corporation taxes; no stockholders exempt from company debts; do business in any state you choose. We prepare everything you wish; lowest cost organization possible. Conn. Law Organization Co., 4 Randolph, Detroit, Mich.


$20 a Week, Evenings. I made it with a small investment—business—continued my regular job. Details free. Tell how to operate. Alex. W. Scott, Cohoes, N. Y.

Auctions

Auctioneers make from $30 to $50 a day. Free catalog. Missouri Auction School, Kansas City.

Postcards

Twenty Pretty Assorted Postcards 18c. 45-30.

Castle Co., N. Locust, Hagerstown, Md.
ELECTRICAL EXPERIMENTER

January, 1919

Wireless

Bargains—10,000 $2 Wireless Coils complete, guaranteed, 500c., send postage. Also, 250g., less Coils with parts, 250c., send postage. A. Dubs, 152 Fifth Ave., Brooklyn, N. Y.

Better stock up now on switches and switch points. Get a large supply of the most perfect on the market sent free. Eureka Secondary Co., 609 S. May St, Chicago, Ill.

Mooradian Tubes: Last 50% longer; require less high-voltage; eliminate STARTING and STOPPING. Avoid the RUSH later! Satisfaction GUARANTEED.

Quick-Axes Advertising—How is it Building Business for the Progressive Advertisers of tomorrow? Advertisements told by the advertisers themselves—not the publisher. You will be interested in reading this little book which we have prepared for prospective advertisers, a copy of which will be gladly sent you without obligation.


Electrical Supplies and Appliances

Recharge 2 dry cells for five cents. Directions 10c. Gilbert & Chestnut, Binghamton, N. Y.

Tungsten Steel Magnets U type. Have a number of these magnets weighing 2 lbs. each and will lift 6 or more times their own weight, $1.75 while they last. Henry Althaus, Bluffton, Ohio.

Blueprints for building of Spark Coils from 3½" to 12" with Instructions. Each, 50c. Also for Waves, Amplifiers, etc. Blueprinted with full instructions, 60 cents prepaid. Luther Reiner, 1201-Arch, Pittsburgh, Pa.

Better stock up now on switches and switch points. Get a large supply of the most perfect on the market sent free. Eureka Secondary Co., 609 S. May St, Chicago, Ill.

Mooradian Tubes: Last 50% longer; require less high-voltage; eliminate STARTING and STOPPING. Avoid the RUSH later! Satisfaction GUARANTEED.

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Electronic Scenery for Hire


Inventions Commercialized.

Cash or royalty. Adam Fisher Associate, 410 Chester St., Baltimore, Md.

20 Word Ad. in 100 Filling magazines, $1.00. About 75000 readers. Send copy now. Lindhurst, Martin, 851 St. Mary’s Place, Ottawa, Canada.


Printing

100 Bond Noteheads, 4 lines and 100 envelopes, $1.50. Duck Letterheads, 50 lines, 3 envelopes, 3 lines, $1.00. Shamrock Press, 86 Mitch., Columbus, Ohio.

Chemicals

50 Chemicals $5.00 each. If you advertise patent as previously advertised containing & chemicals now for $1.00 each, send Chemical Co., 440 Park Place, Brooklyn, N. Y.

Genuine Indian Baskets Wholesale and Retail. Gilham Hills, Springfield, California.

News Correspondents

Earn $5.00 a month writing for newspapers, magazines. Experience unnecessary; details free. Press Syndicate, 956 St. Louis, Mo., or 417 S. Pacific St., Los Angeles, Calif.

Magnetic Motors and Generators:

1000 New Motors and Generators, H. P., A. C., 65.55 each; 5/6 H. P., 55.00. Battery Charging Sets—Brand New out of10 sizes, $50 each and up. Charging Lighting Sets—Brand New out of 10 sizes, $50 each and up. Motors for all phases of current. Immediate delivery. Write for catalog today. 417 S. Pacific St., Los Angeles, Calif.

I Was Bald. Obtained hair growth by an Indian’s oil treatment containing genuine bear oil and herbal ingredients. Free trial size, $100. Results are most hair. Free catalog. Barber Supply Co., 956 St. Louis, Mo.

Photography

Mail Us $5 with any size Film for development and printing. Largest sizes, any size and 1x6 for 6 prints, 8 x 10 mounted enlarges. Prompt, perfect service. Roanoke Photo Finishing Co., Roanoke, Va.

Kodakens: How would you like to get a $9.95 enlarger for $2.95? Send us a card right now asking about it. Films developed, copies made, Satisfaction guaranteed. Ford’s Studio, 619 W. Washington, Chicago, Ill.

Photography and Royalty Accounting—Long time thoroughly and quickly. Unprecedented demand for both sexes at Big Salaries. Oldest and largest school—Established over 10 years. Doodles Institute, Seventh St., Valparaiso, Ind.

Patent Attorneys

Patents—Without advance attorney’s fees. Most prompt in sending out brochures and free report. Books free. Frank Fuller, Washington, D. C.


Patent Your Own Inventions. Save attorney’s fees. Get information as to making and perfecting applications; instructions and give satisfaction. Free information. Writing to C. E. Larson Co., Park Place Building, New York City.


Dogs, Birds, Pets


Free—$5,000 worth of valuable books as premiums. Write for more information and catalog. Book: Great World in Healing, personal magnetism, Clairvoyance, seers and psychics; Magic of Mind, Marianne, character reading, mind power, etc. Tell me what you want. A. W. Martens, J BS, Burlington, Ia.


Money saving magazine offers. Send for free book. C. John Innes, East 69th Street, Chicago, Ill.

Businessmen and Business Men—Something different in Bookkeeping. Perfection Business Sum. makes business 100% more interesting and satisfying. $50 and up. 417 S. Pacific St., Los Angeles, Calif.

How to Locate Oil and Valuable Substances by Wireless; Scientific Book, $3 postpaid. Astral Child Publishing Co., Corpus Christi, Texas.

To Get Better Pictures: Read the Amateur Photographer’s Weekly. Book telling how to win competitions; print criticisms; many unique features. $1.40 per year, 10 cents a copy. 417 S. Pacific St., Los Angeles, Calif.

Old E. E. Back Numbers: We have some valuable old E. E. back numbers on hand as follows: 1912, 1, 2, 3, 4, 5. 1913, 1, 2, 3. 1914, 1, 2, 3, 4, 5, 6. 1915, Oct., Nov., Dec., price each 35c., 1916, Jan., Feb., Mar., April, May, June, July, Aug., Sept., Oct., Nov., Dec., price each 35c., 1917, Jan., Feb., March, April, May, June, July, Aug., Sept., Oct., Nov., December, price each 35c., 1918, Jan., Feb., March, April, May, June, July, Aug., Sept., Oct., Nov., December, price each 35c. We can secure any other old number if you wish to have it. Price per remittance, and if you have not these numbers already, it is doubly your duty to get them. They will probably be snapped up very quickly. Executone Publishing Co., 231 Fulton St., New York City.

A Binder for The Electrical Experimenter will be prepared and sold by the publishers. We hope to have it ready by the time this number comes off the press. Postage on 3 lbs. is extra. Send for one today.

Further information can be obtained from

Quicker Stamp Company, Box 116, East 89th Street, New York.

You benefit by mentioning the "Electrical Experimenter" when writing to advertisers.
Scientific Exchange Columns

The quickest medium in the country for buying what you need or disposing of anything for which you have no further use. Read these ads each month—you'll find bigger bargains anywhere.

NOTICE of CHANGE

Effective with February, 1919, Issue.

Advertisements for the February issue must reach us not later than Dec. 22.

EXPERIMENTER PUBLISHING CO., 233 Fulton St., New York City

For Sale—5 H.P., 4 cylinder Universal Engine and 55 amp. 60 volt D.C. Generator, $200. Will take typewriter or wireless as part payment. Herbert Lauter, Geneva, Nebr.

Swap—Electrical apparatus or small camera for field glasses or telescope or what you have. Lloyd Solomon, Cordelle, Ga.

First Twenty Dollars takes Goodell-Pratt bench lathe. Same as new, been in use only one month. Am buying large engine lathe so must sell. C. C. Cole, Whittier, Cal.

Trade—Movie Machine and Seneca Camera for wireless goods. Frank Gaede, Winamac, Ind.


Swap—Two §x§ Electras, books and magazines for phonograph or wireless. John G. Sawyer, 567 West 86th St., New York City.


Edison Exhibition Motion Picture Machine to Exchange—Want chemicals, chemical apparatus, motorcycle, or typewriter. Valuation, $85. H. E. Robinson, 126 S. Stewart, Sedalia, Mo.

Swap—Electrical goods. Want half to two K.W. Transformer and Rotary spark gap, Warwick, 2412 Ave. So, Minneapolis, Minn.

Wanted—Wireless transmitters, ammeters, quenched gap, etc. Sell or trade Automatic Photo Button Online, cost $2.50; also Automatic Stereoclip, capacity eighteen slides. Prefer Wireless goods. Radio Amateur, Marion, Ill.


Wanted—Wireless goods, describe fully, Will pay cash. Merle Hawkins, 1053 Prescott, Canon City, Colo.


Sell—12 dial omnigraph and other things. Her- scu, Burlington, Iowa.


Will Buy—No reasonable offer refused. Tubular Audion, other make also, variable condensers mounted and unmounted. Piled, Audion amplifying transformer, Audion impedance coils. Sell now, give description and time used. State lowest price. Aubrey Thobin, 120 1/2 E. Rockford, Ill.


Will Exchange complete motorcycle engine for Johnson skates, W. A. Schoenieder, 545 So. Andrew Ave., Chicago, Ill.

Amateurs—Bugs—Send stamp for my list of Radio Apparatus, Electrical Goods, Ancient and Modern, Coils, Sawaths, Arrowheads, Chemical Laboratory, Rife, Movie Projector Lenses, etc. Luther Regents, 500 So. Park, Chicago, Ill.

Marionettes, miniature people who walk, talk, sing and dance. Five professional figures. Will sell for cash or exchange for Smith Motor Wheel or similar outfit. The Wallace, Barbwire, Wisc.


CARNOTITE

(Radium Mineral.) The American Pitchblende found in Colorado, from which Radium is extracted.

A generous piece, enough to conduct experiments, such as affecting photographic plates thru opaque material (similar to X-Ray pictures), first made by Sir W. Crookes and Mme. Curie, is furnished in neat, wooden box.

URANIUM ORE

(Radio-Active)

Containing about 35% of pure Uranium; also Radium and Vanadium. One of the most rare and interesting minerals. Twenty milligrams are furnished in glass vial protected by lead cover.

One box of Carnotite and one vial of Uranium Ore as described above sent prepaid. 50c.

SIDNEY SPECIALTY CO. 233 Fulton St., New York City

BOYS, LOOK! A REAL Electric MOTOR 50c

Some hummer. Develops wonderful power. Will run your Erectors, Meccano, etc. Works on 1 to 6 dry cell, battery or A. C. transformer. Mounted on hardwood base. Has 5/8 in. grooved pulley. On two cells you can hardly stop it with your finger. Buna all kinds of toys. Has nickelized steel frame and copper armature. Put 35 cents in stamps in an envelope.

FREE A 3½ volt tungsten flashlight lamp if you order at once.

Use Coupon Below. Return mail will bring you Motor.

G. D. WOOD ELECTRIC CO., Dept. 60, 441 Broadway, New York City.

HRS: Send me a MONO COIL Motor. Enclosed find 50 cents.

Address

CORE WIRE

We have been fortunate in securing thru auction several tons of guaranteed pure, double annealed Norway Iron Core Wire and are selling this wire to "Experimenter" readers

AT PRE-WAR PRICES 20cts LB.

This wire is just the thing for spark coils, transformers, etc., and in low, very much more suitable product than the usual iron wire. We absolutely guarantee the quality. Set of this kind and most所需 applicaton is now the chance to get the right material for it. As far as we know this is the only lot of Iron Norway Core Wire in the hands of any dealer at the present time, and none can be gotten until after the war. We have only two sizes left:

26 INCHES Thickness about No. 21 B and S 36 INCHES

If either of these sizes should be too long we advise cutting the wire down yourself by means of shears. It will pay you to do so as real Norway Iron Wire, sold by a few dealers last year, brought from 45c to 50c a pound. American core wire now sells for from 35c upwards per pound.

As long as the supply lasts we offer this wire as described above to our customers at the very low price of 20c a pound. Order at once.

ELECTRO IMPORTING CO., 231 Fulton St., N. Y. C.
$5. EXPERIMENTERS!

A Sample of What You Can Do With This Outfit

No. EX2002

The Boy's Electric Toys

ELECTRO IMPORTING CO.,
231 Fulton St., New York

January, 1919 ELECTRICAL EXPERIMENTER 679

THE BOY'S ELECTRIC TOYS contains enough material to make and complete over twenty-five different electrical apparatus without any other tools, except a screw-driver furnished with the outfit. The box contains the following complete instruments and apparatus which are already assembled:

Student's chronograph battery, compass galvanometer, solenoid, telephone receiver, electric lamp. Enough various parts, wire, etc., are furnished to make the following apparatus:

Electromagnet, electric candle, magnetic picture, dancing spiral, electric hammer, galvanometer, voltmeter, book for telephone receiver, condenser, sensitive microphone, short distance wireless telephone, test storage battery, shocking coil, complete telephone set, electric riveting machine, electric buzzer, dancing fishes, singing telephone, mysterious dancing man, electric jumping jack, magnetic geometric figures, rhombo, erratic pendulum, electric battery, thermo electric motor, visual telegraph, etc., etc.

This does not by any means exhaust the list, but a great many more apparatus can be built actually and effectually.

With the instruction book which we furnish, one hundred experiments that can be made with this outfit are listed, nearly all of these being illustrated with superb illustrations. So no materials, goods or supplies are necessary to perform any of the one hundred experiments or to make any of the 25 apparatus. Everything can be constructed and accomplished by means of this outfit, tools, hands, and a screw-driver.

The outfit contains 114 separate pieces of material and 24 pieces of finished articles ready to use at once.

Among the finished material the following parts are included: Chronic salts for battery, lamp socket, bottle of mercury, core wire (two different lengths), a bottle of iron filings, three spools of wire, carbons, a quantity of machine screws, flexible cord, two wood bases, glass plate, paraffin paper, binding posts, screw-driver, etc., etc. The instruction book is so clear that anyone can make the apparatus without trouble, and besides a section of the instruction book is taken up with the fundamentals of electricity to acquaint the hammy with all important facts in electricity in a simple manner.

We guarantee satisfaction.

The size over all of the outfit is 4 x 9 3/4. Shipping weight, 8 lbs. $5.00

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That is the idea several engineers have had, but an English engineer seems to have solved the problem successfully with his specially designed tidal turbines and triple basins. His name is J. O. Boving, and his scheme is so practical that it has been proposed for the development of electric power from the tide water at the mouth of the River Dee. Mr. Boving's description of the tidal power plant is as follows:

Altho the (English) Government a few months ago took a very wise and necessary step in appointing a committee to inquire into the possibilities of water power development in the British Isles, there is one aspect of the question which does not seem to have attracted adequate attention, and that is the utilization of tidal power. The rise and fall of the tides around the English coasts vary greatly, from a maximum of nearly fifty feet in some places on the west coast to only a few feet at others. Generally speaking, the differences on the east coast are small, but on the west coast there are many river estuaries and other inlets which offer abundant possibilities for obtaining power from the tides.

Some years ago I had an opportunity of examining the possibilities of developing a tidal water power on the estuary of the River Dee, where the tidal differences are roughly thirty-five feet at highest Spring tide and thirteen feet at lowest neap tide.

The proposed River Dee Tidal Power Development As Designed By a Famous English Engineer—J. O. Boving. This View Shows His Two Basin Proposal Where the Area of the Impounded Water Would Amount To Forty-Four Square Miles. The Maximum Tidal Difference Is In This Case About Thirty-Five Feet. A Large Railway Embankment Is a Part of the Scheme. This Railway to Connect Up the Welsh Railway System With Birkenhead and Liverpool.
such a way that a power station could be worked continuously under constant head and with constant output. The plan was roughly as follows:

Supposing that we start with high tide, the flap gates leading from the sea to the high basin would be open, and the water would flow in and pass through turbines into the lower basin, the automatic flap gates to this basin being closed by the water pressure outside. This flow would continue until the level in the sea equaled that in the high basin, when the flap valves to this would slowly close. In the meantime the electric transmission is easy. In such cases the surplus power might be used during the periods when it is available for pumping up water to such reservoirs, while during the intervals, when power is required, it could be obtained thru high-pressure turbines driven by the stored-up water supplied.

It will perhaps be argued that this is a very elaborate and costly arrangement which would not pay. The problem in fact resolves itself to this: Assuming (1) that an ordinary water power in a river was developed and used for commercial purposes during twelve hours out of the twenty-four and that it was a good commercial scheme under these conditions; and (2) that a high-pressure power development could be obtained by using stored water for twelve hours of the twenty-four, and that this was also a commercially good undertaking in itself; then it must be equally sound commercially to link the two together and produce power around the twenty-four hours. In the tidal scheme the only things added to the arrangement described above are pumps, which are a negligible factor in the general costs (they would correspond to something like $3.50 per h. p.). The pipes thru which the water is pumped up are, of course, the same as those which return it to the storage reservoir plant. Everything else is in common.

The calculation for such a scheme is simple, and in the case referred to, assuming that any case as that across the Dee mouth, for railway purposes, there is no doubt that this power development would pay well. In cases where two tidal rivers flow together, the necessary conditions could be realized by connecting them. There would be nothing new in this, as the turbines would be of standard design, the variation in the head would be only such as would be allowable for in ordinary turbine plants, and the flow could be used in any periods when the power developed fell much below the average power.

However, in most cases it would be impossible to develop the three-basin idea, and it would be necessary to rely only on one inner reservoir and the sea. Obviously under such conditions the scheme would contend with very great variations in head and power. The great variations that occur in the tidal ranges at various times compel him to calculate his average head derived from neap tides.

The general idea of a one-reservoir tidal scheme is as follows: At the beginning of high tide the sluice gates are opened, and the water rushes into the inner reservoir, filling it up as quickly as possible. Then the gates are shut for a certain time, until the water level outside has fallen by an equal or greater difference in level between the reservoir and the sea. (See detailed illustration of one reservoir scheme.) The sluice gates are now opened and kept in operation under virtually constant head, while the level in the reservoir falls at the same time as the tide. Some time before the lowest level of the tide the turbines are shut off, the gates opened, and the remaining water in the reservoir allowed to rush out with the lowest tide. Then the gates are closed, the tide rises outside until the difference in level between the sea and the reservoir has again reached the agreed level, the turbines are started, and the same procedure is gone thru for the rising tide as just described for the falling. Thus for certain definite periods power is obtained at a straight constant rate, but in the intervals no power is produced.

Up until now we have been satisfied to mine and burn coal, prospect for oil gushers, and, in fact, have tried out about every expensive source of power we could think of. This comes of prosperity. America is rich, and the keynote of the future is "expensive." Design, develop, build,—do all these things—say our great philosophers and educators, but do them FAST. Speed is a fine thing—in its place; but there is bound to be a big bill to pay, some day. Why not live and work efficiently; not necessarily in a slow, plodding, unenlightened way, but in an economical manner. Coal and oil will not last forever. If you have ever visited Holland, you have doubtlessly been impressed with the simplicity of things and those windmills. There is a fine bit of antique engineering. The Hollander is using the force of nature—the wind. Besides these you will find in all parts of Europe the ever-present water wheel and turbine. Examine the steady progress of water power in most cases; but do the American farmers and developers put the free wind and water power to work? Not, they do NOT. They would rather spend a thousand dollars or so for a gasoline engine and then work their heads off for the rest of their lives to get the same. If you can see hundreds of windmills and waterwheels rusting to pieces all over the country. A great pity and a prodigious waste.

Sweden, which is rich in water power, sends electricity across the sound to Denmark.
Producing Rain by Electricity and X-Rays

FROM time to time in the world's history, there have been schemes promulgated for and attempts made at producing rain by artificial means under the control of man. One of the most promising of the recent schemes for producing rain-fall at any desired time, providing there happened to be aqueous particles contained in the atmosphere, is that due to an Australian scientist, John Graeme Balsillie. He has taken out patents on his system of producing rain-fall electrically, and one of his latest American patents is here pictured and described.

The illustration shows how Mr. Balsillie proposes to send up a series of balloons or large box kites of sufficient size to carry an extra large X-ray tube, and also capable of supporting two thin electric wires of considerable length. As the inventor states in his patent, his invention "consists in electrical means for assisting and promoting under suitable meteorological conditions the formation of aqueous particles in the atmosphere and assisting in promoting the deposition of water particles (rain-fall) from the atmosphere, and further to provide suitable apparatus for producing the necessary electrical conditions for that purpose." This balloon may be controlled from a tractor truck which can speed over the country to various points wherever it may be desired, and a portable gasoline engine and dynamo outfit on the truck may supply the necessary current for operating the powerful X-ray tube carried by the balloon, as shown in the illustration, and also for developing the high potential current, about 350,000 volts, which is employed for charging the metallicized surface of the balloon.

As has been pointed out in previous articles on similar inventions in this Journal—and as substantiated by the opinion of several well-known scientists, included Dr. Henryt Arocken, the Aroctic explorer, of New York—the inventor informs us in his patent that his discovery is susceptible to practical use only when the cooling of aqueous vapor resulting from its expansion in elevated regions of the atmosphere and other natural influences brings the vapor above the saturation point, so that condensation becomes possible.

It has been ascertained that ions, produced in this case by Mr. Balsillie by the powerful X-rays, which ionize the atmosphere in the vicinity of the balloon, may act as nuclei, upon which, under certain conditions, water vapor will condense. Aqueous particles comprising cloud, fog or mist are invariably electrified by natural causes, and also their electrification is of one sign, the potential or voltage distribution through the mass is uneven. Aqueous particles of approximately equal dimensions and potential will therefore naturally repel each other, and no condensation will result. However, nuclei, upon which water condensation may take place, can be created by ionizing the atmosphere, such as by powerful X-rays, and further if under normal conditions, a mutual repulsivity of charge of the aqueous particles is altered to a condition of mutual attraction, then the presence of such aqueous particles will be assisted, and rain caused to fall.

As the accompanying detail illustration shows, if a metal plate (or the metallicized surface of the balloon) is charged at a very high potential of say several hundred thousand volts, then the electrified body serves to give an opposite charge to the aqueous particles floating in the atmosphere.

The aqueous particles thus become positive of a charge of opposite sign to that which they originally had. This charge of opposite sign, however, is not and cannot be communicated instantaneously to all the particles in said zone. The particles in close proximity to the source of electrification are rapidly charged by electrostatic induction with a charge of opposite sign to the one they have acquired. The particles in close proximity to each other, are posset of electrical charges of opposite sign. Such particles consequently attract each other, coalesce, and then fall as rain, under the influence of gravity.

The apparatus used for producing the high potential uni-directional current for charging the metallicized balloon surface is produced by a transformer and interrupter supplied from a dynamo or other source on the ground. The secondary circuit of the induction coil is equipped with rectifying valves in order to rectify the current. Similar apparatus, also provided with vacuum.

(Continued on page 749)
Moving Platform for New York's Cross-Town Subway

By H. WINFIELD SECOR

SUBWAY commuters and others who use New York's great underground transportation systems can be promised a less crowded and harrier in the past several months by the various difficulties occasioned by the change in the two principal north and south lines of the system. In other words, the subway system was changed over a few months ago from the old familiar "Z" system to the new so-called "H" system, which gives a continuous east-side and west-side subway express route, the—the of the "H" connecting at the present time by shuttle trains running under 42nd Street between the Grand Central Station and the Times Square Station. The Grand Central Station is located at 42nd Avenue and 42nd Street, while the Times Square Station is located on the west side at the junction of 7th Avenue, Broadway, and 42nd Street.

For several reasons the shuttle train service seems apparently not to be the best solution of the problem confronting the company. The traffic is rapidly and quickly transferring the cross current of traffic between these two stations, and therefore Public Service Commission No. 1 has ordered a continuous moving platform such as here illustrated to be installed in the space now occupied by two of the four tracks. Mr. Smith, the general staff engineer, has decided that the original idea called for the installation of this continuous moving platform on the two northerly tracks of the subway system, leaving the two southerly tracks for shuttle service, which might be necessitated when the moving platform might get into an order, where the shuttle train service could be put in use. Also, the two tracks could be used for the extension of the Queensboro Subway system, which is another proposal in the minds of the New York City Rapid Transit engineers, so that eventually the Queensboro trains which now end their westward run at the Grand Central Station, two levels under the ground as here illustrated, will terminate at Times Square.

In a recent interview with Mr. M. Everhart, the chief engineer of the construction concern which will build this gigantic moving platform, six thousand feet in length and capable of carrying a crowd of people at one time, a different suggestion was made concerning the location of this proposed continuous moving platform. Instead of having tracks over the space on which the two northerly tracks will run, Mr. Smith pointed out that it is much more feasible and practical in every way to have it occupy the present position of the extreme northerly and southerly tracks, leaving two tracks in the center for emergency shuttle train service or for the extension of the Queensboro system to Times Square. This consideration of the design and layout of the moving platform system is even more important, it is thought, for the reason that if the return loop of the platform pass along in the position now occupied by one of the inside tracks of the original design, this track might be at right angles to any point desired, excepting at the terminal stations at either Grand Central or Times Square.

As a consequence there should be not less than three moving platforms in any case, each moving at a different speed, the outer one at three miles, the intermediate at six miles, and the inner platform carrying the seats, at nine miles per hour. Therefore, as Mr. Smith suggested, in discussing Mr. Whitney's original idea, it would be necessary for passengers traveling east to attempt to cross a high speed (9-mile per hour) platform moving west. To give the greatest service, and to obviate the possibility of injury for both passengers on the moving platform at any point along the entire route, the moving platform system should occupy the space now used by the two center or the two outside tracks. In other words the two moving platforms would have to have adjacent to them a stationary platform, provided with suitable exits and entrances. If the present shuttle train service should be extended to connect with other subways as well as between 7th Avenue to Times Square, the trains, Mr. Smith explained, would not conflict with the moving platforms, because the latter would be operated only on the train stations. In this case the moving platform would be used merely for the collection and distribution of passengers within the area of the Times Square system, and of its best of it.

Concerning the initial cost of this great moving platform it is estimated that it would be approximately $15,000,000, and that it would take six months to install. But the present time of the engineers of the Public Service Commission and the subway design is very efficient, and the cost of the moving platform, concern, are busy trying to find a satisfactory space for the platform return loops at the station ends. Times Square as these return loops being quite an extensive affair, the minimum diameter of the loop being about 130 feet. The moving platform idea is not so entirely new or untried, as it might appear at first. They have been built and used at different stations years ago, both abroad and in the United States. The same concern which is now designing the one for installation under 42nd Street, had one in successful operation at the World's Fair in Chicago, 4,400 feet in length. Visitors to that Fair will undoubtedly remember the great attraction, the platform which was designed to transport to the total of 150 horsepower, which had a carrying capacity of 6,000 passengers. On Chicago it is twice the daily traffic of the Brooklyn Bridge—were carried without any inconvenience. The total live and dead weight was 900 tons. As aforementioned, the new platform proposal for 42nd Street, New York City, is approximately 6,000 feet in length, with a capacity of 10,000 passengers, and will require electric motors distributed along its length to a total of about 250 horsepower.

Undoubtedly some of our readers will be interested in some of the more or less obvious technical details and just how the various parts are to operate. Thru the courtesy of Mr. M. Everhart Smith, we are pleased to have this illustration, which has been submitted to the editors. First, the three moving platforms, moving at three gradually increasing velocities, will be constructed, on board it without being thrown over or requiring acrobatics, will not be exactly on the same track, but only a very slight, even, and will overlap the next succeeding platform, this practice having been found the best from past experience. The detailed drawings in the accompanying illustration show how the platform is made in a large number of jointed sections, each of which is provided with a flexible coupling so as to easily negotiate the curves at the station loops. Under the whole moving platform there is installed a stationary series of wheels or pulleys mounted on axles. The depending rails of the various platforms rest on the respective pulleys or wheels between the platform rails in each case, as the drawing indicates. At about every eighth or tenth pulley there will be located a small electric motor connected to the drive of the particular pulley. All together about 250 horsepower in electric motors will be required, which would practically mean that the two thousand horse-power in electric motors necessary for the operation of a ten-car subway train.

The matter of seats on the third or high-speed platform is a very flexible one, and at first most probably but one row of seats will be installed, as the illustration shows, but later, more than at least two and perhaps three rows might be used by women, as Mr. Smith pointed out. Another feature at this point is that those in a hurry can walk along any one of the moving platforms. For instance, a man walks at the rate of four miles per hour on the nine mile per hour platform. He will actually be moving in that particular direction at a rate of two miles per hour. In addition to the advantages of constantly moving platforms with no waits for shuttle trains, and with entrances and exits at every cross-street, such as at Madison, Fifth and Sixth Avenues, an immense income could be derived from the storerooms and advertising spaces along the platforms.

Referring once more to the platform and its operation, it will be seen how the motor-driven wheels under the rails of the platform sections will cause these sections to be propelled forward in a direction depending upon the rotation of the wheels. The end-wise junction between the sections of the moving platforms is on an even level, and they are closely curved on the order of a knuckle-joint so that no gap occurs between the rails of the moving platforms or is also desined as to correspond both at front and back, and thus this unique design permits of the section allowing smooth and easy loop curves in a smooth manner. Light steel posts, containing straps for the use of the "strap hangers" brigade, without which life could be a large part of its vim and pep, will be provided, as the illustration shows. Of course the chaps on the way home from the club will have to remove their hat in this English say—well—WELL, by that time the Nation will be dry anyway, so we should worry!! And besides the late home-comers using the platform during the "G. M. home" will most probably be lucky enough to find it pretty well deserted in the event that they have drunk up many glasses of near-beer or cherry flip.

Regarding the heating of this long tunnel, Mr. Smith has suggested that during the cold weather of the tunnel system, in which the moving platform is installed, could be steam-heated at regular intervals, and also special ventilating fans and baffle walls could easily be provided at the various stations, as well as at the terminals, so as to ensure the proper ventilation and heating of the passageway.
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(For full description see opposite page)
The Unknown Purple

By DOROTHY KANT

What would you do if you had the power to make yourself invisible—not by means of Aladdin’s wonderful lamp, but by an actual scientific invention? Ask Dad, he knows! Thus, for instance, it certainly would be a boon to some delicately balanced husband, homeward bound, to escape the shark eye of his better half, not to mention into a play that seems to have so big a success with New York’s critical audiences.

The scientist in this play who is incidentally our hero uses his invention to wreak vengeance upon his unfaithful wife and her paramour by making himself invisible and by playing pranks with the fortunes of both wife and lover.

But how does he do it and at the same time raise the tension of the audience to such a height that you can hear a “dew” drop?

One of our ingenious readers not so long ago wrote, jocularity, suggesting that we run a perfectly blank cover on the magazine under the caption “Camouflaged Ship on the Ocean”. The joke was supposed to be that the ship was so well camouflaged that you could not see it at all—hence the blank cover page! The authors of the “Unknown Purple” evidently used a similar line of reasoning on which they built up their play.

The problem was how to show a man walking across the stage who is supposed to be invisible. The answer is simplicity itself: don’t show him at all, but make the audience believe that he is really there. This is certainly simplicity reduced ad absurdum. But in order to show that the man was really there—alack, of course he wasn’t—something had to be done, else the audience would not be sufficiently impressed and would take the hero’s “absent treatment” as a joke. So the authors simply have a purple spot light arranged overhead, which light travels at a slow gait across the stage, and the lighting effects are so cleverly arranged that the audience obtains the impression that the invisible man is ever the purple light appeared, and when our invisible hero was on the stage, the effect was still further heightened by a certain low buzz produced by a spark coil vibrator or the like and which buzz was supposed to emanate from the substance in the hero’s hand which created the invisibility. Needless to say it had the desired effect and many a young damsel felt purple goose skin take the place of her natural one, and becoming the recipient of creeps and thrills such as never were hers before.

Of course, the usual stage tricks were resorted to, as for instance when our noble hero stealthily and invisibly opens the safe to abstract certain important papers. We thus see the purple spot or ray centered on the safe, amidst the mysterious buzzing sound—then the click of the combination as it is turned—the opening of the safe door slowly and mysteriously. Yes, you guess it, the safe was opened by invisible threads or strings, as no hands or anyone were visible. A similar trick was used whenever the hero entered the stage by means of the door. The door, of course, opened without any visible mechanical means and the solution in this case too obviously was strings or threads. There was only one scene that was staged elaborately and that was in the

(Continued on page 748)
Zeppelin Flew 4,130 Miles Round Trip from Bulgaria to Khartoum

A RECENT wireless dispatch from Berlin correspondsent contains some most interesting news concerning Teutonic developments in giant aircraft. It is said that the Germans are busy constructing a mammoth airplane intended to cross the Atlantic Ocean. This huge aerial craft, now under construction, is said to be able to travel at a speed of 188 feet per second, and it is to be engined by 3,000 horse-power in petrol motors.

The Teuton aerial flight experts are said to be busy constructing a gigantic Zeppelin craft at Friedrichshafen, which is to be propelled by nine engines and eight propellers. It will have a carrying capacity of one hundred passengers, and it is hoped that the international situation will clear up so that the first test flight of the giant might take place this coming July. The voyage across the Atlantic from a point in Germany to New York City is expected to take about forty hours.

But coming down to cold facts and past performances, the accompanying illustration shows one of the most remarkable aerial trips accomplished during the great war, in which a giant Zeppelin flew from Jamboli, in Bulgaria, to a point over Khartoum, on the river Nile in Africa, a distance as the crow flies of 2,005 miles, and a distance of 2,500 miles for the non-stop return trip. The Zeppelin carried a crew of twenty-two men besides twenty-five tons of ammunition and medicines for the Teuton army in German East Africa. The great craft glided from its hangar at Jamboli at eight o'clock on the morning of November 21st, 1917. On the night of November 22nd-23rd, the monster airship arrived over Khartoum, when it picked up a wireless message from the German raider at Khartoum ordering it to return at once, as the Government at Berlin had ascertained in the meantime that the majority of Gen. von Lettow-Worbeck's troops had surrendered to the Allies. Consequently the airship turned about in mid-air without making a landing and arrived at Jamboli at eight o'clock in the morning on November 25th. The technical director of the factory where this aerial craft was built has stated that a ship of this type was easily capable of flying from Berlin to New York and returning without a stop. The air-line distance from Berlin to New York City is approximately 3,930 miles, and the round trip distance would be 7,860 miles, or nearly eight thousand miles. Talking of dirigible gas-bag types of aircraft, the U.S. Navy Department has just announced a remarkable new gas, which is available by a new process. Discovery of this new inert, non-inflammable gas for balloons, dirigibles and other lighter-than-air owned by the Lone Star Gas Company, the statement said, and a ten-inch pipe line to cost $1,050,000 is being laid for a distance of ninety-four miles from the wells to a plant at North Fort Worth where the gas will be compressed into cylinders for shipment to the balloon fields. High proof gasoline is obtained in a ratio of about five gallons of gasoline for every 11 cubic feet of gas, it was said, and after the per cent of "argon" is removed, by agreement with the oil company, the remainder of the gas is turned into the city mains of Fort Worth and Dallas.

The Department estimates that the plant at North Fort Worth, designed by the Navy Bureau of Yards and Docks, and which will cost $900,000 will be completed by April.

INJURING THE EYES BY PHOTOGRAHY.

When one sees so many veteran photographers, both amateur and professional ranks, suffering from astigmatism, one wonders what is the actual cause of this distressing optical defect. On inquiry, it will be found that in many cases the eyes were strained during the early days of dryplate-photography, when the plates were then coated with a very slow emulsion—were handled, and examined during development, by the light of a deep ruby oil-lamp. Amateurs at first used advisedly a small pocket-lamp, and undoubtedly incurred serious injury to the sight. Later—than goodness—light of greater volume was employed, ruby light being also superseded by orange light; preferably fabric instead of glass being used to expose the dryplates sparingly to the rays of this brighter light. Now the photographer confronts the danger of ruining his eyes from exposure to the electric arc when used for printing purposes. To look at the bare arc is obviously injurious to the sight. Arc-rays reflected from the surface of the negatives are also bad for the eyes. A good plan is to use a printing-lamp in which only reflected light is directed on the negatives, or to use a printing-cabinet in which the arc is enclosed, care being taken to cover up empty spaces with strips of cardboard so that the arc or its reflections do not reach the printer's eyes.
Famous Scientific Illusions

By NIKOLA TESLA

Written specially for the Electrical Experimenter

In this original and revolutionizing discussion, Nikola Tesla gives us something really new to think about. First—Does the moon rotate on its axis? Second—Is the Franklin pointed lightning rod correct in theory and operation? Third—Do wireless signals fly thru space by means of so-called Hertzian waves in the ether, or are they propagated thru the earth at prodigious velocity by means of earth-bound oscillations? World-famous conundrums these—questions which have been answered in many ways by some of the greatest scientists. Dr. Tesla explains these three predominant scientific fallacies in a masterly way, so that everyone can understand them.

The human brain, with all its wonderful capabilities and power, is far from being a faultless apparatus. Most of its parts may be in perfect working order, but some are atrophied, undeveloped or missing altogether. Great men of all classes and professions—scientists, inventors, and hard-headed financiers—have placed themselves on record with impossible theories, inoperative devices, and unrealizable schemes. It is doubtful that there could be found a single work of any one individual free of error. There is no such thing as an infallible brain. Invariably, some cells or fibers are wanting or unresponsive, with the result of impairing judgment, sense of proportion, or some other faculty. A man of genius eminently practical, whose name is a household word, has wasted the best years of his life in a visionary undertaking. A celebrated physicist was incapable of tracing the direction of an electric current according to a childishly simple rule. The writer, who was known to recite entire volumes by heart, has never been able to retain in memory and recapture in their proper order the words designing the colors of the rainbow, and can only ascertain them after long and laborious thought, strange as it may seem.

Our organs of reception, too, are deficient and deceptive. As a semblance of life is produced by a rapid succession of inanimate pictures, so many of our perceptions are but trickery of the senses, devoid of contrary to all observation, this planet rotates around the sun; the recognition of Descartes that the human being is an automaton, governed by external influence and the idea that the earth is spherical, which led Columbus to the finding of this continent. And that the minds of individuals supplement one another and science and experience are continually eliminating fallacies and misconceptions, much of our present knowledge is still incomplete and unreliable. We have soothed in mathematics which cannot be disproved. Even in pure reasoning, free of the shortcomings of symbolic processes, we are often arrested by doubt which the strong-
est intelligences have been unable to dispel. Experimental science itself, most positive of all, is not unfailing.

In the following I shall consider three exceptionally interesting errors in the interpretation and application of physical phenomena which have for years dominated the minds of experts and men of science.

I. The Illusion of the Axial Rotation of the Moon.

It is well known since the discovery of Galileo that the moon, in travelling thru space, always turns the same face towards the earth. This is explained by stating that while passing once around its mother-planet the lunar globe performs just one revolution on its axis. The spinning motion of a heavenly body must necessarily under go modifications in the course of time, being either retarded by resistance internal or external, or accelerated owing to shrinking and other causes. An unalterable rotational velocity thru all phases of planetary evolution is manifestly impossible. What wonder, then, that at this very instant of its long existence our satellite should revolve exactly so, and not faster or slower. But many astronomers have accepted as a physical fact that such rotation takes place. It does not, but only appears so; it is an illusion, a most surprising one, too.

I will endeavor to make this clear by reference to Fig. 1, in which E represents the earth and M the moon. The movement thru space is such that the arrow, firmly attached to the latter, always occupies the position indicated with reference to the earth. If one imagines himself as looking down on the orbital plane and follows the motion he will become convinced that the moon does turn on its axis as it travels around. But in this very act the observer will have deceived himself. To make the delusion complete let him take a washer similarly marked and supporting it rotatably in the center, carry it around a stationary object, consider keeping the arrow pointing towards the latter. Tho to his bodily vision the disk will revolve on its axis, such movement does not exist. He can dispel the illusion at once by holding the washer fixedly while going around. He will now readily see that the supposed axial rotation is only apparent, the impression being produced by successive changes of position in space.

But more convincing proofs can be given that the moon does not, and cannot revolve on its axis. With this object in view attention is called to Fig. 2, in which both the satellite, M, and earth, E, are shown embedded in a solid mass, M, (indicated by stippling) and supposed to rotate so as to impart to the moon its normal translatory velocity. Evidently, if the lunar globe could rotate as commonly believed, this would be equally true of any other portion of mass M, as the sphere M, shown in dotted lines, and then the part common to both bodies would have to turn simultaneously in opposite directions. This can be experimentally illustrated in the manner suggested by using instead of one, two overlapping rotatable washers, as may be conveniently represented by circles M and M, and carrying them around a center as E, so that the plain and dotted arrows are always pointing towards the same center. No further argument is needed to demonstrate that the two gyrations cannot co-exist or even be pictured in the imagination and reconciled in a purely abstract sense.

The truth is, the so-called "axial rotation" of the moon is a phenomenon deceptive alike to the eye and mind and devoid of physical meaning. It has nothing in common with real mass revolution characterized by effects positive and unmistakable. Volumes have been written on the subject and many erroneous arguments advanced in support of the notion. Thus, it is reasoned, that if the planet did not turn on its axis it would expose the whole surface to terrestrial view; as only one-half is visible, it must revolve. The first statement is true but the logic of the second is defective, for it admits of only one alternative. The conclusion is not justified as the same appearance can also be produced in another way. The moon does rotate not on its own, but about an axis passing thru the center of the earth, the true and only one.

The unifying test of the spinning of a mass is, however, the existence of

![Image](https://via.placeholder.com/150)
energy of motion. The moon is not possess of such 

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Figure 5

Highly rarefied medium (insulating)...

Moderately rarefied conducting atmosphere above insulating stratum...

Figure 6

Dense thin insulating layer of air:

Earth and dense insulating air layer to scale
Thickness of layer $\frac{1}{10}$ inch when radius of earth model - $\frac{1}{10}$ inches

A Section of the Earth and Its Atmospheric Envelope Drawn to Scale. It is Obvious That the Hertzian Rays Cannot Traverse So Thin a Crack Between Two Conducting Surfaces For Any Considerable Distance, Without Being Absorbed, Says Dr. Tesla, in Discussing the Etheric Wave Theory.

we have experimental evidence. Irrespective of this so exact a coincidence between the axial and orbital periods is, in itself, immensely improbable for this is not the permanent condition towards which the system is tending. Any axial rotation of a mass left to itself, retarded by forces external or internal, must cease. Even admitting its perfect control by tides the coincidence would still be miraculous. But when we remember that most of the satellites exhibit this peculiarity, the probability becomes infinitesimal.

Three theories have been advanced for the origin of the moon. According to the oldest suggested by the great German philosopher Kant, and developed by Laplace in his monumental treatise "Mécanique Céleste", the planets have been thrown off from larger central masses by centrifugal force. Nearly forty years ago Prof. Gregor H. Darwin in a masterful essay on tidal friction furnished mathematical proofs, deemed unrefutable, that the moon had separated from the earth. Recently this established theory has been attacked by Prof. T. J. J. See in a remarkable work on the "Evolution of the Stellar Systems", in which he propounds the view that centrifugal force was altogether inadequate to bring about the separation and that all planets, including the moon, have come from the depths of space and have been captured. Still a third hypothesis of unknown origin exists which has been examined and commented upon by Prof. W. H. Pickering in "Popular Astronomy of 1907", and according to which the moon was torn from the earth when the latter was partially solidified, this accounting for the continents which might not have been formed otherwise.

Undoubtedly planets and satellites have originated in both ways and, in my opinion, it is not difficult to ascertain the character of their birth. The following conclusions can be safely drawn:

1. A heavenly body thrown off from a larger one cannot rotate on its axis. The mass, rendered fluid by the combined action of heat and pressure, upon the reduction of the latter immediately stiffens, being at the same time deformed by gravitational pull. The shape becomes permanent upon cooling and solidification and the smaller mass continues to move about the larger one as tho it were rigidly connected to it except for pendular swings or librations due to varying orbital velocity. Such motion precludes the possibility of axial rotation in the strictly physical sense. The moon has never sped around as is well demonstrated by the fact that the most precise measurements have failed to show any measurable flattening in form.

2. If a planetary body in its orbital movement turns the same side towards the central mass this is a positive proof that it has been separated from the latter and is a true satellite.

3. A planet revolving on its axis in its passage around another cannot have been thrown off from the same but must have been captured.

II. The Fallacy of Franklin's Pointed Lightning-Rod.

The display of atmospheric electricity has since ages been one of the most marvelous spectacles afforded to the sight of man. Its grandeur and power filled him with fear and superstition. For centuries he attributed lightning to agents god-like and supernatural and its purpose in the scheme of this universe remained unknown to him. Now we have learned that the waters of the ocean are raised by the sun and maintained in the atmosphere delicately suspended, that they are wafted to distant regions of the globe where electric forces assert themselves in upsetting the sensitive balance and causing precipitation, thus sustaining all organic life. There is every reason to hope that man will soon be able to control this life-giving flow of water and thereby solve many pressing problems of his existence.

Atmospheric electricity became of special scientific interest in Franklin's time. Faraday had not yet announced his epochal discoveries in magnetic induction but static fractional machines were already generally used in physical laboratories. Franklin's powerful mind at once leaped to the conclusion that fractional and atmospheric electricity were identical. To our present-day view this inference appears obvious, but in his time the mere thought of it was little short of blasphemy. He investigated the phenomena and argued that if they were of the same nature then the clouds could be drained of their charge exactly as the ball of a static machine, and in 1749 he indicated in a publish memoir how this could be done by the use of pointed metal rods. (Continued on page 728)
Curing Soldiers' Ills with Electricity

By PAULINE BERGINS

Electricity is playing no mean role in the vast reconstruction work now being carried on in the great Red Cross as well as Army and Navy hospitals throughout the country. Not only has the electric current been cleverly employed in many diversified ways to treat the many ills and maladies with which the soldiers and sailors have been afflicted in this country, but thousands of these appliances have been and are being used every day in the field hospitals in France, and in other lands which were not many months ago raging battlefields. Portable yet powerful X-ray ambulances sped over the battlefields but a few miles behind the front line trenches, ever ready to loan a helping hand in the merciful work of the medical corps. And not only do we find in these shell-torn regions the invaluable

nervous cases caused by excessive fatigue, and for over-strained muscles and cords. There are more shell-shock victims from the great World War than there have been in any other. And, therefore, the fact that the Bergonie electric chair will help to alleviate and cure these cases, is indeed a great blessing.

It might be said that the majority of shell-shock are cured suddenly and instantaneously. A large French hospital just

X-ray machines, but many other appliances such as electric heating devices for the treatment of "trench fever," electric sterilizers and cauterizers, Faradic outfits for the treatment of lameness and rheumatism, electric light baths, etc.

The accompanying photographs show several very interesting and practical applications of the electric current for the treatment of war ills. The photograph, Fig. 1, showing an American soldier seated in the large reclining chair, was taken at Fort MacPherson, Ga. This curious and complicated looking electric outfit comprises one of the most wonderful electro-medical devices ever invented—the "Bergonie" Electric Chair. The Bergonie invention involves the application of low voltage electric currents of peculiar wave form to the patient's body while seated in the chair shown, the body being weighted with a number of sand bags. The switch-board in the background contains a number of regulating rheostats and motor-driven interrupters as well as measuring instruments, such as a voltmeter and milliampere meter for indicating the strength of the current applied to the patient. The Bergonie chair treatment produces rhythmic pulsations in the nerves and muscles and has been found very efficacious for shell-shock victims as well as for treating severe

Three Interesting Views Showing Electricity's Role in the Reconstruction Work of the Army Hospitals. Above: Fig. 2. Soldier Patient Receiving Electric Arm Bath Treatment For Rheumatism, at the American Red Cross War Hospital at Palmington, Devon, France. Fig. 1. Below, Shows American Soldier Being Treated in the Bergonie Electric Chair, Extensively Used For Shell Shock Treatment, at Fort MacPherson, Ga. Fig. 3. at left, Illustrates the Electric Light Bath Cabinet in Use. A Wounded Marine is Enjoying the Glowing Warmth Produced by This Electrotherapeutic Apparatus For Treating Sore and Stiffened Muscles.

prior to the signing of the armistice there

(Continued on page 748)
THE progressive development of man is vitally dependent on invention. It is the most important product of his creative brain. Its ultimate purpose is the complete mastery of mind over the material world, the harnessing of the forces of nature to human needs. This is the difficult task of the inventor who is often misunderstood and unrewarded. But he finds ample compensation in the pleasing exercises of his powers and in the knowledge of being one of that exceptionally privileged class without whom the race would have long ago perished in the bitter struggle against pitiless elements.

Speaking for myself, I have already had more than my full measure of this exquisite enjoyment, so much that for many years my life was little short of continuous rapture. I am credited with being one of the hardest workers and perhaps I am, if thought is the equivalent of labor, for I have devoted to it almost all of my waking hours. But if work is interpreted to be a definite performance in a specified time according to a rigid rule, then I may be the worst of idlers. Every effort under compulsion demands a sacrifice of life-energy. I never paid such a price. On the contrary, I have thrived on my thoughts.

In attempting to give a connected and faithful account of my activities in this series of articles which will be presented with the assistance of the Editors of the ELECTRICAL EXPERIMENTER and are chiefly addrest to our young men readers, I must dwell, however reluctantly, on the impressions of my youth and the circumstances and events which have been instrumental in determining my career.

Our first endeavors are purely instinctive, promptings of an imagination vivid and asserts itself and we of the greatest moment and may shape our very destinies. Indeed, I feel now that had I understood and cultivated instead of suppressing them, I would have added substantial value to my bequest to the world. But not until I had attained manhood did I realize that I was an inventor.

This was due to a number of causes. In the first place I had a brother who was gifted to an extraordinary degree—one of those rare phenomena of mentality which biological investigation has failed to explain. His premature death left my parents disconsolate. We owned a horse which had been presented to us by a dear friend. It was a magnificent animal of Arabian breed, possesst of almost human intelligence, and was cared for and petted by the whole family, having on one occasion saved my father's life under remarkable circumstances. My father had been called one winter night to perform an urgent duty and while crossing the mountains, infested by wolves, the horse became frightened and ran away, throwing him violently to the ground. It arrived home bleeding and

Mr. Tesla at the Age of 23.

Mr. Tesla at the Age of 29.

Mr. Tesla at the Age of 39.
exhausted, but after the alarm was sounded immediately dashed off again, returning to the spot, and before the searching party were far on the way they were met by my father, who had recovered consciousness and remounted, not realizing that he had been lying in the snow for several hours. This horse was responsible for my brother’s injuries from which he died. I witnessed the tragic scene and altho fifty-six years have elapsed since, my visual impression of it has lost none of its force. The recollection of his attainments made every effort of mine seem dull in comparison.

Anything I did that was creditable merely caused my parents to feel their long-cherished keen disappointment. So I bowed down with little confidence in myself. But I was far from being considered a stupid boy, if I am to judge from an incident of which I have still a strong remembrance. One day the Aldermen were passing thru a street where I was at play with other boys. The oldest of these venerable gentlemen—a wealthy citizen—passed to give a silver piece to each of us. Coming to me he suddenly stopped and exclaimed, “Young man, look in my eyes.” I met his gaze, my hand outstretched to receive the much valued coin, when, to my dismay, he said, “No, not much, you can get nothing from me, you are too smart.” They used to tell a funny story about me. I had two old aunts with wrinkled faces, one of them having two teeth protruding like the tusks of an elephant which she buried in my cheek every time she kissed me. Nothing was so bad as the prospect of being hugged by these as affectionate as unattractive relatives. It happened that while being carried in my mother’s arms they asked me who was the prettier of the two. After examining their faces intently, I answered thoughtfully, pointing to one of them, “This here is not as ugly as the other.”

Then again, I was intended from my very birth for the clerical vocation and this thought continue to oppress me. I longed to be an engineer but my father was inflexible. He was the son of an officer who served in the army of the Great Napoleon and, in common with his brother, professor of mathematics in a prominent institution, had received a military education but, singularly enough, later embraced the clergy in which vocation he achieved eminence. He was a very erudite man, a veritable natural philosopher, poet, and writer and his sermons were said to be as eloquent as those of Abraham a Sancta-Clara. He had a prodigious memory and frequently recited at length from works in several languages. He often remarked playfully that if some of the classics were lost he could restore them. His style of writing was much admired. He penned sentences short and terse and was full of wit and satire. The humor which he made use of was always peculiar and characteristic. Just to illustrate, I may mention one or two instances. Among the help there was a cross-eyed man called Mane, employed to do work around the farm. He was chopping wood one day. As he swung the ax my father, who stood nearby and felt very uncomfortable, cautioned him, “For God’s sake, Mane, do not strike at what you are looking at but what you intend to hit.” On another occasion he was taking out for a drive a friend who carelessly permitted his costly fur coat to rub on the carriage wheel. My father reminded of it saying, “Pull in your coat, you are ruining my tire.” He had the odd habit of talking to himself and would often carry on an

**NIKOLA TESLA**

**THE MAN**

*By H. Gernaback*

The door opens and out steps a tall figure—over six feet high—gaunt but erect. You are appalled. You are become conscious at once that you are face to face with a personality of a high order. Nikola’s hands shake your hand with a powerful grip, surmounting for a moment your surprise. A winning smile from piercing light blue-gray eyes, set in extraordinarily deep sockets, fascinates you and makes you feel at once at home. You are left for some time immeasurable in its ordinariness. Not a speck of dust is to be seen on his table, desk, everywhere. Everything is in its place. And if the man himself, immeasurable in attitude, orderly and precise in his every move, were a dark trolley coat, he is entirely devoid of all jewelry. No ring, no watch-chain can be seen.

Tesla—speaks—a very high almost falsetto voice. He speaks quickly and very convincingly. It is the man’s voice chiefly which fascinates you.

As he speaks you find it difficult to take your eyes off his own. Only when he speaks to others do you have a chance to study his eyes. They have a high forehead with a bulge between the eyes—the never-ending sign of exceptional intelligence. Then the long, well-shaped nose, proclaiming speciality.

How does this man, who has accomplished so much in a very young age and managed to surprise the world with more and more new inventions as he grows older? How does he who is a professor of mathematics, a great mechanical and electrical engineer, the greatest inventor of all times, keep his physical as well as mental powers?

To begin with, Tesla, who is by birth a Serbian, comes from a land inhabited by races.

His family tree abounds with centurians. Accordingly, Tesla—bearing accidents—fully expects to be still inventing in A.D. 1960. But the chief reason for his perpetual passion for intellectual frugality, Tesla has learned the great fundamental truth that he who only eats all of his bodily ills, but actually eats themselves—these do too much or too little by food that does not agree with them. With the hope to find that tobacco and black coffee interfered with his physical well-being, he quit both. This is the simple daily meal of the inventor.

**Breakfast:** One to two pints of warm milk and a few eggs, prepared by himself—yes, he is a bachelor.

**Lunch:** None whatsoever, as a rule.

**Dinner:** Celery or the like, soup, a single piece of meat or fowl, potatoes, one or two other vegetables; a glass of light wine. For dessert, perhaps a slice of cheese, and inevitably a bit of fruit.

**Tesla** is very funny and particular about his food but he eats very little but what he does eat must be of the very best. And he knows how much of him by his great inventor in science he is an accomplished cook who has invested his most dainty dishes.

His only vice is his generosity. The man who, by the ignorant unthacker has often beard, I have never been able to find how many millions of dollars was made over a million dollars of his inventions—and Tesla has kept them all. But Tesla is an idealist of the highest order and he is of men whom self means but little.

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(Continued on page 743)
Subways of Down-Town New York

T he down-town section of lower New York, including the financial or banking district in the vicinity of Wall Street, offers an excellent opportunity to make a thorough study of the various electrically operated tram and subway systems, as well as of the engineering and technical features connected with these. This section is dotted with, or passes through, some of the most thickly populated districts anywhere in the world. Here office buildings rise twenty to thirty stories in the air, while the heavy steel trains rumble along thru the bowels of the earth under these gigantic business structures day and night. Fortunately for New York that it has a very solid foundation, as it is doubtful if all the ambitious subway and other arteries of travel now in operation and contemplated, could be operated with any degree of safety without the aid of mechanical equipment. The accompanying illustration, courtesy is due to the engineers of the Public Service Commission, who have supplied the necessary information concerning the various subway routes here illustrated, several of which are now under construction and not yet in operation.

In looking at this illustration of down-town New York, the well-known "battery loop" section is shown at the bottom, the top of the illustration being north, the bottom south, and the right and left—east and west respectively. The insert map shows the various underground systems including the Hudson Tubes under the North River, as well as the Pennsylvania Railroad Tunnels under the North and East Rivers. Beginning at the west side of the illustration and looking thru we come to the new West Side Subway, sometimes referred to as the 7th Avenue Subway. This is a two-track under-ground system running under the 9th Avenue Elevated Railroad, as becomes apparent. A down-town train moving toward the Battery, on the West Side track, passes under the loop on the "A" track, and after it has past the Battery Subway Station, goes down an incline so as to reach two levels underground, thru a tunnel which passes under the East Side Subway (which runs on Broadway in this district) and comes out on the up Subway at the older one, and the second arrow "A" indicates. Right here we have one of the most unique and clever bits of subway engineering imaginative, for this two-track system fulfills two important functions.

Firstly, and as just explained, it serves as the return loop for the trains of the West Side Subway. Secondly, the inner track of this battery loop, or track "B," is used to return the local trains of the East Side Subway (which runs on the other way Subway), and by following the inner or "B" track around the loop, by means of the dotted lines, it will be seen that the downtown or local trains run thru the complete loop, and eventually swing around on to the north-bound local track. The two center tracks of the East Side Subway are dotted with the other press tracks. As the dotted lines convey, these trains dive downward two levels and pass thru the 1st Avenue, the Brooklyn Bridge Tubes, one of the tubes carrying traffic thru to Brooklyn, and the other the trains returning from Brooklyn to New York. The East Side Subway is the older one, and the one that visitors are most familiar with and until recently,—when the change was made to the subway shuttle service between the Grand Central station and Times Square, due to the opening of the West Side Subway—this route of the East Side Subway trains was northward from the Brooklyn Bridge terminus along Fourth Avenue, to Park Avenue, Grand Central station, thence northward under 42nd Street, then northward along Broadway, etc. At the present time, owing to the change caused by the shuttle service, the effect between the Grand Central and Times Square stations, these trains make a turn to the eastward, at Grand Central station, and then proceed northward along Lexington Avenue.

The next subway of interest is the new Tri-boro Subway, which is often referred to as the B, R, T, Subway, but the official subway system of New York, the "Tri-boro Subway System." These trains will come from Brooklyn thru two new under-river tubes shown in the illustration, and proceed northward under 42nd Street, then northward under the East Side Subway, as the illustration clearly shows. The most southerly point of operation at the present time, is the Whitehall and Nassau-Broad Streets Subway. This remarkable engineering feat is taken care of by means of two interlocking two-way switches in the subways, etc. At this point, and, of course, a very elaborate system of interlocking switches and signals has been provided in order to prevent any accident, as may have happened in the past. This must be said to the credit of the New York Subway System, that there have been very few accidents, and these were very slight, incidentally. Some of the more accurately conceived electric safety systems are in use, whereby one train cannot pass into the next "block" while it is still occupied by another train.

At present the two westerly under-river tubes leading to the Tri-boro Subway at the Battery, a mile and a half north, and the two easterly branches are dead-ended a short way underground, in the vicinity of the Construction Shaft.

The William Street Subway will soon be completed and connected with the West Side Subway, running across the Park, and shall be called the Tri-boro Subway System. This tunnel takes its name from Clark Street, Brooklyn.

In this illustration, the several modes of travel available in New York City are vividly shown by the trains, cars or trolley cars which run along the various streets, as well as under the elevated railways. In the Battery district, here illustrated, the 6th Avenue Line, with the underground elevated tracks shown close to the street, is one of the finest examples of the system, and is a very popular train with the residents.

A similar plan is followed in the operation of the 2nd and 3rd Avenue "L" lines, as the illustration indicates. Thus two lines run as a single system from the Battery "L" to the 9th Avenue. This route is only a short way underground, and the numerous tunnels, which is just above the Battery Station. A similar plan is followed in the operation of the 2nd and 3rd Avenue "L" lines, as the illustration indicates. Thus two lines run as a single system from the Battery "L" Station up to a short way into the 9th Avenue, and then switches into two distinct lines of traffic. From this point elevated system runs along 2nd Avenue and the other along 3rd Avenue.

WHAT IS AN ENGINEER?—ASK UNCLE SAM

Especially interesting, from the standpoint of the war, is the publication of a new definition of the engineer which has been written by A. H. Krom, director of engineering, United States Employment Service, Chicago. The definition comes as the result of many queries that have originated thru a confusion of engineering terms and standards now in general use. After serious study and consultation with the various engineering authorities, Krom prepared the following definition:

"An engineer is one who economically directs man power and, by scientific design, utilizes the powers of nature for the benefit of mankind."

In writing this definition, Mr. Krom has sufficient space to offer a practical definition that will be of real value to technical men and to employers of technical men. The definition will doubtless be useful in clarifying the ideas of students of engineering and prominent scientific authorities declare that Mr. Krom's definition will give the public a true engineering ideal and that it covers all classes of engineering. In view of the importance of the engineer in the present war, it is especially important that his status be properly defined.
A Comprehensive Semi-Sectional View of the Battery Section of New York City and Its Multifarious Modes of Travel, Including Subways, Elevated Lines, Surface Cars, and Ferry-Boats. This Represents One of the Most Thrively "Subwayed" Sections of Any City in the World, and There are As Many As Four Levels of Passenger-Carrying Railways in Operation At Some Points. This View Shows the 6th and 9th Avenue Elevated R.R. Lines On the West Side, and the 2nd and 3rd Avenue Lines Running As a Single System In This District Down to a Common Station At the Battery. At This Point There is a Large Subway Station for the Local Trains of the "East Side" (Old Broadway) Subway, These Local Trains Returning Around the "B" Track of the Loop to the Up-Town Track. The Express Trains Drop Down Two Levels Underground and Dive Thru the Two Under-River Tubes to Brooklyn. The "A" Track of the Loop is Used to Return the Trains of the "West Side" Subway to the Up-Town Track, As the Dotted Lines Indicate. These Trains Use the South Platform of the Battery Subway Station, Which Is Not Shown Here. The Many Other Interesting Problems Which Are Being Engineered At This Point, Are Clearly Explained In the Accompanying Article.
THE MILKY WAY

By ISABEL M. LEWIS
OF THE U.S. NAVAL OBSERVATORY

The Galaxy or Milky Way defines in the heavens the position of the fundamental plane of the visible universe and the equatorial belt of the celestial sphere. Our own sun, attended by its planet family, is but one of the innumerable stars that stream to and fro in paths as yet undefined in form, but lying closely confined to the galactic regions and apparently controlled by the strong gravitational forces that exist therein. In fact all celestial objects, whether stars, nebulae or star clusters, are influenced by the Milky Way and as a result either crowd closely toward it or seek to avoid it so far as possible. Among the objects that particularly favor the Galaxy are to be counted the helium or blue stars and the hydrogen or white stars. The giant red stars known as the type N stars are found almost exclusively here as are also the stars that appear to form the connecting link between stars and nebulae—the Wolf-Rayet stars. Here also are to be found all the gaseous nebulae, all the temporary stars, except those that have appeared in spiral nebulae, and all the loosely-formed groups or clusters of stars, such as the Hyades and the Ursa Major group, which includes Sirius and the brighter stars of the Big Dipper.

The average width of this equatorial belt of the celestial sphere has been placed at approximately twelve thousand light years, according to most recent investigations, while its diameter is now known to be at least three-hundred thousand light years in extent. Outside this central segment, but symmetrically distributed with reference to it, lie the vast compact systems known as the globular star clusters. These limited in number to less than one hundred they are composed individually of thousands, if not hundreds of thousands, of stars far superior to our own sun in size and brilliancy. The spiral nebulae, to be counted by numbers running into the hundreds of thou-

Taken by Barnard with the 3.4-Inch Lens of the Bruce Telescope Temporarily Located on Mt. Wilson, Cal. This Photograph Shows the Great Star Clouds of the Milky Way in Sagittarius. It is in This General Direction that the Center of the Entire Galactic System is Believed to Be Located.

The photographs were made through the 24-inch reflector of the Yerkes Observatory in Wisconsin, and show the region of the great spiral nebula of Messier 82 in the constellation of Leo. The nebula is seen against the background of the Milky Way, and the photograph is taken in the light of hydrogen and oxygen.

Star Clouds in Sagittarius. Photographed by Mr. Barnard of the Yerkes Observatory. This Covers a Field of About Twenty Degrees.
The hazy, milky light of the Galaxy is a familiar feature to all who have seen it at its best over sea or prairie on a moonless night of early fall, spanning the heavens in a glorious arch of awe-inspiring beauty. With the aid of the most powerful telescopes the nebulous background is resolved into innumerable individual points of light, each representing a star of the universe, a sun attended possibly by planet-worlds of its own. The impression one receives of dense clouds of stars is due, it is believed, to the great extent of the galaxy in the fundamental plane rather than to an actual crowding together of the stars. The Milky Way is known to be extremely intricate and irregular in form. It encircles the heavens in the form of a great circle, but its width varies from twenty or thirty degrees in some parts of the heavens down to barely five degrees in others. For nearly one-third of its circumference it divides into two branches. In the constellation Argo in the southern hemisphere, it separates into several branches cross by dark lanes that in one portion of its path nearly sever it completely. Still further south, in the vicinity of the Southern Cross, is the noted Coalsack, a huge opening in the midst of dense star clouds. The dark markings that are such a characteristic feature of the Milky Way are due in some instances to actual breaks in the star formations thru which it is possible to gaze into the immensity of space beyond, in others to the presence of dark absorbing matter that intercepts the light from the more distant star strata. There are numberless examples of such dark nebulae intermingled with vast star formations and luminous gaseous nebulae. There are all gradations in these dusky markings from an inky blackness to the greyish tinge produced by a feebly glowing nebular light. The form assumed by the star streams of the Milky Way is still unknown. There is no clue to the structure of the whole in the infinite variety of its intricate formations. No two portions of the Galaxy are alike. There is no way of determining the relative distances of the various star clouds when even the nearest are immeasurably distant. It is the comparatively recent investigations of the globular star clusters, which have been found to be symmetrically arranged with reference to the plane of the Milky Way, that have furnished a clue to the great extent of the Galaxy in the central plane of the visible universe amounting to a distance of approximately three hundred thousand light years, a value far greater than any previously assigned to celestial distances. Within six thousand light years of the central plane and fairly evenly distributed above and below it, are to be found nearly all of the stars so far catalogued, including all the naked-eye stars and, in addition, all the irregular and planetary gaseous nebulae. In Fig. 1 is shown a section of the celestial sphere made by a plane perpendicular to the plane of the Milky Way. The crosses represent the positions of some of the globular star clusters projected upon this plane. The equatorial section, A-B, is twelve thousand light years in width and three hundred thousand light years in diameter. Midway between its upper and lower limits lies the plane of the Milky Way the pole of which is at P. C marks the center of the entire system and the globular clusters are distributed symmetrically with reference to this point. The center of the black dot, S, defines the position of our solar system in the Milky Way. The small black dot has a radius of about 1,500 light years. Within a sphere of this radius with a center at the sun lie all stars and nebulae with parallaxes greater than two thousandths of a second of arc. Therefore within the black dot lie all the stars and nebulae, the distances of which have been determined by direct means, that is practically all the stars visible to the naked eye, in cluding such well-known stars as Capella, Vega, Antares, Polaris and, of course, Sirius and Alpha Centauri. Even the most massive stars of the Galaxy, thousands and tens of thousands of times more luminous than the sun, appear blended in indistinct milky light at the distance of C. Only the great telescopes break this misty light up into minute distinctive points of light of the sixteenth or seventeenth stellar magnitudes. These stars form the characteristic star clouds of the Milky Way and it is readily seen from the diagram why one receives the impression of great star density when gazing in the direction of C, from the position of the solar system at S, tho the actual star density may be nearly uniform.

(Continued on page 751)
Women Now Trained as Meter Readers

Can women read electric meters satisfactorily? They can. Even when the meters are located in the darkest cellars. All of which has come to pass because the government had indicated that industries must help produce the needed additional military man power, and a Chicago electric light company has begun to train and employ women as meter readers. To train these new employees a temporary meter readers’ school in charge of the foreman of meter readers has been opened. The equipment consists of chairs and tables, an exhibit of a number of meters and parts of meters, and a large model of a meter dial. This latter is used in meter reading practise, and examinations are held after the class has been thoroly instructed by talks accompanied by demonstrations concerning the construction and working of meters. Twenty or thirty changes are made on the large dial, each student marking down her record each time on a sheet of paper. These sheets are then collected and marked up by the instructor.

TORPEDO TURNS TO STRIKE SHIP

The case of the Norwegian steamer Sommerstad, which was sunk on August 12th off Fire Island by a recurring torpedo, as stated in the official report, has raised the question among experts as to whether the Germans have not utilized the American invention of radio or wireless-directed missiles of that character.

While there is nothing in the official report to indicate that the torpedo which destroyed the steamer took its eccentric course of passing the bow and returning to strike fatally on the port side by the use of radio power, it is not denied that such might be the case.

Secretary Daniels called in an expert when the matter was discuss at Washington. In the latter’s opinion there was nothing remarkable about the return of the torpedo.

He explained that there were well-known mechanical devices, such as the gyroscope, by which a torpedo could be made to go forward from the point of departure for a certain distance and then recurve, as in the present case.

Both the Army and Navy have investigated the directing of torpedoes by wireless from shore, and have found they can be directed just as well as the gyrooscope plan.

An electric lighting company in New Orleans, La., has devised a portable electric light attached to a long pole. The pole is pushed into the ground and the attaching cord connected to the nearest lighting socket. The light is used for illuminating gardens, tennis courts and lawn parties.

The greater efficiency of electric cooking and the consequent conservation of fuel was pointed out in a recent article in Electro-Technich and Maschinenbau. Cases are cited of bakeries in which, other factors being as nearly as possible identical, steam ovens used 0.19 to 0.21 kg. of coal per kg. of bread (i.e., 955 to 1,060 calories), while electric ovens used 0.39 to 0.42 kw-hr. per kg. of bread (i.e., 322 to 359 calories). The power consumption of the electric ovens was 90 kw. and 50 kw. respectively.

SCIENCE IN THE EVOLUTION OF BIG GUNS AND SHELL.

The view below shows one of the laboratories at Sheffield University with a number of the students at that well-known English institution studying closely the recalcence changes occurring in steel by means of the apparatus shown and which are thermally registered. So interesting and important is this particular branch of scientific work, that the King of England, who recently visited this University, was particularly impressed with the results obtained. He manifested great pleasure in observing how an elaborate chart of the changes taking place in the steel under heat treatment in an adjacent furnace, could be registered continuously by a form of tape recording machine working in conjunction with the split-second clock shown in the photograph.
Largest Electric Crane Lifts Complete Tug-boat

The world is fast beginning to realize that American-made goods are the best to be had, and, also that they are built on integrity, and will not collapse like the German character has with great accuracy. In the case of an accidental interruption of electric current, all of the crane's motions are automatically locked by means of brakes, and so ensures the impossibility of dropping the load.

The German Floating Cranes did for the Panama Canal. This "Made in America" crane is said to be the largest ever constructed in this country.

To give a more concrete idea of the amount of work this apparatus can accomplish it may be said that its capacity is equivalent to the weight of 100 of the largest touring cars. The empty lifting hooks weigh about two tons, or the equivalent of a large touring car. When the jib is raised to its maximum height it is over 200 feet above the water level, a height greater than that of an 18-story building. As previously stated, the whole structure is mounted on a flatboat, or floating pontoon, and must not be endangered by handling these immense loads.

The boat contains a complete boiler plant, and an engine driven generator which supplies the electric current for operating the various motions of the crane, which are controlled from a small house mounted high above the deck. By the means of a few levers and master controllers one operator is able to control all the functions with the utmost delicacy.

The speed can always be controlled by the means of the electrical mechanism of the crane. When heavy loads are lowered, the motors are turned into generators and thus the speed is controlled.


The Largest Floating Electric Crane Ever Constructed in America. It is 200 Feet High, and Has a 150 K.W. Engine-Generator Set.

Safety and accuracy are essential, as the crane is used to handle large guns and turrets on battleships, and if thru carelessness or inaccuracy these should be damaged, it would mean a loss of hundreds of thousands of dollars.

One of the illustrations shows the first work with the crane did. The navy tug Massasoit was suddenly sunk in one of the harbors. After divers had past the necessary cables under the tug, the crane rapidly and quickly lifted it to the surface, as shown.

The following data will give a good idea of the enormous size of this machine. Size of pontoon 140 feet long by 85 feet wide by 15 feet deep; size of engine generator set, 150 kw.; the crane has a main hoist consisting of two hooks of 75 tons each, fixed on the jib; an auxiliary hoist of 25 tons capacity movable up and down on the boom; the crane rotates in a circle, the rotating being controlled by two 60-h.p. motors; the boom lifts up and down from a practically vertical position to an angle of about 30 degrees from the horizontal in its lowest position; the lifting is accomplished by two 10-inch screws operated by two 60-h.p. motors; the main hoists can operate separately or simultaneously, as desired; when lifting the maximum load it is operated by two 60-h.p. electric motors; the auxiliary hoist has separate motors for hoisting and trolleying, each of which is 60-h.p. The counter-balance at the rear end of the crane is fixed and amounts to 600,000 pounds; the total weight of the pontoon crane (displacement) is 5,000,000 pounds; the capstans are electrically driven, four in number, one at each corner of the pontoon; the anchor hoists are steam-driven, two in number, one at each end. The main pivotal bearing, or step bearing supports a ball or universal joint and carries a maximum load of 2,021,000 pounds; the speed of the main hoist under maximum load is about 6 feet per minute; the speed of the auxiliary hoist is 20 feet per minute; the speed of the rotation is one revolution in four minutes; speed of lifting boom, entire range 12 minutes. The boom is of the cantilever type.

Photos courtesy Westinghouse Electric & Manufacturing Co.
SELLING ELECTRICITY BY THE "CAN."

ELECTRICAL Main February, 1919

W e of this generation are quite familiar with the method of supplying kerosene and gasoline by the "can," but who ever heard of selling electricity by the can? But such an arrangement promises to come into vogue in Chicago, where the new "metering can" here illustrated has recently been developed and perfected. It has been protected by United States patents issued to Mr. E. O. Switzer, of Chicago, Ill., and the various details have been practically all worked out, including the design of the metering element for direct current as well as alternating current service. Owing to the abnormal conditions resulting from the great war, it was not deemed advisable to try to put this device so far on the general market, but now that peace conditions are with us, the concern who has developed this remarkably simple device are getting ready to place it on the general market. This "metering can," as it may be called, is intended to take the place of the conventional watt-hour meter, or kilowatt-hour meter, especially for small current consumers, where it is firstly—quite expensive to install a watt-hour meter, and secondly, considerable expense is incurred on the part of the operating company, by having these meters read by professional meter-readers every month. When these metering units have become available, all Mr. Householder will have to do will be to go to the electric light company or their agents, and purchase several of these cans. These he takes home and uses one at a time as necessary. The apparatus works on the electrolytic principle, a certain amount of metal being acted upon by the passage of the current thru it, and after a certain number of hours the metal will have been sufficiently eaten away to open the circuit.

The measurement of current depends upon the electrolytic action of a small copper cylinder of known weight, this being gradually disintegrated by electrolytic action during such time as the current may be used to light lamps or operate motors, etc., but is unaffected during the time when no current is being used. The electrolyte used either for D. C. or A. C. is a saturated solution of copper sulfate. These metering cans are arranged to give a warning signal so that the householder will know ahead of time when he should replace one of the units with a new one. The accompanying photographs show how the metering can is plugged into a wall receptacle in a very simple manner. The meter can here illustrated is so constructed as to be enclosed in a metal case, as to remove all chances of tampering with it or derangement by accident.

As aforementioned, the can is provided with a projecting contact arm which is inserted in the keyhole of a switch box. It is then given a slight twist to engage the contact with the spring clips of the main circuit and left there until the predetermined amount of current has been consumed. Truly it may be said that this device will mark a new era in electric service to the public.

NEW ELECTRIC FURNACE REGULATOR.

The device is installed easily, and when once in operation relieves the householder of all of his cares in relation to the furnace except the merely mechanical process of "putting on coal." The time clock arrangement makes it possible to maintain a low temperature during the night, and at the time set in the morning, opens the drafts and increases the temperature to the point desired.

This device consists of a thermostat with a clock attachment which operates a motor in the basement, which, in turn, regulates the drafts and dampers of the furnace. Two types are provided, one for use in houses already wired for electricity, and the other in which two dry batteries supply the impulse from the thermostat to the motor box, and a spring motor operates the drafts and dampers.

In the type used in houses already wired the alternating current motor is connected to the alternating main house wires. A transformer on the bottom of the motor box steps the 110 volts down to 6 volts, for use on the thermostat circuit. Thus the dry batteries are dispensed with. The diagram shows clearly how the regulator works. The thermostat may be set at the heat desired and it will keep the room in which it is installed at that temperature, because if the temperature falls the motor in the cellar will operate sufficiently to open the drafts and increase the heat. The reverse is true when the temperature rises. The thermostat should be installed in a room as near the center of the house as possible and should not be in such a position that its action is subject to the effects of drafts from doors and windows opened for only a moment. — (Photo courtesy W. E. Co.)

Section and Diagram of "Metering Can". 1. Series Resistance. 2. Copper Leads Forming Part of Main Circuit, and Making Connections with the Anode. 3. Protecting Tubes of Hard Rubber. 4. Solid Copper Cylinder Forming Part of Main Circuit, and Connected to Copper Lead at its Upper Terminal by Means of Special Solder Which Melts at 60 Degrees. 5. Copper Cylinder. 6. Copper Sulfate Solution. 7. Rubber Washers. 8. Copper Anode. 9. Shunt Resistance.

Automatic Electric Regulator Which Tends the Furnace Drafts for You. It Comprises a Thermostat, Clock, Motor and Battery or Other Sources of Current.

A mong the hundreds of new devices and appliances published monthly in the Electrical Experimenter, there are several as a rule, which interest you. Full information on these subjects, as well as the name of the manufacturer, will be gladly furnished to you, free of charge, by addressing our Technical Information Bureau.
ELECTRICAL

AN ILLUMINATED SERVICE FLAG FOR HOME AND STORE WINDOWS.

An enterprising electrical concern of Milwaukee is now offering the device shown in the accompanying illustration, known as the "Honorlite," which is made in a form to take the place of a military service flag. The device consists of a handsome indestructible wood pulp pedestal with two modelled eagles holding a flat alabaster globe, which is 8 inches in diameter. A 3-by-5 inch service flag is shown on one face of the ball, while five blue stars are furnished loose and can be attached to the circumference or face of the ball as desired. This decorative device stands 12 inches high by 6½ inches wide at the base, and is wired with 6 feet of cord and plug. It is pointed out by the maker that this device is one which can be used for other purposes, such as special advertising and as a special window display.

A NEW "INDUCTOR" TYPE MAGNETO FOR AUTOS.

This new auto and motor-boat ignition magneto is of the inductor type, which means that the coils in which the current is induced are stationary, and the revolving part or rotor consists merely of a block of laminated steel. Instead of horseshoe magnets, as always used in the conventional type of magneto, this magneto employs straight bar magnets, which are accurately ground and securely clamped to top and bottom yokes. The bottom yoke forms a pole piece extending nearly half way around the rotor tunnel, while the top yoke has two poles, one carrying the windings or coils, and the other serving as a magnetic by-pass. The magnetic circuit is shown diagrammatically in the two accompanying sketches. In one the rotor pole is shown opposite the pole of a top yoke which carries the windings or coils, and with the rotor in this position, the maximum flux passes thru the coils. In the other sketch the rotor is shown opposite the end of the magnetic by-pass, and in this position all of the magnetic flux passes thru the by-pass and none thru the coils. As the rotor has two poles, the flux thru the coils passes thru a maximum and a minimum twice during every revolution of the rotor.

As all coils and current carrying parts are stationary, there are no slip rings or brushes, except the brush in the distributor. The distributor gears, of bronze and steel, are of ample dimensions, and in connection with the rotating member of the current distributor, are carried in steel and bronze bearings, the sleeve of which is cast integral with the front die casting. The base and top yokes are made of gray iron, and are tied to the die-cast end plates by screws. They are located in place by dowel pins. The field structure is bored and ground as a unit, thus insuring thoroughly accurate alignment of the yokes and poles faces. The stationary coil, condenser and laminated pole piece are assembled as a unit and mounted integral with the top yoke.

This new inductor magneto gives two sparks per revolution. The spark characteristics are said to be such as to give very effective ignition, the current rising suddenly to substantially its maximum value at the beginning, and being well sustained. One feature that distinguishes the spark obtained from this type of magneto compared to that obtained from other magnetos, is that it passes thru the gap of the spark plugs always in the same direction. That is to say, the same part of the spark plug is always positive.

AN ELECTRIC "MOVIE" MACHINE FOR THE PARLOR.

A new type of moving picture machine for commercial, educational and home use has just been brought out by a New York concern.

Its special features are electric motor drive, by a motor that can be used on both direct and alternating currents; high illumination, and a feed mechanism that gives practically perfect results.

Motor drive was used on the older types, but it was necessary to have separate motors for the different kinds of current, and this naturally limited the use of the motor driven machines. The new motor used here, however, operates at practically the same speed with either kind of current. Hence this machine can be used wherever there is electric light.

The illumination is provided by a 14-volt, 2-ampere, argon-filled, high efficiency light, that is sufficiently brilliant for throws as long as 100 feet, and for pictures up to 12 feet wide. The 110-volt current received from the lighting circuit is reduced to low voltage for the use of the lamp, by means of a rheostat; this rheostat is adjustable, so that the degree of illumination can be varied to suit conditions.

The film-moving mechanism is of the intermittent type and is of a novel design. The manufacturers claim that this projector projects an absolutely flickerless picture.

This machine is safe to use since it can take only slow-burning films, the standard celluloid film being unusable in it. Many hundreds of these special films have already been made up; special subjects can be made up as desired, and standard films can be copied on to the special stock.

The weight of the machine is 23 pounds and it is arranged for packing in a carrying case similar to a small dress suit case.

India has increased its annual coal production to 12,000,000 tons and is introducing electrical machinery into some mines.

An electric alarm clock which awakens deaf sleepers by jarring their beds has been invented in Germany. They need it.

A NEW ELECTRIC HORN SWITCH.

Something new in the way of an electric horn switch or push button, for Ford cars, has been recently put on the market. It is attached to the throttle lever by means of two small clamps, and therefore is always within reach of the hand without an extra movement.

You Have Often Wished for a Small "Movie" Machine for the Parlor—Here it Is. Its Universal Motor Operates on Alternating or Direct Current.

The device is a tube-shaped cylinder about ½ inch in diameter and 3 inches long, which contains contact point and wiring, which are cemented in place to insure durability and safety from dampness. The connection is made to the regular equipment by cutting in on the main wiring on the post.
Amateurs Win Questionable Victory

By H. GERNSBACK

Pyrrhus, when congratulated by his friends on the occasion of his victory over the Romans under Fabri-cius—but which cost a terrible slaughter of his own men, threw up his hands and exclaimed: "Yes, but one more such victory, and we are done for!"

attempted any nation wide movement to secure the defeat of the bill in question, save and only the Electrical Experimenter. At this very time a few thousand letters, no concentrated effort was made to appraise the entire radio fraternity as was done by this publication. About 50,000 letters were mailed out to all radio amateurs interested, and the response we know has been nothing short of wonderful. The writer was in receipt of thousands of letters from amateurs, who in turn in concert with their friends had protested vigorously to Washington, with the result that the amendment printed elsewhere in this issue came about.

Not only that, but the press was also appealed to as well, and many papers publish comments and express themselves in no uncertain language about the drastic and entirely unjustified measure known under the title of H.R. 13159.

The surprising thing however was that none of the other technical publications—there were only two of them commenting about the bill at all—had the situation right in hand. One publication which professes to have the interests of the amateur at heart did not even know that there was such a thing as the Padgett bill! Not one
Alexander Wireless Bill—Amended

65TH CONGRESS, 3D SESSION, H. R. 13159.

IN THE SENATE OF THE UNITED STATES, December 11, 1918.

Referred to the Committee on Commerce and ordered to be printed.

AMENDMENTS.

Intended to be proposed by Mr. Watson to the bill (H. R. 13159) to further regulate radio communication, viz.: On page 2, after line 8, add the following:

"The word amateur, or private, station shall be construed to mean any radio station operated by a citizen of the United States for the benefit of himself and science, and which does not employ commercial radio communication."

On page 2, line 14, insert the words "private or amateur before the words "technical and training schools stations.""

On page 2, strike out section 3 and in lieu thereof insert the following:

"First. The wave length of private or amateur stations shall be from one hundred and fifty meters to two hundred and twenty-five meters.

Second. The Government shall have the right to stipulate that the power used by private or amateur stations shall not be greater than five hundred watts as measured in the antenna circuit, except by special license and shall not be greater than two hundred and fifty watts as measured in the antenna circuit, except by special license, within one hundred and fifty miles of any seacoast, lake front of the Great Lakes, or coast of the Gulf of Mexico.

Third. The Government shall have the right to prevent all persons below the age of fifteen years to use, operate, or own any sending outfit or to engage in the receiving of radio disturbances into the ether.

Fourth. The Government shall have the right to require all private or amateur stations to be licensed, and failure to procure a license shall be punishable by a fine not exceeding $600.

This is wholly satisfactory in all respects. It would give the twenty-five to more meters to operate on than he has now. The present wireless law confines the amateur to 200 meters.

We can see no fundamental objection against this.

"Fifth. The Government shall have the right to require all owners or operators of private or amateur stations to pass an examination whereby the operator of such station shall be able to receive ten words a minute before said operator may be licensed to operate any sending station.

"Sixth. Private or amateur station operators shall not be permitted to operate unmanned sending outfits of greater capacity than two hundred and fifty watts as measured in the antenna circuit, except by special license, within the territorial limits of the United States.

This restriction to us seems to be too severe. We should like to see 15 K. W. inserted instead.

We see no fundamental objection to this, except that it seems rather mysterious to us why regulations should require an examination to pass ten words a minute. What good does the receiving do him? Perhaps the framers of the bill meant "send" not "receive."

Object most strenuously against this unjust measure. There is no necessity for licensing receiving stations only. Our jewelers, thousands of them scattered all over the country must have receiving stations to receive accurate time from Arlington and the like. Not many would want to be licensed under this measure. Secrecy in wireless is impossible anyway. If anyone must receive signals he can do so very readily and easily anyway, law or no law. Important messages are never sent out by the Government or commercial companies unless they are in code. On top of this the present wireless law already has penalties for divulging contents of messages.

"There is no occasion or necessity for such a drastic measure at the present time. It is not justifiable to take the present antidote which has been carried on for the last month in Washington, the thousands of protest letters sent to Senators and Representatives, as a fair indication as to how the wind blows, we think we are correct in saying that the temper of the statesmen in Washington may not be such as would support legislation of this kind at this time.

We might write volumes why amateurs should not be supressed, but we believe that official Washington today understands the situation fully. They know by this time what service the amateurs have rendered their country, and how many thousands of expert operators were recruited into the Army and Navy at the outset of the war. Congress will surely not blot the amateurs out of existence in recognition of their work, particularly when there has not been advanced one single, solitary, good reason why the amateur should not be allowed to pursue his innocent endeavor.

America, the greatest democratic country in the world, the one that cherishes the highest ideals of any nation, is not going to start in at this late date to take away the liberties of hundreds of thousands of loyal citizens who have already proved their worth, and will do so again.

In printing the amendment to the Alexander bill below, we call particular attention to paragraph 13. This constitutes nothing but a joke, for the bill below becames a law, and if the Navy Department was in power, it could very readily and without any trouble whatsoever prohibit the sending of messages, let us say, between the hours of 5 P.M. to 1 A.M. This, in the language of the bill, would be "definite periods of the night or day."

If we would have a law, let us have a law without "ifs" and "buts". Paragraph 13 is entirely too elastic in favor of the Government and would inevitably result in shutting the amateurs out at the slightest pretext.

There are certain things in the amendment which are undoubtedly satisfactory to everyone, but as a whole, we are not in favor of the measure. It is too autocratic, particularly the clause whereby it would be necessary for amateurs who had receiving apparatus only to secure licenses. Not one in a hundred would wish to go to the trouble of obtaining a license for very obvious reasons. It has been found in the past, that wherever an amateur had to obtain a sending license, it was done most reluctantly, and it was the cause of keeping thousands of amateurs away from wireless. It would work even more disastrously if every receiving station were to be licensed. Most of the jewelers—who receive time by this method—would not operate receiving outfits for the word, "Government License", to many simple folk means a big undertaking, and in many cases when a young man finds out that he must obtain a Government license in order to have his wireless sect, he prefers to be without it.

What good is it anyway to license a receiving wireless station? If a record of amateur stations is wanted in Washington why not let us insert a clause in the bill which would make it compulsory for every manufacturer or seller of wireless apparatus to give a list of the amateurs buying such instruments, which to all intents and purposes would be the same thing as licensing and thus frightening the amateur. This system was in vogue during the war where it became necessary for all manufacturers to supply a list of radio sales to the Navy Department.

No manufacturer would object to this, we are certain, and as the government would then have the list of names it would work out the same without discouraging thousands of amateurs.

The Alexander bill, amended, follows with our comments in parallel columns:

(Continued on page 735)
President Wilson Always in Touch with Washington—via Radio

For several days, going and coming in completing his mission to the European peace conference, it was and will be necessary for the President to administer the affairs of Government from the high seas. Unique as this situation is, hardly less so were the preparations made to enable him to keep in communication with the world during the voyage.

What is considered the most powerful wireless system ever installed on any ship is that carried by the steamer "George Washington." A corner of the wireless room, fitted with the latest radio devices, is seen in the accompanying picture.

Special arrangements never before used were made for handling President Wilson's wireless messages and to keep him in constant touch with Washington.

This announcement was made by Secretary of the Navy Daniels in connection with a statement that the Navy Department was in continuous communication with the "George Washington" and the battleship Pennsylvania on their trip from New York.

Means were at hand whereby he could be brought instantly into communication thru the powerful radio station at Abpoeon, Md., and Arlington.

Mr. Daniels said:

"The George Washington and the battleship Pennsylvania are both equiped with the most modern radio apparatus, some of which was installed for this particular trip.

"This apparatus includes, on the Pennsylvania, the most powerful transmitting set on any United States naval ship and also special receiving apparatus for receiving from high power stations used ordinarily only for transatlantic messages. The George Washington was also especially equiped with similar receiving apparatus. On board both ships were installed radio telephones and the newest type of low power sets. These only in communicating from ship to ship. The George Washington and the Pennsylvania were thus able to communicate with each other and at the same time receive messages from shore.

"All messages for the President were sent by the new naval high power station at Annapolis, which is five times as powerful as the Arlington station. These messages were received by the George Washington and the Pennsylvania simultaneously. All replies were forwarded from the George Washington to the Pennsylvania and then instantly relayed to shore by the Pennsylvania.

"At three special naval radio receiving stations, one in Maine, one in New Jersey and one in the Navy Building, Washington, expert operators listened continuously for the Pennsylvania's messages. The messages when received were forwarded with utmost despatch to the transatlantic radio division of the office of the Director of the French high power stations forwarded messages direct to the ships. The President was thus kept in touch with Washington and Paris or London simultaneously, for the George Washington easily received the messages sent from the Annapolis station until the end of the voyage and the ship was in Brest, France."

The first Cabinet meeting in all history, directed to a certain extent by wireless from mid-ocean, was held in the White House on December 10th, with Vice-President Marshall officiating in the President's absence.

A wireless message from the George Washington asked Vice-President Marshall if he would preside and the latter assumed his temporary duty as acting President.

President Wilson was in constant communication with the United States and France during his entire voyage from the United States to France thru the Pennsylvania's powerful radio transmitting and receiving sets. The Annapolis high power transmitting station, transmitting on 16,000 meters, the high power transmitting set at New Brunswick, N. J., transmitting on 13,000 meters, the high power transmitting set at Tuckerton, N. J., on 9,200 meters and the high power radio station in Lyons, France on 15,500 meters were used for communications to and from the President.

The President on board the U. S. S. George Washington was conveyed by the U. S. S. Pennsylvania (which is the best equiped ship aloft for signaling purposes in regard to radio communications) and five torpedo boat destroyers. The Pennsylvania's radio equipment consisted of the following apparatus: One 30 kilowatt Federal arc transmitter, which was used for transmitting messages to the United States and France on 3,000 meters, one 10 kilowatt Lowenstein spark transmitter, transmitting on 600 and 952 meters, which was used for intermediate communication with low power coastal stations; one short range radio telephone transmitter, transmitting on 207 meters and one vacuum tube short range transmitting set, transmitting on 450 meters, which were used for intercommunication between the Pennsylvania and U. S. S. George Washington.

The Pennsylvania transmitted messages direct to the United States up to a distance of 2,500 miles. Communications with (Continued on page 743)
THE Harvard Radio School has developed hundreds of expert radio operators for the United States Naval Service, and a group of them are here illustrated practicing with one of the portable wireless outfits which landing parties use. It is surprising how quickly they can erect an aerial mast and connect the various instrument cabinets together with the dynamo, ready for instant service. It is all a matter of discipline, the commanding officer will tell you. Discipline and system whereby each man does a certain thing, but does it well. That in a nutshell is the whole secret of Uncle Sam's naval efficiency. These men are trained to perform their duties with clock-like precision, and each move in erecting the wireless set here shown is done identically the same each time, which is the only way that real speed can be obtained. Unlike the German system, Uncle Sam's boys are trained not only to do a certain thing in a complex task and to do it well, but they are each and every one of them educated and carefully instructed on all the details governing the operation and functioning of the complete radio outfit. Thus in an emergency any one of these radio men can do anything from tapping the key to erecting or disassembling the gasoline engine driving the dynamo, in the event that it fails to work, and ascertain just what the trouble may be. It has been a great task to train all of these thousands of radio operators in the various complex branches of the art, but Uncle Sam's radio instructors, both naval as well as civilian, have proven their worth.

345 MARCONI RADIO STATIONS BOUGHT BY U. S. NAVY DEPARTMENT.

All of the American Marconi radio stations, except the four high power plants, have been bought by the Navy Department, a Washington dispatch of December 5th stated. At the same time it developed that the department purchased the great Sayville station recently from the Alien Property Custodian along with the Marconi purchases. The American Marconi company relinquishes the field of handling ship to shore messages.

The purchase includes all Marconi coastal stations, nineteen of which are situated on the Atlantic and Gulf coasts, sixteen on the Great Lakes, and ten on the Pacific coast. The four high power units which the company still retains include the Belmar-New Brunswick station in New Jersey, for transmission of messages to England; Chatham-Marion, Massachusetts to Scioodonia; Marshall-Bolinas, California to Hawaii; and Koko Head-Kahuku, Hawaii to Japan. Two units represent each station, each about fifty miles apart, one being utilized for transmission and the other for receiving.

In taking this station the United States is merely following the lead of other nations in controlling the ship to shore business. England took over these stations on her coast 12 years ago, and since that time they have been operated by the Postal Department. The same applies to France, Italy, Germany and countries in South America. Brazil has always operated her coast radio stations.

An official of the company points out that the cream of the business in the future will be the transatlantic message traffic. The ship to shore business has been rapidly forwarded, and with the exception of a few ships the private business aboard ships or to them has never been large. At the same time development of the transatlantic business is going forward, and when the Government relinquishes control of these big stations, they undoubtedly will produce big results for the company.

The price paid by the Government is not announced at this time although it has been definitely settled. The Government has also purchased from the Marconi Wireless Telegraph Company of American wireless apparatus on some 300 ships now under Government control. An announcement to that effect was recently made by Edward J. Nally, vice-president and general manager of the company.

The sale of apparatus to the Government Mr. Nally said, is "the first result" of a change in the company's policy whereby "it will in the future sell as well as lease wireless apparatus."

A recent London dispatch quotes Godfrey Isaacs as saying that the Marconi Company would outfit airplanes employed in air passenger and mail service with wireless and would supply operators in the same way as it now serves ships. It is also intended to receive regular reports on air conditions in different localities and to circulate these for the information of the pilots. As every airplane will have either a name or distinguishing number, it will be possible to send telegrams from any part of the world or from any ship to an airplane. It is intended that this organization will be ready by the time the peace is made.

Arrangements recently have been made for the erection of wireless stations in the extreme parts of China, one on the frontier of Cashmere, and another on the Chinese side of Siberia. Mr. Isaacs has arranged with Handley-Page for the transport of the necessary machinery by one or more of his big machines. The journey will take two or three days in place of the same number of months.

NAVY MODIFIES RADIO RULES.

Naval conditions in the North Atlantic are such now that restrictions upon commercial radio communications are being removed, according to an official announcement. Personal and commercial traffic with naval vessels as well as with merchant vessels is now permitted west of the 40th meridian.

The restrictions upon land wire telegrams addressed to naval personnel on board naval vessels, which caused such telegrams to be forwarded thru the Bureau of Navigation, have been removed, and it is now permissible to address personal telegrams direct to men on naval vessels in an American port. Restrictions on amateur wireless stations have not been lifted.
ELECTRICAL EXPERIMENTER
February, 1919

Vacuum Valve Action and the Electric Current

By K. G. ORMISTON, ASSOC., I. R. E.
RADIO INSTRUCTOR, HEALD'S ENGINEERING SCHOOL, SAN FRANCISCO

Nearly all text-books on physics and electricity state that the direction of the electric current in the terminal of the source of pressure to the negative terminal. The average radio student, from the time he first takes up the study of electricity, is taught that the positive pole of a battery or dynamo is in a state of high pressure and the negative pole in a state of low pressure, and that the direction of the electric current is from positive to negative. This conventional theory is quite satisfactory until the vacuum valve and its action is considered; then the confusion begins.

Figure 1 represents a vacuum tube with the filament heating circuit and plate circuit. (The grid is omitted as it has no bearing on the present discussion.) The positive terminal of the battery B is necessarily connected to the plate P. In studying the action of this circuit the radio student is asked to believe that the current in the plate circuit flows from the positive terminal of the battery to the negative terminal; that is, from positive to negative within the tube, in spite of the fact that the ELECTRON STREAM IS FROM THE FILAMENT TO THE PLATE.

In this connection the leading text-books make the following statements:

1. "Using the ordinary convention for the direction of the current flow (which is opposite to the direction of flow of the electron stream), we say that a current flows from the plate to the filament." 2. "It will prevent confusion . . . if the student understands that inconformation with the old theory electricity FLOWS IN THE DIRECTION OPPOSITE TO THE FLOW OF THE ELECTRONS."

3. "The number of electrons drawn from F to P per second, that is, conventionally the current from F to P, is found to be roughly proportional to the square of the field intensity."

The instructors in a certain Government Radio School are in their efforts to "conform with convention," even go so far as to teach that positive ions flow from the battery B to the plate P to neutralize the negative electrons discharged from the filament to the plate, and thus endeavor to show that a current actually flows from positive to negative. But these instructors fail to explain how positive ions, WHICH ARE ATOMIC IN SIZE, can flow freely thru a copper conductor or a vacuum!

It is my personal experience that much confusion is caused by the lack of a better understanding of vacuum valve action, as well as certain other phenomena, is gained if the radio student is taught from the start that the electric current is in reality a flow of negative charges, or electrons, from the negative (high potential) to the positive (low potential) pole of the source of E.M.F.

The above statement concerning the direction of the electric current is not a theory; it is a conclusion drawn from experiment. That the electric current consists of a movement of ELECTRIC CHARGES can readily be shown by the following simple experiment.

In Figure 2, P is an insulated metal plate. G is a sensitive D'Arsonval galvanometer, connected between the plate and the earth. The simple circuit of the galvanometer is shown in the accompanying diagram. The terminal plate is connected as shown, with the zinc or negative terminal of the cell connected to the same side of the galvanometer as the metal plate P. R is a gutta-percha rod, which is held in the hand and may be electrified by rubbing with cat's fur. The gutta-percha rod, which is negatively charged, will become negatively charged. When the charged rod is moved near the plate P, the galvanometer will deflect in a certain direction, let us say to the right. The deflection of the galvanometer is caused by an electric current passing thru its windings, and the current must consist of negative electric charges.

Negative charges may be repelled from the plate by the presence of the negatively charged rod, and flow thru the galvanometer to the cell. These charges may be attracted from the earth and flow to the plate. In either case, it is the flow of electric charges which produces the effect of an electric current. It would be expected, when the charged rod is removed the galvanometer deflects in the opposite direction, that is, to the left. Only if the rod R were to electrify the plate P will either the negative charges which were driven from the plate to the earth, return to the plate, or releases the excess of positive charges which were repelled to the plate and pass off to the earth.

During the first part of the experiment the key K has remained open. Now place a heavy shunt on the galvanometer, so that the current from the simple cell cannot damage the instrument. Then close the key K. The galvanometer will deflect TO THE RIGHT. Note that the deflection is in the same direction as when the charged rod was made to approach the plate P, and therefore either negative charges are flowing thru the galvanometer from A to B or positive charges from B to A. We can now draw this conclusion: The electric current consists of either a stream of negative charges flowing from the negative terminal to the positive terminal, or a stream of positive charges from positive to negative, or possibly both.

The smallest possible electric charges, both positive and negative, have been isolated in the electron microscope and other scientists, and their mass and velocity are definitely known. The smallest charge is negative in sign, that is, it shows the same characteristics as a gutta-percha rod when electrified to approximately 1/1800th the size of the smallest atom (hypothetical atom). The smallest positive charge is found in the atom which has lost one or more electrons, and is therefore atomic in size. This smallest positive charge, which is but an atom deficient in negative electricity, is called an ion.

It is evident that the positive ion cannot act as a carrier of electricity in a solid medium, or in a vacuum, on account of its size which must be at least as large as the smallest atom. But the electron, bearing the negative charge, can easily pass between the atoms of a solid conductor.

From the experiment of Figure 2, we conclude that the so-called electric current consists of a stream of electric charges, either positive or negative. Thompson's measurements show that the positive charge cannot flow (in the media with which we are dealing); therefore, we may state that the electric current is a movement of electrons (negative charges) from the negative pole of the source of pressure to the positive pole.

For further proof let us again consider the vacuum tube circuit. We have a circuit connected to the battery B, made up of copper conductors and the space F—F, which is devoid of all matter. The electron A is an atom that an electric current flows in this circuit. Since no ponderable matter exists in the vacuum tube, the only possible carriers of electric charges within the tubes are electrons. The filament F is heated to incandescence in order that ionization will take place, and electrons will be emitted from it. It is necessary, in order to have any current at all in the plate circuit, that the positive pole of the battery B be connected to the plate P, so that the negative charges (electrons) will be attracted to the plate rather than repelled from it. With the arrangement of Figure 1 there will be a stream of electrons or negative charges flowing from F to P within the tube, and it follows that the current in the plate circuit indicated by ammeter A must consist of the movement of electrons from the NEGATIVE pole of battery B to the POSITIVE pole.

Let us not be hampered by "convention" and "old theories," but endeavor to seek the Truth. Then Progress will be assured.

Figure 1

Experimental Circuit Which Students Are Trained to Learn The Actions of and Which Proves the Audion Explanation Here Set Forth. G is a Sensitive D'Arsonval Galvanometer Cell, K Represents a Key, E the Earth Connection, P a Metal Plate, R a Gutta-Percha Rod, Which Can Be Electrified.

Fig. 1

Fig. 2

This Diagram Represents a Vacuum Valve Circuit. Minus the Grid Which Does Not Enter into the Present Discussion. This Article Discusses the Direction of Current Flow Thru the Valve—a Mooted and Foggied Point to the Radio Student. How to Read the Current Pass thru Filament to Plate Or Vice Versa?

K. G. ORMISTON.

Los Angeles Polytechnic High School are required to possess this textbook. See "Elementary Electricity," by Prof. H. LaV. Twining.

*All students in elementary electricity at the

K. G. ORMISTON.
THREE GOOD "HOOK-UPS" FOR A SMALL RECEIVING SET.

Four instruments are needed for this simple receiving set, and all are of the "K. I. Co." make. They are, one small tuning coil, one miniature detector, one sext condenser and one pony telephone receiver. In the diagrams, which are self-explanatory, A is the aerial; G the ground; T.C. the tuning coil; M.D.—miniature detector; F.C.—sixth condenser and P.R.—pony receiver. With a suitable aerial and ground system, you will be surprised by the good work this little set will do. It is interesting to try the different "Hook-Ups" to find which works best in your locality.

Contributed by FRED FLOYD, JR.

HOW TO LEARN THE INT’NL CODE ABBREVIATIONS.

The attached drawing is that of a rotating dial to be used in quickly ascertaining the definition of the various International Radiotelegraphic Abbreviations. Such as:

QRA? What ship or coast station is that? QSA? Are any signals strong?

As shown in the drawing the bottom or larger disc is made stationary to a wooden base and upon it the various definitions are printed above the QR’s and below the QS’s, so that when the smaller disc, firmly held by the rod holding the handle, is rotated in alignment with the letters of the alphabet, the definitions are indicated thru the slot cut in the rotating disc.

Contributed by E. T. J.

EFFICIENT GALENA DETECTOR.

Everyone is sure to have a small piece of brass rod for which he can find no use. The hard rubber top to an ink bottle in connection with a brass cap from an old dry cell forms a cup. A garage will give you all the slightly worn ball bearings you can use and you need but two. If you have never broken a ruler with a brass strip in it you are a wonder. A few screws, a nut, a couple of binding posts and a piece of board or fiber and you have the makings of a good detector. The accompanying illustration tells the rest. Once you have the tension screw, all you do is hook her up and with a second’s adjustment (which won’t knock out) in come the signals fine and clear.

Contributed by H. C. BENEDICT, JR.

NOVEL BUZZER PRACTICE SET.

In the drawing (A) is a key of any type, mounted on a board as shown. (B) is a buzzer of high pitch. (C) is a coil of wire which is wound non-inductive; an inductive coil will not work. This coil may be made by using 50 feet of No. 24 insulated wire, doubling it and winding it double, starting with the loop end. Why this is done need not be explained here. (D) are the battery binding posts, and (E) are for the phones. A 75 ohm resistor will work fine.

Contributed by M. ABRAHAM.

A HANDY ADJUSTABLE CONDENSER.

The feature of this condenser is that the capacity units are stationary and therefore least apt to get out of order; the switch element only rotates. The builder can make the condenser of any size desired. The case is made of hardwood, sandpapered and varnished in the usual way. This condenser has been found suitable for every kind of work where an adjustable capacity is employed. The scale is read thru an index window attached to the moving switch blade.

Contributed by H. B. MASSINGILL.

DEAD-END SWITCH.

The ends of coil units are brought to switch points, one on each end of wire, (1, 2, 3, 4, 5, 6, 7). Note the fiber or other insulating plate, carrying at the under edge brass strips (C) which, when disc is turned (by knob B) connects the switch points over which the strips lie. D is a brass strip which makes contact only with outside row of points. Suppose (D) were on point 5. Then the pairs 1, 2 and 3 would be connected, but 6 and 7 would be entirely out of circuit, because (D) touches only the outside switch point. D connects to ground.

Contributed by HERBERT RICHTER.
The Vortex Ring Theory of the Electron

By F. W. RUSSELL and J. L. CLIFFORD

The discussion of the various theories of matter is one of the most important problems that confront the scientist today. Chemistry, Physics, and nearly all branches of science hinge upon this question. The atomic theory has been thoroughly established, but

They claim that the electron is nothing more or less than a minute whirl in the ether, or as we shall call it an ether vortex ring.

When Lord Kelvin brought forward about 1870 his famous vortex ring theory of the atom, the scientific world hailed with them the same material with which they issued from the box, and seemingly possess elasticity of form. Altho many interesting phenomena may be observed using this simple form of apparatus, for accurate and detailed experiment the liquid ring apparatus, described below, will be found the more practicable.

The first requisite is a glass tank at least 30 inches long by 12 inches wide and high. A gold fish aquarium will answer the purpose, provided it conforms to the dimensions. If an aquarium is not available, a tank may be easily constructed by making a box with the base of wood and the sides of glass plates. This box should be well coated with asphaltum in order to make it water tight. When the experimenter has provided himself with a suitable tank, the next problem which confronts him is the construction of the "gun" or projector with which to generate the vortex rings. An efficient gun may be easily manufactured from odds and ends to be found in any experimenter's laboratory. As may be seen in the drawing, Fig. 1, the two principal parts of the gun are the liquid container and the electric agitator. At one end of the liquid container, which consists of a round tin box, is fastened a diagram of the ultimate structure of the atoms is still an open question. The leading theories of today make use of smaller particles called electrons to form their hypothetical atoms. These particles were first discovered by Crookes, and about 1897 were definitely proved by Weichert, and Sir J. J. Thomson, to be negatively charged particles traveling with the enormous velocity of nearly 180,000 miles per second. In addition it was found that these particles had an extremely small mass. In fact about one eighteen-hundredth the mass of an hydrogen atom, the smallest known atom. The presence of these particles was again proved by the disintegration of Radium, and even an electric current is now believed to be a flow of these electrons. The electron then is one of the most important entities in the world today, and yet there are very few theories as to the nature of the electron. The physicist has side-stepped the problem in the past by simply calling it a hard negatively charged corpuscle, but what a hard corpuscle is, is left to the reader's imagination to picture. Lately, however, the new school of French physicists have brought forward the theory which seems most complete and astounding delight this tangible explanation of the structure of the atom. Upon the discovery of the electron, however, the vortex atom theory was thrown into the background and into obscurity. Since the new theory of the electron has been proposed, however, it is interesting to repeat and discuss the experiments with smoke and liquid rings performed by the experimenters wishing to prove the vortex atom theory.

The simplest form of apparatus needed to produce rings of smoke is a round cardboard box with a small aperture in one end. If the box is filled with smoke or with fumes of Ammonia and Chlorid formed by the action of Ammonia and Hydrochloric Acid, and the opposite end tapt sharply, rings of smoke will be projected from the box and will hold their shape for some time. The rings move swiftly forward, carrying with

Phosphor-Bronze sheet or other flexible substance. In the opposite end, which may be the cover to the box, a small hole about \( \frac{1}{8} \) of an inch is cut, care being taken that the sides of the hole are smooth in order to insure perfectly formed rings.

Here We See the Actual Vortex Ring Apparatus Set Up in the Authors' Laboratory.
The box should be made water tight. As may be seen in the drawing the agitator consists of a strong electric bell with the gong removed, and the leads taken directly from the coils. The bell should be well impregnated in paraffine or other insulating compound so that it may be submerged without danger of short circuit. The bell should be so placed that the striker will strike the diaphragm of the diaphragm, a hollow blow when the magnets are energized. The best position for the striker can only be determined by actual experiment.

When the projector has been completed, if the experimenter wishes to use red colored rings, the liquid container should be filled with Sodium Hydroxide and Phenolphthalein. Be sure that all the air has been expelled, as any air in the container causes the rings to be irregular. The gas is then lowered into the tank, and the magnets energized by means of batteries, controlled by a telegraph key. Rings will be seen to issue from the aperture, and traverse the length of the tank intact. If the water is slightly acidulated with Sulfuric Acid the rings will immediately disappear upon breaking up. If the experimenter wishes to make milk-white rings, an emulsion of Silver Chlorid can be used that will become colorless in a weak solution of Ammonia. To make such an emulsion a tablespoonful of gelatin should be dissolved in about a liter of hot water. About 15 grams of Silver Nitrat previously dissolved in water should be added. Then stirring well, add a weak solution of Hydrochloric Acid until the Nitrat is all precipitated as a chlorid. This milk-white solution should be diluted with equal parts of water before using. Rings of this solution shot out into a weak solution of Ammonia, will hold their form until broken, and will then completely disappear. The amount of current necessary for each gun can only be determined by practice, and the nature of the rings wished. After some practice, the key can be so manipulated, as to produce swiftly, or slowly moving rings. Two guns should be constructed, as it is necessary in some experiments to connect them in series, and shoot rings towards each other. The guns should be so arranged on handles that it is possible to shoot rings from all angles under the water. When the guns have been adjusted and the tank filled, the experimenter is ready to begin on his experiments.

The kinetic energy of these rings is considerable, as shown by several rather interesting experiments. If a light ward chain be suspended in the path of a ring it will be noticeably deflected by the impact of the ring striking it, altho the ring itself is by no means changed. A layer of light paper is tightly stretched on a frame, and held in the path of the rings, the rings will break thru the paper, but in turn are broken up by the impact. A pretty experiment is to similarly stretch a piece of chiffon cloth and hold it before the gun. The rings will pass thru it without being broken or disturbed in their motion.

If two guns are placed opposite each other, and rings be projected simultaneously, it will be observed that if they strike each other fairly, both will be broken up. If, however, their path is such that they would merely have touched on their edges, they will bend out of their course and will pass each other without injury. This phenomenon of the mutual repulsion of the rings is in accordance with the modern idea of the electron; namely, that they are like charges of electricity, which repel each other. These vortex rings, of course, are not supposed themselves to have any electric charge, tho acting like an electron; they are simply clever illustrations of what an electron is supposed to be.

If a ring is shot towards the surface of the water in the tank, it will be noticed that at certain angles, it is reflected from the surface and continues on a new path the same as the angle of incidence. At other angles the ring will not be reflected but will jump out of the water with a spurt. Besides this it can be shown that these vortex rings can be refracted. The tank should be half filled with water, and a dense solution of Sodium Chlorid siphoned into the bottom of the tank, so as to D the streamline of the liquid outside the aperture will be somewhat as is indicated by the full lines. After the liquid has issued from the aperture it would be expected that the liquid would move as the broken lines indicate. Instead it bends into spirals, each particle moving towards the place where the pressure is diminishing, and the ring formed continues to rotate around a circular center.

TESTING THE QUALITY OF MILK.

By means of two simple tests if it is possible to determine with a reasonable degree of accuracy the quality of milk. A qualitative test to show whether the milk contains water or not is made in the following manner: Take a perfectly clean steel hatpin and immerse it point down into the milk. If on withdrawing it a film of milk covers the same, there is no free water present. On the other hand the presence of water in small quantities will prevent the milk adhering to the pin.

Should the above test show the presence of water the percentage of the same can be obtained in the following manner: Take an ounce of plaster of Paris and wet it with the milk under test till a smooth paste is formed. Allow the paste to dry, determining the length of time that elapses before it hardens. The percentage of water can then be obtained from the following table:

<table>
<thead>
<tr>
<th>Time</th>
<th>% Water</th>
</tr>
</thead>
<tbody>
<tr>
<td>20 min.</td>
<td>75</td>
</tr>
<tr>
<td>30 min.</td>
<td>65</td>
</tr>
<tr>
<td>1 hr.</td>
<td>50</td>
</tr>
<tr>
<td>2 hrs.</td>
<td>25</td>
</tr>
<tr>
<td>3 hrs.</td>
<td>10</td>
</tr>
<tr>
<td>4 hrs.</td>
<td>5</td>
</tr>
<tr>
<td>5 hrs.</td>
<td>3</td>
</tr>
<tr>
<td>6 hrs.</td>
<td>2</td>
</tr>
<tr>
<td>7 hrs.</td>
<td>1</td>
</tr>
<tr>
<td>8 hrs.</td>
<td>0</td>
</tr>
</tbody>
</table>

This test depends on the fact that the cream in the milk retards the hardening.

Contributed by T. W. BENJAMIN.
ELECTRICAL February, 1919

"Ball Lightning" Experiments
By SAMUEL S. WEISIGER, Jr.

In the January, 1916, issue of the Electrical Experimenter you publish a discourse on "Ball Lightning" and gave instructions for the experimental production of it. Thru the kindness of Mr. Porter, Instructor in Physics at the Allegheny High School, I have been able to make the several photos accompanying this letter. Under each photo there is given a short description of the circumstances under which each discharge was made and the phenomena connected therewith.

In making these photos a 75,000 volt Toepfer-Holst static machine was used. The distance between the sharp metal points was from 5.5 to 6 centimeters. This distance must be found by experiment, and although it is absolutely essential to have the correct distance between points, it will nevertheless differ with the capacity of the static machine.

Much trouble will be encountered if the sharp points, used to produce the discharge, are not free from grease and highly polished. The best way to polish the points is to take a little powdered chalk (blackboard chalk which has been scraped to a fine powder with a knife) and put it on some kind of cloth and turn the point of the electrode, at the same time giving considerable pressure to the cloth where the point is being turned. The best connection for the electrodes was found to be obtained by means of two brass chains.

Two large-sized, sharply pointed damaging needles suitably mounted form admirable electrodes. It is practically impossible to use blunt needles.

There will be much trouble in finding the correct spacing for the electrodes and it will probably require some experimentation. In any case the spacing is dependent on the power of the static machine.

Some Trouble Was Encountered in Getting this Spark-Ball to Form. Evidence of This Is Shown By the Plate Being Exposed By a Tiny Charge Or Burst of Light On One Side of the Negative Electrode. The Uneven Course of the Spark-Ball Is Clearly Defined.

When the plate is put under the electrodes be sure to get the emulsion side up, as the discharge occurs better when the plate is placed in this manner. When the plate is under the electrodes and the static machine has been started, the spark ball should form very quickly. After the ball has detached itself from the electrode, turn the machine very slowly in order to expose the plate longer. The rate of travel of the spark ball is proportional to the speed of the static machine.

Should the machine be stopped before the spark ball reaches the other electrode, the plate will only show the path of the ball to that point.

Knowing that there is considerable interest in these "Ball Lightning" experiments we have republisht below the original directions for producing ball lightning in the laboratory as outlined by the famous French scientist M. Leduc. His experiment makes possible the production of a slowly moving globular spark not easily obtainable in any other way, in so far as we know.

To produce this imitation ball lightning it is necessary to employ two very fine metallic points, each of which is in connection with the positive and negative poles, respectively, of a static machine of small or medium size. These globe as it travels is quite slight, it taking from one to four minutes for it to traverse a path of six centimeters in some cases, and before reaching the positive electrode the globe bursts into two or more luminous balls which individually continue their journey to the positive electrode. On developing the photographic plate (which, of course, should be placed under a ruby light while the foregoing experiment is conducted) there will be found a trace on it of the exact route followed by the spark globe—the point of explosion, the routes resulting from the division, and the effluxium around the positive electrode point. Also, if one should stop the experiment before the globule's arrival at the positive electrode, the photographic plate will only show the route to that point. The fireball takes for its course the conductor, which apparently short-circuits the static machine. If sulfur or some other powder is thrown on the photographic plate while the experiment is being conducted, and also while the ball is moving, its path will be marked by a line of ares, looking very much like a luminous rosary.

[The Editors will be glad to hear from any of our readers who have made experiments in this direction. Photographs are particularly welcome.—Ed.]

HORSE-POWER OF WIND MILLS

Below is given a table showing the actual useful horse-power developed by a windmill working under different conditions.

<table>
<thead>
<tr>
<th>HORSE-POWER OF WINDMILLS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diameter of Wheel</td>
</tr>
<tr>
<td>8 feet</td>
</tr>
<tr>
<td>10 feet</td>
</tr>
<tr>
<td>12 feet</td>
</tr>
<tr>
<td>14 feet</td>
</tr>
<tr>
<td>16 feet</td>
</tr>
</tbody>
</table>

This Is One of the "Freak" Ball Lightning Discharges. The Spark Ball Formed At the Negative Electrode and Travelled Straight For the Positive Pole, But Did Not Reach It. It Disappeared Without Exploding. The Machine Was Kept Going and for Some Unknown Reason Another Ball Formed and Backed Away From the Negative Electrode, and Broke Into Two Pieces Before It Reached The Positive Electrode.
A USEFUL ELECTRICAL LABORATORY SWITCH-BOARD

By H. DANNER

A SWITCH-BOARD is a valuable accessory to any Experimenters electrical laboratory. The switch-board here described is intended for use on an alternating current circuit of 110 volts, 60 cycles frequency. But if the switch-board is to be used on a direct current circuit the only changes necessary are the substitution of D. C. instruments and the removal of the low voltage transformer.

The marble or slate panel is 3 ft. 10 in. long, 2 ft. 6 in. wide and 1 or 1½ in. thick. It is supported by two angle iron uprights, 2 x 2 inches, and 6 ft. 4 in. long, plus four inches which is bent back at a foot as illustrated in Fig. 4. To make this bend saw off one side of the angle four inches from the end and after heating it red hot at right angles by putting it in a vise. Use a hammer to make a square bend. The panel is fastened to the angle iron by six ¾ inch bolts as shown in Fig. 1. The weight of the marble or slate is supported by a piece of angle iron across the bottom of the switch-board fastened as shown in Fig. 5 (a bolt can be used instead of a rivet). The top of the board is braced to a wall by means of a flat piece of iron bent on one end to permit it being bolted to the wall.

A marble drill should be used in drilling the marble, but an ordinary drill will serve the purpose. Water will help to drill either marble or slate.

We are now ready for the instruments and switches. The voltmeter is preferably a Weston model 151, 0-150 volt scale range. The ammeter is the same model, 0-150 amperes scale range. Both instruments are 9½ inches in diameter. All connections are made at the back, conforming to standard switch-board practice.

The main line cut-out is of 100 amperes capacity and is located between the instruments. The main line switch, 100 amperes, connects to the bus-bars to the line. The ammeter is connected in series with the switch (see Fig. 1). The voltmeter is connected to a small, double-pole, double-throw knife switch, one side of which is connected across the main bus-bars and the other side across the step-down transformer outlet.

The upper set of ½ inch bus-bars are ¾ x ¾ x 24" and are spaced two inches apart. The bars leading from the main line switch to the second set of bus-bars are of the same size. The lower or second set of bus-bars are ¾ x 6/4 x 24".

The bus-bars are fastened by No. 8-32 copper or brass machine screws (½" in diameter). All connections must be well made. The bars are insulated by bending them up and over the other bars. The switches are connected to the bus-bars by short pieces of copper bars.

The upper row of switches consist of two 60 amp D. P. S. T. switches placed in the center and two 30 amp D. P. S. T. switches on each side. All the switches have fuse clips attached of proper capacity.

The four switches in the lower row are 15 amp D. P. S. T. switches.

Below this row are placed three plug receptacles, two polarized and the other unpolarized, located as shown in the drawing. A double-pole double-throw 15 ampere switch is placed in the middle with a small charging rheostat on the right. This switch connects the storage battery to the motor-generator and to the discharge outlet. The plug receptacle on the right is connected directly to the motor-generator and affords a source of direct current. The one to the left of the switch is connected to the storage battery and is of use in many experiments. The plug on the left side is connected to the step-down transformer.

The service to which the individual switches are put depends upon the needs of the experimenter. The two 60-amp switches are intended for the arc, electric furnace, or for a 5 K.W. step-up transformer and other apparatus requiring over 30 amperes. The switch for the arc is connected to the stage plug at the bottom of the switch-board. A variable resistance is connected in series with the stage plug.

The first switch on the left-hand side, second row, connects the primary of the step-down transformer to the line. The next switch to the right is for a high voltage transformer. Then comes the hand wheel or knob of a small field rheostat for the motor-generator. The field rheostat is mounted behind the board in such a position as not to interfere with the other apparatus. To the right of this comes the motor-generator switch, and on the right is the switch for the lights.

The transformer slide at the lower left-hand side consists of a ¾ square brass rod 14½" long. Over this rod a ¾ square hollow tube, 1 inch long is fitted, with a handle and spring contact large enough to cover only one contact point at a time. The contacts can be made from ¼ round brass rod and fastened and connected in the same manner as starting box contacts.

Use your judgment in all of this work. There (Continued on page 753)
Experiments in Radio-Activity

By IVAN CRAWFORD

- PART II—Ionization (Continued)

In the first installment the construction of a super-sensitive electroscope was outlined, and the conduction of electricity thru gases partially discussed. Before going further into the mysteries of radio-active phenomena it is fitting that further experiments with this electroscope should be given. Another method for the detection of ions will also be given.

The retardation which an alpha particle experiences in its course thru matter, depends entirely upon the atomic weight of the atoms thru which it passes. Bragg and Kleeman found that the retardation of the alpha particle was approximately proportional to the square root of the atomic weight of the substance. In the case of metals, their weight per unit area, required to completely overcome the alpha radiation, is proportional to the square root of their atomic weight.

It was found that the retardation of the alpha particle by complex molecules was an additive property. For, consider that a molecule is composed of N number of atoms of atomic weight W, together with N' number of atoms of atomic weight W', etc. Then the retardation of the alpha particle is \( N \sqrt{W + N'} \sqrt{W'} \).

Sir Ernest Rutherford has determined the specific retardation of alpha rays in metals both by observation and calculation. A few of his results with the commoner metals are given below: s is the observed stopping power of the atoms in terms of air as unity; \( w \) is the atomic weight. It will be noticed that the quotient \( s / \sqrt{w} \) is approximately equal in all cases.

<table>
<thead>
<tr>
<th>Metals</th>
<th>Al</th>
<th>Fe</th>
<th>Cu</th>
<th>Pb</th>
</tr>
</thead>
<tbody>
<tr>
<td>s</td>
<td>1.495</td>
<td>2.29</td>
<td>2.46</td>
<td>4.27</td>
</tr>
<tr>
<td>( \sqrt{w} )</td>
<td>5.2</td>
<td>7.48</td>
<td>7.96</td>
<td>14.35</td>
</tr>
<tr>
<td>( s / \sqrt{w} \times 10^3 )</td>
<td>287</td>
<td>307</td>
<td>309</td>
<td>298</td>
</tr>
</tbody>
</table>

By a series of simple experiments the reader may determine the retardation of alpha particles by thin sheets of the commoner metals. On a grounded metal disc a quantity of radium bromid is placed. See Fig. 1. Thin sheets of aluminum, brass, copper, iron and lead should then be interposed between this active material and the electroscope. The discharging current should then be measured as outlined in the previous paper. The sheets of the various metals should be of the same thickness to allow comparison. It is noticed that the experimental results will compare very favorably with the calculated values.

A very interesting experiment is to interpose successively various thicknesses of aluminum between the radium bromid and the electroscope. With the electroscope charged, a gold leaf past over five divisions on the scale in 412 seconds. The time with uncovered radium bromid was 15 seconds. Upon placing a sheet of extremely thin aluminum leaf over the ionizing agent the electroscope discharged in 25 sec., showing that a portion of the alpha radiation was stopped by the aluminum leaf. When a sheet of aluminum foil about .001 of an inch thick was interposed, the electroscope was discharged in 137 sec. A sheet of aluminum .01 of an inch thick cuts off the entire radiation, and the ionization caused by beta particles, which easily penetrate this obstacle, is very small, discharging the electroscope in about 380 sec. A sheet of lead cuts off the entire radiation, the electroscope discharging the same as when empty.

To determine the retardation of alpha particles by aluminum the following experiment was performed. The radium bromid is covered by successive layers of aluminum leaf and the discharging current measured in each instance. For radium the ionization falls off in geometrical progression as the thickness of the aluminum is increased. Thus, as Maloney has shown, where \( I \) is the intensity of the active substances uncovered, then \( I = I_0 e^{-\frac{a}{t}} \), where \( e \) is the base of the Naperian logarithms and \( a \) is an absorption constant which has a different value for each substance. It is proportional to \( s \) in the preceding table. This law holds true for homogeneous radiations, but when using ordinary radium bromid, any ionizer, four sets of rays are given off, each having a different penetrating power. Until the thickness of the aluminum is great enough to cut off one set of rays, the law given above will hold true. The author has found that about 6 thicknesses of aluminum are sufficient to cut off the first set of radiations. In the accompanying graph Fig. 2, the full line indicates the successive stopping powers up to 6 thicknesses of aluminum leaf for radium as determined by Rutherford. These results were obtained by the author and experiments by the reader should be proportional to these.

That the radiums given off by radio-active materials ionize the air into positively and negatively charged carriers can be readily proven by the following experiment: Connect a spark gap with an induction coil and with a vacuum tube as indicated in Fig. 3. A large Geissler tube will give excellent results, the larger the better. The spark gap should be capable of fine and delicate adjustment. The coil must not give too strong a discharge, but the discharge must be very steady. Arrange matters so that the coil gives a steady discharge at the spark gap and then draw the electrodes apart until the discharge just passes thru the vacuum tube, only an occasional spark crossing the gap. A small quantity of radium bromid is then brought into the vicinity of the spark gap. When this is done the Geissler tube will be partially dimmed and the discharge will pass by way of the spark gap. The greater the amount of radium bromid used the more the tube will be dimmed. This is caused by the ions formed by the radiations from the active radium bromid. If care is taken that the conditions named above are secured the experiment will always be successful.

(To be continued)
A NOther valuable feature that the lathe possesses is the cutting of tapers. Standard tapers are rated at the amount with which the diameter changes in a foot of length. We will take as an instance the standard Brown and Sharp taper, which is one-half inch per foot, and how it is turned in the lathe.

First, it can be turned by the use of a taper attachment on the saddle of the machine, or else by offsetting the tail-stock from its regular central position to give the tool for cutting the prescribed taper. The second method of offsetting the tail-stock is not as simple as the first. If the distance of the center points enter the work, or the mandrel is ignored, the mandrel length can be considered as the distance between the centers. In order to determine at what length the centers shall be offset for a given taper, a simple arithmetical calculation will be required. This is done by multiplying the length of the work or mandrel in feet by one-half the required taper in inches. To turn a Brown and Sharp taper, on a piece of work nine inches long, the problem would work out in the following manner. This particular calculation refers to the one-half inch taper per foot specified in the opening paragraph of this lesson:

\[
\frac{9}{2} \times \frac{1}{12} = 0.1875 = \text{3/16 inch.}
\]

The value of 3/16 inch would be the required amount necessary to offset the center of the tail-stock. The off-centering is accomplished by unscrewing the set screw on the base of the tail-stock and shifting it towards the cutting tool 3/16 inches away from its original center-line position. Fig. 3 illustrates the simplicity of accurately figuring the exact position of the respective centers by the use of a steel scale or rule. It will be noticed that in the above illustrative problem that both the length and amount of taper are given. However, at times it happens that the amount of taper is not given. Let us suppose that a piece eight inches in length is to be turned on one end. The taper portion should be four inches in length. The difference in diameters of this four inch section is to be one-half inch. The problem is, how much must the taper be offset? If the taper is 3/4 in 4 inches, it would be 1/2 inch in a foot or three times as great, and the tail-stock would be moved over one-half of 1/2 inches or 3/4 inch. This calculation holds good were the piece a foot long, but as it is 8 inches, or 3/4 of a foot, the tail-stock should be moved over 3/4 x 3/4 or 1/4 inch. Should the piece be twenty inches long, the tail-stock would be moved 1/2 x 3/4, or 1/4 inches.

The above problem was assumed for simple calculation, the lathe centers merely touching the ends of the working piece, thus making the length of the piece the same as the distance between the centers. In actual practise the depth of the centers in the work must be considered. The calculation must be so as possible to avoid continually changing the tail-stock in order to get a reasonably good taper fit. The necessity of considering the exact distances depends somewhat upon its length. If the piece is very long the actual taper will differ considerably from the calculated taper. If each center point is 3/4 inch, then we would enter a total of 3/4 inch. The length of the piece should thus be reduced by 3/4 inch in the calculation. While turning the taper, the calipers should be used frequently so that it may quickly be determined whether or not the tail-stock is correctly placed for the job in hand.

In order to test the accuracy of the taper as it is turned it should be prest lightly into a steel bar and worked back and forth sufficiently to mark the places where bearings points occur. If the work has been lightly covered with some marking pigment (chalk), the bearing points will be more distinct. However, care must be taken that the coating is not too heavy, as it will be liable to deceive the amateur. Adjust the taper setting until a correct fit is obtained. Another very good method of testing the exactness of the taper is to obtain another taper mandrel or form of standard size, having the same taper pitch, and placing its surface against the one cut, as shown in Fig. 3. If the two tapers can be the standard. Then set a pair of calipers on one side, and run over the entire surface with the same distance on the calipers. If no indication is shown of surface irregularity the taper is said to be true; if high or low marks are present, the taper is not true and a readjustment of the tail-stock setting is necessary to correct it.

In turning down a taper the centers must be employed. This work must be turned down with the aid of the face plate and dog shown in Fig. 3, which illustrates the position of offset work for taper cutting. A lathe chuck cannot be used for this class of work, as the piece to be turned down is kept rigidly in place in a central position, thus preventing its position from being offset. The chuck is used only when a taper attachment is employed. It should never be used otherwise. At times in cutting a very short taper or conical point and when a compound rest is at hand the compound rest is turned to an angle equal to the angle of the taper to be cut. However it is advisable to adhere to the simple method of cutting a taper and as soon as the novice feels quite safe with this method he will then be at liberty to try those more difficult.

The experimenter who is mostly familiar with the use of the lathe for turning concentric objects will now see that the lathe is just as useful in turning objects of eccentric shape. The most common of such objects is the eccentric which operates the valves of a steam engine. If the work has a hole thru it, as in the above example, the hole is first finished to the required dimensions and then a mandrel is used for carrying the work on the lathe centers. While the mandrel has been built on one set of centers exactly true with its axis, for concentric turning, it has a second set of centers which offset the amount required for the eccentricity specified. In the case of eccentrics made solid with the shaft, there are two sets of centers, one for turning the shaft—and the other for stabilizing the opposite end of the shaft. Fig. 4 shows how such an eccentric is arranged in the lathe for proper turning. Note the position of the central axis of the object with respect to the live and dead centers of the lathe. At certain times the specified eccentricity is too extreme to allow both pairs of centers coming within the limits of the diameter of the shaft. Special ends may be cast, forged (or clamped) on the ends of the work, and can afterward be machined off. In crank-shaft turning, special attachments should be provided for the ends of the shaft, or special chucks for the turning may be made to hold the work.

The turning of crank pins on shafts is (Continued on page 749)

Diagram Showing Plainly How a Piece of Stock is Placed Between Off-Set Lathe Centers When It is To Be Turned On a Taper.
Experimental Chemistry

By ALBERT W. WILSDON

Thirty-third Lesson

ARSENIC: History.

The ores of Arsenic, in the form of its two kinds, Realgar and Orpiment, were known to the Alchemists. Geber was familiar with the oxid, and Mangus refers to the metal; but Brandt, in 1773, first showed that white arsenic was obtained by burning the metal.

Like its salts it is poisonous when taken into the stomach. At a temperature higher than 180°C, it unites directly with most elements. It unites with metals to form arsenids, analogous to the sulfids.

Oxids.

Two oxids are known Arsenous Oxid (AsO₂) usually written As₂O₃ and called arsenic trioxid, Arsenic Acid, Arsenic, White Arsenic, etc., and Arsenic Oxid (As₂O₅). The former only is important, being the most important commercial compound of the element. From this other compounds of the metal are formed. It is a white substance, sometimes amorphous and sometimes crystalline which resembles flour when pulverized. It dissolves very slightly in cold water, upon which its particles seem to have a repellent action, but on boiling for a long time more dissolves. The best solvents are Hydrochloric Acid and Alkalis. With Hydrochloric acid it forms:

\[ \text{As}_2\text{O}_3 + 6\text{HCl} = 2\text{AsCl}_3 + 3\text{H}_2\text{O} \]

Salts.

There are two classes of salts, the -ate and the -ite, of which Sodium Arseniat [Na₂AsO₄] and Sodium Arsenit [Na₃AsO₃] are examples. In the former, the valence of Arsenic is 5, in the latter 3. The -ite salts are more frequently met with. The

\[ \text{As}_2\text{O}_3 + 3\text{HCl} = 2\text{AsCl}_3 + 3\text{H}_2\text{O} \]

There are four important tests, Marsh's, Reinsch's, the Carbonic, and the Hydrogen Sulfid. Besides these there are the modified Gutzeit Test, Bettendorf's, etc.

MARSCH'S TEST.—This is the most delicate and interesting, and consists in first forming Arsin [AsH₃], then decomposing it and subliming the arsenic. Any soluble arsenical compound in presence of nascent hydrogen forms Arsin, which is readily decomposed by heat, when the arsenic sublimes. By this process a quantity far too small for the most delicate balance, can be detected,—in fact a mere trace of the element.

Explanation.—Suppose the compound to have the composition Asₓₓ, in which X is any nonmetallic monad. Hydrochloric acid gives this reaction:

\[ \text{As}_x\text{X}_y + 3\text{HCl} = \text{AsCl}_3 + y\text{HCl} \]

Nascent Hydrogen decomposes AsCl₃ and combines with both elements.

\[ \text{AsCl}_3 + \text{H}_2 = \text{AsH}_3 + 3\text{HCl} \]

The Arsin passes out and is burned together with the excess of hydrogen.

\[ 2\text{AsH}_3 + 3\text{O}_2 \rightarrow 2\text{As}_2\text{O}_3 + 6\text{H}_2\text{O} \]

A Bunsen flame decomposes the Arsin.

\[ \text{AsH}_3 = \text{As} + 3\text{H}_2 \]

When the metal sublimes in the capillary tube. The question arises whether any other element than arsenic would act in a similar way. Antimony acts almost exactly like it, forming gaseous and combustible SbH₃, which likewise decomposes and sublimes as a metallic mirror. Several tests serve to distinguish the sublimed Arsin from Antimony, the best being the solubility of Arsin in Sodium Hypochlorit (NaClO) and the insolubility of Antimony. The quantity of Arsenic can be determined by comparing the depth of shading on the deposit with that of tubes containing a known quantity.

REINSCH'S TEST.—This consists of depositing Arsenic on copper, then oxidizing the Arsenic and subliming the As₂O₅ formed.

The compounds of Arsenic will first change to AsCl₃ by Hydrochloric acid. The copper in the heated acid will withdraw the arsenic and deposit it, leaving copper chlorit in solution. Heat will not sublimate the arsenic, which at the same time will combine with the oxygen in the tube to form As₂O₅, and this in turn will sublime as a white solid on the close sides of the tube. Identification is then made by examination under a microscope, when a portion of it

(Continued on page 750)
This department will award the following monthly prizes: First Prize, $3.00; Second Prize, $2.00; Third Prize, $1.00. The purpose of this department is to stimulate experimenters towards accomplishing new things with old apparatus or old material. Any useful, practical and original idea submitted to the Editors of this department, a monthly series of prizes will be awarded. For the best idea submitted a price of $1.00 is awarded; for the second best idea a $2.00 prize, and for the third best prize of $3.00. The article need not be very elaborate, and rough sketches are sufficient. We will make the mechanical drawings. Use only one side of sheet. Make sketches on separate sheets.

FIRST PRIZE, $3.00

AN ELECTRIC FLAG FOR THE LAPEL.

The materials necessary for this are: 3 feet of electric cable, a flashlight bulb, a flashlight battery, a small U. S. (or service flag) paper flag and some cardboard. Fix the cable as shown in Fig. 1, and then bend both wires on each end, as shown in Figs. 2 and 3. Make a cardboard box an inch larger each way than the flag and 3⁄4-inch thick. On the front cut out an oblong opening 3⁄4-inch smaller all around than the flag. Paste the flag over this. Contributed by FRANCIS V. SLAGT.

INTENSIFYING THE SHOCK FROM MAGNETOS.

Most people are aware that the "mag" out of an old-fashioned telephone makes a fine "shocker." My "rig" will increase its shocking capacity tremendously, as all who try it will be fain to believe.

Cut a piece of thin brass of suitable size to rest against the driving wheel when it (the brass) is secured to the base. No dimensions are given as the mageto-ringers vary in size. Contributed by L. G. S. TROREY.

SECOND PRIZE, $2.00

THIS MICROPHONE MAKES AUDIBLE THE FLY'S FOOT-STEP.

This microphone, when properly constructed, is capable of making audible the footfall of a fly, the drawing of a thread across the instrument, the slightest touch on the table on which it is placed, the blowing of one's breath on it, etc., etc. To construct this instrument first take a cigar box and remove the lid. Next hunt up a discarded alarm clock and remove the hair-spring. Secure a piece of wood, 4" x 3½" upon which to fasten the uprights, and a piece of copper sheeting or any other suitable metal for the uprights. Connect these as in the diagram. From an old flashlight battery obtain the necessary carbon. Paste the hair spring onto one upright, and the carbon to the other, first hollowing out a

THIRD PRIZE, $1.00

CONTACT POINT FROM UPHOLSTERY NAIL.

An ordinary upholstry nail is flattened with a hammer and a hole punched thru it with a set punch, as shown in sketch. The hole serves to thread and hold the wires. This is a cheap and practical contact point. Contributed by BERT O'LEARY.

WHAT MAKES THE PLATINUM RING HOT?

If a platinum ring (or even a piece of platinum wire) is warmed gently for a few moments and then suspended in a glass, having a small amount of alcohol in the bottom, the platinum will become red hot. The glass had best be covered with a piece of pasteboard having a hole in the center. The phenomena may be explained by the fact that platinum has the peculiar property of causing certain gases to condense on its surface. The condensation of alcohol fumes is so rapid as to cause the platinum to become incandescent.

Contributed by S. S. GARRETT.

SEWING MACHINE MAGNET WINDER.

Here with is illustrated a wire-winding machine which is easily constructed. Most all wire winding machines are turned by hand, but by using this scheme you can both wind faster and easier. The pulley of the machine is brought against the belt of the sewing machine and the same is caused to turn due to friction. Contributed by E. T. JONES.

This wire leads to other coils of mag. 53
A HOME-MADE GAS TORCH.

As I needed a gas torch I set about to make one. I first procured two pipes, one gallon can; the gas may be taken from the gas service pipes or from a carbide generator.

Contributed by HERBERT PEHRSON.

HINTS ON DRILLING GLASS.

Drilling glass is a difficult proposition and very few amateurs possess tools suitable for this purpose. The following apparatus will drill holes, varying in size from the smallest up to an inch or more.

First procure a brass tube the outside diameter of which measures the same size as the desired hole. Revolve this on the surface of the glass, either by hand or better by means of a small hand drill. The drilling must be started by allowing the lower end of the tube to be guided by a wooden block, with a hole cut in it the size of the tube. After the tube has past thru the glazing this guide can be removed. An excellent abrasive for this drill is emery dust and turpentine. It is an excellent idea to drill from both sides, since this results in a clean, smooth edge.

Contributed by PAUL G. EDWARDS.

COINS FOR WEIGHTS.

In an emergency, ordinary coins can be used as weights. The weights given in the following table are near enough for all the usual purposes.

- Dime weight ............. 40 grains
- Cent weight ............. 50 grains
- Nickel weight ........... 80 grains
- One-quarter Dollar weight 100 grains
- One-half Dollar weight ... 200 grains
- One Dollar weight ...... 400 grains

By simple addition and subtraction a great many different weights can be made with these coins. For instance, to obtain a weight of 20 grains, place a nickel on one side of the scales and a quarter on the other, and then add enough of the chemical solutions above to reach the load.

Contributed by HUGO J. ENGEL.

A RELIABLE HYDROGEN SULFID GENERATOR.

Here is a plan and description of a simple and cheap hydrogen sulfid generator.

This hydrogen sulfid generator has given very satisfactory service to the author. It can also be used for generating hydrogen, carbon dioxide, etc.

The necessary parts are:
1. Student lamp chimney.
2. Glass or porcelain jar (a large fruit jar will do).
4. Rubber stoppers, three hole and one plug.
5. Iron sulfid (FeS).
6. Hydrochloric acid (HCl).

Contributed by JOHN R. BUXTON.

THE PREPARATION AND USE OF BLUE-PRINT PAPER.

The following describes the manufacture of blue-print paper in terms that can be easily understood by any one. No difficulty should be experienced in either the making or the use of the paper.

In order that the best results be obtained it is necessary that good material be used. All vessels in which the solution is made must be kept clean and when not in use should have water in them as far as possible. Do not use soap when washing the trays, as the least trace will do harm to the solution.

Where ordinary work is to be done, any kind of well sized paper will answer, if tough enough to be washed. Different grades of unsensitized papers can be bought at engineers and photo supply houses.

The following formula is for a good solution that will give excellent results to the amateur; this solution is made up of two salts, dissolved in water and applied to the surface of the paper:

Solution No. 1.
- Ferrocyanid of potassium .... 1 oz.
- Pure or distilled water ...... 6 oz.

Solution No. 2.
- Ammoniocrat of iron ....... 1 oz.
- Pure or distilled water ...... 6 oz.

When solutions are to be used mix equal parts of 1 and 2 and filter thru cotton or filter paper. This solution we will call No. 3.

The solutions should be applied to the paper in a dark and dry room with a very subdued light just enough to barely see by.

Small sheets of the paper may be best covered by floating upon the surface of No. 3. This is done by taking a sheet by two diagonal corners and laying it gently on the surface of the solution. This method does away with the possibility of air bubbles forming.

One minute or less will be sufficient for sensitizing. Remove the paper by drawing over the edge of the tray to remove any surplus liquid and to prevent any solution from getting on the back of the paper.

Large pieces are best sensitized by taking down upon a smooth table with thumb tacks and painting the solution on with a wide camel's hair brush. Take care to get it on quickly and evenly. Dry the paper by hanging up by its corners to a wire so that it will swing free. Before sensitizing a batch of paper it would best be to make a trial sheet and print it. The solution may not be mixed properly or the paper may be too absorbent, in which case the solution will go into the paper and will not come out when washing the paper, causing the print to fade in a short time.

After the paper has dried hard and without the slightest trace of dampness it should be rolled up tightly in a tight (tin or cardboard) tube and kept in a dark and dry place.

Printing is the exposing of the sensitized paper to the action of a powerful light with the copy to be printed placed over the paper. The direct rays of the sun are best for printing, but the electric arc is nearly as quick and has the advantage of being always constant—regardless of weather.

The drawing, tracing or negative is placed in the frame next to the glass with the paper under it, having its sensitive side up. Exposure will vary from 5 to 10 minutes, according to the light and tracing. The correct time is only found by experiment.

After the paper is sufficiently exposed, it is taken from the frame and immersed in a bath of clean running water. A print should be washed for not less than fifteen minutes or it will fade when placed in the light.

Excellent prints may be made in the following manner: Slightly expose the print so that when it is washed the white lines are not clear but appear bluish. Take the print out of the bath and lay it on a table and sponge it with a solution made up of one part of sodium dichromate of potash and two gallons of water. The lines will come out pure white and the background an intense bluish. Wash print thoroughly and dry.

White lines may be added to blue prints by the use of a solution made of soda and water to which a small quantity of prepared chalk has been added to thicken it. This solution may be applied with a ruling pen. Engineers generally use a white, red or yellow pencil for making corrections.

Contributed by RUSSEL MERRELL.
Telephone Amplifier. (No. 1,280,556; issued to Louis Seber.)

A telephone amplifier providing a loud-speaking portable telephonic apparatus enabling persons with impaired hearing to satisfactorily use the ordinary telephone. The usual Bell telephone receiver is placed on one side of the cabinet in which there is an opening communicating with a microphone transmitter. The transmitter in turn is connected from a rheostat and battery as well as switchboard to a low resistance, loud-speaking telephone receiver.

Signaling Apparatus. (No. 1,280,210; issued to Fulton Gardner.)

An ingenious signaling apparatus comprising an electromagnet in a receptacle, together with a coherent form of armature, the whole arrangement operating an alarm bell when actuated by voice or other sound waves. It is intended for bank vault protection and the like. The sound waves impinge on the microphone which is connected with a battery and primary of an induction coil. The secondary of this induction coil connects with the electromagnet of the alarm in question. This electromagnet acts on an iron filing armature, causing the filings to cohere, and thereby closing the alarm bell circuit. A condenser is shunted across the bell in order to provide a more steady current by virtue of its charging and discharging action.

Telegraph Transmitter. (No. 1,280,566; issued to John J. Sherry and John L. DuFrane.)

A clever mechanical arrangement comprising an automatic machine for sending distress signals and dashes, such as on a telegraph or radio circuit, by means of the apparatus called the "earth" or familiar with the code may send distress messages from a ship, etc. The device should prove a fine auxiliary in all ship radio rooms, especially in case of fire, etc., as the transmitter could keep the radio apparatus sending out distress calls with location and name of ship, even though the operator had to abandon the wireless room. There is provided a circular disk with a groove around its periphery, and in this groove there can be placed various telegraphic characters, made of clay and spaced thus the notched slugs corresponding to dots and dashes actuate a cam member, opening and closing electric contacts in the manner apparent.

Electrical Experimentaler.

February, 1919

Dancing Toy. (No. 1,280,307; issued to Harry Bunt.)

This is an interesting electric toy and comprises a jointed doll or other figure suspended at the top in the manner shown. Underneath the figure there is a spring platform, one end of which is provided with an electric contact, and also an electromagnet to attract it. The action is as follows: When the switch is closed, the magnet attracts one end of the spring armature, but immediately the circuit is broken and it flies back. These rapid vibrations of the spring over the magnet, transmit similar impulses to the opposite end of the armature which forms the tread under the figure, and which results in many curious and grotesque stops being evolved for the amusement of the children.

Novel Telephone Receiver. (No. 1,283,304; issued to Thomas Rhodes.)

The receiver as shown is of the monocular type, and the central iron core is secured to a flat base plate. In the improvement here shown, the bell base is formed with radial spires in its marginal portion to provide a series of integrally connected sectors corresponding in number with the series of independent sections which constitute the outer anular pole-piece. This pole-piece comprises a series of radially disposed iron sections. The bobbin of the coil is 70 ohms for telephonic work.

Electromechanical Interupter. (No. 1,283,388; issued to Francois de Cannart d'Hamalle.)

A unique electromechanical interrupter wherein the circuit is made and broken, not by virtue of an electromagnet acting on an armature and pulling it away from a stationary contact screw, but by means of a weighted auxiliary spring placed in a hermetically sealed compartment and acting by means of the weight supported at the top of the contact spring tends to keep on moving when the armature itself is suddenly stopped by striking against the contact point, thus providing a very sudden break, which is highly desirable for operating induction coils.

Electric Lamp Fountain. (No. 1,280,784; issued to Matt Lockenhart.)

An electric lamp fountain operated by the heat radiated from the incandescent lamp placed in a conical chamber in which there is an expansive fluid such as air. The inventor mentions that a 150-watt lamp has worked the apparatus. The liquid sprayed out thru the small capillary tube falls back into a second chamber, thru which the water can reach the inner chamber again thru a check valve. A thermostat may be used to make and break the circuit intermittently when desired. The cover of the fountain may be of glass and colored when preferred for the purpose of transmitting upward thru the fountain spray a portion of the light from the lamp.

Electric Phonograph. (No. 1,281,382; issued to Hans Brockmuller.)

The idea is to provide a simple form of electric motor-driven phonograph with separable record turn-table and tone arm, so that for economical and other reasons it is not necessary to have a large special cabinet about the house. Any cabinet can be quickly converted into a first-class phonograph by the addition of a turn-table and a vertically driven shaft being secured underneath the table. The turn-table has a shaft which passes thru a hole in the top of the table, so as to engage the driving shaft frictionally. The tone arm has a special suction foot which does not require any screws, and the sound emanates around this foot.
Our Amateur Laboratory Contest is open to all readers, whether subscribers or not. The photos are judged for best arrangement and efficiency of the apparatus. To increase the interest of this department we make it a rule not to publish photos of apparatus unaccompanied by that of the owner. Dark photos preferred to light-toned ones. We pay $1.00 prize each month for the best photo. Address the Editor, "With the Amateurs" Dept.

"Amateur Electrical Laboratory" Contest

THIS MONTH'S $3.00 PRIZE WINNERS—F. L. BROOKS and W. P. CECIL

The accompanying photos are views of our Electro Chemical Laboratory and Radio Station (which is now closed). We have quite a number of electrical apparatus such as Oudin and Tesla coils, motors, spark coils, 12 volt storage battery, Leyden jars, electrolytic interrupter, galvanometer—which was described in the ELECTRICAL EXPERIMENTER several months ago, 50 watt step-down transformer, also 200 watt transformer located behind switch-board and controlled by a five point switch, ammeter and voltmeter also on switch board, arc spot light which will throw a beam of light over a mile, small step-up transformer, condenser and spark gap. Our Chemical "Lab" consists of about 85 chemicals and about 15 pieces of apparatus such as test tubes, Florence flasks, delivery tubes, hydrometer and other apparatus for carrying on experiments on a small scale. Last of all comes our work bench where everything has its beginning. We have a vise, gasoline blow torch, pliers, screw-drivers, twist drills and numerous other accessories. We also have a good supply of binding posts, screws, magnet wire, copper, brass and all such junk as is found in a red-headed bug's "Lab" like my pal's, not saying anything of myself—Floyd L. Brooks and Wm. P. Cecil, Ardmore, Oklahoma.

HONORABLE MENTION (1 Year's Subscription to the "ELECTRICAL EXPERIMENTER") T. C. QUAYLE

My Chemical "Lab" consists of over 150 chemicals and reagents, also apparatus such as pipettes, burettes, retorts, test tubes, thistle tubes, delivery tubes, crucibles, caserole, condensers, a Centigrade-Fahrenheit thermometer, chemists' scales, and many other pieces of laboratory glassware and apparatus, with which I carry on many interesting experiments in quantitative, qualitative and spectrum analysis. I also have gas, a Bunsen burner and a spout for water in the "Lab", and have made a storage battery as described in the 1917 (Nov.) issue, also an arc searchlight, experimental arc furnace, magnetless buzzer, selenium cell (Bidwell type), Wheatstone bridge, electroscope, electrophorus, (sensitive) ohmimeter, electrolytic rectifier and interrupter, Leyden jars, and many other pieces of apparatus described in the ELECTRICAL EXPERIMENTER. I also have an Oudin coil which is operated by an E. I. Co. half kilowatt coil and a rotary spark gap of my own design, also 110 volt and battery motors, hand generator, hot wire ammeter, small storage cell, switches, fuse blocks, Geissler tubes, etc.

My work-shop is complete in tools for both wood and metal working and here is where I made the articles described in the "E. E." I have drills for both wood and metal, braces, chisels, files, saws, wrenches, planes, pickers, levels, two sets of taps and dies, one for small rods, the other for pipes, also an enery wheel and bench lathe, which I designed and built—Thomas C. Quayle, Berkeley, Cal.
Phoney Patents

Under this heading are published electrical or mechanical ideas which our clever inventors, for reasons best known to themselves, have as yet not patented. We furthermore call attention to our celebrated Phoney Patent Offizz for the relief of all suffering daffy inventors in this country as well as for the entire universe.

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HUN U-BOAT UTILIZER

Prize Winner: HUN U-BOAT UTILIZER. Particularly Adapted for Traffic Over Deserts. Take One Gyro Electric Destroyer a la Gernsback, Knock Out All Machinery, Axles, etc., and Mount Plate Glass 16-inches Thick in Framework Covering Both Sides. Make Waterproof and Fill Cruiser with Pure Prohibition Liquid; Also one Hun Submarine. Weight of Submarine Pressing Against Sides, as Shown, Navigates Cruiser at Rate of 25 Knots an Hour with a Fair Zephyr Breeze Nor' by West. Inventor, Jose Matz, 300 Baker St., San Francisco, Cal.

I'SCREAM GENERATOR

I'SCREAM PARLOR GENERATOR. In Order to Save Tremendous Energy Now Going to Waste in All Ice-Cream Parlors, Due to Rotating Seats, My New Patent Provides Extending Shaft to the Rotating Seat, Which Shaft Operates Rotary Air Compressor. This Control Operates Air Tank, Air Motor, Dynamo, etc. The Great Advantage to this Scheme Is That the Device Works Better the More Ice-Cream You Eat Because of the Added Momentum. Separate Patent Application Provides to Charge Customers an Extra Nickel for Allowing Them to Spin Around. Hoover says Economize, Hence no Free Rides. Inventor, Garrett W. Lewis, Yuba City, Cal.
HURLING THE VOICE ONE MILE.

(929) W. J. M. asks:
Q. 1. Is there any practical way of enormously amplifying the human voice so that same can be distinctly heard for a radius of, say, a mile, the atmosphere being comparatively free of other disturbances at the time?

I understand that there are telephone transmitters now made for handling heavy currents of electricity. It occurs to me that possibly the above could be accomplished by using such a transmitter in connection with a mammoth receiver and a suitable horn.

A. 1. One of the leading phonograph companies have developed a very clear and powerful form of comprest air amplifier which we believe might be worked up on a sufficiently large scale to answer your requirements. In this system a low power aural or electrical voice signal is caused to act, by means of a relay or other appropriate device, on an extremely sensitive valve, which permits successive puffs of comprest air from a tank or bellows to pass out thru a large amplifying horn and reproducer. We also believe that the de Forest amplifier might solve your problem, as one model is capable of amplifying 1,000,000 (one million) times. Also their Mr. C. V. Logwood has stated that he believes that your problem of amplifying the human voice so that it could be heard for a radius of one mile can be solved by modern engineering design. He states that by means of microphones suitably connected to a large Osclion bulb that he has actually heard the human voice at a distance of one-half mile in California.

The Alexanderison G. E. Co. magnetic amplifier should be of service to you in this connection. This clever and highly efficient magnetic amplifier was described in detail in the March, 1918 issue of the "Oracle". We believe that these amplifiers are being used on a practical basis to amplify voice currents in the telephone lines.

ARTICLES SCHEDULED FOR MARCH "E. E."

"My Inventions"—No. 2 of a series by Dr. Nikola Tesla. Written exclusively for the Electrical Experi-
menter.


"How Powerful Electric Gyros Stabilize Ocean Ships"—Illustrated with excellent photos by J. W. Hor-
sath.

"Multiplex Telephony and Tele-
graphy and How It is Done," written by a Telephone Engineer.

"Exploring Polar Regions and the North Pole by Airplane."

"Locating Ore Bodies Under-
ground by Electricity—A New Method."

A New Talking Motion Picture Invention.

"How Jimmy Saved the Bank"—A cracker-jack electrical story, by E. W. Russel.

"Experiments in Radio-Activity—Part III."

A Wave-meter and Decimeter De-
sign for Radio Students, Operators and Inspectors. With data on In-
ductances, condensers, etc., by H. Winfield Secor, Assoc., R. E. Prac-
tical Electro-plating, by Joseph Haas.


"Experiments With Ultra-Violet Light, for Amateurs," by J. C. Morris, Jr.

in the April, 1916, issue of the Proceedings of the Institute of Radio Engineers.

Several companies manufacture straight electro-magnetic systems of amplifying the voice, which systems are operated from 110 volt circuits. We can supply names of these concerns on receipt of stamped enve-
lope.

Relative to these systems, the Oracle Editor would say that he has heard the loud talker put out by both of these concerns throw the voice a distance of from 800 to 1,000 feet. The horns used are not over 2 feet long in this system, but the makers utilize special electro-magnetic reproducers which are connected in parallel when two or more are used, and these in turn are con-
nected in series with a special microphone capable of operating on 110 volts D. C. and a bank of incandescent lamps.

ODIN COIL CONNECTION.

(980) Forrest A. Miller, Shelbyville, Kentucky, writes:
Q. 1. Asking several questions about Oudin and Tesla coils.
A. 1. By means of high frequency Tesla or Oudin currents you can charge the body so as to emit sparks and charge other bodies or persons, etc., and you will find the appar-
atus and method of doing this completely described in the book you are se-
curing, viz.: "The Experimental Electricity Course," which contains a special chapter on high frequency currents, with diagrams and full description of the apparatus used.

We can also very highly recommend a book by Transtrom, entitled "Electricity at High Pressures and Frequencies" which our "Book Department" can supply at $2.15 price.

The diagram herewith shows how a spark coil, Leyden jars, spark gap and Oudin type of high frequency coil are properly connected. The ground connec-
tion is optional, but usually intensifies the unpolar discharge for electro-therapeutic requirements.

SIX-INCH SPARK COIL DATA.

(981) Marshall M. Wrenn, Baltimore, Md., asks the Oracle:
Q. 1. For data on six-inch spark induction coil.

(Continued on page 726)
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The primary conductor to be connected across the vibrator should comprise 450 sq. in. if there are less than six wires and interspersed between slightly larger paraffin sheets. If an electrolytic interrupter is used on 110 volts A. C. or D. C. there are no prime requirements.

There should be a hard rubber insulating tube between the primary and secondary coils. The dimensions of this tube should be 2 x 1/4 x 1/16" wall.

The secondary consists of thirty-eight coils, each 1/4th thick, having an outside diameter of 3/4". The spools should be placed between each section six pieces of well-soaked paraffin paper.

An excellent book dealing exclusively on spark coils building can be obtained from our "Book Department" for $3.00.

The title of this book is "Design and Construction of Induction Coils," by Collins. In this book there are sketches for the construction of spark coils such as core dimensions, size of wire, length of primaries, etc.

DATA ON WIRELESS POWER TRANSMISSION.

(98) By Paul V. Page, Detroit, Michigan, writes the "Oracle":

Q. 1. The sketch herewith shows my idea on the wireless transmission of power. Where can I find engineering data on the design of such a system? How can I figure the voltage required to transmit a given kilowattage over a certain distance? etc., etc.

A. 1. We have examined your query, together with diagram showing your ideas for the wireless transmission of power to railway cars, etc.

We regret to say that there is at the present time no engineering data available for solving such problems as outlined, as while Nikola Tesla has successfully lighted lamps and operated motors by the one wire and no-wire wireless system for distances of 60 miles, in the experiments, this branch of advanced alternating current engineering has not been made available in book-text book form as yet.

You would do well to visit your public library and look up Dr. Tesla's book, entitled "Experiments with Currents of High Potential and Frequency".

ELECTRICAL EXPERIMENTER
February, 1919

THE ORACLE.
(Continued from page 724)

A. 1. We give you herewith necessary information for constructing a six-inch jump spark coil.

Primary, 24 ft. No. 13 D. C. C. wire.
Secondary, 7 lbs. No. 36 double silk covered wire (or enameled).
Core, 1/4 x 14" soft iron wire (thoroly annealed).

The primary condenser to be connected across the vibrator should comprise 450 sq. in., if there are six wires and interspersed between slightly larger paraffin sheets.

An electrolytic interrupter is used on 110 volts A. C. or D. C. There are no prime requirements.

There should be a hard rubber insulating tube between the primary and secondary coils. The dimensions of this tube should be 2 x 1/4 x 1/16" wall.

The secondary consists of thirty-eight coils, each 1/4" thick, having an outside diameter of 3/4".

The spools should be placed between each section six pieces of well-soaked paraffin paper.

An excellent book dealing exclusively on spark coils building can be obtained from our "Book Department" for $3.00.

The title of this book is "Design and Construction of Induction Coils," by Collins. In this book there are sketches for the construction of spark coils such as core dimensions, size of wire, length of primaries, etc.

PRACTICAL ARMATURE AND MAGNET WINDING METHODS, by Marsan & Touhey. Leather covers, 252 pages, 128 illustrations, size 4½ x 6½ inches. Price $1.00 in cloth; $1.50 in leather. Published by Frederick J. Drake & Co., Chicago.

This is a handbook for the practical electrician, especially drawn with regard to winding troubles and faults in the windings, armature calculations with wire tables, alternating current windings, etc. The authors give the principles with special illustrations of armature design, armature windings and the mechanical features such as winding firsts of different types of armatures, etc. The section on armature problems gives the necessary information for laying out drum and lap windings, and applies to dynamo pole.

The authors then give a discussion on armature troubles and faults in the windings, armature calculations with wire tables, alternating current windings, etc. One of the most interesting sections is the work on that field magnet winding, and of course this applies to magnet winding of any type. The special formulas and tables given greatly facilitate and simplify the calculation of field and other magnet windings, and it is written in clear language so that any student can grasp the simple arithmetic involved after once reading it. An appendix of useful tables is given at the end of the book which will prove of great value in conjunction with the work treated upon.


An excellent course on flying instruction which is very ably illustrated by comprehensive sketches and diagrams. It covers the essentials of modern sailing and gliding planes and methods of operation of the air in air. This book, with its clear text, practical advice, and the practical help of the pilot, is one that any aviator or flying enthusiast can read with profit, and it will greatly improve his understanding of the heavier and more powerful flying machines into the hands of Flight-Commander of the British Royal Navy and other experts of the United States.

The chapters are subdivided under departmental heads, so that the book forms a very excellent reference work, as well as a well-organized and general reading volume. Flight-Commander McMinnies is the author of many books and covers such points as—"which men make good pilots," "building and flying," a chapter on the subject of applied psychology. As we pass through the elementary stages of both the machine and its component parts, we find the text and drawings so interesting, that it does not tire us at all.

Some very excellent diagrams and drawings are given, showing the various stages of building and how they occur, also how all the fancy tricks are performed in an age of the matter. The sections treating on cross-country flying and determination of distances and altitudes are very important. All the text is clearly written and treated on in a manner following the excellent by the Allied fliers on the Western front.


This volume contains some of the most interesting lectures given by Dr. Steimets, and forms a valuable work which will find a welcome in the library of every engineer, electrical man and student of electrical engineering, as Dr. Steimets is a speaker and writer of articles which are always well considered and pointed. In his typical manner, the lectures are presented, the reader will be surprised at the wide field covered by these lectures. The lectures are divided into two parts, the first part dealing with the important types of lamp and their relevant operational characteristics. The lectures are intended to be a complete and comprehensive guide to any electrical engineer, of all his friends in the field, and of all his friends and colleagues. The lectures are written in a clear and concise manner, and are written in an excellent and comprehensive manner, and are written in an excellent and comprehensive manner, and are written in an excellent and comprehensive manner, and are written in an excellent and comprehensive manner, and are written in an excellent and comprehensive manner, and are written in an excellent and comprehensive manner, and are written in an excellent and comprehensive manner, and are written in an excellent and comprehensive manner, and are written in an excellent and comprehensive manner, and are written in an excellent and comprehensive manner, and are written in an excellent and comprehensive manner, and are written in an excellent and comprehensive manner.
Thousands of skilled Electricians are needed. The demand is becoming more urgent every day. The big Industries are employing every one they can get, causing a great scarcity of trained men, throughout the country. **Big salaries are being paid everywhere.** Right now is your big opportunity. Make up your mind now to prepare for one of these big jobs and then get here as quick as you can for your training.

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**The War is Over — Yes!**

but the men “over there” will not be back for months—perhaps years, for their work “over there” isn’t over. And so you, and thousands more must fill up the gap now that the absence of these brave workers has made in the ranks of skilled labor. **Trained Electricians are needed more, perhaps, than any other class of men.**

The sudden ending of the war has caused the big Industries to start up work sooner than any of us expected and in consequence the Manufacturers are Calling for Trained Men, and we are training men as fast as we can to meet these urgent calls. **You are needed, Young Man, now!**

Don’t wait. Don’t put it off. Get in touch with us “Today.” Get ready to join the great “Peace Army” here at home. Your country calls. Again we say, prepare to serve your country! We’ll make a trained electrician of you in three months! Let’s go!

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Famous Scientific Illusions

(Continued from page 694)

The earliest trials were made by Dali- brand in France, but Franklin himself was the first to obtain a spark by using a kite, in June, 1752. When these atmospheric discharges manifest themselves today in our wireless station we feel annoyed and wish that they would stop, but to the man who discovered them they brought tears of joy.

The lightning conductor in its classical form was invented by Benjamin Franklin in 1752 and immediately upon its adoption proved a success to a degree. As usual, however, its virtues were often exaggerated. So, for instance, it was seriously claimed that in the city of Pietermaritz- burg (capital of Natal, South Africa) no lightning strokes occurred after the pointed rods were installed, silhou the storms were as frequent as before. Experience has shown that just the opposite is true. A modern city like New York, presenting innumerable sharp points and projections in good contact with the earth, is struck much more often than equivalent area of land. Statistical records, carefully compiled and examined over a long time, demonstrate that the danger from lightning to property and life has been reduced to a small percentage by the use of lightning conductors, but the damage by fire amounts, nevertheless, to several million dollars annually. It is astonishing that this device, which has been in universal use for more than one century and a half, should be found to involve a gross fallacy in design and construction which renders its usefulness and may even render its employment hazardous under certain conditions.

For explanation of this curious fact I may refer to Fig. 3, in which \( r \) is a metallic sphere of radius \( r \), such as the capacity terminal of a static machine, provided with a sharply pointed pin of length \( h \), as indicated. It is well known that the latter has the property of quickly dissipating the accumulated charge into the air.

To examine this action in the light of present knowledge we may liken electric potential to temperature. Imagine that sphere \( s \) is heated to \( T \) degrees and that the pin or metal bar is a perfect conductor of heat so that its extreme end is at the same tem-
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ELECTRICAL EXPERIMENTER

FAMOUS SCIENTIFIC ILLUSIONS.
(Continued from page 728)

\[ \frac{nq}{(r+q)} = \frac{q}{r} \]

Thus the difference of potential between the point of the pin and the medium around the same

The positive charge of the cloud induces in the earth an equivalent opposite charge, the density at the surface of the latter diminishing with the cube of the distance from the state center of the earth. A discharge is then formed at the point of the rod and the action Franklin anticipated takes place. In addition, the air is ionized and rendered conducting and, eventually, a bolt may hit the building or some other object in the vicinity. The virtue of the pointed end is to allow the charge, which was uppermost in Franklin's mind, is, however, infinitesimal. Careful measurements show that it would take many years before the electricity stored in a single cloud of moderate size would be drawn off or neutralized through such a lightning conductor. The grounded rod has the quality of rendering harmless most of the strokes it receives, therefore occasionally the charge is diverted with damaging results. But what is very important to note, it invites danger and hazard on account of the fallacy involved in its design. The sharp point which was thought advantageous and indispensable to its operation, is really a defect detracting considerably from the practical value of the device. I have produced a much improved form of lightning protector charging it by employment of a terminal of considerable area and large radius of curvature which makes impossibly uniform density of the charge and neutralization of the air.* These protectors act as quasi-repellents and so far have never been struck tho exposed a long time. Their safety is experimentally demonstrated to greatly exceed that invented by Franklin. By their use property worth millions of dollars which is now annually lost, can be saved.

III. The Singular Misconception of the Wireless.

To the popular mind this sensational advance conveys the impression of a single invention but in reality it is an art, the successful practice of which involves the employment of a great many discoveries and improvements. I viewed it as such when I undertook to solve wireless problems and it is due to this fact that my insight into its underlying principles was clear from their very inception.

In the course of development of my induction motors it became desirable to operate them at high speeds and for this purpose I constructed alternators of relatively

*Refer to the October, 1918, issue of this journal wherein Dr. Tesla's novel use of non-pointed lightning rod was fully described and illustrated.

(Continued on page 732)
ELECTRICITY

Taught By A Practical Man
and in Your Home!

IT IS UP TO YOU

I am teaching electricity and drafting to many men, women, and women, and wish to interest you sufficiently so you will send for my catalog which tells the whole story, as it is too much to tell here. It is up to you whether you look into the proposition, but if you are earnest in your desire to get into the electrical industry, or to become more proficient in this line, you will send for the catalog and you will not regret the time you give in doing so.

THE PURPOSE OF THE COURSE OF STUDY

I have been designing courses in electrical instruction and teaching electricity, of and on during the past 17 years, and during that time I have had an unusual opportunity to make a special study of the teaching business, from the standpoint of a practical man. This course of my own is designed with that view of teaching those who do not have a lot of time and money to devote to study work, and give the student the knowledge of the subject which he can build upon, and which will add to the everyday work of electrical experience, and from which conditions I say particular stress on. This part of the instruction is for the course particularly attractive and valuable to those already engaged in some electrical work.

Apparatus, Instruments, Material, Etc.

Equipment, instruments, materials, etc., as detailed in the catalog, are included in the course and are a part of the regular instruction for which there is no extra charge as it is covered by the regular monthly payments.

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BURGESS ELECTRICAL SCHOOL
745 E. 42d Street
Chicago, Ill.

To Practical Men and Electrical Students:

(See review of this book by Editor in December issue of your Electrical Experimenter, page 568)

I have prepared a pocket-size note book especially for the practical man and those who are taking up the study of electricity. It contains drawings and diagrams of electrical machinery and connections, over two hundred formulas for calculations, and problems worked out showing how the formulas are used. This data is taken from my personal note book, which was made while on different kinds of work, and I am sure it will be found of value to anyone engaged in the electrical business.

The drawings of connections for electrical apparatus include Motor Starters and Starting Boxes, Overload and Underload Release Boxes, Reversing Types Elevator Controllers, Tank Controllers, Starters for Printing Press Motors, Automatic Controllers, Variable Field Type, Controllers for Mine Locomotives, Street Car Controllers, Connections for reversing Switches, Motor and Dynamo Rules and Rules for Speed Regulation. Also, Connections for Induction Motors and Starters, Delta and Star Connections and Connections for Auto Transformers, and Transformers for Lighting and Power Purposes. The drawings also show all kinds of lighting circuits, including special controls where Three and Four Way Switches are used.

The work on Calculations consist of Simple Electrical Mathematics, Electrical Units, Electrical Connections, Calculating Unknown Resistances, Calculation of Current in Branches of Parallel Circuits, How to Figure Weight of Wire, Wire Gauge Rules, Ohm's Law, Watt's Law, Information regarding Wire used for Electrical Purposes, Wire Calculations, Wiring Calculations, Illumination Calculations, Shunt Instruments and How to Calculate Resistance of Shunts, Power Calculations, Efficiency Calculations, Measuring Unknown Resistances, Dynamo and Dynamo Troubles, Motors and Motor Troubles, and Calculating Size of Pulleys.

Also Alternating Current Calculations in finding Impedance, Reactance, Inductance, Frequency, Alternations, Speed of Alternators and Motors, Number of Poles in Alternators or Motors, Conductance, Susceptance, Admittance, Amplitude, Angle of Lag and Power Factor, and formulas for use with Line Transformers.

The book called the "Burgess Blue Book" is published and sold by the Burgess Engineering Company for one dollar ($1.00) per copy, postpaid. If you wish one of the books, send me your order with a dollar bill, check or money order. I know the value of the book and can guarantee its satisfaction to you by returning your money if you decide not to keep it after having had it for five days.

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U. S. A.

Electrical Experimentor

February, 1919

FAMOUS SCIENTIFIC ILLUSIONS

(Continued from page 730)

high frequencies. The striking behavior of the currents soon captured my attention and in 1889 I published a systotic investigation of their properties and the possibilities of practical application. The first gratifying result of my efforts in this direction was the transmission of electrical energy thru one wire without return, of which I gave demonstrations in my lectures and addresses before several scientific bodies here and abroad in 1891 and 1892. During that period, while working with my oscillation transformers and dynamos of frequencies up to 600,000 per second, the idea gradually took hold of me that the earth might be used in place of the wire, thus dispensing with artificial conductors altogether. The immensity of the globe seemed an unsurmountable obstacle but after a prolonged study of the subject I became satisfied that the undertaking was rational, and in my lectures before the Franklin Institute and National Electric Light Association early in 1893 I gave the outline of the system I had conceived. In the last paragraph of Chichakly's World's Fair, I had the good fortune of meeting Prof. Helmholtz to whom I explained my plan, illustrating it with experiments. On that occasion I asked the celebrity physicist for an expression of opinion on the feasibility of the scheme. He stated unhesitatingly that it was practicable, provided I could perfect the device of putting it into effect but this, he anticipated, would be extremely difficult to accomplish.

I assumed the work very much encouraged and from that date to 1896 advanced slowly but steadily, making a number of improvements. The chief of which was my system of "concentration and dispersal" as a method of regulation, now universally adopted. In the summer of 1897 Lord Kelvin happened to pass thru New York and honored me by visiting my experiments where I entertained him with demonstrations in support of my wireless theory. He was very much interested and enthusiastic but, nevertheless, condemned my project in emphatic terms, qualifying it as something impossible, "an illusion and a snare." I had expected his approval, but I was not surprised. But the next day he returned and gave me a better opportunity for explanation of the advances I had made and the true nature of my system. In my system the process is one of true conduction which, theoretically, can be effected at the greatest distance without appreciable loss. I can never forget the change of attitude that came over the famous philosopher the moment he freed himself from that erroneous impression. The skeptic who would not believe was suddenly transformed into the warmest supporterers. He parted from me not only thoroughly convinced of the scientific soundness of the idea but strongly exhorting an effort in its success. In my exposition to him I resorted to the following mechanical analogues of my own and the Hertz wave system.

Imagine the earth to be a bag of rubber filled with water, a small quantity of which is periodically forced in and out of the bag in the shape of a wave. As the waves are transmitted, they are reflected from the sides. If the strokes of the latter are affected in intervals of more than one hour and forty-eight minutes, sufficient for the transmission of the impulses thru the whole mass, the entire bag will expand and contract and corresponding movements will be imparted to the medium. Pistons with the same intensity, irrespective of distance. By working the pump faster, shorter waves will be produced which, on reaching the opposite end of the bag may be reflected and give rise to stationary nodes and loops, but, in any case, the fluid being incompressible, its inclosure perfectly elastic, and the frequency of oscillations not very high, the energy will be economically transmitted and very little power consumed. It is longer than not making for the receivers. This is a crude but correct representation of my wireless system in which, however, I resort to various refinements. Thus, for instance, when the circuit of a resonant system of great inertia, enormously magnifying the force of the impulses. The receiving devices are similarly conditioned and in this manner the amount of energy collected in them vastly increased.

The Hertz wave system is in many respects the very opposite of this. To explain it by analogy, the piston of the pump is assumed to vibrate to and fro at a terrific rate and the greatest quantity of fluid passes in and out of the cylinder is reduced to a small hole. There is scarcely any movement of the fluid and almost the whole work performed results in the production of radiant heat, of which an infinitesimal part is recovered in a remote receiving. However incredible, it is true that
the minds of some of the ablest experts have been from the beginning, and still are, obest by this monstrous idea, and so it continues carelessly, for which I founded the foundation in 1893, has been re-
tarded in its development for twenty years. This is the reason why the "statics" have produced a great deal of interest why the "mechanics" are of little value and why the Gov-
ernment has been compelled to interfere.

We are living on a planet of well-nigh in-
finite extent, surrounded by a non-conducting layer of insulating air above which is a
rarefied and conducting atmosphere (Fig. 5). This is providential, for if all the air were to be completely replaced by insulation, elec-
trical energy thru the natural media would be impossible. My early experiments have shown that if high frequency waves are sent across a considerable distance, without being ab-
sorbed. The theory has been seriously ad-
vanced that these radiations pass around the earth with infinite"efficiency," but it is clear that the show the absurdity of this suggestion reference is made to Fig. 7 in which this process is dia-
grammatically indicated. Assuming that there is no refraction, the rays, as shown on the right, would travel along the sides of a polygon drawn around the solid, and the direction of transmission of the waves as a boundary in which case the length of the side would be about 400 miles. As one-
half the circumference of the earth is ap-
proximately 25,000 miles, there are roughly, thirty deviations. The efficiency of such a reflector cannot be more than 25 per cent, so that if none of the energy of the waves are absorbed in one deviation, the part recovered would be measured by the fraction (3/4)^30. Let the transmitter radiate
Hertz waves at the rate of 1000 kilo-
watts. Then about one hundred and fifteen billionth part of one watt is all that would be collected in a perfect receiver. In truth, that is as good as nothing. It is inconmis-
urable as shown on the left of the figure, and owing to this and other reasons, on which it is unnecessary to dwell, the amount recovered is nothing.

Consider now the process taking place in the transmission by the instrumentality of the wireless telephone. The object of this purpose attention is called to Fig. 8, which gives an idea of the mode of propagation of the current waves and is largely self-
explanatory. The drawing represents a
solar eclipse with the shadow of the moon just touching the surface of the earth at a point where the transmitter is located. As the shadow falls over the earth's surface, first with infinite, and then gradually diminishing velocity until the sun's rays will again will attain its true speed in space. From on it there will proceed with increasing velocity, reaching infinite value at the op-
posite side of the earth. It has already be
en stated that this is merely an illustration and not an accurate representation in the astrono-
mical sense.

The diagram will be readily understood by reference to Fig. 9, in which a transmitting circuit is shown connected to earth and to the transmitter being in action, two effects are produced, viz: electrical waves pass thru the air, and a current traverses the earth. The former wave travels thru the light and the latter has nowhere to go. It is the latter which is uncovered in the circuit. The latter proceeds with the speed varying as the cosecant of the angle which a radius drawn from any point under consideration forms with the central axis, and becomes greater as the earth is approached.

In conclusion I wish to add that the work that I have been doing for years, in the design of the telephone, but have not been permitted to make public in any form, has been of the greatest value to me. I have always been be
lieved that the telephone is one of the greatest inventions of all time, and I am convinced that it will ultimately become the greatest.
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SKINDERVKEN TRANSMITTER BUTTON

Fig. 1

The SKINDERVKEN TRANSMITTER BUTTON can be placed in any position and it will talk loudly and distinctly and is at the same time extraordinarily sensitive. It was primarily designed to replace the old damaged or burnt out transmitter. Simply unscrew and remove the transmitter from inside the wires, unscrew and remove the bridge and the old electrode. There remains only the diaphragm. These wires are then connected with the Skinderviken button, the latter screwed to the diaphragm, and after screwing the old transmitter housing together again, the telephone is ready for work.

ELECTRICAL EXPERIMENTER readers will be particularly interested in all the different experiments that can be performed with the Skinderviken Button. Fig. 1 shows the Skinderviken button attached to the back of an ingot steel watch case. When speaking towards the inside of the case, it will be found that the button transmits with the axis of symmetry of the waves. At the origin the speed is infinite but gradually diminishes until a quadrature is traversed, when the velocity is that of light. From there on it again increases, becoming infinite at the antipode. Theoretically the energy of this current is recoverable in its entirety, in properly attuned receivers.

Some experts, whom I have credited with better knowledge, have for years contended that my proposals to transmit power without wires are sheer nonsense but I note that they are growing more cautious every day. The latest objections to my method is found in the cheapness of gasoline. These men labor under the impression that the energy flows in all directions and that, therefore, only a minute amount can be recovered in any individual receiver. But this is far from being so. The power is conveyed in only one direction, from the transmitter to the receiver, and none of it is lost elsewhere. It is perfectly practicable to recover at any point of the globe energy enough for driving an airplane, or a pleasure boat or for lighting a dwelling. I am especially sanguine in regard to the lighting of isolated places and believe that a more economical and convenient method can hardly be devised. The future will show whether my foresight is as accurate now as it has proved heretofore.

SHIP RADIO OPERATORS ASK INCREASED WAGES.

Increased wages and the fixing of a standard wage scale for radio operators on vessels operating under Government direction was asked of the Shipping Board recently by a delegation representing the Marconi Radio Telegraphers' Association. The radio operators included in the request made of the Board are those on vessels operating in transatlantic and Gulf waters. Assurances were given the radio representatives by Board officials that their request would be taken under advisement for immediate consideration.

March 1919

S.K. SKINDERVKEN TELEPHONE EQUIPMENT CO.

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ALEXANDER WIRELESS BILL, AMENDED.

"Good Night." It would, of course, hold out all the sending stations which I have mentioned other than private ones, with one stroke. If we must have a time limit, let it be stated in the law so there will not be any "Ifs" and "hows" at all such clause as this would tend to create jealousy and friction between amateurs and Government officials. We believe such a clause is unnecessary and only at best reflects on Government apparatus and therefore inefficient Government radio operators.

No objection to this, although every amateur operator before the war was only too proud to display his Government license, once he had gone to the trouble to get one.

"Fifteenth. The owner of any private or amateur station must, within six months, after the date of the regulations of the Government stations and failure, to do so shall be liable by a fine not exceeding $100, such rules and regulations to be furnished by the Government at a nominal cost."

No objection to this.

RADIO AMATEURS DISCUSS OFFICIALLY.

During the hearings of the Alexander Bill before the committee on the Merchant Marine and Fisheries on December 12, 1918, many interesting points were brought out.

Lieut. Cooper, Jr., U. S. N. R. F., had been intrusted with drafting the amateur amendment, printed elsewhere in this issue. He called him self an "amateur naval officer," undertook the thankless job of drafting an amendment which would satisfy both the Navy and amateurs. As Lieutenant Cooper, let us state that he tried hard to be fair to both interests. But it is our opinion that neither Navy Department nor Amateurs are satisfied with the compromising amendment.

Lieutenant Cooper's statement before the committee.

Statement of Lieut. J. C. Cooper, United States Naval Reserve Force.

Lieut. Cooper: Gentlemen, I am an ex-amateur radio operator and "amateur naval officer," as I am told. I will take up the practice of my profession again. As many amateurs, when questioned, tell us offhand to do what I could for the service, I have had some duties in connection with radio work which have given me an opportunity to be able to see the point of view of the Navy and the point of view of the amateur as well as the same point of view.

Several days ago there was a meeting called in Capt. Todd's office—without knowing how many men who would be possible amateurs who happened to be on duty in the naval service in Washington. There were about 25 or 40 men present.

The question of the operation of amateur stations after the war was very liberally discussed, and a memorandum was prepared and sent to each of the men and the men in the naval service in Washington. We had been amateurs that we could locate, with the request that the questions be answered and sent back as soon as possible, with an idea of drafting an amendment to the present law which would, as far as possible, meet the combined view of themselves as previous amateurs, knowing amateur operations and knowing what the amateur desires do is a question so long as we have been amateurs.

I have the unfortunate responsibility of having to say the final word on collating those opinions and putting them into the form of an amendment. There is no body of men, I believe, who are more closely associated with everyone else in this country than these amateur radio operators. I am convinced from now on, as these hearings are going to be printed, my name is going to be raised in this connection among the amateurs to some as guilty of high treason, to others as one of the noblest services that a man can perform, and a credit if this amendment goes into law. I do not expect to be able to agree with it all, as I am the individual judge, however, of a certain number of questions that have been seen to the Navy point of view and the amateur point of view, and I, myself, believe that the the Government, and it is offered as an amendment to the bill.

The present law states that the amateur who does not hold a special license is authorized within 3 miles of a Government station to use a transformer input of one-half kilowatt, elsewhere 1 kilowatt.

(Continued on page 737)
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ELECTRICAL EXPERIMENTER

February, 1919

Mr. Saunders: I want to ask you a few questions about the amateur business. Have you ever looked over the bill that is under consideration by the committee? Lieut. Cooper: I have read it, sir.

Mr. Saunders: Aside from your amendment you have been discussing, there is no provision in the bill whatever relating to amateurs, is there? Lieut. Cooper: I understand, sir, it was the intention of the department to license amateur operators.

Mr. Saunders: Under the bill that has been introduced there is no provision for the amateur? Lieut. Cooper: No, sir.

Mr. Saunders: Is there under any other name? Lieut. Cooper: I think, sir, there has been no reason why amateur stations should not have been licensed under some section of the "experimental stations."

Mr. Saunders: Suppose it is just an individual, I understand, sir. I understand, sir, a great many of these people who are amateurs took up this thing before the war and young men went up and took up the business themselves.

Lieut. Cooper: I did so myself.

Mr. Saunders: That would not be called a station, would it? Lieut. Cooper: Oh, yes, sir.

Mr. Saunders: Do you think, under the language "experimental stations," that any little individual amateur operator in the wilds of the name, I will say, who has been working on the thing himself, as an intellectual improvement, could be described as an "experimental station."

Lieut. Cooper: I think so. But I say it is a most point in view of the amendment.

Mr. Saunders: I do not see how that could be done with respect to the provision as to who is to be licensed as an amateur. Under that, necessarily there any many more amateurs, he must have had the opportunity to take some preliminary training, at some station.

Lieut. Cooper: Very frankly I think that very few amateurs ever went to a training school.

Mr. Saunders: You mean to say there is no possible classification by certain capacities by your amendment; they have got to have a certain facility.

Lieut. Cooper: The amateur can learn that by putting the buzzer. All amateurs do the same thing, all operators.

Mr. Saunders: Can he experiment enough with the wireless apparatus to acquire that facility without having a trainer?

Lieut. Cooper: May I suggest, sir, that the process would be something like this: That by listening in call—call—call, and you will note that no license is required for receiving—a man can become accustomed to using the receiving apparatus, and he can become accustomed to sending with a key to the buzzer, which is not a radio operator, and he can be taught to send up to any speed he can maintain.

Mr. Saunders: He can teach himself, in other words, can he?

Lieut. Cooper: Teach himself, or be taught by other amateurs.

Mr. Saunders: He can pick that up by his own efforts, and by his own ingenuity and application as a home, he can acquire the facility which you have imposed upon him before he can receive a license.

Lieut. Cooper: I think any of the amateurs here will be able to teach you.

Mr. Saunders: With respect to this amateur, after he has attained that speed, and when he is given the license that you say that your provisions would be controlled by the terms of his license.

Lieut. Cooper: They are at present, under the present provisions.

Mr. Saunders: Do you contemplate any difficulty in that connection if he operates in connection to the terms of his license, with the commercial operation of the Government system, or any other commercial system?

Lieut. Cooper: The limitation of wave lengths, sir, and the limitation to power in accordance with the law of 1913, as amended by this amendment, are designed to prevent the amateur from causing interference with commercial stations.

Mr. Saunders: But you can see no danger of interference with the wireless system in the hands of an experimental operator?

Lieut. Cooper: It was my view, sir, in drafting the amendment as it is, that these limitations on power and wave lengths would prevent such interference.

Mr. Saunders: So that in considering the general problem with respect to the necessity of having the Government business unimpeded by this control, and control, we can eliminate any factor of danger from experimental operators.

Lieut. Cooper: I think so, sir, with the exception of the fact that some of these experimental stations must be had in the future if the amateur is to maintain the dignified position in the radio world as he should.

Mr. Saunders: That is by regulation for me.

Mr. Saunders: As I know, I have eliminated the amateur. I am going to try to substitute a factor in this favoring this policy, because they will operate in a field outside of the field that has been under the control.

Lieut. Cooper: That is the idea of the amendment.

There is one coming factor in radio work which may adversely affect amateur operating which should be looked forward to at the present time. The fleet—and this is not disclosing military secrets—it is used for interference purposes; very short wave length, shorter than the one hundred fifty meters mentioned here as the minimum length that an amateur should use. Aircraft are also using various wave lengths, some of which are almost

(Continued on page 742)
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tubes where a displacement of the liquid will take place gradually, we believe that the device will function with a greater degree of success.

Automatic Air Hose Coupling.

(201) James Wilson, N. Y., submits a drawing of an automatic air hose coupling with drawing, and wishes to have our opinion whether it is patentable and if it would be of any value if a patent could be obtained.

A. It is impossible to figure out on paper whether the hose would work satisfactorily. Indeed, we are not even sure the device is at all new. We would advise our correspondent to have someone search made for him. The assistance of the patent attorneys can ascertain what has been done previously in this art.

Electric Heater.

(303) Gottlieb Samuel Leventhal, Elmira, N. Y., submits a drawing on an electrical idea for heating water. It appears to be of the usual type; whereby it can be attached to any faucet, the water started and the current turned off. As the water runs thru this device and over the heat, the water is heated.

A. There is nothing fundamentally new to the device submitted, nor any regulation or device that our correspondent has given it, which is in the shape of a round ball. Outside of this, there is nothing new here that are quite certain that no patent could be obtained.

Mechanical Brake.

(304) Emilio Man, Havana, C. A., writes as follows: I am enclosing blueprint and description of a contrivance to apply brakes on railroad cars with the idea of publishing it with your advice on the idea in your Patent Advice column. Will you kindly tell me whether the possibilities of this invention?

A. This is a very simple contrivance, and without seeing a model we think it is almost impossible for anyone to give an intelligent opinion. A brake of this kind looks all right on paper, but it is difficult to predict in advance if it will work out in practice. We therefore advise you that before applying for patent on this apparatus that a model should be tried.

BOY BURNED WHEN WET KITE STRING TOUCHES WIRES.

While Wm. Oliver of Port Stanley was amusing himself recently flying his kite he was severely burnt on both hands, when the flying string came in contact with the high voltage wires of a local railway. While flying his kite a strong wind sent it to the ground, and the wire, which was in a relaxed condition, came in contact with this power wire, as it fell over it. The victim got the full benefit of the voltage. This was much too strong for the string as it burnt. Two of his fingers which William is very thankful as it saved his life.

The only other small boy there ran away when he saw what had happened so he was alone when all happened. The burnt hands healed up all right, but Master Oliver, for one, will keep clear of all overhead electric wires hereafter, for he goes kite flying.

It is remarkable that he was not killed outright, the high resistance of the kite string probably being the factor that saved his life.

RADIO AMATEURS DISCUSS OFFICIAL.

(Continued from page 738)

down to 250 meters. There may be trouble in the future, as between aircraft operating over long distances, and working with their receiving or transmitting apparatus, and as the weather is a possibility of the future that I will call the attention of the committee, which this thing may come up here at another time under some future law, and I simply want to warn the com-

mittee that this is a new field that we know nothing about. Aircraft radio was not in existence to any extent when we were there. There may be interference between amateur operators and airmen radio stations, and there will not be.

Mr. Sanders: Government ownership has nothing to do with that problem.

Lieut. Cooper: Government ownership would probably be operating the stations for aircraft.

Mr. Sanders: It is a question of which you speak of which may arise hereafter is a thing that will be met by appropriate regulations.

Lieut. Cooper: It might be be, sir, if this amend-

ment is past, that it might have to be met by legis-
la
tion
gainst the wave length back where it is now.

Mr. Sanders: Appropriate legislation?

Lieut. Cooper: It might be legislation and not regula-
tion.

Mr. Sanders: Legislation is just that much more author".

Lieut. Cooper: I usually think of "regulation as a regulation of a department.

Mr. Sanders: I admit that is so in general, where you think of something issued by some de-

PARTMENT, or some Bureau Chief, you bene-

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was merely an automation endowed with power of movement, responding to the stimuli of the sense organs and thinking and acting accordingly. The practical result of this is a perfect automaton which has been so far carried out only in an imperfect manner. Its latent possibilities will, however, eventually be shown. I have been since years planning self-controlled automata and believe that mechanisms can be produced which will act as if possessed of reason, to a limited degree, and will create a revolution in many commercial and industrial departments.

I was about twenty years old when I first succeeded in banishing an image from my vision by willful effort, but I never had any control over the flashes of light to which I have referred. They were, perhaps, my strangest experience and inexplicable. They usually occurred when I found myself in a dangerous or distressing situation, or when I felt that my situation or intellect was in some way being exaggerated. In some instances I have seen all the air around me filled with tongues of living flame, but of diminishing, with time and seemingly attained a maximum when I was about twenty-five years old. While in Paris 1888, a prominent French manufacturer sent me an invitation to a shooting expedition which I accepted. I had been long confined to the factory and the fresh air had a wonderfully invigorating effect on me. On my return to the city that night I felt a positive sensation that my brain had been given a light as a small sun was located in it and I past the whole night applying cold compressions to my tortured head. Finally the flashes diminished in frequency and force but it took more than three weeks before they wholly subsided. When a second invitation was extended to me my answer was an emphatic NO!

These luminous phenomena still manifest themselves from time to time, as when a new idea opens up possibilities strikes me, but they are no longer exciting, being of relatively small intensity. When I close my eyes I invariably observe first, a background of dark uniform blue, not unlike the sky on a clear but starless night. In a few seconds this field becomes animated with innumerable specks of green, arranged in several layers and advancing towards me. Then there appears, to the right, a beautiful pattern of two parallel lines of parallel and closely spaced lines, at right angles to one another, in all sorts of colors with yellow-green and gold predominating. Immediately thereafter the lines begin to move, brighter and the whole is thickly sprinkled with dots of twinkling light. This picture moves slowly across the field of vision and in almost every variant to the left, leaving behind a ground of rather unpleasant and inert grey which quickly gives way to a lillows sea of clouds, seeming to breathe and mould themselves in living shapes. It is curious I cannot project a form into this grey until the second phase is reached. Every time, before falling asleep, images of persons or objects fit before my view. When I see them I know that I am about to lose consciousness. If they are absent and refuse to come it means a sleepless night.

To what an extent imagination played a part in my early life I may illustrate by another brief experience. Like most children I was fond of jumping and developed an intense desire to support myself in the air. One day, just after lunch, I found myself charged with oxygen blown from the mountains rendering my body as light as cork and then I would leap and float in space for a long time in a delightful sensation and my disappointment was keen when later I undeceived myself.

During that period I contracted many strange habits, some of which I can trace to external impressions while others are unaccountable. I had a
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violent aversion against the earrings of women but other ornaments, as bracelets, pleased me more or less according to design. The sight of a pearl would almost give me a fit but I was fascinated with the glitter of crystals or objects with sharp edges and plano-spherical surfaces. I would not touch the hair of other people except, perhaps, at the point of a revolver. I would get a fever by looking at a peach and if a piece of camphor were placed in the house it caused me the keenest discomfort. Even now I am not insensible to some of these upsetting impressions. When I drop a little square of paper in a dish filled with liquid, I always sense a peculiar and awful taste in my mouth. I counted the steps in my walks and counted the cubic contents of soup plates, coffee cups and pieces of food,—otherwise my meal was unenjoyable. All repeated acts or operations I performed became second nature and if I mist I felt impelled to do it all over again, even if it took hours.

Up to the age of eight years, my character was weak and vacillating. I had neither courage or strength to form a firm resolve. My feelings came in waves and surges and vibrated uneasily between extremes. My wishes were labile and consuming force and like the heads of the hydra, they multiplied. I was oppressed by thoughts of pain in life and death and religious fear. I was swayed by superstitious belief and lived in constant dread of the spirit of evil, of ghosts and sprites and other unholy monsters of the dark. The more I seemed at one time, the more became a tremendous change which altered the course of my whole existence.

Of all things I liked books the best. My father had a large library and whenever I could manage to get a hold of my satisfaction for reading. He did not permit it and would fly into a rage when he caught me in the act. One day I ventured when he was off and found that I was reading in secret. He did not want me to spoil my eyes. But I obtained tallow, made the wick and cast the sticks into forms, and every night would burn the keyhole and the cracks and read, often till dawn, when all others slept and my mother started on her arduous daily task. On one occasion I came across a novel entitled "Abai" (the Son of Aba), a Syrian translation of a well known Hungarian writer, Jolna. I worked some how awakened my dormant powers of will and I began to practise self-control. At first my resolutions faded like snow in April, but in a little while I conquered my weakness and left a pleasure I never knew before—that of doing as I willed. In the course of time this vigorous mental exercise became second nature. At the outset my wishes had to be subdued but gradually desire and will grew to be identical. After years of such discipline I gained so completely a mastery over myself that I toyed with passions which have meant destruction to some of the strongest men. At a certain age I contracted a mania for gambling which greatly worried my parents. To sit down to a game of cards was for me the quintessence of pleasure. My father led an exemplary life and could not excuse the senseless waste of time and money in which I indulged. I had a strong resolve but my philosophy was bad. I would say to him, "I cannot very well. I have so much work to do, I can only make use of it worth while to give up that which I would purchase with the joyes of Paradise? On frequent occasions he gave vent to his anger and contempt but my mother was different. She understood the character of men and knew that one's salvation could only be brought about thru his own efforts. Once I had lost all my money and was craving for a game, she came to me with a roll of bills and said, "Go and enjoy yourself. The sooner you lose all the better it will be. I know that you will get over it." She was right. I conquered my passion

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Yours truly,
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then and there and only regretted that it had not been a hundred times as strong. I not only vanquished but tore it from my heart so as not to leave even a trace of desire. Ever since that time I have been as indifferent to any form of gambling as to picking teeth.

During another period I smoked excessively, threatening to ruin my health. Then my will asserted itself and I not only stopped but even removed. Long ago I suffered from heart trouble until I discovered that it was due to the innocent cup of coffee which I drank every morning. I discontinued at once, tho I confess it was not an easy task. In this way I checked and bridled other habits and passions and have really saved my life. I derived an immense amount of satisfaction from what most men would consider privation and sacrifice.

After finishing the studies at the Polytechnic Institute and University I had a complete nervous breakdown and while the malady lasted I observed many phenomena strange and unbelievable.

(To be continued in our March issue)

ELECTRICAL EXPERIMENTER

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(To be continued in our March issue)

TEN TELEPHONE OR FORTY TELEGRAPH CURRENTS OVER ONE CIRCUIT.

POSTMASTER GENERAL BURLINGTON, on December 12th, made public a letter from Theodore N. Vail announcing the invention and development by the technical staff of the Bell system of a new method of multiplex telephony and telegraphy, which is expected to revolutionize long-distance wire communication.

Mr. Vail, who is President of the American Telephone and Telegraph Company, explained that there can be a combination of ten telephone conversations or forty simultaneous telegraph messages together on one pair of wires. Each pair of wires a total of five telephone conversations are simultaneously operated, each giving service as good as that provided by the circuit working in the ordinary way.

Herefore the best telephone methods known to the art provided only one telephone conversation at a time over a single pair of wires. About a hundred years ago there was developed the phantom circuit arrangement, by which three telephone circuits were obtained from a pair of wires. This was an important improvement, of which extensive use has been made commercially. Now, by the multiplex method we are enabled to obtain five telephone circuits over one pair of wires, that is, ten simultaneous telephone conversations from the two pairs of wires which formerly could be used only for a single simultaneous telephone conversation. This means an increase of more than three-fold in the telephonic capacity of the wires, as compared with the best previous state of the art.

Some proposals made by the earlier workers in this particular field have naturally covered many of the successes of the solution of the problem, particularly a suggestion made by Maj. Gen. George O. Squier, Chief Signal Officer of the United States Army, ten years ago, which at the time attracted very general attention.

Furthermore, while working in entirely different fields and with a different objective, Dr. Lee deForest a number of years ago invented a wireless device known as the Audion, which by improvements and adaptation has been made an important part of the Bell telephone system.

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ELECTRICAL EXPERIMENTER

CURING SOLDIERS' ILLS WITH ELECTRICITY

(Comment from page 695)

were 3,000 shell-shock victims; the day the
armistice was signed 2,000 of them re-
covered, showing what a peculiar and
balancing mental aliment this is.

The photograph on page 2 was taken at
the American Red Cross War Hospital, lo-
cated at Paignton, Devon, France, which
is one of the finest and best equipped in the Red
Cross service. This hospital has a staff of
150 nurses under the direction of Army
medical officers. The photograph shows a
soldier undergoing the electric bath treat-
ment for rheumatism. This treatment is
given in the massage room at the hospital,
where multiform other electric machines
and apparatus are found, in-
cluding electrical massage vibrators, electric
heating pads, etc.

In some of larger base hospitals, very
elaborate electric equipment has been
made available. In some of the American
Army hospitals in the United States, where
the returning wounded are being carefully
attended to, so as to make them as well and
strong as they were when they went overseas
to fight the Boche, there are some of the
very latest in instruments and apparatus
about which little is known outside of the
medical profession. This equipment in-
cludes among other things the Electro-car-
diograph, which is an extremely
sensitive galvanometer, capable of
recording the beats of the heart on a pho-
tographic film, so that the exact condition
of the heart with regard to its manner of
beating and its strength, can be minutely
and accurately studied by the physicians.

At one of the largest declaration
hospitals everything is done by
electricity—even to the cooking. This hospital
has one of the largest X-ray laboratories
in the world, each X-ray rooms
being equipped with a special dark room for
rapidly developing and finishing the X-ray
plates. The X-ray in itself has undoubtedly
saved thousands of lives from great con-
lict, in many cases when the victims of
bullet and shell wounds would certainly
have died, had it not been for this wunder-
ful scientific machine. Owing to the
terrible fragmentation (splintering) of the
shell now used, which often causes small
shrapnel splinters to penetrate parts of the
body where they would never be suspected,
and which, if they were not quickly dis-
covered by the X-ray, would be quite li-
able to affect the heart, lungs, or blood vessels
at some unexpected time and cost the victim
his life. For this reason the returning
wounded are most minutely examined and
X-rayed, especially in the abdomen and
chest regions, where many of these shell
splinters, and even bullets, are found
and podged themselves until the play itself makes
the meaning clear. To wit: "The first epi-

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month (after 8 years) how to earn $750 a
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success. We tell you how to get more sales from 100 men than
they had ever made. You will learn how to
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sode of the last act occurs before the last episode of the preceding act.” It simply means that at that critical time the action is going on in two places at once: and because the stage cannot jump back and forth in a flash like the motion picture, part of the story has to be postponed until the scene shifts elsewhere.

The illustrations which we present here-with are, of course, doctored up for the reader, assuming if they were not nothing at all it would be seen. It is very necessary to show the pictures in this manner, otherwise we would revert back to our camouflaged frontispiece,-the blank, spacey cover,-nothing,—and as the Editors must show pictures—well you know how it is:

A little camouflage here and there is often mightier than the pen!

EXPERIMENTAL MECHANICS. (Continued from page 717)

much more difficult than the ordinary run of lathe work. Fig. 5 shows how a crank pin, 1, with its rods, is set to be revolved between centers 2, 2, of the lathe. This is made with provisions for attaching to the crank rod 4, 4, temporary support plates 5, 5, that the crank shaft, and interconnecting center hoes in the plates in line with the center of the crank pin to be turned. The main D, D, must be turned first, then the second one finished. The plates 3, 3, must be bored out to be a tight fit on the ends of the crank shafts, to which they are further secured by a set screw as indicated. The crank pin is then laid on a surface plate or on the lathe bed, which will answer this purpose very well, and the centers of the crank pin, 1, determined and carefully marked on the supporting plates, 3, 3, so that when mounted between lathe centers the axis shall pass thru the central axis of the crank pin. The center holes should be drilled and countersunk in the usual way at these points, and each shaft may then be mounted in the lathe on its centers, and one end secured to the face plate with a dog and the crank pin turned to proper size.

It will be found in turning crank shafts that the work as a whole is very much out of balance, and a counterbalance weight on the opposite side is the driving of the lathe. This work will be of interest to those building engines, etc.

(To be continued)

PRODUCING RAIN BY ELECTRICITY AND X-RAYS. (Continued from page 687)

valve rectifiers, is used to produce the high potential current for operating the X-ray tube, and this current is fed to the tube thru the two wires leading up to the bellows. The X-ray tube itself is placed in a light-water-proof compartment suspended from a spar just below the balloon, as the illuminating shaft shall be seen. When used, the Röntgen-ray tube is so hung that the rays are directed upward, so as to impinge upon the metallicized surface of the balloon, which, as will be remembered, is charged at a very high potential. Suitable high voltage, strain insulators are placed in the lead wires at all the points shown. A recording instrument, such as a hot wire ammeter is connected in series with the high tension lead wire. If the ground switch is closed, then any leaky charge in the neighborhood of the balloon is conveyed to earth, and all conditions are obtained on the instrument. When the ground switch is opened, the air surrounding the balloon for a radius of several hundred feet is endowed with conductive qualities as a result of the emanations from the X-ray tube. When the ultra-high voltage

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Charging circuit is closed and the metallized balloon surface electrified, then the air in the vicinity of the balloon receives a powerful electronic charge, which acts on the aforesaid particles, suspended or floating in the air in the manner aforementioned. The inventor has been engaged for many years in the design, construction, and operation of electrical apparatus and means for application against lightning discharges.

The inventor mentions that two or more operating stations for rain production may be used in cooperation, depending upon the observed meteorological conditions, these stations being located at considerable distances apart. In operating multiple stations the degree and sign of the charges used therein, respectively, may be varied as required. The effect of ultraviolet rays instead of Röntgen rays for ionizing the atmosphere is discussed by Mr. Balsille in the description of the apparatus, but they are of little practical interest, as he points out, for they produce practical ionization effects only when reflected from a fluorescent surface.

EXPERIMENTAL CHEMISTRY.

(Continued from page 71)

will contain crystalline deposits. Some of the sublimat will be amorphous.

(THE CARBON TEST).--In this the Arsenious Oxide is reduced by Carbon [CO being formed] to metallic Arsenic, which sublimes as in Marsh's Test.

HYDROGEN SULFID TEST.--The hydrodor sulfid solution, [AsS] [Yellow] from an acid solution of any arsenic salt.

2AsCl + HJ.S = AsS + HCl.

Physiological Effects.

Like other arsenical compounds, the oxide is very poisonous, the lethal dose being about 2% gram. It is called an Irri- tant poison, and acts rather slowly, as the digestive fluids have to transform it before absorption. The antidote is freshly prepared ferric hydrat (Fe(Oh)3), together with Magnesia. 2FeCl + 3Mg[OH] = 2Fe(Oh)3 + 3MgCl.

This forms a compound of arsenic insoluble in the fluids of the body, and precipitated in the stomach, etc. An overdose may act as a purgative.

For evidence of arsenical poisoning in post-mortem examination of the liver, the stomach, etc., these organs and their contents are sometimes analyzed before the Marsh and other tests can be applied, in order to separate the arsenic from the vessels and food products. After being treated with HCl, KClO, etc., the finely divided substances are put into a dialyzer (a parchment membrane, see Fig. 150), and suspended in water, when the arsenic compounds, being more diffusive, pass through the membrane in the water of the outer vessel, leaving the other substances behind. This water is then concentrated, and tested for arsenic. Generally, however, the contents with the arsenic are dissolved in aqua regia and then tested by Marsh's or Reason's test.

Use.

It is employed in shot manufacture to give a globular form to the shot. Cobalt Glance, a compound of Arsenic and Cobalt, has considerable use as fly-rose under the name of Fly-stone. Arsenic also finds use in many rat poison compounds.

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glass (about 25 cm. long, and 8 mm. diameter) by the use of a blast-lamp flame. The first capillary should be 5 or 6 cm., from one end of the tube, and as is convenient to hold in the flame; the second one 5 or 6 cm. from the first. These capillaries should not be less than 4 or 5 mm., in diameter at the narrowest part. Between the two constrictions bend the tube upward at an obtuse angle (1D). See Fig. 157. The opening at the base is then fi:

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(Continued from page 715)

are fifteen contacts and they should be spaced about 3/4" apart. The construction is

shown in Fig. 8. The rods in both the transformer slide and the rheostat are

mounted on a hardwood or fiber block, the dimensions of which are shown in figure

9. The rod is fastened to the block by means of screws or by a long pin thru the

entire rod and block. The handle is fastened by bending a piece of brass as

illustrated in the side-view. The contacts are six in number and are 3/4" thick 1/4" long

and 3/4" wide. Each marble with No. 8—32 flat-head machine screws counter-

sink into the contacts. Make them extend far enough behind the board to serve as

contacts. The roller heads must fit snugly because they will have to carry 60

ampere of current.

Next we will take up the construction of the transformer. The dimensions are given in

Fig. 6. The core is built of No. 28 sheet iron or stove pipe iron will do. The pieces are

cut 5 x 1 1/2" and 2 1/2" x 1 1/2". Use enough to build a core 1 1/2" thick when

comprest. For 110 volts consist of 380 turns, 290 turns on each of No. 18 D.C.

The secondary consists of 180 turns of No. 14 or better No. 12 D.C. Taps are

brought out at every 300 turns and at every additional five turns until the tap

for 10 volts is brought out. Then bring out taps at the 60th turn, the 90th, 120th,

150th, 180th and 195th turns. These are connected to the transformer contacts and the beginning of the coil is connected to one side of the

plug receptacle. The other side of the plug receptacle is connected to the brass rod.

But the transformer must be mounted first. Figure 7 shows how this is done.

The rheostat is made of No. 18 iron wire on 6 wooden cylinders three inches in diameter and 12 inches long. Wind 29 ft. of wire on each. Use nails or screws to hold the winding. Connect in series and immerse in water. Tap the iron wire connections between each coil by using brass or copper wire and be sure to let the copper make the connection below the water. If the water gets too low the wire will almost instantly melt if it is carrying full 60

ampere. The connections are much the same as those of a starting box. Connect one side of line to rod and the other side to the 50 amperes stage plug; connect other terminal of stage plug to last lead of rheostat and connect the first terminal or beginning of the coil. No. 1, beginning of second coil to second contact, etc.

The main-line wires must be No. 1. This wire is the expensive—switch-board must or rather should be near the entrance cut-out.

A 100 amperes current at 110 volts is 11 K.W., and if you mean the transformer supplying your house must be of that capacity. 

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(Continued from page 703)

detailed description of the process of figuring the mirror. Roughly speaking it may be divided into two stages. In the first stage the mirror was brought to a spherical figure, and in the second this spherical form was charged to paraboloid. The second process the requiring much more time than the first, involved great care and frequent optical tests to avoid the introduction of zonal errors. The largest deviations from the paraboloid form in the sphere in the case of this mirror is only one-thousandth of an inch. All of the optical work, with the exception of the first rough shaping, has been carried out with wooden tools of various sizes and forms, and the use of rouge and distilled water as the polishing material.

After the completion of the mirror a series of photographic tests made was to determine the accuracy of its figure. These showed a remarkably high degree of perfection, every part of the surface having the same focal length to within one part in about 90,000.

A few figures may be of interest in this connection. The finished mirror weighs 414,800 tons, about one ton of glass having been removed in the process of shaping and figuring. Its diameter is closely 101 inches, and its thickness at the edge 13 inches. The depth of the curve at the center is about 114 inches. The focal length of the mirror is five times its aperture, or 42 feet. At the center of the moon at this focus, accordingly, would have a diameter of 4.4 inches. As in most modern reflecting telescopes, the mirror will be provided with two small convex mirrors to be attached to the upper end of the tube, either of which may be employed to increase the focal length in much the same way as telephoto lenses are used in ordinary photography. With these mirrors focal lengths of 34 and 251 feet may be obtained and the magnification correspondingly increased.

As soon as the optical work upon the mirror disk was finished the sign of every way of the telescope mounting was begun. In view of the great size and the immense weights involved the "closed fork" type was finally adopted. This form of mounting the telescope tube is hung in the center of a rectangular frame of massive steel girders, the bearings providing for north and south movements of the tube being built into the two side members. The entire rectangle is mounted on bearings at top and bottom, which furnish the east and west motion of the telescope. To relieve friction the system of mercury flotation used most successfully for the 60-inch reflector is employed, there being two large steel floats and corresponding mercury tanks, one at each end of the rectangular axis. These floats are about 98 per cent of the moving parts of the telescope, or some 50 tons, the remaining two per cent being carried by two large spherical defining lens. The instrument is completed by electric motors, which provide for three rates of speed in both north and south and east and west directions.

The driving clock, which moves the telescope at a uniform rate corresponding to the rotation of the earth is placed within the concrete pier which supports the instrument and makes movements of the driving shafts. From the clock and meshes with a worm wheel 17 feet in diameter, which is attached to the telescope 34, 58.

The building and dome which enclose the telescope form a steel structure 100 feet high and 95 feet in diameter. The walls and roof are double throught to admit of the free circulation of air, and thus to keep the temperature within the building. The shutter of the double section type, divided in the center, and when fully open provides an aperture 2 feet wide. Like the observing platform, the crane hoist and the dome mechanism, it is operated by electric motors. The dome is mounted on 24 four-wheeled trucks resting, for the most part, on ground rails, and power is applied by two driving trucks at opposite sides. When rotated the motion of the dome has been found to be remarkably smooth and free from vibration in spite of the great weight involved, which is approximately 600 tons.
Opportunity Adlets

You will find many remarkable opportunities and real bargains in these columns. It will pay you to read and investigate the offerings made by reliable dealers and manufacturers for automobile accessories, the opportunity to make money, or anything else, you will find listed here the best and most attractive special offers of the month.

Advertisements in this section are subject to the above restrictions. No advertisement may exceed one inch in width and seven lines in length. No service fees are charged advertisers. Ten percent discount for 6 issues, 20 percent discount for 12 issues from above rate. Objectionable or misleading advertisements not accepted. Advertisements for March issue must reach us not later than January 22.

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Forc Start Easy in Cold Weather with our new 1919 carburetors. 34 miles per gallon. Use of carburetor, etc., $20, or a few parts to fit your car. Send for price.


Vulcanize on Anderson Steam Vulcanizer. See advertisement.

Motors, Engines and Dynamics

Small Gasoline Engines for Home Use and Generators from Bankruptcy Stock, 10 H. P. C., $25.00 each; 15 H. P., $40.00. Battery Charging Batteries, etc., etc. New models and patents. 50% cash up. Motors for all phases of immediate delivery. Less than 5% required. Write for free bulletin. Johnstoll, West End, Buffalo, N. Y.

Small Gasoline Engines, 11 H. P., $25.00. Drives Dynamo, Washing Machines, Air Brush, etc. Houbolt, West 89th St., New York.


Help Wanted


To Ascertain the Vacation for which you are best suited. Send for special, 30c. S. E. Zancle, 467 W. 32nd St., New York.

Business Worth While. I Start You silversmithing and silver electroplating. See all my works and prices. Clarence Sprinkle, Dept. 49, Marion, Indiana.


Sona Poem Wanted

Write the Words for a Song. We write music and words for Edison, Cupples, etc. All prices given. Franklin Institute, Dept. B6, Rochester, N. Y.

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Telegraphy, Wire and Wireless, and Railway Accounting bought thoroughly. DEAN$NIELD for both. Seeices. BIG SALARIES Oldest and Largest. School—est. 45 years. Catalog free. Dodge Institute, Seven St., Valparaiso, Ind.

Agents Wanted


$10 Daily rehashing chandeliers, brass beds, automobiles in this country. Specials in every advertisement. Write for prices. T. C. Jackson, 9 Luther St., Binghamton, N. Y.

Charlette, N. C.

Oct. 4, 1918.

Dear Sirs:

It certainly was SOME RESULTS.

For your information, I have enclosed about $8.00 in stamps from China. Shanghai can you beat it! I'm enclosing a check for $3.00 to collect.

I'm a-goin' guil, and will never do it again, or at least I won't promise to answer all the letters that I hear about a "Deal that I put in the "E. E."

Desperately want a Bicycle to come in. The apparatus advertised has long since been sold. The agents are from all over the United States, AND ELSEWHERE. I'll be out of sight from Shanghai, China. Can you beat that. I'm enclosting five cents for your trouble.

It's a great life, if you don't weaken. I wish to THANK the "E. E."—Some circulation.

Very Respectfully,

JAMES MATHERS,
403 N. Brevard St., Charlotte, N. C.

Exchange Ads—Cont'd

Thirty Dollars takes Radio cabinet Transform- er, Condensers, Phone and large Omnipgraph. <s>Sale</s>. 343 Fulton St., New York.

Have 22 Marlin pump-action rifles; chemicals. Want closed-core transformer, Murdock moulded condenser, 2000 ohm meters, etc. Cheap. For sale.

Swap, New Auto Knitter Hosiery Machine and accessories for motor cycle or anything you have, all answered. David Grillo, 654 E. 5th Ave., Minneapolis, Minn.

For Sale. Signalt Printing Press No. 12; two borders, 2 sets of type, complete, 15; John A. Appleton, 1115 Summit Ave., Jersey City, N. J.

Brownian, Flattbacker, etc., Scientific, excellent tone, $25; plant sounder, $100; Erector motor, $30, or John8on, 9 Luther St., Binghamton, N. Y.

Sell. 2000 ohm phonos, headband, 8 ft. cord, $4.00. Used. $3.00 in spark coil, 75c. wire set. 2000 ohm set. 75c. Extra, s. E. Rye, 796 Ave., S. E., Minneapolis, Minn.

For Sale. Omnigraph Spring motor hardly used, an $8.00 machine.

Here They Are, Ballopticon, High grade Bausch & Lomb Model C instrument, with attachment for open objects, and carrying case; good efficient Hoyer Sweater Sweep, £3; large Lionel Electric Grain outfit; E. I. Co. Telsa Transformer; general assortment of apparatus and accessories; Baldwin Camp Lamp; 6 in. Red Devil Wash Motor; the above in best condition, all at money-saving prices. First one, served first. Be fast. State very clearly what you have. Wilker Wireless goods. Vernon Chabed, 36 Custer Ave. Youngstown, Ohio.

For Sale—3½ H.P. Gasoline Engine, $10.00. Generator, 110 volts, delivers 100 watts, $30.00. B. J. Klink, 736 Pennsylvania Ave., Wash. D. C.


$65.00 Course in Aviation complete with blue prints, $10.00. Robert White, Madison, St. Dak.

For Sale—Motorcycles, Printing Outfits, En- gines, Typewriters, etc. Sold on monthly pay- ments. We buy. Cathey, for Scopus, Station Ex- change Experiment, Dept. EE, Port Huron, Michigan.

Mail—Wireless and Electrical apparatus. Send stamps for list. Marcel Scharer, 120 West 30th St., New York.

For Sale—Electrical Instruments, Send stamp for list. M. Fraiger, Kinston, N. C.

Wanted—Small lathe, screw cutting. Will pay $5.00 for small "Goodwill" lathe. Andrew Ellison, Kirkville, Mo.


Will Exchange—$4 course in Aeronautics with blueprint, for Electrical Tiger, 8 oz., or Microscope. Chas. Jeffries, Lake Charles, La.

Scenery for Hire


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ELECTRICAL EXPERIMENTER

EXPERIMENTAL CHEMISTRY. (Continued from page 751)

3. The burning of hydrogen. 4. Burning of arsin. 5. Breaking up of arsin by heat. The solution of arsin in sodium hydrosulphite gives:

\[ 2\text{As} + 5\text{Na}_2\text{SO}_3 + 3\text{H}_2\text{O} = 2\text{H}_3\text{AsO}_3 + 5\text{NaCl}. \]

In the same manner as above, test some solution imagined to contain arsenic.

**Experiment No. 149.**  
Perform an experiment using SchC solution in exactly the same way as the AsCl was used, and compare the results. Pay particular attention to the difference between Sulfuric Acid and Deposition, in color, and in solubility in NaOCl.

**Reinisch's Test.**

**Experiment No. 150.**  
Pour into a dish 3 or 4 cc. of a solution of arsenic chlorid (AsCl) or sodium arsenit (NaAsO), added with hydrochloric acid. In this solution place a strip of bright copper foil (about 3 cm. x 4 cm.) and boil the liquid for three or four minutes—longer, if no discoloration of the copper appears.

What is the color? No change in the copper indicates absence of arsenic. In that case shake more HCI and boil again. If the copper is finally darkened, take it from the liquid with the forceps, rinse it carefully, and press it lightly between the folds of filter paper to remove moisture. Then cut it into small strips with scissors; drop these strips to the bottom of a long and narrow test tube, and slowly heat the lower part of the tube.

See whether the copper changes color. Look for a sublimate. State its color; its position in the tube; its appearance, like the sublimate in Marshall's test? Compare it with metallic arsenic, arsenious oxide, etc. Examine the sublimate under a microscope and scratching off a little for this purpose. Is it crystalline or amorphous?

**Experiment No. 151.**  
Make arsenious sulfit (As₂S₉), wash it free from impurities, dry it and put it away for future use.

**Experiment No. 152.**  
Ascertain by experiment a solvent for arsenious sulfit (As₂S₉). Try (NH₄)₂CO₃.

**Experiment No. 153.**  
Make Paris Green (Cu₂AsO₄·11H₂O), wash, filter dry, and put away for use.

**Experiment No. 154.**  
Make arsenious oxide (As₂O₃), using not over ½ gram.

**Experiment No. 155.**  
See whether As₂O₃ is at all soluble in water.

Examine the various compounds of arsenic with special regard to colors—red, yellow, green, and white—and attach names.  

(To be continued)

**JAPAN HAS WIRE-WIRELESS CENTRAL.**

An exchange to wireless and wire telephones is to be established in Kobe very shortly by the Government Department on Communication. A copy of the Japanese newspaper in Japan port will be connected by “Are you there?” girls with the telephones of subscribers in Kobe, Osaka, Kyoto and neighboring cities, thus serving the most densely populated section in Japan.

**Opportunity Ad-Lets.**

**Tricks, Puzzles and Games**

1,000 stage tricks with catalog. Catalogue 10c, small catalogue FREE. Hornmann Magic Co., Sta. & 79th Eighth Avenue, New York.  

Black Art Hindos Exposed, 89 page, 15c.  

Magic Card Trick. Get these magic cards and fool your friends, 10c. Reeves & Taylor Magic Co., West Somerville, Mass.  

Complete Hingham Solvent, 100¢.  

**Electric Supplies & Appliances**

10 Wireless.

Better stock up now on switches and switch points for that new set. Circular describing the latest for the market sent free. Eureka Secondary Co., 693 5th St., Chicago, Ill.  

Radio Aire, 15c.  

Reinisch's Test. Experiments. Photograph thru opaque matter, displace electrons, etc. One 9½ uranium oxide, others 12½. Both $10. To Order: To get to twenty metals. Half ounce first, quarter second, gram uranium oxide, $3.00. Refund with order.  


**Build a Radio-Airo Station—Bine print, plans, catalog, all free—J. M. Rogers, 35 Moriss Ave., Haledon, N. J.**

**Mechanics—Quickest method of making tapers in 1 minute.**  

Electrical, 15c.  

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Make your boy proud. Give him feet dry and comfortable. Just one of those wonderful Hi Tops shown. See them strongly they are made. Solely made of strong wear-resisting retanum leather. Two buckles and straps fasten instantly. Laces Blucher style on comfortable wide last—full round toe. All sound strongly sewed. Extra heavy sole leather sole and heels to stand the wear. You can have it for $3.00. SEND your name and address. See us at our store or order for mail. Pay $2.50 for shoes on arrival. If not satisfactory your return and we will refund your money. Be sure to state what size. Order by No. X155, Send your order today. No risk to you. LEONARD-MORTON & CO., Dept. XX53, Chicago.

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Electricity from your light socket is transformed into health and beauty-giving Violet Ray—powerfully effective, yet gentle, soothing, perfectly safe. Voltage is raised from ordinary lighting current to several hundred thousand volts, giving tremendous penetrative force. The tremenous, revitalizing powers of Renulife Violet Ray are applied at once to every nerve cell, fibre and part of body. Blood is enriched and purified by a flood of oxygen, giving added vitality and strength. Assimilation and digestion improved—functions restored to normal—extra supply of fresh blood quickly brought to area treated, removing congestion and supplying nourishment. While relieving pains and aches, the manifest results of disorders, it removes the deep-seated cause; combines the benefits of electricity, vibration, exercise, stimulation and oxidation.

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OF THE DEEP

SEE PAGE 772
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ACT NOW
Underground Wireless

By H. Gernsback.

But the most spectacular feature of Mr. Rogers' revolutionary invention probably is his "Sub-sea Wireless." Scientists the world over, Marconi included, declared it an utter impossibility to communicate by wireless with a totally submerged submarine. Mr. Rogers, however, has carried his theory this far ahead and does it, not with fresh water but with salt water as well. Indeed he established wireless communication with a submarine whose aerial wires were laid below the surface of the ocean.

Altho Mr. Rogers, during the war, gave most of his attention toward receiving messages, he has made considerable progress in underground radio transmission as well. His experiments prove conclusively that, while underground radio receiving is here to stay, underground sending too will soon be practical enough, even for high power stations. It is merely a question of good insulation at present, and the end of this year, we are quite confident, will bring the solution of the problem. The Navy Department has just succeeded in transmitting a distance of 30 miles with the underground system.

And it would seem a reasonable thing that any long wave lengths could be used with the Rogers system. But this is not the case. Underground Radio-telephone messages, several miles distant, come in just as clear on 30 meters wavelength as does the Nauen (Germany) station with 12,000 wavelengths of wave length. This indeed is good news for our amateurs.

But in the meanwhile, all of our pet theories on wireless are thrown in a sad chaos. For we do not know as yet how the Rogers system works. We can now expect a war to the knife between our wave-propagation theorists and the new school of ground-impulse savants. Mr. Rogers himself takes the view—and he is seconded by Tesla—that the transoceanic messages which he receives over his underground system are not Hertian waves pure or even converted—but merely high frequency ground impulses.

The future may tell us which school is right.
How One Evening’s Study Led to a $30,000 Job

A Simple Method of Mind Training That Any One Can Follow With Results From the First Day

By a Man Who Made Formerly No More Than a Decent Living

I HOPE you won’t think I’m conceited or egotistical in trying to tell others how I came to be comfortably off. I am not trying to show to what my friends term a phenomenal success.

In reality I do not take the profit to myself at all. It was all so simple that I believe any man can accomplish practically the same thing if he learns the secret, which he can do in a single evening, I assure him. I was not so much the beneficiary as the reader, as I had done much better than I by following the same method.

It all came about in a rather odd manner. I had been worrying along in the same way as the average man thinking that I was doing my bit for the family by providing them with three square meals a day, when an old chum of mine, Frank Powers, whom I had always thought was about the same kind of a chap as I, suddenly blossomed out with every evidence of business prosperity.

He moved into a fine new house, bought a good car and began living in the style of a man of ample means. Naturally the first thing I did was to notice these things and then I realized that I had said nothing to me about his sudden good fortune—was to congratulate him and ask him what it was that had brought the evident change in his finances.

"Bill," he said, "it’s all come so quickly I can hardly account for it myself. But the thing that has made such difference in my life lately began with an article I read a short time ago about training the mind.

"I compared the average person to a bank and its contents as it went along, which carried any distance would arrive at its destination practically empty."

It brought to my mind that instead of making the pail leakproof most of us kept filling it up and then lost all we put into it before we ever reached the place where the contents would be of any real use.

David M. Roth

When Mr. Roth first described to me his highly successful method of mind training, I was a little worried about its profit to me. But I was overly worried about my memory one way or another, but it had always seemed to me that important things fairly well. Certainly it never occurred to me that it was possible or even desirable to improve it, as I thought the memory was a sort of natural gift. Like most of us, I imagined training to be something that was something that had been too long and that I had no assurance that until it was written in a memorandum pad or in a pocket notebook. Even then I would sometimes forget to look at my re- membered facts. I had happened to be one who had not been—by being obliged to ask some man whom I had previously met that my name was a sort of natural gift. Like most of us, I imagined training to be something that we should know before it is written in a memorandum pad or in a pocket notebook. Even then I would sometimes forget to look at my re- membered facts.

"And still," he continued, "I was a little worried about my memory one way or another, but it had always seemed to me that important things fairly well. Certainly it never occurred to me that it was possible or even desirable to improve it, as I thought the memory was a sort of natural gift. Like most of us, I imagined training to be something that was something that had been too long and that I had no assurance that until it was written in a memorandum pad or in a pocket notebook.

I began to observe myself more closely in my daily work. The frequency with which I had to refer to records or business letters always impressed me with the feeling that I was getting something that in some previous time had come under my particular notice."

The men around me were doing things that I had not been doing."

"But I did not use this feeling to train my mind as it was about the matter of the memory power."

F. W. Thomsen

Mr. Roth ran and has hundreds of times at different times and places asked himself, "What do you mean?"

"I was never met to tell him his mind was the same."

"And then," he continued, "I was an acquaintance with the mind and in the way the things that are going to be useful to him as he goes along.

Farther on in the article it was stated that the power of the mind is like a battery, and that the things that go on in the mind are like the power of the battery."

Mr. Roth says, "What I have done any one can do."

I had reached my decision. On the recommendation of experts, I got in touch with the Independent Corporation which shortly before had published the David M. Roth Method of Memory Training, and thus came the surprise of a lifetime. In the very first lesson of the course I found the key to a good memory. Within thirty minutes after I had opened the book the secret that I had been in need of all my life was mine. Mr. Roth had boiled down the principles perfectly the way I had thought the method could not be grasped at a glance. And the farther I went, the more I thought that I had learned that method and reliable your memory becomes. Within an hour I found that I could easily memorize a list of 100 words and call them out in order without a mistake. I was thunderstruck with the ease of the thing. Instead of study the whole thing seemed like a fascinating game. I discovered that the art of remembering had been reduced by Mr. Roth to the simplest mode of learning. It required almost nothing but to read the lessons! Every one of those seven simple lessons gave me new powers of memory, and I enjoyed the course so much that I look back on it now as a distinct pleasure.

The rest of my story is not an unusual one among American business men who have realized the value of a reliable trained memory. My income today is close to $30,000. Many decisions involving thousands of dollars are made by me every day, and I enjoy every moment of the process."

SEND NO MONEY

Mr. Roth’s fee for personal instruction to classes limited to any member is $1,000. But in order to secure nation-wide distribution for the Memory Course, the Independent Corporation will send without charge the price at only five dollars, a letter containing the secret of a good memory to one evening, that they are willing to send the Course on free examination.

If you send any money. Merely mail the coupon or write a letter and the complete course will be sent, an charge prepaid, at once. If you are not entirely satisfied send it back any time within five days after you receive it and you will not have to pay for it."

The only course that will give you a secret of a good memory is in one evening, that they are willing to send the Course on free examination.

* On the other hand, if you are as pleased as we are the thousands of other men and women who have used the book, and are glad to have such a wonderful book, you take no risk and you have everything to gain in sending for it."

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33 Assembled Locomotives on One Ship

The Enterprise of American War Engineering Which Enabled Thirty-Three Assembled Locomotives to be Delivered 'Cross Seas in a Single Ship, for Immediate Duty at the Front

ERN persevering American ingenuity and the knowledge that "over there" thousands of our boys were depending on us folks back home, to keep our shoulders to the wheel, makes records of the seemingly impossible to get supplies across seas infested with mines and submarines, and still a greater task to move this material with all possible haste to the points where it would be most needed. It is well known that the French railroad system had collaps; all it could do of his first cables home was for the urgent delivery of locomotives, cars and rails. He made the War Department see the need of providing these facilities so that the American effort in the Great Cause would not be a failure. And so it was that Army officials

deeds actually accomplished, read like the magic of Aladdin's Lamp.

As a specific instance, let us look at the railroad situation in France when General Pershing arrived on the scene of action with the first vanguard of American troops. French Atlantic ports were nearly 270 miles from the fighting front. It was one problem to care for the French army, and to move the thousands of tons of material necessary for the successful campaigning of Pershing's army behind a few creeping French locomotives left at our disposal was well nigh impossible.

General Pershing saw the immediate need for American railroad equipment and one undertook the buying and shipping of locomotives. The first locomotives sent were in great big boxy cases—knocked down. As yet they did not dream of sending them completely assembled.

Once these parts reached France they were put in the hands of a dozen or more (Continued on page 810)
Five Conversations Over One Wire

Multiplex Telephony and How It Works

The story of the development of the multiplex telephone and telegraph system reads like that of many other inventions. It is a story of long years of effort to accomplish a great result. The steam turbine, for example, is but recently developed to be practically useful and was suggested in principle as long ago as 130 B.C. Dr. Alexander Graham Bell was experimenting with a telephone in a Boston attic in 1875. Its possibilities lie in the direction of expansion of long distance service. Physically it can be employed on any open wire telephone line, but practically it is not advantageous to use it on any short line, say less than 100 miles in length. The highly technical equipment required is so costly that it is economically available only for long lines. There is at now it has been carrying messages, which come to Baltimore from Washington over the ordinary circuits and these are given to the multiplex for transmission to their destination.

For some years past the Bell System engineers have sought to make it possible for anyone to talk to anyone else in another part of the country at any time. The phantom circuit, which utilizes wires in two ordinary circuits to provide a third conductor of speech, was a great step forward this goal, greatly expanding the service possibilities of existing long lines. Then came transcontinental telephony, making a real neighborhood of the Nation. Now, with the multiplex system, the engineers greatly expand the service capacity of all long lines which economically may be equip with the system. The three transcontinental circuits, for example, two of which are of wire while one is a phantom circuit, when equipped with the multiplex system can carry 10 telephone conversations at once, instead of 3 as at present. The new system sends five voice currents simultaneously over one telephone circuit of two wires, each current as it is delivered into an ordinary telephone, exactly as it was formed at the sending point. These five voice currents travel together and are sorted for delivery at the destination. Not a tone or inflection of the speaking voice is changed in passage. This result is achieved by combining each voice with a high-frequency audible carrier current which has characteristics in degrees of frequency that are entirely different from those of other carrier currents. See the various forms of the voice and carrier currents shown herewith. The carrier current (Continued on page 826)
The Latest Style in Flashlights

A pocket flashlight with its small, one-half or one-quarter power tungsten bulb operated by a small dry battery, has practically become a household article the world over. Flashlights are today manufactured by the million, while more millions of people are daily clamoring for them. The progress of millions of flashlights was in constant use during the war-time activities in Europe, and what a great boon it has been to the soldier can well be imagined. The accompanying illustrations show a number of extremely useful and not always well-known applications of the pocket flashlight which will prove of practical use on many occasions.

One of the latest and ingenious arrangements for utilizing a flashlight is that shown at Fig. 1, which comprises an illuminated note-pad for use at night or in dark places. The use of this illuminated note-pad will prove very extensive undoubtedly, and for the use of Fig. 1 it may often prove of assistance in taking notes at lectures, not to mention a very wide application in the Army and Navy. The illumination is so arranged that no noticeable glow is seen, but simply the illuminated square opening over which the paper roll slides. A second paper roll is included, so that a carbon copy can be kept for record. The case when closed resembles a kodak.

Figure two shows a self-contained electric light mirror, invented by Mr. H. Herschbeck several years ago. This unique mirror has a small flashlight battery placed in the hollow handle. On the front of the handle a push-button is placed and the wires to the lamp at the top of the mirror frame are secreted within it.

Figure three shows the gun-light which has been quite extensively exploited, and while we have never heard of it the sight of a flashlight or a larger model flashlight attached to a rifle, we have seen the pistol flashlight used. It proves one of the most deadly combinations imaginable.

All the marksmen have to do is to move the pistol about until the target lies in the center of the subdivided flashlight zone and then pull the trigger. It should prove a fine thing for hunting down burglars, rats, cats, and what not.

A recently patented eye-diagnostic lamp, known as a retinoscope is illustrated in Fig. 4. This compact and efficient electric lamp and mirror, as well as a sight device for the use of opticians in examining the eye. The flashlight battery is contained in the handle of this efficient instrument, and the bulb of the flashlight projects a beam of light on to the small mirror, which is set at an angle of 45 degrees. Turn the center of this mirror there is a small hole which is in line with a sight tube at the rear of the mirror frame. It is used in the manner illustrated.

The well-known flashlight combination, known as the shave light, is shown at Fig. 5. Several varieties of this handy device are on the market and it has proved a blessing indeed to thousands of soldiers—officers and dough-boys alike—who have often had to shave in dingy or pitch dark dug-outs and other places of shelter on the battle-field. In the shave-light device illustrated by Fig. 5, the flashlight battery is connected by means of a small flexible twin-conductor with a lamp bulb placed over the mirror.

One of the latest and most practical ever-day uses of the flashlight is meter-reading. See Fig. 6. The usual application of the flashlight in this field involves the carrying of an ordinary tubular flashlight by the meter reader, but the illustration herewith shows one of the newer developments in the form of a flashlight meter camera. With this clever device it is only necessary to place the camera before the meter to be read, the button is pressed, several flashlight bulbs connected in multiple throw a strong light on the meter dials, the camera-shutter clicks simultaneously, and (Continued on page 831)
“The Border Wireless” and
“The Hun Within”

STEVE RANSOM (William S. Hart), a typical March, has shot fierce assistant, attacked telegraph and unaware for younger the Yellow Dog. Elsa Miller is a telegraph operator at United States. Steve forces Brandt to kiss the American flag. War with Germany is declared, and Steve determines to enlist. He calls on Elsa, determined to reveal his past love to her, and invites her to ride part of the way with him to Fort Scott; she plainly evinces her love for Steve. During their absence Steve’s shack is ransacked by Brandt and Schloss; photographs of Steve’s father with an inscription on the back, reveals the fact that Steve’s real name is Ransom, and not Allen—which name he assumed while in Yellow Dog. Brandt sends a telegram to the Sheriff at Willow Springs, asking for information regarding other spy ride by. They go thru his clothes and find the message, which is translated with the aid of a code book. Carl, who has regained consciousness, overhears the translation of the message, the purport of which is that General Pershing is on his way to Europe and the Germans are planning to sink the vessel on which he has sailed. The two men take their departure, leaving their man to watch Carl. Elsa now appears and Carl whispers to her the nature of the message. The German, hiding behind the bushes, overhears Carl and is about to shoot him, when Steve, who has been hiding in the bushes.

Yellow Dog, and the guardian of her younger brother, Carl. Elsa is on her way to deliver a message to Herman Brandt at the Magdelenas Mines and is attacked by Mexican bandits. Steve rescues and falls in love with her and decides to remain at Yellow Dog. Frederick Brandt loves Elsa, but she is unaware that the Magdelenas Mines have been converted into the headquarters for German spies with a cleverly concealed wireless apparatus by which messages are transmitted to Mexico and from there to Honduras and then to Berlin. Brandt is in direct communication with Von Helm, head of the German Secret Service in New York City.

Steve becomes suspicious of Brandt, when he and his assistant, Frederick Schloss, express contempt for the American flag and the fighting abilities of the Steve and thus learns that Steve is a fugitive from justice. Carl reveals the fact that Steve is on his way to Fort Scott to enlist, and Brandt forces the boy to telegraph the commanding officer at Fort Scott the facts he has discovered regarding Steve. While awaiting examination at Fort Scott, Steve overhears the conversation between the commanding officer and the telegraph operator, and makes his escape through a window. He is pursued by the soldiers but eludes them and takes refuge in a wooded canyon. Elsa learns of the occurrence, but this does not shake her faith in him. A day or two later, a code message comes for Brandt, and Carl starts with it for the Magdelenas Mines. He is thrown from his horse and is lying unconscious, when Brandt and Schloss and another man attempt to kill him. Carl, who has regained consciousness, reveals the message, which is translated with the aid of a code book. Carl, who has regained consciousness, overhears the translation of the message, the purport of which is that General Pershing is on his way to Europe and the Germans are planning to sink the vessel on which he has sailed. The two men take their departure, leaving their man to watch Carl. Elsa now appears and Carl whispers to her the nature of the message. The German, hiding behind the bushes, overhears Carl and is about to shoot him, when Steve, who has been hiding in the bushes.
M ost probably you will remember having read some of those entrancing fairy tales in your younger days, wherein a person happened to be gifted with such transcendental intellectual powers, that he could for example stamp his foot on the ground or simply make a certain sound when the location of gold or silver would immediately be made known and found. Of course this all sounds like "Bu-lgar-ia" to us nowadays, but thanks to a twentieth century magician, Prof. R. A. Fessenden, the brilliant American inventor and scientist, it has become possible to do this identical thing, i.e., to project a sound wave, and by measuring its refraction and reflection scientifically by means of suitable detecting and recording instruments, to locate exactly the position of underground ore bodies, no matter what the ore may be, whether gold, silver, lead, zinc, copper, etc.

As Prof. Fessenden points out in his patent on this scheme of locating ore bodies, his invention fairly tells its story and apparatus whereby, being given or having ascertained two or more of the following quantities, i.e., the distance, the intensity and medium, one or more of the remaining quantities may be determined. For example, being given the distance between two points in a mine, and having determined the time required by a sound wave to travel between the two points, it is then possible to draw calculations in regard to the probable nature of the rock between the two points; also, if an echo be observed or a refraction of the sound, it is possible to estimate the distance of the reflecting or suspected, a space may be laid off about five miles square, as the accompanying illustration shows. This gives an area of twenty-five square miles under survey. At each corner of this square there are driven four drill holes, A, B, C, D, which are filled with water. Toward the bottom of these water filled holes there are placed sensitive sound detectors, such as microphones or small Fessenden oscillators, D, D, D, and D. These sound receiving devices are connected to the secondaries of transformers as indicated, and to oscillographs of the photographic recording type. These oscillographs employ the quartz-fiber Einthoven galvonometers. In one of the wells there is placed a powerful sound producing apparatus, O, preferably of the Fessenden oscillator type also. This is connected thru its leads, with the primaries of the transformers in the oscillograph circuits and to the alternating current dynamo, A—D, whenever the key K is depressed. Hidden ore detectors or microphones, D, D, D, and D, and is recorded on the oscillographs R—O's, 3, 4, 2 and 1.

Instead of using the alternator to produce the sound at the oscillator, O, a condenser discharge may be employed to actuate a sounder, the condenser key on being depressed charging the condenser from a battery, and on the key being released and coming against a second contact, it discharges the condenser thru the sound producing mechanism. The patent describes this auxiliary sound producing mechanism.

Since the oscillograph photographic strip moves along thru the machine with a regular and known velocity, the distance on the strips between the records produced thru the transformers whenever the key, K, is depressed, and the records made by the sound waves received, whether direct or by reflection, refraction or echo, will indicate the distance between the drill and holes and

(Continued on page 828)
Sorting Tobacco Leaves by Electricity

By GEORGE HOLMES

ANY ingenious machines and devices have been invented and are widely used in the manufacture of tobacco products and all modernly equipped cigar and cigarette factories bristle with machinery. The more striking is the fact that the tobacco growers and planters have been much neglected by the genius of inventors. Thus we see that tobacco is grown today with the same primitive methods as it was 100 years ago.

The inventive spirit of our progressive age, which benevolently gave a helpful lift to almost every trade and industry and helped so many labor-saving appliances to agriculture, has almost neglected the extensive tobacco plantations of America and the world.

Upon the initiative of one of the largest tobacco growers in the world, a New York inventor and engineer, Mr. H. Hartman, took up the problem several years ago of tobacco planting and handling right at the farms. And what he saw there set him to thinking that one of the most costly operations at a tobacco plantation is the sorting of leaves by their different lengths. Every leaf is taken by hand at both ends and measured and placed according to its length into a different box.

So-called sun-grown tobacco is usually sorted or “sized” by two inches, while shade-grown tobacco, which is used for wrappers, is “sized” partly by inches and partly by two inches. This work is done after the leaves have passed thru the “curing” process and are brown, soft and pliable.

Now anyone can easily imagine the tremendous amount of manual labor involved in measuring each single leaf of the many millions grown on an average tobacco farm. But the tobacco can not be sold if not sorted into different lengths.

After many experiments with three gradually more and more improved machines, which Mr. Hartman constructed at his workshop and laboratory, he finally succeeded, and the semi-electric “Leaf Tobacco Sizing and Sorting Machine”, illustrated here is the result. This machine also marks as a milestone the opening of tobacco growing to mechanical development.

In this machine, which is also shown diagrammatically, the tobacco leaves are simply placed upon a feeding belt by an operator in front of the machine. This belt brings rollers, which stand vertically in the path of the motion of the clamps. As long as a leaf is between the contact rollers, a metallic electric contact between the latter is prevented, but a low voltage circuit will be closed thru the moment the tip of the leaf passes out. As the contact rollers are co-operating with a series of contact segments arranged at the center line along the bench, one of these segments will be swept by a contact brush from the clamp in circuit with the rollers. An electric current will then pass thru the rollers, said particular segment and one of a number of solenoids will attract its armature and thus open one of the covers, which can be seen arranged under an incline at both sides of the machine.

At the same time an electromagnet will emerge from the flat table and, being in the center line with the clamps, will force the latter to open, and to drop the leaf upon the table, from where it will be blown the next moment by compressed air over the entire table and slide by gravity downward to fall into the box arranged below the open cover. According to the length of a leaf, a certain contact segment on the table will be in circuit with the contact rollers only at the moment said leaf passes entirely thru the rollers, and only that particular cover connected with said segment will open, as intermediary relays will at the same moment interrupt for a predetermined time the connection between all following segments and their respective solenoids.

There are as many segments and solenoids as there are different covers. The first section, having five boxes, will receive the five shortest leaves. If a leaf is longer, no segment will come into contact in said first section, the electro-magnetic stop will not appear and the clamp will carry that leaf into the second section where the same process will be repeated. The second section provided with five boxes of longer dimensions, is an exact

(Continued on page 810)
PERHAPS you are familiar with the mechanical device known as a "gyroscope", which possesses remarkable self-centering or stabilizing properties. The Sperry airplane stabilizer, as well as the non-rolling ship stabilizer, utilizes this clever device. It involves the simple phenomenon that if you take a heavy steel or other wheel and spin it at high speed, then the spinning wheel and its attached frame will tend to preserve the same plane of rotation. This is daily demonstrated by the ordinary bicycle. Hold the bicycle clear of the ground and have someone turn the pedals rapidly. Now try to turn the bicycle sidewise while the wheels are rotating at high speed. You will find it very difficult—all because of the law above stated. Thus the naval engineers have discovered that by placing one or more powerful gyro's in a ship, that the ship will not roll to any appreciable extent in a heavy sea. Hospital and war-ships are therefore being fitted with giant electric driven gyro's for the purpose of keeping them on a more even keel in stormy weather. The improvement in gunnery from warships so equipped and stabilized is readily apparent.

One of the accompanying photos shows Gyro unit No. 2 of the twin set just being transferred by a hundred-ton S-3 leg crane. A second photo shows a close-up of the two Gyro units, while the third photo shows the relative size of the Gyros with the ship and also the massive traveling crane used to swing them into the ship. These gyro's were installed in a Naval Hospital ship so that the wounded on board would be subjected to the least amount of rolling, that to the present time is very apparent on all ships, especially in bad weather. The final stabilizing test with the Gyros was found to reduce the rolling some 90 degrees, which can be readily seen that they do help some.

The combined weight of the unit was 100 tons and the ship was the largest hospital ship ever constructed. The weight of the two gyro wheels is 25 tons each. The weight of the two casings is 25 tons each. The diameter of the gyro wheels is 9 feet, and of the casings 12 feet. The bearings used are standard roller type and self-aligning, fitted to 12-inch shafts. The power used to drive the gyro wheel is a 75 H.P. A.C. electric motor in each. The casing was made absolutely vacuum-tight and the gyro runs in 20 inches of nearly perfect vacuum. The bearings receive a continuous bath of oil, pumped at the rate of 200 gallons a minute, properly screened and cooled. In 35 minutes the gyro attained a speed of 1,100 R.P.M. (working speed). A trial speed of 1,600 R.P.M. was attained, the current cut off and the gyro ran for three and one-half days, gradually dropping in speed to "Dead".

The side of the ship had to be cut away in order to install the gyro's and they were slid into place by means of skids; the time required to slide them into place was 71/2 minutes. Besides the 75 H.P. A.C. motor in each gyro, a rotary-converter is used and another 75 H.P. motor is used to process the gyro's from left to right to meet the roll of the ship. This last motor is controlled by another sensitive gyro (small and of high speed) located on the ship's bridge.

The two gyro's were located amidships below medi-centric height and they ran in opposite directions to each other; that is, the port gyro ran clockwise and the starboard gyro ran anti-clock-wise, both at the same speed. To reduce the vibration of the gyro's to a minimum they were balanced by the plug-method and it took several experts two months to balance them, so perfect must the rotational balance be. Two years were required to complete the gyro's and others of larger size are being constructed for super-dreadnought warships. These will enable more accurate aim to be had in firing from the ship. Gyros of smaller size are also installed on submarines and destroyers, both classes of installations giving remarkable results.

gallium and silver sulfid were found to have but small photoelectric activity when charged to a negative potential and exposed to light. No change was observed in the electrical conductivity of tellurium, bismuth, pyrite, silicon, and mixtures of the sulfids of lead and antimony, when exposed to light. An increase in conductivity was observed in crystals of bismuthinite, cylindrite, molybdite, selenium, stibnite, boulangerite, jamesonite, and silver sulfid when exposed to light.

Experiments are described in which some of these substances were joined thru a battery to the grid circuit of an audion amplifier and a telephone. The light stimulus was interrupted by means of a rotating sector disk, as used in Bell's selenium photophone. When using a cell or crystal of selenium the fluctuations in light intensity produced a sufficient change in conductivity to cause a musical note in the telephone. Similarly, in some samples of bismuthinite and of molybdite, a change in conductivity was produced, which caused an audible sound in the telephone receiver. Further experiments are in progress to determine to what extent and for what wavelengths this is a true photoelectric change (increase) in conductivity, and to what extent it is caused by fluctuations in temperature with a resultant change in resistance within the crystal.
Searchlights of the Deep
Wonderful Fish of the Ocean Depths, That Carry Their Own Lights.

By Dr. E. BADE

In former years, when the depths of the ocean were still unexplored, it was the common belief that its surface was an uneven monotonous plain, unenlivened by precipices and mountains, hills and valleys. But these ideas have been thoroughly repudiated by numerous expeditions sent out to investigate and explore, as far as possible, the conditions existing at the vast bottom of the sea.

The higher parts of the ocean bed, the gentle slopes, the precipices, and the plateaux, which connect the extensive levels of the ocean, are of such an immensity that they can not be compared to anything found on the land. Deep basins of continental extent are interrupted by gigantic marine mountains, while table lands rise from the greatest depth with almost sheer and perpendicular walls.

Only those animals which live near the surface of the ocean and which have ventured within reach of the nets of fishermen, were known in the last century. These nets seldom if ever penetrate more than five hundred feet. But when speaking of the deep sea, a 1,000 foot depth or more is to be considered.

Altho depths of 12,000 feet are common throughout the ocean, a depth of more than 30,000 feet has been reached between two small islands of the Malay Archipelago.

Three hundred feet below the level of the ocean the light is so diffused that it is gloomy, and at a depth of six hundred feet our eye can not detect an infinitesimal ray.

Photographic plates sunk in the Sargasso seas show, at a depth of three hundred feet, all of the different colors of the rainbow; at a depth of 1,500 feet many of the rays can still be found; at a depth of 3,000 feet of water is equal to the pressure exerted by it. This pressure becomes greater the deeper we go down, and down in the profoundest depths it exerts a pressure of thousands of pounds to the square inch. A result of the pressure is that the tissues of the fish are loosely knitted together, and when this enormous pressure is released by bringing these denizens of the deep to the surface, the internal pressure of the body becomes so great that the fish literally explode.

Therefore it is no wonder that when the deep sea fish are violently torn from their natural habitat they are invariably in a mutilated condition.

But in these depths of the ocean, where gloom and semi-darkness prevail, the conditions of life are far different from those of the surface waters. The brightly colored algae and sea weeds, the food of many fish, are the children of the sun, while the sinister inhabitants of the profound depths are scavengers, which kill and devour each other.

The faint almost infinitesimal light which penetrates this utter darkness is insufficient to light up the paths of the fish. They do not see their way; they only feel their way by means of lateral organs when they come in the vicinity of some boulder or rock. In this darkness we find the most unique and fantastic forms of life—the deep sea fish—which live in perpetual darkness. There, searchlights play thru the watery night, faintly illuminating the vast depths with a cold, death-like glow, a thing man has, as yet, not created.

This wonderful light is produced automatically by the fish. Tiny glands secrete the lighting fluid, reflectors throw it outward, and one or more lenses magnify and control its intensity. (See the illustrations herewith.)

(Continued on page 830)
THE UPS AND DOWNS OF A THEATER CHAIR.

E said it, friends, "the ups and downs of a theater chair", and we might add the "downs and ups" for can you imagine in your wildest moments of philosophical ecstasy what our theaters are looking like when Mr. Frank Adsit's electrical elevated opera chair is adopted by our theater managers. No, you're wrong. This is not a phony patent, but an honest to goodness U. S. patent. Our artist has endeavored to show several of the incidents which might and likely will occur if this invention comes into vogue, and who will gainsay that it will—or have not forty-eight states—tried and true—gone clean dry without a whisper? This wonderful motor-operated theater chair is also a real boon to the prohibitionist inspector, for all he has to do is push the button and the occupants of the chairs will rise "high and dry" without a word. Coming down to the real philosophy involved in the design and operation of this newest theater chair, we find that the inventor has provided for causing it to rise and fall whenever a person wishes to pass in front of one of the chairs in order to get to his seat, to one side or the other, by means of three distinct electromechanical agencies, to wit: 1—by means of an electric motor and screw-gear; 2—by means of mechanically driven worms placed under the floor and screw gear; 3—by means of compressed air.

A small electric motor is connected with a pinion and gear which in turn drive a vertical screw in the base of the seat. This screw registers with an "internal nut" (so, Ella, not the "nut" in the chair) in the position of the chair as the detail illustration shows, so that when the screw is turned in one direction, the chair will be raised, and when it is turned in the other, the chair will be lowered. The running of the motor is positively controlled by the push button placed on the arm of the chair.

AN AMPHIBIAN LAND, WATER AND AIR HYDROPLANE.

The accompanying illustration shows one of the latest inventions in the realm of hydroplanes and this particular species might well be classified as an amphibian of the first water. As its inventor states in his patent, yes, he has really been granted a patent by Uncle Sam on this marvelous contraption—his airship may be used in the air, thru water or upon the land with equal facility. The inventor provides in his design for the combination of a lighter than air or buoyant flying machine with a water-tight passenger compartment. Thus he has given us a vehicle which may be used on inundated or marine surfaces, and the vehicle is further provided with wheels, in such a manner as to move readily over any ground surface. The machine is fitted with suitable motors, planes and rudders, all of which are accessible and controllable from the interior of the enclosed cab of the airship. This remarkable hydroplane should prove a great boon to the management of summer resorts, who are forever on the watch for something really new and novel. As our illustration discloses, a great variety of pleasure is afforded the passengers who embark on a voyage of adventure in this hybrid airship.

The superstructure consists essentially of a cylindrical metallic tube having a cigar-shaped front end and an outer wall formed of a number of longitudinal ribs, which are in turn connected to an inner encircling band, thus forming a substantial framework for the ballonets or gas bags, which are used to give the airship the desired buoyancy. The car attached to the superstructure and ballonet frame on the bottom, is provided with windows and doors, all of which may be sealed hermetically from the interior of the car, so that the car may be run thru the water, fully submerged, when desirable or necessary, and in any event the passengers are assured of a most delightful trip among the fishes.

At the rear end of the car is a revolving screw for propelling the hydroplane thru the water, while a rudder is also used to control the direction of the airship in its flight thru the water. On top of the ballonet superstructure, the inventor places two masts for the support of a radio antenna one of which may act as a flag pole.

You Must Not Fail to Visit the Summer Resorts This Year. They Promise to be More Alive Than Ever Before. For Example—Be Sure This Wonderful Amphibian of the Sea, Air and Earth. The Inventor Patented and Described Everything But the "Fare." Anyhow, We Are Going to Take Out "Accident Insurance Before Starting." (Continued on page 815.)

Bear, the Rising and Falling Electric Opera Chair. "It's a Hard Job to Keep the Old Man at Home Now." It is the Complaint of Some Wives, But Can You Imagine What Show Wifey Is Going to Have to Keep "This Nib" at Home by the Fire-side with His Slippers on. When the 10-20 and 30-Cent Vaudeville Show Around the Corner Affords Such an Enticing, Bacchanalian and Irresistible Saturnalia as This. "Wow! Wow! Three Booms and a Tiger for Inventor Adsit (at's it)."
PROBABLY one of the most far-reaching and revolutionary discoveries made by Mr. Tesla is the so-called rotating magnetic field. This is a new and wonderful manifestation of force—a magnetic cyclone—producing striking phenomena which amazed the world when they were first shown by him. It results from the joint action of two or more alternating currents definitely related to one another and creating magnetic fluxes, which, by their periodic rise and fall according to a mathematical law, cause a continuous shifting of the lines of force. There is a vast difference between an ordinary electro-magnet and that invented by Tesla. In the former the lines are stationary, in the latter they are made to whirl around at a furious rate. The first attracts a piece of iron and holds it fast; the second causes it to spin in any direction and

with any speed desired. Long ago, when Tesla was still a student, he conceived the idea of the rotating magnetic field and this remarkable principle is embodied in his famous induction motor and system of transmission of power now in universal use.

In this issue of the Electrical Experimenter Mr. Tesla gives a remarkable account of his early efforts and trials as an inventor and of his final success. Unlike other technical advances arrived at thru the usual hit and miss methods and hap-

hazard experimentation, the rotating field was purely the work of scientific imagination. Tesla developed and perfected, entirely in his mind, this great idea in all its details and applications without making one single experiment. Not even the

magnetic field was thus tested. The frequency of the two-phase A.C. current, which varied from 23 to 300 cycles, the best results being obtained with currents of from 35 to 40 cycles. This laboratory was lighted by a great number of lamps, some of which may be seen on the ceiling, and each of which emitted 50 C.P. Two coils resting on three legs and disposed in the immediate foreground to the laboratory, were connected with the primary circuit of the transformer which collected energy from an auxiliary circuit exciting the laboratory, no matter in what position the transformer was placed. A few tesla secondary of one or two turns of insulating cable (not visible) was provided for stepping down the energy collected by “mutual induction,” and supplied for various tests such as lamps, vacuum tubes, motors and electro-magnets. When the circuit around the hall was strongly excited, the secondary furnished energy at the rate of about three-quarters of one horse-power.

The usual first model was used. When the various forms of apparatus he had devised were tried for the first time they rotated exactly as he had imagined and he took out some forty fundamental patents covering the whole variation he had explored. He obtained the first rotations in the summer of 1883 after five years of constant and intense thought on the subject and then undertook
the equally difficult task of finding believers in his discovery. The alternating current was but imperfectly understood and had no standing with engineers or electricians and for a long time Tesla talked to deaf ears. But, ultimately, his pains were rewarded and early in 1887 a company bearing his name was formed for the commercial introduction of the invention.

Dr. Tesla recently told the editors an amusing incident in this connection. He had approached a Wall Street capitalist—a prominent lawyer—with a view of getting financial support and this gentleman called in a friend of his, a well-known engineer, at the head of one of the big corporations in New York, to pass upon the merits of the scheme. This man was a practical expert who knew of the failures in the industrial exploitation of alternating currents and was distinctly prejudiced to a point of not caring to even listen to several discouraging conferences Mr. Tesla had an inspiration. Everybody has heard of the "Egg of Columbus." The saying goes that at a certain dinner the great explorer asked some scoffers of his project to balance an egg on its end. They tried it in vain. He then took it and cracking the shell slightly by a gentle blow, made it stand upright. This may be a myth but the fact is that he was granted an audience by Isabella, the Queen of Spain, and won her support. There is a suspicion that she was more impressed by his portly bearing than the prospect of his discovery. Whatever it might have been, the Queen pawed her jewels and three ships and sailed for the New World. It so happened that the Germans got all that was coming to them in this war. But to return to Tesla's story. "Well," he continued, "what if I could make an egg stand on the pointed end without cracking the shell?" If you could, I would drown the news that you had gone Columbus one better. "And would you be willing to go out of your way as well as lose much time and no crown jewels to pawn," said the lawyer, who was a wit, "but there are a few ducats in our buckskins and we might help you to an extent."

Mr. Tesla thus succeeded in carrying the experiment a step farther. He knew—indeed the judges of the New York Exposition were impressed with the fact that he had given the world a new and valuable invention. They were asked by the counsel, "Do you want any money?" "Columbus," he said "never in a worse predicament," said the great inventor, who had parted with his last portrait of General Washington in defraying the expenses of the preparation. Before the meeting adjourned he had a substantial check in his pocket, and it was given with the assurance that he was to be had in the same bank. That started the ball rolling. Tons of millions of horsepower of Tesla's induction motors are now in use all over the world and their production is rising like a flood.

In 1893 Mr. Albert Schmidt, then Superintendent of the Westinghouse Electric and Mfg. Co., constructed a perfect rotating field ring with an egg made of copper, and larger than that of an ostrich, for Dr. Tesla's personal amusement at the Chicago World's Fair. This piece of apparatus was one of the most attractive novelties ever publicly shown and drew enormous crowds every day. Subsequently it was taken to Mr. Tesla's laboratory and served there permanently for demonstrating rotating field phenomena. It was practical to use as much as 200 horsepower for a short time, without overheating the windings and the effects of the magnetic forces were wonderfully fascinating to observe. This is the very ring indicated in the accompanying photograph (Fig. 1), giving a view of 3/4. The egg in the center was 32 inches in diameter, but Mr. Tesla transformed it to the three- and four-phase when desired. On top of the ring was fastened a thin circular board, upon which was provided a small disk around its circumference with a guard to prevent the objects from flying off.

Even more interesting than the spinning egg was the exhibition of planetary motion. In this experiment one large, and several small brass balls were usually employed. When the field was energized all the balls would be set spinning, the large one remaining in the center while the small ones revolved around it, like moonlets about a planet, gradually receding until they reached the outer guard and raced along the edge.

But the demonstration which most impressed the audiences was the simultaneous operation of numerous balls, pivoted discs and other devices placed in all sorts of positions and at considerable distances from the rotating field. When the currents were turned on and the whole animated with motion, it presented an unforgettable spectacle. Mr. Tesla had many vacuum bulbs in which small, light metal discs were pivotally arranged on jewels and these would spin anywhere in the hall when the iron ring was energized.

Rotating fields of 15,000 horsepower are now being turned out by the leading manufacturers and it is very likely that in the near future capacities of 50,000 horsepower will be employed in the field of other industries. Self-propulsion of Tesla's electric drive which, according to Secretary of the Navy Daniels' statement, has proved a great success.

But any student interested in these phenomena can repeat all the classical experiments of Tesla by inexpensive apparatus. For this purpose it is only necessary to make two slip ring connections on an ordinary small direct current motor or dynamo and to wind an iron ring with four coils as indicated in diagram Fig. 3. No particular rule need be given for the windings but it may be stated that he will get the best results if he will use an iron ring of comparatively small section and wind it with as many turns of stout wire as practicable. He can usually copy plate an egg but he should bear in mind that Tesla's egg is not as innocent as that of Columbus. The worst that can happen with the latter is that it might be broken, but the Tesla egg may explode with disastrous effect because the copper plating is apt to be brought to a high temperature from the induced currents. The sensitive experimenter will, therefore, first suck out the contents of the egg—thus satisfying both his appetite and thirst for knowledge.

Besides the rotating field apparatus Mr. (Continued on page 308.)
My Inventions
By Nikola Tesla

2. MY FIRST EFFORTS IN INVENTION

SHALL dwell briefly on these extraordinary experiences, on account of their possible interest to students of psychology and physiology and also because this period of agony was of the greatest consequence on my mental development and subsequent labors. But it is indispensable to first relate the circumstances and conditions which preceded them and in which might be found their partial explanation.

From childhood I was compelled to concentrate attention upon myself. This caused me much suffering but, to my present view, it was a blessing in disguise for it has taught me to appreciate the inestimable value of introspection in the preservation of life, as well as a means of achievement. The pressure of occupation and the incessant stream of impressions pouring into our consciousness thru all the gateways of knowledge make modern existence hazardous in many ways. Most persons are so absorbed in the contemplation of the outside world that they are wholly oblivious to what is passing on within themselves. The premature death of millions is primarily traceable to this cause. Even among those who exercise care it is a common mistake to avoid imaginary, and ignore the real dangers. And what is true of an individual also applies, more or less, to a people as a whole. Witness, in illustration, the prohibition movement. A drastic, if not unconstitutional, measure is now being put thru this country to prevent the consumption of alcohol and yet it is a positive fact that coffee, tea, tobacco, chewing gum and other stimulants, which are freely indulged in even at the tender age, are vastly more injurious to the national body, judging from the number of those who succumb. So, for instance, during my student years I gathered from the published necrologues in Vienna, the home of coffee drinkers, that deaths from heart trouble sometimes reached sixty-seven per cent of the total.

Similar observations might probably be made in cities where the consumption of tea is excessive. These delicious beverages super-excite and gradually exhaust the fine fibers of the brain. They also interfere seriously with arterial circulation and should be enjoyed all the more sparingly as their deleterious effects are slow and imperceptible. Tobacco, on the other hand, is conducive to easy and pleasant thinking and detracts from the intensity and concentration necessary to all original and vigorous effort of the intellect. Chewing gum is helpful for a short while but soon drains the glandular system and inflicts irreparable damage, not to speak of the revolution it creates. Alcohol in small quantities is an excellent tonic, but it is toxic in its action when absorbed in larger amounts, quite immanently as to whether it is taken in as whiskey or produced in the stomach from sugar. But it should not be overlooked that all these are great eliminators assisting Nature, as they do, in upholding her stern but just law of the survival of the fittest. Eager reformers should also be mindful of the eternal perversity of mankind which makes the indifferent "laissez-faire" by far preferable to enforced restraint. The truth about this is that we need stimulants to do our best work under present living conditions, and that we must exercise moderation and control our appetites and inclinations in every direction. That is what I have been doing for many years, in this way maintaining myself young in body and mind. Abstinence was not always to my liking but I find ample reward in the agreeable experiences I am now making. Just in the hope of converting some to my precepts and convictions I will recall one or two.

A short time ago I was returning to my hotel. It was a bitter cold night, the ground slippery, and no taxi to be had. Half a block behind me followed another man, evidently as anxious as myself to get under (Cont. on page 839)
An interesting study of the great inventor, contemplating the glass bulb of his famous wireless light. A full description of the invention will appear shortly in the Electrical Experimenter. This is the only profile photograph of Mr. Tesla in existence. It was taken specially for the Electrical Experimenter.
Oldest and Newest Styles in Trolleys

VERY interesting indeed from a historical point of view are the accompanying photographs, which show respectively the oldest and newest style in trolleys, in the greatest trolley town in the universe, Brooklyn, N. Y., the home of the passengers tumbled out post haste and helped the crew (he was a fine fellow) pull the car off the horse! And you paid as you entered, Oh! yes. If you didn’t pile up front and slip your jitney in the fare box, the driver (he was the whole show) bawled you out properly. When you didn’t have the change, the motorman past you an envelope containing change for your bill, and you then selected the fare and deposited it in the fare box. This wonderful mechanical masterpiece had an oil lamp inside it, so that the driver could see that you actually deposited the fare.

Electricity was a long time finding its way to trolley roads. The electric motor was developed at that time sufficiently to be adaptable for the propelling of trolley cars, but the complete details for the distribution of the current had not been fully worked out and developed to any appreciable extent. About the only thing electrical around this early traffic carrier was the “bell,” and more often than not this was simply a large clapper intended to be yanked with a pull of cord. Horse-drawn trolleys, or “horse-cars” as they used to be called in the good old days, only disappeared from the streets of New York about a year and a half ago. Up to this time horse-cars were also used on Houston Street—the greatest attraction ever to out-of-town visitors. They talked about them for weeks and weeks and weeks.

HISTORIC ELECTRIC SWITCHBOARD AND DYNAMO.

By J. Locketz.

The electric switchboard, together with the 15 kilowatt generator shown in the accompanying photograph forms a very interesting link in the history of electric light and power development. This switch-board, as well as the dynamo, date back over thirty years and were used until recently by a Western Railroad when it was still equipped with the old apparatus. The historic switch-board and dynamo have been donated to the Dunwoody Institute at Minneapolis.

The first thing that one notices on these old style switch-boards is that they are made of wood. A wooden—board was all right some years ago when 110 or 220 volts potential was considered a fairly “high” one, but nowadays when we have power developed at such tremendous voltages as 50,000 to 100,000, and even as high as 150,000 volts, there is required a better insulator than wood, such as marble.

The 15 kilowatt generator will be familiar to electricians as one of the famous old Edison machines of the bi-polar, vertical (Continued on page 808)
A “White Coal” Motor to Harness the Tides

From time immemorial men have been active in trying to evolve methods that will relieve humanity from physical toil. The worldwide campaign for increased efficiency is in a large degree dependent upon this same desire to be relieved from physical labor and there is a demand everywhere for cheap power, which can, as everyone knows, be best supplied by water power.

It is claimed by Government officials that the United States has more than 40,000,000 horse-power of undeveloped water power within its boundaries. If this is true, it represents an amount of power correspondingly to the amount of energy that would be derived from about 300,000,000 tons of coal worth about $600,000,000 a year in the boiler furnaces.

A new motor, shown in the illustrations, invented by Mr. P. J. Griffin of Boston, is designed to harness the energy of the tides and generate electricity by this means. The White Coal Motor, as it is known, is built on unique principles, being almost devoid of resistance. With this simple motor a farmer may harness the latent power of the nearest stream and generate his own electricity at very low cost. Flowing water is the only power used to generate the electricity. Mr. Griffin, the inventor, is shown on the left in the photograph.

The inventor makes use of two sets of crosses, used as arms and mounted on a concave shaft. Secured between the outer ends of said arms are a set of flaps or wings; these wings or planes are held in place on one of their vertical edges between the outer ends of said cross arms by means of a rod (or pivot, to make a circle of 360 degrees from one side of the concave shaft to the other or opposite). On account of the above radius these wings or flaps take advantage of the same currents in its reverse, identically as that of the forward serving with the same continuous motion without any change whatsoever of any part of the device.

This invention is a cross or disk, not a wheel; it becomes a motor when wholly upright shaft. With this motor wholly submerged in water the inventor claims 1,500 h.p. to 60 square feet of surface of blades with between a five and six-mile current.

As will be seen, this new tide motor is a cross or disk. It becomes a motor when wholly submerged in water the inventor claims 1,500 h.p. to 60 square feet of surface of blades with between a five and six-mile current.

Insulating rods, tongs and similar appliances have been so perfectly developed to-day that linemen often work on charged wires carrying as high as 40,000 volts with comparative safety.

A “RADIUM DETECTOR.”

A new detector of radioactivity has been evolved by a California inventor, Mr. L. M. Karsch, and it is a highly sensitive scientific apparatus, constructed on the principle of an Electroscope, by means of which it is possible to distinguish radioactive substances from others. It is claimed that the presence of radium in quantities less than 100,000,000th part of a pound can be detected with absolute certainty.

The Radium Detector consists of two insulating stands, to each of which is fastened a small “flag.” A generator, in the form of a stick of electric or hard rubber composition, 23/4 inches long, 5/8 of an inch in width, and 1/16 of an inch in thickness completes the outfit. The detector is mounted on a small sulfur compound block which forms a 3/4 of an inch cube. A small piece of aluminum sheet extends horizontally 3/4 of an inch from the cube and has a width of 3/8 an inch; it is bent into an “L” shape, the vertical side of which stands from each side of the upright aluminum 3/4 of an inch above the top of the cube. There is a thin wire stretched taut across the plate and on this wire is placed a small “indicating flag.”

Detection of the presence of Radium is accomplished by the use of two of these detectors placed on a flat surface, preferably a glass plate, at some point of height, convenient for observation. The detectors are placed six inches apart and an initial charge is imparted to each one by means of the brisk rubbing of the generator stick between a folded piece of dry wool cloth or silk. The application of the generator to the detector causes the latter to become actively charged.

After the detectors have become charged, the small flag raises and stands out in a horizontal position. The substance to be tested is placed under or near the metal part of one of the detectors, without touching it. The second detector is located about six inches away without any substance near it and it is used as a check upon the first detector. The flags of both detectors are then observed for a period of five minutes.

If the flag of the detector near which the substance or ore has been placed, drops from the horizontal position with greater rapidity than the “check up” detector, the substance is radioactive. The strength of the radioactivity can be approximately determined with this detector by noting the period of time it takes to discharge the detector. The flags will fall in about 8 or 10 minutes when a weak radioactive substance is employed, such as Uranium Nitrate, while Carnotit and pitch bled will cause the flags to fall in from two to three minutes.
Popular Astronomy
Saturn—The Ringed Planet
By ISABEL M. LEWIS
OF THE U.S. NAVAL OBSERVATORY

Nearly everyone, with the exception of a few unusually earth-bound individuals, has felt at some time or other a strong desire to gaze at some of the beauties and wonders of the heavens thru a telescope and the one object that all of us wish to see, if, perchance, this desire is to be gratified, is Saturn, whose unusual ring system has so far as we know no counterpart in the sky.

All the planets in the solar system with the exception of the two innermost, Mercury and Venus, are attended by satellites but Saturn, alone, has in addition to a large and imposing family of nine moons, three distinct rings of great dimensions which form a total mass composed of swarms of minute particles revolving around the planet.

Why Saturn should be the only planet to possess such a system of rings has not yet been explained in an entirely satisfactory manner, depending as it does upon the manner of the origin of the entire solar system which it is now agreed could not have followed the course outlined by the Nebular Hypothesis of Laplace. The theory of the origin of the Rings of Saturn is involved in the theory of the origin of the solar system and every theory advanced to explain the manner in which the solar system came into existence must satisfactorily explain the cause of this peculiar appendage of Saturn.

There is an interesting law known as "Roche's Law," however, named from its investigator, that states that no satellite of a planet can exist intact within 2.44 times the radius of the planet. This limit is spoken of as "Roche's Limit" and applying it to the planet Saturn we find that the rings of Saturn fall within this limit. It does not necessarily follow from this that the minute particles of which the rings are composed are the shattered remains of one small satellite but rather that they are the material from which a satellite might have been formed were it not so close to the planet. Within "Roche's Limit" the mutual attraction of the various particles for each other that would tend eventually to gather them into one body is overcome by tidal forces that arise from such close proximity to the huge planet. The stress and strain of such forces is so great that no grouping of particles can take place. This explains, possibly, why the rings continue.
In Order to Understand How Tremendously Large the Saturnian System Is, Our Artist Projected upon the Rings of Saturn All of the Minor Planets, Including the Earth. It Should Be Understood That These Rings Are Not Solid, but Are Merely Composed of Small Little Moonslets (See Large Drawing on Opposite Page). It Will Be Noticed That If All the Minor Planets and Our Own Moon Were Laid Side by Side, They Would Just About Cover the Breadth of Saturn’s Rings. The Moon Is Arranged on the Opposite Side to the Outer and the Second Ring.

Comparative Sizes of the Nine Satellites of Saturn, Arranged in the Order of Their Distances Outward from the Planets (Reading from Top to Bottom). Titan is the Exact Duplicate of the Planet Mercury in Size, and Japetus is Very Nearly Equal to Our Own Moon in Size.

Fig. 1 Shows the Dimensions of the Ball and Rings of Saturn and the Orbits of the Five Inner Satellites.

members of our solar system may have had such appendages in the far distant past.

The appearance of the rings of Saturn as viewed from our planet changes periodically as a result of the revolutions of the earth and Saturn around the sun, which places them in constantly changing positions with reference to each other. The rings lie in the plane of Saturn’s equator, which is inclined twenty-seven degrees to its orbit and twenty-eight degrees to the earth’s orbit.

Since the position of the equator remains parallel to itself while the planet is moving around the sun, it may be said that half the time the earth is elevated above the plane of the rings and the remainder of the time it lies below the plane of the rings. Twice in the period of Saturn’s revolution around the sun, which occupies nearly thirty years, the earth lies directly in the plane of the rings and at this time the rings, which do not appear from view for a short time. The last disappearance of the rings of Saturn took place in the fall of 1907 and the next disappearance will occur in November, 1921. Between these two dates the southern surface of the rings remains the visible one. Half way between the two dates of disappearance the rings are tilted at their widest angle with reference to the earth and they are then seen to the best advantage. They are now becoming narrower and narrower and as the date of their disappearance approaches they will appear more and more like a line of light extending to other side of the planet’s equator. Even in the most powerful telescope the rings entirely disappear from view for a few hours at the

time the earth lies exactly in the same plane. It is at this time that the ball of Saturn may be seen in the sky.

(Continued on page 821)
How Jimmy Saved the Bank

By F. W. RUSSELL

As the hands of the big clock in the office of the First National Bank pointed nine, old Mr. Hutchinson past between the long rows of desks towards the door of the big burglar-proof safe. For the last ten years he had past along that same isle and at exactly the same hour. He reached the door and put his hand on the huge nickel-plated handle, by means of which the door was pulled open. The great weight was so delicately balanced that only a slight pull was neces-
sary to open it, but this time it did not yield to the usual effort; Mr. Hutchinson applied all his strength to the task, but the door did not yield an inch. What could be wrong?

Mr. Wallace, the president of the bank, had wanted an absolutely burglar-proof safe, so his brother, an Electrical Engineer, had undertaken to design one, which he claimed would foil the efforts of the most ambitions cracksmen. It had a marvelous time-lock consisting of five clocks timed to a hair. These, beginning at fifteen minutes to eight, closed five different contacts in a special motor circuit; that is, the first contact was closed at a quarter to eight, the next at exactly eight, and so on at intervals of fifteen minutes, until the last contact was closed at a quarter to nine, starting an induction motor which drew the bolts.

The current for this motor was brought in thru the top of the safe. Two holes had been made here which were comparatively small at the top and bottom but which bulged out at the center. Heavily flanged brass rods had been set in these holes and porcelain molded around them. These were protected by a thick layer of concrete which covered the safe on all sides, excepting the front. The current which operated the clock contacts, was supplied by a small storage battery kept in the safe and charged every day.

Mr. Hutchinson's first thought was that he might have been too soon, for even his

"No sir! no sir!" He raced on, getting his breath in gulps. "I went there at the usual time sir, and the door would not give. I know I was not ahead of time, for I waited nearly five minutes and tried again. I pulled with all my might, sir."

He paused and looked inquiringly at the secretary, who had sunk into one of the large leather arm chairs against the wall, and sat gazing at the floor. Suddenly he got up and looked at his watch, started to sit down again, changed his mind and be-
Mr. McGinnis looked at him reprovingly. "He keeps in touch with his home thru his son Jimmy's wireless. We will go and see him, if he goes with us.

They left the building together and hailed a passing taxi. After giving the direction, Mr. McGinnis settled back in the seat with the thought of a meeting and a worry. Mr. Hutchinson sat with clasped hands, and silently shook his head. He had not run into this business, and had done nothing so the man, even in anything, now that the safe which had always been his pet had failed them. They stooped on the way, and Mr. McGinnis explained to the Geographical and International Bank, securing a sufficient loan to carry them thru the day. The car soon cleared the town, and drove down-town, and sped along the smooth streets, until after a short ride it drew up before the white marble home of the Wallaces.

"You were opened by John, the butler, who informed them that Jimmy was at home. He was at that moment in his workshop, or in good American, his "joint." Was the gentlemens business very important? It was. Well John might venture into those dangerous regions if that was the case. Mr. McGinnis slowly showed enthusiasm for his task. There were memories still fresh in his mind of electrified doors. They led into the hall, and a rug in particular on which he had shown a surprising amount of activity. He approached the door cautiously and knocked.

"Mr. McGinnis, who is it?" came a voice from within.

"Mr. McGinnis and Mr. Hutchinson are downstairs wishing to see you now."

"I am coming down, too; busy too; tell them to come up on." Jimmy said this last standing in the open door. He was a tall slender man, but well built with a shock of brown hair, above a pleasant face. He was a typical "Bug"—always had a binding-post or a piece of wire in his pocket, and his time collecting "junk" or "making something." Mr. McGinnis and Mr. Hutchinson were standing in the room. It was a regular "joint" all right; wire on the floor, hung from the ceiling and draped along the wall, switches sailed up here and there, and tables and chairs covered with tools and apparatus. Jimmy swept two chairs clean, but his visitors remained standing.

"Our story begun paradoxically, for the first time in many years not pausing to weigh his words, "The bank is in great danger. The safe won't open and there are very important papers which have to be attended to. I want you to call your father, and ask him if there is any way to open it. You can get him, can't you?"

"What's this, you say, the safe won't open?" burst out Jimmy, looking dazedly at Mr. McGinnis.

"Yes, yes, and I want you to ask your father if he knows any way to open it I say, you can get him, can't you?"

"Sure, of course, just a minute." Jimmy dashed to his wireless table and threw in the antenna switch. In a moment the room was flooded with faces, and the door was being drownd by the high-pitched spark, as the call of his father's yacht was being tapped out rapidly. After the second trial Jimmy was answered by the Yacht's radio operator.

After a few minutes, Jimmy rose from the table with a downcast look. The two men hesitated a moment before opening his mouth. "He don't know—he's all excited. That's natural enough tho. He's coming right back," Jimmy stood for some time by the floor in a thoughtful attitude. Finally, as Mr. McGinnis started to go, he called him back. "Wait a minute, I have to come some way to open that safe; sit down and think; there is no use getting excited!"

Mr. McGinnis was far from being excited. "There's no use," he said, starting to go again. "You know how your Uncle

THE APRIL NUMBER "E.E."
The April number of the Electrical Experimenter will abound with new and refreshing articles. Among those in preparation there are the following attractive contributions:

"My Inventions."—No. 3 of a series by Namoco Tesla, the genius of the electrical scientist. This paper will describe his wonderful discovery of the "Revolving Magnetic Field"—the foremost advance in the art of mechanical motor, which has revolutionized the electrical power industry.

"What is the Injurious Travel Above the Earth or Thru It?" by De Forest, an exclusive feature article which you can't afford to miss. Mr. McGinnis is the author of a Thousand Uses. How it furnishes every conceivable want to the hotel guest—all at the push of a button. "New X-Rayology of the Bones," by Charles Battell Loomis. "How can Man Freeze to the Earth? Can he Exhale the Heat-Giving Radium?" by E. T. Bronson. "The Necessity of Phonograph—It won't annoy the neighbors." by Thomas Reed. "Putting It Over" on Fritz. Some Rare and Incurable Tricks of the war. by K. K. Sammurner. "New French and American Auditions."

A New Lightweight Commercial Radio Transmitter."


New Experimental Chemistry Questions and Answers," "Physics."

me, have you got 220 volts A. C. at the bank?"

"Oh yes," stammered Mr. McGinnis. "Yes, but what—"

Mr. McGinnis obeyed, and Mr. Hutchinson trailed out after him, not having recovered his senses as yet. The car was out in Front and the two got in. In a moment Jimmy came running down the steps of the plantation, which was apparently very heavy. The big car dashed thru the streets, narrowly missing several bewildered pedestrians and shoving passing vehicles into ditches. As the car drew up in front of the bank, Jimmy was out over the door in an instant, dragging Mr. McGinnis with him. When his father's secretary reached him, he was busily running the extension cord from a near-by lamp socket to the safe, in the mean time warding off a swarm of inquisitive bank clerks. When he had finished and had attached the two loose cord ends to two more protruding from the motor, he turned to Mr. McGinnis—"That motor is exactly in the way, isn't it?"

"You mean the one that draws the belts? Yes, yes, exactly; I remember that from your account. It's chained to me. What are you going to do?"

"Roll one of these desks over here," was all the answer they got. The order was given and half, who soon had one of the big flat tops on the required spot. By piling some large books and a file cabinet on top of this the required level was soon attained. Jimmy lifted up his bag and took something out of it.

Just then a little man in great excitement based in the corner of the clerks' eyes. he exclaimed. "So it is true. I couldn't believe it. What are you doing, James, my boy?"

"Little idea of mine, going to try to open it," said Jimmy, "don't get excited. I; may not work."

"Going to try to open it?" Mr. Wallace queried dazedly. He had just arrived and had driven to the bank at top speed.

"Ugh, ugh," said Jimmy. Then turning around, gave us a little idea of my fellows! In the scramble which followed some one accidentally pushed the right button, and the desk fell.

All eyes were turning inquiringly towards Jimmy, who stood on the desk holding a push button which was connected to a round black spot in the ceiling, and the desk fell. Suddenly, he stepped the button and bent his ear to the door of the safe; a low hum was heard on the inside and then a click, which was unmistakable.

A cheer burst from the surrounding clerks, and as the desk was rolled away, Jimmy grasped the big nickel plated handle, and swung the door wide open. But the mystery was yet to be explained and all eyes were again trained on the door.

"How did you do it, son? How did you do it?" gasped Mr. Wallace, looking with mingled wonder and pride at his young helper.

"Oh, it's nothing!" said Jimmy. "You see an induction motor has no electrical wire connection between the field and the armature. All nodded understandingly. And so I figured if I used a bigger and more powerful field, I ought to be able to spin that little field back, just line it up and you know what happened. Simple little thing, isn't it, when you come to think about it.

"I've done nothing that transformer you were longing for in that catalog the other day? How much does it cost?" asked Mr. McGinnis, as he sat down and began to fill out a check.

(DO I ELECTRICAL.

When Milli Ampere first saw Volt Her charms past all resistance. A mark was made in his heart poor Volt—

He never remembered her.

And she, tho plighted to old Watt, Could alternate affection,

So let her eye be keener, not Right in poor Volt's direction.

The current of Watt's wrath inflowed strong! He vowed Volt should not meter.

For daughter Polly Phase had long Hoped that Volt would be sweeter.

And so to Milli Ampere, he demanded. "What do you mean, Requesting she transform, and be. If possible, less bitter.

So Milli Ampere flitted not, she felt that it was wise, To regulate the rage of Watt

And with him synchronize.

The current inflowed fast. From her he did not roam.

They rectified divergent views And started a small Ohm.

J. F. Leggett, in Western Electric News.
Submersible Boat Resembles Sea Monster

The peculiar looking submersible one-man boat shown in the accompanying view has for its primary object, so its inventor, Mr. Worth R. Barringer, of Denver, Colorado, states—to provide a vessel of this character constructed so as to contain a single occupant and provided with suitable means whereby submergence of the vessel as well as its travel thru the water may be controlled by the occupant. He mentions, among other advantages, that it should prove useful and convenient for submarine observations and in the removal of submerged mines and for various other similar and analogous purposes. Also the inventor claims that his device can be used as a diving suit, and can be readily donned by the individual.

The body of the submersible diving suit is preferably made of aluminum. The front or nose portion of the body is provided with transparent panels or windows, as shown, thru which the occupant can see either to the right or left and forward. Suitable rubber or other flexible water-proof compartments are adapted to receive the lower limbs of the operator. An electric motor is arranged to operate a propeller, the motor receiving its current from a storage or other battery. But this is not all. The inventor takes time by the fore-lock and practises safety first. He also supplies a compres-air motor with a storage tank containing air under high pressure for operating it, all of which is used to drive the propeller. Suitable vents are provided for the efflux of vitiated air as well as air inlets or ventilators, which are arranged in the top wall of the body. These vents are fitted with suitable valves, such as the float-ball type, which will automatically close, due to the pressure of the water upon submergence. An electric light bulb is also arranged in the top of the body, which is supplied with current from the storage battery.

Sleeves made of rubber or other suitable flexible material are attached on the front of the body on either side to accommodate the arms. These are fitted with suitable gloves to receive the hands of the operator. To submerge, the human fish, a collapsible tank is arranged on the under side of the body. The tank is equipped at its lower end with suitable valves and hand-holds. There is also a pipe connecting the compress air tank to the upper end of the collapsible bellows tank, in which pipe line there is placed a suitable valve. When it is desired to submerge, the bellows tank is collapsed, the air being expelled from the tank thru suitable valves. This results in the displacement of the vessel, so that it will submerge. When the operator desires to rise to the surface, he withdraws his arm from one of the sleeves and opens a compress-air pipe valve from the storage tank into the collapsible bellows tank, thus expanding it and causing the vessel to rise, owing to the increased buoyancy.

Finally, the inventor mentions that it will of course be understood that the vessel may be provided with an oxygen supply tank, so as to afford an ample supply of oxygen during prolonged submergence of the vessel. If there is anything under the heavens that this inventor forgot, we have failed to perceive it in looking over his patent, but he might have conscientiously attached a 69 cent alarm clock to the rear wall of the inner compartment so as to arouse the submarine explorer from prolonged slumber, which might result disastrously in the event the "ship" became uncontrollable and started off on a long journey toward foreign shores. We presume the sailor carries sufficient tea biscuits in his box to weather the voyage, and providing he has the foresight to procure a few dozen choice tea and bouillon capsules as adapted by the United States Army for emergency rations, he should have a delightful cruise. Bon voyage!

PREDICT AERIAL MAIL SERVICE BETWEEN EUROPE AND AMERICA.

All mails between Europe and the United States eventually will be carried by airplane, according to Lord Morris, who has championed a movement before a Parliamentary committee for the establishment of a port of call for Atlantic aerial liners on the west coast of Ireland.

Already, he says, a regular daily mail service by airplane is maintained between England and France without interruption by the weather.

BRITISH TANKS CARRY THEIR OWN "CARPET."

The photograph herewith shows a giant British tank ready to go into action. This tank is fitted with a new superstructure, which comprises a rugged steel wire timber net. It is used to breach shell-holes, gulleys and trenches, in making advances over rough ground. This "carpet" is quickly unrolled when needed, and is very effective on rough ground. Of course giant caterpillar tracks or belts do not grip into the mud when the carpet is used, and thus one of the greatest drawbacks to the use of the tanks has been overcome. This photograph is one of the most remarkable taken during the war and shows British infantry reinforcements accompanied by tanks, all awaiting orders to "get into it." The smoke from the battle almost obscures the tanks and men in the background of the picture.
Experimental Physics
By JOHN M. FURIA, A. B., M. A., (Columbia University)

LESSON NINETEEN

Radio-activity—Experiment 108.

RAP a photographic plate in a piece of perfectly opaque black paper. Lay a coin on top of the paper and suspend a pinch of the mineral Uranium a little above the coin. Set this aside for a few days, after which time develop the plate. A shadow picture of the coin such as one would obtain after exposure to X-rays will appear on the plate. This is precisely the experiment that Henri Becquerel, of Paris, performed in 1896, which led him to the conclusion that Uranium is a source of rays that affect photographic plates and which have the power of penetrating opaque objects just as X-rays do. The rays are known as Becquerel Rays, after their discoverer, and the phenomenon is called Radio-activity. Shortly after Becquerel’s discovery Madame Curie, of Paris, assisted by her husband—Prof. Curie, made an investigation of all the known elements to ascertain which of them possess this same remarkable property that Uranium possesses. She found that Thorium in any of its compounds was a radio-active substance (Thorium is the chief constituent of Welsbach gas mantles). During the investigation Madame Curie noticed that Pitchblende (the crude ore from which Uranium is extracted) which consists of Uranium Oxid to a great extent, discharged her electroscope (a test for radio-activity) about four times as fast as pure Uranium does. She concluded that the radio-activity of pitchblende was due to some unknown element in it more powerfully radio-active than either Uranium or Thorium. After a tedious and difficult research she succeeded in separating a few hundredths of a gram of this hitherto unknown element from several tons of pitchblende. This new element which she named Radium proved to be a million times more radio-active than Thorium or Uranium. Radium has attracted the attention of the foremost scientists the world over.

Before proceeding with the following experiments let us note carefully the following characteristics of Radium. The Radium atom is heavier than any other atom. Radium constantly emits three distinct kinds of rays namely alpha, beta, and gamma which I shall refer to by α, β, and γ respectively. α, β, and γ-rays all affect photographic plates, discharge a charged electroscope and are deflected by magnetic fields. α and β-rays, both impart electric charges to bodies they come in contact with. In particular, the α-rays are not as penetrating as the β and γ-rays; they are deflected by a magnet in a direction opposite to the direction of deflection of β-rays and travel at about 20,000 miles per second. The β-rays are like cathode rays and they travel at from 50,000 to 180,000 miles per second. The γ-rays are not deflected by a magnet but they have greater penetrating power than either the α or β-rays. From these properties we conclude that α-rays are streams of positively charged particles (atoms of Helium); β-rays are negatively charged particles like cathode rays, i. e., electrons and γ-rays are irregular pulsés like X-rays.

Experiment 109.

The goldleaf electroscope, one of the oldest electrical measuring instruments known and which was described in the lesson on “Static Electricity,” was used merely as a detector of the presence of an electrical charge. This same instrument in a delicate form is used to measure electric currents of very small magnitudes where other instruments fail. In Fig. 98, A is a metal case (a cocoa can serves admirably; in fact an authority on the subject of radio-activity made the statement that he secured better results with a home-made cocoa can electroscope than with the fancy priced, highly polished commercial instruments). A metal rod E (about 1/32 inch in diameter) passes thru an insulating plug D, made of boron, amber or sulfur. C and F represents insulation of the same material as D, B and G are metal rods like E, bent as in the figure (hairpin with the enamel scraped off is quite satisfactory). H is a narrow strip of gold or aluminum foil about one and one-half inches long and 1/32 inch wide. (The narrower the strip the more sensitive the electroscope). To cut the aluminum or gold foil the following method has been found best. Place the foil between two sheets of thin paper. Press the edge of a razor flat against the “sandwich” and carefully saw (Continued on page 806)
Amateurs Win
Alexander Wireless Bill Is Killed
By H. Gernsback

The Alexander Wireless Bill and its amendment as reported in our last two issues has been killed. On January 15th the Merchant Marine Committee and the House of Representatives gave the Administration's movement toward Government ownership of public utilities a very definite setback. By unanimous vote it tabled the bill which was to authorize the Navy Department to take over and operate permanently all radio stations.

As our readers will remember from our January issue the bill was sponsored and urged by Secretary Daniels. Representative Bankhead made a motion to table the bill and Chairman Alexander characterised the proposed plan as "a hopeless task." He added: "In view of the sharp difference of opinion both in the Committee and in the House on this subject, it would be impossible to put the bill thru at this session."

As our readers will remember from our January issue, the original Alexander bill proposed to make all wireless stations Government owned, and the present wireless law, the act of 1912 was to be changed to such an extent that the amateurs were testing letters, which not only reached Mr. Alexander's committee but every Congressman and Senator of the United States as well. This unparalleled unity of the American amateurs had an instantaneous effect in Washington, and even before the hearing started, a number of amendments, all of which favored the amateur more or less were rushed thru, printed and distributed.

There were at least three amendments of which we have record. One of them, the last one dated December 11 was printed in full in our February issue. Before the bill was definitely killed, however, we had information which tended to show that the Government was not ready to make wireless a Government ownership affair. As far as the amateur was concerned we were not at all disturbed, for we said: "As a matter of fact as things stand (Continued on page 835)
America's Greatest War Invention

The Rogers Underground Wireless

(Special Interview to the ELECTRICAL EXPERIMENTER.)

By H. Winfield Secor

(Associate Member Institute Radio Engineers.)

An invention which has been termed the greatest American war achievement is the Rogers underground and sub-sea radio system. The Rogers system does away entirely with aerial wires, and it is only a matter of months now before all aerial wire systems the world over will be pulled down. The Rogers system has been accomplished by the new Rogers underground system, chief of which is the total elimination of the increase of the loudness of received signals, which is often as high as 5000 times the usual strength. Interference, too, is done away with almost entirely. The Rogers invention is of tremendous importance and revolutionizes our previous ideas on wireless to an extent never dreamt of before. We urge every one interested in radio to read the accompanying authoritative article which discloses the full technical data on the new system for the first time in any periodical.

The greatest invention in the field of wireless telegraphy since Marconi first placed commercial radio-communication on a firm basis by his historic experiments in Italy, and later in England, is without a shade of doubt this latest triumph of radio research—the "Underground and Sub-sea Wireless", conceived and developed to a working stage by an American scientist and inventor, James Harris Rogers. Mr. Rogers is known as a second Edison, among his town-people in Hyattsville, Maryland, where he has lived for many years, and now the whole world acclaims him.

It is Revealed Now That the Navy Department Had Been Using a Powerful Undersea Wireless During the War. The Instruments and System Were Invented by James H. Rogers, of Hyattsville, Md., and were Adopted by the Navy Department as an Invaluable Addition to the Wireless System of the Navy. The Two Lower Photos Show the Inventor, Mr. Rogers, in His Laboratory at Hyattsville.

Who is Mr. Rogers?

James Harris Rogers, practically unknown a few years ago in radio circles, except by a few select radio men who were investigating his invention for the Navy Department, has practically become overnight the center of all attractions in the field of science. Mr. Rogers is a son of the confederacy and a veteran of the great Civil War. He has followed electrical experimenting ever since and has been a strong devotee of radio telegraphy since Marconi performed his first experiments in this new branch of applied science. He is a refined, cultured southern gentleman who makes you feel at home at once; an invariable attribute of all of the truly great. Mr. Rogers was one of the first inventors of the "printing telegraph" and his full-sized working models saw actual commercial service on a circuit between Baltimore and Washington, also in New York, back in 1880. These were seen by the writer and are wonderful pieces of mechanism.

The Rogers laboratory, which comprises several large rooms, is lined on all sides with glass cabinets containing electrical apparatus which he has invented from time to time thru his studious career. A novel and original high frequency generator was another of the devices that greatly interested the writer. It employed a jet of water shunted by a large capacitor, the stream of water being connected to a high potential source of direct current. High frequency currents of any range up to the limit of audibility, or about 30,000 cycles per second, could be readily obtained with this apparatus. The writer merely cites these facts to substantiate the standing of Mr. Rogers in the scientific field. Hundreds of other electrical inventions have been made by this modest genius of the quiet little Maryland town of Hyattsville, and the principal outstanding fact of all of his work is that he can show you a working model of each of these inventions, unlike many other inventors whose ideas exist only on paper, and which often fall down miserably when actually built and tested.

In this connection it is interesting to consider for a moment that not one of the new wireless "static and interference preventers" proposed to the government radio experts during the war, proved practicable in the least.
The Rogers Undersea Wireless Opens Up an Entirely New Field to Submarines and Ship Communication. Mr. Rogers has recently stated that he has been successful in bringing to the surface to intercept radio messages, but the Rogers Instrument Co. has just announced that it has successfully transmitted a message from a U.S. Subsea Boat Submerged Off the American Coast to a Depth of 8 Feet and Picked Up Nauen, the German Station. At Depths of 21 Feet Stations with Wave Lengths over 12,000 Meters Were Easily Picked Up. Transmission to Submarines Has Also Been Accomplished.

For a decade Mr. Rogers has been studying radio subjects, and long before the United States entered the war he had experimented with the problem of underground aerial communication of this static atmospheric electricity. He disagreed with all authorities who believed that the air, and not the earth and water, was best suited for wireless communication. At first Mr. Rogers used the earth alone for sending messages to amateurs stationed near by. Using an audion bulb, he then buried a wire from his laboratory and heard Philadelphia and other stations. Further experiments were conducted at a laboratory

Official recognition of Mr. Rogers as the one and only original inventor of "Under-ground and Sub-sea Wireless Communication," was soon forthcoming, and here it is in brief. These two official letters of recognition of Mr. Rogers' wonderful and revolutionary invention represent but a

very small fraction of those he has received from radio engineers of high repute in all parts of the world, congratulating him on his masterly work. The Navy Department has just permitted information on the Rogers system to be given out, and how well they kept their secret during the World War, during which time this system has been in use by the Navy Department, may be judged by the fact that radio men everywhere are amazed at this feat. The distinguished radio savant Prof. George W. Pierce of Harvard University, congratulated Mr. Rogers heartily when he first tested and heard the new system work thru salt water, which he at first thought absolutely impossible.

Below we give the two letters of official recognition by the Navy Department of Mr. Rogers' accomplishments, which are all that we have space for.

In response to an inquiry from Clarence J. Owens, director general of the Southern Commercial Congress, Admiral Griffin, U. S. N., chief of the bureau of steam engineering, wrote under date of December 27, 1918, as follows:

In reply to your question regarding the originator of the underground radio system, you are advised that Mr. J. H. Rogers of Hyattsville, Md., was the originator of this system. There have been other claimants to methods of underground radio signaling, but none were useful, within the Navy Department's knowledge, to the extent of being a valuable asset to the general scheme of radio communication. The Rogers' receiving system marked the beginning of the use of underground aerials for receiving, to great advantage over raised aerials, and has been valuable to the Navy Department.

Rear Admiral Strother Smith, then Capt. Smith, wrote Mr. Rogers on December 7, 1917:

It is a great pleasure to me to feel that I have been instrumental in bringing the result of your work before the Navy Department and assisting somewhat in putting it into actual practise. Out of the many thousand ideas presented you can realize that a very, very small percentage are valuable and it is worth at least a year's work to get one that I feel will give lasting benefit to the service that I serve. The Navy Department is interested, Thru Dr. George H. Lamar and Senator Blair Lee the discovery and the status of the patents were brought to the attention of Secretary Daniels of the Navy. Secretary Daniels ordered inquiry into Mr. Rogers' claims, which showed that his invention worked, and requested Secretary Lane to give special consideration to pending patent applications.

Secretary Daniels then submitted the Rogers system to Rear Admiral (then Capt.) Strother Smith, who called into consultation Capt. Hooper. These officers made a thorough study of the system and found it practicable. Capt. Hooper ordered it installed at New Orleans first and since then it has been employed at Belmar, N. J.* and other stations.

To the American Radio Amateur:

WITHIN the next few months peace will be declared and the amateur will be allowed to operate his station as before. Thanks to Mr. James H. Rogers, it will not, however, be necessary for you to put up an aerial again—at least not for receiving. Elevated aerials will be a thing of the past, and well they may.

But ordinarily the amateur would not be permitted to use the underground aerial system on account of Mr. Rogers' fundamental patents. The writer, however, in conversation with Mr. Rogers, prevailed upon him to turn over the free use of his revolutionary, as well as epoch-making invention.

Mr. Rogers thru the Electrical Experimente therefor wishes to announce that he personally has no objection if amateurs use his system privately. It should be understood that the inventor only gives this permission to amateurs as such, and that this permission, of course, does not extend to firms or corporations or to individuals engaged in commercial Radio work. We wish to congratulate our readers upon this important decision of Mr. Rogers, who certainly deserves the everlasting gratitude of all American Radio Amateurs.

H. GERNBACH.

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*At the time of writing this article the Belmar Trans-Atlantic Receiving Station is still employing the Rogers underground antenna.

Hyattsville, Md., January 13, 1919.

Dr. Nikola Tesla, New York City, N. Y.

Dear Dr. Tesla—

I have just read with great interest your article in the Electrical Experimenter. For years I have been a firm believer in the theory that far distant aerials were activated thru the medium of the Earth and not thru the ether above, and it is a source of great satisfaction that so illustrious a personage as yourself has held to the same belief. I have never met a scientist who would entertain such a proposition until I demonstrated to them results described in the enclosed paper, illustrating one of the ways I have found for utilizing the energy so clearly and forcibly described by you. I am, nevertheless, confronted by some who will not give up old theories. If you would do me the great honor of writing a few lines upon the subject the feature I would deem it a great favor.

Should you choose to be in Washington at any time I will be highly gratified to have you visit my laboratory and witness the results obtained.

Very sincerely,

(Signed) J. Harris Rogers.
ELECTRICAL EXPERIMENTER

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near Bladensburg, which he called "Mount Hooper," in honor of Commander Hooper of the Navy, who rendered excellent service in adapting the invention to the needs of the Navy Department.

When Mr. Rogers first stated that messages could be received and sent from submarines when submerged it was unani mously declared to be impossible and the officials of the Bureau of Standards were not alone in this belief, as no less a personage than Marconi declared at a banquet given in his honor in Washington, that when wireless was used on submarines, "it was necessary for the submarine to come to the top in order to catch the ether waves."

To demonstrate more clearly the underwater station, Mr. Rogers constructed an underground station, wholly inclosed beneath the surface of the earth, there being no visual existence of it outside. This place in Prince Georges county was visited by some very noted men, including Dr. Abraham, the head of the French Scientific Commission, who, upon entering the cave at Mount Hooper expressed his amazement and remarked, "the Germans can't get us here." Lieutenant Paer, of the French Scientific Commission and the radio representative of France, also heard his native stations talking and expressed equal satisfaction, pleasure and amazement.

How He Conceived the Under - ground System.

The writer asked Mr. Rogers how he came to form the idea of the "Underground and Subsea Radio." He explained that from having studied the method of transmitting radio signals by means of an elevated antenna, the question constantly presented itself to his mind—"If 50 units of power are passed into the aerial, then what becomes of the equal amount of energy which passes into the ground?" He became so obsessed with this conundrum that he finally asked several prominent radio savants this question. What do you suppose the answer was?—"It is dissipated in the form of heat in the ground," they answered. But still Mr. Rogers thought they were wrong and now

he has proved it. Another early idea of his in the theoretical aspect of radio-communication was as follows, and very logical it was, too, as you will agree: He held that if the outer crust of the earth is a conductor, and the surrounding atmospheric envelope is an insulator, then how infinitely better must the former be for the transmission of any form of electric current.

To Mr. Rogers' mind it was more reasonable to suppose that the energy liberated at the base of an aerial was propagated thru the earth as well as thru the ether above, and that an elevated aerial, at great distance, would be activated by them as effectively as if the same point thru the ether above; when the waves thru the earth reached the base of the potential of the plate would be raised and lowered and the aerial would accordingly resonate the basic and original idea conceived and settled upon.

Mr. Rogers' first trial with the underground wireless to nearby radio amateurs began about seven years ago, but his theory of the reason why it must work was formulated over ten years ago. Further, he conjectured that much less power would be required to propagate a wave or current thru the earth's conducting crust, which for one thing has smaller geometrical dimensions, than to propagate it thru the insulating atmospheric envelope alone.

See Fig. 1.

The Theory of Operation.

A number of other radical ideas were entertained for several years by Mr. Rogers, and in the course of time he has found that his ideas were correct—it worked! It worked! Again how the radio experts far and wide are holding a post mortem inquest on their theories and how it all happened. To start with, Mr. Rogers stated, "special credit is due the following gentlemen, who have re-

(Continued on page 582)
self strongly upon my attention. My first thought was that I had discovered a new form of detector of Hertzian waves, of extraordinary sensitiveness, and was, naturally, much enthused, as any young investigator would have been under similar circumstances. But upon closer investigation of this novel phenomena I found that when the door of the closet was closed, or almost closed, the effect of the spark upon the gas burner ceased! This proved conclusively that I was dealing with sound waves coming upon a sensitive flame and not with electrical waves.

The delusion lasted, however, long enough to force upon my mind the conviction that heated gas molecules were sensitive to high frequency electrical operations, and I determined to investigate further at my first opportunity and actually discover evidence to substantiate my theory. I was unable to do this until the fall of 1902 or '03 when I returned to my gas mantel experiment. I first attempted to investigate the new detector phenomena by using two needles of steel, or platinum, placed close together in the incandescent Welsbach mantel. These needles were connected to a dry battery and telephone receiver. I was, however, unable to obtain any appreciable current between the two electrodes in the mantel. I then investigated the flame of a Bunsen burner and soon found a point in the outside envelope of the flame where an appreciable current did pass between the two electrodes, making a soft fluttering sound in the telephone receiver. (See Fig. 1, Patent No. 824,638, issued in 1906.) Then, connecting one electrode to an antenna and the other to the earth, I heard for the first time signals in the telephone receiver; signals which represented clearly the sound of the transmitting spark. Here at last was actually demonstrated my earnest belief in the existence of this new detector principle. My next step was to enrich the gas flame by putting a lump of potassium or sodium salt in the flame directly below the two platinum electrodes. This increased ionization caused increased flow of battery current, and a corresponding increase in sensitiveness of the new detector. I did considerable work then with various types of Bunsen burner arrangements for permanently enriching the gas flame, etc., and set up a laboratory type of flame detector which was actually used in 1903 for receiving signals from ships down the Harbor of New York.

The inconvenience of supplying a source of gas for the new detector was, of course, obvious, and I sought for other means of obtaining the necessary heated gas and heated electrodes. The electric arc first suggested itself. I anticipated that while this arc would be a detector, it would be exceedingly irregular and noisy in the telephone receiver. This was found to be the fact. The battery fed the arc thru the primary of the transformer, in the secondary of which was connected the telephone receiver, and, although at times the looked for response to electric waves was thus obtained, the noise in the telephone receiver from the arc was so deafening that the idea was abandoned.

The next plan which suggested itself was to use incandescent filaments in an enclosed chamber. This arrangement as well as the gas detector, was illustrated in my patent No. 979,275, which bears the first date of November 4, 1904. This patent application was actually awarded a Patent No. 979,275, April 14, 1908.

Here We Find the "Third Electrode" Placed Inside the Bulb, Where it Logically Belonged, as Dr. de Forest Points Out. Fig. 4 Shows the First Use of the "Stopping" Condenser.

(Continued on page 817)
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NE of the most powerful wireless stations yet designed is that now nearing completion at Lyons, France, and we are indebted for the following description of this remarkable and extremely high power station and the very latest advances in radio engineering, to Dr. Lee de Forest, the well-known American radio engineer and physicist who has recently returned from a trip thru Europe. Dr. de Forest stated that apparently no expense was being spared in the design and construction of this new famous Lyons station, and that the engineers were apparently having carte blanche, for there seems to be no limit to the apparatus installed, and in contemplation for installation at this powerful station.

A glance at the map shows that Lyons lies southeast of Paris, and about half way between Paris and Marseilles. This station has been, and is at the present time, handling all of the official Government radio traffic to the United States, communicating principally with the powerful new naval radio station at Annapolis near Washington, D. C. The Lyons station is in daily communication, and has been in connection with various parts of the Continent, as well as Africa, different countries of Asia, and many other far-flung places in all parts of the globe.

At first this may sound somewhat exaggerated, but when the great capacity of this radio station and the extremely efficient apparatus is considered, it will seem all the more reasonable and possible. To begin with, the Lyons station has a very large aerial, comprising twenty strands of phosphor-bronze cable stretching away over a distance of 2,400 feet and supported on eight steel masts, each of which rises to a height of 650 feet. The masts are placed about 800 feet apart. It is interesting to note in this connection as Dr. de Forest pointed out, that the engineers responsible for the design of this station have found that contrary to the generally accepted idea concerning the effective effect of inverted L aerials of this type, that where great distances and long waves are concerned, the correct and efficient use of transmission in any certain direction about the antenna does not differ appreciably. The general direction of the present antenna is north and south, but the plan shown in the plan view of the station indicates, the free end of the huge antenna pointing toward the south.

The aerial conductors at the station end are fan-tailed together as are also and large twisted cable forming the lead-in, leads down thru a copper on top of the building, underneath which there is a large and very often circular, antenna from which lead separate connecting aerial wires to the various transmitting apparatus, several distinct types of which are installed in this station.

The lay-out of the station buildings has been planned, and the larger building, containing all of the long distance radio transmitting equipment, is in the form of a cross. West of the large building there are two small structures, a small one containing a 3-K.W. high-frequency generator of the beltender (French) type, having a speed of 6000 r.p.m. operating at an antenna frequency of 80,000 cycles. The building next to this houses a 150-K.W. arc generator of the Elwell type, and this transmitting set has an antenna running to the central aerial switch in the main station building. This particular set is of great interest to Americans, as it is the one which has been used in transmitting all of the official Government messages to the United States. It has been operated right along with a United States naval radio crew, and has been very busy night and day. The powerful arc-oscillation generator has been in use continuously, and has often required twenty-four hours of operation, only shutting down the arc periodically for renewing the electrodes.

The following description of the main station transmitting equipment, which is being installed in duplicate, is given in the order of its installation, the first apparatus described being the older.

In the long northern wing of the station of the main building there are installed two 150-K.W. spark sets. These are somewhat similar in design to the well-known General Electric-Alexander design, rated at 150 K.W., and the other set being of the Beltender (French) design, rated at 150 K.W. and twenty-four hours of operation. They are tuned and adjusted to operate at an antenna frequency of 20,000 cycles. By means of the cleverly arranged automatic switch-gear, either of these sets can be connected up to the antenna. Also, when necessary, two such sets may be connected in parallel to the antenna for extra long range.
Experiments With Ultra-Violet Light

By J. C. MORRIS, Jr.

ALTHO the majority of experimenters are interested in the subject of X-Rays, little attention has been given to the study of the ultra-violet rays. These rays have been extensively studied by Finsen and other investigators and were found to have a wave length of about 3600 A. This is far too short a wave to be seen by the human eye, but their production is usually accompanied by manifestations of visible light.

All of the apparatus required to produce these rays is extremely simple and is to be found in nearly every experimenter's workshop. Figure 1 shows how the apparatus is connected: C is an induction coil giving a spark 1 inch or more in length; L is a Leyden jar of other form of high voltage condenser; H is a coil consisting of 10 or more turns of heavy wire (a good wireless helix will do very well) and G is the generator of the ultra-violet rays. It consists of a spark gap whose terminals are composed of iron or steel nails. A convenient form of generator may be made out of a short length of cardboard tubing, thru which the nails are driven. A gap of 1/8 inch must be left between the nails. A small opening must be cut in the tube in the rays to pass thru. A quartz (not glass) window may be placed in the opening, if desired. See photograph. A small spark gap may be placed at N, if desired.

The following are some simple experiments with the ultra-violet rays.

Experiment No. 1.—Secure it possible a piece of willemite (which is a natural silicate of zinc). When the willemite is exposed to the ultra-violet rays it will fluoresce with a pale greenish color. This is a test for zinc.

Several other substances besides willemite will fluoresce when exposed to these rays, among these are sodium silicate, fluorescence, acetylum, sulfate of quinin, also platinum—barium-cyanid screens, such as are used for X-Ray purposes.

Experiment No. 2.—One of the most peculiar properties of the ultra-violet rays is their ability to ionize air; that is, to make air a partial conductor of electricity. The following three experiments demonstrate this property of these rays.

Make two disks of metal about 5 inches in diameter. Place one of these on top of an electroscope. Suspend the other about 1/2 inch above the electroscope. Now charge the electroscope with positive or negative electricity. Focus the ultra-violet rays between the plates. The electroscope will soon be discharged, due to the ionizing (rendering conductive) effects of these rays. This experiment is given for producing these rays in quantity is illustrated and described hereafter.

Experiment No. 3.—Start a small induction coil and separate the secondary terminals just beyond the sparking distance; focus the ultra-violet rays on the spark gap. The spark will now jump the gap, due to the ionizing effects of these rays.

Experiment No. 4.—Take two small metal sheets and separate them a short distance apart. Connect these plates in series with a powerful high voltage battery and a very sensitive galvanometer or telephone receiver. No current now flows, due to the resistance of the air gap. Focus the rays between the plates and a minute current will now flow, due to the ionizing effects of these rays.

Experiment No. 5.—Start the generator of the ultra-violet rays. Place a piece of glass in front of the opening. Examine a piece of willemite. It does not fluoresce. Substitute a piece of quartz or of ice in the place of the glass. The piece of willemite will now fluoresce. Substitute glass that is opaque to these rays, while quartz and ice are transparent to them.

Experiment No. 6.—There are certain substances which are able to transform the short ultra-violet rays into visible rays of light. A Geissler tube is a generator of these rays and may be used to show the fluorescence of certain substances. Make a fairly dilute solution of sulfate of quinin, and add a few drops of sulfuric acid. Partially immerse a Geissler tube into the solution and connect with an induction coil or preferably to the positive pole of a static machine. While the tube is being operated the solution will appear to be light blue in color.

Other substances besides quinin will fluoresce. Some of these are acetic acid, fluorescein, and hydroquinon, such as used in photography.

These are only a few of the many interesting experiments which can be performed with these rays. The photograph is a picture of the author's apparatus for generating these rays. This sketch of the ultra-violet rays is exceedingly interesting and will amply repay the time spent in making the apparatus. It represents an uncommon field for experiment and one that holds much promise for the future of science.

WORKSHOP ACCIDENTS.

It is well to know what steps should be taken in the case of minor accidents that may happen tohandicraftsmen and experimenters in the prosecution of their hobbies. These are mostly in the nature of cuts, scalds, and bruises. It is a good plan to keep a lump of alum handy to stop the bleeding in the case of small cuts. Toil alum, sold by druggists, is the best, and is preferably used by those who shave themselves.

A simple clean-cut wound should be cleansed in cold water under the tap, which generally stops the bleeding at the same time, after which the sides should be brought together carefully and supported with strips of sticking plaster held in position by a bandage.

Wounds inflicted by rusty nails and other pieces of metal often lead to serious inflammation or blood-poisoning. These ill effects may be prevented by the following very simple remedy. Place a little brown sugar on a fire shovel and heat until it smokes, holding the wound in place for several minutes. A few scraps of clean woollen rag will answer the same purpose, but sugar is best. Peroxid of hydrogen and iodin tincture are reliable solutions for treating wounds that involve abrasions.

Some boric acid ointment should always be kept available in case of large cuts or wounds, resulting in a raw surface, or a strong solution of washing soda may be used. Severe burns, and in particular those caused by splashes of molten metal, are best treated with raw linseed oil poured over the burn and covered with a pad of lint.

Hook-up of Spark Coil, Condenser, Induc- tance and Spark Gap for Producing Powerful Ultra-Violet Rays.—Fig. 1.

Small splinters of steel or wood are often run into the flesh and cannot be removed with the fingers alone. In the absence of a pair of fine pointed tweezers an ordinary sewing needle may be employed. Heat the end of the needle, or dip it in peroxid of hydrogen, iodin, or carboic acid and water, to kill any germs on it before touching open cuts. Slip the eye of the needle over the protruding end of the splinter, give it a twist to make it grip, and then raise the needle when the splinter will come out as well in most cases.

Contributed by H. J. Gray.
Wood Finishing for the Amateur

By ARNO A. KLUGE

WHEN the experimenter is con- 
scious of the presence of apparatus, 
whether it be an instrument cabinet 
or of Tom Reed’s famous 
clocks, he is confronted with 
the problem of choosing the wood to give it, 
if such there be. We often find that 
this last process is neglected to a degree where it 
seriously affects the appearance of the instrument, 
and as “looks is everything” to the uninitiated, 
we should give the matter a little more time and study, 
for a number of general processes used in finishing 
a piece of wood, namely: Sandpapering, Stain- 
ing, Filling, Starching, Varnishing, Rubbing, and Polishing, in the order 
in which they occur. Each of these 
will be treated separately, also any 
subdivisions which may come under 
them; but we should bear in mind 
that it is not always necessary to use 
all of them, and so the finisher 
should select that which suits the 
piece to use before starting any piece 
of work. Also, of all the material 
required, he should have on hand so that 
the work may proceed expeditiously 
and without waste of time.

The first operation, that of sand- 
papering, is to give the wood an 
absolutely smooth surface and prepare it 
for the filling. It is assumed, of course, 
that the wood has already 
been planed reasonably smooth, so 
that No. 0 sandpaper is about right for 
the job. A sandpaper block about 
four inches square and one inch thick 
should be prepared, taking care 
that one of the four-inch surfaces is 
perfectly flat, with no high corners. The 
piece of sandpaper is placed under- 
neath the block, the surplus sides 
turned up, and the sandpapering done 
ACROSS the grain. Never sand- 
paper with the grain, as this produces 
tiny grooves on the surface, especially 
with soft woods.

One other precaution should be 
noted. Be careful when sandpapering close to the edges, they will 
be rounded off if you bear down too 
hard. If desired, a piece of scrap 
wood whose surface is flush with the 
work may be laid up against the 
edge, so that the sandpaper will pass over 
to this piece when it reaches the edge 
of the work. After these operations are 
completed, the filling is in order, and it should 
be done thoroughly, to remove every 
particle of dirt from the surface.

We are next ready for staining the 
wood, if desiring to change its color in any way. Remember, however, that staining is only 
resorted to when we do not wish to finish 
it in its natural state, but have decided 
either the exact processes he is to follow, or give it 
another in imitation of some other wood. Most hard woods are more beautiful 
in their own color than they are in a false 
dress.

There are two kinds of stains 
in common use, and both have their faults and good 
points. There are the aniline stains, in which 
the pigments are reduced to a workable 
consistency by the use of turpentine, 
namely, the different aniline dyes, 
as indicated by the name, use water in 
preparation, and hence must use water-soluble 
 pigments. The main advantage of the 
 oil stains is that they do not raise the 
 grain of the wood, and do not show the 
 laps of the brush strokes upon soft, open 
grained woods such as white pine, poplar, etc. 
Upon hard woods, however, they do not 
penetrate deep enough to be desirable, and 
water stains are commonly used for such. 

Water stains are very penetrating, and if 
properly made will bring out the grain of 
the wood very beautifully, instead of cloud- 
ing it as most oil stains do. Their 
chief fault lies in the fact that they raise 
the grain, involving additional sandpapering 
to obtain a level surface, but this is offset by 
the additional beauty of the finished 
product.

The above formula is typical of all aniline 
stains.

Antique Oak. Dissolve asphaltum in naphtha, 
making a very thin mixture, and then 
should be the antique filler.

The third step is filling the wood, if staining 
has been necessary, and by this we 
endeavor to level up the surface, and get a 
mirror-like smoothness. It is best to 
purchase fillers ready-made, and it is difficult 
to get the proper consistency. They consist of 
very fine silica stone, in a mixture of 
half linseed oil and half turpentine, 
with the proper filler added. After the filler has been 
applied, and its color begins to 
change to the finish, it is dull to 
be rubbed dry. 

After filling, shellacking is re- 
sorted to with hardwoods, in order 
to close the pores, and also to use 
hard pressure, so as not to cut thru the 
coat of shellac. With new 
sandpaper it is best to rub two pieces 
together several times to remove the 
danger of scratching.

When applying varnishes a brush 
suited to the size of the work should 
be used, and the operation should be 
performed in a room temperature 
of at least 70°, to insure free flowing. 

Altho it is impossible to tell just how 
varnish successfully, practise being 
the only way to learn, a few simple rules may be given. Apply the 
varnish with the flat of the brush, 
along the grain; then rub it out crossways 
to get an even application; finally 
finish it off with the grain. Care 
should be taken not to apply too much 
at one time, but at the same time not to put too much on. This is another matter where 
practise is the only answer.

After one coat of varnish has been 
applied and is thoroughly dry, the surface 
is rubbed smooth, using ground pumice stone and 
and a pad of roughing felt, until the fibers of 
are the best, as there is less danger of scratching thru 
the varnish. One should always rub with 
the grain and not bear down too hard at 
the beginning or end of the strokes. Some 
lime oil should be at hand as rubbing oil, 
the felt being dipped into the oil and then into 
the pumice stone. As the fibers 
are thus adhering to the felt, cleaning 
off should be done at once, using soft 
cotton cloth. This is necessary, as any 
remaining coarse fibers should not be rubbed until 
two or more coats of varnish have been 
applied, waiting each time until the 
previous coat is dry. This is necessary, or the 
fibers will come up above the surface, thru 
the varnish.

Having rubbed the surface perfectly 
smooth we may now give it a high polish, 
or we may leave it with a “dead” finish. If 
polishing is elected we may proceed in 

(Continued on page 810)
SILICON is the central element in the mineral world, like carbon is in the animal and vegetable kingdom. Unlike carbon, silicon never occurs in the free state. Next to oxygen, it is the most abundant element. Oxygen is estimated to make up nearly half of the solid crust of the earth, and silicon to constitute about a third more. Its occurrence is chiefly in combination with oxygen in quartz and silicon dioxide (SiO₂). This non-metallic oxide is often further united with some metallic oxide, such as aluminum oxide (Al₂O₃) to form a silicate. It is, further, the chief constituent of nearly all rocks, and consequently, also of the soils which have resulted from the decomposition of rocks. It is also found in ashes of many plants, having assisted to make up their mineral structure. Despite the fact that this element is so widely distributed, the element itself has been, until recently, separated from its compounds only with such great difficulty that it was only a curiosity. By the present methods of reduction it is no longer difficult.

**History.**

Amorphous silicon was first separated and isolated in 1810 by Berzelius in an impure form. Later, in 1823, he obtained the pure element, by fusing together iron, carbon, and silica (Silicon Dioxide SiO₂). Deville prepared the crystalline variety in 1854, and in 1864 first reduced it by magnesium.

**Occurrence.**

As previously stated, the element does not occur in the free state. Its affinity for oxygen is so great at a high temperature that in early ages, when the earth was a molten mass, the silicon all combined with oxygen to form silicon dioxide (Silica SiO₂), this later uniting with metallic oxides to form silicates.

**Preparation.**

Amorphous Silicon is best prepared by mixing powdered coal with a mixture of powdered and well-dried white sand (SiO₂) and magnesium. This mixture is placed in a test tube and heated with a Bunsen flame. The reaction soon begins with a glowing which quickly extends through the entire mixture.

\[ \text{SiO}_2 + 2 \text{Mg} \rightarrow \text{Si} + 2 \text{MgO} \]

The cooled, hardened product is powdered and then washed with dilute Hydrochloric Acid to remove the magnesium oxide. The product thus obtained is an amorphous, brown powder, which, when heated in air, ignites and burns with the formation of the dioxid SiO₂.

Silicon is insoluble in water and acids, except hydrofluoric, which dissolves it readily.

The crystalline variety is prepared by fusing sodium silico-fluoride with aluminum, or zinc and sodium:

\[ \text{Na}_3 \text{SiF}_6 + 4 \text{Na} \rightarrow 4 \text{NaF} + \text{Si} \]

The liberated silicon dissolves in the fused metal and on cooling crystallizes. The crystals are separated from the mass by treating successively with hydrochloric, boiling nitric, and hydrofluoric acids. Crystalized silicon is also prepared in an electric resistance furnace from pure silica sand and finely pulverized foundry coke.

\[ \text{SiO}_2 + 2 \text{C} \rightarrow \text{Si} + 2 \text{CO} \]

**Properties.**

The silicon of the silico-fluoric process is in the form of hard, brittle crystals, possessing a degree of hardness, sufficient to scratch glass. They withstand white heat without igniting and resist the action of all acids except a mixture of hydrofluoric and nitric, which, when hot, dissolves them slowly.

The silicon product of the electric furnace is in the form of crystalline masses, having a lustre of a dark silver luster. It is quite brittle and melts at 1420°C.


**Fig. 161. Illustrating Various Optical Properties of Glass.**

**Glass.**

What a common substance! Among the many necessities of daily life, few manufactured articles are more important than glass. The importance of this substance will be brought home forcibly when we only mention the sciences of Chemistry and Physics and all branches utilizing the microscope and telescope (see Fig. 161) would probably never have been advanced to their present elevation. Bacteriology and its allied studies would have been unexplored, and as a result the lives of many who have been cured by microscopic examinations and subsequent proper treatment would have been sacrificed. Aside from the fact that it is an everyday necessity, being employed among other equally important uses, as a container for the milk which is delivered in the morning, the glasses used for drinking purposes; in rural districts as chimneys for lamps; and in large cities and dwellings for electric lamp and gas lighting. It would tax the reader too much to even for a moment try to imagine what kind of an existence we would have without our glass windows. It would mean that we would have no use for clocks, as our time would be controlled solely by the sun and moon; which is great if you can such a superstructure as the Woolworth Building, as well as many others, practically a city in itself without windows.

It is true that there may be other substances, but it is hard to conceive of anything which would compare with glass.

What is this substance which we could hardly do without? Generally speaking, it is an amorphous mixture of the silicates of calcium or lead with those of an alkali carbonates or silicates, obtained by fusing sand (Silicon Dioxide), lime or lead oxide with sodium or potassium carbonate. The cheaper grade of glass contains instead of the alkali carbonates a mixture of one of the sulfates and coal dust. Thus the sulfates are reduced to sulfids, which form silicates with the sand. Upon the composition depends the degree of fusibility, hardness and refractive powers of the glass. Thus we must distinguish between the various kinds.

**Fig. 159. The Ingredients Used in Making Glass Are Placed in Refractory Fire Clay Pots. The Glass Is Melted at a Great Heat in a Furnace.**

**Lime (Plate) Glass:** This grade is much cheaper, harder and less fusible than "lead" glass. It is either a soda or potash-lime glass, which is readily fusible, is the common sort, such as is used where cheapness is desirable, such as is used for window glass, plate glass, bottles, etc. The potash-glass, also known as Bohemian and Crown glass, is a silicate of lime and potassium. This kind fuses only at a high temperature, and is harder, and withstands the action of water and acids better than soda-glass. For this reason it is used extensively for the manufacture of chemical glassware, such as test tubes, for highly temperatures without fusing. Potash glass is used for Leyden jars.

**Lead (Flint or Crystal) Glass:** Litharge (PbO) or red lead replaces the calcium oxide of lime glass. This kind is used for cut-ware, optical glass, such as lenses and prisms, being heavy, possessing great luster and brilliancy.

Replacement of a portion of the lead oxide by thallium oxide or boron tri-oxide, causes the refractive property of the glass to be increased considerably. Such a glass is called "strass" and finds use in the manufacture of imitation gems.

The varied colors of glass are obtained by the addition of various metallic oxides or salts. Blue glass is made with cobaltic oxide or copper oxide; Violette glass, by using manganese dioxide; Red by metallic copper

(Continued on page 831)
SECOND PRIZE, $2.00

SIMPLE RECTIFIER MADE FROM POLARIZED RINGER.

The materials required are: a low-resistance polarized telephone bell, two pair of binding posts, preferably rubber-covered, about 3" of 1/8" x 1/16" brass or copper strip, and a plain wooden base, 4" x 3", and two silver dimes.

Remove the gongs from the bell and mount it on the base by means of two oblong blocks of wood, to the ends of which are screwed the attachment lugs on the bell; the blocks in turn being screwed to the base. Bend up 1" of each brass strip. To the upper portion solder half of a dime, previously filed to a smooth surface. Solder the other two halves of the dimes onto opposite sides of the hammer; see sketch for arrangement of parts. These two strips must be held down to the base by a pair of small screws. The two pair of binding posts should be placed at opposite ends of the base. Connect as in wiring diagram.

Simple Rectifier Constructed From Polarized Ringer.

This rectifier will only handle currents from 1 to 9 amperes without dangerously overheating and operates best on 25 cycle frequency. Connect the terminals leading from the coils directly to the 110 volt A. C. current; direct current at about 50 volts D. C. will be obtained at the other terminals, due to auto-transformer action and drop due to resistance of contacts. Lubricate the armature pivots.

Contributed by GEORGE LUNGE.

FIRST PRIZE, $3.00

HOW TO MAKE A TABLE LAMP FROM SHEET METAL.

Cut four pieces of sheet iron, brass or copper, as per Fig. 1, solder together and then cut one piece as in Fig. 3, and fasten to this. Then cut one piece like figure 2, and bend as on dotted lines, making a stand three inches square and twelve inches high. Put this thru the opening in the completed base until it strikes bottom, then solder securely; cut a hole for the cord about one inch from the top of the base.

Next cut one piece (Fig. 6) for socket and solder socket base securely to this, then wire up, putting wire thru base and soldering top on. For the shade holder cut four pieces of 1/4" iron or brass wire and solder as in Fig. 4. For the shade cut four pieces (Fig. 5) and solder; then fasten to holder. You can glue a piece of felt on the bottom of lamp. A ten-cent can of Mission Green enamel will make an attractive color for the lamp, if it is to be used in the deg.

It is a Simple Job to Cut Out the Parts for Making the Table Lamp Here Shown. Copper or Brass Gives a Fine Finish.

The shade may be made quite artistic at small expense by cutting out the side of the shade in some such pattern as shown. These are backed up by pieces of ground glass cut after the pattern of Fig. 5, or figured glass may be purchased reasonably at any fixture shop. If made of brass the lamp may be polished and lacquered or given an oxidized copper finish. Such a lamp will prove very useful in the camp and bungalow.

Contributed by M. F. HOLMES.

THIRD PRIZE, $1.00

HOW TO MAKE A COMBINATION VOLT AND AMMETER.

A combination meter can be made from a burned out or otherwise damaged winding of a volt or ammeter of the permanent-magnet pocket type.

Remove the old winding and rewind with No. 20 silk covered or enameled magnet wire, fastening the negative end to the shell or negative terminal, and the other end to the positive terminal. This is the weak current reading, such as for old cells, coils, etc.

The volt reading is obtained by connecting a resistance (R) of varied size at J, and terminal V, which is tested by a dry cell reading approximately 1½ volts.

The amperes are now read by connecting a piece of No. 22 or 24 copper wire (A.W.) in shunt with the coil at J and a suitable switch, SW, to the case. The proper length may be found by testing with a cell of known amperage.

Contributed by L. W. CAMERON.

This department will award the following monthly prizes: First Prize, $3.00; Second Prize, $2.00; Third Prize, $1.00. The purpose of this department is to stimulate experimenters and for the most useful, practical and original idea submitted to the Editors of this department, a monthly prize of prizes will be awarded. For the best idea a prize of $3.00 is awarded; for the second article need not be very elaborate, and rough sketches are sufficient. We will make the mechanical drawings. Use only one side of sheet.
HOMEMADE PERISCOPE FOR READING TEMPERATURES AND OIL GAUGES.

The submarine commander has found the periscope invaluable for readily locating enemy vessels and obtaining his bearings under war-time conditions, and any electrician or engine room attendant, who has once used one of these home-made periscopes for reading meters, oil gauges or thermometers in inaccessible places, will never be without one. To make one of these periscopes, procure a piece of round or square metal tubing about two inches across. The tube may be of any length desired. Two small mirrors of suitable size are procured at a ten-cent store, and these are placed at an angle of 45 degrees, one at the bottom of the tube and the other at the top of the tube, in the manner shown. The image of the scale is reflected in the top mirror, thence down the tube onto the face of the lower mirror, and then out thru the opening in the tube to the eye. In some cases, these meter-reading periscopes are fitted with flashlight bulb at the top and a push button and battery on the base of the tube suitably secured in place, in order that the gauge may be illuminated.

MAKING FLEXIBLE-CORD COVERS.

Cut a strip of cloth, any kind and any length, half an inch wide, fold it lengthwise as in Fig. 1, with the wrong side out if there is a wrong side, and sew a line of machine stitch down the side as shown. Don't try to sew too near the edge.

Next, run a piece of stout twine thru with a tape needle, as shown in Fig. 2. When thru, gather the upper edge of your cloth tube together, as in Fig. 3, and sew it to the piece of twine. Don't try to tie your twine, as that makes rather too large a knot to start thru easily.

Now hold the other end of the twine in one hand (or if your tube is very long, tie it to a door-knob) and with the other hand work the puckered end down inside, with a motion like pulling on a glove-finger, (Fig. 4). Once started, there is not the slightest difficulty.

Fig. 5 shows the end of the operation, with the completed tube coming thru, right side out, with the seam concealed, and with the extra flap serving to stuff the tube and make it plump and round. The conductor, composed of a dozen braided wires from your old Ford secondary, is run thru with the tape needle, and there you are. Cost per yard, exactly $0.00.

I have a particular affection for this invention because I had a dollar on it once—about the only dollar I ever did wring from Science. The stenographer was aiming to replace a broken belt-loop on her velvetcost, and was stumped to know how the tailor had got the seam inside. Recognizing my old process, I was explaining it to her, when the boss came in and bet me a dollar I couldn't do it. The girl made the tube, I ran the string, manipulated a second, and "Past" thru it went, like a rat two jumps ahead of the feline. The boss handed over his dollar, while the stenographer said something which in polite such cases will be very turbid and in a state resembling fermentation. Contributed by ARTHUR SCHALLER.

NEARLY PERFECT—WHAT 1/1000TH INCH ACCURACY MEANS.

Such is the perfection of modern machinery that 1/1000th of an inch is a large error in metal working, tho a sixty-fourth of an inch was near enough for the craftsman of the years ago. Optical glasses, like lenses and prisms can now be made with surfaces accurate to 1/50,000th of an inch without undue difficulty, and for the most exacting purposes, glass objects can be so worked that it is possible to make a flat or curved surface to an accuracy of one millionth of an inch.

But even such marvelous accuracy as this falls far short of theoretical precision. If the most perfect mirror could be magnified until the molecules became visible, it would appear anything but flat. In fact, when X-rays were discovered this form of radiation appeared not to be subject to regular reflection like a beam of light falling upon a mirror. This has since been found to be due to the fact that the most perfectly polished surface is relatively rough to the exceedingly short waves of X-rays, just as a sheet of paper is rough to ordinary light, and so reflects it diffusely. Contributed by H. J. GRAY.

PREPARATION OF PYROMORPHIC CARBON.

Pyromorphic carbon is a substance which takes fire spontaneously. It is prepared from lead tartrat. To prepare the lead tartrat mix solutions of tartaric acid and lead acetate. Lead tartrat is precipitated. This is filtered, washed and dried in the air. Next an amouple is prepared by drawing out a test tube. (See diagram.) The tartrat is now put in the amouple and heated until no more white fumes are given off. It is then sealed at the constriction before cooling. After it is thoroly cooled and if the tip is broken off the substance when sprinkled out will burst into flame before reaching the floor.

On heating, lead tartrat decomposes, leaving lead and carbon. These are in such a finely divided state that they absorb oxygen—thereby bursting into flame.

LIGHTING A BUNSEN BURNER WITHOUT MATCHES: If a crystal of potassium chlorat is rubbed on the side of a safety match box, tiny sparks of flame will result. This is due to the combustion of the phosphorous on the box with the oxygen of the potassium chlorat. Contributed by JOE BRENNAN.

ANOTHER STORM GLASS OR BAROSCOPE.

Potassium nitrat: . . . . . . Gr. 30
Ammonium chlorid . . . . Gr. 30
Absolute alcohol . . . . Fl. Dr. 6
Alcohol . . . . . . . Fl. Dr. 6

Put the mixture into a bottle 18 inches in length and 1/4 inch in diameter, and cover the mouth with a piece of perforated plaster.

If the weather is to be fair the insoluble matter will settle at the bottom of the tube, while the liquid remains pellucid; but previous to a change for rain, the compound will gradually rise, the fluid remaining transparent. Twenty-four hours before a storm or very high wind the substance will be partly on the surface of the liquid, apparently in the form of a leaf; the fluid in

Contributed by S. GERNSBACH.
of accomplishing this object. Each one of the cells is closed and a vent pipe is connected to its interior, which is arranged to discharge the fluid, and to the outside of the box. An arrangement of inlets and outlets valves and an air pump regulates the discharge of the gases, acid, electrolytes, etc., that may escape from the cells by accident. Also a means of air circulation is provided around and between the cells for regulating the battery temperature.

**Electrolytic Process** (1,282,262; issued to Matthew M. Merritt)

A new improvement in the manufacture of copper or other metallic sheets by electro-deposition on a rotating cathode. By proper control of the proportion of the surface of the cathode which is immersed, to the speed at which the cathode is rotated, the formation of rough deposits on the deposited sheet caused by liberated hydrogen may be reduced to a minimum. Also the burning of the deposits by the use of a high current is also eliminated, while maintaining that rate of deposit which is satisfactory from a high current density. Also the current is automatically balanced by the formation of various oxides, which results from a high amperage during the deposit, may be avoided by the use of an oily or greasy coating over the surface of the mandrel, which is preferably treated with mercury.

**Annaling Metal Wire by Electricity** (1,285,887; issued to Herbert Alexander, Wyndham T. Vint and Arthur Inberry)

Annaling and tempering of traveling steel and other metal wire has, previously been accomplished by its being made to form a part of an electric circuit, the ohmic resistance of the wire with the requisite amount of current flowing automatically producing the desired heat. This invention improves on this process in that it consists of a means for the gradual heating of the wire when first entering the apparatus or after emerging from a cooling bath thereunto, including a mechanism for holding the coils in place. A periodicity of over 25 cycles per second is an advantage in overcoming the tendency to the production of non-electrolytic phenomena which may occur.

**Collapsible Wireless Telegraph Pole** (1,285,940; issued to Leon Chodkowski)

Atta-Boy, Leon. Why didn’t you think of this before the war, you silly fool, I wish I had! That’s thanks to Mr. Roger’s underground radio. A wire-less telegraph pole of the collapsible type for elevating the wireless antenna consists of a semi and inflatable bag adapted for arrangement in pole form, which is inflated and carrying wires near the top. The device is so made as to be readily filled with gas and emptied as desired. A means of carrying the gas in tanks with the signal corp section may be provided for the filling of the bag, or competent air may be used.

**Means for Recording Sounds** (No. 1,286,259, issued to Thomas A. Edison)

This invention relates to an improved method of recording sounds. Its object is the making of small discs for talking pictures. Where only a single horn is used to catch the sound waves a very poor impression is received on the record and many of the sound waves are not caught at all. In this invention the sound waves are collected at a plurality of points which are so separated as to extend over the field of action. It also intensifies the impulses before they reach the recording device. A number of microphones and the receivers are connected in series with the battery and the primaries of the induction coils, corresponding in number to the receivers, are also in series with each other and the microphone upwardly extending arms from the base. The arms are constructed by means of pivots so as to enable the body to swing in any direction of flight the plane might assume. Any shift of this spherical body tends to raise or lower a disc which floats on the surface of the liquid and this shifting disc automatically adjusts the planes and keeps the machine in equilibrium.

**Wireless Apparatus and Method Therefor** (1,279,850; issued to William Dubiler)

The apparatus consists of a simple, light weight electromagnetic vibrator intended to produce oscillations. As a closed circuit condition exists at starting the oscillations, a high primary potential is not necessary, and therefore a direct current source of energy of low voltage is sufficient to operate the apparatus. It operates most efficiently when the period of vibration of the spring of the vibrator is in a selected ratio to the natural frequency of the oscillating circuit; that is to say, when such period of vibration is either equal to or a harmonic of the natural frequency of the oscillating circuit.

**Target Apparatus** (1,286,215; issued to Clarence H. Brainard)

Each plunger is so set in the target that it is immediately absorbers all the kinetic energy of the bullet on impact and then drops the bullet into a receptacle. At the same time the movement of the plunger actuates an indicator by closing a switch arranged in the path of the bullet, and electrically connected in the circuit with one or more annunciators, properly numerated.

**Process and Apparatus for Inducing and Stimulating Rainfall** (1,284,982; issued to John C. Ballestine)

An electric conductor is used to form a path for the flow of energy between earth and clouds. The lower end of such conductor being connected to the earth and the upper end having a terminal of electrically conductive material. To secure effective connection between earth and clouds it is necessary to have the upper terminal consisting of a great number of fine metallic points. For practical purposes the upper terminal consists of a mat or fabric sheet of considerable surface, with a great multiplicity of electrically conductive points, and its area is two to ten square yards.
Our Amateur Laboratory Contest is open to all readers, whether subscribers or not. The photos are judged for best arrangement and efficiency of the apparatus. To increase the interest of this department we make it a rule not to publish photos of apparatus unaccompanied by that of the owner. Dark photos preferred to light-toned ones. We pay $3.00 prize each month for the best photo. Address the Editor, "With the Amateurs" Dept.

"Amateur Electrical Laboratory" Contest

THIS MONTH'S $3.00 PRIZE WINNER — E. J. J. Gobrecht

The accompanying photograph shows the laboratory of this month's prize winner, E. J. J. Gobrecht, who has certainly one of the most interesting that we have had submitted for some time. Everything is systematic, and there is sufficient space to have a place for everything and everything in its place. At the extreme right may be seen an elaborate switchboard containing several knife switches as well as a specially made heavy current rheostat, current meter, switchboard lamp, testing lamps, telephone transmitter, etc. Storage batteries can be charged from this switchboard when desired, and several of them may be seen on the laboratory bench in the background. The table in the foreground contains an electrolytic interrupter operating a spark coil, a pair of home-made Leyden jars and a small Oudin high frequency coil having a primary wound with copper ribbon. Several small dynamos and miscellaneous tuning coils, loose couplers and rheostats are to be seen about the laboratory showing that the owner has been actively interested in the theoretical and practical study of electricity and wireless. The usual collection of "miscellaneous" comprises telephone parts, boxes of screws and nails, wet battery elements, chemicals, etc. A goodly assortment of tools are on hand for the construction of the various apparatus which the author happens to be interested in. Note the beautiful model of a monoplane suspended in front of the central window of the laboratory, also the partly constructed model airplane fuselage on the floor just under the center table. Also do not miss the large sketch of Dr. Nikola Tesla on the rear wall, presumably enlarged and sketched from the supplement given with the "Electrical Experimenter" several years ago. There is a photopath in the laboratory to stimulate ideas at odd moments when the owner's "think tank" goes dry. This is a good specimen of what the average American boy can do in making up an attractive and useful workshop in which to try out his ideas and supplement his theoretical studies with the actual application of the principles involved.—E. J. J. Gobrecht, Hanover, Pa.

HONORABLE MENTION (1 Year's Subscription to the "ELECTRICAL EXPERIMENTER") — WM. H. MOORE

I give herewith contents of my laboratory. Among the usual requisites of such a laboratory there are: 2 K.W. high frequency sentit. 2 Mignon Audion cabinets, 5,000 meter coupler, together with smaller couplers, phones, storage battery and condensers. I also have a motor-generator set with which I charge my own and other batteries. The chemical division I think is fairly complete. It contains a retort, pipettes, a burette, flasks, beakers and all reagents necessary for any ordinary experiment or analysis.—also tripod, ring stand, porcelain crucible, evaporating dishes, mortar and pestle, U-tube, drying tubes, conical and cylindrical graduated, hydrometers, balance, etc. The electrical division contains among other things, a motor, audions, generators, etc., also an arc, light, resistance, storage, transformer, telephone transmitter and that inevitable collection of miscellaneous articles commonly known to the profession as "junk." I also have a set of Marconi-Victor Code Records and receive at a speed of from 15 to 20 words per minute.—Wm. H. Moore, Charleston, W. Va.
A QUEER man you will find him, Captain A. J. Stokes, deep and studious, yet a man of the world of sport and levity. He has nosed into every port in the seven seas and has seen the Amazon River looking east. It is needless to say he is independ-

“I have smoked a carload of Havanas over this subject”—he lit a cigar and lollled back in his chair—“from books and men I have gained some certain amount of knowledge concerning our ‘Juice’.

“Way back in the dawn of History, when the dim diffused light of the dawning day of experience made its vague appearance thru the hydrous canopy that surrounded our terrestrial abode, the unknown force manifested itself before unseeing eyes. According to some authorities, we are not informed of any observations until a Thales of Mileitus, only six hundred years before Christ, carved his discoveries of the funny things that amber would do when rubbed.

“Also a bird by the name of Theophrastus, who seemed to be an authority on gems, noted that when he shined some of his sparklers on his pant—(oh, excuse me! That duck wore a tablecloth) that the said sparkler would attract small objects like pins in balls and dust from his culinary garb. Besides Thales and Rastus and a very few other guys who were ‘on’, old Jope himself made the rith halls animated by the frictional performance engendered by lightning.

“That meant to her no more nor less than AIBERT! Here she would probably jerk an amber dodangle from her enchanting locks and sneer, ‘How could this sting me here!’ clapping her jeweled digits on an also jeweled hip, ‘You are dismiss from court. Lack of evidence! Whereupon you would be forced to consider yourself at bay. That was a way Cleo had about her—right or wrong.

“Nevertheless you would be right and Galvani would not be as skeptical as the Queen. No doubt, he would shuffle it whole and believe you outright. Then he would more than likely demonstrate his recent discoveries on the freshly murdered frogs and calves. Of course, the Bologna physician was deluded. We all know that a Prof. from the Pavian University had to set the popular right after Doc’s assertion

(Continued on page 812)

“Andy Ampere, Whom Thanks Are Due for Such Latter-day Questions as: ‘How Many Amperes Has a Volt?’”

“Mike Faraday, Who Successfully ‘Vamped’ Dame Electra Out of a Batch of Her Darkest Secrets.”

“Funny it took so long from Creation before the old timers ‘got hip’ to those primary examples, isn’t it? But I suppose that is what the bunch that will be here years anon will say of we present moderns.

“Of course Cleopatra must have drawn sparks from the red nose of some enamored Gaul when she shuffled across the Persian rug and did a Can-can before the Hun’s grandad, some spotty morning on a winter visit up in Gallia. We know that it was static electricity, but the Egyptian Boss didn’t. Neither did the Dutchman. As for that bird—it probably struck him as a severe charm of his friend, Miss Ptolemy, esq. Had you been there and slip her the info that we have christened ‘Electricity’ that caused the prickling spark to play between Her Royal Iluim and Dutch’s crimson lock, she would have looked at you as foolishly as could have been possible for such a sagacious female as the daughter of the Nile to look, and perhaps confess that you were talking rag-time to her. She might proffer the chatter, were she in the mood, that as near ‘Electricity’ as she could come was the Greek noun wëptor and the Latin Electrum, and

“Prof. Volta of WET Battery Fame. This Bird Would Have Invented a DRY Battery Sure as Nails, Even if He Had Lived in ‘Bone-dry’ America.”

“Benny Franklin, the Lightning-rod Kid,” essentially wealthy. Yet it is evident that he has a speaking acquaintance with the more serious things of life, and has thumbed the pages of History and Science in his speedy course of life.

-To-night he sat across the fireside from me at the club. In his hand he held a copy of a current electrical periodical. Seeing this, I ventured to ask, “What have you framed up in your noggin as being the right dope on the origin, use, nature and future of Electricity?”

He looked over at me and smiled a quaint smile. “That was just the sort of thing I was thinking of, the nature and future of the something we are wont to call ‘Electricity’—but how happened you to ask? “Oh, I don’t know,” I replied. “I was just wondering about it myself—and I just wondered what you entertained as to it.”

“This Tiled Roof—the Hon. W. Gilbert—is Guilty of the Term ‘Electricity’.”
The "Oracle" is for the sole benefit of all electrical experimenters. Questions will be answered here for the benefit of all, but only matter of sufficient interest will be published. Rules under which questions will be answered:

1. Only three questions can be submitted to be answered.
2. Only one side of each question to be written on; matter must be typewritten or else written in ink, no penciled matter accepted.
3. Diagrams, etc., must be on separate sheets. Questions addresst to this department cannot be answered by mail free of charge. A nominal charge of 25 cents is made for each question. If the questions entail considerable research work or intricate calculations a special rate will be charged. Correspondents will be informed as to the fee before such questions are answered.

COLLINS-SANCHEZ HIGH FREQUENCY 3-INCH SPARK APPARATUS.

(983) George Litty, West Phila., Pa., inquires:

Q. In the November, 1915, issue of the Electrical Experimenter you publish an article on "High Frequency Currents and Apparatus," by H. Winfield Secor. Fig. 2 shows the circuit of a Collins-Sanchez high frequency circuit. I would like to have the following questions answered in the "Oracle".

1. The resistance of the magnat coil and how to construct it.

10,000 METER LOOSE COUPLER.

(984) Paul H. Gelser, Roseville, P. T., Cal., writes for data on a 10,000 meter loose coupler.

A. I. We give below data regarding the construction of a loose coupler for 10,000 meters:

Primary, 8 x 1/2" wound full No. 24 s.c.c. wire.

ODD PHOTOS WANTED AT $1.00 EACH!!

Now is the time to make your Kodak pay for itself in a real practical way. We are interested in photographs of radioing-the-ordinary electrical, radio and scientific subjects and are willing to pay $1.00 cash for every one we can use. Please have the photographs well reproduced in a magazine, a photograph should be particularly sharp and clear. Of course, if a subject happens to interest us particularly well, we can have the photo retouched. For the general run of subjects, however, it does not pay to go to such expense. Therefore, please take pains to properly focus and expose your pictures. It often happens that a really mediocre subject will photograph well and cause approval on an excellent subject poorly photographed. And don't send us plate film "reproduced", send unmounted or mounted "prints", preferably a light and dark one.

As to what to photograph: Well, that's hard for us to say. We leave that up to you, and every reader now has the opportunity to become a reformer of the latest delinquent in the realm of Electricity, Radio and Science. But, please remember—it's the "odd, novel or practical shots" that we are interested in. Every photo submitted should be accompanied by a brief description of 100 to 150 words. Give the "facts" don't worry about the style. We'll attend to that. Enclose stamps if photos are to be returned and place a piece of cardboard in the envelope with them to prevent mutilation. Look around your town and see what you can find that's interesting.

Address photos to—Editor "Odd Photos", Electrical Experimenter, 233 Fulton Street, New York City.

LOW VOLTAGE, HIGH AMPERAGE DYNAMO BRUSHES.

(986) John Voorhees, Jr., Kennett Square, Pa., says:

Q. I have a low voltage, high amperage dynamo fitted with copper leaf brushes. How can I apply carbon brushes?

A. 1. Concerning the replacement of the copper leaf brushes on your small dynamo by carbon or woven wire brushes, the appended diagram, we believe, will cover your requirements very nicely. Many of these small dynamos are successfully changed over in this way. The brush holders being either of the round or square pattern, should be clamped or some way secured to the brush holder studs on your present rocker arm. You can obtain the round type brass brush holders complete with springs and brushes from any electrical repair shop or electric fan dealer.

NITROGEN RADIATOR FOR ELECTRIC HEATING.

(985) Harry B. Genders, Wednesbury, England, asks the Oracle Department: Q. 1. I would like to know if you would give me a few particulars regarding the Portable Electric Nitrogen Radiator, as described on page 464 of November, 1918, issue of "E.E." I presume the radiator is simply filled with nitrogen at ordinary atmospheric pressure. I should like to know if an ordinary hot water radiator could be converted to one of the above type? Also would it do if simply filled with air at atmospheric pressure? I suppose the efficiency would not be as great as with nitrogen filling.

A. 1. With reference to converting an ordinary hot water radiator to an electrically heated type, most probably with a little ingenuity you could do this, but, of course, it will not be as efficient as the nitrogen filled radiator. There are several electrical radiators on the market on the principle of the simple form as you suggest, i.e., comprising nothing more than a suitably protected and insulated electrical heating element, which is caused to either heat up water with which the radiator is filled, or in some other way to produce heat in the ordinary manner.

This High Frequency Coil Operates on 110 Volts A.C. or D.C. It Produces a 3" Flaming High Frequency Spark. The Interrupter Coil Has an Iron Wire Core 3/4 Diameter by 3 1/2 Long, Wound with a Coil 2 1/2" Long of No. 28 D.C. Magnétique Wire. Outer Diameter of Coil 1 3/4". Vibrator Fitted with 1/2 Diameter Silver Contacts. Condenser Sheets of Tinfoil 2 1/4 x 3 1/2. Placed Between Mic'a Sheets 6 Mils Thick and Measuring 3" by 4 1/4".

(2) The capacity of the condenser.
(3) The size of the condenser.

A. 1. We give herewith diagram of the Collins-Sanchez high frequency apparatus, including the dimensions of the interrupter magnetic, the condenser, and the proportions of the Oudin high frequency coil, the latter being best encased in a wax mould thoroly surrounding it.

Secondary, 7/8 x 1 1/2" wound full No. 30 s.c.c. wire for crystal detector.

For use with audion, wind full with one layer of No. 34 s.c.c. wire.

Proper Setting of Carbon Brushes on Low Voltage Dynamo. These Replacing Flat Copper Brushes Which Did Not Prove Satisfactory.

When the round type of brushes are used (Continued on page 802)
FREE Test Lesson In Draftsmanship

Send for this free lesson which explains the Chicago “Tech” method of teaching Draftsmanship by mail. Positions at big salaries are now waiting for competent men. Even draftsmen of limited training and experience are snapped up and paid good salaries. If you are dissatisfied with your opportunities, learn Draftsmanship. Chicago “Tech” will train you in the most practical way in the shortest time. Mail the coupon today and let us tell you about the Chicago “Tech” method. The free lesson will show you how well equipped you are to follow Draftsmanship. Enroll in the course only if you decide that you can take it up to advantage. No cost, no obligation on you to make this investigation. Send the coupon.

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Draftsmen always command good salaries. And now when American industries are to be called upon to meet vast foreign and increased domestic demands, the opportunities are greater than ever. This is the time for you to prepare for a better position—a higher salary.

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Hold your present position while training. Our experts will instruct you by mail. Only your spare time is required. You are directly under practical draftsmen and engineers. You are taught exactly the work required in the drafting rooms of big concerns. No time put in on unnecessary studies. This means thorough instruction and early graduation.

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Every student of the Chicago “Tech” mail course in Draftsmanship receives this set of instruments, or a cash credit in case he already has a set. These instruments are of the same make and sizes as are used by high salaried experts in drafting rooms of factories, shops, railroads, etc. You use them while learning—then take them right into your practical work.

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A complete instruction in auto repair work. Realize you for high pay or to plant a business, and ascend to the very top. Practical pointers make up a career which will keep you in demand and make you safe.

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FREE $20 Violin, Hawaiian Guitar, Ukulele, Guitar, Mandoline, Coronet or Banjo

Wonderful new system of teaching note music must be seen. To fruit quickly in each locality, we give a free expert teacher, Mandolino, banjo, violin or Hawaiian guitar. Very small charge for lessons only, you receive immediate access to original methods. Write for our free book, "The Choraleon School Music, Book". Chicago, Illinois.

ELECTRICAL

THE ORACLE.

(Continued from page 800)

A sufficient number of these should be employed to take care of the comparatively heavy current of these low voltage machines. Sometimes two or three can be placed in a row on most of the small commutators. Also a very good brush for this machine, and one of the very best that the Editor of this Department has come in contact with his extensive motor repair experience, is that having a special grattie-carbon brush body about 1/2" wide by 3/8" thick, with a woven wire core or center.

WINDBINGS FOR SMALL A. C.

WE wish to introduce to the public the new Sonora Needle, and we are confident that it will be a great improvement in the Arena. We have been using them for some time, and have found them very satisfactory.

Sonora Semi-Permanent Silvered NEEDLES

Replace steel needles! They play 50 to 100 times longer than steel. Use Sonora Needles for lower tone, greater economy, convenience and for longer record life.

Load-Medium-Soft
30c. per card of 5
All other sizes.

Sonora Phonograph Sales Company, Inc.
GEORGE E. BURBRECHT, President
270 Broadway, Dept. 6, New York

CAUTION: Be sure that the needle is properly inserted into the needle seat.

ELECTRICAL EXPERIMENTER

March, 1919

WINDINGS FOR SMALL A. C. INDUCTION MOTOR.

(987) Harry Ostness, River Falls, Wis., asks:

Q. 1. The diagram herewith shows an induction motor which I wish to wind so as to operate satisfactorily on 110 volts, 60 cycles, A. C. Can you give me data for starting and running coils?

A. With regard to your query concerning the rewinding of a small 12 pole A. C. induction motor, we are pleased to give you the following suggestions on your problem:

To start with you might try winding each of the stator poles with a coil composed of four layers of No. 20 D. C. C. magnet wire. These coils are best wound on a form in a small winding jig or in the lathe, and tied by means of four springs, one in each corner of the form so as to hold the coil in shape. In repair shop practice, these coils are sometimes wound on a form in the manner mentioned, and afterward taped with white cotton or linen tape, using narrow tape in this instance. Only a wide tape can be obtained, then this should be split. The coils may be given a coat of black asphaltum, but in most cases a piece of felt paper is wound around the pole-piece and the coil placed over this, and after all the coils are in place, the windings are treated with a liberal coat of orange shellac. All of these running coils should be connected to give alternate north and south poles.

Regarding the starting coils, these may be composed of about 20 turns of No. 26 D. C. C. magnet wire, wound on a form so as to slip over one side of the pole-face. The coils are placed in series in turn to give alternate north and south poles. It may be said that the running coils and the starting coils are wound on the two circuits; the starting coils being invariably provided with an automatic centrifugal switch mounted on the shaft of the motor so as to open the circuit as soon as the motor has attained synchronous speed.

In this connection, we believe you will do very well to try the copper or brass shading plates which are also extensively employed. These are used on a number of the commercial A. C. induction motors below 1/4 h. p. in size. They are about 3/8" thick and have a slot in them so as to fit over the half projection of the pole shoe. One or two laminations on either side of the pole shoe are then bent over and hammered down to retain the plate in position. The rotor will revolve in the direction of the plates; to reverse the direction of the rotor, the plates should be placed on the other half-projection of the pole shoe so as to face in the opposite direction, or else the stator frame should be reversed in position. All of the shading plates, of course, must be placed on the same relative side of the stator poles in any case. To reverse the direction of a motor supplied with a starting winding instead of shading plates, the leads connecting this circuit to the 110 volt supply are reversed.

THE ARMSTRONG AUDION CIRCUIT.

(988) John M. Burrell, Pittsburgh, Pa., asks:

Q. 1. Data on condensers, inductances, etc., for the "Armstrong" regenerative audion circuit.

A. Herewith is a typical Armstrong regenerative receiving circuit. As all dimensions are given in the diagram, we deem it unnecessary to go into further details.

![Diagram of Armstrong Regenerative Audion Circuit](image)

**ARC WELDING QUERIES.**

(989) Wm. S., Torrington, Conn., writes:

Q. 1. Can arc welding be done with regular city lighting circuits? If yes, A. C. rectified to D. C.? Would common iron wire resistance be sufficient or would a special low voltage transformer be necessary?

Q. 2. Can oxygen be produced by the electrolysis of water by 110 volt D. C.? Would a solution of acid be necessary to act as a conductor of the current? Is it possible to use for welding, brazing or burning out carbon in motors? Could any useful amount of oxygen be obtained?

A. 1. Concerning arc welding you will find very valuable information on this work contained in a recent paper by Mr. Horner in the Electric Welding of Steel ships read before the Philadelphia Section of the American Institute of Electrical Engineers. Copy of this paper can be obtained by mentioning the subject and the author's name to the Secretary, Mr. F. L. Hutchinson, A. I. E. E., 33 W. 39th Street, New York City.

Also you will find a very good article on this subject in the December issue of the Electrical Experimenter. A typical arc welding outfit is illustrated and described therein, including A. C. motor and D. C.

(Continued on page 804)
“Humanize”
Your Talking Machine

If you have been using an ordinary reproducer on your phonograph or talking machine, you have been missing the real music. You have failed to hear the beautiful overtones which musicians listen for—you have heard but a poor imitation of the composition as originally played or sung by the artist. The true tone coloring is not—can not be—faithfully reproduced by ordinary reproducers.

It took ten years of hard study and constant experimenting to develop and perfect the one reproducer that does faithfully bring to life all there is in the record. It is called the

Ellis “Music-Master” Reproducer

Now being used by thousands of music-lover owners of talking machines—and every one of them enthusiastic in praise of its wonderful merits

Below we reproduce just a few of the thousands of unsolicited testimonial letters we have received. Read them—they are more convincing than anything we could tell you.

What Satisfied Users Say

MR. J. H. ELLIS,
Milwaukee, Wis.

My Dear Mr. Ellis—
It is delightful to listen to records played with your “Music-Master” Reproducer; it brings out certain niceties and details I had decided could not be recorded or else reproduced.

Your reproducer certainly is a marvel.

Last week when Galli Curci sang here with the Chicago Opera Company it was necessary for me to explain to one of my advanced students that it was not Galli Curci, in person, singing in your laboratory next to our “Studios” but one of her records played with your “Music Master” reproducer.

This proves that the little invention speaks for itself which should be very gratifying to you.
Wishing you success, I remain,
Very truly yours,

FLEETWOOD A. DIEFFENTHAELER, Director.

A Chicago customer says—
“Your latest Ellis “Music-Master” Reproducer reached me several days ago and I have tried it out in every shape and form and it is simply a revelation, a wonder, a thing of beauty and a joy forever. I am delighted beyond my fondest dreams. I tried one of Caruso’s hardest records with the loud steel needle, also my hardest band records and never a blue or discordant note.

“I spend my spare time enjoying the marvels of the “Music-Master” and the harder I try it the harder it is to stop. We have never enjoyed our records as completely.”

One enthusiastic user says—
“There is more music in my records than I imagined possible until I discovered it by means of your Reproducer.”

Another user says—
“The “Music Master” Reproducer brings out the musical and tone coloring true to Life.”

And another—
“The reproduction of the human voice is wonderful and the rendition of violin as true to the artist’s performance as when making the record even to the down touch of the bow.”

Still another says—
“I would not sell my Ellis “Music-Master” for a thousand dollars unless I first get another equally good.”

J. H. ELLIS, Patentee and Manufacturer
P. O. Box 882 MILWAUKEE, WIS.

You must hear the “Music-Master” to appreciate its great merit

Words cannot convey to you an adequate idea of how much this wonderful little device will do to improve the playing of records. You must see it—hear it—compare the effect with any and all other reproducers you know of, then you will understand why every music-lover owner of a phonograph who hears the “Music-Master” Reproducer wants to own one.

For all machines—
Plays all Records

No matter what style, size or make of talking machine you have, if it uses disc records you can use the Ellis “Music-Master” and enjoy the real music. The “Music-Master” is easily put on any machine—it does not harm the records; in fact it prolongs their life, because it is much lighter in weight than other reproducers.

Write Today for Full Details

Fill out and mail the coupon below. If you will also enclose 5c in stamps, I will send you a valuable little booklet entitled “Pointers on the Care of Talking Machines and Records.” But, send the coupon for full details about the “Music-Master” Reproducer whether or not you wish the booklet.

MAIL THIS COUPON NOW!

J. H. ELLIS,
P. O. Box 882, Milwaukee, Wis.

☐ Please send me full information about the Ellis “Music-Master” Reproducer.

☐ I enclose 5c in stamps. Please send me your booklet “Pointers on the care of Talking Machines and Records.”

Name
Address
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You benefit by mentioning the "Electrical Experimentor" when writing to advertisers.
ELECTRICAL EXPERIMENTER

THE ORACLE.
(Continued from page 802)


A handy pocket manual primarily intended for the use of Wireless Operators, but equally valuable to the perennial student. It thoroughly handles Marconi equipment and as such serves its purpose admirably. Large, clear diagrams covered in many other previous works on this subject so that the operator has nothing to do but to glance at the diagrams to have an idea of the ground covered. General information, principles, etc., are also treated, as well as making the apparatus, inspections, etc. Preparing installations for laying up, transmitting apparatus, marine switching and cable connections, rectifiers, converters, keys, transmitters, condensers, disc distributors, receiving apparatus, the care of the same, both the replacing of parts, the aerial and its fittings, the file, the diode, etc., are treated.

A very complete chapter on the storage battery is included, which explains how to take care of the battery while in actual use, also some remarks on how long it can be kept in storage without being out of service for any length of time. A brief concluding chapter treats of the Marconi wavemeter and its addition to the measurements aboard ship, such as the wave length of the transmitted and incoming wave lengths.

This book is very brief in its explanations and presupposes only a very slight previous knowledge of the theory of radio circuits and apparatus. Similar books have appeared on this side of the Atlantic which have been much broader in scope so far as wave length and ship radio equipment is concerned at any rate.

MODERN WIRING DIAGRAMS AND DESCRIPTIONS, by electrical workers, by Horstmann & Touseley. 298 pages, 207 illustrations, size 6¼ x 4½ inches. Cloth bound $1.00, leather bound $1.50. Published by Frederick J. Drake & Company, Chicago, Ill.

This work forms a tried and true friend of the electrician and wiring professor. It contains two hundred diagrams of electrical apparatus covering every conceivable device with which the every-day electrician is called upon to work. Diagrams and connection for various switches and telephone circuits, including the inter-communicating system so widely used in offices. One section deals with connections of telegraph instruments, especially the United States patent telegraph. Another section on the connections for electrical writing instruments made in America and Great Britain in conjunction with the connections of X-ray and gas lighting apparatus, primarily that used in telephone offices. Here are located faults on circuits, electric lighting, and a host of other connections for two- and three-way switching, house and office building wiring, etc.

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### Experimental Physics

(Continued from page 285)

**Experiment 110.**

In conducting experiments with the electroscope all parts except the gold leaf system should be grounded; since any part insulated is likely to become charged slightly and owing to the extreme sensitivity of the instrument the gold leaf system would thereby be disturbed.

We will now proceed with the fundamental experiment of charging and discharging the electroscope. Rub an electroscope rod or ordinary fountain pen with cat's fur or flannel or your coat sleeve (or a glass rod with silk.) Bring this charged rod in contact with bent rod B, at same time turning B so that it touches the rod G. Now by means of the charged rod charged charge will travel thru the conductor B to G and therefore G and the gold leaf, having the same charge, will repel each other. Since the rod G is rigidly fastened and the leaf H is not, H will spring away from G. Now by means of the charged rod bend rod C away to position of figure 99-B. Since G and H are insulated from the rest of the electroscope the charge cannot leave and the electroscope is now charged. To discharge touch the finger to the bent rod and bring the rod into contact with the gold leaf system H-G. The charge will pass to the finger and thru the body to the earth.

**Experiment 111.**

After the electroscope has been charged and allowed to stand awhile we find that it loses its charge slowly but surely. The rate at which the charge is lost, is called the natural leak of the electroscope. To measure the natural leak, set up a telescope pointing at the window of the electroscope, as in figure 100-A. A paper scale may be attached in the electroscope behind the gold leaf system so that the field of view of the telescope will appear as in figure 100-B. Take readings of the telescope at equal intervals of time and the average will give a good approximation of the natural leak.

**Experiment 112.**

We cannot determine the presence of radio-active substances in a compound or mixture by chemical means, because these substances are found in such small quantities. We may, however, detect their presence as Becquerel did by the use of the photographic plate or by the use of the electroscope, by which method Madame Curie discovered Radium. (See Experiment No. 108). Let us recall the passage of electricity thru a liquid. The liquid ionizes and we call it an Electrolyte. In a similar manner, a gas ionizes, the velocity of the ions in the gas being tremendously greater than that of the ions in the electrolyte. This explains the natural leak of the electroscope, i.e., the air is somewhat ionized, depending upon atmospheric and other conditions.

Place the electroscope near the stove or radiator. We find that the natural leak of the electroscope is the same, i.e., heat does not cause any additional ionization of the air. If however a Bunsen flame is placed

---

**TABLE 102.**

**Uranium-Radium Series.**

<table>
<thead>
<tr>
<th>Substance</th>
<th>Kind of Radiation</th>
<th>Period of Half Decay</th>
</tr>
</thead>
<tbody>
<tr>
<td>Uranium (U)</td>
<td>α</td>
<td>5,000,000,000 years</td>
</tr>
<tr>
<td>Uranium 2</td>
<td>α</td>
<td>200,000 years</td>
</tr>
<tr>
<td>Uranium 3</td>
<td>β, γ</td>
<td>24 1/2 B. years</td>
</tr>
<tr>
<td>Uranium 4</td>
<td>α, β, γ</td>
<td>200,000 years</td>
</tr>
<tr>
<td>Uranium 5</td>
<td>β, γ</td>
<td>2,000 years</td>
</tr>
<tr>
<td>Uranium 6</td>
<td>α, β, γ</td>
<td>3 1/2 days</td>
</tr>
<tr>
<td>Uranium 7</td>
<td>β, γ</td>
<td>26 1/4 minutes</td>
</tr>
<tr>
<td>Uranium 8</td>
<td>α, β</td>
<td>1 1/2 minutes</td>
</tr>
<tr>
<td>Uranium 9</td>
<td>β</td>
<td>16 1/2 years</td>
</tr>
<tr>
<td>Uranium 10</td>
<td>α</td>
<td>130 days</td>
</tr>
<tr>
<td>Thorium (Th)</td>
<td>α</td>
<td>13,000,000,000 years</td>
</tr>
<tr>
<td>Thorium 1</td>
<td>rayless</td>
<td>94 years</td>
</tr>
<tr>
<td>Thorium 2</td>
<td>β, γ</td>
<td>94 years</td>
</tr>
<tr>
<td>Thorium 3</td>
<td>α</td>
<td>73 days</td>
</tr>
<tr>
<td>Thorium 4</td>
<td>α</td>
<td>31/2 days</td>
</tr>
<tr>
<td>Thorium 5</td>
<td>β, γ</td>
<td>60 years</td>
</tr>
<tr>
<td>Thorium 6</td>
<td>α, β</td>
<td>Very short</td>
</tr>
</tbody>
</table>

**Thorium Series.**

<table>
<thead>
<tr>
<th>Substances</th>
<th>Period of Half Decay</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thorium 1</td>
<td>94 years</td>
</tr>
<tr>
<td>Thorium 2</td>
<td>94 years</td>
</tr>
<tr>
<td>Thorium 3</td>
<td>73 days</td>
</tr>
<tr>
<td>Thorium 4</td>
<td>31/2 days</td>
</tr>
<tr>
<td>Thorium 5</td>
<td>60 years</td>
</tr>
<tr>
<td>Thorium 6</td>
<td>Very short</td>
</tr>
</tbody>
</table>

**Actinium Series.**

<table>
<thead>
<tr>
<th>Actinium</th>
<th>Period of Half Decay</th>
</tr>
</thead>
<tbody>
<tr>
<td>Actinium</td>
<td>Rayless</td>
</tr>
<tr>
<td>Actinium</td>
<td>α, β, γ</td>
</tr>
<tr>
<td>Actinium</td>
<td>31/2 days</td>
</tr>
<tr>
<td>Actinium</td>
<td>60 minutes</td>
</tr>
<tr>
<td>Actinium</td>
<td>Very short</td>
</tr>
<tr>
<td>Actinium</td>
<td>31/2 days</td>
</tr>
</tbody>
</table>

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Let the I. C. S. help you. Choose the work you like best in the coupon below, then mark and mail it today. This does not obligate you in the least, and will bring you information that will start you on a successful career.

(Continued from page 806)

EXPERIMENTAL PHYSICS.

near the electroscope, we find that the electroscope discharges rapidly. The Bunsen flame ionizes the air very rapidly. A small quantity of radium must still discharge the electroscope very rapidly, showing that radio-active materials have the ability to ionize the air. The larger the amount of radio-active material the faster the rate of discharge of the electroscope. A pinch of Uranium Oxid in the electroscope chamber, will ionize the air so rapidly that the leaf will fall practically instantaneously.

Experiment 113.

A third test of the presence of most radio-active substances is the "Fluorescence Effect"—which some of them have upon certain compounds, especially Zinc Sulphide. And of the various compounds given off as alpha radiations (see figure 102) will cause a zinc sulphide screen to fluoresce. If the screen is observed through a sufficiently high-power magnifying lens, or microscope (say ten or fifteen diameters magnification), the continuous soft glow of the zinc sulphide by the eye becomes, on magnification, hundreds of tiny flashes of light, not unlike the sparks obtained by striking a zinc sulphide screen. Figure 101 shows the Spinthariteoscope, which can be easily made by the reader. A is small metal tube with a hole, S, in its cap. E and F are the lenses of the fluorescent screen on the cap of tube B. D is a small particle of the radio-active substance. A practical use of the fluorescent effect of alpha particles is familiar to all of us in the radium paint, luminous dials, etc. These compounds consist of specially prepared zinc sulphide mixed with about 2000 parts of radium bromide, or a radio-active compound having an equivalent of alpha-ray activity. Alto the period of half decay of radium is nearly 20,000 years, see table 102, the luminosity of the compound falls off, due to the fact that the zinc sulphide loses its power to luminesce, but not because it has become radioactive. Some specifications for luminous paint, as for government work, stipulate that the zinc sulphide and radio-active substance be mixed in such proportions that the average useful life of the paint will be from 8 to 10 years.

The discovery of radio-activity has given us a vast field for research and as a result the physicist has been able to make substantial progress in his investigations by exploding and out as fragments, the alpha and beta particles. Alto the energy liberated by these explosions is far higher. The most weight of the radio-active substance has been detected after the liberation of the energy. J. J. Thomson computed that the disintegration of one gram of radium would liberate sufficient energy to raise a million tons 300 feet. See Fig. 103. If only this energy could be trapped, and research shows the possibility of it, Garfield and his coal-house gang would lose their job, for who would use ten tons of coal when one gram of radium would supply the equivalent heating table. Value 102 gives interesting data concerning the radio-active substances. Table 102 gives interesting data concerning the radio-active substances. The first row contains the name of each substance. The second column gives the second on disintegration and the second, etc. The second column gives the kind of radiation given off by the respective substances, the third column tells how long it takes for the substance to disintegrate to half of the original amount. This half-period means the time after which, one-half of the substance in question will have disintegrated. After 400,000 years, one-half of the remainder, or disappeared, etc. The total life of pure Nudium is computed from this law to be 22,000 years.

(Experiments continued)

HISTORIC ELECTRIC SWITCH-BOARD AND DYNAMO.

(Continued from page 778)

field magnet type with surface wound armatures. There are quite a number of these generators still in existence in various parts of the country, and as the designer, it should be said that they perform their duty very well indeed, considering the time at which they were built, for thirty to thirty-five years in the electrical industry, we might almost say, witness the entire development of the whole scheme of electrical generating plants. The advantages of utilization of power, under the directorship of such men as Edison, Thomson, Houston, Tesla, Westinghouse and Sprague.

The modern switch-board shown in the photograph, contains four box-type field rheostats, and it is peculiar to note that they are mounted on the face of the board instead of in the rear, as in present day practise.—Photo by Richard Nelson.

THE TESLA EGG OF COLUMBUS.

(Continued from page 775)

Tesla had other surprises for his audiences, which were even more wonderful. So, for instance, on holography, the glass, in the foreground, was used to operate wireless motors, lamps and other devices, and, in the background, he showed a wonderful installation of very high potential phenomena, as streamers of great length.

ULTRAVIOLET ENERGY AND ITS USE.

By M. Luckich, Physicist, Nela Research Laboratory.

Since the discovery of ultraviolet rays, more than a century has passed, and the laws and properties have been subjected to a great deal of investigation. However, notwithstanding the extensive literature on the subject, the investigator of the Author, who says in his book on Photo-chemistry: "We are only at the beginning of the consequence of the radiation of the light, as distinct from the unconscious enjoyment of them."

Owing to the many unique properties of ultraviolet rays, they are valuable in certain scientific investigations, tests, and industrial processes, and it appears certain, that with the progress of the science, and the knowledge and of media transparent to the, the usefulness of ultraviolet energy will be rapidly extended. The problems in which these unique properties may be utilized are manifold.

As to Sources:—There are many sources of ultraviolet energy, but few are powerful enough to be widely useful. The ideal source, which emits a continuous non-banded spectrum of high intensity through the entire ultraviolet region does not exist. Some of the sources are here ranked in order: magnetite arc, old mercury arc, new mercury arc, and carbon arc.

The blue flame arc emits ultraviolet energy very strongly. It is a simple matter to construct an arc which will emit ultraviolet energy strong enough for control is satisfactory. An iron rod and a carbon rod may be employed successfully for these poles. Iron and carbon rods may answer the purpose very well. These poles may be kept cool effectively by means of heavy brass or copper sleeves, which may be wound around the iron rods as the latter are consumed.

Uses of Ultraviolet Rays:—Irradiation of air: powerful bacteriical agent, kill germs in the air, effective in preventing the growth of germs to control the utilizations, and to brine the skin. In industrial processes such as acetylene and arc welding, which are attended by powerful ultraviolet energy, there is a demand for eye-protecting glasses.
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The Paragon Alphabet:

Twenty-six simple word-signs:

<table>
<thead>
<tr>
<th>Six prefix contractions:</th>
</tr>
</thead>
<tbody>
<tr>
<td>One general rule for abbreviations:</td>
</tr>
</tbody>
</table>

THAT IS ALL. The simple explanations and exercises are divided into seven lessons, the principles of which one can grasp in one evening.

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Take the ordinary longhand letter: D

Eliminate everything but the long downstroke and you will have the Paragon symbol for D. It always writes downwards.

From the longhand letter D rub out everything except the upper part—just like—with the Paragon symbol for D. Write this circle at the beginning of each word and you will have the Paragon symbol for D.

By letting the circle remain open it will be 0, and this hook stands for 0. Write another A at the end of your line and you will have a girl's name, Ada.

From these four symbols you can write the initial and final strokes and O will remain which is the Paragon symbol for O.

For the shorthand-who-which is made it 7 strokes, you use this one horizontal stroke:

Therefore, would be Me:

Now add the E on the M, see how D and you will have Med. Now add the large circle 0, as you have Med. and you will have Med., which is een. Again use the A and W.

Now you have 5 of the characters. There are an additional 12. These are simple word-signs, six prefix contractions and one general rule for abbreviations. That is all.

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Paragon is used in the offices of the largest firms and corporations in the world such as Standard Oil Company, United States Steel Corporation and the great Railway Systems.

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Business

Address

Electrical Experimenter 5-19
SORTING TOBACCO LEAVES BY ELECTRICITY.

(Continued from page 770)

duplicate of the first section, except that where a permanent step is provided in the path of movement, to prevent any leaf from returning to the starting point, but deposit it in the box provided for the longest leaves.

All boxes, ten at each side of the machine, are standing on a kind of steps, so that each one is, according to the inclination of the covers, a little below the foregoing one. As the machine is but a duplicate, the device being a double action machine, there are ten boxes for ten different sizes of leaves at each side, or 20 boxes altogether.

The contact segments on the table are movable, and the machine can thus be so finely adjusted that it will not only measure and sort the leaves, but require, but even up to a quarter of an inch if so desired. The machine is driven by an electric motor, arranged so that the table and not visible in the illustration, and by means of an electric regulator the speed of the machine can be regulated to meet the speed with which a sorter will be able to place leaves upon the feeding belt.

33 ASSEMBLED LOCOMOTIVES ON HIRE

(Continued from page 765)

expert locomotive engineers for assembling and it took the better part of a week before even one engine was complete. The locomotive had been ordered on a continuous order in the shops, as well as having all the parts of the machine carefully marked before being disassembled on this side of the border. We ordered in as many days and extra necessary work—especially when time was at a premium. Those same engines which at one time there were thirteen ships loaded with knocked down locomotives in ports in France waiting for the discharge of their cargoes.

This was the situation confronting the Shipping Control Committee on January, 1918. The locomotive problem was immedi-dately discernible. Indeed there was not way by which the complete locomotives could be sent across the ocean intact.

The ships steamed Feltoro, Cubore, and San-ter, each 466 feet long, with three great holds and five hatches, the smallest of which was 33 feet by 37 feet and the largest 39 feet by 37 feet. Each ship had a cargo capacity of 11,000 tons and was fitted with electric turbines capable of driving the ship at a speed of ten knots.

On May first loading started, and the holds of the steamer Feltoro were filled off with five layers of railroad rails and spires to secure stability and also to protect the hull of the ship. Next day a railroad float came alongside with eight assembled locomotives ready for the trip.

The problem of getting the locomotives into the hold of the ship was solved by requisitioning one of the largest cranes in the world capable of lifting 150,500 pounds in France. This derrick captain took his stand on the deck of the steamer and by the use of electric signals directed every movement of the machine, which was a single hitch, each and every one of these steel-bound monsters of the rails, was lowered and set on heavy oak planks; after which two more ooz of hay and bags of oats were packed around them.

And so seven days after the start of this great trip, there were on the waves at Brest, France, 33 large assembled locomotives and tenders, 2,400 tons of rails and splices, 2,300 tons of hay, 600 tons of oats, and fifty-three motor trucks.

ELECTRICAL EXPERIMENTER

March, 1919

WOOD FINISHING FOR THE AMATEUR.

(Continued from page 793)

either of two ways, which are known among finishers as the “quick” and the “slow” methods of polishing.

The quick method is as follows: Dip a handful of raw cotton into a mixture of half peanut oil (refined cottonseed oil will do), and a few alcohol, mix well with a rotary motion, which will give a fine lustre in a short time.

The better of the two is the slow process. After the work has been in the dead finish mentioned above, put on an extra coat of finishing varnish, allow it to dry, and rub down again with Pumice stone, washing up thoroughly after each ground rotten stone over the surface with a soft chamois skin, using a circular motion, and then dry, rub it off with the palm of the hand.

There are several other kinds of polishing, notably wax polishing and oil polishing, which may be used if desired. In wax polishing the polish is put on at the same stage that the varnish would have been applied. Using any method convenient to get the wax on the surface, the next step is, to warm the wax and apply it with a brush, the same as varnish. This gives an even coat of wax, which is then polished with a cloth. There is also a number of manufactured waxes on the market, any of which will give the desired results. The chief objection to wax polishing is that it lasting very easily, but it is also renewed very easily, hence this is not a such an objection for many kinds of work.

Oil polishing is the most durable of all, and therefore is used for table tops, counters, etc., and which is used for a number of years. The process is very simple, but heartbreaking. It consists of applying either natural or man-made linseed oil upon the surface, and then rubbing it until a polish is secured. The polishing is done by means of a piece of felt wrap around a heavy block, to give it weight.

This is about all that need be said about the various processes used in wood finishing, but a brief description of the various kinds of waxes has been omitted, as the Electrical Experimenter would not be out of place. A perusal of the list will often help determine the kind of wood required for any particular piece of work.

Birch.—Black birch takes on a fine polish, as it is close grained. Its natural color is light, so it is usually stained in imitation of oak, walnut, or mahogany. For table tops, counters, etc., it is close grained, a filler is not absolutely necessary, but when staining this wood to imitate some other, a properly colored filler gives it a better coloration.

Cherry.—This wood is very close grained, and will take a high polish. It has little tendency to warp, and because of its close grain filling is not necessary, and shellacking will prepare it for any of the finest polishes.

Oak.—Oak is the “King of woods", and is very useful. It consists of grains of wood and must always be filled before shellacking. Almost any sort of polish may be used for finishing oak, one of the most beautiful and the “grain filler” formula which has already been given. The linseed oil polishing will also make an excellent and durable finish. There is but one objection to this finish for wood apparatus, which has made it unjustly unpopular, and that is that the acid in the water and the wood have a peculiar effect upon hard rubber panels.

Mahogany.—If expense were not an objection in most cases, mahogany would be an ideal wood for every purpose. It is coarse grained, requiring a filler, but is sus-
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CORE WIRE

(Continued from page 810)

certible of a fine polish, which makes it much in demand.

Maple.—Hard maple is close grained and requires no filler, but soft maple is just the opposite, and hence it is of little value. It looks best in its natural color, very light, which is preferably obtained by the use of white shellac and the very whitest ivory varnish—be found. Hard maple takes the finest polish of any of the woods.

Black Walnut.—This is a dark-colored wood, rather open grained, requiring a filler to make its color, but a good one. One good coat of orange shellac will suffice to level its surface previous to polishing.

Pine, Poplar, etc.—These soft woods are open grained and easily worked. Having little beauty of their own they are usually stained, but we should remember that oil stains are the best to use, owing to the difficulty of getting an even coat. Shellac will do very well as a varnish for these soft woods, being applied on top of a liquid filler.

In conclusion it is to be hoped that anyone attempting to do wood finishing will do the work justice and conscientiously perform all the operations required. Everyone has preferences as to the finish liked best, but after a study of the foregoing it should not be difficult to select the right one.

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The former Kaiser is believed to be constantly in communication with Germany. It is reported that a wireless station has been erected on top of Count von Ber- tinch’s castle, and that German airplanes frequently fly over the estate, dropping messages.

SCIENCE IN SLANG

(Continued from page 799)

that it was the inherent what-you-may-call-it in the deceased animal and not the contact of the two dissimilar metals on the nerve and muscle, and the chemical action created thereof, that caused the insensible corpse to do the post-mortem Hula.

“Even at that the Dago doctor opened up a lot of dope that the terrestrians were dead to, and laid another foundation next for the next of the scientific gang to add to. And now we have galvanic current instead of homoeo, as would be the case had the blind ditty writer pulled the stunt.

“And then Count Professor Allesandro Volta, B. S., enlightened himself with Couronne de Tasses (no, not demi-tasses) and plates, and condensing electrosopes, not to speak of the other heterogeneous paraphernalia that would make a Hebrew junk dealer itch in the palms. Well, Aleck stamped his cognomen in the pages of electrical history, as well as on fuse plugs and such other electrical stuff that has the potential inscribed on it.

“Here comes along Andre Marie Ampère and drops the aching public a string of facts tabulating a stack of laws governing the flow of the ‘juice’ and propounding with such effect that we now wilt into the store and order the fuses that we shot—or rather to replace the ones we shot—and then the ampere (unless we bought them by the dozen).

“So it goes. Watt then bounces into the limelight and does his act and exit. Then, when they are sure he is dead, some favoring girl—usually a Prof.—takes some thing after him. In this case it happened to be the great what-is-it. So, too, we get ohms and farads—see; Mike’s handle was too long for laboratory use so the printers just stuck in the first half dozen characters and let it go at that. Likewise we amputated...
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ELECTRICAL EXPERIMENTER

March, 1919

line, along comes a lot of other by-product stuff. A load of new hypotheses and another load of theories to explain them. You know when you hook up some plants in parallel that there enters into the circuit a condition known as 'harmonics' that jiggles the peak around and cuts it off, and goes negative when the generators are trying to make a positive impression on the line. Alternating current is great stuff and the guy that hits on it in the first place is far ahead of the man who stands on the wimpy ground of the direct. Steinmetz has this alternating current stuff pretty well under his hat and can tell you just what will happen, and when and why. If you ask 'Stemy' how he figures it he will tell you with a paper and pencil—if he did not do it in his head; but when the figures run ten into one or two hundred he generally reaches for his pencil. With his calculus he calculates the two-stepping oscillatory currents correctly thru his heavy cigs.

"Surely we all know what Tommy Edi-son has done to us in the line of sidewalks and phonographs, in stock tickers and electric plugs on street railways and chemistry.

That old duck works overtime seven days to the week and sleeps with his hat and shoes on, with a copy of Clerk Maxwell's dictionary for a pillow. Yes, Tom is a bright boy.

To-day, after all the headlights and sidewalk signs on history, we know more or less, but and less of, the so-called 'electric' force that causes our incandescent globes to glow and the amber to attract pitch balls than our propertizers who wore fig leaves and bed-spreads.

Perhaps some day a man—maybe a woman will come along and kick the mud out from the electrical puddle and let us see what a 'wait' really is. At least we will find more things that the mysterious force is the cause of. We may add a new mental, static, dynamic and other present forms we have so far classified yet more. 
High frequency may be the way to it—it may. But I realize that we merely collect or cause to flow in our set paths the 'juice' we use, we do not create it. In a way we are only considerably crudely in the field of electricity.

A lot escapes us, a lot leaks, as it were, and we get the use of a very small amount for the work we put into it and get out of it. Yet it is the most efficient forms of energy that we now have at our disposal. Perhaps some one will stumble on something other than dynamos and batteries for our support. It may be a sort of collector or electric acumulator. Thru electricity we may over-come taxation, that sort of a thing that would make possible are unlimited. Of course, that is supposition, but 'wireless' and the World War were all suppositions a few years ago.

'Speaking of wireless, Hertz looked over our heads and saw something we had overlooked since Galvani's 'return shock' on the frog's hind legs.

Then Marconi and others, notably De Forest, boosted the proposition along, so that now, with the audion amplifier, we transmit music, both chim and instrumental, for miles and miles on thin ether. Whether next we will transmit or merely collect energy for power I don't know, but I would not be surprised at either.

'Some scientists tell us that once our present planet was a whirling mass of molten globular mass. It came into existence via a gaseous state. As these cooled they formed rings or films surrounding the earth. Later these rings descended upon the earth, periodically. Thus the earth was thru the Paleozoic and Carboniferous.
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A short time ago I, too, felt that way. I was a bill clerk earning only $12 a week, and I used to worry myself sick about my future.

To-day—it seems like a dream—all my financial troubles are over—my weekly income is about $1,000—more than I know how to spend. I have two automobiles and have a chauffeur to drive me around.

My children go to private schools. I have just purchased, for cash, a $25,000 home. I go fishing, motoring and traveling, whenever I care to. I live in a new kind of world.

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Gigantic 1,400 K.W. Radio Station at Lyons, France

(Continued from page 791)

work, it having been found readily possible to synchronize two such high-speed radio frequences at the works of the General Electric Company, some years ago.

North of the main antenna switch platform, at the station where the large, French design of static frequency multiplying system rated at 150 K.W. This set operates on the principle of the transformer frequency-changing principle, as developed by Joly and Arco.

Next we come to the western wing of the station, and here are two of the largest motor-generators ever built. They were designed by Mr. C. F. Elwell, formerly Chief Engineer of the Federal Telegraph Co., San Francisco, who first developed the Ponsan arc system to large powers, and each of these gigantic arcs are rated at 250 K.W. Either of these arc generators may be connected to the antenna thru the central antenna switch gear, the lead wire running to the arc apparatus, and on a massive single-pole, double-throw change-over switch, about five feet in length, which permits the instant connection of either set to the antenna.

Either of these powerful arc sets can be operated from the 300-K.W., 750-volt, direct-current motor-generator set, shown in the figure, or fed directly, without any use of the arc apparatus itself. This motor-generator comprises a three-phase, alternating-current motor, driven by a direct-current, 300-K.W. generator, which supplies the necessary high voltage direct current for operating the arcs. Dr. de Forest states that, in his opinion, these large arc generators represent one of the very finest developments in radio transmitters, that have yet been conceived, or perfected. They have a distinct advantage over frequency alternators in that quick changes in wave length or frequency can be rapidly obtained, merely by changing the inductance and capacity in the oscillatory circuits connected to the arc itself. The radio frequency alternator is very reliable, and development in this line has been a very rapid and reliable manner, but it is difficult, at least with the present design of this machine, to obtain and maintain a sufficiently accurate, changeable change in the range of wave lengths and frequency, yet as Dr. de Forest has intimated, they are very efficient and desirable where you turn your attention to the wave lengths available, as such where but one or two wave lengths only are desired. The arc apparatus is, of course, very simple and rugged in design, and requires but very little attention, even when operated over twenty-four-hour non-stop periods, which is the case in many of the Government stations which are using arc sets, and many of which are in very successful operation in some of the larger stations of the United States as well as in Europe at the present time.

All of the transmitters at the Lyons station, as the reader will perceive from the antenna frequency values given above, and the undamped wave system is used in all except the spark sets. The receiving apparatus is very elaborate, and has been installed in sound-proof receiving rooms, so as to realize the highest degree in the necessity of long distance signals. The French radio engineers are using nothing but three electrode audions in all of their work, and one of the finest sets is illustrated and described in the April issue. The French receiving sets make use of two or more amplifiers, and it is necessary to a six-stage amplifier is used, which boosts the strength of signal received 1,000,000 times. Some of the clever work accomplished by the French Army and Navy radio experts during the war, with these powerful audion amplifiers can readily be imagined, and it is a matter of record that many valuable radio as well as regular telegraph and telephonic wire messages were sent out, and that these were taken by the French stations equipped with these powerful amplifiers.

The power for the Lyons radio station is transmitted for a long distance from a hydro-electric plant. The receiving apparatus was built by the Compagnie Generale Radiotelegraphique, situated at Paris. The detector is, of course, the French type of audion. They employ a six-step audion amplifier, using the same standard bulb both for detecting and amplifying.

The ground connection of the station consists of a large number of copper wires radiating from the station and buried about two miles (650 feet) below the surface of the earth. Many of these wires terminate in copper plates.

HOW I INVENTED THE AUDION.

(Continued from page 790)

pleation was not filed until the following February, as shown in Figs. 2 and 6, of this patent show the incandescent or glow lamps members both in the air, and sealed within a closed enclosure.

It will be noted now that I approached the general problem of this new type of detector from an entirely different angle from that commonly supposed to-day. In the first place I always employed a battery, and this original battery was what is now universally called the "B" battery. My source of electric current for heating purposes was second, and secondary, so that the vociferous contention of the advocates of the Fleming valve and the tube detectors for the Fleming valve, and was originally the Fleming valve with the "B" battery added as an afterthought, is but a trifle.

It was now a very obvious development of the evolution thus far described, to partially exhaust the glass envelope containing the two incandescent electrodes, or filaments, so as to increase the conductivity of the space between them.

But the real value of this patent, showing the inclosed filament and glow lamp bulb, is interesting from another consideration because it contains the first embryonic germ of the later audion and cathode-ray tube. It was realized from the very first that a certain proportion of the high frequency energy from the antenna could be lost thru the bypath circuit connecting the audion and telephonic receiver. In order to prevent this the arrangement shown in Fig. 5 was tried out, wherein the local and high frequency circuits are kept separate. In this arrangement, as actually tried in the gas flame, no actual advantage was observed, because the high frequency electrodes were necessarily some slight distance from the path conducting the direct current, and hence the effect of the high frequency currents upon the ions carrying the local current was weakened.

During the years of 1904 and '05 my duties kept me almost continually away from my laboratory, in travelling about the country directing the installation of numerous radio stations; consequently there was little opportunity for carrying on this development work, and carrying out the designs and sketches which I made from time to time. It was not until 1905 that a lamp manufacturer was found to under-take the construction of the various experimental forms of lamps which I had designed as a successor to the flame or arc detector, I was familiar in 1905 with Prof. Fleming's work on the subject of the "Edi-
ELECTRICAL EXPERIMENTER

March, 1919

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In the spring and summer of 1906 I had opportunity to spend a good deal of time on the audion problem, and was always seeking to improve its efficiency. Keeping in mind then the disadvantage of directly connecting the high frequency circuit with the local circuits, and harking back to the four electrode gas-flame detector above mentioned, I sought to keep one electrode of the high frequency circuit distinct from the two electrodes of the local current. Obviously the most simple experiment was to wrap a piece of tinfoil around the outside of the glass bulb and connect this to one end of the secondary transformer of my receiver. The other end of the transformer was connected to the filament, it being obviously unnecessary to employ four electrodes to effect the end desired. Exactly this arrangement, with the third electrode around the outside of the bulb, is shown in Fig. 3 of patent No. 841,366, which was filed in August, 1906. It will probably be recalled that this outside electrode has been very recently "re-discovered" with considerable eclat and acclaim! I also at this time wrapped a coil of wire around the bulb, connecting one end of this to the antenna and the other to the ground, seeking thus to exercise an electrostatic condition in the inner electrodes by electro-magnetic influence from the high frequency oscillations passing around this helix. See Fig. 4, patent No. 841,366.

The arrangement of the external tinfoil belt may therefore be called the parent of the third electrode. It showed a decided improvement in the sensitiveness of the detector, as I had anticipated. I recognized that by this arrangement I had in effect a condenser between the filament connection and a hypothetical third electrode, which consisted of the conducting layer of gas located on the interior walls of the bulb, the other arm of this condenser being the tinfoil belt outside the glass. I recognized also that this was a very inefficient and indirect way of impressing the effect of the high frequency oscillations upon the conducting medium between the filament and plate. The third electrode should therefore be placed inside the bulb. I immediately instructed McCandless & Company to make such a bulb. The first type of this third electrode was in the form of a plate, located on the opposite side of the filament from the "B" battery plate. This arrangement showed an increased efficiency and sensitiveness anticipated. It is shown in Figs. 2 and 4 of patent No. 841,387, filed October, 1906. This is the audion amplifier and telephone relay patent. Fig. 2 of this patent is interesting as showing also for the first time a third battery ("B") in the external circuit between the third electrode and the filament. T in this figure represents the high frequency transformer.

In Fig. 4, where this battery is omitted, it is shown for the first time the grid stopping condenser C. In studying this type of three electrode bulb, I recognized that the third electrode was not yet in its most efficient position. It should be placed directly in the path of the ionic or thermionic stream, passing from filament to plate, where the high frequency electric charges impinge on the electrode could best affect this stream. But if placed directly between two electrodes, a solid plate, of course, would constitute practically a complete barrier. Hence I devised the grid or perforated screen structure. In fact, the first audion where the third electrode was placed between the filament and plate utilized the wire bent in grid form which is familiar to every amateur or user of the audion prior to 1914, to which third electrode so located was so marked an improvement over the preceding three-electrode bulb, that shortly thereafter a patent was applied for on it. This was issued in February, 1908, No. 879,532. See Fig. 1 where the complete receiving arrangement and the grid audion is clearly shown.
The audion remained in this form for six years. During that time its merits became gradually recognized in Europe as well as here, and it was not long before the little stranger was, like its predecessor, the two electrode brother with "B" battery, adopted into the Marconi family, and its predecessor rechristened the "Fleming Valve". As soon as the audion amplifier had been developed for long distance telephone service by the engineers of the Western Electric Company, and installed on most of the long distance lines of the A. T. & T. Co., we find certain English publications adopting it also into the Fleming valve family; and now after the three-electrode device has demonstrated its utility as a radio transmitter of absolutely constant undamped waves and made possible transoceanic telephone, we learn that this big brother which I first named the Oscillion, is also to the Fleming valve. The term "junior" or "senior" is used to distinguish one from the other in this rapidly growing Fleming valve family.

The art founded on the three-electrode audion has grown of late years with enormous strides. The great war has produced a tremendous intensity of development for various military purposes and it cannot be disputed that the engineers of the Western Electric Company were in a foremost position, and much of the present-day efficiency of the detector and amplifier has been due to their efforts, spurred on as they were by the difficult demands and specifications of our Signal Corps officers and engineers. It is estimated that there has been constructed for the U. S. Signal Corps during the war between 240,000 and 300,000 audion and amplifier tubes, and at least 50,000 small oscillators. In Great Britain war-time production has probably equalled or exceeded the goal. While in France we are informed that during the last two years of the war, the audion production has averaged about 5,000 per month! The French bulk is particularly interesting as being efficient and suitable in all three uses, detector, amplifier and oscillator. For such purposes, of course, a compromise in efficiency was inevitable, and maximum efficiency in either of these three branches has been somewhat sacrificed.

Considerable discussion has lately arisen as to the first use of the audion as an oscillator or source of alternating current. This matter is now being thrashed out in a multiple interference procedure in the U. S. Patent Office. But the evidence so far indicates that the writer's application of this property of the audion in the spring of 1916 should be the first use of the audion as a generator of undamped electrical currents. In view of recent developments, particularly the highly interesting announcements of President Vail of the A. T. & T. Co., regarding multiplex wire telephony and telegraphy over a single conductor pair, it may be prophesied that the application of the audion as a generator of alternating currents will be fully as useful as that of detector and amplifier.

There is, in the writer's opinion, no doubt but that if the development of radio is not now made a Government monopoly, it will not be long before commercial trans-oceanic wireless telephony will be effected. This work, whether the generator be a bank of oscillators or a high frequency alternator, will be made possible only by the extraordinary amplifying properties of the audion, when used as telephone repeater or relay. The simplicity of the oscillation transmitter in small sizes, coupled with the extraor-dinary sensitivity of the "zero beat" audion detector or amplifier of received high frequency energy, warrants the belief (Continued on page 531)
the nineteen-set of meters dial is an instantaneously photographed film. When the meter-reader gives back to the office, the exposed roll film is removed from the camera and the roll inserted. The film is then developed and the bills made out from the record photographed thereon.

Down on the farm we find another interesting light, the Uncle Josh will swear that the old barn lantern is much better, and this is in the testing of eggs for fertility. Several attachments have been produced, or one can easily be made from a piece of cardboard, aluminum or tin, in the shape shown in the accompaniment, Fig. 7, so that a strong beam of light is thrown against the egg, as it is placed in the opening in the candle screen. In connection with it it is interesting to note that by holding a flashlight bulb against the hand or against the finger that it is possible to locate foreign bodies in the finger. The illumination is very intense, and will act almost like an X-ray.

Figure eight shows a doctor's hand lamp fitted up in an emergency or for regular use as a flashlight. The battery is connected with a piece of flexible tinfoil to the lamp bulb, which is preferably mounted in a cardboard envelope secured to a piece of fiber, and which in turn is wired or sewed to a strip of elastic webbing. A small buckle can be secured to the free end of the webbing, so as to hold it in place on the head in any desired position. A polished nickel reflector is held in place by the lamp when screwed into the socket, as illustrated.

Another clever use for flashlights is in the form of a deep signal, and this scheme is so light that it has been tried out with great success in several offices. A diagram is given for a three-wire return call system. The beauty of the flashlight call is that it is not given to any nervous person a shock to the ordinary buzzer or bell, and it is also very simple and cheap to install. Any one can install such a signal system in a few minutes' time. Ordinary bell wire or some flexible lamp cord is used for connecting the two stations. The internal connections made to the flashlight battery are clearly shown in the diagram. Where two or more flashlights are used on one desk, the lenses may be of different colors, so that the patty calling is indicated more quickly.

Figure ten shows one form of electric clocklight. Of course, most ordinary mortals find the pocket flashlight very useful about the bedroom, and invariably keep one under the bed, so that it is only necessary to flash it on the clock or watch and ascertain the time whenever desired, but in some instances it proves more convenient or desirable to have the lamp bulb mounted on the clock base as here shown. Those desiring to utilize this scheme can easily arrange what is necessary is the ordinary flashlight, the proper length of flexible tinfoil and a push-button, preferably of one kind and variety.

Figure eleven illustrates one out of about ten thousand possibilities in electric flashlight advertising and tie-in novelties. The illuminated "Stove pipe" and shirt box shown, were not merely sketched by the artist, but were actually used for several years in New York City, and tickled the heart of the younger set well before they grew up. The man fitted with this illuminated silk hat and shirt bosom was quite a hit on Broadway at one time, and created one of the most novel surprises progressive advertising ever initiated. Needless to say, the best results are obtained with such an arrangement when the lights are flashed on and off at short intervals. In the present case the hat became illuminated first and then the shirt bosom, the arrow in the front of the hat sign causing the onlooker to glance downward invariably, and at that psychological moment, lo and behold! the shirt boson blazed forth in its red-and-white-striped glory, to the effect that "Killian's" whisky was the only stuff that had the "punch"—it didn't say it was a deadly punch, to be sure.

The illustration at Fig. 12, shows a very ingenious and most useful instrument utilizing the flashlight principle and known as the "inspectoscope." As the illustration shows, the inspectscope comprises a tube either of fact length, or else made telescopic, at the lower end of which there is a mirror inclined 45 degrees, while at the upper end of the tube a small flashlight case and its battery are mounted. The lamp on the tube receives current thru the metal tube, and the other side of the circuit is completed thru a single insulated wire leading up to the flashlight battery, the button switch on the battery case being used to light the lamp. This instrument has been found extremely useful in reading name-plates on motors and other machinery where they happen to be in inaccessible locations, such as close to a wall, etc. Many other practical and ingenious uses of the flashlight will suggest themselves to the reader, and it is doubtful if there has ever been any one invention in the electrical field that has become more universally adapted than the pocket flashlight.

POPULAR ASTRONOMY.

(Continued from page 781)

the planet is best seen. Its flattening at the poles, which is nearly ten per cent of its equatorial diameter gives it a decidedly oval appearance. Ordinarily one of the hemispheres of Saturn is partly or entirely concealed by the rings so that the oblate form is not noticeable. After the time shown on the diagram the rings in 1920 the earth will pass from a position below the rings to one above them. The northern hemisphere of the earth and the northern hemisphere of Saturn will come more and more into view after this date, the southern surface of the rings being invisible and the southern hemisphere of the planet being seen until the rings once more approach their widest opening or maximum separation. From this time on until the earth is once more in the plane of the rings, after another quarter revolution of the planet, the elevation of the rings above the earth becomes less and less and the width of the system decreases in proportion to its length. It was this change in the tilt and visibility of the rings that so perplexed Galileo when he attempted to make out the nature of the appendages of Saturn with his crude telescope of insufficient magnifying power. So great was his bewilderment when the rings finally disappeared that he cried out in despair that Saturn must have swallowed his children—another Jesuit legend. He finally became so exasperated with the results of his observations that he gave up observation of the true nature of these appendages of Saturn and remained a mystery until Huygens solved the problem in 1655, some time after the death of Galileo.

In addition to the rings, Saturn has nine satellites named in the order of their distance outward from the planet: Mimas, Enceladus, Tethys, Calypso, Rhea, Titan, Hyperion, Iapetus and Phoebe. The last mentioned satellite was discovered by W. H. Pickering in 1918 with great interest at the time because it was the first satellite to be discovered with "retraged" motion in its orbit. Two satellites of Jupiter since discovered revolve in the same direction around their primary. The satellites of Saturn approximate to

(Continued on page 823)
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ELECTRICAL EXPERIMENTER readers will be particularly interested in all the different experiments that can be performed with the Skinderviken Button. Fig. 1 shows the Skinderviken button attached to the back of an Ingersoll watch case. When speaking towards the inside of the case, it will be found that the voice is reproduced clearly and loudly.

$1.00 prepaid This shows how button is attached to ordinary telephone transmitter.

Fig. 2 shows another interesting stunt. By attaching the button to a tin diafram about the size of half a dollar, and by holding the diafram at the side of the throat, as shown, speech can be transmitted with surprising clarity. Fig. 3 illustrates the same arrangement placed on the chest as shown. In this position the transmitter will talk clearly and loudly. Fig. 4 shows an arrangement whereby the Skinderviken button is attached on a thin wood board at the preacher's pulpit. His voice is clearly transmitted so that people hard of hearing can readily hear the sermon. Fig. 5 shows how a very sensitive Detectophone can be made by placing one of the buttons in the center of a lithographed cardboard picture, so that only the small brass nut shows. The large surface of the picture acts as a big diafram, and the voice is well reproduced. Fig. 6 shows an interesting stunt, whereby a hole is drilled in the side of a thin glass water-tumbler; the sides of the glass thus acting as a diafram, the voice is clearly transmitted. Fig. 7 shows a simple match box Detectophone. The Skinderviken button is concealed inside of the box, only the small brass nut showing on the outside. This device talks well. Fig. 8 shows how to transmit phonograph music at a distance merely by drilling a small hole in the phonograph arm and attaching the Skinderviken button: a very favorite experiment with all experimenters.

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Prospects and after being educated in Germany he returns home just before Germany involves the

Near the Wagner home lives an invalid, with her daughter, Beth, a charming patriotic girl. Her father at his death leg afterwards to watch over Beth and she

Sirs:

Examination of the satellites of Jupiter can be easily found that they are not as interesting to observe as the satellites of Jupiter because they are on the average four, hundred million miles more distant.

The time they require to make one journey around Saturn varies from nearly twenty-three hours for Mimas, the nearest, to approximately five hundred and twenty-four days for Phoebe, the most distant.

Like Jupiter, Saturn is marked by belts parallel to its equator but they appear more indistinct than those of Jupiter on account of the greater distance of Saturn. Saturn also resembles Jupiter in its physical composition which is largely, if not entirely, gaseous and in the extremely short period of rotation on its axis which is approximately ten hours.

In more ways than one, Saturn is a very unusual planet. In addition to possessing an enormous ring system it is the lightest of all the planets, its density being only three hundred times that of water, and it is the most oblate, or flattening at the poles alternating nearly to one-tenth of its diameter. Its equator is more highly inclined to its orbit than is the case with any other planet, not even excluding the earth's axis to Mars. For this reason its seasons are very great, in marked contrast to Jupiter whose equator lies very nearly in the plane of its orbit. Since Saturn is so far away from the sun that it receives only one-nineteenth as much light and heat per unit area as the earth, its outer gaseous surface must be extremely cold unless considerable heat is conveyed to the surface from within its hot interior.

Prof. Lowell concluded from certain observations made at Flagstaff, Ariz., that Saturn is composed of layers of different densities and that the inner layers are more flattened at the poles and rotate faster than the outer layers. Marked variations in the color and brightness of the ball of the planet have been noted from time to time. In 1833 the planet was described as pinkish-brown and consequently darker than the brighter portions of the rings and it may be said to have been found in the constellation of Leo not far from the star Regulus at the end of the handle of "The Sickle." It is more than twenty years since the planet was noticed in any other pinkish tint. As it was in opposition to the sun on February 14, it is now most favorably placed for observation, being visible all thr sun.

THE BORDER WIRELESS AND "THE HAIR WITHIN."

(Continued from page 768)

because of his hatred for Prussian autocracy and who has been intensely American. His son Karl, however, whose nature is cold, is pro-German despite his father's

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I don't care how much druggist's dope or patent pilfe you may have tried without success; three hundred years ago the greatest brain in England wrote "Throw Physics to the Dogs"—and Shakespeare knew, as every doctor knows today, that physic isn't the kind of food that makes men strong and vital, that fills them full of overflowing life and energy and spirit.

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cupy a range between the frequencies of the ordinary telephone currents, which are those of the human voice, and the lowest frequencies which are used in wireless communication. This frequency range has not herefore been commercially used. It is interesting to note that under favorable conditions the whole range is audible to many and the lower part of the range is audible to any one with normal hearing. It is found that frequencies within this range are high enough to be used as "carriers" of ordinary telephone currents and yet with proper arrangements can be transmitted over long telephone lines without the large transmission losses and large interference between circuits which would be brought in by lower frequencies.

Each additional circuit in the new system makes use of some frequency within this range. At the sending end of each circuit, the ordinary telephone current is made to modulate this "carrier" frequency by means of an audion tube so that the unmodulated carrier frequency sent out on the line varies with the amplitude of the ordinary telephone currents. At the receiving end the carrier current is put into a demodulating circuit, which includes another audion, and which then gives out the original telephone current.

The different circuits are kept separate at each end by inserting in each circuit a combination of impedances which make up an electrical "filter." This transmits the range of frequencies passing through each circuit and stops all other frequencies. An important difference should be noted here between this system and wire systems in which wireless working is done. It has been generally sufficient to send and receive in "tuned" circuits. In the multiplex system, however, tuned circuits would not be sufficient since each telephone channel occupies a range of frequencies of about 2,500 cycles and any circuit tuned to these comparatively low frequencies would be too "selective" to receive such a range in the proper manner.

Vacuum tubes (audions) are used in the modulating and demodulating circuits and are also used as amplifiers in the transmitting and receiving branches and at intermediate points along the line where necessary to prevent the currents from becoming too highly attenuated.

In regard to the increased telegraphic capacity afforded, Mr. C. C. Harbison states:

"The advantages of the system when applied to telegraphy as well as to telephony were clearly shown in tests. We found that we can combine our system with the printing telegraph so as to secure the full advantages of the latter and the full advantage of the modulated multiplex system in reducing wire requirements. Using our multiplex system with the ordinary hand operated telegraph instrument, connected with a telephone circuit, we can send from 1,500 to 2,000 words in a minute. When the multiplex system is connected with the printing telegraph, we can send, from 4,000 to 5,000 words in 60 seconds."

GOLD AND SILVER LOCATED WITH SOUND WAVES.

(Continued from page 769)

the ore bodies. For example, if the distance between the record made on the oscillograph, R-D, by the triangulation on depressing the key K, and the record made by the arrival of the sound directly along the line Q, which would be the first sound to return after the depression of the key, is five inches—then one inch on the photographic record corresponds to one mile in distance, since drill hole R is located six miles from the key. D. This establishes the standard of measurement on the oscillograph.

Now for example, if the length between the key depression record and the record made at D, by the sound reflected at P is...
9 inches, it is evident that the sound proceeding from O and reflected at P, and finally reaching the point Q, had traveled 9 inches. Again, the length between the key depression record on the oscillograph, R—O, and the record made by the sound sent out from O, and reflected back from the bottom Fig. 2, is a 9 inches, then it follows that the ether body 1, is located approximately 4 miles from the point O. The error in this measurement of the intersection of the sphere described about O, with a radius of 4 miles, with the sphere described about D, with a radius 9 miles, is 1, i.e., 5 miles.

There are a number of ways outlined in Prof. Fessenden's description of his invention, which may be utilized for locating the exact point on the line of intersection where the ore bodies are located. As he points out, it is possible to find this point of intersection mathematically, if the angle deflection between the key depression record and the echo record made by reflection, say at J, Fig. 4, together with a determination of the direction of the sound received, which employs two of his oscillators connected together, separately. This scheme of locating ore deposits may sound a little hazy or improbable at first glance, but the theory, can be readily tried out by means of a small siren and a receiver or two, together with some auxiliary apparatus which any electrical experimenter can readily devise, the difference in such an experiment being that the waves are not reflected or refracted in air, but in applying this system to the location of buried ore deposits, the sound waves travel through rock and soil as well as water, in which mediums the velocities of sound propagation varies considerably. The velocity of sound propagation through water is about four times as great as that through air, or approximately 1,100 feet per second for air and 4,700 feet per second for water.

BOOK REVIEW.
(Continued from page 801)


This work is the official reference and study manual used by all naval men. The various operations of the navy, the details of a naval life are described and illustrated. This work contains the daily life of the navy, specially described and suitably illustrated. The reader is thus able to learn the life of a ship's crew and understand the duties of each rank. The work is written in an easy manner, and is published so that by reference to the special indexes given in the book, the reader can locate certain sections of the text concerning the ship, the crew, the work of the ship's officers, etc. The work is a valuable guide for those interested in the navy.

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SEARCHLIGHTS OF THE DEEP.

(Continued from page 772)

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HOW I INVENTED THE AUDION.
(Continued from page 820)

that before long the wireless telephone will be installed on thousands of vessels, supplementing, and in many cases, supplanting the wireless telegraph. In addition there is an enormous number of small vessels where a wireless telephone installation is more feasible.

As indicative of the growth of the Audion Art, a number of patents issued on various devices and circuits dependent thereon, gives a pretty fair key: Up to 1912 there had been issued about 20 patents, all filed subsequent to 1904. To-day there are over 100 United States patents on the Audion Art, and the number is very rapidly growing. It is not the intent of this paper to review all the work that may be applied to the device patented, practically everyone of these patents since 1906 shows the three electrode bulbs. They may all, however, be properly described as the outgrowth of the ideas first shown in the audion amplifier—patent No. 841,887.

EXPERIMENTAL CHEMISTRY.
(Continued from page 794)

cuprous oxide, or gold; Yellolowish-green, by uranium oxide; Green, by chromic or cupric oxide; red, by ferric oxide; white, by manganese dioxide; and black, by manganous oxide. The green color of the common window glass or bottle glass is caused by the presence of ferrous oxide in the sand; this decoloration may be removed by addition of manganese dioxide in the make-up. This is done by adding a green copper oxide, which imparts a yellow tint, being neutralized by the violet produced by the manganese as a complimentary color.

Pure white is produced when the metallic oxides required, in the proportion which experience has shown gives the best result, but a small amount of "cuttle" is added to improve the quality. The mixture is then put into pots as shown in Fig. 159. These pots are made of the most insulating materials and placed in a circular furnace with openings thru which the workman can dip his long iron blowpipe into the pots. Fig. 160 shows such a furnace in cross-section.

The fuel now used is mostly gaseous, and an intense heat is maintained for hours, till the substances are completely fused and mixed. The glass worker dips his blowpipe—a hollow iron rod 5 or 6 feet long, into the fused mass, removes a small portion, rolls it on a smooth iron
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March, 1919

THE ROGERS UNDERGROUND - WIRELESS.

(Continued from page 789)

The illustrations and materials in all the tests and installations made of my underground radio system thru all the trials and testing of its development, even when the system seemed to prove unworkable. Their perseverance and high skill in the radio art has hastened the official recognition and the installation of the buried and submerged antenna.

Commander A. Hoyt Taylor, D.Sc., U. S. N.; Dr. E. H. Haswell, Bureau of Standards; Admiral Strother Smith, U. S. N.; Commander Hooper, U. S. N.; G. H. Clark, Expert Radio Aid, U. S. N.; Dr. George W. Taylor, Harvard University; and Ensign A. Crossley, U. S. N., who has been actively engaged on the installation of the Rogers system at the Great Lakes Naval Radio Station besides New Orleans, New London, Conn., (test station, now abandoned), and Norfolk, Va.

Like many inventions the exact mode of operation is hard to ascertain and define. The views of Mr. Rogers on the operation of this wireless system are briefly described as follows—First, that the electric energy liberated at the base of an antenna will be propagated thru the earth even in the absence of etheric space waves above it, and second, that the electric energy propagated in all directions is the cause of the electric phenomena observed in the real world. The latter is a new and important discovery which is of tremendous importance in electrician practice, industry, and research.

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INDEX to Volumes

MAY 1919

ELECTRICAL EXPERIMENTER

Contains 24 pages and shows every article of interest that has been included since the inception of this magazine up to and including April, 1919. It is completely indexable and is intended for any kind of electrical research work.

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These ground currents travel with the speed of light and are picked up at the receiving station. The space waves persist for an appreciable distance, which accounts for the ability of air-plane and air-plane-to-earth radio-communication, but it is the belief of Mr. Rogers that in such long distance radio transmission at half-way around the globe (12,000 miles) that it is the ground wave current that does the work, and that the free space wave above the surface of the earth never reaches the station due to the high resistance of the atmospheric envelope.

One of the Naval experts present mentioned that it has been found, that the penetration of the ground wave component increases with an increase in wave length. This is an important fact and helps to explain the operation of this new radio system, with its aérais buried in the ground. He also mentioned that "Radio to Mars" or other planets would be impossible, if we are to believe in the well-known "Heaviside" ionization layer, surrounding the earth at a height of 30 to 50 miles, for no etheric wave can pass this layer without being reflected back to the earth, or at least restrained within this passage-way.

Rogers System Eliminates "Static" and "Interference".

Mr. Rogers stated that his underground antenna, in itself, did not solve entirely the static or interference problem, but it made the nearest approach to this ideal condition—the goal of all radio engineers—that had ever been accomplished before. This problem has, thanks to a new arrangement perfected by Commander A. H. Taylor, D.Sc., been solved and static and interference have been practically totally eliminated, for all year-around radio service. Think what an advancement this is! Further, there is no rise and fall in the signal strength during the night or day, at any time of year, so that the sun's ionization effect, as is the case where elevated antennas are employed. The U. S. Naval reports and tests made with the Rogers' ground aérais in comparison with the usual form of elevated aérais, several of which are appended hereafter, show the incomparable efficiency of this new radio system.

What The Facts Show.

First we will mention the test which Mr. Rogers and a naval officer conducted for the writer. The apparatus used in these tests is shown in the accompanying photographs. They included several large tuning inductances, variable condensers, a step-up audion amplifier (single Audion bulb only!) and two pairs of Baldwin phones (telephone receivers). This apparatus was connected up to one of Mr. Rogers' latest buried antennas—a single rubber covered, stranded copper cable, about the size of a small ignition cable, extending westward for a distance of 4,000 feet, so as to be in a plane with the high power European radio stations. This cable is buried in trench 20 foot wide by 20 foot by 20 foot, 10 feet deep, consisting of about 3 feet deep, filled in with soil. The cable is insulated at the free end and is connected up as in Fig. 2. The rubber covered wire alone has been in use in all sub-aquatic tests, and gives fine results when simply buried in the ground, the decay not being so rapid as probably would be imagined. This latest aerial in the iron pipe is a new development and experiments are in progress on it. It works wonderfully well. The 4,000 foot aérial here described is best suited to receiving wave length of 6,000 to 16,000 meters. For short waves longer aerials of smaller dimensions are employed.

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ELECTRICAL EXPERIMENTER
March, 1919

"Here's the 'Lyons' station in France," said Mr. Rogers. A turn of the knob on the specially calibrated condenser, and there was "Lyons" (France)—satisfactory enough. Static and interference were unheard. Next the great stations across the broad Atlantic at New York, Washington, Car-

Avenue, England; and Rome, Italy, were heard with equal loudness and clarity. This laboratory station, which has been used by the Navy Department during the war, has picked up practically all the high power stations on the globe. American stations were then picked up by changing the wave length, and finally a station made on a short (250 feet in length) buried ground antenna, adapted to receiving wave lengths of 200 to 800 meters. Wireless telephone messages were picked up from Washington, a distance of about seven miles. It is most interesting to note at this juncture, as the Naval tests at Norfolk, Va., on a similar aerial have shown, that a radio message from an airplane cannot be picked up on the underground aerial, until the 'plane is directly over the station. This would seem to prove two things—first, that the short waves sent out by the airplane do not penetrate down into the ground very far, if at all;—and second, that airplane radio transmission and reception are effected solely by etheric waves.

Referring to Fig. 3-A, 3-B, and 4, we have several interesting points. Fig. 3-A shows how a double ground aerial is sometimes connected. Also, as in the case of Mr. Rogers' test station, sets of these buried antennas are best employed, distributed about the station as shown in Fig. 3-B.

The Rogers underground antenna system has been used at New York, New Jersey, and during the war with most gratifying results, as reported by the Navy Department, and its successful operation during the twenty-four hours of the day, resulted in trebling and quadrupling the capacity of this great trans-Atlantic highway of intelligence communication. The official reports in connection with the work accomplished with the underground Rogers system at Delmar state that not a single word of communication was lost during the reception of thousands of important official messages from Europe. The station at Tuckerton, N. J., has also been equipped with the Rogers underground aerial system and all of the larger stations of the Allied Powers in Europe have been copied successfully thru the 24 hours, at this point also.

Submarine Wireless.

Perhaps the most interesting tests of all are those which were made on submerged aerials in salt water. The aerial in this case was of heavily insulated stranded cable, stretched from stem to stern as Fig. 4-A illustrates. The two ariels were brought down thru the counting tower and joined to the receiving apparatus. A second form of aerial is illustrated at Fig. 4-B, where the insulated aerial wires are placed in iron pipes within the submarine. Here are the results of some of these tests, which do not include the transmitting tests to the submarine from a grounded antenna on shore. When submerged 8 feet, the German station at Nauen was picked up by the submarine while lying off the American coast! Submarine tests, picked up distant stations when submerged 21 feet, on a wave length of 12,500 meters or greater.

One of the naval officers, who has had much to do with the testing of the Rogers' system, stated that experience had demonstrated the fact that even submerged antennas may be placed at any depth. Salt water acts differently, but the aerial may be submerged any desired depth for wave lengths above 10,000 meters.

The same officer, who has made a close study of all American and European work in radio, explained how the best work ever done in radio was accomplished at the Great Lakes Naval Station, on the shore of Lake Michigan. Fig. 5 gives the general arrangement of this station. The test station was on the beach and acted as a "remote control" station for the standard station at A. The shortest distance between a 'receiving and control station for the radio service heretofore has been 36 miles. Here a distance of 600 feet only, separate the elevated aerial of the main station from the submerged Rogers antenna terminating at the test station, B. Said he, "Now let the inventors of 'static and interference preventers trot out their wares, and show what they can DO!" Here's what this station actually did on schedule service:

With 4 amplifiers, at 4,000 meters wave length, being radiated in the elevated main antenna—the beach station, ONLY 600 FEET AWAY, was picking up Nauen on 12,000 meters; and New Orleans on 5,000 meters, without any interference or static—all on the Rogers sub-aqueous ariels. These were rubber-covered cables spreading in different directions, any one of which could be used, and laying 50 feet deep in the water at their outer extremities.

Imagine such a wonderful performance! But this is not all. The official tests show that the station at Camp, P. I., 8,100 miles away, was received regularly on the Rogers sub-aqueous ariels at the Lake Michigan Station, on schedule service, at 11 A. M. and 5:30 P. M. daily, the working periods of that station.

Transmitting On Underground Aerials.

Tests were made by the naval experts, as well as by Mr. Rogers in his very first experiments in transmission from a ground or under-water antenna. These were all successful. It is only a matter of properly insulating the antenna so that it will not break down under the high potential applied to it by the transmitter. The early tests by the inventor were made with a one inch spark coil to the Bureau of Standards Radio Laboratory, a distance of seven miles, and the received signals having an audibility of 2,000, i.e., 2,000 times the strength of a clear, readable signal. The audibility of the signals at the Washington Navy Yard.

The Burgess BLUE BOOK for all practical Men and Electrical Students

(See review of this book by Editor in December issue of your Electrical Experimenter page 568)

I have prepared a pocket-size note book especially for the practical man and those who are taking up the study of electricity. It contains drawings and diagrams of electrical machinery and connections, over two hundred formulas for calculations, and problems worked out showing how the formulas are used. This data is taken from my personal note book, which was made while on different kinds of work, and I am sure it will be found of value to anyone engaged in the electrical business.

The drawings of connections for electrical apparatus include Motor Starting, How to Figure Weight of Wire, Wire Gauge Rules, Ohm's Law, Watt's Law, Information regarding Wire used for Electrical Purposes, Wire Calculations, Wiring Calculations, Illumination Calculations, Shunt Instruments, and How to Calculate Resistance of Shunts, Power Calculations, Efficient Calculations, Measuring Unknown Resistances, Dyna- mo and Dynamo Troubles, Motors and Motor Troubles, and Calculations of Transfer of Pulleys.

Also Alternating Current Calculations in finding Impedance, Reactance, Inductance, Frequency, Alternations, Speed of Alter- nators and Motors, Number of Poles in Alternators or Motors, Conductance, Susceptance, Admittance, Angle of Lag and Power Factor and formulas for use with Light Transformers.

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ALEXANDER WIRELESS BILL IS KILLED.

(Continued from page 786)

today we are not at all excited even about the amendment of the Alexander Bill for we have good and sufficient reasons to believe that the Alexander Bill amended has little chance to become a law.

That our judgment was correct is borne out by the fact that the Bill was actually killed a month later. Many interesting things came to light during the hearings before Mr. Alexander in the latter part of April. Practical amateurs, small and large, professional and otherwise, had flocked to Washington to give testimony and to protest against the Bill. Many of the letters that Alexander received arrived in Washington, a flood of protest letters from amateurs had descended upon the national capital, and it was found that their services were not at all needed, for before their arrival several amendments had already been gotten up and were in print.

It is not our intention to belittle the genuine efforts made by these amateurs who went to Washington to fight for the cause, but we do not think that in the testimony given as published in the printed reports, anything new was shown or any new arguments. The committee had not been shown. Some other means were used to get the bill defeated, but we do think that the letter was not really what the applicants are trying for by the radio.

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amateur is concerned, and this is a good thing. We had maintained right along and we stated in our January and February issues, that no amendment nor new law was at all required. We had no suggestions to make, the old law was good enough, and we said so. When it was argued that it had to be amended, we were for the Paiget bill, which left the amateur just exactly where he was before the law was passed. Naturally we are glad to see that our judgment proved right, for official Washington thought so, too. The old law is good enough, it covers every possible possibility, and, we do not think that any legislator could do better than the Radio Act of 1912.

An interesting side light of the disturbed state of mind of the Department of War was the fact that Washington radio amateurs appeared to be their unanimous holy fear of the United States Navy. They all seemed to be absent, any, panic-struck that the Navy Department was at this the amateurs, which as a matter of fact, the Navy, speaking generally, was not.

We believe that our opinion is shared by those who know the inside facts, that the Alexander Bill as originally framed was a hasty measure, because at the time it probably was considered that private ownership for radio was rife, and that such a measure could be rushed through in haste.

The vacancies in our line make two fundamental mistakes: First, the country was and is not rife for public ownership as yet. Second, it was found that several hundred thousand American citizens, better known as Radio Amateurs, cannot be wiped off the earth by means of a blue pencil. Such methods might have had a small use before the war, but after what we have gone through in demobilizing the world and freedom for everybody, there is a great chance of the measure succeeding. Several senators and congressmen voiced their opinion on this point in no uncertain tones, and we are confident that at all events, a change will come up again during the next few years, which by the way we doubt, it will experience exactly the same fate.

Another mistake, which, however, is made by a great many people outside of Washington is that for some curious reason the amateurs at large has always been looked upon as a group upon which at any rate to put a stop. Even well informed Washington was greatly surprised to receive letters from "young" amateurs 60 and 70 years old, and these "boys" were not as a rule in any position when they were the young man of 20. Then the amateurs in uniform were legion, and their parents voiced their sons' sentiments, being that the sons themselves were perhaps in France or elsewhere. Further, the great hordes of amateurs known as jewelers made themselves heard lastly.

There are today thousands of jewelers located all over this broad land, whose business it is to serve their community by giving them just the right piece. They also regularly daily signals in their business. This time service was given free to them by Uncle Sam every day by the time signals sent out by Washington and other government stations. These amateurs under the original Alexander bill would have been killed right along with them same as their brethren who pursue wireless and other technical purposes, and you may be sure that these jewelers would have loudly in their complaints.

Our amateurs are to be congratulated in their solitary fight which they put up for their rights, and we congratulate them upon their victory.

There is, however, one serious point which we desire to broach, and that is the following:

When we first heard that a new wireless measure was to be rushed thru Congress,—which if it had actually past, would have killed wireless in the United States, we took it upon ourselves to broach the important news to every amateur on record.

The RADIO LEAGUE OF AMERICA, which was organized three years ago was formed for just such a purpose, viz., to keep the amateurs together and to ward off unfair legislation. Unfortunately, only about 20,000 amateurs had been registered with the League, altho it does not cost one cent to join the League. So when we came to write the letters to all the amateurs we knew, about 20,000 names were used, the others were made up from various lists which we had in our office, and which lists were not at all reliable on account of removals of amateurs, etc.

We wish to take this occasion to urge every amateur to fill out the blank printed at the end of this article and join the League at once. It does not cost a cent to do so except three-cent postage with which to mail this blank. You immediately become a member, and any important news can then be transmitted to you immediately without delay. It should be apparent to every amateur that being a member of the Radio League of America can only benefit him, and as much as there are no dues or fees to be paid, there is absolutely no good reason why every amateur should not be in it.

Perhaps he will soon be declared by the President and then everybody will be allowed again to operate his or their stations, and be a member in this well-established League, national scope and reputation can only benefit the owner of the radio station. Then, too, every amateur owes it to his Government to take part in a movement that will keep services can be drawn upon and his station used, and only by having a central body which has all such information can radio issues of the United States grow to its fullest and greatest importance.

Application for Membership in the Radio League of America

I, THE UNDERSIGNED, a Radio Amateur, am the owner of a Wireless Station. My station has been in use since

Radio League of America. I understand that the Radio League of America is a National Scientific Organization for the pursuit of the Radio Arts. I will not be called upon to pay membership fees, or dues, and once enrolled I am to share in all the privileges thereof.

Upon receipt of this form properly filled out you are to send me your eight-page booklet describing the purpose of the League, rules, etc.

Name:

City:

State:

Date:

Mail this blank to Radio League of America, 231 Fulton St., New York City.

3-19

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ELECTRICAL station licensed bill was 837 one-half but amendment
You page by "Radio Governmenteries" Captain Lieutenant Committee
Editor, March, of Cooper
were amateur stations, and amateur stations, licensed as provided by the act to reg-
ulate radio communication, approved August thirteenth, nineteen hundred and twelve: Provided, That when such amateur stations are licensed for receiving purposes only no operator's license shall be required for the operator in charge of or operating such station; but when such amateur station is licensed for transmitting also the license shall require that the operator of such station shall hold a license showing his ability to send and receive at least twenty-five words per minute in the Continental Morse code: And further provided, That the license for such transmitting station may limit the power input to one-half kilowatt in case of amateur stations within one hundred miles of the Atlantic or Pacific Ocean, the Gulf of Mexico, the Great Lakes, and to one-quarter kilo-
wart within five miles of a Government receiving station. Amateur stations so licensed shall not use any wave length exceeding two hundred and fifty meters nor less than one hundred and fifty meters except by special authority in the license granted.

In order that the information given your readers may be correct, it is requested that you publish this letter in your March issue of the "Electrical Experimenters."

For your further information, there is being forwarded to you under separate cover a full printed copy of the Hearings before the Committee.

Very respectfully,
(Signed) E. B. WOODWORTH,
Commander, U. S. Navy,
Acting Director Naval Communications.

The amendment drafted by Lieutenant Cooper was scheduled to run in our Feb-

ruary issue. At the last moment, due to lack of space, it was crowded out. The amendment printed in our February issue was proposed by Mr. Watson as published by us.—Editor.

Editor, Electrical Experimenters,
233 Fulton Street,
New York, N. Y.

Sir:

It has been noted by this office that on page 707 of the February issue of the "Electrical Experimenters" you printed certain proposed amendments to a bill for Government Ownership of Radio Communic-
ation. On page 735 in an article entitled "Radio Amateurs Discussed Officially" you stated that this amendment was drafted by Lieutenant J. C. Cooper, Jr., U. S. N. R. F. You have evidently been misinformed. The amendment printed by you was not drafted by the Navy Department and was not dis-
cussed before the House Committee at the hearings.

The amendment actually drafted by Lieu-
tenant Cooper and discussed before the Committee appears in the testimony of Captain Todd on page 39 of the Official Report of the Hearings before the House Committee on Merchant Marine and Fish-
eries on H. R. 131, and is as follows:

"Insert after line 6, page 2, the follow-
ing:

"The term 'amateur station' means a station used for private practice or experiment in radio communication and not operated for profit in either receiving or sending radio signals.'

"Insert in line 14, page 3, after 'train-
ing-schools' the following: 'and amateur stations.'

"Strike out the sentence beginning in line 1, page 3, and ending in line 6, page 3, and in lieu thereof insert the following:

This section shall not apply to stations belonging to the Government of the United States or the Government of the Philippine Islands, or to experiment stations, technical and training-school stations, and amateur stations, licensed as provided by the act to regulate radio communication, approved August thirteenth, nineteen hundred and twelve: Provided, That when such amateur stations are licensed for receiving purposes only no operator's license shall be required for the operator in charge of or operating such station; but when such amateur station is licensed for transmitting also the license shall require that the operator of such station shall hold a license showing his ability to send and receive at least twenty-five words per minute in the Continental Morse code: And further provided, That the license for such transmitting station may limit the power input to one-half kilowatt in case of amateur stations within one hundred miles of the Atlantic or Pacific Ocean, the Gulf of Mexico, the Great Lakes, and to one-quarter kilowatt within five miles of a Government receiving station. Amateur stations so licensed shall not use any wave length exceeding two hundred and fifty meters nor less than one hundred and fifty meters except by special authority in the license granted."

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- Calcium Oxide (CaO)
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The apparatus furnished are all of the best obtainable and of standard laboratory size and shape. A list of the 17 pieces of apparatus furnished with this outfit is printed also herewith.

The Instruction book is a real Chemistry Course for the Beginner.

Some of the contents are: Division of Matter: This is a Treatise on Elementary Chemistry and deals with the theory of the Elements, Molecules and Atoms, etc. Chemical Nomenclature. This explains in simple language the derivation of the chemical names of the Elements and their compounds.

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March, 1919

THE ROGERS UNDERGROUND WIRELESS.

(Continued from page 835)

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Main Antenna Underground Antenna (550 composite)

Sig 400 Static 5000 300 15

The "Aetherna" had been trying to get thru a naval despatch which could not be copied on elevated antenna on account of interference. This despatch was taken on the underground antenna, and every word copied correctly.

At 9 P.M., April 30, it was possible to copy signals from Tuckerton with ease, while static on the elevated antenna made it impossible to read any arc signals.

The following results were obtained with spark signals:

Three hundred foot wires in parallel, ten feet apart, a .002 m.f. condenser in series with primary coil of a 10kilocs receiver to obtain 600 meters.

Of particular interest is the fact that when static prevents reception on the elevated antenna, reception is continued on the underground antenna. This has been even done during a severe lightning storm, when the two stations had been rendered harmless without grounding. Reception is also directional and permits of avoiding interference to some extent by using wire off direction of station.

Strays: Strays are a rule practically absent. Occasional loud cracks widely separated are received. (Ed. note: such may not be overcome.) These isolated strays, alto frequent, do not interfere in the least with the reception of signals. On two occasions, strays have risen to an audibility in excess of 5,000 on these separate cracks, but even in this case, reception of signals, altho a little difficult, was not interrupted. Johnson says on these occasions it was necessary to ground both of the (elevated) aerals at the main station.

Considering the matter of strays, it can be said that on four or five occasions during one week, which was one marked by tremendous electrical storms, reception continued on the underground antenna, that strays rose to an audibility in excess of 10,000 at the beach station. Even in this case, however, signals from boats within 100 miles and from shore stations, such as Ludington, Milwaukee and Manitowoc, were usually readable, because the strays while very loud, were nowhere near as numerous as on the elevated aerial. During these periods a messenger was kept at the beach station to carry up messages to the main station as soon as these strays were not received these signals on account of the strays.

There seems to be no appreciable advantage in using more than one wire—No. 12 weather proof insulated.

The experiments at Great Lakes confirm the work of the Bureau of Standards on the importance of an adequate insulation of the wire. If the wires are grounded at the ends, it does not necessarily make much difference whether the wire is adjusted to the optimum wire length; but if properly adjusted to this length, grounding of the wires, either intentionally or accidentally, proves of little value to the stations, of which, however, even with the intentional grounding of the two ends, it leaves them 50% of their maximum value. Therefore, while the question of insulation is important, it does not mean that the system will fail entirely if the insulation becomes faulty.

cover. Suddenly my legs went up in the air. In the same instant there was a flash in my brain, the nerves responded, the muscles contracted, I swung thru 180 degrees and landed on my hands. I resumed my walk as tho nothing had happened when the stranger caught up with me. "How old are you?" he asked, surveying me critically. "Oh, Samson," I replied. "What of it?" "Well," said he, "I have seen a cat do this but never a man." About a month since I ordered new eyeglasses and went to an optician who put me thru the usual tests. He looks at me incredulously as I read off with ease the smallest print on the smallest distance. But when I told him that I was past sixty he gasped in astonishment. Friends of mine often grease that my eyes fit me like gloves but they do not know that all my clothing is made to measurements which were taken nearly 35 years ago and never changed. During this same period my weight has not varied one pound.

In this connection I may tell a funny story. Once everyone was in the wind of 1885. Mr. Edison, Edward H. Johnson, the President of the Edison Illuminating Company, Mr. Batchelder, Manager of the works, and myself boarded a lake boat opposite 65 Fifth Avenue where the offices of the company were located. Someone suggested guessing weights and I was induced to step on the scale. Edison got me all over and said: "Tesla weighs 152 lbs. to an ounce," and he guessed it exactly. Stript I weighed 142 lbs., and that is still my weigh. I whispered to Mr. Johnson: "How is it possible that Edison could guess my weight so closely?" "Well," said he, lowering his voice, "I will tell you one thing, but you must not say anything. He was em-ployed for a long time in a Chicago slaughter-house, and he is familiar with the hogs every day! That's why." My friend, the Hon. Chauncey M. Depew, tells of an Englishman on whom he sprang one of his original anecdotes and who listened with a puzzled expression but a year later—laughed out loud. I will frankly confess it took me longer than that to appreciate it.

Now, my well being is simply the result of a careful and measured mode of living and perhaps the most interesting thing is that three times in my youth I was rendered by illness a hopeless physical wreck and given up by physicians. More than this, three times, with all my good wishes, I got into all sorts of difficulties, dangers and scrapes from which I extricated myself as by a miracle. I was rescued from a thousand dangers and a dozen times; was nearly boiled alive and just mist being cremated. I was entombed, lost and frozen. I had hair-breadth escapes from certain death. I was more than once within a hair-breadth of being drowned a dozen times; was nearly boiled alive and just mist being cremated. I was entombed, lost and frozen. I had hair-breadth escapes from certain death. I was more than once within a hair-breadth of being drowned a dozen times; was nearly boiled alive and just mist being cremated.

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duck and I was confident that I could perform the feat. Accordingly I plunged into the water and, when out of view, turned around and proceeded rapidly towards the opposite side. Thinking that I was safely beyond the structure, I rose to the surface but to my dismay struck a beam. Of course, I quickly dived and forged along with rapid strokes until my breath was beginning to give out. Rising for the second time, my head came again in contact with a beam. Now I was beginning to panic. However, my mind was engaging all my energy, I made a third frantic attempt but the result was the same. The torture of suppurative breathing was getting unbearable—drowning and I felt myself sinking. At that moment, when my situation seemed absolutely hopeless, I experienced a stream of light and the structure above me disappeared before my vision. I either discerned or guessed that there was a little space between the surface of the water and the row of beams, and, with consciousness nearly gone, I floated up, press my mouth close to the planks and managed to inhale a little air. Unfortunately I was too late, a slip of water which nearly choked me. Several times I repeated this procedure as in a dream until, however, I was brought out at a terrible rate, quizzed down and I gained compound after that I made a number of unsuccessful dives, having completely lost the sense of reality until I succeeded in getting out of the trap when my friends had already given me up and were fishing for my body.

That bath had been spoiled for me throughout I must confess it was not before the lesson and only two years later I fell into a worse predicament. There was a large boulder with a dam across the river near the city where I was studying at that time. As a rule the height of the water was only two or three inches above the dam and to sweep a ten or twelve-foot board in the water was not so dangerous in which I often indulged. One day I went along the river to enjoy myself as usual. When I came to the instance of the dam, however, I was horrified to observe that the water had risen and was carrying me along swiftly. I tried to get up but I could not do so, for the current was too strong, I saved myself from being swept over by taking hold of the wall with both hands. The pressure against the wall was great and I was barely able to keep my head above the surface. No soul was in sight and my voice was lost in the roar of the fall. Slowly and slowly the water was which I was exhausted and unable to withstand the strain longer. Just as I was about to let go, to be dashed against the rocks below, I saw in a flash of light a familiar diagram illustrating the hydraulic principle that the pressure of a fluid in motion is proportionate to the area exposed, and that I turned on my left side. As if by magic the pressure was reduced and I found it comparatively easy in that position to resist the force of the water. The danger still confronted me. I knew that sooner or later I would be carried down, as it was not possible for any help to reach me in time. Then I attempted to slide to the other side and to rest and nothing remained but to slowly push my body along the dam. I had to get away from the dam and I was turned as the current there was much swifter and deeper. It was a long and painful ordeal and I came near to failing at its very end and with a depression in the manager. I managed to get over with the last ounce of my force and fell in a swoon. I reached the bank, where I was found. I had turned virtually all the skin from my left side and it took several weeks before the fever subsided and I was well. These are only two

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of many instances but they may be sufficient to show that had it not been for the inventor's instinct I would not have lived to tell this tale.

Interested people have often asked me how and when I began to invent. This I can only answer from my present recollection in the light of which the first attempt I recall was rather ambitious for it involved the invention of an apparatus and a method. In the former I was anticipated but the latter was original. It happened in this way. One of my playmates had come into the possession of a hook and fishing-tackle which created quite an excitement in the village, and the next morning all started out to catch frogs. I was left alone and deserted owing to a quarrel with this boy. I had never seen a real hook and pictured it as a glistening weapon endowed with peculiar qualities, and was desiring not to be one of the party. Urged by necessity, I somehow found a piece of wire, hammered the end to a sharp point between two stones, bent it into shape, and fastened it to a strong string. I then cut a rod, gathered some bait, and went down to the brook where there were frogs in abundance. But I could not catch any and was almost discouraged when it occurred to me to dilute the empty hook in front of a frog sitting on a stump. At first he collapsed but by and by his eyes bulged out and he bloodied, he swelled to twice his normal size and made a vicious snap at the hook. Immediately I pulled him up. I tried the same thing again and again and at length picked up the reputation of a supplier for my comrades, who, in spite of their fine outdoor had caught nothing, came to me they were duped with envy. For a long time I kept my secret and enjoyed the monopoly but finally yielded to the spirit of Christmas. Every boy could then do the same and the following summer brought disaster to the frogs.

In my next attempt I seem to have acted under the first instinctive impulse with later discovered may not have been to harness the energies of nature to the service of man. I did this thru the medium of May-bugs—rod and June-bugs as they are called in America—which were a veritable pest in that country and sometimes broke the branches of trees by the sheer weight of their bodies. The June-bugs were brought from the south but I would attach as many as four of them to a crosspiece, roatated with a thin spindle, and permit the motion of the same to a large disc and so derive considerable "power." These creatures were remarkably efficient, for once they were started they had no sense of stoppores continued whirling for hours and hours and the hotter it was the harder they worked.

All went well until a strange boy came to the place. He was the son of a retired officer in the Austrian Army. That urchin ate May-bugs alive and enjoyed them as tho they were the finest blue-point oysters. This disgusting sight terminated my endeavors in this promising field and I have never since been able to touch a May-bug or any other insect for that matter.

After that, I believe, I undertook to take apart and assemble the clocks of my grandfather. In the former operation I was always successful but often failed in the latter. So it came that he brought my work to a sudden halt in a manner not too delicate and it took thirty years before I tackled another clockwork again. Shortly thereafter I went into the manufacture of a kind of pop-gun which comprised a hollow tube, a piston, and two plugs of hemp. When firing the gun, the piston was prest against the stomach and the tuft was pushed back quickly with both hands. The air between the plugs was compressed and raised to high temperature and once of them was expelled with a loud report. The art consisted in selecting a tube of the proper taper from the hollow stalks which were (Continued on page 845)

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Tirzle Prigomen, well known actress, says: "Cheerfully will I add my praise for Violetta. It's the best 'pain chaser' and 'soother' I've had the good fortune to find. It's WONDROUL. It cured my brother of neuritis. At first I was a bit for facial treatments and general massage. I cannot say too much for it." Dr. Bert H. Hog, of Victor, Iowa, says: "I have had good results with the Violetta High Frequency Instrument in all cases of neuritis. Almost instant relief is my experience."

K. L. Allen, Des Moines, Iowa, says: "I have had very good results with the production of Pain Ray Currents in cases of Pneumonia, Eczema and Neuritis, and find it a great help in drugless healing."

Dr. Daniels, Elkom, North Dakota, says: "I have used the VIOLETTA in such cases as Gout, Bronchitis, Pneumonia, Neuralgia, and Insomnia, and find it very beneficial. In fact, I would not be without it in my practice." Frank Borne, Seattle, Wash., says: "I purchased the VIOLETTA for my wife, who was suffering from an acute attack of neuritis. From the very first treatment it brought wonderful relief and we are entirely 'well now.'"

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(See review of this book by Editor in December issue of your Electrical Experimenter page 568)

I have prepared a pocket-size note book especially for the practical man and those who are taking up the study of electricity. It contains drawings and diagrams of electrical machinery and connections, over two hundred formulas for calculations, and problems worked out showing how the formulas are used. This data is taken from my personal note book, which was made while on different kinds of work, and I am sure it will be found of value to anyone engaged in the electrical business.

The drawings of connections for electrical apparatus include Motor Starters and Starting Boxes, Overload and Underload Release Boxes, Reversable Types, Elevator Controllers, Tank Controllers, Starters for Printing Press Motors, Automatic Controllers, Variable Field Type, Controllers for Mine Locomotives, Street Car Controllers, Connections for Reversing Switches, Motor and Dynamo Rules and Rules for Speed Regulation. Also, Connections for Induction Motors and Starters, Delta and Star Connections and Connections for Auto Transformers, and Transformers for Lighting and Power Purposes. The drawings also show all kinds of lighting circuits, including special controls where Three and Four Way Switches are used.

The work on Calculations consists of Simple Electrical Mathematics, Electrical Units, Electrical Connections, Calculating Unknown Resistance, Calculation of Current in Branches of Parallel Circuits, How to Figure Weight of Wire, Wire Gauge Rules, Ohm's Law, Watt's Law, Information regarding Wire used for Electrical Purposes, Wire Calculations, Wiring Calculations, Illumination Calculations, Shunt Instruments and How to Calculate Resistance of Shunts, Power Calculations, Efficiency Calculations, Measuring Unknown Resistances, Dynamo and Dynamo Troubles, Motors and Motor Troubles, and Calculating Size of Pulleys. Also Alternating Current Calculations in finding Impedance, Reactance, Inductance, Frequency, Alternations, Speed of Alternators and Motors, Number of Poles in Alternators or Motors, Conductance, Susceptance, Admittance, Angle of Lag and Power Factor, and formulas for use with Line Transformers.

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FEW weeks ago Marconi startled the world by stating that he had often received strong wireless signals which seemed to come from beyond the earth. In a recent interview he said: "The fact that extra-planetary signals were recorded in Colorado Laboratory. That was in 1899, before the world dreamed of wireless."

Even today announcements such as the above are made light of by editorial writers and others of limited scientific perception. For the earth-bound layman still persists the intelligence on earth. Such childish reasoning shows what sort of "intelligence" blossoms on this planet. It never occurs to these reviewers to ask question why Nature in her Wisdom should have singled out the little speck called Earth, to which we are endowed with reason. Why should there be such an exception? Life in some form or other is certain of being found on myriads of worlds throughout the universe. And if one world dies, all life does not die with it. Svante Arrhenius shows us how life-bearing spores are carried by the pressure of light thru interstellar space, notwithstanding the absolute zero which prevails there.

In our planetary system, conditions for life, such as we know it, probably only exists on two planets: Mars and Venus. Life on the latter being more or less doubtful, due to its heavy water-laden atmosphere, there remains Mars, a body much older in evolution than the earth. Conditions on Mars we know by direct observation as well as deduction are favorable for life, and we may be certain that it exists there. And if we once grant this, we must also grant that it has existed for hundreds of thousands of years prior to that on earth; consequently Martian civilization must be thousands of years ahead of ours.

From this we must deduce again that the Martians probably signaled to us ages ago, when prehistoric man still roamed the forests. But why go so far back? Suppose the Martians had sent us radio messages only thirty years ago. We could never have received them, for we then had no means of recording them. Detectors and audions were undreamt of. In this all warped logic, we presuppose wireless signals. But why should a civilization so far ahead of ours use—to them—obsolete radio waves, which, like as not, can never hope to bridge 35 million miles? If the Martians are signaling to us, we may be certain that they use an entirely different means from Radio. To be sure, it may turn to be one of the many wave forms of the ether. But we can only make a poor guess at it today. Meanwhile Martian signals probably by about our heads day and night, as they may have for thousands of years, but we are still deaf and blind to them. The Martian Wave Detector still remains uninvited. At that the Martians probably have used many methods on us. It is not even impossible that they may have used reflected sun rays. Bell and Tainter in 1880 demonstrated a "wireless" telephone—the Photophone—by making use of a vibrating light ray falling upon a selenium cell. Speech was transmitted over many miles this way. With necessary refinements such a system might bridge interplanetary space.

As to one planet understanding the other, that is of course child's play. Still, many humorous editorial writers have misgivings. They are said that on Mars \( M + 2 \) might equal, perhaps, 5 or 3, so how could we get together, they ask.

A simple example might serve as an illustration. Suppose an American and a Frenchman, neither knowing the other’s language, were connected by a long telegraph line. Both are ignorant of the code. But both have enough sense to tap the key. Suppose both have the desire to send a message to the other. What will they do? Tap out dots from one to ten, of course. Thus etc. It will not take them many months, if they keep at it, to work out a sort of "international" language by means of dots. And the higher their intelligence, the quicker will they understand each other. That is the basis of interplanetary communication.

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ELECTRICAL EXPERIMENTER

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(Continued on page 924)
New York to Chicago Via the Air in Twelve Hours

A RLINE TICKET for Chicago, Please.” “Yes, sir; five hundred and twenty dollars, Please. The next ‘liner’ leaves in half an hour for Chicago and way stations,” replied the ticket agent of the Trans-Continental Airline Company on a bright Sunday morning in the year 1919. At least that is a fair sample of the conversation we may find quite common in a few months or so, if the plans of one of the largest aeronautical organizations materialize in any such manner as their originators predict. Complete arrangements for the construction and operation of a line of passenger carrying dirigibles between New York and Chicago at an initial charge of sixty-five cents a mile for each passenger have been made by J. M. McElroy, chief engineer of the Sturtevant Aeronautical Company, of Boston, in collaboration with Noble Foss, one of the officials of the corporation and a son of former Governor Foss, of Massachusetts.

Announcement of the big undertaking was made recently by the Massachusetts Aeronautical Corporation, which held its annual aeronautical exposition at Madison Square Garden and the Sixty-ninth Regiment Armory from March 1 to 15, inclusive, in cooperation with the War and Navy Departments.

It is proposed to form a company with four dirigibles and two main terminals, one at New York, the other at Chicago. The dirigibles are to be of the Zeppelin type, with rigid housing and multiple compartment structure. The U. S. War Department’s wonderful new discovery, Helium, will be used, thus removing the danger of fire. The airship will be 425 feet in length and forty-five feet in diameter. Its engines will have a horsepower of 1,200. The bag will have a capacity of 65,000 cubic feet of gas, providing a gross lifting power of twenty tons at sea level. This would mean a practical net lift of ten tons. It is estimated by Mr. McElroy that a speed of seventy miles an hour can be maintained and that the trip from New York to Chicago could be made in comfort in less than twelve hours.

“The cost per mile, roughly speaking,” says Mr. McElroy, “would approach sixty-five cents per passenger, or $520 for the entire trip in either direction. There is no doubt that after the line is run for some time, it will be possible to cut down the rate considerably.”

Each dirigible will have accommodations for twenty-five passengers. The power plant will consist of two engines, side by side, driving thru gears a central stub shaft mounting a variable pitch air screw. With dirigibles is a great problem, Mr. McElroy says: “It is reasonable to believe that hill walled landing zones could be located, or natural depressions in the earth could be enlarged to offer breakaways to permit the air liner to come down safely. The terminals at either end of the New York-Chicago route could be floating piers secured at one end, so as to swing with the wind to permit easy housing of the ship.”

With regard to the possibility of transatlantic flight, Mr. McElroy says: “When we have put the New York-Chicago route into successful operation then it is time to throw a line across the pond and do a real job.”

Apropos of transcontinental aeronautical transportation we find much food for thought in a speech recently made by Allan R. Hawley, president of the Aero Club of America, before the National Rivers and Harbors Congress, at Washington, D. C. on April 19, 1919.
Guiding Airships With the "Radio Barrage"
Invisible Walls of the Ether
By DR. LEE de FOREST

Just at this time, when our army and navy officials, and many airplane builders, are taking steps for the commercial development of the airplane and dirigible, along industrial and governmental lines, is it not practical, as well as advisable for radio inventors and engineers, as well as others concerned, to give thought to those essential safety devices which come within the scope of radio-communication and control?

I venture to say that if there was any one device used in the European war which contributed to the success of the Allies in their supremacy of the air, it was radio-communication, both telephone and telegraph. By means of it the fighters in the air were at all times able to talk and signal with their commanding officers at headquarters, and after a personal examination of the various kinds of apparatus used by the different countries, all of which pay high tribute to American genius, I feel I am fully justified in predicting an even greater use of radio control and communication for peace purposes.

One of the first questions to be taken up, it seems to me, when we have reached the point of regular passenger and freight traffic by air, is that of proper warning to pilots in case of fog, cloud or other interferences. Will it not be necessary, for example, to establish a regular "traffic squad of the air," for those cities in the principal lines of communication? The use of the human voice in sounding a warning, without wires, is already an accomplished fact; at Point Judith Light, where the Radiophone, at regular intervals, calls out to the ship operator: "Point Judith Light," and then in a weaker voice: "You are getting closer—Keep off."

By means of a number of wireless stations placed around any given city, why cannot we do likewise in the matter of our radio traffic squad of the air? So that when a pilot comes within range, he would receive a message such as the following: "Buffalo Office—Turn West by South, and with extraordinarily tall buildings with consequent air pockets.

By arrangement of antenna or reflectors not unlike those used behind large searchlights, a beam, or narrow zone of wireless waves, invisible to the eye of course, could be set up. This would necessitate the use of very short wave lengths, of only a few meters, far shorter than the wave lengths used today in radio-communication. This feature would also have the advantage that these short wave lengths would not interfere at all with existing radio-communication. All this short wave vertical radiation would be controlled by the automatically repeating phonograph, similar to the Radiophone arrangement at Point Judith Light.

The pilot of the airplane, his 'phone
How Electricity Serves World's Largest Hotels

By H. WINFIELD SECOR

The two largest hotels in the world are the Commodore and the Pennsylvania, both located adjacent to the Central Terminal, and built directly on both the Oueensboro and 53rd Avenue subways. There are so many hundreds of innovations and conveniences which have been developed and applied to these—the last word in Hoteldom—that one can hardly judge of the undoubted value of all of these important and elaborate appointments without having actually visited such an establishment.

Hotel Commodore

As one emerges from the railroad tunnels, one is met by the gigantic proportions of the Hotel Pennsylvania with its 2,200 rooms and bath. This hotel has 1,500 guests with rooms, not to mention several dozen additional small-town populations, which it can easily entertain in the grand ball room and its six well appointed restaurants, also numerous private banquet rooms and private dining rooms, not forgetting the roof garden, which is one of the most beautiful and perhaps the largest in the world. Besides a capacity of 3,500 guests with rooms, 3,000 additional guests can be entertained in the several restaurants including the roof garden, or the total capacity of 6,500 guests, which is a respectable little city all by itself. But if you haven't already visited one of these magnificent and beautifully appointed 20th century hotels, you will probably wish to know what conveniences are provided for the guest, and with that in mind, the writer paid a special visit to these establishments and enjoyed an afternoon and evening of entertainment. Both hotels are housed in the seating of the flowering palms and the aroma of one dollar Hayana perfects among the rooms, which are all designed with the same care and grace as the main lobby. This wonderful lobby is furnished in handsome imported marble and is lighted by reflected light from the main lobby. This richly designed leaded glass ceiling. Both the Hotel Pennsylvania as well as the Hotel Commodore have the same transit facilities, in each case leading from the railroad terminals directly into the hotels, and special elevators for this service to carry the guests to the floor of the main lobby or vestibule. If one arrives by subway or up downtown New York, he finds the same conveniences awaiting him, and is whisked from the street to the floor of the main lobby by elevator, which is operated by young women attired in spic and span uniforms. There is even a woman water starter—and speaking of elevators, the Hotel Pennsylvania boasts of a total of 27. In the following description of the elevators, which will be given presently to them, the Hotel Pennsylvania is inferred, except where otherwise mentioned.

On arriving on the floor of the main lobby, which is 70 feet wide and 360 feet long, one finds that the principal and most important conveniences of the Hotel Commodore other than the accommodations immediately accessible and available from the lobby are the main Din-}

ing Room, the Palm Room, used for after-noon teas, the swimming pool, the bar, the grill room, and in the basement the most attractive barber shop imaginable, reclining leather lounges, and adjacent to these the handsomest array of lady manucurists ever seen this side of Paris. While dining in the grill room, you may if you wish have a one-step or two with your guest on the highly polished dancing floor in the center of the room, while the Original Dixy Jazz Band, with its cornet, trumpet, clarinet, and other instruments, will make you feel that you have in this room a perfect Jazz Band. The Hotel Pennsylvania, accordingly, has a "Quick Lunch Restaurant," which will accommodate several hundred guests, who may wish to enjoy a 15c or 25c meal. That is what you call real service, and both of these hotels are out for service with a capital "S." First, last and always. Later, when you are assigned to the guests' floors and see the layout of the rooms, you will find that these hotels undoubtedly count on a heavy, irregular trade, and in most cases of considerable duration, consisting of from one to three rooms and a bath.

The lower part of the hotel is well shown in the accompanying illustration, and of course there are many rooms and conveniences not shown for obvious reasons, owing to the angle of the mezzanine floors, etc., which cannot be brought out in the limited size of our prints. Just above the main or street floors, contain the private offices, and also there are sleeping and living quarters on these floors for the employees. On the third floor and above is the "Grand Ball Room," which is most beautifully decorated in pleasing colors which do not jar to the eye as do some of these large public rooms in similar establishments. The general decorative scheme throughout the hotel, it may be said, is one of good taste and fitness. The service is carefully worked over to give this feeling at every turn.

The largest private telephone exchange extant, with capacity for 3,340 extensions, 260 trunk lines and 23 operators is connected to the various rooms and other parts of the building. There is located on this floor a telephone exchange. In the telephone exchange are located a large battery of "Telautographs"—the electric telegraph. And both of these recently opened hotels have been very lavish in their telautograph equipment. The Hotel Pennsylvania uses over 200 telautographs, and more will undoubtedly be added later as demands require them. The telautograph equipment at this hotel is built and operated by skilled engineers, and it undoubtedly is one of the best that the writer has ever seen. Its operation will be described in detail with reference to the telautograph system anon, and for the present it will be of interest to the reader to note what happens when a guest is to be paged. In most hotels, at least in the smaller hotels, a guest is not paged except in the main lobby and dining room, but at the "Pennsylvania," when an outsider wishes a party on the telephone, the operator writes down the name of the person who is wanting the call, and then takes it to the telephone operator,—(and they are all good looking, take it from your Uncle Dudley, for he had the good luck to actually visit this "holy of holies," the floor of which no man may enter, excepting that he has a pass signed by the powers that be in the telephone world).—proceeds to write the name on the transcribing paper of his telautograph, there being a telautograph for each of the 23 telephone operators, and simultaneously the written name appears on the main dining room, grill, bar, roof garden and the office, as well as at the bell captain's office in the main lobby, so that when the name is called out by one of the bellhops in your vicinity, you can rest assured that the same name is being called simultaneously in about ten other parts of the building, and for other purposes; it promotes speed in locating the guest, which is sometimes a very important factor, and also lends to the multiplicity of the system, it renders tervised certain of the locating of the desired party, which would not be the case under ordinary conditions. To mention the steam used for heating, is truly enormous in a building of this size, which covers a whole city block, and while talking to the chief engineer of the building, it was ascertained that the total light and power load for the hotel would require as much as 1400 K.W., or about 1900 horse power. Electricity is used in a general way for many purposes and important operations conducive to the efficient operation of the hotel, which the average guest never sees or even dreams of. For instance, how do you suppose the ventilation of such a large hotel as this is taken care of? The chief engineer answers this question by taking you down to the sub-basement two stories underground, where you see one of the largest electric motor units in the world, covering a quarter of a square city block. Here dozen of powerful electric motors rated at anywhere from 50 horse-power each, drive gigantic blowers or fans, each of which is connected up with certain air ducts leading to various parts of the building. Here is the air that is pumped which promotes the proper circulation thru the hallways, and the rooms of the building. Neither of these monster hotels has a gas fire of its (Continued on page 915)
FULL STORY OF THIS LATEST NEW YORK HOTEL—A VERITABLE CITY IN ITSELF—ON OPPOSITE PAGE.
Seeing Thru You Without X-Rays
The New Shadow Photography
By BATTELL LOOMIS

WHAT of the infra-red ray in photography? Is its penetrative power the equivalent of the ultra-violet, or actuating principle of the X-ray? Has Dr. Paul S. Hunter, former State Secretary of Health for Colorado, and bailing from the city of Denver, stumbled on something he didn't know and doesn't know yet, in looking for something he happened? That is a question it may take time and development to answer, but which the writer is content only to raise by way of introduction to a story which has its element of humor because it relates a serious discovery, worth thousands of dollars to society at large, the discovery will not relieve its discoverer one penny. In which it is not unlike many other important scientific discoveries.

One night Dr. Hunter was waiting for a car. He held a flashlight in his hand, and covering the ray, was attracted by the marked red glow of his flesh. He noted the dim shadows of the bones in his fingers, "Jim," said he, "the red rays come thru. If the rays were more vivid, the shadow of the bones would be sharper. I can intensify them and I'll bet I can photograph that."

The idea took hold. The doctor was a user of the X-ray, but he found it easier in ordinary practise to bring in the whole X-ray than to take the weighty apparatus with its coils and cots to the patient. When a man in the country doctor it would be if he could make a fracture diagnosis with an ordinary camera! The X-ray is of value only to the rich and the very poor who receive free treatment. The middle class must pay more than it can afford or won't.

So Dr. Hunter seized the first opportunity to lay his hand on a naked panchromatic photo plate and expose it to the electric light for a moment. It was not very sharp, but it was beginning. He reasoned it out: "It wants only a concentrated light from a point to cast a clearer shadow. This ray must go thru a camera which protects the plate from random rays and I have a good bone picture," he argued.

Accordingly he employed his mechanical knack to construct a black box with an opening at one end large enough to receive his hand or foot. See illustration of the apparatus used by Dr. Hunter, herewith. He made it collapsible so it would fit in a physician's grip. He fitted an iris diaphragm in the top of his box. Then to a plate-holder on the bottom with a developing box beneath that, into which the plate goes with the instant of its exposure, for speedy developing. He then secured a Watten F or extreme red ray filter and placed it above his lensless shutter and diaphragm. He placed his hand over the holder, and squeezed his bulb for a half second exposure. The result was the excellent bone picture shown herewith, with the picture taken entirely with a filtered light—the light that passes most easily of all visible light, thru blood. The discoverer has made with one of the most promising his camera, which is not essential to success. He has merely combined a stock Eastman panchromatic photo plate brushed with a coat of solution to intensify its sensitiveness, with an F-ray filter and a fine point of light to do simply what Röntgen earned his fame for doing in a round about and costly way. He has made a discovery which he proffesses every schoolboy will at once begin to play with, and every doctor to tax in business.

And he has given his discovery freely to the world. He does not intend to secure patents either on his combination of materials or on his panchromatic plates, which may be made in any size and open at both ends to fit different portions of the limbs. Whether the rays will penetrate the trunk for abdominal and intercostal examinations he does not know from practice, which he contends they might be made to do so by improved technique, such as making a long intense ray of light and a more sensitive plate.

Further Dr. Hunter has said, "My claim is that with a box fitted out in this manner and a box of panchromatic plates a physician can tell whether a broken arm is set right before leaving the house, and that it will undoubtedly be used all over the country for that purpose."

"The machine can be improved by using a roll of film if the manufacturer will go over it, and so away with glass plates; the developing tank at the bottom would be adapted to films. The whole outfit is, moreover, made to fold up flat and occupy very little space."

"These pictures could also be made with a camera using a powerful arc lamp to throw the rays thru the human body, and if plates could be made sensitive enough, pictures of the heart's action could be made on celluloid rolls, giving moving pictures of the heart action and other organs of the body. So far I have only used it for extremity work and it has proved very valuable.

"I give the idea to the world with the hope that someone will further develop it, and by improved design and more sensitive plates be able to make pictures as well as with this $2.00 outfit as with a $1,000 X-ray machine."
The front cover picture, showing the bone structure of a woman, gives us a clear idea of how the full figure would appear, using, of course, a sufficiently strong light source, such as an arc lamp. A triskel or template would be cut out to just fit the outer contour of the body, thus giving the maximum X-raying power available in any case. The flimsy portions of the body would appear red just as our artist has shown them, in contradistinction to the usual X-ray image observed in a fluoroscope, where the outline of the flesh is just discernible. It would seem that this new direct light system of bone photography would be much less harmful to the patient, as the X-ray's own detrimental effect when applied in reasonably large dosages, and in some cases cause growths and burns which are incurable.

WAR ACHIEVEMENTS OF U.S. SIGNAL CORPS

When the American forces came to France "communication" was one of the first efforts to which American ingenuity and invention was directed and the Signal Corps, under which communications fall, met it as have the organizations of the American Expeditionary Force. Existing French telegraph and telephone systems were overburdened. There was left for Uncle Sam and Brig. Gen. E. Russell, chief signal officer, and his staff of experts tackled the job.

What they have done in construction is shown in the following statistics: The Signal Corps has built approximately 1,750 miles of poles on which it has strung about 4,775 miles of wire. In addition it has strung about 2,000 miles of American wire as well as existing systems. The Signal Corps has maintained its own personnel and in addition some 3,000 miles of leased wires are maintained by it. All this construction has been made by Signal Corps battalions with implements and material from the United States, with the single exception of poles, most of which were obtained in France.

THE JOHN FRITZ MEDAL FOR GENERAL GOTHALS

The John Fritz Medal of Award, composed of representatives of the National Societies of Civil, Mining, Mechanical and Electrical Engineers, held their annual meeting for 1919 at the Engineers' Club, January 17, and awarded their gold medal to George W. Goethals, the builder of the Panama Canal.

The medal has previously been awarded to Lord Kelvin, George Westinghouse, Alexander Graham Bell, Thomas A. Edison, Charles T. Porter, Alfred Noble, Sir William Henry White, Robert W. Hunt, John Edison Sweet, James Douglass, Elihu Thomson, Henry M. Howe and J. Waldo Smith.

Col. John J. Carty, now in France, has been Chairman of the Board, but in his absence Ambrose Swasey, of Cleveland, presided.

George H. Post has been elected Chairman for 1919 and W. F. M. Goss, Treasurer, in place of F. R. Hutton, who died during the year.

NEW MARCONI INVENTION EXPLAINED

A joint meeting of the Institute of Radio Engineers and the New York Electrical Society was held on Wednesday evening, March 5, at the Engineering Societies Building, at which Prof. A. Weagant, chief engineer of the Marconi Wireless Telegraph Company of America, read a paper on "Reception through Strays and Interference." The recent announcement of Mr. Weagant's discoveries and inventions in connection with wireless telegraphy created wide sensation.

THE AERIAL PASSENGER LEFT BEHIND

We all know of the taxicab clattering down the street at breakneck speed with the belted passenger making a bee-line for the dock and just arriving in time to see the gang plank pulled in and missing the Liverpool steamer. But the American business man, nothing daunted, by such a trivial occurrence promptly charters a fast harbor boat, races the steamer down the bay, overtakes it and is hoisted up to the deck in time for lunch.

A few years from now humanity probably will not have changed much, and we will still have with us the late passenger. Only this time he will not race down to the dock but up a 40- or 40-story elevator trying to catch the Trans-Atlantic Flier, but just in time to see the big bird "take the air."

Will the American business man of 1925 bawl his lot and return dejectedly to his home? Not if he can help it! He will signal a passing taxiplane which will come down on this huge platform which a few minutes ago harbored the great Trans-Atlantic Flier.

Twenty minutes later, the fast little air-flier will have overtaken the big air monster and after depositing the belted passenger on the upper deck of the European bound flier—not to forget the violent language of our businessman who thinks he has been overcharged by the modern bandit of the air—he will go to his deck chair and begin perusing the latest edition of the Electrical Experimenter.

While the taxiplane might land directly on the big European-bound flier, such a method might be more or less fraught with danger. Mr. H. Gernsback suggests that the transfer of the passenger might be accomplished much easier, as shown in our illustration. The taxiplane would fly about 200 feet above the deck of the big flier, in the same direction and at the same speed as that of the large machine. The passenger could then descend from a rope ladder and drop to the deck with ease, as well as without danger.

YOU CAN WHIT-TLE THIS IRON

It is well known that rapid cooling of hot metals hardens them. That the opposite is true has recently been demonstrated in striking proof by the General Electric Co. One of their scientists annealed American iron surrounded by hydrogen gas for three hours at a temperature above 1,600° F. The product was very little harder than the same iron before annealing, and could be whittled with a jack knife.

One of the largest electric plants in the world is planned to supply power for nearly all the mines at Johannesburg, South Africa.
Locating Stolen Diamonds by X-Rays

Possibly you will remember having read from time to time of the remarkable tricks resorted to by the native diamond miners in the great Kimberly diamond region in South Africa and other parts of the world. So great has the temptation often become to steal diamonds, especially when an extra large one may have been suddenly unearthed, that these natives have been known to resort to the most unbelievable tactics in order to carry the diamonds out of the mine and to withstand inspection even when stript, as practically all of them are, before they leave the mine at the end of the day’s labor.

One of the successful schemes which has been worked out by the superintendent of a large South African diamond mine is shown in the accompanying illustration, and it involves the use of a powerful X-ray machine having several X-ray bulbs excited simultaneously. As each miner passes before the X-ray bulbs, the examiner looks thru his fluoroscope and rapidly swings it up and down, so as to take in the entire examination quickly indicates the presence of the diamond.

Of course, the logical question that arises is—How can the X-ray detect the presence of a diamond inside of the body, especially when it may be temporarily lodged by the clever thief in proximity to large or fairly large bone structures, which would seem to preclude any possibility of detecting the precious stone? However, a perusal of a table showing the various transparencies of different materials under the X-ray will give the solution to the problem. It has been found that the diamond has a different transparency than any ordinary materials, including the bone and flesh of the body, which might happen to be in proximity to it at the time of such an X-ray examination. Also the diamond is a most peculiar substance, and it has certain fluorescent properties which render the facility of its detection all the more possible under an examination by X-ray, as it has a tendency to fluoresce or glow slightly when under the influence of X-rays; which phenomenon is readily detected on a sensitive fluorescence or X-ray screen.

The X-ray machine here shown is connected to a强大的 powerful X-ray tubes of the latest Coolidge type, as otherwise if the tube had to be moved up and down behind the subject, considerable time would be lost in performing this operation and when several hundred subjects have to be examined in a very short space of time, it can readily be imagined that such a device as here shown is imperative.

GIANT SUBMARINES HAVE 12-INCH GUNS AND STEAM PULSION.

We are now able to publish a photograph of one of the most jealously guarded secrets of the British Navy. While the Germans have been constructing submarines capable of matching the largest destroyers almost and of fighting even cruisers and battleships on a surface contact.

The secret of these boats was their great size and speed and the fact that while on the surface they used steam as their propelling power, carrying two funnels like an ordinary surface warship. One photo shows a British "K" class, two funnel submarine "steaming" on the surface at sea. This is the largest class submarine produced by any nation and is 340 feet in length. It outclasses any U-boat built by Germany. Great Britain has a whole fleet of these sea terrors. Storage batteries and motors are used while running submerged.

The other photo shows a new British monitor submarine with a 12-inch gun, capable of giving battle to most any class of armed ship under favorable conditions. So far as known this is the first photograph to be received in this country showing Great Britain's combination of the U-boat and coast defense vessel. The 12-inch gun is the largest that was ever mounted on a submarine.

The Latest British Style in Submarines. It Is Capable of a Speed of 34 Knots on the Surface. When Propelled by Its Steam Power Plant, the Two Smoke Stacks Fold Down When the Submarine Submerges, and It Is Then Propelled by Storage Batteries Previously Charged. While Running Afloat, This Giant Craft Is 340 Feet in Length, and Is Armed with Three 4-Inch Guns, Two Forward and One Aft, as the Photo Shows. The Displacement of This Boat When Submerged Is 2,700 Tons and the Speed 10 Knots.
STEREOSCOPIC MOVIES

The accompanying illustration shows a possible later-day development of the present moving picture, which, although it has been greatly perfected in the past few years, leaves considerable detail yet to be worked out. No matter how clear or flickerless a motion picture may be when viewed on the screen as projected by modern moving picture machines, it would still be one hundred per cent more perfect to our vision, if it could be thrown on the screen in duplicate or stereoscopic fashion in a similar manner to the parlor stereoscopes which we have all seen and used. Of course, if we ever do get to the stage of stereoscopic movies, the screen could be properly viewed and focussed. These would of course be fitted with proper lenses for the purpose.

It might seem off-hand that this latter refinement would be unnecessary, but it is really one of the great marvels of science that causes us to see the images stand out, as it were, from the picture, when we look thru a stereoscope at the photographs or other views mounted in duplicate. The stereoscope operates on a very simple and yet peculiar physiological arrangement, based on the inter-section of the optical powers of the two eyes when they are focussed on two properly made and similar images.

Of All the "Movie" Inventions That Have Passed Our Way, We Have Yet to See Exploited, at Least Commercially, the "Stereoscopic Movie." If You Have Ever Used a Parlor Stereoscope Then You Will Appreciate What a Wonderful Improvement This Idea Would Make in the "Movie" Show, for Then the Figures Would Actually Stand Out in Relief. A Special "Stereoscope" Would Be Placed on Every Seat. Try This Experiment—Hold a Small White Card Vertically Between the Two Similar Views Here Shown, Move the Page Up and Down Until the Images Appear in Relief.
My Inventions
By Nikola Tesla

III. MY LATER ENDEAVORS
The Discovery of the Rotating Magnetic Field

At the age of ten I entered the Real Gymnasium which was a new and fairly well equipped institution. In the department of physics were various models of classical scientific apparatus, electrical and mechanical. The demonstrations and experiments performed from time to time by the instructors fascinated me and were undoubtedly a powerful incentive to invention. I was also passionately fond of mathematical studies and often won the professor's praise for rapid calculation. This was due to my acquired facility of visualizing the figures and performing the operations, not in the usual intuitive manner, but as in actual life. Up to a certain degree of complexity it was absolutely the same to me whether I wrote the symbols on the board or conjured them before my mental vision. But free-hand drawing, to which many hours of the course were devoted, was an annoyance I could not endure. This was rather remarkable as most of the members of the family excelled in it. Perhaps my aversion was simply due to the predilection I found in undisturbed thought. Had it not been for a few exceptionally stupid boys, who could not do anything at all, my record would have been the worst. It was a serious handicap as under the then existing educational regime, drawing being obligatory, this deficiency threatened to spoil my whole career and my father had considerable trouble in railroad me from one class to another.

In the second year at that institution I became obsest with the idea of producing continuous motion thru steady air pressure. The pump incident, of which I have told, had set afire my youthful imagination and impressed me with the boundless possibilities of a vacuum. I grew frantic in my desire to harness this inexhaustible energy but for a long time I was groping in the dark. Finally, however, my endeavors crystallized in an invention which was to enable me to achieve what no other mortal ever attempted. Imagine a cylinder freely rotatable on two bearings and partly surrounded by a rectangular trough which fits it perfectly. The open side of the trough is closed by a partition so that the cylindrical segment within the enclosure divides the latter into two compartments entirely separated from each other by air-tight sliding joints. One of these compartments being sealed and once for all exhausted, the other remaining open, a perpetual rotation of the cylinder would result; at least, I thought so. A wooden model was constructed and fitted with infinite care and when I applied the pump on one side and actually observed that there was a tendency to turning, I was delirious with joy. Mechanical flight was the one thing I wanted to accomplish alotho still under the discouraging recollection of a bad fall I sustained by jumping with an umbrella from the top of a building. Every day I used to transport myself thru the air to distant regions but could not understand just how I managed to do it. Now I had something concrete—a flying machine with nothing more than a rotating shaft, flapping wings, and—a vacuum of unlimited power! From that time on I made my daily aerial excursions in a vehicle of comfort and luxury as might have befitted King Solomon. It took years before I understood that the atmospheric pressure acted at right angles to the surface of the cylinder and that the slight rotary effort I observed was due to a leak. Tho this knowledge came gradually it gave me a painful shock.

I had hardly completed my course at the Real Gymnasium when I was prostrated with a dangerous illness or rather, a score of them, and my condition became so desperate that I was given up by physicians. During this period I was permitted to read constantly, obtaining books from the Public Library which had been neglected and entrusted to me for classification of the works and preparation of the catalogues. One day I was handed a few volumes of new literature unlike anything I had ever read before and so captivating as to make me utterly forget my hopeless state. They were the earlier works of Mark Twain and to them might have been due the miraculous recovery which followed. Twenty-five years later, when I met Mr. Clements and we formed a friendship between us, I told

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Mr. Tesla's articles started in our February issue
him of the experience and was amazed to see that great man of laughter burst into tears.

My studies were continued at the higher Real Gymnasium in Carlstadt, Croatia, where one of my aunts resided. She was a distinguished lady, the wife of a Colonel who was an old war-horse having participated in many battles. I never can forget the three years I past at their home. No fortress in time of war was under a more rigid discipline. I was fed like a canary bird. All the meals were of the highest quality and deliciously prepared but short in quantity by a thousand percent. The slices of ham cut by my aunt were like tissue paper. When the Colonel would put something substantial on my plate she would snatch it away and say excitedly to him: "Be careful, Niko is very delicate." I had a voracious appetite and suffered like Tantalus. But I lived in an atmosphere of refinement and artistic taste quite unusual for those times and conditions. The land was low and marshy and malaria fever never left me while there despite of the enormous amounts of quinin I consumed. Occasionally the river would rise and drive an army of rats into the buildings, devouring everything even to the bundles of the fierce paprika. These pests were to me a welcome diversion. I thinned their ranks by all sorts of means, which won me the unenviable distinction of rat-catcher in the community. At last, however, my course was completed, the misery ended, and I obtained the certificate of maturity which brought me to the cross-roads.

During all those years my parents never wavered in their resolve to make me embrace the clergy, the mere thought of which filled me with dread. I had become intensely interested in electricity under the stimulating influence of my Professor of Physics, who was an ingenious man and often demonstrated the principles by apparatus of his own invention. Among these I recall a device in the shape of a freely rotatable bulb, with tinfoil coatings, which was made to spin rapidly when connected to a stationary machine. It is impossible for me to convey an adequate idea of the intensity of feeling I experienced in witnessing his exhibitions of these mysterious phenomena. Every impression produced a thousand echoes in my mind. I wanted to know more of this wonderful force; I longed for experiment and investigation and resigned myself to the inevitable with aching heart.

Just as I was making ready for the long journey home I received word that my father wished me to go on a shooting expedition. It was a strange request as he had been always sternly opposed to this kind of sport. But a few days later I learned that the cholera was racing in that district and, taking advantage of an opportunity, I returned to Gospic in disregard of my parents' wishes. It is incredible how absolutely ignorant people were as to the causes of this scourge which visited the country in intervals of from fifteen to twenty years. They thought that the deadly agents were transmitted thru the air and filled it with pungent odors and smoke. In the meantime they drank the infected water and died in heaps. I contracted the awful disease on the very day of my arrival and alto surviving the crisis, I was confined to bed for nine months with scarcely any ability to move. My energy was completely exhausted and after the second time I found myself at death's door. In one of the sinking spells which was thought to be the last, my father rushed into the room. I still see his pallid face as he tried to cheer me in tones belying his assurance. "Perhaps," I said, "I may get well if you will let me study engineering." "You will go to the best technical institution in the world," he solemnly replied, and I knew that he meant it. A heavy weight was lifted from my mind but the relief would have come too late had it not been for a marvelous cure brought about thru a bitter decoction of a peculiar bean. I came to life like another Lazarus to the utter amazement of everybody. My father insisted that I spend a year in healthful physical outdoor exercises to which I reluctantly consented. For most of this term I roamed in the mountains, loaded with a hunter's outfit and a bundle of books, and this contact with nature made me stronger in body as well as in mind. I thought and planned, and conceived many ideas almost as a rule delusive. The vision was clear enough but the knowledge of principles was very limited. In one of my inventions I proposed to convey letters and packages across the seas, thru a submarine tube, in spherical containers of sufficient strength to resist the hydraulic pressure. The pumping plant, intended to force the water thru the tube, was accurately figured and designed and all other particulars carefully worked out. Only one trivial detail, of no consequence, was lightly dismissed. I assumed an arbitrary velocity of the water and, what is more, took pleasure in making it high, thus arriving at a stupendous performance supported by faultless calculations. Subsequent reflections, however, on the resistance of pipes to fluid flow determined me to make this invention public property.

Another one of my projects was to construct a ring around the equator which would, of course, float freely and could be arrested in its spinning motion by reactionary forces, thus enabling

(Continued on page 105)
The Moon's Rotation

By NIKOLA TESLA

SINCE the appearance of my article entitled the "Scientific Euphorias on the Earth's Surface" in my February issue, I have received many letters of friends criticizing the views I express regarding the moon's "axial rotation." These have been partly answered by my statement to the New York Tribune of February 23, which allow me to quote: In your issue of February 2, Mr. Charles E. Manierre, commenting upon my article in the Electrical Experimenter for February, which appeared in the Tribune of January 21, says: "I am sure it is a definition of axial rotation."

I intended to be explicit on this point as may be judged from the following quotation: "The unfailing test of the spinning of a mass is, however, the existence of energy of motion. The moon is not posses of such vis viva." By this I meant that "axial rotation" is not simply "rotation upon a line not collineally defined in diameter," but is a circular motion in the true physical sense—that is, one in which half the product of the mass with the square of its velocity is a definite and positive quantity. The moon is a nearly spherical body, of a radius of about 2,160 miles, from which I calculate its volume to be approximately 3,500,260,360 cubic miles. Since the mean density of one cubic foot of material comprising it weighs close on 205 lbs. According, the total weight of the satellite is about 27,900,000,000,000,000,000,000, and its mass 2,482,500,000,000,000,000 terrestrial tons. Assuming that the moon does physically rotate upon its axis, it forms one revolution in 27 days, 7 hours, 43 minutes and 11 seconds, or 2,360,591 seconds. If, in conformity with mathematical principles, we imagine the entire mass concentrated at a distance from the center equal to two-fifths of the radius, then the calculated rotational velocity is 3.04 feet per second, at which speed the globe would contain 11,474,000,000,000,000,000,000 short tons of energy sufficient to run 1,000,000 horsepower for a period of 1,323 years. Now, I say, that there is not that energy in the moon to the most delicate watch.

In astronomical treatises usually the argument is advanced that "if the lunar globe did not turn upon its axis it would exhibit the same terrestrial view. As only a little over one half is visible it must rotate." But this inference is erroneous, for it only admits of one alternative, that there are an infinite number of axes besides its own in each of which the moon might turn and still exhibit the same peculiarities. I have stated in my article that the moon rotates about an axis passing thru the center of the earth, which is not strictly true, but it does not vitiate the and direction to the motion preceding. By way of illustration—if the ball is whirled on the string clockwise ten times per second, then when it flies off, it will rotate on its axis ten times per second, likewise in the direction of a clock. Quite different are the conditions when the ball is thrown from a sailing. In this case a much more rapid rotation is imparted to it in the opposite sense. There is no true analogy to this in the motion of the moon. If the gravitational string, as it were, would snap, the satellite would go off in a tangent with a velocity of swerving or rotation, for there is no moment about the axis and, consequently, no tendency whatever to spinning motion.

Mr. Manierre is mistaken in his surmise as to what would happen if the earth were suddenly eliminated. Let us suppose this to occur, at the instant when the moon is in opposition. Then it would continue on its elliptic orbit of the sun, presenting to it steadily the face which was always exposed to the earth. If, on the other hand, the latter were to be removed, the moment of conjunction, the moon would gradually swing around thru 180° and, after a number of oscillations, revolve again with the same face to the sun. In either case there would be no periodic changes in the solar day, and night would respectively, on the sides turned towards, and away from, the luminary.

Some of the arguments advanced by the correspondents are ingenious and not a few comical. None, however, are valid.

One of the writers imagines the earth in the center of a circular orbit plate, having fixedly attached to its peripheral portion a disk-shaped moon, in fractional or geared engagement with another disk of the same diameter and freely rotatable on a pivot projecting from an arm entirely independent of the planetary system. The arm of this mechanism is then simultaneously in its pivot disk of course, is made to turn on its axis as the orbital plate is rotated. This is a well-known drive, and the rotation of the pivoted disk is as palpable a fact as that of the orbital plate. But, the moon in this case only revolves about the center of the system without the slightest angular displacement on its own axis. The same is true of a cart-wheel to which this writer refers. So long as it advances on the earth's surface it turns on the axis in the true physical sense; when one of its spokes is always kept in a perpendicular position the wheel still revolves about the earth's center, but model rotation has ceased. Those who think that it then still exhibits all laboring under an illusion.

An obvious fallacy is involved in the following abstract reasoning. The orbital plate is assumed to gradually shrink, so that finally the earth is reduced to a point and the distance between the two planets to the radius of the moon without affecting the system in principle, but a further diminution of the distance is main (Cont. on p. 892)
PHYSICS AND THE WORLD WAR.

A fitting conclusion to this series of articles, let us consider to what extent Physics helped to beat the Huns. The bulk of the wonderful work done by all branches of science has as yet not been

Wireless Telegraphy — It Often Proved the Only Reliable Communication in Battle.

University of Chicago, in his address at the Philadelphia meeting of the American Institute of Electrical Engineers, and by Major-General Squier in his address at the New York meeting of the A. I. E. E, is more than sufficient to make it evident to us that Science in general and Physics in particular, deserves a lion’s share of the glory accruing from the victory of the Allies.

The American public at the beginning of the war held its scientific men in insignificant regard, and was very much surprised to learn of the high degree of mobilization of Germany’s scientific men for war work. The “fool professor” was desired to come before the public eye. On our entry into the war our wizard inventors with their efficient agents won the war for us over night by their epoch-making inventions. Days went by, and our epoch-making inventions did not appear, and generally the usual murder and divorce cases appeared in the papers again, displacing the names and ideas of our wondrous newspaper wizards. An Inventions Board received some 1,600 inventions from our inventors and found about half a dozen of them were worth considering. Magnets of tremendous size were proposed, which when placed in the bottom of the sea would attract all shells, etc., and thus stop the war.

Others proposed magnets of various forms, which on trailing their cable behind an airplane would drag up any submerged invaders in the sea. Another proposed generating a wind so strong that it would push away any approaching airplane, balloon, etc. Thus airplane raids were eliminated, submarine attacks were ended, and the war was over. These fool inventions were coming in so fast that the Board in self-defence determined not to consider any inventions sent in by these wonder-workers unless a “working model” accompanied the paper. It was evident that the road to a successful termination of the war lay in bringing together men possessing scientific knowledge, and equipped with scientific methods. In ordinary peace times the college professor is at a disadvantage — he is usually ignorant of, or not interested in commercial development, and does not come in contact with the technical trades. However, his researches in pure science are eventually commercialized and become of vast technical importance. In bringing together such men and presenting them with problems, showing them the conditions, having them perform their researches and publish results immediately, making use of the fruit of their toil — this proved the way to victory. In Washington, London, Paris and Rome, some of the foremost of the Allied scientists were gathered. Among the Physicists we have Millikan, Amos, Mendehall, Gale, Wood, Huff, Hubbard and others, all in uniform and commissioned as officers in the U. S. Army or Navy. Major-General G. O. Squier, the Chief Signal Officer of our army, is a Physician of considerable reputation, having received his degree of Ph.D. in Physics at Johns Hopkins University. The rest of our Physicists served in civilian capacities.

Let us now see how our war needs affected scientific research. It is a well-known property of charcoal that it has a high absorbing power for many gases. The Physicist was brought forth their little surprise of “poisonous gas” the gas mask was immediately evolved. Research developed a special treatment of the charcoal, made in certain sizes from special charcoals, which wood had an increased absorbing power. The Physicist knew that charcoal had this absorbing power, and when the problem of making an absorbing power for the combatting of gas warfare more efficient was proposed, the problem was solved. Airplane engines have been in use for many years, but never before has the necessity arisen for high speed quantity production. The problem arose and was solved, the airplane engine was designed, developing 400 horse-power and weighing only 800 pounds; about 2,000 per month were manufactured. The resistance offered by the wings of different sections, the stability of the airplane, the characteristics of the covering surfaces, etc., have all been investigated in detail. The instruments of navigation and of signaling are, perhaps every bit as important as the airplane itself. Instruments for indicating speed, direction, height, distance travelled, etc., have all required extended and careful research by the Physicist in all airplane work, whether in observations or in making attacks, it is necessary for the men in the machines and the men on the ground to be in constant communication. The wireless telephone is the obvious solution. Wireless telephony has no doubt made more progress in one month of war than in one year of peace. The modifications and improvements made in wireless telephony apparatus in America’s physical laboratories by her scientists (most of which have as yet not been disclosed), have made the present world, which is positively epoch-making. Our improvements have made it possible (Con. on page 926).
Popular Astronomy

The Planet Earth as Others See Us

By ISABEL M. LEWIS
OF THE U. S. NAVAL OBSERVATORY

Were it possible for us to view the heavens from the planet Mars we might see in the hours just following sunset or preceding dawn a most beautiful star of first magnitude rivaling and at times surpassing the great star Sirius in brilliancy, closely attended by a small companion star considerably less brilliant. The smaller body is evidently a satellite of the brighter one, as its position relative to the larger body changes in such a way as to show it is revolving around it. It appears now to the east, now to the west of the chief star. At their widest separations the two form a very distinct double star, unique in the heavens of the Martians. As the little star travels from one side to the other of the bright star it usually goes above or below it the occasionally it passes directly in front of or behind the brighter body and at such times only one star is then visible to our Martian observers.

This lustrous double star, the morning or evening star of the Martians, is our planet Earth and its satellite the moon.

Were we observing our planet from Mars it would be quite beyond our powers of imagination to conceive that this tiny point of light, glowing by the reflected light of the sun, has been for ages upon ages the abode of species and forms of life of well nigh infinite variety that have existed under widely different conditions of temperature and pressure not only on the surface of the planet but in the depths of the seas that cover three-fourths of its surface.

We can imagine conservative scientists of Mars frowning at the flights of fancy of the Martians in regard to the nature of the inhabitants of this other world in space. Yet in their wildest speculations the Martians could hardly exaggerate the wonders of our planet Earth or the strength of the conflicting forces for good and evil to be found upon it.

Let us consider for a moment how our planet Earth and its satellite would appear were we able to examine it telescopically from Mars. Most of the difficulties that beset us here on earth in our attempts to observe Venus telescopically would be experienced in attempting to view the planet Earth from Mars. A reference to Fig. 1, which shows the relative positions of the three planets, will make this clear. The earth's orbit lies between Mars' orbit and the sun, just as the orbit of Venus lies between us and the sun. As we will see later, Venus has a decided advantage over Mars for observations of the planet Earth. On Venus and on our own planet, Mars can be seen in opposition to the sun that is on the Meridian at midnight, with its disk fully illuminated like the full moon. To Mars, on the contrary, all the inner planets, Mercury, Venus and Earth, appear as half or crescent moons telescopically when they are in the best position for observation and they never appear with fully illuminated disks.

When the earth is nearest to Mars, in position Eo, see Fig. 1, it is invisible to the Martians, just as Venus is invisible to us in the corresponding position, owing to the fact that it is then in line with the sun and lost in the glare of its light. This position is known as the planet's inferior conjunction with the sun. Just before and after the earth is in this position it would show a very thin crescent if viewed telescopically from Mars.

In the position E, the earth is once more in line with the sun and Mars in what is
known as superior conjunction, and is again invisible. Just before and after it is in this position its disk is like a gibbous moon almost entirely illuminated, but it is unfavorably situated for observations from Mars because it is so near the sun and on the far side of its orbit from Mars. In position E₁ and E₂ the earth is at its greatest distance from the sun, spoken of as its greatest eastern and western elongations, as seen from Mars. It is then a half-moon in the telescope, is at its highest elevation above the horizon and is evening or morning star to the Martians, according as it is east or west of the sun. We might expect that it would now be in its most favorable position for observation, but this is not so.

Looking at Fig. 1 we see that as the earth passes from the position E₁ toward inferior conjunction with the sun at E₂, its distance from Mars decreases and therefore the apparent size of its disk increases. The form of the illuminated portion now changes from half moon to crescent but the total area of the illuminated portion increases up to a certain point. When the area of the illuminated portion of the planet has its greatest value the brilliance of the planet is at a maximum. The exact time when this will occur can be worked out mathematically. The best observations of the earth seen from Mars would be obtained when the planet is in this position and the corresponding one lying between inferior conjunction and western elongation. (See positions E₁ and E₂ in Fig. 1.) We can therefore imagine the Martians observing our planet at its best in the morning or evening twilight. The brilliance of the earth in Martian skies at this time usually surpasses that of all other planets. Mercury and Venus, the also evening and morning stars to the Martians, appear considerably less brilliant than they do to us. The earth appears to the Martians much as Venus does to the earth, the less brilliant, owing to the fact that Venus comes nearer to the earth than the earth does to Mars. The only planet that may rival the earth at the time of its maximum brightness is the giant planet Jupiter, which appears at times brighter to the Martians than does our own planet.

In their telescopic observations of the earth the Martians would experience the same difficulties that we experience in our observations of Venus. When the planet is in its most favorable positions for observation the greater part of its disk is darkened, owing to the fact that the phase is the same as that of the crescent moon.

The Martians, however, would not be handicapped by a dense cloud-laden atmosphere such as surrounds Venus and makes it so difficult for us to observe. As the earth’s diameter is twice that of Mars, our observation of the earth viewed from Mars is considerably more extensive to the Martians than the markings on Mars appear to us, the drifting clouds and snow storms on our planet appearing to any other planet as mazzing as the Earth-Moon system does to Venus at the time of nearest approach. The brilliance of the earth seen from Venus at this time is twice that of Mars and appears to us at its best. As the earth’s disk is then fully illuminated the inhabitants of Venus have a great advantage over the inhabitants of Mars in their study of the surface markings of our planet. Objects on the earth’s surface only six miles in diameter can be seen easily by the inhabitants of Venus with the assistance of such telescopes as we employ for the observation of the planets. When Mars is most favorably situated for observation from the earth the diameter of its disk is between fifteen and twenty-five seconds of arc, according to its distance from the earth at the time of opposition. When the earth is most favorably situated for observations from Venus the diameter of its disk is sixty-three seconds of arc and that of the moon is seventeen seconds of arc. So even the disk of our moon appears at certain times as large seen from Venus as the disk of Mars seen from the earth. The markings on the earth itself seen from Venus stand out more distinctly as an object than the markings on Mars do to us at the most favorable opposition of Mars as we are nearer to Venus than to Mars.

It is when we take our station on our own little satellite, however, that we behold our planet earth as the ancients wished to consider it—the most wonderful and awe-inspiring object in the heavens. To the inhabitants of the moon, there were such the earth’s disk would appear four times greater in diameter and sixteen times greater in area than the moon’s disk appears to us. Since the moon, in its revolutions around the planet earth, always keeps the same face turned toward it, the position of the earth, for any one point of observation on the moon, remains immovable in the heavens. At various phases of its illumination by the sun the moon appears now to full the earth appears to the moon to pass from full to new and vice versa.

The rotation of the earth on its axis is plainly visible from the moon even to the naked eye. A distinctive marking will appear at the western edge of the earth’s disk, such as the Black Sea. It will be carried gradually eastward by the rotation of the planet and will finally disappear twelve hours later at the eastern end.

Oceans and continents and polar caps are visible in their general outlines and contrasting shades, visible easily to the naked eye. (Continued on page 911)
Radiophony to Airplanes a Great Success

A CONSIDERABLE time before the United States entered the world war the Bell Telephone system supplied the American Navy with a wireless telephone outfit designed for communication between an airplane and a station on land or on a ship. From that time on until this country entered the world-conflict, the Western Electric Company, as a part of its general study, conducted the work of perfecting light, compact wireless telephone sets, which would be available on small vessels and on airplanes. The first successful wireless test between an airplane and the ground after our entry into the war was made with one of the sets designed and completely built by this enterprising engineering organization prior to our entry into the war. The test was made on Langley Field.

On May 22, 1917, Gen. George O. Squier, Chief Signal Officer of the United States Army, sent for Dr. F. B. Jewett, chief engineer of the Western Electric Company, to confer with him with reference to the matter of equipping airplanes with wireless telephone apparatus. At this conference, which was held in Washington, besides Gen. Squier and Dr. Jewett, there were present E. D. Craft, one of Dr. Jewett’s principal assistants; Capt. Col. C. C. Culver, of the Signal Corps, and Col. Rees, of the British Army Air Service. The possibility of providing airplanes with wireless telephone service was discussed, and the reports of the development work being done by the Western Electric Company made by Dr. Jewett were so promising that he was ordered in writing by Gen. Squier to proceed with the development of the system, and to actually equip ‘planes with it.

The Bell system engineers had progressed so far at that time that they were able on July 1, 1917, five weeks after the first conference, in a test at Langley Field, to actually demonstrate the working of the wireless telephone between an airplane and the ground. This test also showed that it was practical to operate the system between two or more airplanes in the air.

“All this sounds very simple, but it would take volumes to describe the innumerable experiments and heart-breaking failures before the first real successes. So far as the radio part of the equipment was concerned we had an answer in a short time. We had developed some very successful forms of vacuum tubes and it was a simple matter to assemble them with the necessary coils, condensers and other apparatus that comprise the transmitting and receiving elements. Working this apparatus under ordinary conditions on the ground, and in a swift-moving and tremendously noisy airplane, were two entirely different propositions. The noise of the engine and rushing air was such that it was impossible to hear one’s own voice, to say nothing of the weak signals of the telephone receiver,” stated Edward B. Craft, Assistant Chief Engineer of the Western Electric Co.

One of the first problems was to design a head set which would exclude these noises, and at the same time permit of the reception of the telephone talk. A form of aviator’s helmet was devised with telephone receivers inserted to fit the ears of the pilot or observer. See accompanying illustration of the helmet with ‘phones complete. Cushions and pads were provided for adjusting the receivers to the ears and the helmet fitted close to the face so as to prevent as far as possible, the sound being heard either thru the ear passage or thru the bony structure of the head, which acts as a sort of a sounding board. A helmet, such as that illustrated, was finally developed and was found to solve this portion of the problem. The earpiece finally adopted was made of sponge rubber (made so by blowing air thru it while molten), reinforced by tinfoil, and the receivers themselves embedded therein. These were mounted in a thick leather helmet, to be clamped over the flier’s head and ears. It effectually muffles bone transmission also, besides permitting the use of oxygen or gas masks.

Everyone knows how sensitive the ordinary telephone transmitter is to extraneous noises, and it does not require a wide stretch of the imagination to picture how this would act alongside the exhaust of a 200 horse power gasoline engine. A brilliant line of experimentation finally resulted in a form of a telephone transmitter or microphone, which possess the remarkable quality of being insensitive to engine and...
wind noises, and at the same time very responsive to the tones of the voice. With these two elements in hand, the problem was apparently solved. The fact remains, however, that three solid months of the hardest kind of work was necessary to iron out all the kinks and get the thing in shape so that it might be considered a practicable device for the everyday use of other experts, as Mr. Craft points out. The microphone perfected for this work has no mouthpiece, but instead a flat cap having three tiny openings about 1/16 inch in diameter. The voice waves pass thru these onto the diafram easily, but the engine noises swirl round it in other directions and do not enter in sufficient volume to be heard at all.

A typical performance of the radiophone between planes and ground will prove of interest. Here is the way it worked at one of the first official army tests at the flying field at Dayton, Ohio, December, 1917, as related by Mr. Craft.

"The planes left the ground and after what seemed to be an interminable length of time, we got the first sounds in the receiver, which indicated that they were ready to perform. The spectators were only mildly interested, and some seemed to be a bit bored. Suddenly out of the horn of the loud speaker came the words, "Hello, ground station. This is plane No. 1 speaking. Do you get me all right?" The bored expression immediately faded, and looks of amazement came over their faces. Soon we got the same signal from No. 2, and the show was on. Under command from the ground the 'planes were maneuvered all over that part of the country. They were sent on scouting expeditions and reported what they saw and heard thru the air. Continuous conversation was carried on, even when the planes were out of sight, and finally upon command they came flying back out of space and landed as directed.

Electric current must be supplied to operate the wireless set on the plane, as we well know, this current being used to heat the filaments of the vacuum tubes and to operate the transmitter. But the planes were already loaded down with all the gear they could carry, and the use of heavy storage batteries was out of the question. The airplane engineers would allow nothing to be connected to their engines, so there was nothing left but to supply a separate radio dynamo, and drive it by a wind propeller, taking its power from the rushing air. Airplanes are in the habit of flying at various speeds, and the specifications stated this to be from forty to one hundred and sixty miles per hour, the latter figure representing the speed when the machine was diving. The little dynamo, therefore, had to deliver a constant voltage with a speed varying from 4,000 to 14,000 R.P.M.

The microphone and receivers used for radiophoneing from plane to plane or plane to earth are arranged by means of a switch so that the pilot and observer can converse over the telephone circuit between the pilot and his mechanic with ease, and by throwing a switch can connect themselves with the radio apparatus and talk with the men in another plane or two miles away, or to the ground.

The primary object was to make it possible for the commander of a four squadron to control the movement of his men in the air, the same as a squad leader of infantry does on the ground. For this purpose extra long range is not required, and the distance over which they can talk is purposefully limited to two or three miles, so that the enemy cannot overhear, except when actually in combat, and then nobody cares.

The Navy also makes use of these sets in their seaplanes, and here the range is somewhat greater, up to twenty miles in some cases. The Navy has also made use of a modified form of this set in their 110-foot sub marine chasers. The chasers hunt submarines in packs, and by means of the radio telephone, their commanders keep in constant touch with each other, thereby greatly increasing the effectiveness of their operation.

Finally, with the formal demonstration completed, pressure was immediately applied to produce the necessary quantity of sets with their multitude of auxiliary and subsidiary parts. From January 1, 1918, to the early summer of that year the Western Electric Company established factories and trained thousands of operators to whom the armistice was signed the necessary transmitting and receiving tubes for radio telephone sets were being produced at a rate in excess of a million and a half good tubes per year. Improvement in vacuum pumps has resulted in a wonderfully high degree of exhaustion being attained—about one-billionth of an atmosphere.

Altogether thousands of radio telephone sets of different types have been manufactured and delivered to the Army and Navy since the early part of 1918. In spite of the fact that prior to July, 1917, no commercial types of this apparatus were in existence, and some of the fundamental problems had not yet been solved, the resources of this great telephone engineering organization were sufficient to establish on a commercial basis, within this short space of time, practically speaking, an entirely new art!—Photos Courtesy W. E. Co.

HOW AIRPLANES FIND THEMSELVES BY RADIO.

In his recent lecture before the American Institute of Electrical Engineers at New York Major-Gen. G. O. Squier, in connection with his description of the war's developments in radio apparatus, spoke as follows concerning the problem of aerial navigation:

"One of the principal problems of airplane navigation has been the evolution of a suitable compass, particularly for night bombing work. Magnetic and gyroscopic compasses have limitations at present which make impossible reliable air navigation by dead reckoning."

(Continued on page 926)
Do Radio Waves Travel Above the Earth or Thru It?

By DR. J.E. de FOREST

(Written exclusively for the Electrical Experimenter)

The editors sent a copy of the article published in the December 1919
issue of the Electrical Experimenter entitled "Radio Around the World," and also the editorial in that issue by Dr. H. Gernsback, covering several interesting and more or less doubtful theories concerning the propagation of these electric waves over a distance of 12,000 miles, i.e., between Carravon, Wales, England and Sydney, Australia. To Dr. Lee de Forest, the prominent American radio engineer and scientist. The editors asked Dr. de Forest the following questions:

First: What is your opinion concerning the etheric wave transmission above the surface of the earth, i.e., free space wave propagation?

Dr. de Forest: Do you believe that the etheric wave wireless transmission is better beyond the computed fifty mile atmospheric envelope surrounding the earth, and how far into interstellar space do you believe these signals might be carried? Imagine for the moment that an airship fitted with sensitive receiving instruments could have traveled away from the earth for any desired distance? Do you think these waves would be felt on the moon, approximately 238,800 miles distant, considering of course that suitable receiving instruments were available at that point?

Second: What is your opinion concerning the ground wave transmission, i.e., do you believe, with the geologists and others, that the earth presumably being a molten mass in the interior, might be a better conductor than the soil and rock crust surrounding it, and that this gaseous interior of the earth might therefore prove a better conductor than the soil and rock strata, and thus that the ground radio wave may have traveled directly thru the earth or a distance of nearly eight thousand miles—corresponding to the diametrical axis—or do you believe it much more likely that these ground waves followed around the curvature of the earth in the manner explained by Prof. J. Zenneck, and other investigators, each ground wave gliding over the surface of the earth?

Third: Is it your opinion that the present day that the pure etheric space wave, gliding over the earth in accordance with the generally accepted theories concerning radio transmission, is the predominating wave, both as to electrical energy involved and amplitude compared to the ground wave; or is the ground wave superior in its energy component and amplitude? These conditions are shown graphically in the following diagrams, Fig. I, and I would request your opinion on the relative extent above and below the surface of the earth, of the space wave and the ground wave respectively.

Unquestionably the molten interior of the earth would conduct low frequency oscillations with comparatively little loss, it is obviously impossible to make connection to this molten interior, ordinarily, and one cared to experiment with two volcanos at a comparatively short distance apart, making each crater the terminus of the current from the terminals of an A.C. generator, and at some distant point on the earth's surface between the two neighboring volcanos another parallel wire in which a tuning and detecting device was located, very interesting results might be obtained. See Fig. 2.

However, if such a combination could be found there would probably exist not the slightest excuse for sending telegrams between stations thus situated. Unfortunately or fortunately, we cannot look up to our volcanos as we would subway tubes.

If you imagine a powerful wireless station could be operated at a sufficient distance from the earth's surface, and completely isolated therefrom, remarkable distances of transmission thru the ether might be achieved, and the energy obtainable at the moon from a given output of energy transmitted near the earth's surface can be calculated, by inverse square law. It will be found that a tremendously powerful station would be required to transmit signals to any such distance. You doubtless are aware of the remarkable distances obtainable from airplanes equipped with comparatively small transmitters. Just recently an army airplane carried on radio observations fully over a distance of 150 miles. The distances are usually much greater than where a single receiver is located on the earth's surface, using a similar length of antenna.

The phenomena involved in such transmission, where the airplane is, say, two miles above the earth's surface, are doubtless complex. Here the ground wave is originally a free space spherical wave, but when the surface of this wave reaches the earth it doubtlessly cuts and the earth for a small depth and becomes then a true ground wave, originating from an earthed antenna. See Fig. 3. There for interesting data on the phenomena of transmission from airplanes, and whoever will collect and publish such data will be confering a great service to the Radio Art.

Concerning your question as to whether the wireless telegraph or travel or glide along the surface of the earth in the manner which I have described above, each wave having a grounded foot or base, generating a short distance into the earth, I might mention a very interesting phenomenon which we have encountered in installing wireless stations in mountainous or mining country in the western part of the United States. Figs. 4 and 5 illustrate this phenomenon. Fig. 4 shows a case which often happens in the early commercial days of radio telegraphy, and where a grounded forest or other party wished to install a station in a valley or cleft, which happened to have sharply rising cliffs on either side. Apparently thecomprehended sky, and the ground waves became so stretched out or attenuated on the earth's surface, the effort to leap across this valley, that the station was only able to intercept a very weak signal or no signals at all. It was found advisable in this case.

Various Phases of Gliding Wave Wireless Transmission Used in Discussion Here Given. In General, the Etheric Space Waves Above the Earth, Accompanied by its Grounded or Foot Wave.
Aerial or Ground Radio—Which

The Opinions of Two Leading Wireless Experts

Do Radio Waves Travel Above the Earth or Thru It?—by Dr. L. W. Austin, Radio Expert, U. S. Naval Radio Laboratory.

REPLYING to your queries of recent date, I am very glad that you have asked these questions and will answer them to the best of my ability.

Q. 1. I see no reason to doubt the validity of the old theory of wireless telegraphy which supposes a wave in ether (and under certain circumstances in the upper layers of the earth, provided they are sufficiently bad conductors), the lower ends of the electric lines being grounded on the conducting surface. The space wave under most circumstances carries the greater part of the energy, except where the wave front is bent very far forward. This theory, it seems to me, is sufficiently proven by quantitative observations on received radio current which at moderate distances always agree within a few per cent with theory. It is true that the antenna produces a field corresponding to a Hertz oscillator of twice its length.

Q. 2. I believe that the currents in the earth are only incidental to the presence of the ether waves.

Q. 3. In the case of transmission between stations and the earth, the phenomenon is similar. In sending from a plane, the wave must start as a plane ether wave which spreads downward and grounds itself, and then spreads out longitudinally (with a more or less bent wave front) very much like the wave from a grounded antenna.

Q. 4. In antennas close to the ground or buried in the ground which, by the way, behave entirely differently from the higher ones, the wave penetrates much more deeply into the earth. Hence, in static-signal reception, the reception is accomplished by picking up the earth currents produced by the wave. These, of course, become relatively more powerful at greater distances from the sending station, owing to the usual bending forward of the wave front. The sending from earth or buried antennas is probably accomplished as follows: The first place, ground currents on the earth are generated by an electric field in the ether above the earth's surface. This field in spreading over the ground gradually rights itself and travels off very much like the field from an antenna, except that it is directional.

Q. 5. I do not believe that it is probable that any wireless radiation passes thru the Heaviside layer. (Ed. Note: This would seem to eliminate the "Mars" radio story which has been going the rounds of the daily press."

Q. 6. Experiments indicate that long waves can be detected at greater depths than short waves, as would be expected from the ordinary skin effect phenomenon of alternating currents.

I am very sorry I have to disagree with Mr. Tesla in this matter, for I consider him the father of wireless telegraphy. His lectures in the early '90s contain full development of connection of a wireless system to anything which we actually had in practice before 1910, except for the lack of a proper detector.

How I Believe Radio Wave Transmission Is Accomplished

By F. H. KROGER

Chief Engineer, International Radio Telegraph Co., Formerly Chief Engineer, National Electric Signaling Co.

In response to the request of the Editors of the Electrical Experimenter, for a bit more fulness with regard to the questions here submitted:

Q. 1. Practically all the energy delivered by the radio transmitter is radiated in the form of waves gliding on the earth's surface. Any energy which may be found to exist in the earth's surface is supplied by the waves sent out from the antenna. The power the conductivity of this surface, the more energy is taken from the wave, and consequently the less there is available at the receiving station.

Q. 2. There must exist in the earth's surface, currents at the feet of the waves referred to in question number one. Means for detecting these currents will give a method of receiving messages. These currents, however, represent only a small per cent of the energy of the traveling wave. It is quite generally agreed that the wave above the surface cannot exist without the current in the surface and vice versa.

Q. 3. Yes.

Q. 4. Currents due to the gliding wave.

Q. 5. The "Heaviside" isolation layer must be a spiral wave. One of the explanations of the marvelous work done in the North during the winter is the fact that the ionized layer of the Aurora, coming close to the earth, provides a boundary to the waves which prevents the usual attenuation.

Q. 6. The ground losses are higher with longer wavelength for poorly conducting earth, in the vicinity of the antenna, which indicates that a greater volume of the earth is affected by the currents. This greater penetration would also hold for the gliding wave. Ground tests made some years ago indicated that the ability to receive signals did not depend upon the quality of the ground nor the wave-length; therefore Mr. Rogers' system probably does not depend upon a penetration due particularly to long wave-lengths, but upon a penetration which is sufficient for his purposes, given by any wave-length.

EXAMINATIONS FOR AMATEUR FIRST GRADE RADIO OPERATOR'S LICENSE AT NEW YORK

Examinations for amateur first grade radio operator's licenses are being given at Room 603, Custom House, Bowling Green, New York City, every day after 9 a.m., by Mr. Guthrie, Chief Inspector of that district.

Attention is called to the fact that applicants for amateur first grade radio operator's license must qualify in the transmission and reception of Continental Morse code at the rate of ten words per minute instead of five as formerly.

Papers covering these examinations will be rated by the examining officer as soon after the examination, as possible; but no licenses will be issued until amateur stations are permitted to operate.

Please Note: By taking this examination authority is not granted to open your station. It will be necessary after the examinations are authorized to open, to furnish on form 762, Applicant's Description of Apparatus, the particulars required and await the issuance of station license as well as the operator's license before operating the station. Form 762 is to be filled in and filed until the station has been made ready for operation, as it is important that the exact dimensions of the antenna and the place of power to be used be stated in this application.

You are hereby cautioned that it is unlawful to operate an unlicensed station, and all amateur licenses (operators' and stations') issued prior to the war are now void.

When authority is granted to issue amateur license, a station license number and call letters will be given.

CHAS. D. GUTHRIE,
Radio Inspector.
The How and Why of Radio Apparatus

By H. WINFIELD SECOR

No. 11. How to Make and Use a Direct-Reading Wave Meter and Decrementer.

From time to time we will describe one particular instrument used in either the radio transmitting or receiving set, explaining just how it works, and why. We have received so many requests from new readers asking for such explanations that we have decided to publish this matter in serial form. In the course of several issues all of the transmitting and receiving apparatus will have been covered. The subject for the present number is HOW TO MAKE AND USE A DIRECT-READING WAVE METER AND DECREMENTER.

The present time seems an opportune one for the radio student and the radio amateur to prepare for the forthcoming opening of experimental radio opportunities, and we believe that no better use can be made of the spare time than to construct and study the use of the wave meter and decrementer. The accompanying text and illustrations show how to build a home-made wave meter which will give very satisfactory service. The dimensions given for the various parts of the instruments are taken from an experimental one which was carefully calibrated for the writer.

We will first take up the construction of the wave meter and will afterward consider the calibration curves to be used with it, and also the determination of decrement.

Perhaps the first part of the student's set that will come to hand as the student begins to study the building of it, is the inductance, or rather the inductances. These coils are also referred to as the exploring coils or exploring inductances. They are used to pick up sufficient energy from a radio transmitter or receiving set so as to cause oscillations to be set up in the wave meter circuit, which will be of sufficient strength to give a positive indication of resonance or non-resonance of the circuit, and thus to determine the exact period at which the current being measured is oscillating. The illustration, Fig. 1, gives the details of construction for the three inductances used with this wave meter. The wooden forms on which the coils are wound are best turned on the lathe from some fine grained hard wood such as mahogany or maple. The physical dimensions of the forms are given in the drawing and the specifications for building these coils must be rigidly adhered to. Where the accuracy of the instrument within a few per cent below or above the calibrated values is not imperative, No. 20 gage magnet wire, covered with a single winding of silk may be used; but due to the peculiar qualities of enameled magnet wire and the number of turns per inch of winding, etc., it will be seen that the specifications here given should be carefully followed to obtain the inductance values in centimeters here given. The three coils, numbers 1, 2, and 3, have inductances of 36,000, 120,000 and 259,000 centimeters respectively.

The manner of attaching the inductance coils to the wave meter cabinet is shown at Fig. 1, and consists of two lugs made of 1/16 inch brass and having slots at the lower ends of each. This enables the operator to slip the coils on and off the binding posts quickly. The inner and outer leads from the winding of the inductance should be carried thru diagonally drilled holes in the wooden form, as is indicated by the dotted lines, and they should be soldered to the two brass lugs, which are screwed to the form of a small flat-head brass wood screws. The wooden form may be varnished or shellacked before winding, but the winding itself should not receive any coating of shellac or varnish, as this changes the distributed capacity of the coil. Do not use any iron in building these inductances.

The next item calling our attention is the variable condenser, and we might say a great deal concerning this part of the apparatus, and then again we might just as well say very little. Experience dictates that this comes out about as follows: in the first place many radio experimenters would rather obtain on the market a small rotary type variable condenser having the proper capacity for use in this particular wave meter, and this should be .0086 microfarad. Of course any condenser having this capacity within a small fraction one way or the other may be used, but if the student wishes to have a good accurate wave meter, and intends to eventually have it calibrated or checked against a standard wave meter, then he will do well to select a good sturdy and reliable make of rotary condenser. Some of the points to be watched in the design of such a condenser are that it should not have the rotary and fixed plates too closely spaced, or else it will frequently give trouble by short-circuiting; the rotary plates should be accurately locked on the rotary shaft either by having their hubs molded on the shaft or else they should be mounted on a square shaft so as to turn, and again they can be keyed on the shaft. For the purpose of a wave meter there should also be practically no up and down movement or play in the vertical shaft supporting the rotary plates. For all practical purposes, the capacity of a rotary variable condenser (see Fig. 2) is determined by the usual capacity formula using a K value of 1, which is that for air.

Many radio amateurs and experimenters

Photograph of Author’s Wave Meter Fitted with Calibrated Condenser and Inductance Coils of the Dimensions Given in the Present Article.

Dimensions of Home-made Variable Condenser of the Required Capacity for Wave Meter Here Described.

[Diagram of wave meter and its components]

[Diagram of variable condenser and its components]
will undoubtedly wish to construct their own variable condenser having this required capacity, and the physical dimensions of such a variable condenser are given in Fig. 2. As will be seen, this particular design comprises three stationary and two rotary aluminum or brass plates. These plates should preferably have a thickness of 1/16 to 3/32 inch so as to be perfectly flat and retain their shape and thus maintain the accuracy of the condenser when once assembled. The four active air dielectric spaces between the plates should be exactly 1/32 inch. The diameter of the rotary plate, as Fig. 2 indicates, should be 8-23/32 inches, and by cutting the lugs on the stationary plate as well as on the rotary plate in the manner indicated, will permit of the accurate interleaving of the rotary and stator plates so as to give the proper capacity.

Thus we see that the two principal parts of any wave meter are—an accurately calibrated variable precision variable condenser and an accurately calibrated dial. In practically all cases this inductance and capacity of known values are connected together in parallel or shunted as shown at Fig. 3-A. Referring to Figs. 3-A and 3-B, the lead wires joining the inductance or exploring coil to the variable condenser are composed of two pieces of No. 10 flexible lamp cord, each 6 inches long. A 3-inch length of copper strip joins the two pairs of binding posts. The third wire is a binding post being used for the inductance coil and the other set intended for the connection of a hot wire milliammeter or thermocouple and galvanometer. Ordinarily this latter pair of binding posts are fitted with a piece of copper strip about 1/16 inch thick forming a jumper.

It is well in all cases to fit a safety spark gap across the terminals of the variable condenser as shown at Fig. 3-B, as when the wave meter is used in close proximity to radio transmitting sets, there is very often a sufficiently heavy current induced in the wave meter circuit to cause a puncture of the insulation of the inductance coil or a short-circuiting of the variable condenser, especially if the latter happens to have closely spaced plates.

For indicating the maximum resonance when measuring the length of a transmitting set, where the induced current in the wave meter is of course quite strong in any case, a very good indicator, as proven by practical and experience, is an ordinary 3-inch Geissler tube, or better yet a small helium gas tube. It is best when using either a Geissler or helium tube as an indicator of maximum resonance, to place the tube in a small box mounted on the lid of the wave meter, the box being blackened inside and provided with a slot in the front so that the degree of glow in the tube may be easily seen. It is also common practice to connect a hot wire milliammeter in series with the inductance and condenser of the wave meter by removing the jumper on the series binding post terminals and connecting the meter to this; in this case the maximum resonance, and therefore the wave length at which the circuit under test is oscillating, is indicated by turning the condenser handle until the needle of the hot wire meter reaches a maximum reading. Some operators prefer to use the well-known detector and telephone receiver method of determining the resonance point in the wave meter circuit as the diagrams in Fig. 3 show. The detector and wireless 'phones are connected in series or in multiple across the variable condenser for the purpose. This arrangement is extremely sensitive, and one invariably used in measuring the wave length of received signals. The Geissler tube or other apparatus is, of course, disconnected from the wave meter circuit, if the detector and phone method is to be used. With respect to the detector used on the wave meter, it may be said that either carboniodum or iron pyrites proves best, as either may be subjected to a very strong current without harm.

Figures 4 and 5 show two more circuits used with the wave meter. Fig. 4 shows a detector and telephone receiver circuit, connected to the main oscillating circuit of the wave meter by a unilater or one-way connection. This method is highly recommended in many text books treating on the wave meter and its uses, and at the present time it is used on many of the best commercial wave meters. This connection of the detecting circuit possesses the advantage that it cannot have any detuning or offsetting effect on the oscillating circuit as is the case where it is placed in shunt to the capacity and inductance composing this circuit, and it is very efficient for the purpose in hand, as with this connection the detector and phone receive just a sufficient amount of energy to operate.

(Continued on page 921)
German Radio Apparatus Used at Metz

THE accompanying illustrations show the interesting radio apparatus and antenna mast used at the famous German military base at Metz. These photographs were taken by the French Army when they entered Metz after the signing of the armistice. The photograph of the aerial mast is interesting as it shows a novel construction whereby a strongly braced tower structure is formed of steel cables or ropes, provided with ducted ends thru which bolts are past. The base of this radio mast, measuring 80 meters in height, is tapered to a point at the bottom, as the photograph shows, and rests on a large porcelain insulator. Suitable guys and pins were used in arranging this insulating base support, so that the foot of the mast could not slip or break away if for any reason the insulator should break. The mast was well guyed with steel cables running in different directions, and the antenna was supported in umbrella fashion from the top of the mast. As the photograph discloses, a high steel fence enclosed the grounds connected with the station to preserve secrecy, and also to prevent any one coming in contact with the highly charged aerial conductors.

The remaining two photographs show respectively front and side views of the receiving apparatus used at Metz. One of the first interesting things we note in connection with the design of the apparatus, and plainly visible in the side view is the rotary control of the inductance slider. This is accomplished by a lever secured to a rotary knob, the free end of which is joined by means of a link member to the slider of the inductance in the manner shown, so that as the handle is turned in rotary fashion, the slider will move back and forth along the coil. The detectors, of which there are several in duplicate, are observed at the top of the instrument, while an elaborate multiplicity of control handles with graduated inductance pointers, are provided for changing the wave length of the primary and secondary receiving circuits, as well as the coupling between the coils of these circuits, and also the capacity values used.

The telephone receivers, several sets of which may be used when desired, are connected with the receiving set cabinet by means of flexible cords and jacks, eight of which are placed in a group at the lower center of the front panel.

Among other things, we find it interesting to note the very neat arrangement of the interior wiring of the cabinet, the various connections being run symmetrically in straight lines, evenly spaced and held rigidly in place by means of insulating cleats. In the side view of the apparatus, which shows the interior, one may perceive the nearly wound inductance coil at the bottom of the cabinet, and as will be seen, it is square in form with a number of inductances placed along the form on which it is wound. This set is designed so as to be suitable for receiving either spark or arc signals. No cleaner, being as a vacuum is always clean? And whether undamped waves oscillate or vibrate? Whether it would be murder to kilowatt? And whether you can measure water with a wave-meter? And how a bus-line can run from place to place without moving? And whether it would be nice to be a miner in the mines of Asia Minor? And if a condenser is over charged by a conductor would it cause a disturbance on the trolley line? And where does the dogo when nite approaches? And how to tell when onion plants armature? And what is the price of a drink at the bus bar? And why some books persist in saying a.c. current and d.c. current instead of a.c. and d.c.? And whether there are any seeds in a transformer core.

CHAIN OF RADIO STATIONS.

The establishment of a chain of radio stations, approximately 30 miles apart along the Atlantic Coast, was announced at the headquarters of the 1st Naval District recently. The statement intimated that by this arrangement incoming vessels, when 150 or 200 miles off coast, could determine their position easily by communicating with shore stations, regardless of weather conditions. Along the 250 miles of coast included within the 1st District eight stations are already in operation.

COAST GUARD STATIONS TO HAVE WIRELESS.

In the near future radio stations will be installed at the coast guard stations at the Isles of Shoals, at Station No. 2 at Cross Island, Buck’s Harbor, Me., and Station No. 8 at Damiscove Island, Boothbay Harbor, Me. A number of radio operators will be sent to these stations.
A Timely Reinforcement
A Copper Plated Stomach

By THOMAS REED

THERE'S a lot in being forehanded. Mother was that way. Every Saturday we used to have salt fish for dinner, so she wouldn't be bothered with getting up anything to eat on baking-day. That sounds like a paradox, but, wasn't it, a shame, for the "baking" was very appetizing and savory, while the fish was—well, not so savory.

Now, when you wanted salt fish on Saturday, you had to begin way back in the week somewhere. Tuesday was a good day because there wasn't much of anything to do (so just the regular chores) except the ironing, and you had a chance to think. Follow me carefully—you know how long it is to go to work and separate the fish, and then had up with cooking formulas, and would need an accommodating sized pot to cook the fish could of been most anywhere without hurting it, so tell us children to go to it and forget the whole business. On Tuesday she commenced deodorizing the fish. You see, while the fish abode with the grocer, it was always picking up scents like coffee and spices and matches and kerosene, from the clerk's habit of wiping his hands on it in passing, and the hostler would chuck a horse-blanket on it often enough to give it a quaint stable tang. But what you called the basic flavor was imparted by "Tabby"—the store cat. The pile of codfish was the place where the cat slept and took her bath (the kind of dry-cleansing a cat calls a bath); also her refuge from stray dogs—or ambush, according to whether she could lick the dog or not. The result was you couldn't say the cat smelt fishy, or the fish catty, but they smelt about alike! It was a blend, like this fancy-named toiled water you have to have pronounced for you, can do something or other.

If you are interested in the fish for a smoking fish, you didn't have to do anything to it, it was all right as it was. But when you wanted to use it for an eating fish, you had to do just about—the fish part from the odor part, or as much of it as you could. It wasn't difficult or laborious at all, but it took time, and that's why you had to be forehanded. You put this fish into a good stout pan—a pan that wasn't particular whom it associated with—and covered it with cold water. The water didn't stay that way very long. In a few hours it was most unaccommodating, yellowing to heaven and casting into the air bunches of assorted perfumes, like Springtime tripping o'er the lea and scattering flowers—I mean the operation was the same, not the raw material.

When one dose of water had suffered about enough you poured it off and renewed it, and so on. If you tended right to your business thru Tuesday and Wednesday and Thursday and Friday and Satur- day morning, then by Saturday noon there was your fish—transformed into a regular eating fish—at least those who had to eat it could. That's how you had to plan meals in those days—no fretting away your time at tea-downtoons till the last minute, and from that moment nothing was thought of but comebacks to hand to Germany in return for her favors—about 40 years, with the accent on the last 4—which was righto, and success to the job; but in the rush of business, a very important point was overlooked by everybody but ME. I'll tell you what I mean.

You know how thick and fast the celebrations came, along there in November? They made a record, you know, and but that won't be beaten till "Bill" gets back from Hell. There was the "Fake Peace Celebration" on Monday, the "Real One" on Monday, and the "Regular One" on Tuesday. I don't know how it was with you, but by "Home" itself, the one with the good thought—and it was the only kind of food I was able to sit up and take.

The thought, being fed, was mainly to the effect, how nice it would have been if I'd had one of those dinners that are always being talked about and never realized. I don't know as I ever appreciated before how in a copper boiler is. Viewing the ruin of my faithful Gastric Cavity thru handling the few easy objects I'd sent down to it, I envied the old copper boiler at home—how it used to digest 3 or 4 bushels of the family wash, or boil up a barrel of soft soap, or a tub or two of whitewash-stunts really exacting, you know—and get away with it year after year.

Ah me, as the fellow says. With a tummy built on the lines of that boiler, one could celebrate Peace till the cows came home with their 16-cent milk, and then tackle a New Year's Eve and a couple of "wakes" on the side, instead of rueing the day—whatever that is—as I was doing.

But the real horror of the situation was this: here were a million or two of soldiers and sailors and meekly go thru this celebration—thing multiplied to the hundredfold-power. The big cities were going to send out—then the smaller branch cities, and the railroad towns, and the home towns—the strain all the time increasing as the burg grew smaller—till finally they'd fetch up the Big "H", with Mother roasting chickens and frying flapsjacks and baking pies in a wild effort to make up a year's deficiencies in army rations all at one meal. All that, and only an ordinary membranous stomach to stand it! Was there any time to lose? No. The copper-plate stomach, so long post-poned, had to be invented tout de suite if it was going to be ready for the occasion.

Well, here it is, all ready and waiting. (Continued on page 927)
The Alkaline Storage Battery

By J. F. SPRINGER

STORAGE batteries are of two principal kinds—(1) the lead-acid battery, and (2) the alkaline battery. Our attention is now directed upon the latter. There is but one alkaline cell of prominence on the market—the Edison battery. Each cell is a complete self-contained unit and may be used alone or in conjunction with other cells. A typical cell will have a voltage of about 2.0 average discharge potential; the maximum discharge potential is about 1.45 volts at the start. The charge and discharge voltage characteristics are given in the accompanying graph, Fig. 1. While charging the cell voltage may rise as high as 1.85 volts. The amperage will vary with the size of the cell. By connecting a battery of cells in series, it is possible to run the voltage up to any desired point; see Fig. 2-A. A usual voltage for rather short circuits—under 300 feet—is 30-32 volts. Accordingly, about 30 cells are required. The battery used as a unit will have the voltage equal to the sum of the voltages of the individual cells. The amperage will remain the same as with the single cell. It is necessary, therefore, to choose a size of cell that will give the amperage required for the service or else use more than one battery. Connecting the batteries—not the cells—in parallel, see Fig. 2-B. For a 110-volt system, a large number of cells will be needed. In making such calculations, it will be best to rate the alkaline cell at just about 1 volt. Thus, for 110-volt service use 110 cells, connected in series.

In purchasing a battery, it will be necessary to decide on the voltage to be used. There are probably more household and similar devices on the market that are designed for the 110-volt system than for any other. At the same time, there is a considerable range of such devices which are adapted to, and available for use on 30-32 volt circuits.

The alkaline cell has a tight-fitting cover. As in all batteries there will be generated a certain amount of gas; this escapes thru a special valve. The cell is well suited to rough usage, partly because of the tight cover and partly because the container is of sheet steel and not of glass or hard rubber. The liquid is of an alkaline character. It

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**Diagram Showing Voltage and Amperage With Series and Parallel Connections of Battery Cells.**

A. Cells connected in series. Volts = A x number of cells; volts per cell; amp-hour capacity X A x num. of cells.

B. Cells in parallel. Volts = 1/2 x volts of one cell, amp-hour capacity = A x Amp. Hour Capacity of cell, number of cells.
Experimental Mechanics

BY SAMUEL D. COHEN

LESSON XI

THE THEORY OF TWIST DRILLS.

The student who has been following the past lessons in "Experimental Mechanics" now finds himself confronted by a more or less difficult task in properly utilizing a very important tool, namely—twist drills, and thereby is presented with the subject of twist drills and their grinding. Because it is very essential to follow understandingly the subject of twist drills, a short mathematical treatise of simple nature will be given in order to more readily facilitate the understanding of the subject.

The twist drills stand in use so far above flat drills that they are now an indispensable tool in every workshop for metal working. They may be manufactured by milling or forging two spiral grooves out of a cylindrical bar, or by twisting a bar of the desired cross-section, so that the lines originally running parallel to the axis become spiral lines. The first method of manufacturing is today still the most common one. When we take a spiral drill and turn it with the top towards us, we shall see it as shown in Fig. 1. d are the spiral grooves, cc both cutting edges, so that the drill will have to turn in the direction of the arrow, cc is the solid part of drill; the top of the drill nearest to us is the edge c', which unites the two edges cc, making an angle of about 55 degrees with each of them. The cylindrical surface of the drill at ss, only exists for the part aa, for, to prevent unnecessary friction against the walls of the hole, the top of the surface is brought to a somewhat smaller diameter. Sometimes the surface cc is gradually laid off, beginning at the edge without a distinctly perceptible step, as in Fig. 1. The profile of the grooves dd, is chosen so that the intersection with the top plane b, gives as far as possible a right angle line c. The shape of the line c is of lesser importance provided that the groove d is wide enough to allow the chips to pass easily. The dimension of the weakest point of the drill where the edge c' is found, is fixed by the demand of strength in the drill. The edge c', which cuts very badly, should be as short as possible. Ordinarily, it is taken 1/10th of the diameter at the point of the drill and gradually increases to the upper end, for reasons of strength.

When looking at the drill sideways we now see it as shown in Fig. 2; cc are the sectants which form together an angle of about 120 degrees, c' the connection, dd the grooves, the pitch of which amounts to 5 to 8 times the diameter of the drill. We consider cc as being the cutting edges of two chisels, which, turning around the axis must cut chips from the metal. The form and the position of these chisels in regard to the metal will have to answer the same requirements as every other cutting chisel, which are these: In Fig. 3 A represents a cross-section of the chisel, B the piece of work from which the chip C is cut by moving A in the direction of the arrow.

To prevent the chisel breaking its cutting edge—the angle c—obtained by grinding, and therefore called the grinding angle, must be sufficiently strong. For cutting mild steel and iron c is made upon an average of about 55 degrees; with very good steel the angle can be somewhat smaller; with a poorer grade steel it must be somewhat larger. The loosening of the chip from the metal is not done at the lowest point of the chisel, but at a, being the point most advanced. The metal is pushed down at a length l, Fig. 3, and therefore returns to its level a-d. The smaller the angle i, which may be enlarged or diminished by the position of the chisel, the longer l will be, and the greater will be the resistance of the metal being pushed down. Experience tells us how large the angle i must be; it varies between 4 degrees to 8 degrees for lathe and planer tools. We shall see how great it must be made for twist drills. In no case may it be smaller than 4 degrees, or the chisel will refuse to cut.

Referring to Fig. 4, the point a, of the cutting edge c, situated on the cylindrical surface of the chisel, we find the grinding angle a, appointed by the tangent to the spiral and by the tangent to the line sectant of the cylindrical surface of the drill, and the ground top B. So the size of this angle is determined with regard to the strength of the edge and practically amounts to about 55 degrees. Then follows the angle i in Fig. 3: where to find it. While turning around on its axis the drill advances into the metal. So each point describes a spiral line with the pitch equal to the feed of the drill for one revolution. These spiral lines, however, are of unequal diameter. Point a, in Fig. 4, on the circumference of the drill is given in Fig. 5, as if moving on the spiral line da. The diameter of the drill being D = 1 in, and the feed 1/50th in; the inclination of the spiral line is found by:

\[ \tan \beta = \frac{1}{50 \times \pi} = 0.00637 \]

In Fig. 5 the value of the feed has been given immoerately large for the sake of clearness, and the angle \( \gamma \) has consequently been drawn much larger than it is in reality.

The spiral lines, da and ce, are the lines in regard to which the angle i, in Fig. 3, has to be measured. They are with the line a-d, in that figure. From this it follows that for point a of the drill the setting angle i is measured in regard to the line, inclining already 0° 22', and therefore must be so much greater than usually. For point c this difference becomes 3° 39'. The setting angle becomes a changeable value, increasing towards the center of the drill. In giving it everywhere the same value for simplicity’s sake, that is to say the largest cutting cross-section desired in the center, the edge would become too weak at the circumference.

With the above facts in mind the writer will give a complete practical discourse on how to handle twist drills, grinding, et cetera, in the next installment.

(To be continued)
Practical Chemical Experiments
Butter and Butter Substitutes
By ALBERT W. WILSDON

Butter is obtained by skimming the milk and putting it thru the process of churning, the globules coalesce and the solid fat separates more or less thoroughly from the other constituents of the milk. As found on the market, butter is rarely found to contain more than 80 to 85 per cent fat; the rest being principally water, with some proteins and lactose from buttermilk still remaining in it, and more or less salt or saltpeter, to flavor and preserve it. It quite frequently is colored with some harmless vegetable compound.

Oleomargarine is usually prepared from the fat contained in the intestinal folds of beef cattle. It is carefully stripped from the fresh carcass, washed, chilled and washed exceedingly fine. It is then rendered in water-jacketed kettles at a temperature of about 30 deg. C. The scum which separates out at the top is drawn off and the scaps settle at the bottom. The liquid fat is then run into vats and there permitted to stand for a day or two at about 27 deg. C., at which temperature butter is just liquid. The semi-liquid mass is then wrapped in cloths and prest to remove the thin yellow liquid oil (oleo oil) from the solid fat (oleo-earin). To turn this liquid oil (oleo oil) into a very good substitute for butter, it is churned with some milk so that it can absorb some of the butter taste, then some coloring matter is added (vegetable compound), and the mass is finally run into ice-water, thus chilling it rapidly. It can then be salted and packed like ordinary butter. Two marked advantages which this material has over butter are: (1) It is much cheaper, and (2) owing to the absence of buttermilk and butter fats it has much better keeping qualities. Its flavor ranks well with second-class butter.

"Renovated" or "Processe" butter is in general prepared as follows: Old, rancid, and unsalable butter is melted in a large vat surrounded by a hot water jacket at a temperature of about 45 deg. C. The curd and brine are then drawn off at the bottom, the scum being taken off at the top. Air is blown thru the mass, to remove the disagreeable odor, and after mixing with some milk, the mass is churned and then run into ice cold water to make it granular in structure. It is then ripened, worked to free it from buttermilk and salted. It is required by law in some states that this product be marked "Renovated Butter."

Simple Test for Butter
Experiment No. 1. See Fig. 1.

Heat about 3 grams of the sample in a large iron spoon over a low Bunsen flame, stirring constantly. Genuine butter will boil quietly, with the production of considerable froth or foam, which may, on removal from the flame; in the case of genuine butter these particles are small and finely divided, but in the case of oleomargarin the curd will gather in large masses.

Milk Test for Butter
Experiment No. 2. See Fig. 2.

To make a "milk test" for butter, place about 60 cc. of sweet milk in a wide-mouthed bottle, which is set in a vessel of boiling water. When the milk is thoroughly heated, a spoonful of the butter is added and the mixture stirred until the fat has melted. The bottle is then placed in a dish of ice-water, and the stirring continued until the fat solidifies. If the sample is butter, either fresh or renovated, it will be solidified in a granular condition and distributed thru the milk in small particles. If, on the other hand, the sample consists of oleomargarin, it solidifies practically in one piece, so that it may be lifted by the stirrer from the milk.

By the two tests just described, the first of which distinguishes fresh butter from process butter or renovated butter and oleomargarin; and the second of which distinguishes oleomargarin from either fresh butter or renovated butter, the nature of the sample examined may be determined.

Every house-wife should know how to test butter and oleomargarin and the important differences between them. That is one object of the present paper. The author trusts it proves of value.

(Continued on page 894)
A SIMPLE WHIMSHURST IN-FLICKER MACHINE.
By Melville Fisk.

The static machine described herein is made of simple materials, is easy to construct and the work does not require the use of special tools. A similar machine, built by the writer produces a violent and steady spark discharge about an inch or more in length, without the use of Leyden jars.

The plates are two-twelve-inch phonograph records of the disk type. Select two which have one side blank. The thin film sectors are cemented to the smooth side. It is not necessary to varnish the plates. The bosses that carry the plates parallel on the shaft are small cotton spools, that have a hole in them the size of the one in the record. Fit the spools up with brass tube bearing and fasten to the plates with glue. A thin cloth or paper washer inserted between the boss and plate will help the glue to hold. Rubber tire cement will hold better if at hand. The shaft on which the plates revolve extends out ⅝ of an inch on either side of the wooden standards; it is held stationary by a cotter pin inserted in a hole bored down thru the top of the standard. Glue a cardboard washer ⅜ inches in diameter to the inside of one of the plates. The base and standard are made of wood in the manner illustrated.

Make the double driving pulley from a large spool such as wire spool. Fasten it to the shaft by drilling thru the shank and shaft inserting a cotter pin or screw. Be sure and make the grooves in the pulleys deep enough to hold the belts securely. Rubber bands tied together make very good driving belts. Tie them with strong linen thread and leave a half inch of slack between each band. As the plates are to revolve in opposite directions, cross one belt.

The neutralizing rods are made from ¼ inch copper wire bent to shape. They are pivoted on the protruding ends of the shaft by a short piece of tubing soldered to the center. Press the tubing slightly together at the open end to make it grip firmly. The brushes are made by cutting a long copper strands secured from wire such as is used in receiver cords (gilt tinsel). Cut about twelve strands two inches long; tie a knot in the center, and fold over so that all ends are together. The brushes are then slit into the small tubes soldered onto the ends of the rods and are fastened by squeezing the end of the tube together.

Make the collectors as per sketch, using heavy copper wire. The points are long phonograph needles, fastened to the arms by drilling and then soldering. The needles should be slanted slightly in the direction in which the plate rotates. The supports are brass tubing, soldered on.

The discharging arms are of brass rod of a size that will fit in the collector supporting tubes. Make a small dent in each tube so that the rods do not slip all of the way thru. Fit balls to the ends of the rods by boring, then pegging and soldering.

The jars are used as supports only. Varnish them inside and out and fit with stoppers, bored to hold the collector tubes. A simple stopper is made by cutting a large wire spool in half and then winding paper around the shank to make a fit with the jar. Before using soak the stopper in melted paraffin. Further insulation can be obtained by placing pieces of a broken record under the jars. Glue the jars to the base.

In operation the neutralizing rods should be at right angles to each other, the best angle, however, can easily be found by trial. The brushes should touch the plates lightly—no pressure is necessary. The collector points should be about ½ inch away from plates. Be sure that they are all the same distance away or else some will not contribute to the collecting. The distance between the plates should be about ½ to ¾ inch.

THE FIRST PRIZE, $3.00
BLINKING LIGHTS TELL YOUR FORTUNE.

A glance at the illustration will show that while the magnet side of the relay is open, the small battery motor is running, revolving the drum. A gear may be used if a slower speed is necessary. When the push button is pre-stressed, the armature of the relay is attracted, breaking the motor circuit and making connection on the other side of the relay which goes to the one set of brushes on one side of the drum. The armature is itself connected to one side of the battery for the motor, and to one side of the current supply for the lamps. On the other side of the drum are the brushes connecting to the different rings on the drum. These brushes also connect with the various lamps which are again connected to the other side of the current supply for the lamps.

As the button is pre-stressed, the circuit thru one of the lamps is made, the particular lamp depending upon the position of the drum when the motor stops. Front of each lamp is a pane of glass on the back of which is pasted the fortune telling matter. The front of the glass may be painted with a thin white paint.

Contributed by WILLIAM F. HAASE, JR.

THE SECOND PRIZE, $2.00
PORTABLE BATTERY HAND LAMP FOR THE HOME.

The articles for the construction of this lamp can be purchased at a small sum, if you haven't them at home. Flexible lamp wire is the best for the wiring of this light.

About ten feet of wire is needed, when a large dry cell is used which cannot be carried around. For a pocket (flashlight) battery only a few feet is necessary. By means of the hook the lamp can be hung anywhere or in any corner on a nail, etc. A 1½ volt tungsten lamp is right for a single dry cell. A reflector adds greatly to the efficiency of the light.

Contributed by RAYMOND WAGNER.
A Simply Constructed Gas Generator

By IVAN CRAWFORD

Among the automatic gas generators on the market there are few within reach of the average experimenter. To meet this condition, Prof. C. D. Ditto has recently developed a generator which may be easily and cheaply constructed. In experimenting with qualitative analysis a constant supply of hydrogen sulfide is essential. This generator, being self-regulating, will furnish a constant flow of hydrogen sulfide, carbon dioxide, or hydrogen. The principle of operation is the same as that of the well-known Kipp generator, namely that when the gas formed is not allowed to escape the solid material is automatically raised out of the liquid, but when the pressure is relieved the solid substance is lowered into the liquid, and the generator begins to function. As will be seen in the drawing, the four parts are: first, a glass jar or container; second, a bottle of slightly smaller diameter, with the bottom removed, and fitted with a stopcock in the top; third, a lead basket for holding the solid material; and fourth, a small wash bottle.

The glass jar may be easily made by cutting off the top of a large bottle. There are many methods which may be employed in removing the bell of the bottle, but by far the best and surest is the one described below.

Several long strips of newspaper, about an inch wide, should be soaked in water and wound about the bottle in two bands at the place where it is desired to break the bottle. About a quarter of an inch should be left between the two bands. The bottle should then be slowly revolved with the bands, allowing a blowpipe flame to play upon the exposed part between the bands. When this portion is heated sufficiently the application of a drop of water will cause the glass to be evenly broken. The edges should then be smoothed on a soft grindstone. The bottom of the smaller bottle is removed in the same manner.

The sheet lead for the basket may be procured at any plumbing shop. It may be easily bent to the required shape, leaving small holes in the bottom to allow the acid to enter. The basket is suspended by means of a closed piece of glass tubing, bent to form a hook, which runs thru the two-hole stopper. The delivery tube from the bottle may be fitted either with a glass stop-cock or with rubber tubing and metal pinchcock. Altho not absolutely necessary, a wash bottle is a desirable addition to the generator, as it not only steadies the flow but cleans and purifies the gas.

The apparatus should now be assembled as is illustrated in the drawing and photograph. The solid material, such as iron sulfid (when H₂S is desired) is placed in the lead basket and the dilute acid in the glass jar. When the smaller bottle is placed in the jar the acid, reacting with the iron sulfid, engenders a flow of H₂S which forces the acid out of the basket if the stopcock is closed. When the stop-cock is opened, the gas escapes and allows the acid to touch the iron sulfid, again causing the formation of H₂S. Thus gas is always easily procurable without waste of material.

The generator, when in operation, is beautiful to look on. The gas is seen issuing from the stop-cock in a beautiful little stream of smoke, and the result is not unlike the effect of a miniature volcano. The smoke is caused by the heat generated in the closed jar, and this effect may be increased by introducing a small quantity of absorbant to the gas, which will cause it to be retained in the jar. A piece of lead is also valuable in this particular. Allowing the gas to pass thru a piece of lead will result in the formation of a beautiful ignite on a sheet of paper.

TESTED CHEMICAL LABORATORY STUNTS.

1. Spoons That Will Melt in Hot Water.—Fuse together in a crucible 8 parts of bismuth, 5 of lead, and 3 of tin. These metals will combine and form an alloy, of which spoons can be easily made which possess the remarkable property of melting in hot water, coffee or tea.

2. A Self-dancing Egg.—Take a thin glass tube about 3 inches long and fill it with mercury then seal both ends with good hard wax. Next have an egg boiled and then break a small piece of the shell from the smaller end and thrust the tube with the mercury in, lay it on a table and it will not cease tumbling until the egg is cool. The same can be done by taking a small balloon and blowing it up, then warm the balloon, it will stop about as long as the heat remains.

3. To Give a Piece of Charcoal a Coat of Silver.—Lay a crystal of silver nitrate upon a piece of burning charcoal; the metallic salt will catch fire and will emit sparks of various colors. The silver is reduced, and, in the end, produces upon the charcoal a very brilliant and beautiful appearance.

4. In Water But Not Wet.—Powder the surface of a large or small vessel of water with some lycopodium, which may be obtained at any drug store; you may then challenge any one to drop a coin into the water, and that he will get it without wetting your hand. The lycopodium adheres to the hand and prevents its contact with the water.

5. Artificial petrifications (turning into stone).—In a retort place a small quantity of pounded fluor-spar and sand, and pour upon it some sulfuric acid; fluorosilicic acid gas will be disengaged, holding silice in solution. The subjects you wish to petrify must be moistened with water and placed in a vessel connected with the neck of the retort, the silice will be precipitated upon them like a frost and will have a beautiful appearance. It will wear for years. Note: Do not breathe in this gas.

6. An Experiment With Sugar.—Take about 5 or 6 pieces of lump sugar and place them in a cup; next pour about 3 tea spoons full of boiling water upon them, and then add some sulfuric acid. It is truly a wonderful spectacle, and more instructive than reading, to see the sugar turn black, then boil, and now, rising out of the cup in a black color. It is now charcoal.

7. To Melt Steel.—Heat a piece of steel to redness in a fire, then hold it with a pair of pincers. In the other hand take a stick of brimstone or roll sulfur and touch the piece of steel with it. Immediately after their contact the steel will melt and drop like melted butter.

8. Explosion Without Heat.—Take a crystal or two of nitrat of copper and bruise them; then moisten them with water and roll them up in a piece of tin-foil, and in a minute the foil will begin to smoke and soon after will take fire and explode. Unless the crystals of copper are moistened, no heat will be produced.

9. To Melt Lead in Paper.—Wrap up a very smooth piece of lead in a piece of paper, then hold it over the flame of a taper; the lead will be melted without burning the paper providing there are no wrinkles in the paper and that it is in contact with the lead everywhere.

Contributed by EUGENE McGOWAN.
Electric Engraving Apparatus
(1,289,001; issued to Andrew M. Braggings]

An electric engraving apparatus employing a source of electric current for impressing characters on a metallic body to produce the engraving. It consists of an apparatus employed with graduating tools, etc., for marking metal parts of machines, etc. A further object in the invention provides an auxiliary electric current or circuit connected to the pencil, and means in the pencil for controlling the make and break of the auxiliary circuits to open and close the main circuit so as to prevent arcing when it is raised from the work. This apparatus eliminates this objectionable feature. The case contains a transformer, also a number of switches, by which the character of the current may be varied at will.

Application for Patent
(1,288,117; issued to Francesco Morano)

The chief object of this invention is a metallic microphone for high currents, which microphone is constituted by one or more metallic gripping contacts, which gripping contact is formed of two contact elements, one of them grips the other. The gripping element is firmly mounted by the diaphragm, whereas the other element is supported by such means that the pressure of the contact which is formed by both elements accurately affects it. In consequence, the electrical resistance of the contact itself may be capable of varying in rigid conformity with the vibrations of the diaphragm according to the amplitude of said vibrations.

Apparatus for Locating Sunken BodieS
(1,287,507; issued to Patrick B. Delany)

Sunken ships and bodies, by the use of this invention, may be found very readily. It is an electrically operated device, used with some form of communicating device, such as a telephone receiver, and acts upon the principle of the circuit being closed, and having normally a certain definite resistance, i.e., the inventor does not use coils conductively or otherwise for the detection. The bare electrode is lowered by means of an insulated wire through the water, and depends upon actual contact with some metallic body for its location. The circuit is formed thru a pair of sensitive head receivers, the bare electrode, the water and the electrode, and normally is of high resistance.

Recording Telephone
(1,290,021; issued to John F. Maloney)

A new form of recording telephone is more or less on the style of the dictating telephone. A device in convenient size and weight for use on office desks, etc. It is constructed so that it may be used for receiving direct dictation over the telephone, and also be used to receive telephone messages from the ordinary telephone receiver, and in this manner to record the same on a photograph record. Particular attention is attached to a new form of reed diaphragm constructed of the same width from end to end; approximately at its center is mounted a square soft iron disc held in place by clips, which on its under side has a holder for supporting the suffire point of the photograph.

Advertising Lamp and Radiometer
(1,290,749; issued to Edward J. Hunt)

The device consists of a motor operating on the principle of the radio-motor in which the moving motor elements are caused to rotate upon their axis by the action of the light. The device is primarily intended to be inserted with the enclosure of any ordinary incandescent lamp and combined with the filament support in a manner permitting the use of the usual lamp filament, so that the light issuing therefrom shall cause the rotation of the several motor vanes. The motor element consists of a series of vanes, preferably four or more, on silvered upon one side and blackened upon the other side with carbon or lamp black.

Secondary Or Storage Battery
(1,285,660; issued to Bruce Ford)

A new type and form of storage battery, its principal object being to minimize leakage between cells and still have a multiple voltage battery of sufficient strength to withstand the stresses and wear arising on such a battery. The structure may be described as a number of plates having a central portion, one face provided with a negative formation and the other face having a positive formation, with a rim projecting beyond both formations so as to fit and be pressed into soft rubber tubing, which will make it leakless. The spaces between are filled with an electrolyte, which may be any liquid, or else held in blotting paper or some other gelatinous formation.

Method of Telephonic Transmission Without Return-Wire
(1,287,180; issued to C. Bardoloni)

A new method of transmitting speech without a return wire. It is common necessary to use a separate single wire for telephonic transmission without earth return. A condition like this might exist in connection with an observation balloon, where the stringing of the separate telephonic cable would not be feasible. Under these conditions the circuit does not close by conduction, but remains as an open circuit, the return being formed by one or more metal conductors, squares, electrostatically and electromagnetically connected between each other. This invention has the object of effecting telephonic transmission by the variations of the electrostatic and electromagnetic conditions, without any metallic conductors, or the earth, connecting the circuits of the system.

Radium-Applicator
(1,288,048; issued to George Kunkle)

A radium applicator adapted for the use of radium and other radioactive salts. The applicator is properly calculated in proportion, and arranged so that the physician using it can accurately measure and administer by any of the approved methods the correct dosage at any moment by a simple adjustment of parts. This instrument manually and even irritatingly surfaces of widely various areas, as, for instance, areas of from one millimeter to thirty-two centimeters in different directions.

Compass-Gyroscopic
(1,289,813; issued to Emil Klahn)

The invention consists primarily in mounting the gyroscopic in such a manner that at all times it is unaffected by gravity, and utilizing this property of the gyroscopic to regulate the position of the controlled member, when a disturbing force is acting on the gyroscopic. Its application is mainly a non-magnetic compass, when such disturbing or directive force results from the rotation of the earth, and for movements and changes in the course of a vessel carrying the compass, and apparent rotation of the compass card or controlled member taking place and serving as a measurement of the change in course. The gyroscopic is a small apparatus, in which the gyroscope is rotantly mounted. A resilient means is connected with the frame adapted to work on the gyroscopic, when the control member or compass card is in connection with said frame.

Thermostat
(1,287,188; issued to He instrich Beck)

A new design of thermostat, which to a certain extent eliminates many of the troublesome factors of the old style apparatus. This type of thermostat is one which employs but one movable contact, the other being fixed, adjustable, and the two thermostat elements generally control the single movable contact, in response to a variation in temperature. But only one is subject to the action of radiant heat, and acts directly upon the carrier, and thereby acts directly upon the moveable contact. The heat ray may be concentrated on the thermostatic element by means of a condensing lens. The element is at a normal room temperature, and is in such a manner that the heat beam strikes the thermostatic element, and then in a manner so that this moves a crank upon the carrier, thereby closing the circuit.
“Amateur Electrical Laboratory” Contest

THIS MONTH'S $3.00 PRIZE WINNER—RAYMOND L. CASSELL

HEREWITH I present three pictures of my Electrical Laboratory. In this "Lab" you can find anything from a binding post to a six hundred thousand volt Tesla coil. I have constructed two high potential transformers and one welding transformer with output of three volts and five hundred amperes. Practically everything in this "Lab" was built by me. There are several motors, both A. C. and D. C., dynamos, about a dozen spark coils, transformers, storage batteries, small steam engine, rectifiers, Tesla coil (Oudin type), switches of all kinds, telephone instruments, condenser, volt and ammeters, et cetera. I can get a twelve to fourteen inch spark from the Oudin coil. If the spark is not drawn off, it will brush discharge to a length of ten inches, crackling and waving like a thing alive. I perform some very interesting experiments with the coil. I also have a small storage battery set with a separate switch-board for charge and discharge. I have a searchlight (arc), which will throw a beam about two miles. I operate this on a 110 volt circuit with a transformer built for the purpose. I am now building a 330 watt D. C. dynamo. I experiment with almost everything going and a lot more.—Raymond L. Cassell, Roanoke, Va.

HONORABLE MENTION (1 year's subscription to the "ELECTRICAL EXPERIMENTER")—J. H. ENGLAND

HEREWITH are photographs of my Laboratory. In one of the photographs may be seen my "Wireless Table," which contains all the different instruments used for both sending and receiving. The transmitting set consists of a 1/4 K. W. step-up transformer, condensers, spark gap, key, ammeter, et cetera. There is also a 1 inch spark coil for sending short distances. For receiving I have used successfully (before the war) a tuning coil for short distances and a home comb for long distances, in connection with a silicon detector, 2,000 ohm Brander's phones, bugging coil, variable and fixed condensers. To the left may be seen my switch-board, which is home-made. It contains a number of different switches, a buzzer, a lamp resistance, and a pilot lamp. To the left of the switch-board there are several shelves on which are different electrical books, such as "Hawkins' Electrical Guides," Houston's "Electricity in Everyday Life," and many others. There are various other instruments on this table, such as telegraph key and sounder, electric fan, Solderall torch, and an interrupter. Another photograph shows the chemical and photographic table. This table consists of a complete developing and printing set. To the left will be seen the printing box, which is home-made. The frame is an Auto Mask Printing Frame and is secured to the box by means of small hooks, so as to permit it to be removed easily. Inside there is a red and a white light. To the right there are a large number of chemicals, such as nitric acid, bromine, sodium, et cetera. This part of my "Lab" comes in handy when I need a picture of some electrical experiment. This laboratory is the result of but one year and a half of earnest work and study.—J. H. England, 509 George, Greenwood, Miss.
Science in Slang

Jazz Stokes on Wireless Dope

By EMERSON EASTERLING

"I saw a while back in a paper that Tesla and Marconi were expressing their ideas on interplanetary wireless communication. It don't look very reasonable to me that it could be done in the way that they proposed it, but I don't say that the feat is impossible," remarked Jazz Stokes the other night.

"How does a wireless wire?" asked Bender.

Heiney Hertz — Who While Monkeying Around Spark Coils and a Micrometer Spark Gap, Fell over the Hertzian Wave.

"It don't wire, that is why they call it wireless," returned Jazz.

"Well," I put in, "of course, Punk and I know all there is to know about wireless, but for Bender's sake I wish you would tell us a little about wireless."

"You are probably familiar with the African tumb-tums and the Indian signal fires," he began. "They were the original form of wireless.

A scientist by the name of Hertz, Herr Heinrich Hertz, got to monkeying around with spark coils and developing the micrometer spark gap or resonator. This apparatus worked on the principle that electro-magnetic waves radiate from a point of discharge. The twinkleing spark between the gap was due to induced current, being virtually a secondary coil of one turn. Well, this set Heiney to deducing, and he deduced the present Hertzian theory of wireless wave radiation.

"While Heinrich, never having caught up with the second syllable of his first name, died a poor man, Nick Tesla hadn't been napping either. The whole wireless dope to this bird was an unsealed book as early as 1882, when Marconi still slid down the hamster in his knickers. Thus we see Nikola two-stepning it nonchalantly to the Pat. Office, where he grabs the first REAL wireless patent along in 1900. The old boy had it all down in black on white, aerial, ground, spark gap, et al—the real, honest to goodness dope. This earned him the title of "Papa of the Wireless." But in those days there were no detectors and few experimenters to boast. So the then wiseacres sniffed at Nick's Patents, tapt their foreheads significantly and made known that this wireless stuff was all loco, bunque, and then some. The same gizmos today however sing a different tune and admit that in 1900 THEY were fast asleep and deadner than an Egyptian mummy, with heads as sold.

"Then along comes Kid Marconi and devils around with oscillators, sending waves thru buildings and other masses until he gets to work and builds a real wireless telegraphing station. By sticking his aerials up so as to clear the buildings and other masses he finds that he can send and receive for miles instead of blocks. In 1901, on the twentieth day of December, he shoots a 'can-you-get-it' across the Atlantic—and they got it. Soon all the first class vessels were equipped with radio men and added antennae to their rigging, in that they could let the world know that all was off with them by their C. Q. D. and S. O. S. yelps, instead of leaving floating spars upon the bight deep for some long to sight later.

"Marconi went on improving his apparatus and handled the financial end so that besides being a first rate experimenter and Italian gentleman of standing, he don't have to eat macaroni with a pencil.

The world wallows along, and the patent offices pile up the documents in the wireless department, when an ardent bird, Dr. Lee de Forest, waltzes on the stage of industry, to the tune of "N' EVERYTHING and shows us something. You might mistake it for an incandescent bulb, but it is as much like a light globe as a Victrola is like a centre table. We call it the Audion Amplifier, and with it in your receiving set you are able to make a squeal a scream. The wireless nuts first found that it was a scream when the ionizing sunlight failed to close the Hula-hula island and 'Frisco communication in the wee sma' hours of the morning, after the hour that the other detectors went mad on 'em.

"For Bender's sake I will give you 'Kicks' the line up on a simple wireless station. First the transmitting apparatus obtains its juice from batteries or other sources. Is that plain? Yes, well next there is a spark coil that steps the voltage up to a dangerous stage and a spark gap that lets the high tension current break down across the air space. This discharge sets up an oscillating current of high frequency. To increase the efficiency there are condensers inserted in the circuit—these store up and discharge the juice like a nigger squiring prune juice thru his teeth, only very much faster."

Taking a pen and pad from his pocket Jazz proceeded, "It is like this—see the K is the key; C, coil; e', condenser; A, aerial; G, ground; and B is for the source of juice. Then the receiving station is like this—A, aerial; D, detector, R, receiver. There is added more stuff to sensitize the layout, but they would only look like a telephone central station wiring diagram here on paper, and besides, there are more different kinds than there are ways for a young boy to go wrong.

In Guglielmo Marconi's original contraption the Signor used a coherer, where we use a detector or audion now. The coherer works by being welded by the incoming waves, the electrical resistance being less when the filings in the coherer are welded. The current is so regulated that when the wave waltzes in and unites the nickel and silver filings, the sounder that is connected in the circuit bangs down with a faint tap. The coherer is tapt by a de-coherer, jarring the nickel and silver filings loose for the next dot or dash.

"The detector rectifies the oscillating current, making it fit to vibrate the diafram on the receiver that the 'Radio-bug' has glued on here.

"The audion is an incandescent bulb with a parallel grid and plate, working on the theory that current will flow "That word is Kick and not Hick. Kick is a San Francisco slang word—it means almost anything, originating from a kick in horse and now applying to almost anything, good, bad, and indifferent."

(Continued on page 911)
500 K. W. DYNAMO DEVELOPS BURNT SPOTS ON COMMUTATOR.

Geo. W. B., Chicago, Ill., inquires of the "Oracle",

Q. 1. What causes commutator bars to burn, blacken and roughen up in the following manner? There are about 4 bars under a set of brushes and every set of 4 bars spaced equally between centers of field poles, all blacken. Description of machine: D. C. 500 K. W. rope drive, 8 poles, compound wound, 220 volts. Even airgap all around, commutator undercut, commutator true, field coils equal strength, no reversed coils, no overload, machine runs alone most of the time; sometimes in parallel with a 150 K. W. Brushes have a perfect gloss, practically no sparking. Four hundred segments to the commutator, all tight. Sanding commutator stops the trouble for 2 to 6 months. What causes it?

A. 1. We were particularly interested in the phenomenon you describe where the 500 K. W. D. C. dynamo, which also apparently in perfect shape and maintenance, develops burnt spots all around the commutator at points corresponding to the spacing of the brush studs.

The Editor of the Oracle, while serving as engineer in a large power house some years ago, had similar trouble, and it practically solved by any of the experts who attempted to remedy it. Also in this case, it is clearly recollected that the machine, of about the size you mention, was in very fine running condition, and every thing seemed to be in favor of its perfect operation. But still these spots developed just as you state. After some thought on the matter it would seem from later experiences that some of the following troubles might be the cause of these burnt spots appearing on the commutator:

1. From experience with several smaller machines, especially motors on elevator service, it is found that all discharge currents, which are often of very high instantaneous e.m.f. value, would be liable to cause this burning. The remedy, or rather safeguard, against such trouble from this source would be to provide a field break switch fitted with an extra contact, so that when the switch is open half-way it makes connection, so that the field can discharge through, and in some cases has been formed of a lamp bank, and if you try this, you will be surprised to see how brightly the lamps flash up whenever the field switch is opened. When the dynamo is being shut down and after the main D. C. bus-bar switch has been opened. The field magnet, of course, possesses very high self-induction, and when the field switch is opened, a very high self-induced current occurs in the field winding, tending to prevent the magnetization, and causing therefore, a very heavy current of high e.m.f. to occur in the field winding—testing to prevent the magnetization, and causing therefore, a very heavy current of high e.m.f. to occur in the field winding—testing to prevent the magnetization, and causing therefore, a very heavy current of high e.m.f. to occur in the field winding—testing to prevent the magnetization, and causing therefore, a very heavy current of high e.m.f. to occur in the field winding. Practical all dynamos above 50 K. W. capacity are equipped with proper protective field discharge resistance and field break switches of the type described.

2. It seems that insufficient brush tension would also cause this trouble, not perhaps while the machine is rotating at its normal speed and load, but due to a tendency while the brushes in such a case might have to jump when the machine was started.

3. Another possible but hardly probable source of this burning might be traced to hard commutator bars. High mica would also cause the trouble, but as you state, in your particular case the mica has been undercut.

4. Trouble is often experienced in power-station work where two or more dynamos are run in parallel, and especially when there is any weakness in the design of the equalizing circuit between the two or more machines, which may cause heavy cross currents to pass between the two machines. As you will readily conceive, such a current might be caused by a parti l unbalancing of the load between the two machines, might cause a momentary and in fact a fairly high e.m.f. transitory current to pass thru the brush and commutator system of one of the machines, and such a current would tend to have the effect of producing the burnt commutator.

5. Another trouble which would seem to point very strongly as a frequent source of this trouble, and one also that is very often overlooked entirely, is the unequal distribution of the armature current in such a large machine as this. The Editor recollects a case at one of the southern universities a few years ago, where no end of trouble was experienced in the operation of a large D. C. generator unit, due to this very reason, i.e., the unequal distribution of the current thru the armature. From a defect in design, for that, of course, is what it is, causes a number of current paths to be formed up periodically, and comparatively heavy currents will start flowing along these paths, their area being that enclosed between the axial lines of the two field poles in most instances. In the case in question, this was finally solved by the proper designing and installation of

(Continued on page 888)
The Opportunities In Draftsmanship

By CHAS. W. MOREY
President Chicago Technical College

During the twenty-five years in which I have had exceptional opportunities to observe the progress of technical work of every character, I have never known of such opportunities as exist today for competent draftsmen.

Very naturally the war had a great effect in producing the present conditions. Men were drafted from their drafting rooms to the trenches, leaving great gaps in our industrial organization which have not yet been filled.

And now when the war is over, we find many men not returning to their old jobs. We see business pushing harder than ever for markets. We hear of great building operations to be undertaken. We see a vast area of Europe devastated beyond description, to be rebuilt and very largely I believe with American materials and with the help of American technical experts.

When it is considered that the draftsman must be employed on every detail that goes into the manufacture of structural work of every kind, machinery, ships, roads, buildings, etc., the vast field for men in this profession must be somewhat appreciated.

The problem before thousands of ambitious young men is not whether to become draftsmen or not, but how and where to learn most quickly and thoroughly.

Formerly it was necessary to attend a resident school, which often meant giving up a position, Blacks and time as well as money. It also often meant, if a man wanted to graduate, taking studies not really bearing upon technical training. Some got their training in drafting rooms of factories, architects' offices, or other places where they started out as boys and slowly worked their way up.

It has remained, however, for correspondence instruction to give every man a chance to become an expert in any branch of draftsmanship without leaving any job he may have and as quickly as his industry will let him pass from one lesson to another.

The Chicago Technical College by its method of training has prepared, and is now preparing men, who, as a result of their education, are earning well at home and then stepping into high-paying positions.

By this method no time is wasted on unnecessary branches. The student gets exactly the training he will use in practical work and in every case he has the direct personal instruction of specialists in the branch he has selected.

Before he decides about enrolling, any man can easily find how well he stands in the art he may be to follow Draftsmanship. A test lesson is sent free to show the plan of instruction and to give the prospective student a chance to "size himself up.

We are ready to help ambitious men to get into this great profession with the least expense of time and money. We believe in the opportunities are the calls we have to furnish good draftsmen to every kind of an organization prove every day that the job is always ready for the man who can fill it. If young men throughout the country could really what a future there is in Draftsmanship, many a one would be wondering what his future is to be would come to a quick decision.

I hope that every reader of the Electrical Experimenter who is now doubtful about the calling he is to follow will write for information on one of our Drafting courses. If in doubt about which branch to take up, a letter sent to me personally will bring suggestions based on my own experience and that of our staff.

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CAUTION! Beware of similarly constructed needles of inferior quality

THE ORACLE.

(Continued from page 886)

current equalizing rings placed on the back of the armature, as shown in the accompanying illustration.

Many different windings have been proposed and used successfully, but the majority of direct-current armatures are wound with either the single-parallel ring winding, or the single-series drum winding, or the single-series drum winding. The single-parallel drum winding is probably more used for other than on large multipolar machines, any unbalanced condition in the magnetic circuits is likely to cause the current to divide unequally among the several paths in the armature. For example, if the air gap on one side of the armature becomes slightly shorter than that on the opposite side, which may easily occur due to wear of the bearings, the flux in the short air gap will become unduly dense, thus causing the generation of higher e.m.f. in the armature conductors on that side than in those on the other side, and the path that develops the highest e.m.f. takes the greatest share of the current. In some cases this unbalanced condition may not be had enough to cause trouble other than some slight sparkings, but in extreme cases, the line of the path on one side of the armature may become so excessive as to reverse the current in some of the other paths, making part of the armature act as a generator and part of it as a motor at the same time.

This condition is usually accompanied by some vibration of the whole machine, due to excessive mechanical strains, with more or less violent sparking or flashing at the brushes, and the machine is said to be "bucking," in which the effect of the unbalanced condition may be eliminated by providing the armature with equalizer rings as shown.

By means of equally spaced leads these rings connect points of equal potential in the winding and allow an equalization of current between the various paths in the armature.

Sometimes erratic line disturbances, motor flare-backs, defective motor control apparatus, will cause the effect you describe.

We would recommend that you look up some of the books by D. C. machines and see what they say about the effects of armature reactions, bucking is somewhat more liable to occur in motors than in generators, for in the armature, the effect of the unbalanced condition may be eliminated by providing the armature with equalizer rings as shown. By means of equally spaced leads these rings connect points of equal potential in the winding and allow an equalization of current between the various paths in the armature.

CAUTION! Beware of similarly constructed needles of inferior quality

You benefit by mentioning the "Electrical Experimenter" when writing to advertisers.

HOMOPOLAR DYNAMO.

(990) O. S. M., U. S. N. R. F., writes:
Q. 1. Giving a sketch of a commutatorless dynamo, in your February, 1898. Also you would do well to refer to Professor Thompson's complete treatise, "Dynamo Electric Machinery," and a most thorough cover on the subject in the design and calculation of the electrical as well as the magnetic circuits of the "homopolar" dynamo, is given in Prof. Alfred E. Wiener's excellent book, entitled "Continuous Current Dynamo Electric Machinery Design." These books are available through Book Department.

The outline of the action of the machine you show is in accordance with the opinion of this machine given by Prof. Silvanus Thompson, in which he says in part:

"There is a class of dynamo-electric machine, differing entirely from any of the commutating types, in which the coil or other movable conductor slides around one pole of the magnet and cuts the magnetic lines in a continuous manner without alternations in the direction of the induced currents. Such machines, sometimes called "homopolar" or "uni-polar," have a very low resistance, and the Faraday's disk machine belonged to this class.

The stream that has been supplying the ancient city of Damascus with water for forty centuries has been harnessed to provide electricity to light the city and operate a water-pumping plant.

According to an Italian scientist's figures, a square mile of the earth's surface in six hours of sunshine receives heat equivalent to the combustion of more than 2,000 tons of coal.

BAILLIS COST FOR ALTERNATING CURRENT ARC-LAMP.

(991) Henry Tustin, Ocean Grove, N. J., writes:
Q. 1. I am having trouble in operating an experimental arc-lamp on 110 volts. What can you suggest?
A. 1. Regarding the operation of arc lamp at 110 volts house lighting current, you do not state what kind of current you have, whether alternating or direct. For one thing, this factor will determine whether your experiment will be a success or not, for the reason that if you are fortunate enough to be alternating current, then you will find invariably that it will not operate well using a simple resistance coil or rheostat in series with it.

For alternating current operation the proper ballast consists of an adjustable impedance or choke made up of an iron core or laminated sheet iron core on which various lengths of magnet wire are wound. Where an ordinary C. P. arc, such as used in ordinary street lighting, etc., is employed and taking about 5 amperes on 110 volts, the impedance coil may be composed of an iron core about 4" in diameter, wound about six layers of No. 14 C. C. magnet wire, taking off taps from the third, fourth, fifth and six layers.

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Due to Mr. Branch’s long experience in and close contact with the engineering field the courses embrace such questions as are usually asked by the various Boards of Examining Engineers throughout the country. Our graduates will testify to the ease with which they were able to pass these examinations, and the cooperation received from us in helping them get positions.

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ELECTRICAL IDES complimented elements; the elastic various his "gob" organic appended a does committee in inches, conversation, naval Action, very much. For instance, we find the term "all-client" among the words very significantly "—consists of a metallic tube made to slide over insulating tube for metallic lining." This definition does not mean very much to those who have not a radio trade definition, while as a matter of fact most of the regular textbooks on wireless telegraphy describe this type of radio work in terms as definite electrical capacity of one bill-farad. This little work for a hand-book on the employment of wireless terms which may prove of considerable use to radio students and others interested generally in this line of work.


This work is something out of the ordinary and places in the hands of chemistry students and chemists in great need. It is a collection of tables and formulas worked out, which would require many volumes on chemistry and physics in order to determine these quantities. Their presence makes the giving of the complete equations for various organic compounds; physical constants of the elements; physical data, organic compounds; and analysis procedure; flame and heat testing; various solutions of ions; and a large number of tables giving glycerin factors and their logarithms; a very complete bibliography is appended at the close of the book, giving a valuable titled list of several hundred works in chemistry and physics. The volume is well indexed.


This work proved of great value during the war and is one of the most complete books on the subject of military and naval organizations throughout the world. It is the only complete gazetteer of rank in the various organizations of the armed forces of the world, but the customs of the service as well, such as etiquette of enlisted men, officers, etc. The book was composed by the Secretary of the Navy, the treatment starts with the organization of the army bureau and corps, the composition of the army and its various departments, how the staff is composed, and the divisions into the various arms of the service, such as cavalry, field artillery, coast artillery, infantry, and engineers. The book describes all the various coast artillery districts throughout the United States, their ranks here and there, as well as the duties of the officers holding these ranks, armament and customs inductively and customarily; a great many questions in conversation, when and when not to address a lieutenant by his title; how to address a colonel, etc.

The succeeding chapters take up the composition of the navy and the rank in the naval force ashore, including an explanation at length in the book 31, of the duties of the Bureau of Steam Engineering, and how it comes about that the personnel of the new war fleet is to be formed as well as what do with the installation of Radio Equipment on ships of the navy and on shore—a nice little book which is a reproduction of "Oracle Department," and of the editors person by person, every time we see a "Radio-log." We then follow interesting chapters on naval etched book, indicating what is the position of the officer in the peacetime fleet, the way he stands, and so forth. It is prescribed in the rules and regulations on naval etched book, that it is unbecoming an officer in uniform to carry a package of any kind. But at the close of the hum-drum of red tape, which tells you how you shall place your feet, and which you shall take off your hat, also when you can use your hands, etc., there comes that mighty interesting read to poor land-lubbers come to the sea. It is a book that everyone who is interested in the work in the navy must have. It tells you why it is customary for a committee of the navy to make the rules and regulations that—"is customary for the Secretary of the Navy to issue maxims for New Year’s Day all on ships in the same port," and further—when in Washington, it is customary to call on the Secretary of the Navy to issue maxims for New Year’s Day and you shall appear full dress uniform and have it accordingly leave your umbrellas at home. This is the work for officers, and it is good. We have been going through it a few times, and it is interesting, and written in a very interesting style in which he has compiled the work.

**ELEMENTARY NAVAL ORNAMENT AND GUNNERY**, by Lieut. H. C. Ramsay. Limp leather cover, size 7 1/2 x 7 1/4 inches, published by Charles Scribner’s Sons, New York, 1918, Price $3.00 net.

One of the most valuable works published during the war as a read by the students in the Naval Gunnery Schools and also as a good book for any man interested in the military and naval armaments. It has been prepared in a simple, easy and direct manner so that all classes of readers may gain a firm foundation in the essentials of the fundamentals and general principles of the art of modern naval gunnery.

The material has been gathered from lectures delivered at the Ensign School at Harvard University, and a number of instructors who have been incorporated in the work with full answers.

A few of the many important chapters follow:—Naval Guns, Manufacture of Naval Guns, Gun Mounts, Breech and Firing Mechanisms, Electrical Firing Mechanisms, Torrets, Gunpowder, Projectiles, Magazines, Inspection and Showers, How the Battery in Action, Care of Turrets, Automatic Machine Rifles, Battleship, The Gunnery Of a Destroyer, Bunkers, etc.

The chapter on Infantry has been included in order that those new to the service may understand some of the requirements as practiced in this branch of the service.

There is no doubt but that this book will fill a distinct want in the work. We are studying this subject, besides giving to the layman a real glimpse of the part Gunnery plays in every battle engagement whether on land or sea. Lieut. Ramsay is to be congratulated upon the work he has done which he has covered in the book. The reader is particularly impressed with the clearness just how the breech mechanisms of the great naval cannon work as well as the small breech mechanisms which have been described, etc. Every kind of projectile is fully explained with sections and cutaway drawings in place, computed, calculating the range from a moving war-vessel with the complications made by the wind temperature of the air, wind, order charge, etc. Most a interesting, authentic and valuable work.
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No matter how much you are earning now, I can show you how to increase it. I have even taken failures and shown them how to make $100—$200, and in once case as high as $2,000 weekly. I am willing to prove this entirely at my risk and expense.

I T was a simple thing that jumped me up from poverty to riches I've said, I'm no genius. But I had the good fortune to know a genius. One day this man told me a "secret." It had to do with getting ahead and growing rich. He had used it himself with remarkable results. He said that every wealthy man knew this "secret,"—that is why he was rich.

I used the "secret." It surely had a good test. At that time I was flat broke. Worse than that, for I was several thousand dollars in the hole. I had about given up hope when I put the "secret" to work.

At first I couldn't believe my sudden change in fortune. Money actually flowed in on me. I was thrilled with a new sense of power. Things I couldn't do before became as easy for me to do as opening a door. My business boomed and continued to leap ahead at a rate that startled me. Prosperity became my partner. Since that day I've never known what it is to want for money, friendship, happiness or any of the enormous benefits that the "secret" surely made me rich in every sense of the word.

MY sudden rise to riches naturally surprised others. One by one people came to me and asked me how I did it. I told them and it worked for them as well as it did for me.

Some of the things this "secret" has done for people are astounding. I would hardly believe them if I hadn't seen them with my own eyes. Adding ten, twenty, thirty or forty a week in a man's income is a mere nothing. That's merely playing at it.

In one case I took a rank failure and in a few weeks had him earning as high as $4,000 a week.

Listen to this: A young man in the East had an article for which there was a great worldwide demand. For twelve years he had put out his "pentered round" with it, but barely eking out a living. He then bought a patent which was worth $200,000. He was building a $25,000 home and paying cash for it. He has three automobiles. His children go to private schools. He goes hunting, fishing, traveling wherever the mood strikes him. His income is over a thousand dollars a week.

In a little town in New York lives a man who two years ago was quitied by all who knew him. From the time he was 14 he had worked and slaved—and at sixty he was looked upon as a failure. Without in- debt to his charitable friends, with an ideal good to support, the outlook was pitch black.

Then he learned the "secret." In two weeks he was in business for himself. In three months his plant was working night and day to fill orders. During 1916 the profits were over $250,000. During 1917 the profits ran close to $400,000. And this giant 64-year-old young man is enjoying the pleasures and comforts he had little dreamed would ever be his.

I COULDN'T tell you thousands of similar instances. But there's no need to do this, as I'm willing to tell you the "secret" itself. Then you can put it to work and see what it will do for you.

I don't claim I can make you rich over night. Maybe I can—maybe I can't. Sometimes I have failed. But in my experience everyone has a friend that can help 90 out of every 100 people if they will let me. I've found a friend of it all the people using only about one-tenth of that wonderful brain power. That's why you haven't won greater success.

Throw the unused ninth-tenths of your brain into action and you'll be amazed at the almost instantaneous results.

Will is the motive power of the brain. Without a highly trained, intelligent will, a man has about as much chance of attaining success in life as a railway engine has of crossing the continent without steam. The biggest ideas have no failure without willpower to put them over. Yet the will, also heretofore entirely neglected, can be trained into powerful force the brain or memory and by the very same method—intelligent exercise and use.

If you held your arm in a sling for two years, it would become powerless to lift a feather for lack of use. The same is true of the Will—it becomes useless from lack of practice. Because we don't use our wills—because we continually bow to circumstances—we become unable to assert ourselves. What our wills need is practice.

Develop your will-power and money will flow in on you. Rich opportunities will open up for you. Driving energy you never dreamed you had will manifest itself. You will thrive with a new power—a power that nothing can resist. You'll have an influence over people that you never thought possible. Success—in whatever form you want it—is your own creation. The laws are the same for all, and all who fail are those who don't know or don't use these rules. And if you'll learn them, you'll get your share of the money to come.

How You Can Prove This at My Expense

I KNOW you'll think that I've claimed a lot. Perhaps you think there must be a catch somewhere. But here is my offer. You can easily make thousands—you can't lose a penny.

Send no money—no, not a cent. Merely clip the coupon and mail it to me. By return mail you'll receive—not a pamphlet, but the whole "SECREt" told in this wonderful book, "POWER OF WILL."

Keep it five days. Look it over in your home. Apply some of its simple teachings. If it doesn't show you how you can increase your income many times over—just as it has for thousands of others—mail the book back. You will be out nothing.

But if you do feel that "POWER OF WILL" will do for you what it has done for over a quarter of a million others—if you feel as they do that it's the greatest book to the Bible—send me only three dollars and you will be the square.

If you pass this offer up your chance to turn that small profit on a three-dollar sale. But you—you may never be able to realize what a difference between what you're making now and an income several times as big as you. Have you seen a lot—a whole lot—more to lose than I? Mail the coupon or write a letter now—you may never read this offer again.

PHELTON PUBLISHING COMPANY
301 Wilcox BLOCK—MERIDIAN, CONN.

Pelton Publishing Company
Meridian, Conn.

You may send me "Power of Will" at your risk. I agree to return $3.00 or remail the book to you in five days.

Name .

Address .
The Moon’s Rotation

(Continued from page 806)

festy absurd and of no bearing on the question under consideration.

In all the communications I have received, the different in the mode of presentation, the successive changes of position in space are mistaken for axial rotation. So, for instance, a positionary argument is found in the observation that the moon exposes all sides to other planets! It revolves, to be sure, but none of the evidences is a proof on its axis. Even the well-known experiment with the Foucault pendulum, albeit exhibiting similar results on the globe, would merely demonstrate a motion of the satellite about some axis. The view I have advanced is NOT BASED ON A THEORY. It is MUST BE POSEST OF MOMENTUM. If there be, there is no axial rotation, all appearances to the contrary notwithstanding.

A few simple reflections based on well established mechanical principles will make this clear. Consider first the case of two equal weights a and b, in Fig. I, whirled about the centres of gyration as shown. Assuming the latter to break at a both weights will fly off on tangents to their circles of gyration, and, being annihilated with different velocities, they will rotate around their common center of gravity o. If the weights are whirled n times per second then the outer and the inner one will be, respectively, \[ V = 2(R + r)r \] and \[ l' = \frac{2\pi}{n}r, \] and the difference \[ l - l' = 4\pi r n, \] will be the length of the path of the outer weight. Inasmuch, however, as there will be equalization of the speeds until the mean value is attained, we shall have

\[ \frac{2\pi n}{n} = 2\pi n, N \] being the number of revolutions per second of the weights around their center of gravity. Evidently then, the weights continue to rotate at the original rate and in the same direction. I know this to be a fact from equal experiments. It also follows that a, as shown in the figure, will behave in a similar manner for the two half-spherical masses can lie in their centers of gravity and \( m \) and \( m \), respectively, which will be at a distance from o equal to \( \frac{4}{3}r \).

This being understood, imagine a number of balls \( M \) carried by as many spokes \( S \) radiating from a hub \( H \), as illustrated in Fig. 2, and be rotated \( n \) times per second around center \( O \) frictionless bearings. A certain amount of work will be required to bring his structure to this speed, and it will be found that it equals exactly half the product of the masses with the square of the tangential velocity. Now, if the moon rotates in reality on its axis this must also hold good for \( E \) of the balls as it performs the same kind of movement. Therefore, in impinging at a given velocity, energy must have been used up in the axial rotation of the balls. Let \( M \) be the mass of one of these and \( R \) the radius of gyration, then the rotational energy will be

\[ E = \frac{1}{2}M(2\pi R)^2. \]

Since for one complete turn of the wheel every ball makes one revolution according to the prevailing theory, the energy of axial rotation of each ball will be \( E = \frac{1}{2}M(2\pi R)^2, \) r, being the radius of gyration about the axis of rotation for 0.625 r. We can use as large balls as we like, and so make \( E \) a considerable percentage of \( E \) and yet, it is positively established that even if the rotating balls contain only the energy \( E \), no power whatever being consumed in the supposed axial rotation, which is, consequently, wholly illusionary. Something even more interesting may, however, be stated. As I have shown before, a ball flying off will rotate at the rate of the wheel and in the same direction. But this whirling motion, unlike that of a projectile, neither adds to, nor detracts from, the energy of the translatory movement which is exactly equal to the work consumed in giving to the mass the observed velocity.

From the foregoing it will be seen that in one sense the moon is corrected, but once it gets off on the wrong path, the momentum of the earth is not enough to make it be bisected by a plane tangential to the orbit, the masses of the two halves are inversely as the distances of their centers of gravity from the earth’s center and, therefore, if the latter were to disappear suddenly, no axial rotation, as in the case of a weight thrown off, would ensue.

WHAT IS MAN?

A man weighing 150 pounds will contain approximately 3.500 cubic feet of gas,—oxygen, hydrogen and nitrogen in his constitution which at ordinary pressure per cubic foot of cubic feet would be worth $2.80 for illuminating purposes. He also contains all the necessary fats to make a 15-pound candle, and thus, together with his 3,500 cubic feet of gases, he possesses considerable illuminating possibilities. His system contains 22 pounds and ten ounces of carbon, or enough to make 780 dozen, or 9,300 lead pencils. There are about fifty grains of sugar in his blood and the rest of the body would supply enough of this metal to make one spike large enough to hold his weight. A healthy man contains 54 ounces of phosphorus which his deadly poison would make 500,000 matches, or enough poison to kill five hundred persons. This, with two ounces of lime, make the stiff bones and brains. So, it might be decided that the man contains about 60 lumps of sugar of the ordinary cubical dimensions, and to make the seasoning complete, there are 20 of a portion of salt. If a man were distilled into water, he would make about 38 quarts, or more than half his entire weight. He also contains a great deal of starch, chlorid of potash, magnesium, sulfur, and hydrochloric acid in his wonderful human system.

Break the shells of 1,000 eggs into a huge pan or basin, and you have the contents to make a man from his toe-nails to the top of his head. This is the scientific answer to the question, "What is Man?"
What Would Their Advice Be Worth to You?

Suppose you have a knack for things electrical—that you realize what a wonderful opportunity for earnings and advancement the field of Electricity offers. What, then, would it be worth to you to have Edison and Steinmetz, the two foremost figures in the electrical world, tell you of a thorough, practical plan by which you can acquire, right at home, the training you need for success?

Well, here is their advice, based on years of familiarity with the instruction given by the International Correspondence Schools and on personal knowledge of I. C. S. trained men in their employ:

"I know of the success attained by men who have taken your Courses," says Edison. "It is a practical and economical way to acquire a knowledge of the profession," says Dr. Steinmetz. Read their full statements above.

For 27 years the I. C. S. have been training men at home in their spare time for success in Electricity and 280 other subjects. It is training over 100,000 men and women right now. It is ready and anxious to prepare you for advancement in Electrical Engineering or any special branch of it—or in any other line that appeals to you.

Pick the position you want in the work you like best, then put it up to us to prove how we can help you. Here is all we ask—without cost, without obligation, mark and mail this coupon.

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You benefit by mentioning the "Electrical Experimenter" when writing to advertisers.
HOW BOY SCOUTS CAN GAIN "WIRELESS MERIT" BADGE.

The committee on badges, awards and
scout requirements of national headquar-
ters has just established a "wireless merit
badge" which will become quite popular
as soon as there is an opportunity
for scouts to perfect themselves in the
discipline. The requirements are as fol-
lores:

- Be able to receive and send correctly not less than 10 words a minute.
- Know the correct form for sending a message.
- Be able to tell in own words the principal
laws regarding radio communication.
- Know at least one radio gram abbrevia-
tions (Q signals).
- Be able to name two types of detectors
and explain how they work.
- Name five minerals used in detectors
in the order of their sensitiveness.
- Draw a diagram of a simple transmitting
set, showing how the following instruments
are connected: microphone (dynamo
or storage battery), transformer, condenser,
spark gap, helix, key, and explain their
function.
- Draw a simple diagram showing how to
connect the following instruments: Tuning
coil or loose coupler, condensers, test or
variable, detector and ground. Tell the
use of the above apparatus.
- Draw a diagram of three different types
of aerials and tell their advantages or faults.
- Know how to properly ground a radio
set and know what precautions to take
during a thunderstorm.
- Demonstrate how to rescue a person
in contact with a live wire, and have a know-
ledge of the methods of administration of
a person insensible from shock.

Write a brief essay on the development
of wireless telegraphy.

ELECTRIC DRIVE FOR U. S. WAR-
SHIPS.

America’s capital fighting ships of the
future will be superior to those of other
nations because of their electrically
driven machinery, Capt. Robert D. Dalles,
told the House Naval Committee recently in
disclosing remarkable results attained by
the new dreadnought New Mexico, equip-
ted with the electric drive which is to be a
feature of all the big ships authorized since
1916.

The New Mexico’s turbo-electric ma-
machine was designed to develop 26,500
horse-power at full speed and to give the
ship a speed of twenty-one knots.

"It actually developed more than
31,000 horse-power," Mr. Daniels said, "and
maintained for four hours a speed of twenty-
one and one-quarter knots, and this when
the ship was loaded to nearly 20,000 tons
greater than its design called for.

The secretary said fuel economy at cruis-
ing speed had been one of the things sought
in substituting electric drive for the ordi-
nary turbine equipment.

Practical Chemical Experiments

(Continued from page 880)

TO TEST FOR COAL TAR COLOR-
ing. Experiment No. 3. See Fig. 3.

To test for coal tar color in butter,
a small sample is mixed on a porcelain plate
with Fuller's earth, and if coal tars are
present, there will be littleعال, while if
absent the color will be only light yellow or
brown.

Experiment No. 4.

Put little butter in a test-tube, and
a little oleomargarine into another. To each
add one inch or so of alcohol potash solu-
tion, and warm each in the steam of the
water bath until the one from the
other by smell. Add a little sulfuric acid
(dilute) to each and smell again. Notice
that "oleo" test tube will only smell of
alcohol, but the other will smell, besides,
of butyric ether.

Radium Substitute.

We are all quite familiar with the uses
of radium in medicine and as an ingredient
in luminous paint, both of which have been
brought to the general public’s attention
within the past few years.

Luminous paint in particular offers a field
whereby a substitute for Radium may be
judiciously utilized. This is not in any
important rôle in the war which has just
terminated, having been used more par-
cularly on the diaphragms of instruments used
on airplanes, so that they could be read at
night. It has also been used for electric
push buttons, door numbers, etc. The paint
is permanently luminous in the dark and
contains from 0.1 to 0.25 milligrams radium
element to one gram of zinc sulfid. A
luminous watch face usually contains from
ten to twenty cents worth of radium on it.

An excellent substitute for radium
for certain purposes is Meso-thorium. This
is a radio-active Cesium and Monazite,
and other thorium minerals. When
first extracted it is not satisfactory for
luminous paint, and consequently must be
"ripened" for several months, or even a
year before it can be used. During this
time the alpha radiation, which is required
for luminous paint, becomes sufficiently
strong. On the other hand the beta and
gamma radiation of Meso-thorium grows
and it can be put to practical purposes within a few days after prepara-
tion.

Radium, we are told, has a long life, half
of it decaying in approximately 1,800 years.
Meso-thorium on the other hand possesses
a short life, 5 or 6 years being its useful
life for luminous purposes. For luminous
paint to be used on objects which themselves
have a short life, it is an excellent substi-
tute for radium and will conserve the ele-
ment radium for medicinal purposes only.

Static Electricity and Gasoline.

Static electricity, superinduced by the
process of gasoline at a chamois skin dur-
ning the filtration process, was declared to
be full of great danger. When this idea
became prevalent, a well known automobile
concern undertook a series of rigid experi-
ments to learn what prospects there were
of real danger. Their investigations re-
sulted in their finding that the static elec-
tric charge cannot be developed with the temperature
above freezing (32 deg. F.), while at zero
(0 deg. F.) the conditions for producing
the spark are most favorable.

Two Trade Secrets.

There are two trade secrets at least that
the workmen have at a chamois skin dur-
ing the work, but which it is well worth the
while of inventors to study. One is the Chinese
method of making the bright reddish color
known as Vermilion, or Chinese red; and the other
is a Turkish secret—the inlaying of
the hardest steel with gold or silver. Among
the Chinese there are very few of the
trade who are guarded well. Apprentices, before
they are taken for either trade, are compelled
to swear an ironclad oath to reveal nothing
of the processes in the workshops; but
they also belong to families of high standing,
and must pay a large sum of money as a guaran-
(Continued on page 911)
Learn Electricity

In the Great Shops of COYNE IN 3 1/2 MONTHS

Thousands of Electrical experts are needed to help rebuild the world. Come to Chicago to the great shops of Coyne and let us train you quickly by our sure, practical way, backed by twenty years of success. Hundreds of our graduates have become experts in less than four months. You can do the same. Note is your big opportunity. Come—no previous education necessary.

Earn $125 to $300 a Month
In the Electrical business. Come here where you will be trained in these great $100,000 shops. Experts show you everything and you learn right on the actual apparatus. You work on everything from the simple bell to the mighty motors, generators, electric locomotives, dynamos, switchboards, power plants, everything to make you a master electrician. We have thousands of successful graduates. Just as soon as you have finished we assist you to a good position. We now have more positions than we can fill. Think of it.

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No need of taking from 1 to 4 years to become an expert, we have proved this in thousands of cases. The Coyne method of practical training eliminates all books, useless theory and other non-essentials and trains you in just what you need to know to become an expert.

Earn Your Way
Don't tell yourself you haven't got the money to come to Coyne. If you have ambition and the nerve of a real man, that's all you need. Dozens of our students every year work in their spare time and earn their living expenses. Dozens of others work in the day time, earn all their expense and attend our evening school. Our employment department will help you without charge.

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Don't worry about the money. Anyone with ambition can learn here. Our tuition is low with small easy payments if desired. All tools and equipment is furnished free. Our students live in comfortable homes in the best section in Chicago—on the lake—just a few minutes' walk from our school.

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ELECTRICAL EXPERIMENTER

April, 1919

INTRODUCING
Mr. R. W. DeMott

For eight months past Mr. R. W. DeMott has been advertising manager of your magazine. You have noticed the rapid growth of "E. E." during that time. One big reason for this astounding growth and betterment of your magazine is due directly to Mr. DeMott and his "ads."

If you have the welfare of your magazine at heart, read Mr. DeMott's message. It means money to you.
The Publishers.

Advertising Talks

You, as a reader of the ELECTRICAL EXPERIMENTER, grow through the influence you derive from reading articles of permanent interest in every department of the magazine. There are some very strong reasons why you should be doubly interested in the advertising pages of the ELECTRICAL EXPERIMENTER.

The publishers are constantly striving and planning to improve the quality of the magazine offered you each month. But it is your magazine and it is up to you as to how big it shall grow. There are a great many things that you ought to know about advertising and how this powerful force affects you personally. Progressive and responsible firms all over the country announce what they have to offer you through the advertising pages of the ELECTRICAL EXPERIMENTER. Not only will they help your magazine by showing an interest in its advertisers, but you will benefit yourself to an even greater degree. I will take up these points one by one each month, and hope that every reader will follow this column and offer any suggestions or ask any questions that may come to his mind regarding advertising and its relation to a big magazine.

If you have any suggestions to make regarding the advertisements that appear, if there is any information you would like to see advertised in general, write me personally and your questions will be taken up in due course through this column. For the time being I will tell you about "E. E." advertising and its relation to you. Each month I will give you one reason more why the advertisements should be of vital interest to everyone of us.

You have watched the EXPERIMENTER grow from a single-page magazine to its present size. You have watched the class of articles improve, its staff of authors, who contribute each month get bigger and better, finally resulting in the wonderful announcement made in our January issue that the magazine is acquired by you for the services of the world's greatest inventor, Nikola Tesla, to give you exclusive feature articles in every issue for the next two years at least.

One of the principal factors in this rapid growth has been advertising. Next month I will show you how, by reading and answering the advertisements, you will help to still further the cause of increasing the size of the EXPERIMENTER.
WHAT IS A “KILOWATT” AND “KILOWATT-HOUR”.
By Frank Szabo.

THERE seems to be quite a wrong conception of the terms kilowatt and kilowatt-hour. Quite frequently one hears expressions such as “10 kilowatts per hour”, but such an expression does not mean anything.

What is a kilowatt? Kilowatt is a term for power or rate of work. According to Kent and other authorities, one kilowatt is the energy consumption of one hour of 3.52 lbs. of water per hour from and at 212 deg. F., or 3.415 heat-units per hour. In this definition, per hour is a necessary part of it, without which the definition is incomplete. If it takes approximately 3 lbs. of burning coal to evaporate 3.52 lbs. of water from and at 212 deg. F., then one kilowatt represents the consumption of 3 lbs. of coal per hour, and not simply the consumption of 3 lbs. of coal. If we extend the evaporation of 3.52 lbs. of water from and at 212 deg. F. by a consumption of 3 lbs. of coal uniformly over a period of two hours, we do not have the equivalent of one kilowatt, but one-half, or ½ kilowatt, because during one hour only one-half of 3.52 lbs. = 1.76 lbs. of water have been evaporated with a consumption of one-half of 3 lbs. = 1.5 lbs. of coal. Also, if we did the above performance in 30 minutes, or one-half hour, we would not have the equivalent of one kilowatt-hour, but one-half, or ½ kilowatt-hour, because at the same rate we would, during one hour, evaporate 2 x 3.52 lbs. = 7.04 lbs. of water with a consumption of 7.04 lbs. of coal. Hence, one kilowatt represents the consumption of 3 lbs. of coal per hour.

Of course the quantity of 3 lbs. of coal in the above example is not fixed, but may slightly more or less than 3 lbs. per hour for one kilowatt, depending on the heat value of the coal and the efficiency of the steam and current generating units, but 3 lbs. is a fair average figure.

What is a kilowatt-hour? According to Kent, it is the evaporation of 3 lbs. of water from and at 212 deg. F., or 3.415 heat-units. In this definition, per hour is left out because no matter how fast or how slow the water evaporates, the actual work done in evaporating 3.52 lbs. of water from and at 212 deg. F. is equivalent to one kilowatt-hour.

In actual practice, one kilowatt-hour is the equivalent of one kilowatt for a period of one hour. The rate of ½ kilowatt for a period of 2 hours is the equivalent to one kilowatt-hour. Hence:

\[ \text{Kilowatt-hours} = \frac{\text{No. of hours}}{2} \times \text{kilowatt-hours} \]

The instruction work is laid out and given in a way easily understood. It is not a cut and dried book plan, but the lessons are prepared especially for the purpose for which they are used and additional instruction is given to the individual student, with a view of meeting his particular needs. I have the information to give and I believe the ability to impart it to others, a fact which is in a way proven by other institutions which have made use of my services in the design and perfecting of instruction courses. To understand this work, IT IS UP TO YOU TO SHOW I am correct in this view of the matter. It is only as you work, and work correctly, that you will make the most of the instruction, and hence, you will get the most out of this book.

The Purpose of the Course of Study
I have been designing courses in electrical instruction and teaching electricity, of and on during the past 17 years, and during that time I have had an unusual opportunity to make a special study of the teaching business, from the standpoint of a practical man. This course of my own is designed with a view of reaching those who do not have a lot of time and money to devote to study work, and to give them as thorough a knowledge as possible of electricity, in the shortest possible time. The instruction is given like you were working the various jobs and I was the boss telling you what to do and how to do it, and giving the explanation necessary for the understanding of the theory covered by the subject under discussion. There are many conditions which seldom occur in the everyday run of electrical experience, and these conditions I lay particular stress on. This part of the instruction makes the course particularly attractive and valuable to those already engaged in active electrical work.

It Is Up To You

Practical Men: Take My Course and Recommend it to Others
Sixty percent of my students are actively engaged in electrical work and find the instruction I give well suited to their needs. Several of these men have had their fellow workers take the course also and they are taking the instruction together, making a class-room proposition of it and the results are in every way satisfactory to all concerned. One of these classes was started by a Chief Experimenter, one of my students in Glen White, W. Va., who now has practically all the men under him taking my course. I believe the fact that these men who understand electrical work approve of my course to this extent is one of the strongest endorsements I could get.

FIFTY FIFTY

I work absolutely on a 50-50 basis with my students. You pay me the comparatively low price I ask, and I give you the instruction and other help as is stated in my catalog. No student is permitted to pay cash for his entire course on starting, the course being paid for in small monthly payments as you go along. Students have the privilege of discontinuing the work if they should find that it was not just what they were after, and their payments stop at the same time. This is my way of doing business and I would not want your money when I was not giving you the instruction.

Apparatus, Instruments, Material, Etc.
Certain electrical apparatus, instruments, material, drills, sketching implements, etc., as detailed in the catalog, are required to the course and are a part of the regular instruction for which there is no extra charge as it is covered by the regular monthly payments.

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You do not need any previous training or experience in order to become a successful Wireless Expert. By our practical ten weeks' Home Study Course you can quickly qualify for a good position at big pay. Many of our students have secured positions before completing the course.

Get Your Instruction From the Nation's Capital

Our Course Is Endorsed by Officials of the U. S. Government

The National Radio Institute, headed by authorities who have been closely allied with government training of students, has perfected an easily mastered course in wireless telegraphy whereby students are taught completely in ten weeks, either here in Washington at our large residence school or at home, by mail. Many of our students are ready to take up actual wireless work in much less time. The course is founded on actual practice, hence the rapid progress of the student.

Earn Up to $200 Per Month

In the short period of ten weeks we can make of you a wireless operator, a man with a profession, independent, and not subject to the rise and fall of wages in the labor market. Salaries are as high as $200 per month. We give you this training at home, by mail, in your spare time. It is not necessary for you to lose any time from your work to take the course. Then when you have received your diploma we help find you a good position.

Free Instruments to Every Student

In addition to text books, lessons and personal instruction, we send you a Home Practice Set consisting of a standard sending key and buzzer, and a Universal automatic wireless transmitting and receiving set. These instruments are free to every student. No other school can offer you what we do.

Pay As You Go Along With Your Lessons

Our plans of payment bring a wireless education within the reach of anyone who desires to learn. A small payment down and small payments twice a month enable you to earn the cost of your tuition while actually learning to be a wireless operator.

Wireless News Notes

The U. S. Shipping Board has recently announced an increase of nearly 30% in the pay of Merchant Marine Wireless Operators.

Nicola Tesla, world famous inventor, has recently perfected his Wireless Light, one of the wonders of the age. Another new invention has been perfected whereby wireless messages may now be sent underground.

Due to the recent perfecting of the Wireless Telephone, we expect to soon be able to communicate with our Home Study students by wireless.

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Our booklet, "WIRELESS, the Opportunity of Today," gives you complete information in regard to our course, the quick and easy methods by which you can master wireless, and other important facts you should know. It is free. Just mail the coupon. No obligation whatever on your part.

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State
TRANSMISSION OF LIGHT THRU WATER.

The comparative transmission of light thru varying depths of water is a problem that science until recently knew but little about. Now, thanks to Mr. S. L. E. Rose, of the General Electric Company's illuminating engineering laboratories, who describes his findings in the General Electric Review. Photometric readings were taken every six inches through the available range of 5/8 feet of water in the cylindrical tank in which the tests were conducted. The water used was Schenectady city water, which is clear artesian well water. Sea water would transmit much less light owing to the apparent blue or greenish tint it possesses which tints bespeak a fairly considerable amount of suspended matter and consequently increased opacity.

The accompanying graphic curve shows vividly the relative transmission of light from a Mazda lamp, fitted with waterproof connections. A table of constants is given in the article, together with a formula for computing the illumination intensity for different depths of water when the initial intensity is known. The present graph shows, however, just how rapidly the illumination falls off in water for any given initial illumination. The particularly interesting feature of the results from a practical standpoint is the very considerable cut-off of light produced by a substance apparently so transparent, amounting for a single foot (0.05 m) of water to 27.5 per cent. On this basis the transmission through 50 ft. (15.2 m) of water would be only about one part in 10,000,000 of the incident light.

The rapid decrease in the transmission factor with increased light in water coincides with the well-known facts that, for a so-called transparent medium, the ocean permits the penetration of daylight to but a surprisingly short distance below its surface and that fish native to the depths are blind or carry their own illuminants.

HAMMOND RADIO CONTROLLED BOAT SUCCESSFUL.

Army and navy experts have reported the device of John Hays Hammond, Jr., for radio control of surface craft to be sent laden with explosives against enemy ships a success, and predict similar results with submerged craft.

Secretary Baker wrote the House appropriation committee recently that the joint army and navy board was "convinced of the practicability of the control" of the surface craft, and added that there had also been demonstrations of the possibility of the control of a craft, completely submerged, except for an air in-take pipe.

Before finally deciding on the purchase of the patents for $750,000 the board desires further experiment with the submerged craft.

Construction of the submerged craft, which will be about 80 feet long by 7 feet in diameter, will take two years, according to Mr. Hammond, who told the committee he had spent ten years and $400,000 on his invention.

"The board considered the ability of the enemy to interfere with the control of the vessel by radio energy. Mr. Hammond's claims are that no interference can be had with the craft outside a radius of 100 to 150 yards from the source of the energy; that is, from the radio plant of a battleship, for example."

Major-General F. W. Cole said he had run the craft "all around vessels coming into the harbor at will." Mr. Hammond said an aviator after four hours' training on control, was able from a height of 9,000 feet and a distance of six or seven miles to exercise absolute control over the high-speed boat.

ELECTRIC SNOW MELTER FOR TRACK SWITCHES.

The electric snow-melter device for track switches here illustrated is purely and simply an electric heater enclosed in a 3/8 inch wrought iron pipe, 20 inches long. These heaters are placed between the ties, just under the rail. They are wired from a circuit as the amount and character of the supply current may vary, and a switch is placed in this wiring at some convenient point clear of the track. The current can be turned on as the snow storm starts by an employee as readily as an electric light. The heat generated does not melt.

The temperature in the heater rises about 100 degrees Centigrade in the first half hour and by the end of an hour is about 135 degrees Centigrade above the ambient temperature. This heat is not enough to set fire to anything but is sufficient to melt the snow.

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ELECTRICAL EXPERIMENTER

April, 1919

What is a "kilowatt" and "kilowatt-hour"? (Continued from page 897)

will give a constant reading of 80 kilowatts; in other words, for a speed twice as great the watt-meter will show a constant reading twice as high, whereas the watt-hour-meter reading will be the same for the same distance traveled.

Applying the formula to this example for a speed of 10 miles per hour and a power consumption of 40 kilowatt-hours, we get

$$40 \text{ Kilowatts} \times \frac{897}{40} = 40$$

Making the same run in one-half hour we get

$$\frac{40}{897/2} = 40$$

Dividing the total power consumed by one car in kilowatt-hours by the distance in miles, we get the power consumption in kilowatt-hours per car mile.

Applying the above terms to electric light, a 40-watt electric light is one that consumes electric power at the rate of 40 watts or 40 watts-hours per hour. A circuit having, say, twenty 40-watt lights in parallel will then consume electric power at the rate of 20 x 40 = 800 watts or 800 watts-hours per hour, or 40 watts-hours per lamp-hour. If

an electric power station charges you ten cents per kilowatt-hour you can burn one 40-watt lamp

$$1000 = 25 \text{ hours, or twenty 40-watt lamps}$$

$$1000 = 1\frac{1}{4} \text{ hours, for ten cents, since both conditions represent one kilowatt-hour.}$$

Something new in lamp guards.

A new departure in portable lamp guards is shown in the illustration of a split handle which can be quickly attached to a special expanded steel lamp guard supplied by the manufacturer. This portable successfully fills a demand for a substantial handle guard which does not need to be wired. The halves of the handle including the guard itself, open or close at the hinge at the bottom of the guard and can instantly be closed and locked around the socket at the end of any extension cord. The cord itself runs thru grooves in the handle.

The convenience of this new product will be appreciated by the motorist in his garage as well as in every factory, mill or warehouse because it permits light to be safely carried to dark corners, in stock lins, engine pits, etc. Fire danger is avoided and lamp users will readily see the advantage and economy, as the modest cost of the guard is quickly repaid thru prevention of lamp breakage.

Another "useless" Patent.

A Chicago woman has patented a shoe with an electric battery in the heel to supply a mild current to a wearer's ankle as a tonic. Another "useless patent!"

The photoelectric sensitivity of various substances.

SOME time ago an examination was made of various substances to determine their electrical sensitivity to light; and in the view of the fact that some of the results obtained are at variance with the measurements made by Case, it seems desirable to publish a summary of these observations, which were made at the Bureau of Standards.

Two of the herein described substances were examined for the change in electrical conductivity caused by the action of light upon them, and all of them were examined for photoelectric activity when they were charged to a negative potential in an evacuated bulb and exposed to light, reports Messrs. Cobblett and Emerson in the Journal of the Washington Academy of Sciences.

When the substances were examined for an increase in electrical conductivity, a potential of 2 to 6 volts was connected thru a resistance of zero to 1,000,000 ohms into a circuit containing a d'Arsonval galvanometer and the current was measured.

In most cases the substances were slightly conducting when not exposed to light, so that the dark current had to be annulled by joining a counter e.m.f. thru a resistance of 10,000 ohms to the terminals of the galvanometer. This counter e.m.f. was obtained by shunting across the circuit a resistance of 100 ohms which was in series with a cell of 2 volts and a variable resistance of zero to 70,000 ohms.

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specified, was a 10-c.p. carbon incandescent lamp, placed at a distance of 10 cm. from the substance under investigation. One disappointing feature of this investigation is that no substance was found which compared in sensitivity with the potassium photoelectric cell and with the selenium cell. Thomson. This metal was said to differ from the impure material, which is a liquid.

The results obtained proved disappointing. This metal was quite insensitive to light. When the cell was exposed to day-light the photoelectric current produced a deflection of only 4 mm., whereas similarly exposing a potassium photoelectric cell the photoelectric current was sufficient to give a deflection beyond the range of the scale.

Silver Sulfide. The sample examined was a thin flat strip, 6 by 10 mm. in area, to one side of which was formed the negative electrode of a photoelectric cell (evacuated glass bulb about 5 cm. diameter with a ring of platinum wire for the anode). It was connected to an electrodynamometer, and the cadmium measured. The result of this measurement showed a very small current when exposed to day-light. The sensitivity was practically the same when exposed to day-light or to the standard incandescent lamp.

Tellurium. This specimen was examined in a rectangular block 3 by 1.5 mm. It was held by compression between copper electrodes. After the specimen was heated to redness, it was placed in a glass tube and a tellurium deposited upon a glass plate by cathode disintegration. Suitable terminals were attached to a sample 4 by 30 mm. No change in conductivity was observed when it was exposed to light.

Boleite. The sample of boleite [3PbCl (OH). CuCl(OH) + AgCl], from Boleo, Mexico, examined was a single rectangular crystal 3 by 1.5 mm. It was held by compression between copper electrodes. No change in sensitivity was noted when the crystal was exposed to daylight or to the standard incandescent lamp.

Stibnite. The size of one sample examined by the method described was attached to it by heating a copper wire to incandescence in a gas flame and bringing it in contact with the plate of stibnite. The standard carbon lamp caused a deflection of 5 cm. Stibnite may be considered as sensitive as boulangerite, to be mentioned presently, but the deflection drifted, due to the decrease in resistance with time already noticed by other observers.

Boulangerite. The specimen of boulangereite (3PbS. Sb. S.) from Irkutsk, Siberia, investigated was obtained from the Smithsonian collection. Several samples were examined. In one sample, 4 by 7 by 0.8 mm., the electrodes consisted of copper wires which formed the anode and the cathode was just described. The radiation from the standard lamp gave a deflection of 10 to 20 cm. Another sample, 1 by 1.2 by 2 mm., held by compression between two heavy electrodes of copper, when exposed to the standard incandescent lamp produced a deflection of 0 to 3 cm., which is comparable with the preceding when one considers the size of the exposed surfaces.

Altho this substance seems fairly sensitive, it is not apparent to be sufficiently so to justify an investigation of its spectral sensitivity with a view of using this mineral as a selective radiometer.

Jamesonite. (2PbS: Sb:S.) Smithsonian Institute.
collection, from Cornwall, England.) The sample examined (size 2 by 7 by 1 mm.) had the copper wire terminals attached by fusing the incandescent wire into the material. The standard lamp gave a deflection of only 1 to 2 cm., which seems to indicate that the material is not so light-sensitive as is boulangerite.

Mixtures of galena and stibnite in various proportions were melted in a crucible and poured upon a plate of metal. Several samples, 5 by 10 by 0.5 mm., were examined, but none of them gave any indication of light-sensitivity (change in resistance) when exposed to daylight or to the standard incandescent lamp.

Bismuthinite. Bismuthinite, Bi₂S₃, was obtained from the Smithsonian collection from Jefferson County, Montana. This is the most interesting specimen in the collection and almost every view of the diverse results obtained and the explanation offered thereof.

The sample of bismuthinite examined consisted of a non-homogeneous mass of acicular crystals, which was easily crushed into numerous fine needle-like crystals. The first sample examined was a small mass of crystals, 1 by 1 by 0.2 mm., which was pressed between two heavy electrodes of copper. When the crystal was exposed to the standard carbon lamp no change in conductivity could be detected with certainty.

A second sample, 3 by 6 by 1 mm., had the copper wire terminals attached by fusion, as already described. The e.m.f.'s applied were the same as for the preceding sample. When exposed to the standard lamp no change in conductivity was observed. These results were in agreement with those published by Case, who used a three stage Audion amplifier to detect the change in conductivity of the crystal. The foregoing experiments were repeated in the manner described by him. For this purpose the light from an acetylene flame shining thru a slit 2 by 10 mm., was focused upon the crystal by means of a triple achromatic lens, 6 cm. in diameter and 18 cm. focal length. The light was interrupted by means of a sector disk having 15 openings and operated by means of an electric motor, the speed of which could be varied. The usual speed gave 240 interruptions per second. The crystal was connected to a three stage Audion amplifier and telephone receiver. A crystal of selenium, whose conductivity had been found to be a good note, but the samples of boulangerite and jamesonite, which were by previous tests were light-sensitive, did not give a musical sound in the telephone.

The sample of bismuthinite with electrodes sealed on produced no audible note when exposed to light.

At least a dozen samples of bismuthinite held by compression, compression by hand, and electrodes were examined in connection with the amplifier. Of this number only two samples appeared to be light-sensitive. One sample produced only a faint humming sound in the telephone receiver. The second sample produced a loud note in the telephone. The sound was the loudest when the crystal was exposed along the line of contact with the copper electrode. Covering the crystal with red glass did not reduce the loudness of the note very much, indicating that the effect is due to heating of the material. Unfortunately, this crystal was crushed while under investigation; prolonged tests on other samples gave negative results as regards the production of sound.

In view of the fact that the tests made with a sensitive galvanometer failed to show an increase in sensitivity, it seems highly probable that the bismuthinite was exposed to light, it appears that the change in conductivity which was observed when a certain specimen was exposed to intermittent flashes of light (photoflash or, rather, radiophone) is
the result of a thermal change within the crystal, or perhaps a change in the contact resistance at the electrodes. In this connection the following experiments on thin strips of metals are of interest.

Platinum and Gold. In conclusion it is of interest to record the results obtained when using thin blackened strips of platinum and of gold-leaf as radiophones, by connecting them thru a battery to an amplifier.

These blackened strips were warmed intermittently by exposing them thru a rotating sectored disk to the acetylene flame, as already described.

When a sensitive platinum bolometer receiver was used as a radiophone, the sound produced in the telephone was not very audible. This no doubt was due to the great heat capacity of the material which prevented the rapid alternations in resistance and hence in the current, from being of sufficient magnitude to affect the telephone receiver.

Using a lightly smoked strip (6 by 2.5 mm.) of gold-leaf, the ends of which were clamped between thin (0.02 mm.) strips of tin, the sound produced in the telephone receiver was as loud as was observed in the photophone made of selenium.

This device was mounted in a glass bulb which could be evacuated. As was to be expected, there was no marked difference in the intensity of the sound produced when operated in air and in a vacuum.

In the gold-leaf radiophone as used, the limit of audibility was attained for a light (radiant power) intensity of 4.8 x 10^-5 watts. Using a larger receiver and amplifier and a larger current (which was 0.12 amp. in the present tests) thru the receiver, the sensitivity could be greatly increased.

MENTAL TELEPATHY—A SIMPLE CONCEPTION OF PSYCHICAL ACTIVITY

By Dr. H. Merlitz

In the September issue of the ELECTRICAL EXPERIMENTER there appeared an extremely interesting article by Dr. A. Abrams on Thought Transference and Other Phenomena. Altho he gave many interesting experiments he did not show the relationship of this theory to the rather obvious physical theories. It is the author's intention in the present article to present an explanation for this remarkable phenomenon.

We know very little in regard to the functioning of the human mind. We have practically no insight into the mechanism of thought and memory. We know, however, that the brain in function requires nourishment. Thus it follows that any operation of the brain is accompanied by the absorption of a certain amount of energy. However, contrary to ordinary laws, in storing a thought and in subsequently recalling it, energy is absorbed. These two processes are the reverse of each other, and it would naturally be supposed that in remembering energy would be destroyed.

To commit a thought to memory we repeat it several times, each successive repetition requires the expenditure of a certain amount of energy. Thus we say that the energy expended after a number of repetitions equals:

\[ E_1 + E_2 + E_3 + \ldots + E_n \]

Now when we remember it the process is the reverse, which gives us \((E_1)^n\) which would equal \(E_1\), which means the addition of energy. Thus the act of remembering a fact more firmly implants it in the mind.

We may easily assume that there is a certain practical limit to the amount of effect that can be produced. This limit might be called the saturation of the brain. It would be reasonable to suppose from this that for each repetition or act of remembering the amount of energy stored is less than that of the preceding one, decreasing in geo-
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interesting incident. He wished to make the appearance of a young lady appear to a lieutenant living several miles away. At the time of the experiment a visitor happened to be with the lieutenant, who is said to have seen the apparition also. Many instances are recorded in which persons were hypnotized at some distance. All of these phenomena can be easily explained by the brain wave theory.

Besides the transference of thought, both sympathy and affection may be the outgrowth of these radiations from the brain. Whether our capacity for the reception of these impulses is increasing with the evolution of man, cannot be ascertained directly. It would seem probable, however, that with our increase in education and civilization that consideration of this thought language may be found. Who knows but that the man of the future may find a practical application for this radiation from the brain, and a host of more delicately made creature may result who would effect mutual understanding by means of this mechanism yet but little understood.

MY INVENTIONS
(Continued from page 885)

travel at a rate of about one thousand miles an hour, impracticable by rail. The reader will smile. The plan was difficult of execution; I will admit, but not nearly so bad as that of a well-known New York professor, who wanted to pump the air from the earth to the temperate zones, entirely forgetful of the fact that the Lord had provided a gigantic machine for this very purpose.

Still another scheme, far more important and attractive, was to derive power from the rotational energy of terrestrial bodies. I had discovered that objects on the earth's surface, following the daily rotation of the globe, are carried by the same alternately in and against the direction of translatory movement. From this results a great change in momentum which could be utilized in the simplest imaginable manner to furnish motive energy in any habitable region of the world. I cannot find words to describe my disappointment when later I realized that I was in the predicament of Archimedes, who vainly sought for a fixed point in the universe.

At the termination of my vacation I was sent to the Polytechnic School in Graz, Styria, which my father had chosen as one of the best reputed institutions. That was the moment I had eagerly awaited and I began my studies under good auspices and finally resolved to pursue them.

My training was above the average, due to my father's teaching and opportunities afforded. I acquired the knowledge of a number of languages and waded thru the books of several libraries, picking up information more or less useful. Then again, for the first time, I could choose my subjects as I liked, and free-hand drawing was to bother me no more. I had made up my mind to give my parents a surprise, and during the whole first year I regularly started my work at three o'clock in the morning and continued until eleven at night, no Sundays or holidays excepted.

As most of my fellow-students took things easily, naturally enough I eclipsed all records. In the course of that year I past three nine exams and the professors thought I deserved more than the highest qualifications. Armed with their flattering certificates, I went home for a short rest, expecting a triumph, and was more surprised when my father made light of these hard-won honors. That almost killed my ambition; but later, after he had died, I was pains to find a package of letters which

(Continued on page 907)

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Yes, the Radiotone is Silent. It is not a musical instrument, but a practical, home-made electrical instrument, which is nothing but a toy. It will not work like the big commercial instruments. Simply by setting the slide with the help of the waltz test buzzer, the Radiotone is built along exactly the same lines as the waltz test buzzer. No ordinary musical instrument is used, but a high-speed, magnetic amplifier and a high-efficiency receiver, all kept in one box. A new and improved instrument is used to make the apparatus last practically forever.

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MY INVENTIONS.  
(Continued from page 905)

the professors had written him to the effect that this was the last occasion on which the Institution would be killed thru overwork.
Thereafter I devoted myself chiefly to physics, mechanics and mathematical studies, spending a large amount of time in laboratories. I had a veritable mania for finishing whatever I began, which often got me into difficulties. Thereon I started to read the works of Voltaire when I learned, to my dismay, that there were close on one hundred large volumes in small print that I had to finish whilst drinking seventy-two cups of black coffee per diem. It had to be done, but when I had the last book I was very glad, and said, "Never more!"

My first year's showing had won me the appreciation and friendship of several professors, among whom was Professor Poehl, who was teaching arithmetic and geometry; Prof. Poehl, who held the chair of theoretical and experimental electricity, and Dr. All, who taught integral calculus and specialized in differential equations. This scientist was the most brilliant lecturer I have ever listened to. He took a special interest in my progress and would frequently remain for an hour or two in the lecture room, giving me proofs so clear to the point that I was justified in understanding them.

To him I explained a flying machine I had conceived, not an illusory invention, but one based on sound, scientific principles. It had been realizable thru my turbine and will soon be given to the world. Both Professors Rogner and Poehl were curious men. The former had a number of expressions of expressionism, and himself did there so there was a moment, followed by a long and embarrassing pause. Prof. Poehl, an original and thoroughly grounded German, had enormous feet and hands like the paws of a bear, but all of his experiments were skillfully performed with clock-like precision and without a miss.

It was in the second year of my studies that be received the dynamic formula from Paris, having the horseshoe form of a laminated field magnet, and a wire-wound armature with a commutator. It was connected up and I am not under any impression that it could be possible to have a motor without these appliances. But he declared that it could not be done. He had mastered of driver of electricity lecture on the subject, at the conclusion of which he remarked: "Mr. Tesia may accomplish great things, but he certainly never will do it."

I could not do this. It was equivalent to converting a steadily pulling force, like that of gravity, into a rotary effort. It is a perpetual-motion scheme, an impossible idea." But instinct is something which transcends knowledge. We have, undoubtedly, certain firmer beliefs that enable us to persist without logical deduction, or any other willful effort of the brain, is futile. For a time I wandered, impotent by the way, but suddenly convinced I was right and undertook the task with all the fire and boundless confidence of your.

I seized first picturing in my mind a direct-current machine, running it and following the changing flow of the currents in the teeth, and would have the alternator and investigate the processes taking place in a similar manner. Next I would visualize systems comprising motors and generators, and proceed them in various ways. The images I saw were to me perfectly real and tangible. All my remaining time was spent in intense but fruitless efforts of this kind, and I almost came to the conclusion that the problem was insoluble. In 1880 I went to Prague, Bohemia, carrying out my father's wish to complete my education at the University there. It was in that city that I made a decided advance, which consisted in detaching the commutator from the machine and studying in this new aspect, but still without result. In the year following there was a sudden change in my views of life. I realized that my parents had been making too great sacrifices on my account and resolved to relieve them of the burden. The American telephone had just reached the European continent and the system was to be installed in Budapest, Hungary. It appeared an ideal opportunity to redeem the pledged bond of friendship of my family was at the head of the enterprise. It was here that I suffered the complete breakdown of all the efforts to which I have referred. What I experienced during the period of that illness surpasses all belief. My sight and hearing were always extraordinary, and the various objects in the distance when others saw no trace of them. Several times in my boyhood I saved the houses of our neighbors from fire by the fact crackling sounds which did not disturb their sleep, and calling for help.

In 1889, when I was past forty and carrying on my experiments in Colorado, I could hear very distinctly thunderscalps at a distance of 550 miles. The limit of audition for a scientific man was scarcely more than 150 miles. My ear was thus over thirteen times more sensitive. Yet at that time I was, in spite of this, not to speak, in comparison with the acuteness of my hearing while under the nervous strain. In Budapest I could hear the ticking of a watch with three rooms between my ears and the time-piece, flying alighting in a table in the room would cause a dull thud in my ear. A carriage passing at a distance of a few miles fairly shook my whole body. The whistle of a locomotive twenty or thirty miles away made the bench or chair on which I sat vibrate so strongly the seat was unbearable. The ground under my feet trembled continuously. I had to support my bed on rubber cushions and rest at all times. The roaring noises from near and far often produced the effect of spoken words which would have frightened me had I not been able to resolve them into their accidental components. The sun's rays, when periodically intercropped, would cause blows of such force on my face that I would sometimes have to look up to summon all my will power to pass under a bridge or other structure as I experienced a crushing pressure on the skull. In the desire of a last effort I could detect the presence of an object at a distance of twelve feet by a peculiar creepy sensation on the forehead. My pulse varied from a few to two hundred and sixty beats and all the tissues of the body with twitching and tremors which was perhaps the least to be endured by a physician who gave me daily large doses of Bromid of Potassium pronounced my malady unique and incurable. It is my eternal regret that this illness was not proffered of me capable in psychology and physiology at that time. I clung desperately to life, but never expected to recover, and to believe that so hopeless a physical wound could ever be transformed into a man of astonishing strength and tenacity, able to work thirty or forty years without a day's interruption, and find myself still strong and fresh in body and mind? Such is my case. N power is left to me, and to continue the work, and the assistance of a devoted friend and athlete accomplished the wonder. My health returned and with it the vigor of mind. In attacking the problem again I almost regretted that the struggle was soon to end. I had so much energy to spare. Whenever the task it was not with a resolve such as men often make. With me it was a sacred vow, a question of life and death. I knew that I would perish if I failed to solve the battle

(Continued on page 909)
MY INVENTIONS.
(Continued from page 907)

was won. Back in the deep recesses of the brain was the solution, but I could not yet give it outward expression. One afternoon, which is etched in my recollection, I was enjoying a walk with my friend in the City Park and reciting poetry. At that age I knew the entire book heart, word for word. One of these was Goethe's "Faust." The sun was just setting and reminding me of the glorious passage:

"Se rickt auf, der Tag ist überlebt, Dort eilt sie hin und fürdert heut's Leben. Oh, dass kein Flügel mich vom Boden hebt Ihr nach und immer nach zu streben!"

Ein schöner Traum tuidessen sie entweicht, Ach, zu des Geistes Flügel wird wohl Kein körperlicher Flügel sich gesteigen!"

As I uttered these inspiring words the idea came like a flash of lightning and in an instant the truth was revealed. I drew with a stick on the sand the diagrams shown six years later in my address before the American Institute of Electrical Engineers, and my companion understood them perfectly. The diagrams were wonderful, but sharp and clear and had the solidity of metal and stone, so much so that I told him: "See how these ideas reverberate through my mind. I cannot begin to describe my emotions. Pygmalion seeing his statue come to life could not have been more deeply moved. A thousand ideas were in my head which I myself stumbled upon accidentally I would have given for that one which I had wrested from my brain against all odds and at the peril of my existence.

"The glow retretas, done is the day of toil; It black into a few fields of life existing; Ah, that no wing can lift me from the soil. Upon its track to follow, follow soaring!"

A glorious dream though now the glories fade. Arise the wings that lift the mind to flight. Of wings to lift the body can be bestowed."
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- Ammonium Carbonate (\(\text{NH}_4\text{CO}_3\))
- Ammonium Chloride (\(\text{NH}_4\text{Cl}\))
- Barium Chloride (\(\text{BaCl}_2\))
- Boric Acid (\(\text{H}_3\text{BO}_3\))
- Bromine (\(\text{Br}_2\))
- Calcium Chloride (\(\text{CaCl}_2\))
- Calcium Oxide (\(\text{CaO}\))
- Calcium Sulphate (\(\text{CaSO}_4\))
- Charcoal (\(\text{C}\))
- Copper Sulphate (\(\text{CuSO}_4\))
- Ferric Sulphate (\(\text{Fe}_2\text{SO}_4\))
- Ferrous Sulphate (\(\text{Fe}_2\text{SO}_4\))
- Glycerol (\(\text{C}_3\text{H}_5\text{OH}\))
- Hydrochloric Acid (\(\text{HCl}\))
- Iodine (I)
- Iron Chloride (\(\text{FeCl}_3\))
- Iron Oxide (\(\text{Fe}_2\text{O}_3\))
- Lead Acetate (Pb \(\text{C}_2\text{H}_3\text{O}_2\))
- Nitric Acid (\(\text{H}_3\text{NO}_3\))
- Perchloric Acid (\(\text{H}_3\text{ClO}_4\))
- Phosphoric Acid (\(\text{H}_3\text{PO}_4\))
- Sodium Acetate (\(\text{Na}_2\text{C}_2\text{H}_3\text{O}_2\))
- Sodium Borate (\(\text{Na}_2\text{B}_4\text{O}_7\))
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- Sodium Chloride (\(\text{NaCl}\))
- Sodium Nitrate (\(\text{NaNO}_3\))
- Sodium Phosphosphate (\(\text{Na}_3\text{PO}_4\))
- Sodium Sulphate (\(\text{Na}_2\text{SO}_4\))
- Sodium Nitrite (\(\text{NaNO}_2\))
- Stannous Chloride (\(\text{SnCl}_2\))
- Sulphate of Nickel (\(\text{NiSO}_4\))
- Sulphide of Zinc (\(\text{ZnS}\))
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- Ten Sheets of Filter Paper
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- One book containing Treatise on Elementary Chemistry and 100 Chemical Experiments to be performed with this outfit.

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PRACTICAL CHEMICAL EXPERIMENTS.

(Continued from page 894)

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QUESTIONS AND ANSWERS IN CHEMISTRY.

Standard Soap Solution.

Q. 1. Roy Munson, Henrietta, Okla., wants to know the method of preparing the Standard Soap Solution as mentioned in the lesson on water testing of the "Experimental Chemistry" text.

A strong solution of this soap is first prepared by rubbing together in a mortar, 75 grams of the so-called "head plaque" (which consists principally of fats and bases), which may be obtained from your druggist, and 20 grams of dry potassium carbonate. When the two are thoroughly mixed a small quantity of methylated alcohol is added, and the mixture worked to the consistency of a thin smooth cream. More spirit is then added, and the contents of the mortar rinsed, using more of the spirits for this purpose. This is then collected in a bottle and the solution made to settle. The clear liquid is decanted off thru a filter, and the sediment finally washed upon the filter with more spirit. The volume of the liquid may be made up to 200 or 250 cc., by adding a mixture of equal volumes of spirit and water.

Solvay Process.


A. Sodium Chlorid, commonly known as table salt, is the source from which the sodium alkalies are derived. The starting point of this process is therefore salt—the really strong salt brine. If you open a bottle of ordinary smelling salts and inhale the vapor, you will immediately recognize the ammonia gas of the Solvay process in the form of bird's nest, just as it is contained in the common household ammonia. The third and last noble ammonia gas, the gas which is used to make soda water. For the purpose of this process it is obtained in large quantities by heating the salt stone to a high temperature. Thus we see that Salt, Ammonia and Carbonic acid gas are the three fundamentals upon which the process is based.

The salt brine is saturated with ammonia gas and carbonic acid gas is then blown into the solution of ammonia in the brine. The brine does not take place in one step, but the final products are Sol-ammonic and crude bicarbonate of soda. The crude bicarbonate of soda separates out as a white powder and the sal-ammoniac remains dissolved. The ammonia takes the place of the sodium in the salt, and the sodium carbonate with water and carbonic acid to form the well-known baking soda (Sodium Bicarbonate).

This is separated from the liquids by filtration. It is then necessary to prepare this for a commercial product by heating it in a furnace where it loses all its water and carbonic acid gas. The product is now known as sodium carbonate, or soda ash, the finished product of the Solvay process, and the starting point for other forms of sodium alkalis which are coming from the filtration process contains the sal-ammoniac, and this is distilled with water to remove the ammonia to be used over again—no ammonia remains in the soda.

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Mercury Vapor

Q. 3. Gordon Jones, Jr., Cordele, Ga., wants to know how Mercury Vapor is obtained.

A. Under a pressure of 200 mm., mercury boils at 357.25 degrees C., giving off a colorless vapor. Mercury gives off vapor at ordinary temperatures, and a gold leaf suspended over mercury in a stopped bottle, gradually becomes white upon the surface, owing to its amalgamation with the mercurial vapor. This vapor is poisonous, giving rise to salivation, such as loosening of the teeth, etc.

Buttermilk in Butter.

Q. 4. Theodore Coughlin, Rochester, N. Y., wants to know why buttermilk is objectionable in butter.

A. Buttermilk is very objectionable as it begins to decompose almost immediately, and sets up fermentation, in the butter itself. See article at head of this month's "Chemistry Department."

BACK NUMBERS CONTAINING "EXPERIMENTAL CHEMISTRY SERIES."

The "Experimental Chemistry" series, by Albert W. Wilsdon, started in the June, 1916 issue of the ELECTRICAL EXPERIMENTER and has continued since that date. Prices on the back numbers containing these respective lessons, many of which have been of the greatest value to High Schools, Normal Schools, and University Scholars, as has been proven by many letters which we have received from readers of all classes, will be further reduced upon the purchase of stamped and addressed envelope. If you wish a first-class and clearly explained treatise on Experimental Chemistry, procure all of these lessons and bind them together. Many valuable and original tables and formulas are included in these lessons which the author has found of particular value to him in his commercial experience as a chemist.

SCIENCE IN SLANG.

(Continued from page 885)

one way only where the electrodes are of unequal temperature. With the audition, music has even been transmitted with the help of a barometric wave and the miles, with a clever man at the adjusters, a long dash can be construed into a melody. An absolute flat is a Z sharp on a piano. In other words, you would be unable to hear it. As yet they have not got it down so that they can run the sound waves into the visual strata and make you "See Me What I Am To-day, Now Aren't You Satisfied?" evolve into a likeness of Bill Hohenziemers's "They Are Wearing Them Higher in Hawaii" into an X-ray.

"Fefi, De Forest and Marconi do not hold the whole stage in the wireless field. Prof. Fessenden has bushes of patents in the Pat. office on the stuff, and there are a lot of other guys who have earned the price of a meal from some little thing that makes particular use of audionuts."

POPULAR ASTRONOMY.

(Continued from page 869)

eye. The play of auroral lights around the poles is plainly visible and the earth's atmosphere reflects a rim of light to the moon at the poles of this New Earth. Owing to the lack of atmosphere at the poles, there is no diffusion of light and the earth therefore stands out in sharp contrast to a sky of icy blue, as in which the solar corona (Continued on page 912)

Fig. 7.—Position of Earth, Venus and Sun at Time of Observation at Opposition.

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and the stars appear even in the lunar day. To one equip an opera glass on the moon any of the wonders and beauties of our planet would be revealed; the shadows of our lofty mountain peaks would be seen falling across the adjacent plains and passing rain or snow storms would temporarily veil certain portions. Were our most powerful telescopes on the moon we could easily distinguish small islands and lakes and cities, as well. All objects five miles or so in diameter would be well within the reach of our great telescopes and we can imagine that the lunar inhabitants would spend a considerable portion of their time in attempting to solve the nature of many mysterious markings that come and go over the face of their nearest neighbor. It is indeed a pity that the opportunity to study a living planet at close range is granted to a world devoid of all forms of life while the great telescopes of our own planet sweep searching after a barren mass of lifeless rocks presenting no signs of growth or decay, a desolate and uninhabitable waste.

We have considered how our planet appears to the two other planets that are most likely to be the abode of life, Venus and Mars, and how it would appear if seen from our satellite the moon. It will not take much more consideration to see how we would appear from the major planets—Jupiter, Saturn, Uranus and Neptune. The greatest possible distance the earth could depart from the sun viewed from Jupiter would be a little less than twelve degrees. Mercury, as we know, is not an easy planet to observe, yet it departs at times nearly thirty degrees from the sun. Moreover it is so near to the earth that when it is seen near its elongation it appears as a bright first magnitude star. Our planet earth on the other hand is so distant from Jupiter that it would be invisible to the naked eye seen against a black sky. When we consider that it never gets more than twelve degrees from the sun under the most favorable circumstances as viewed from Jupiter and must therefore always be searched for in the light of the sun's rays we see the hopelessness of expecting to see our planet earth from the distance of Jupiter; we would find that our little planet earth was not only a most elusive little body but also quite uninteresting when found. It would appear only as a very small half moon with a suspicion of a few dark shadings here and there. As we travel outward from Jupiter to the planets Saturn, Uranus and Neptune our interest in the little planet decreases rapidly. It appears to shrink more and more in size in the telescope until at the distance of Neptune it has become so tiny and so near to the sun that it is hardly worth a search in the telescope.

(Next installment will appear in the May number.)
ELECTRICAL PATENT ADVICE

Edited by H. Gernsback

In this Department we publish such matter as is of interest to inventors and particularly to those who are in doubt as to certain Patent Phases. Regular inquiries addressed to "Patent Advice" cannot be answered by mail free of charge. Such inquiries are published here for the benefit of all readers. If the idea is thought to be of importance, we make it a rule not to divulge all details, in order to protect the inventor as far as it is possible to do so.

Should advice be desired by mail a nominal charge of $1.00 is made for each question. Sketches and descriptions must be clear and explicit. Only one side of sheet should be written on.

NOTICE TO CORRESPONDENTS

Questions on Patent Advice are answered in this department every month, and naturally each question must take its turn. We have received so many letters during the past months that it is absolutely impossible for us to answer them all in the "Experimenter." Thus, for instance, the answers appearing in this issue are of letters going back as far as July, 1918. We would therefore ask our correspondents to bear this in mind, and if an answer is wanted quickly, correspondents should make themselves acquainted with the rules printed above.

Angle Finder.

(305) Geo. E. Zeigler, Urbana, Ohio, submits a device which he calls an angle-finder. It is an instrument to enable a surveyor to determine the degree of any angle. Such an instrument could be used in constructing buildings, bridges, or any other construction, etc. Our advice is as follows:

A. In the instrument described, use is made of a spirit tube with the usual air bubble, and by placing the angle which is to be read off in a certain manner. This device itself is not new, and a similar one has been used on autos to read the percentage of the grade, and we do not think it would be possible for this reason to obtain a patent.

Submarine Shell.

(306) J. R. Pelt, Jr., Parkersburg, W. Va., has submitted a device which only explodes fifteen feet under water. Diagram submitted shows the electrical connections which are activated upon being raised by water, which makes a contact as soon as the shell comes within about 15 ft. under the water. We think a patent on electrical depth bombs of this kind would be better ones made which have been used freely in the war.

Steam Boat Brake.

(309) Otto I. Kirby, St. Vincent, B. W. L., submits an idea of a brake for steamers or boats. The idea is short in that it has large steel valves folded up against the body of a ship in normal position. When the boat is to be stopped, the valves automatically open up at right angles to the boat and the ship, thereby exposing an additional surface to the water, consequently must slow down.

A. This idea is a good one but unfortunately it has not been described before. Until our mind no patent can be obtained upon it today. We do not think the device works out in practice.

Grass Cutter.

(310) John C. Reno, Spring Brook, Wis., has an idea of an arrangement to clean out grass that grows over the sidewalks. The device is to be made of sheet steel and by having a triangular nose, in our correspondent's opinion, such a tool would clean out the grass very readily in the corners between sidewalks and grass.

A. While no doubt this device was well satisfactory, we think it would certainly be trouble if the road was composed of cobblestones for instance. Otherwise, we find no trouble with the device, and think that a patent can be obtained upon it.

Fire Truck Device.

(311) M. Dumbar, Lorain, Ohio, writes: "I wish your advice about a patent on an electrical device that will immediately start the engine of a fire truck. My idea is, as soon as the alarm rings it closes the circuit which starts the engine of the fire truck. Please advise if this idea is patentable."

A. Providing such a device can be made rugged enough, so that it conforms with the Fire Department's existing requirements, we believe that such a device should prove of considerable benefit, and that the Fire Department not have devices whereby the fire under the engine is started within a few seconds after the alarm has sounded.

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ELECTRICAL EXPERIMENTER

April, 1919

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The pull chain controls the current to the lamp socket, and the terminals of the receptacle are in the side of the body of the appliance. The appliance is continuous in circuit.

An advantage of this type of socket is that it eliminates the annoyance of the long cord running from the appliance to the outlet. By means of the new fitting, current can be supplied directly below the fixture and various other appliances, such as fans, lights, etc., can be used.

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The "Room Service", as it is called in all modern hotels, and which covers the serving of meals in rooms, is very carefully worked out, in the "Pennsylvania" and the "French-fried" hotel. The "Pennsylvania" system works out in this fashion: Suppose for a moment you are the guest, and that you decide to have breakfast served in your room. As soon as you mention the word breakfast to the telephone operator and give her your order, she writes it down on her memorandum pad, and as soon as your order is written, it is put on the telegraph transmitting plates. Then two important things immediately happen—two telegraphs, reproduce in writing your exact order, and, from coffee to cigars, one telegraph announcing your order in the "room service" kitchen in the basement, and the other one telegraph connected to the same circuit, but situated on your room floor, reproduces the order in writing before the "floor clerk" on your floor, and this is the first notice that she receives that you have ordered a meal. The system works out very beautifully in this way, and gives the greatest expedition possible to rapid service. Each floor has its own service pantry, which contains all ordinary things such as bread and butter, and which is replenished daily. In this room there are also automatic high speed electric dumbwaiters communicating with the "room service" kitchen in the basement, as soon as any broiled meat, such as chops, steaks, etc., are prepared in the main kitchen, they are whisked skyward and delivered on your floor. As soon as the dumbwaiter reaches the floor, a buzzer starts signaling the fact, buzzing continuously until the delivery man at the dumbwaiter station removes the door, and the door closed, after which the dumbwaiter is dispatched Kenneth, by means of a special truck, one for each of the 19 floors, and the kitchen service dumbwaiters may be dispatched roof-and-roof and called to stop at any time, and the door is also locked on the plug in the jack corresponding to that particular floor. When the meal is ready, one of the room service waiters, when his name appears on your floor serves the meal in your room, and invariably of course, a table has to be provided for this purpose. Eventually, we presume that the "room service" idea will be extended and amplified, so as to permit the serving of meals, albeit this is questionable for the reasons already stated.

Returning toward the lower regions of the building we entered the building’s long hall, running long one of the lower floors, and we inspected the children’s open-air playground, arranged in one of the lower large rooms, which was several, and ended up this part of our inspection trip, by looking over the large ladies and gentlemen’s "plunge", provided with large deep pools, and every convenience imaginable. The "plunge rooms" in general are provided with steam rooms, hot rooms, massage and silent rooms, dressing rooms, etc., which the women’s plunge apartment contains specially fitted dressing and rest rooms, as well as a manicure and hair-dressing parlor and chiroprist.

Just as we were leaving the plunge rooms, we were startled by seeing two nursing maids passing down the hall just ahead of us. Upon inquiry we found that the hotel management had made every effort to supply such personnel and to be conjured with when such a large number of guests are considered. Not only was it surprising that the hotel should include a "hospital", but it was more interesting that there is a physician always present. Thus the guests have always available hospital and medical attention for any emergency. Of course, for any protracted illness, the patient would have to be transferred to one of the regular city hospitals. One does not even have to leave the building in order to get a prescription filled, as there is a large and complete drug store on the street floor, which is accessible from the interior.

In various parts of the hotel, where the architects have planned for them, one suddenly bumps into unsuspected scenes of activity. On some of the lower floors, as well as in spare rooms on the roof, one finds carrying cases and decorators, shops, an up-to-date upholstery shop, yes, even a silver-plating room (for taking care of those precious pieces of silverware used in the dining rooms), employees’ club rooms, plumbers shop, etc., etc.

A few words may be said here concerning the elaborate kitchen equipment at these hotels; and we ask the manufacturers of such equipment to give us a revelation to see how cleverly the engineers who designed these departments have worked out their problems. For example, all the soiled dishes from the soiled dishes in the dining rooms are practically never touched by human hands, after once being removed from the dining tables. They are placed in metal carriers resembling large drap pans as soon as they pass the dinner room service door. Here they are placed on continuous moving platforms, which are kept moving at a constantly changing angle, so as to utilize the power of gravity, and eventually the dishes reach the dishwasher automatically, which is quite an establishment all by itself. The dishes are washed by plunging them into large tanks filled with steam and boiling water, and then out again. They are very soon as soon as he hits the tanks, and the dishes are then rinsed in other tanks filled with boiling water, which is so hot that the dishes are carried through the rinsing tank by the force of a stream of water, and the water vapor remaining on them. The clean dishes are then delivered to another continuous moving platform, which takes them back to their respective kitchens. The scenes in these great kitchens are ones that have never been described before, and we visited this important department of the great hotel organization. Here we see dozens of Paris chefs preparing the various meats and cooking them. It would be a great revelation to any housewife to see how rapidly the cooking is accomplished. The dishes are distributed in the various ranges and stoves used for cooking the various foods, and there is a special kitchen fitted with all electric ranges and broiling stoves, which we termed the "home cooking kitchen". This kitchen is one of the features of the "Pennsylvania" and is in charge of the famous chef. Any guest who has gastronomic trouble or for other reasons may desire to have a piece of pie like "Mother used to make" with its full quota of gingersnaps, lemon pies and toothsome apples—can have just what his stomach craves. When the waiter visited the kitchen, it was near dinner time, and the chefs were busy cooking soups by the hundreds in the gigantic ranges, chops by the same number, and steaks by the dozen, not to mention French fried potatoes by the bushel. Other activities of the department include ice-cream making, pastry and candy making, etc., etc. One of the most wonderful sights in this important section of any hotel, and particularly in this giant of all hotels, where wagons of vegetables are kept, not to mention several auto-truck loads of meats and fish. Large, thoroughly ventilated refrigerators, keep the steam着他 and compressor plant operated by the hotel, maintain a constant degree of cold in them.

Of course, there are the usual wine cellars, one of which extends the whole block, not to mention large rooms filled with snow white linen, shining silver and glassware and crockery enough to stock an average department store.
SCIENCE IN SLANG. (Continued from page 911)

the wireless more of a success, but who have not had the public notified that they pulled a good show.

"Old Doc. Fleming got a good one in the form of a 'valve,' which is a lot like the audion. It was a close second in the patent office and only has first place by much writing and perspiration on the part of a wise old judge who weighed the proposition like a pair of assayer's scales."

"Then suddenly, when we kiss the dear old war good-bye, in drops old man Jimmy Rogers. He steps up on the platform, puts up his hand and says: 'Shi, boys, before we send up aeronautical magicies, see me! Nix on those aerial wires!' We say: 'Thehellosusy. Whazzamatter with old Jimmy?'"

"Not much," says Jimmy, 'except that aerials are all wrong. Besides you don't need 'em. Just you take a hundred feet of rubber covered wire cable and bury it three feet underground into a trench, savvy? Hook the loose end to what was once your aerial cable and presto, in cone messages loiter in and out on a tin roof. And you receive twice as far as before, AND the old girl static, who used to tease the life out of our aerials with bad, alone now is getting the war. Simple, if you know how!"

"I guess that is about all for to-day—now for tomorrow. We may be able to carry around in our pockets a telephone that will enable us to talk to our colored friend in Africa—when we are in Siberia or Sing-Sing."

"The present wireless is a great success—so was the Roman chariot, but the Handley-Page aircraft has it over the old go-cart in more ways than altitude.

"Where is the art of cultivation? We thought that we had it down like a scenario until Luther Burbank showed us that cactos did not have to have their stickers and the fruit pigeons that we wear on our coat lapels could aspire to the rainbow. Way back in the old ignorant days, when a gink thought that it was no worse to marry his sister and raise a colony than we consider a divorce or Wall street play, there lived an old bird who observed that a little home and so forth would not hurt a wheat stalk and that other growths were helped thereby. I don't remember the guy's name—it was so long ago—but it seems he was an Egyptian. I would not say for sure though.

"Now look how long ago it was when we got out of the land of slavery in the electrical game—there are a string of years ahead of us yet—perhaps some electrical Bur- banks will show up. Don't get it in your head I am slighting Edison, Tesla, Stein- metz, Marconi, De Forest, Fessenden, and others who now have the WATT under the microscope and wearing their glasses at that. What we have done had he possess a masochist gun or a telephone—what would Edison do with the observations and discoveries of the past? Now we are moving! Moving as men have never moved before!"

PREPARED TO DELUGE GERMANS WITH GAS.

Statements that America next spring would have thousands of German front with undreamed of quantity of poison gases, that Edgewood Arsenal thru gas production would have brought about the capture of Ypres, and that the lone would have had ten tons of mustard gas to Germany's one, and that our chemists had surprises of which German scientists never dreamed—all these were recently disclosed by the War Department.

Colonel Bradley Dewey, who was in charge of that section, said that a mask had been evolved which required no nose clip and no piece in the mouth. A man could wear it indefinitely and could sleep in it.
DO RADIO WAVES TRAVEL ABOVE THE EARTH OR THRU IT?
(Continued from page 822)

stalling later stations under such conditions, to examine very carefully the topography or rise and fall of the country over which this radio system was to operate. Fig. 3 shows a more ideal condition for the operation of a radio station in a valley, and one which has proven to be entirely successful in practice. Here the surface waves have a chance to follow the contour of the ground, as shown, and the antenna in consequence receives a full quota of energy from the waves as they pass across it. It is conceivable in the case illustrated at Fig. 4 that the etheric space-wave component at B, may become totally a space wave without a grounded foot, and this would account all the more readily for the station not receiving any signals.

Some very interesting experiments were made some years ago on the relative efficiency of ground antennae and those which were reported in the journal "Jahrbuch. Für Drahtlose Telegrafie und Telefonie", and the essence of these tests is illustrated diagramatically at Figs. 6 and 7. The investigators, Kiebitz, K. and W., working with such antennae, utilized one form composed of insulated conductors placed in an open trench, as shown in Fig. 6, and later he covered the trench over with boards and piled soil on top of it. The more soil he placed on top of the trench, the weaker the signals became, until finally none were received at all. This showed apparently that if wireless signals were to be received by an ordinary ground antenna, it must be placed in close proximity to the earth's surface, as I have already described in the opening part of this article, or else in a more or less shallow trench, the top of which is open and not covered with any conductive substance or the material. The diagrams, Figs. 6 and 7, show how the gliding composite waves, with their ground components, cut across the antenna wires in the open trench, while in the closed trench, the ground waves or "feet" glide over the raised contour of the soil as shown, and how the ground components, reaching but a short distance below the surface as previously explained, do not cut across the buried aerial conductors, and therefore no currents are generated in them, as the tests prove.

One way in which a submarine may pick up wireless messages is shown at Fig. 8. Here the composite radio waves glide over the water with their ground components, as shown by the dotted lines. Now, if the submarine trails a heavily insulated wire, as shown, the upper end of which is supported on two or more floats, then it naturally becomes possible for this wire to pick up energy from the radio waves travelling in the direction of the wire, and signals will be received. As mentioned above, it is also possible, that by having the floats partly weighted so as to keep the antenna wires a short distance below the surface of the water, that wireless messages can then still be picked up, due to the partial penetration of the grounded components of the waves into the water, in a readily apparent manner. It is very doubtful if the submarine will be able to pick up any radio messages, if it lies at any considerable depth in the water, below 50 feet, with the antenna wire trailing along behind it, as the penetration of the wave base has been shown to be usually but a few feet below the surface. Wireless messages is shown at Fig. 8. Here the composite radio waves glide over the water with their ground components, as shown by the dotted lines. Now, if the submarine trails a heavily insulated wire, as shown, the upper end of which is supported on two or more floats, then it naturally becomes possible for this wire to pick up energy from the radio waves travelling in the direction of the wire, and signals will be received. As mentioned above, it is also possible, that by having the floats partly weighted so as to keep the antenna wires a short distance below the surface of the water, that wireless messages can then still be picked up, due to the partial penetration of the grounded components of the waves into the water, in a readily apparent manner. It is very doubtful if the submarine will be able to pick up any radio messages, if it lies at any considerable depth in the water, below 50 feet, with the antenna wire trailing along behind it, as the penetration of the wave base has been shown to be usually but a few feet below the surface. Furthermore, when submerged in salt water, it must be clearly understood, however, that experiment as well as theory both show that the penetration into moist earth or water increases with increasing wave length. Hence it is that of late, as the wave lengths...
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of the larger stations have been increased, these horizontal receiving antennae can be sunk deeper and deeper before effective screening is observed. Hence the period 'rediscovery' of the astonishingly efficient horizontal receiving directio antenna.

As far as I have heard the first use of the horizontal receiving antenna was at Block Island in July, 1903, where we connected the receiver direct to a telephone line running across the island from the wireless station towards the Point Judith (R. I.) transmitter. Fine land signals were thus received.

In 1905 I used a bare copper wire lying directly on the ground at New Haven, and then determined within a few degrees the direction of the transmitting station by swinging this wire around a circle, the center of which was the receiving instrument and ground stake. The signals were loud when the wire lay in the plane of the station, in either direction to or from the station—practically the same for both. But when at right angles to this plane of propagation nothing at all was received.

But to return to your editorial, "Wireless Around the World", it is highly unfortunante that the esteemed advertising pro-pensities of the Marconi interests should have made capital over this performance of their station in the year 1918, when similar performances had been on various occasions a matter of record for at least two years prior to that date.

I send below a news clipping sent to me back in 1916 by a wireless operator at Awarua, New Zealand, which is self-explanatory. I have received many communications from this section of the world, and fortunately, I have not felt authorized to publish, recounting similar "anti-podal" radio-transmission.

"In connection with Commander Creswell's statement regarding the reception at various Australian wireless stations of messages sent out by Naun and other places in Germany, it is stated that similar messages are received nightly at several of the New Zealand radio stations, especially Awarua, which is probably the best equipped in the Dominion. The distance from Naun to Awarua is about 12,000 miles, which, if it does not constitute an absolute record, is very near it. The secret of these remarkable results which is in less formidable terms 'transmitting to the World War' would excite world-wide interest, lies in the De Forest ultra-ant�ur receiver—one of the most wonderful devices of apparatus invented since Marconi's first experiments. Dr. de Forest is an American, who lives at New York. His 'ultra-ant�ur' has the power not only of receiving the far-flung waves, but can also be used as a wireless transmitter for the equipment has, as yet practically unexplored.'

In fairness to facts wherever an epoch-marking feat of this sort is accomplished, whether in science or discovery, I am sure you will agree that it is highly important that due credit should be given to the first performance and not to a repetition in which the same result was to be generally advertised years thereafter.

Perhaps your article lays unwarranted stress on the improvements which the Anderson alternator today enjoys over the arc transmitter. After witnessing what the big arc transmitters are doing in Europe, as well as in the United States, together with their simplicity and ruggedness and the facility with which any wave length can be instantly obtained, it is but natural that you might wonder whether the alternator will some day supplant the big arcs; at least, except in stations where one wave length only is required.
ELECTRICITY IN FAR-AWAY BOMBAY.

The great success with which the introduction of electric power from the generating station on the Ghats is being developed in Bombay is revealed by the report of the Tata Electric Power Supply Company. The energy now being supplied to motors in Bombay amounts to 48,000 horsepower. Thirty-six mills are receiving power, and only the difficulties arising from the war prevented development being more rapid.

THE HOW AND WHY OF RADIO APPARATUS.

(Continued from page 875)

In the proper manner for giving a good indication, it is well to mention that no matter which form of detector is used in conjunction with the wave meter, that the wave meter itself must be kept at a sufficient distance from the exciting circuit, no matter what its form or make-up, so that there shall be just sufficient current picked up by the wave meter oscillating circuit to give a clear indication in the detecting or indicating device. If the wave meter is held too close to the exciting circuit, then either long wave lengths or harmonics of various wave lengths may be heard, and an incorrect reading obtained.

For many purposes it is desirable and necessary to excite the detector so that it will radiate a wave length of known value, such as in various radio measurements, etc. Fig. 5, shows a circuit in which the variable condenser is shunted across the variable condenser of the wave meter as the diagram indicates. This arrangement will cause oscillations to be set up in the oscillatory circuit of the wave meter, and an auxiliary inductance can be placed near the wave meter inductance so as to link the two inductively, and thus transfer the energy electro-magnetically from the wave meter circuit to the auxiliary circuit, and which energy shall have a wave length of known value.

At this juncture, the matter of arranging the wave meter cabinet, and especially the variable condenser and its scales, etc. should be considered. In this connection we may refer to Figs. 7, 8, and 9, wherein several important and simplified methods of arranging the variable and condenser scales, especially direct reading scales, are given. Fig. 6 shows a method used by the writer for several years with good satisfaction. In the scheme the variable condenser scale is specially made up on heavy bristol board or celluloid, (or else hard rubber with the graduations scratched in with a scriber and then filled with Chinese white), and instead of having simply the angular spaces marked off in degrees, and then having to refer to a direction chart in the usual way, the corresponding wave length values for the coil are read off from the calibration chart (Fig. 9) and marked off on the scale as shown in Fig. 6. Then as the indicator attached to the variable condenser knob is moved over the scale, and by noting which inductance coil is in use at any moment, the corresponding wave length may be read off directly as soon as the maximum resonance point is reached in the detecting circuit.

The indicator, Fig. 6, comprises a piece of heavy sheet brass, soldered or otherwise secured to the shaft of the variable condenser, and to the center of the arm is cut to the form shown, with the two sides edges best out to retain a piece of ordinary glass. With a glass cutter, a straight line is scored across the center of the glass, and this may be darkened

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Health In A Glass Tube

The interesting story of a man "too busy to bother" who appreciated perfect health, energy and vitality only after he lost it—and how he won it back in a startling way

BY FRANK HARTLE

YOU probably know dozens of people like my friend John Brainard. Strong, robust, healthy, he used to have a real bulldog for stamina, and a very likable fellow in spite of his entire lack of sympathy for sickness and sick people. He regarded sickness as a mark of weakness and had such faith in his own excellent health that he had about as much sympathy for sick people as, according to Mark Twain, David had for Jonah. If you happened to mention that you didn't feel extra well Brainard would say, as courteously as was absolutely necessary—"I'll be--but you could almost see the entire matter sail out of his other ear. Sickness and suffering were foreign to John Brainard and he couldn't understand it in other people. That was all.

But as Jos Billings once said, "Health is like money--you never know you have a good thing until you lose it." And quite suddenly John Brainard realized what real health is. Too much overwork, incessant hours, innumerable meals, and general inattention to his health finally "told on him." One day I went to his apartments and found him in bed with a severe attack of sciatica, but fuming with rage in spite of the intense pain. "Why should I have this?"—I've been as healthy as a horse all my life. Why should I be sick?—hang it, I won't be sick," and he jerked himself to a sitting posture only to fall back in pain upon the pillow.

For a week John Brainard lay in bed in intense agony. Those of you who have suffered from acute sciatica or rheumatism know what it is. The doctor came and went, but Tuesday and Friday when I called, John only said, with a weak attempt at his former cheerfulness, "Nothing doing, Frank. They haven't pushed the right health button yet. When will you fellows anyway who know something about a 'man too busy to take care of his health is like a mechanic too busy to take care of his tools.'"

Next day while at lunch with George Conrad, our mutual friend, I mentioned about John's still being so very ill. "Listen, Frank, old boy," he said, "I want you to be pre- sumptuous or anything like that and I certainly believe that the Doc will fix John up fine, but there's a treatment which entirely cured my wife of chronic neur- algia, and now it's bringing total cure to my cousin, another sciatic sufferer. I think if John would give it a trial it might help him some."

Ten minutes further conversation with Conrad convinced me and I went right over to John's home to "spring it." "John," I said quietly, as I tip-toed into his bedroom, "I've got the very thing. Conrad has given me some real facts about what electric violet rays are doing for people and I think—"

"Oh," be interrupted, "I don't know. I don't imagine it can help me."

"Of course you don't know. And you never will until you try. Now don't talk foolish, John, old scout. Won't you even believe your friend? If this violet ray treatment has proved what it is."

And then I went on to tell him all I had learned about the treatment—how it had been invented by the great Tesla in 1890, how it was being used with wonderful success by eminent physicians all over the world, how he could use it on himself and it wouldn't shock him like electricity in other forms, how it would surely at least help his own sciatica when it had cured other folks' sciatica, neur- algia, hay fever, asthma, neuritis and dozens of other diseases, and finally I told him how it would bring back to him his old "pep," vigor, and "knock-em-dead" vitality. Then John rolled over and said, "All right, if it brings me out of this blamed bed a well man I'll swear by it for life. Cart in the dynamo, or whatever it is."

"It's nothing of

"When I ran that glass tube over my 'hide'," said John, "it felt just like a local anaesthetic on a wild tooth."

Now, through the Violetta, you can have in your own home, the wonderful violet-ray treatment—curing as easily as givng a glass of water—by the North American specialists and beauty specialists throughout the country. Now you can rid yourself of Chilblains, Cold, Colds, Constipation, Dandruff, Deafness, Eczema, Eye Diseases, Hay Fever, Headache, Goitre, Insomnia, Lumbago, Nervousness, Neu- ritis, Obesity, Paralysis, Piles, Pimples, Py- othermia, Rheumatism, Skin Diseases, Sore Throat, and many other ailments.

Multiply your bodily health—vitalize your nerves—double or treble your energy and vitality. Sleep better, increase your strength, improve your appetite and digestion. Soothe your nerves, reduce or increase your flesh, toward and strengthen the muscles. Identify your complexion. All with the Violetta.

Trixie Frigiana, the famous actress, says, "Cheerfully will I add my praise for Violetta. It's the best 'pain dared instrument' I've ever had the good fortune to find. It's wonderful. I cured my brother of neuritis. As for myself, I use it for facial treatments and general massage. I've found it very much for it." Frank Borzzone, of Seat- tle, Washington, says: 'I purchased the Violetta for my wife who was suffering from an acute attack of sciatica. From the very first treatment it induced peace- ful rest and she is entirely well now.' Scores of letters like these are received each day.

The Violetta is not a vibrator. It is a machine that contracts the muscles; it does not shock—it does not pound the muscles—it is absolutely painless.

Eminent physicians from all over the country apply the Violetta with wonder- ful results. Dr. Bert H. Rice, of Vinton, Iowa, says: 'I have good results with the Violetta.' Dr. Daniels, Lisbon, North Dakota, says: 'Have used the Violetta in such cases as Goitre, Bronchitis, Pleurisy, Nervousness and neuritis and found it very beneficial. In fact, I would not be with- out it in my office.' Dr. B. G. Duncan, Ke- wanne, Ill., says, 'The Violetta is the finest thing I ever used to relieve congestion in any part of the body; and to relieve pain. Treatments are so pleasant that all of my patients like it.'

Write for this interesting booklet now. Fill out the coupon printed here for further con- venience, and mail at once. Address Bleadon-Dun CO, Dept II, 11 So. Desplaines Sts., Chicago, Ill. For this interesting booklet about the Violetta and ten days' trial offer.

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Name: ____________________________
Address: ____________________________

You benefit by mentioning the "Electrical Experimenter" when writing to advertisers.
GRAND OPERA IN YOUR HOME.

(Continued from page 855)

microphone circuit could be loaded simultaneously with such an immense number of lines as this practice constitutes a short circuit, and while the thing is possible in a limited way by means of induction coils, nothing less than two or three hundred subscribers could be linked up by such means. Therefore, the system herebefore was a failure.

The invention of the Audion, however, has changed this and by using audions to "boost" the circuits, it is now possible to connect a practically unlimited number of listeners to one microphone transmitter and reproduce the music clearly in 50,000 homes at the same time.

The writer who interviewed high telephone officials was informed that the plan was entirely feasible and there was only one objection, which is not of a technical nature. It rather has to do with the advertising factor. Thus, the telephone engineers did not think it good business to tie up say twenty thousand to fifty thousand lines simultaneously for several hours at a time on account of the congestion that would probably ensue, but this is really only a small consideration and not of much importance if the enormous revenue that the companies will derive from this scheme is taken into consideration. While the subscribers now pay only between two and five dollars a month for service on an average, the telephone company could easily double this revenue for at least 20 per cent of all of these subscribers by installing the operating service.

Today the man who owns a phonograph thinks nothing of spending between three to five dollars a month for records which are "dead". If he knew he could hear Caruso, Galli Curci or any of the other stars tonight in one of his favorite operas, he certainly would object to spending 50 cents or even a dollar for the privilege, and that he would want he was getting it cheap because he, with his entire family, would hear the music in his own home, without having to travel to and from the opera house. Eventually, if the system should become vogue, the opera alone will not be the only source of amusement to be drawn up by a telephone subscriber. Any of the musical plays or comedies, farces, etc., could all be heard over the telephone, altogether admitted not to such an enjoyable extent as grand opera, where it is the music that counts most.
As for the technical aspect, we now have very good sensitive microphones, which place a great deal of the work upon the stage and orchestra; the orchestra is not needed. The microphones are then connected to the auditorium or home. The orchestra is not needed. The microphones are then connected to the auditorium or home. The orchestra is not needed.

Here we have a novelty suggested by the writer. In transmitting music over the telephone before, it was not possible for more than one member of the family to listen to the music as there was only one telephone receiver. By means of modern loud talker telephones, however, it now becomes possible to lift off the telephone from the hook and place it over a sensitive transmitter, as here illustrated. The sounds picked up by this transmitter are strongly amplified and projected from the horn in great volume. Thus, it becomes possible for any one in the room to hear the music clearly and as loud as we do sitting in one of the farther rows in the theater, where the hearing is not always good, as is well known.

As for the subscriber's amplifier as shown in our illustration, this may be made of the ordinary loud talking variety, having a simple hyper-sensitive microphone connected to a loud talking telephone, or otherwise it may be a microphone connected to an audion amplifier. The latter probably is the better of the two systems.

The amplifying cabinet can be hung over the telephone, in case of a wall set, or otherwise it can be set in a different shape for table use if the telephone is of the portable type. The amplifier could be sold outright to the subscriber or otherwise rented to subscribers by the telephone companies.

We feel confident that a plan similar to the one outlined here will soon come into general use, as there is a positive demand, particularly in America, for good music and which demand as yet has not been satisfied.

But like all other large interests, the telephone companies are slow-moving organizations and do not make innovations unless they know that a large part of the public actually wants them. Therefore, if you are in favor of this plan, we think it would be a good idea to write the headquarters of the telephone company, advising them what you think of this plan. If, however, you were to write to your local telephone company, not much impression would be made. If, on the other hand, you address your letter to the American Telegraph and Telephone Co., No. 35 East St., New York, then there is a chance that a national movement would perhaps result from such letters. Local telephone companies cannot maintain their present standards if they are governed by the policy which originates at the New York headquarters. Perhaps your letter will help to bring the Opera into your home.

TELEPHONE GIRLS' WORK IN FRANCE.

It is difficult for us to realize the scope of the work that has been done and is still being accomplished by the telephone operators in France. To serve the needs of an army of two million men, and in addition an army that now has the French by telephone was a mission that required no small amount of organization and planning. On the part of the Signal Corps, says the Telephone Review. The distribution of the girls in the Signal Corps service asked for careful study and met with unqualified success.
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EXPERIMENTAL PHYSICS.
(Continued from page 867)

HOW AIRPLANES FIND THEMSELVES BY RADIO.
(Continued from page 871)

"The use of directional effects of loops or coils for receiving radio signals has re-
sulted in the development of a radio compass for airplanes which gives positive in-
formation to the aerial navigator and en-
ables him to locate his position by triangulation with regularity to within a few
land stations or to fly at any given angle with respect to a certain beacon station.

The apparatus consists of two principal parts—the antenna coils and the tuning and
amplifying apparatus. The antenna coils are mounted in the fuselage of the Handley
Page airplane, with suitable means for rotating in azimuth. The amplifier is ex-
tremely sensitive, consisting of a detector and six-stage amplifier. A novel feature of
the amplifier is the use of iron-core trans-
formers for frequencies of 100,000 cycles.

The direction of the beacon land radio
station is determined by maximum strength
of signals, in a highly ingenious manner de-
veloped originally by the British. The pre-
cision of the directional effect is remark-
able. Fact, the radio direction finder may well be called a radio eye."

to send and take messages in spite of
the enemy's interference by sending out im-
pulses of similar wave length and other
disturbing influences. The problem of
using a non-inflammable gas for inflating
balloons and dirigibles has been solved un-
der the direction of a Physicist and a Chem-
ist, both "fool professors".

The submarine has probably attracted as
much attention of the scientific men
as all other war inventions combined, both
as to its detection and its destruction. The
detection of the submarine is a purely
physical problem, and it is estimated that about
one-fourth of the Physicists of the Allies
have devoted a considerable portion of their
time to solve this problem alone. The prob-
lem has been attacked from three stand-
points, light, sound, magnetism and elec-
tricity, three branches of work which almost com-
prise the entire subject of Physics. The de-
struction of submarines has been success-
fully accomplished by the use of the depth
bomb.

In long range artillery work, temperature,
misture, and wind are to be carefull
determined; this is done by physical appa-
ratus. Wind direction and barometric pres-
sure information is essential in a gas attack.
This information is furnished by physical apar-
tatus. Anti-aircraft gunnery is largely in-
depted to physical research and calcula-
tions for its effectiveness. The speed of the
airplane must be ascertained, its direction
of motion, its height above the ground, the
speed of the attacking shell, and its path.

The airplane camera would be almost use-
less were it not for our knowledge of the
branch of Physics known as stereoscopy.
Pictures can be taken which the eye can-
not see because of fog, cloud, haze or dis-
tance. By the use of special glasses the
enemy's guns camouflaged so as to be in-
discernible to the eye, are photographed and
their positions located. The sound method
of locating an attack is not as effective as
the three sounds are heard from a shell sent
by the enemy. First we hear the hissing noise
of the shell whizzing thru the air. Shortly
afterward the boom of the gun is heard. (Since
sound travels at about 1,100 feet per
second and the shell's speed is greater than that), Finally we hear the sound of the
explosing shell. If the time when the first
of these three sounds is heard is recorded
at several observing stations, from the speed
of sound, and the difference in the times
recorded at these stations, the position of the

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ELECTRICAL EXPERIMENTER

A TIMELY REINFORCEMENT.
A Copper Plated Stomach.
(Continued from page 87)

thanks to mother and the salt fish—and the cat.

You have to begin by discarding the whole idea of sheet copper. It would be all right, and a little bit more, if you make up a good tummy in half a day—even including going back to the shop for his tools—but for the fitting of it, or inserting, or whatever you'd call it, a sticker; it's what's kept the invention back all these years.

But why not plate the copper on from the inside? Sure! There it was, right off the bat!

Fig. 1 shows the invention—patents pending—all worked out—perfectly simple. You procure an atomizer, A, and attach to it a long fine rubber tube, B. This tube is surrounded by a spiral wire, C, and both are covered by high-tension insulation, K. At the further end both the tube and the spiral wire are connected with the perforated metallic hollow sphere, E. The atomizer-bottle, F, is filled with a solution of sulfate of copper, and the spiral wire is connected with one pole of the spark-coil secondary, H. Around the patient's waist is then bloused a strip of wire netting J, connected with the other pole of the spark-coil.

All being done, the patient "swallows" the perforated ball, E, with enough of the tube to maintain communication with the outer world. The ball is then resting nicely into the cozy little hole, and the patient closely; a really delightful surprise is about to be handed to him? X! Pressure on the button is all that is required of copper sulfate from the perforations of the sphere, E, while at the same time a touch of the key, L, causes a shower of sparks to be thrown from the ball toward the metallic belt without. The sparks pass easily thru the patient's tissues, but not thru the sulfate. This is decomposed by the electric current, and metallic copper is deposited on the gas- tric lining, forming a dense and highly polished surface, ready to tackle any food product short ofians—red-eye and Irish confetti—brick-bats.

Perhaps you wonder why, before the operation, the patient took a few magnesium pellets, too, before applying the "fever saver"? This was to take care of the other product of the reaction, sulfuric acid—otherwise the ball would be well on its way to death as the way he is. The magnesium neutralizes the acid, producing a pleasant effervescence, which, being flavored by the copper, is not unpleasant, though the equivalent of an ice-cream "sody" fresh from the fountain.

So behold! At the end of the operation, when the patient finishes his cigarette and lets go the nurse's hand, there he is,—equipped with a perfectly-fitting copper stom- ach—each atom of which has been used as a hint to guide him in the selection of future contents for it—like a new tin bank for little Willie, with a dime in it.

No, no, no said that metal. Really I—well, if you must, you must. But I refuse to patent the idea in Germany. Absolutely. It's just limited to the free use of all free and civilized countries. "That's me all over—liberal, Mabel."

"Not so, the editor tried Tom's latest stunt. After he was granted his patent, and was at last equipped with his copper "insides," he felt pretty weak. So he lamped himself up into a bird of zinc dust with his next meal. The copper tummy, the gastric juice,—(an excellent electrolyte)—plus the zinc dust, makes a really excellent battery. Tom received the editor at once. It works so well that he has given up all food in preference to zinc dust. A slight change in diet is had with magnesium dust—it tastes better, and gives a much higher voltage. Iron filings were tried, but they made the editor "ratty!"

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The Alkaline Storage Battery

(Continued from page 878)

Consequently the engine would have to be operated at various rates and at all times. This is uneconomical. By using a storage battery one may arrange to run the engine at its most economical (full load) rate and thus effect a saving to offset more or less constant current losses, current resulting from the use of a storage battery between the generator and the lights. Further, the storage battery tends to improve the character of the steadiness of the light. With a small installation where the current passes directly from the dynamo to the wires supplying the latter, and to manifest undesirable fluctuations in brilliancy because of irregularities in the running of the engine. By using a storage battery one is able to use this fluctuating current in charging and then to get an even current from the battery.

A shunt-wound dynamo is the thing to use--else, when the voltage of the battery rises too high, it may "back up" and oper the dynamo (series type) as a motor, causing considerable damage. If a compound wound dynamo is already installed, or if it is desired to use such a machine for charging storage batteries, it can be done simply by making additions to the terminals, so that the field coils, thus converting the machine into a shunt dynamo.

The dynamo which is used to charge a battery should always have an excess voltage capacity. Thus, if we are going to use a battery of 30-32 volts rating, it is good practice to employ a 45-volt dynamo for charging. In fact, we may largely consult convenience when charging a battery, provided the correct rubber cap is next lower one. A 110-volt dynamo may be employed, at times, for charging a 30-32-volt battery, thru a suitable resistance; the perhaps the correct voltage of a dynamo.

The alkaline battery with which we are concerned is made up in a variety of sizes, of which that known as "A" is quite popular for electric automobiles and trucks. A numeral used along with the letter indicates the number of positive plates used in the cell. These numbers furnish a rough gauge by means of which the comparative capacities of the type of cell may be determined. The reason underlying this is that ampere-hour capacity is in proportion to the total area of plate and to the surface exposed to the action of the electrolyte. An A4 cell will have about half the capacity of an A8 cell, etc.

Charging.

The positive terminal of the battery is connected with the positive line of the supply current; and the negative terminal with the negative line. The positive pole of this type of cell is indicated by a red bushing, and also by a + mark stamped in the metal of the container. A black-bushing is used for the negative pole. A further means of distinguishing the positive and negative poles is by means of the form of the little contain- iners in the plates. The round tubes below the plates, and the flat pockets to the negative plates. If substan- tial heating is noticed at or near a cell pole during the charging operation, it is to be taken as an imperfection in connection. If, however, all the connections are tight, then disconnect and determine what is the trouble. The proper charge for the metal contacts are flat and rigidly clamped.

If there is any doubt as to which is the positive pole, the method is to look down the tube, and if the wire, the following simple test is recommended—Connect one wire of the generator with some form of resistance. The free end of the unconnected wire from the generator may now be brought close together in a cup of salt water. In a moment one wire end will begin to turn bright. Bubbles will form at this wire. This is the negative one. The other is, naturally, the positive wire.

Normal Amount of Electrolyte.

The proper amount of electrolyte is such that plates will be 1/8 inch below the surface. If the level of electrolyte is too high the weak is likely to create a transient level. Tests for the level are to be made after the charging is all com- pleated and the liquid has settled down. As it may not be easy to see conditions inside the cell, a good way to determine the depth below the plate is to use a piece of straight glass tubing with a bore of, say 1/8 inch or more. Introduce one end of the tube, holding it vertical, until the bottom of the tube is on top of a plate. Then close the top of the tube with the forefinger and withdraw the whole. At the point the bulb of the electrom will be in just below level whose height will be the depth of the plate top. When the right amount of electrolyte is in the cell, the level of this col- lumen is said to be 3/4 inch. Simply a glass tube is required. No rubber cap or tube is needed in addition and the tube of an ordi- nary fountain pen is used. The rubber bulb is removed and the larger end of the tube is inserted into the electrolyte.

The operation of charging, as already intimated, involves the production of gas. Some, at least, of this gas comes from the decomposition of water in the electrolyte. If the charge is sufficient, many gases will naturally be lost, and the result will be a slight reduction in the total volume of the electrolyte in the container. Consequently, the proper time for height of the solution is subsequent to charging. The remedy for this loss and any other loss due to withdrawal of water (as, for example, by natural evaporation) is the addition of pure water.

Adding Water.

When water is to be added to the con- tained electrolyte to bring the surface to the required height or to correct a solution which has become too weak, gas should be employed. Only distilled water is to be used, as the method is by means of introducing it. Of course, do not add water during charging, for the reason that the level can not be exactly determined at all times, as already pointed out. The addi- tion of water will not, ordinarily, be re- quired every time the battery is used. Usu- ally, once or twice a week will be sufficient, unless the operation of the battery is very considerable. Other things being equal, water will be necessary oftener when the constant current method of charging is used instead of the tapering current method.

Two Methods of Charging.

To charge by what is known as the constant current method the rheostat is set a few amperes higher than the current it is proposed to deliver. The amperage will fall off as the charge is taken up, but by readjusting the rheostat every 30 minutes or so to a point somewhat higher than the reading of the ammeter at which it is maintained. To charge by what is known as the tapering current method, the rheostat is set a considerable amount above the desired current per cent, and a current delivered without further adjustment. At the end it is proper that the cur- rent should be considerably below the aver- age. An advantage of this method is the relief from attention during the charge.

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Exchange—5000.00 Omnigraph and dials for various generators or motor. W. T. Gralyell, Danville, Va.

Exchange—10000.00 Omnigraphs and dials for various generators or motors. Harry Schultz, 4626 Buchanan St., Baltimore, Md.

For Sale—No. 5 (No. 5) Omnigraph worth 1000.00. For instant delivery. Cleveland, Ohio.

For Sale—No. 5 (No. 5) Omnigraph worth $50.00. For instant delivery. Fort Smith, Ark.

For Sale—Audion Bulb, Tuner, Condenser and dials for telephoning. Cahn, 189 Fisk Ave,. Brooklyn, N. Y.
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Business Brokerage wanted for old established Chicago Concord. We furnish full stock of goods, advertising matter, and equip store complete. Will pay you $200 a week salary, in addition to liberal commission. Work can be started in spare time. No investment required. Address 784, 146 E. Maple, Detroit, Michigan.

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Gold and Silver Plating without costly electricity. This is a new, just completed invention of scientific achievement. Unparalleled opportunity to establish a successful, highly remunerated lucrative business. Experience and capital unnecessary. Complete detailed instructions in both processes. Address Western Plating Co., Echo Park Ave., Los Angeles.

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Motor Winders: See ad under blueprints, etc., this issue. Charles L. Chittenden, 81 N. W. St., Superior, Wis.

One Service Station Storage Battery Generator—High tension magneto; S. D. Motor starter; D. D. distributor; complete equipment. Write addressing Electro-Science Co., 2406X Polk St., Chicago, Illinois.

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$2.00 75-ohm double pole watch case receivers—$1.25 each prepaid. Electro Co., 924 Cleveland Ave., New York.


Recharge 25 Dry Cells for Five Cents. Direct- don't ask for cash. Address Electro-Science Co., 2406X Polk St., Chicago.


E. L. J. Electrolytic rectifiers, glass jars, Knopp motor, 10, 15, 25 and 35 and 5 D. C. mag- net wire, 24 and 32 S. German silver wire, 14 gage iron wire, 100 cell battery, experiment- ture sockets, battery binding posts, spark gap, clean work, 25c each. J. W. Ray, 2296 N. Jersey City, N. J.

Electro-Science apparatus all kinds. Box 100: List for purple stamp. Wm. Doty, 29 John St., Portland, Oregon.

Personal.

Are you self conscious—embarrassed in com- pany—lacking in self control? These troubles E. L. J. Electrolytic rectifiers, glass jars, Knopp motor, 10, 15, 25 and 35 and 5 D. C. mag- net wire, 24 and 32 S. German silver wire, 14 gage iron wire, 100 cell battery, experiment- ture sockets, battery binding posts, spark gap, clean work, 25c each. J. W. Ray, 2296 N. Jersey City, N. J.

Real Estate for Sale.

Is This Your Idea of Florida? A little piece of land near the water, a boat, a garden, some spice plants, and perhaps a few charming, a vine-covered cottage, pleasant neighbors; fish and oysters in abundance, plenty of quail and game—a simple, natural, wholesome life in the open the year round—Home, Health and Con- tentment. Write for free literature of this most modest outlay in this beautiful land of sunshine and contentment. We are the owners. Write and request Brochure, 2104 Island Avenue, 103, Fort Myers, Florida.

Are you tired of long rides? Are you sick and tired of the city? Do you wish to get away from it all? We are the owners of a beautiful lake arable; also on the Dixie Highway. Here we have the atmosphere and the freedom of the open life, yet are only two hours by motor bus from big city life, yet are only two hours by motor bus from big city life. Write for our brochure. 1411 St. Petersburg. Our community is new, but it is tendered out. We have been very successful. Our prices have not gone sky high and living expenses are moderate. 100 Northern families already here. This is a good thing. Perhaps you will. May we send complete information? Board of Trade, Box 296, St. Petersburg, Florida.

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Motorcycles from $125 up—New and second- hand motors, any speed or any engine you want to have. Send 3c stamps for Bulletin "A." Peer- less. 50 Motor Co., 208 East 112th St., Chicago, Illinois.

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Motorcycle from $125 up—New and second- hand motors, any speed or any engine you want to have. Send 3c stamps for Bulletin "A." Peer- less. 50 Motor Co., 208 East 112th St., Chicago, Illinois.

Continued on page 934
You can easily make a highly sensitive deteetophone by using a Skindervenik Transmitter Button to collect the sound waves.

You can build your own outfit without buying expensive equipment. Think of the fun you would have with such an instrument! It's very simple, too, and inexpensive.

You can install an outfit in your home and hear the conversation being held all over the house. You can connect up different rooms of a hotel. Our outfit was used by secret service operatives during the War. It is being used on the stage. So much for its commercial adaptations! You can procure apparatus of the same type.

One of the main advantages of the Skindervenik Transmitter Button lies in its ultra-sensitivity. You can place it in any position you like. It is the greatest invention in micro-phones and has recommendations from men of high standing in the scientific world. It is being used all over the world. You can mount it most anywhere. In figures 3, 4 and 5 are shown some unusual and practical methods. Cardboard boxes, stove pipes, stiff calendars and hundreds of other places will suggest themselves to you. The buttons cannot be seen by any one in the room as they are so small and light. Only a small brass nut is exposed to the view.

Full directions for connecting up the button for use as a deteetophone are given in booklet No. 4 which is sent with each button. Figures 1 and 2 of this advertisement, two of the many illustrations in booklet No. 4, show the circuit connections of the deteetophone. The only instruments needed to complete a deteetophone outfit, in addition to a Skindervenik Transmitter Button are a receiver, battery, and, if desired, an induction coil.

Among electrical experimenters the button has created a sensation. It is not uncommon to receive unsolicited letters like these: "I received transmitter button today and I wish to inform you that it works great and is the best I have ever seen or heard of for the price. I will certainly keep it to my friends. I wish to thank you for your good service."

"I have been using one of your transmitter buttons, and it has proved to be worth more than its value in my experimenting." "I received one (Transmitter Button) some time ago, and they are just O.K. for experimenters. I have been using one of your transmitter buttons for experimental work and it certainly lives up to all you say for it and some too."

Mr. H. Gernsback, editor of this magazine, who is the dean of electrical experimenters, said: "In my judgment the button is probably the most efficient device of its kind on the market today, due to its extreme sensitiveness and other outstanding features. Should have a great future."

Figures 6, 7 and 8 suggest some very interesting experiments. That of reproducing music at a point far removed from the phonograph is very popular with experimenters. The Skindervenik Transmitter Button is mounted in a very small hole in the under side of the sound arm. (Note: There will be no injury to the performance of the phonograph). When the phonograph is being played, the sounds produced are transmitted by the Skindervenik Transmitter Button into a varying electrical current. The receiver, which is mounted in another room, reproduces the music at that point.

Figures 7 and 8 illustrate the methods of transmitting sound by means of the vibrations in a body while speaking. Speech will be reproduced by the receiver just as if the experimenter had spoken into a transmitter. In these experiments the Skindervenik Transmitter Button is mounted on a small iron disc. The same circuit connections apply to all experiments, regardless of how the transmitter button is mounted. The Skindervenik Transmitter Button operates on one or two dry cells. It often happens that two cells produce too much current and the sounds are deafening. We recommend either one new cell or two worn out cells.

We have the utmost faith in our transmitter buttons. We guarantee satisfactory service or we will refund the purchase price. Boys—Young and old—send in a dollar bill RIGHT NOW! You can't lose. If you're not satisfied, you receive your dollar back, isn't that fair?

Send a 3c stamp for a copy of Booklet No. 4.

**USE THIS COUPON**

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