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SEE PAGE 19
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War and the Radio Amateur

If we recognize this truth we realize how absurd it is to close all privately owned radio stations during the war. It will do no earthly good and can do only actual harm. Now we do not wish to have secret stations, nor do we wish to have them classified as unprofitable. Very much the contrary. If the administration, after carefully considering all the facts, decide to close all privately owned radio stations in this country, we will not as much as raise a single word of protest. The administration knows what is best for the welfare of the country and in time of national peril we would be the last ones to annoy our officials.

But is it not true that our splendid body of over 500,000 patriotic American Radio Amateurs, scattered thickly all over the country, can be of inestimable value to the Government? Can not our red-blooded boys be trained to assist our officials in running down spies, who probably would not be readily located otherwise? In our big cities thousands of ears listen every minute of the day to what is going on in the vast other-ocean. Trust our very capable American youths to ferret out the senders of questionable signals or strangely worded messages. The very multitude of these amateurs is a priceless protection. Then again both our America and very badly need Radio operators. What other country can furnish such a vast army of well trained and intelligent operators as ours, thanks to the amateurs?

When in 1916 the writer organized the Radio League of America, he incorporated in its statutes that every member should pledge in writing his station to the Government. Up to this moment the League has forwarded to Washington thousands of such pledges, among them every important amateur station in the country. These stations can be used by the administration at a moment’s notice. At least our amateurs are fully prepared.

Would not it be questionable wisdom to shut down all these stations that can and will do enormously more good than possible harm? Let our officials ponder and let them consider fairly the facts in the case. That is all that we desire.

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A One-Man Electric Submarine
By H. WINFIELD SECOR

WHILE Henry Ford has been urgently advocating the use of a one-man submarine of more or less efficiency, and comprising among other things a long collapsible pole extending from the miniature submarine, on the end of which there is supposed to be placed a torpedo or bomb which is to be exploded by the operator within the submersible, a number of other enterprising inventors have been engaged on

ception of one of these demons of war making its attack on the hull of a mighty Dreadnought, with a magnetic bomb properly timed to explode a few minutes after its attachment, in order to give the operator of the one-man submersible sufficient time in which to get far enough away from his victim to protect himself.

In the first place, it is the inventor's idea to make up these miniature submersibles of about the same size as the modern auto-

at two hundred horse-power for the above range, if the craft is to make a speed of 42 knots or approximately 50 miles per hour. In the event that the navigator of such a submersible should have to make a detour in order to get back to the mother-ship or to his shore base, it would be advisable to equip the boat with an auxiliary gasoline engine as shown in the accom-

panying illustration. Most probably under ordinary conditions, the operator of

a similar yet somewhat different problem. One of the most promising of these designs for a one-man submarine is that of Mr. Eric R. Lyon, the engineer who was responsible for the mastodonic two-hundred-foot high electric gyro-cruiser featured in our February, 1916 issue.

The accompanying illustration shows a detailed view of a one-man electro-mechanical submersible along the lines laid down by Mr. Lyon, and also an artist's com-

This new war engine would have no trouble in getting back to his base of operation by means of the comprest air equipment. It has been claimed by Mr. Ford and other in-

vestigators that it is now possible to operate a gasoline engine under water by means of special absorption apparatus attached to the exhaust manifold of the gas-

oline or other engine, and that this means of propulsion can be attached to submarine war vessels. If such is the case, then it

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"ELEVATING" CENTRAL.

This upper stories of the West Palm Beach Telephone Company's office in Florida, which has just had two floors added to it, was the scene of a remarkable engineering feat recently.

Under the new arrangement it became necessary to remove the big switchboard, at which the operators sit and make the connections that enable people to communicate with each other on an infinite variety of subjects, important or affectionate or merely frivolous, from the third to the fourth story. The move was made in the following simple but effective manner. A platform composed of two pieces of 4x6 timber, on which was laid a floor of 2x12 planks, was built under the heavy switchboard—wide enough to accommodate the operators' chairs around the edge of the board. Slings were then placed about the whole business, to which a tackle and three heavy differential blocks, each capable of handling a weight of four tons, attached to a shing of log chains fastened to a heavy beam at the top of the fifth story.

The switchboard, with the girls seated at it, and still carrying on their work, was hopped thru a hole in the floor of the fourth story.

The work was carried on without a hitch, and the girls remained suspended until the floor had been rebuilt under the switchboard. There was not the slightest interruption to business from first to last during the ascent. Nor did the subscribers, taking over the switchboard, suspect in their wildest utterings, that "Central" Switchboard Girls—chewing gum and all—were moving skyward, angel-like, all the while.

Will mean that the one-man submarine will become a more practicable.

Coming down to the means whereby this novel engine of war is to be used in carrying out offensive operations, we see upon looking over the detail drawing that in front of the submarine there is a detachable war-head in the form of a steel cap which fits against the parabolic nose of the submarine very tightly. This war-head contains the usual quantity of gun-cotton or other high explosive. Suitable quick-acting magnetic clutches enable the operator to instantly release the entire war-head at any desired moment.

This submersible not only carries two distinct forms of prime mover, but also carries the necessary gas tanks to supply a set of ultra-powerful oxy-acetylene flame nozzles, which are disposed along the forward part of the vessel on the exterior, and by means of which the operator can burn his way thru any ordinary submarine net entanglement.

This feature is one of the latest scientific discoveries and involves the operation of an oxy-acetylene flame under water, which is made possible by blowing a stream of compressed air around the gas nozzle, and in this way forming a flame pocket in the water so to speak.

Mr. Lyon is very enthusiastic on this particular innovation, and has drawn plans for a one-man submarine which utilizes an extra powerful and especially contrived set of these high power oxy-acetylene nozzles with which to burn a hole thru the bottom of a Dreadnought, causing it to founder sooner or later.

Among the other interesting features of the idea here pictured we find a collapsible periscope which may be folded down into a suitable pocket provided in the top of the hull, and attached to which there is an air tube and also a (distress) rocket shuts. When running submerged, a special air machine is used to supply the necessary oxygen to the navigator. A powerful electric searchlight is fitted to the front of the detachable war-head and by means of the small periscope shown the operator can see ahead at a considerable distance under the water. A compact but powerful battery is contained in the war-head which can supply sufficient energy to energize the electromagnets which hold the explosive chamber to the hull of the enemy war vessel once the operator has managed to approach close enough to accomplish this result.

The war-head also carries a special electrical circle, which functions a few minutes after the war-head has been attached magnetically to the hull of the enemy vessel, and which causes an electric spark to detonate the gun-cotton charge.

It has been argued by a number of naval experts that the One-man Submarine is doomed to failure for several different reasons. This, however, does not seem to be the case so far as we can see, and providing the submersible is properly designed in its details.

Let us take a concrete case for example to show how the Lyon one-man ship destroyer would go about its task.

Assuming that these engines of destruction, of which there would be most probably several in each attack to make doubly sure that the enemy would not escape, have been despatched either from a fort or other point on the coast, or from a mother-ship several miles out from the enemy, the intrepid navigator of the 20-mule-an-hour submarine starts forth on his perilous journey. With only his periscope exposed and at a distance of several miles, it is well known that a periscope projecting a foot or so above the water presents an almost impossible target for ordinary gun-fire, and moreover, as the vessel darts forth on its way and as the range decreases between himself and the enemy, the buoyancy and submerging tank motor-pumps are manipulated so that only occasional sightings are made with the periscope. It thus becomes very problematical whether the enemy would hit the submarine. Also at a distance of say one mile, and in accordance with standard submarine maneuvering the submarine officer then proceeds to take accurate sightings of the enemy both with regard to the range and the direction geographically, after which he submerges and may proceed at high speed at a depth of fifteen to twenty feet below the surface of the water (the same as modern torpedoes) and in a little over a minute or so, and providing he has gaged the enemy's position accurately, he will find himself in the vicinity of the bottom of the hull. Owing to the high speed possible with this miniature submarine, built like a torpedo, it should be possible for the navigator (in the event that he does not strike his mark) when he has gone the range calculated up.

(Continued on page 47)
Electrifying the Aeroplane

Electricity is being rapidly introduced in the new art of Aeronautics as the illustrations here with tend to testify. The greatest development in the art of flying is the aerial limousine or so-called Autoplane illustrated in Fig. 1, which was exhibited at the recent aeroplane show held in New York City. This aeroplane is built in the form of an automobile limousine and equipped with three planes for the sustaining surface. Aside from its perfect mechanical features its electrical equipment is exceedingly interesting, as the engine is automatically started by means of an electric motor installed exactly the same as the automobile engine electric starter. The engine develops 100 horsepower and drives a four-bladed propeller place at the rear. The interior lighting is accomplished entirely by electric lamps and its ignition is of the very latest electrical design. Altho it may seem that the machine was not made for speed, yet it has a speed range of sixty-five miles per hour and can sustain a weight of 710 pounds. It can carry two passengers and a pilot.

The stallometer illustrated in Fig. 2 is an electric instrument devised to warn the aviator when his machine is approaching a stalling condition by indicating that the minimum air speed has been reached. The stallometer is adjustable for any desired air speed, depending on the airplane on which it is installed. When the predetermined speed is reached, an electric contact is closed in the stallometer, closing the circuit thru an indicating lamp at a dangerous angle. The white lamp signals whenever the pilot dives at too steep an angle. The green light indicates the least climbing angle. Being of low voltage as well as low current consumption, the lights can be operated on a dry battery, encased in metal and installed wherever most convenient. The signals are regulated by a valve operated by the air stream.

The lamp bank container is seen in the background. Each lamp is equipped with the proper colored screen and connected to the required contacts enclosed in the incide indicator chamber. The lead wires are led thru one of the supporting tubes.

Aviators wishing to know at any time the correct fore and aft position of the machine, with reference to the horizontal, can read it on the scale of the dead-beat clinometer illustrated at Fig. 4. The operation of this instrument is simple. Whenever the clinometer is tipped forward or backward by the motion of the plane, this movement is registered on a scale mounted on a wheel which is damped by floating in a liquid.

If the aeroplane tips forward, the scale moves upward, indicating in degrees below the zero line the exact angle. If the machine tips backward, the scale moves downward.

(Continued on page 54)
**THE AUTOMATIC EXPERIMENTER**

**May, 1917**

**The Autograph of Your Heart**

**By SAMUEL COHEN**

One of the most important mechanisms of the human body is the Heart. Its action in health and disease has been the subject of attention by numerous prominent physicians in all parts of the world, particularly those interested in fighting heart disease, the most unrelenting malady with which one can be stricken. Yet it has been said that 15,000 to 20,000 school children in New York alone are suffering from it.

In view of its most important function and the severe,Sure, by way of operation, is usually impossible. Therefore, the only third is, the patient must carefully study the heart, locate the trouble and determine the reasons for this trouble. A first aid in this direction is a biographical history of the patient.

The rapid growth of this disease, and the rapid advancement of science has led to the development of a new instrument called the Electrocadiograph. This instrument is really a modified galvanometer, consisting of a very powerful magnetic field produced by an electromagnet and excited by a constant direct current, such as the current given by a storage battery. A very short air gap is made between the poles of the magnet and in this powerful field a fine quartz filament or fiber is stretched. Delicate adjusting means are provided for controlling the tension of this wire. (Fig. 1.)

A small diaphragm is placed on the center of this which closes two small holes that extend thru in each pole piece. These holes are the condensing microscopes and the projecting microscope to focus the fine beam of light to strike a moving photographic film. If the wire is slightly displaced by the passage of an electric current through it, it will naturally displace the small diaphragm in and turn permit the fine beam of light to pass thru the openings and then pass from the diaphragm to the projecting lamp throwing out the fine beam of light. It will, therefore, be seen that by displacing the quartz wire in certain movements that a record will be made on the film, accordingly. This quartz filament is connected to a Wheatstone bridge of proper dimensions and also to special terminals which are connected to the patient whose heart is to be examined. These terminals are three in number and are made of German silver plates, each of which is fitted with binding posts connected to the leads, connecting the plates with the sensitive galvanometer and ultimately to the bridge circuit.

Two of the plates are secured to the arms of the patient, while the third terminal is strapped around the left ankle. Proper care is taken to see that the electrical connection between the body and the terminal is of low resistance and for this purpose a wet cloth which is saturated with a 20 per cent salt solution is placed between the foot and plate and again the cloth is wrapped about the plate. The Wheatstone bridge circuit is balanced so that the resistance of the electrical path between terminals is constant, and this is obtained when the quartz string or filament of the galvanometer is in a zero position.

It is evident that a slight addition of current to the galvanometer circuit will cause a displacement, which is recorded on the film. Since the contraction of the heart creates an electric current as found by various scientists, and as the intensity of this current depends upon the intensity of the heart contraction, it is therefore obvious that the fine quartz wire will be displaced a certain amount by the generation of current by the heart. With the contraction wave, the electric potential spreads over the heart, and thus the galvanometer records the heart beat and also indicates the origin and path by which the current spreads.

An exact replica of the apparatus used in recording the pulsation of the heart is illustrated in Fig. 2. This shows the apparatus in actual use and how the various electrodes are secured to the patient. This photograph was taken at the time a record was actually being made of the condition of the patient's heart. The sensitive galvanometer is seen at the left, while the beam of light is derived from a powerful arc projector stationed at the extreme left, but near the instrument at the right extreme is the photographic film apparatus. The film is driven at a definite and uniform speed by an electric motor mounted at the bottom of the machine. This instrument is placed in exact line with that of the telescope of the galvanometer, and the resistance box is shown on the shelf of the galvanometer table.

The instrument traces its indication of conditions of the heart by means of dots on the photographic film. These heart pictures are as characteristic as finger prints or photographs. No two individuals' hearts beat alike, and the electrocardiograph, by its extremely delicate registration of the contraction of the muscle, readily shows the most minute difference. The heart of a dying heart is told by the accompanying curves registered by the electrocardiograph. The graphs illustrating this remarkable story are shown in the third figure, were taken by Dr. R. H. Halsey, of New York City.

The record here reproduced form an almost complete electrical record of the heart during the last movements of the patient's life. Tow death was expected, yet its actual advent was much earlier than had been anticipated; the transition from life to death was abrupt. The waning of life is to be found in the lengthened contraction interval and in the changed ventricular complex of Fig. 5. That fibrillation of the ventricles was not the immediate cause of death is clear from Fig. 6, taken when the usual signs of life were in abeyance; the heart was profoundly affected, and the patient past all possible hope of recovery before respiration ceased.

The record was obtained from a female patient thirty years of age, suffering from broncho-pneumonia of both lower lobes. The curves were taken one after the other in quick succession and are described in the following.

In Fig. 1, the frequency of the heart is 75. The duration of the diastole varies from 0.2 sec., to less than 0.1 sec., and is non-rhythmic. The up-stroke of P is quicker than the downstroke. The conduction time is within the normal limits of 0.2 sec. The R wave is well defined and of considerable excursion. In the second figure, the frequency of the heart is 80. There are the same vibrations in the duration of the diastole. The **Electrocardiograph** Figures 3, 4 and 5 show the different frequencies of the heart at different times. In Fig. 5, the frequency of contraction of the heart appears to have dropped to 45, while association of auricle and ventricle is still present. The conduction time is 0.4 sec.; double the time in the earlier record. Dur-
RADIUM AND CANCER.

"The Other Side of the Radium Cure" is the title of an article by Dr. J. H. Blaisdell, in the Boston Herald. This is of such great interest that we give it below, as many of our readers have undoubt- edly read the recent report of the Director of the Crocker Cancer Research Commission printed in these columns.

"Newspaper interpretation of medical subjects, vital to the interests of the health of the community," says Dr. Blaisdell, "should be peculiarly conservative and well advised. To me your editorial comments on radium in cancer on Wednesday morning of this week seem especially open to criticism on this score.

"Briefly stated, your summing up of the findings of the Crocker cancer commission on Columbia University unquestionably placed radium in the discard as a "cure," damned it with faint praise as a palliative, and noted with the cheerful abandon of life opportunity given the medical profession to make 'the patient's condition worse than it had been left alone.' Such is the pessimistic side of the picture based on truth but, unfortunately for your readers, only half the truth. Simply because radium cannot be called a "cure" in inoperable or hopeless cases of systemic cancer is no reason why readers should be instructed to regard it as a discarded fad to the utter disregard of the chances of early malignant disease that this remedy has saved.

"Point out rather to your readers (re- ferring to the editor of the Boston Herald) the significance of the recent purchase of many thousand dollars' worth of radium by the Huntington Hospital of Boston, as an example of how useful it is in experienced hands. Tell them of its effects beyond that of any other remedy in epitheliomas or cancers of the skin. Lay your emphasis on how radium can absolutely prevent cancers of the skin if people could be taught to have the early pre-cancerous possibilities such as keratoses, warts, moles, etc., removed before degeneration starts. By such statements it seems to me you would be doing the greater services to the community and more rightly interpreting the findings of the Crocker Cancer Commission on Radium."

..-Figures 1 to 4.

MARKABLE.-Figures 5 to 9.

MAN SWALLOWED $20,400 WORTH OF RADIUM.

In an article treating on the use of "Radium in Surgery and Gynecology" in Radium, Dr. John M. Lee relates a peculiar accident which happened in applying a valuable tube of radium. Sarcomata and epitheliomata of the tonsil in several patients were yielded excellent results. In one of my first cases, a vigorous, powerful man, with more money than judgment, jerked his head backward through the supporting hands of the nurse, and at the same time turned the mucous-... Fig. 13.

The above Electrocardiograph Records, Numbered 9 to 13 consecutively, represent the most remarkable scientific analysis of just what does happen in a patient's heart under Radium and at the exact period when life ceases to exist, or death. By inspecting these charts of the heart's variations during the last moments of the patient's existence, a case of early pneumonia can see how the heart started to fluctuate progressively, finally stopping action at the right end. (Fig. 13.)
Combating the Torpedo

By H. Gernsback

May, 1917

WAR after all is but a game of chess. The greatest generals of modern civilization realized this, often profusely. And every one of them had been at one time a good chess player. In war, as in chess, luck plays but an insignificant part. Great battles are won by the general who has the greatest strategic ability; will, whether he be in the field or on the chess-board. Also, if both opponents can sufficiently anticipate each other's moves, no one will win. In this case war will be a never-ending stalemate, and no side will be a victor, for it is certainly not defeat.

The present submarine warfare is no exception to the rule of comparing war to chess, for the simple reason that it is an unending one. All the powerful pieces are on the U-Boat's side and no Queen, Rooks and Knights on the other side of the board to defend the King. At least there was a defense worthy of the name up to a few months ago.

But science, as always, is progressing steadily and soon the submarine will have found its master, or at least its equal, with which to stalemate it.

It is the first of a popular illusion. Almost every one of us thinks or speaks of the "deadly submarine," when, as a matter of fact, the submarine itself is not only not deadly but a very weak contrivance at best. Point a 3-inch gun at it and it will vanish instantly. Send a 20-foot motor boat chasing after its periscope and the "deadly" submarine at once becomes a deadlier than the proverbial doormat.

It is the submarine's death weapon,—the torpedo—that has so far out-generated the cleverest brains and has given the greatest statesmen untold sleepless nights. To fight the submarine itself is comparatively easy, given good guns and good gunners on board the attack ship, provided of course that the enemy submarine commander is foolish enough to expose his craft too much above the waves.

Several methods have been adopted of late to combat the submarine, none of which have been generally known.

First, we have the smoke-screen—perhaps one of the most effective schemes devised, by means of dense volumes of chemical smoke, blown around the ship by powerful exhaust pumps, the ship is enveloped almost completely in a fog-like screen and it becomes a very difficult target for a torpedo. The ship's bow, however, is nearly always exposed. The other method is to protect the ship with strong torpedo netting suspended by means of booms from the ship. The torpedo upon striking the net is thus rendered harmless, as it never reaches the ship, unless the netting is made of rope and the torpedo is equipped with cutting blades. In that case the torpedo will strike the ship and blow it up.

But the one great drawback of the net is that it is almost impossible to use it on a fast moving ship. It is too cumbersome and most of all it greatly retards the speed of the ship, due to the excessive friction of the netting against the water.

The next—and poorest—means to combat the submarine is our widely advertised mounting-guns-on-a-ship scheme. No submarine commander in his right senses exposes more than one or two feet of his periscope when making a torpedo attack. And remember no torpedo attack is ever made at a closer range than 800 yards. Two thousand, and even four thousand, yards are very common nowadays. Imagine a gunner on even a slightly rolling ship trying to hit an object one foot high, how low: as a matter of fact, the idea struck me so favorably that I decided to apply for patents in all civilized countries.

Several navy experts have reported favorably on the idea, and while the writing no ships have been equipped with the device, I would not be at all surprised to see the idea put into practise very shortly.

Our front cover and the two accompanying drawings illustrate the idea clearly.

The underlying idea of the whole scheme is that it takes the submarine an appreciable length of time between the instant of being released from its submarine and the moment it strikes the attacked ship. Taking the closest range at which a torpedo can be fired as 800 yards—and it cannot be fired much closer successfully—this gives a time of 55/100th or over half a minute to cover that distance, short as it is. Taking the average of 2,000 yards, it will take the torpedo 1½ minutes before it hits the ship. These figures are for the latest type Bliss-Leavitt torpedo making 43 knots, i.e., 50 miles an hour.

But a torpedo, whether it runs on the surface of the water or submerged below it, always leaves a very noticeable "wake" in its course. Remember a torpedo is propelled solely by compress air, compressed up to 2,200 lbs. per square inch. This gives it a speed of one-fourth the speed of sound or over 20 miles an hour. The disturbance created thus gives rise to the all most snow-white wake which is noticeable from a distance. Thus a man stationed on a ship readily sees the wake as it comes near. And, if he can gaze pretty accurately just where the torpedo will hit. Escape for the comparatively slow-moving ship is impossible, even if the engines were reversed instantly. The vessel's momentum would still be so great
that the deadly torpedo would surely find its mark.

My proposed means of rendering enemy torpedoes ineffective is as follows: Fig. 1 shows the plan view of an average steamer, 600 feet long. On each side we observe five (or more) independent, electrically propelled torpedoes. Fig. 2 shows the construction of the torpedo itself. Briefly, it consists of a little craft with an engine and speed propellers and measures from 15 to 20 feet in length and from 3 to 5 feet in diameter. It has a 12 horse-power electric motor geared to the propellers and there is also a little 1/2 H.P. motor geared to the rudder with which to steer the torpedo. Most of the space between the bow and the motors is taken up with the usual charge of gun-cotton. This torpedo, unlike its other brethren, has a heavily weighted keel to prevent it from rolling over, for reasons which will be apparent later. On the back of the torpedo is mounted a steel mast-like structure thru which the control cable passes. This cable then runs to the deck of the ship over pulley arrangements as shown in Fig. 2. There is also a drum to take up the slack of the cable, or to play out more cable should the occasion arise. The cable then runs up on the mast into a special turret located as high up as is feasible. Here we find one or more operators sitting in front of the electric control-board. All the cables from the star-board side torpedoes run into the forward mast-turret, while all the cables from the port side torpedoes run into the rear mast-turret. Thus each set of operators watches out for the safety of his side of the ship.

All of the torpedoes are painted in such a color that the operator can watch them readily and guide their individual course. Sitting at the control-board the operator sees to it that the speed of each torpedo keeps up exactly with the speed of the ship, for there should never be a drag on the cables. This is readily accomplished by means of rheostats, one for each torpedo. By cutting in more or less resistance the 12 H.P. motor can be made to run faster or slower and the torpedoes are thus easily controlled as to speed. By means of a double-pole, double-throw switch the little 1/2 H.P. motor is revolved in either direction, thus effectively steering the little craft so that it will always keep at a distance of some fifty feet from the mother ship. On the control board furthermore there is a switch connected to a storage battery from which the wires are run thru the cable into the torpedo and thence into the detonator placed in the gun-cotton charge. Fig. 2. Throwing this switch will blow up our torpedo.

The war action of the idea is as follows: Our ship has left New York with all of the motor torpedoes hoisted out of the water and lashed securely to the decks. The moment the need arises the torpedoes are lowered quickly into the water and the control operator starts the machinery of each torpedo, and in less than two minutes all of them should be running smoothly, fifty to seventy feet distant.

Suddenly the outlook scanning the waters with his binoculars sights the periscope of an enemy submarine and in less than a minute later our operator observes the rapidly lengthening wake of a death-carrying enemy torpedo. High up as he is located, he calculates that in less than two minutes the enemy torpedo will strike somewhere between his motor torpedoes Nos. 1 and 2 (see Fig. 1). By cutting in resistance into rheostat No. 1, he immediately blows up motor torpedo No. 1 thereby intercepting the path of the enemy torpedo. Or if, for certain reasons, he wishes to use his motor torpedo No. 2, he leaves No. 1 in its original course but by cutting out more resistance from rheostat No. 2, he speeds up the latter with the result that it advances faster than the ship and in this case as well it will intercept the course of the enemy torpedo.

Suppose he decides to use motor torpedo No. 1. He has nearly two minutes to jockey it for position and he will find little trouble to intercept the course of the hostile engine of death. His eyes glued to the enemy torpedo (or to its wake), his
Sources of Electricity

**Contact Electricity:** It was Volta who showed that the contact of two dissimilar metals in the air produce opposite kinds of electrification, one becoming positively and the other negatively electrified. There has been considerable discussion as to the exact action occurring in the production of electrical current at contact of two dissimilar metals. In 1800, Siméon-Denis Poisson discovered that the electricity is transferred from the metal with the larger proportion of free electrons to the other metal. This discovery opened up a new field of investigation, and it has been found that the electrification results from the transfer of negative charge to the other metal.

**Electricity from Gases:** Fig. 4 shows the famous Grove Gas Battery invented in 1839. It shows how two gases are used to produce an electric current. The two glass tubes contain platinum strips coated with spougy platinum. The glass bottle contains acetylene gas, which fills the tubes. When the two gases mix, they produce a large amount of oxygen, which is used to oxidize the platinum. The oxygen is produced as a result of the chemical reaction between the gases.

**Electricity from Thermoelectricity:** If we take two metal bars, one of bismuth and one of antimony, and join these together, it will be found that an electric current is produced of an appreciable magnitude when the junction between the metals is heated in the flame of a candle or other source of heat. To demonstrate that there is an electromotive force connected with the temperature difference, connect the two terminals with a galvanometer. We shall observe an electric current, the oxygen furnishing the positive terminal, and the negative terminal being the battery. It is important to note that, as we consume the current, the liquid rises in the two glass tubes, but twice as fast in one as in the other, so that the one containing the oxygen. As each tube is identical with the other, except for the gases, it follows that the current can be due only to the gases. Also different gases produce different voltages and currents.

**Emission of Electricity:** In the accompanying Fig. 5, we have several methods by which minute quantities of electricity may be evolved from a crystal of tourmaline, and the crystals which become electrified by heating or cooling are said to be pyro-electric. One of the phenomena of electrical phenomena which are involved in this peculiar action is tourmaline. The tourmaline has been called from its name, and the name tourmaline is derived from the Greek word for tourmaline, which means tourmaline.

The tourmaline possesses the power of polarizing light, and is usually found in slightly irregular three-sided prisms which, when perfect, are pointed at both ends. It is interesting to note that in heating such a crystal as the tourmaline, it attracts light pith balls to its ends when electrified.

If the temperature is kept steady, then no such electrical effects are observed either on the crystal or on the air. The phenomenon ceases altogether if the crystal is warmed above 150°C. If a heated crystal of tourmaline is suspended in air, it will be found to be electrically charged; when it is removed from the air, it may be repelled by electrified bodies or by a second heated tourmaline. Among other crystals which are capable of being electrified are siliicates of zinc, boracite, cane sugar, quartz, tartrate of potash and sulphate of quinine.

Electricity is produced by the disruption and cleavage of certain substances, as for instance, when a sheet of mica is split apart, which actions are accompanied by the production of a number of sparks, and both laminae are found to be electrified. If sulfur is fused in a glass dish and allowed to cool, it becomes powerfully electrified, which action may be tested by lifting out the crystalline mass with a glass rod. Chocolate is another substance which manifests such an electrification while becoming solidified.

**Pico-Electricity:** The term is given to that form of electrical energy evolved when certain crystals are placed under pressure in a certain direction. With respect to the make-up of the crystal, it is found that a small piece of preserved and placed between the fingers so as to compress it along the blunted edges of the crystal, that it begins to produce an electromotive force and charge for some days. This phenomenon is believed to be due in certain crystals to what is known technically as alkali-sodium or hemihydrate in their molecular structure.

**Thermo-electricity:** If we take two metal bars, one of bismuth and one of antimony, and join these together, it will be found that an electric current is produced of an appreciable magnitude when the junction between the metals is heated in the flame of a candle or other source of heat. To demonstrate that there is an electromotive force connected with the temperature difference, connect the two terminals with a galvanometer. We shall observe an electric current, the oxygen furnishing the positive terminal, and the negative terminal being the battery. It is important to note that, as we consume the current, the liquid rises in the two glass tubes, but twice as fast in one as in the other, so that the one containing the oxygen. As each tube is identical with the other, except for the gases, it follows that the current can be due only to the gases. Also different gases produce different voltages and currents.

(Continued on page 71)
**Sources of Electricity**

1. The Static Machine
   - Contact of dissimilar metals produces electricity
   - Galvanometer
   - Copper Bar
   - Zinc Bar

2. The Gas Battery
   - Platinum strips
   - Gas inlet

3. The Primary Battery
   - Fan

4. Electricity from Crystals
   - By heating
   - Crystal under pressure
   - Electrode
   - Electrode

5. The Thermopile
   - By cleavage
   - Pith balls attracted

6. The Electrostatic Machine
   - Electrostatic machine
   - Pith balls attracted

7. The Dynamo
   - Electric generator
   - Carbon
   - Iron vessel
   - Coal burning

8. Electricity Direct from Coal
   - Air pump
   - Fused caustic soda

9. Electric Plants
   - Radium electrically active
   - Radiactive mineral
   - Electrode

10. Electric Fish
    - Photo-electric cell
    - Salt water
    - Polished copper plate

11. Sunlight
    - Oxidized copper plate

12. (For description see opposite page.)

www.americanradiohistory.com
Magnetism Produces Remarkable Photographs

BY F. F. MACE
Superintendent of Public Schools, Pecos, Texas

Fig. 2, Photograph Taken in Usual Manner, Showing the Various Objects "Magnetized" in Vacuum.

Fig. 3, Here We See the Best "Magnetograph" of the Objects in Fig. 2; It Was Made under an Exhausted Receiver.

Fig. 4, Exposure of Photo Plate and Various Objects Placed Over a Magnet Under Atmospheric Pressure. The Magnet is No. 701, Made by Mace, Pecos, Texas. The Magnet Is Paced over the Objects, and the Plate Placed under an Exhausted Receiver. At the End of Three Days the Image Was Developed and the Photograph Taken.

The Author Arranged the Objects to Be Photographed by a Magnet, Placing Them on a Photo Plate under the Bell of a Vacuum Pump, Permitting the Air to Be Exhausted.

W hat causes iron, a dense, heavy substance, to ignore or overcome the laws of gravity and to dart thru space to a magnet? What is this mysterious, so-called, attraction? Can this swift and sure motion of a heavy body thru space be caused by lines of force without motion, by lines of tension in ether or by mere lines of direction, like lines of latitude or longitude? Can these lines of force tending or extending, moving without motion from one pole to the other, or lines of force or tension "emerging," without motion, from one pole and "entering," without motion, the other pole, produce the same result as before? Can any possible arrangement of the molecules of the magnet, supposing this arrangement to be brought about, possibly extend thru space and accomplish this result? Can any or all of these miracles, these things themselves contradictions of the known laws of nature, bring about another miracle—a result opposing, apparently, one of the laws of nature? Is there a cause for these things in keeping with the known laws of nature?

These questions presented themselves when I first studied physics. They asked themselves more insistently when I began to teach physics, and they have been reiterated again and again in varying form by every class of beginners whom I have appeared before. For more than fifteen years I sought to obtain an answer, a true answer, to these questions—an answer which would really account for the facts and which would be in accord with the other known laws of nature. For years only a faint glimmering of the truth appeared. Then gradually the light grew stronger until I had worked out a clear and logical answer. But to answer these questions by pure logic based on the known facts of nature was not sufficient. Modern science demands experiment: the Newton and Galileo, and Laplace never performed an experiment but based their discoveries on the facts before them. Therefore, I worked patiently for years to demonstrate in a new way that which I knew to be true, until I had proven by experiment that which I had proven by logical deduction, that the attraction of the magnet and all of the phenomena of magnetism are produced by the motion of other currents about and thru the magnet, and until I was able to demonstrate the cause, nature, and direction of these currents, and by the direction of these currents to account logically, consistently with the laws of nature, for all the facts of magnetism.

But even this was not sufficient. The facts of nature had been distorted for years. These experiments, conclusive as they were, might be distorted and thrown aside. It must be proven beyond a shadow of doubt in some striking manner that there are actually currents about the magnet, he such as to effect the photographic plate? I could only try it, as I had tried other things, and hope to obtain the result sought.

The result justified the hope. Taking every precaution known to a photographer to prevent the results from effects other or other influences I exposed a plate on which were placed a number of objects of vibration, he such as to effect the photographic plate? I could only try it, as I had tried other things, and hope to obtain the result sought.

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The Therapy of Light and the New "R-Ray"

By H. ROSENTHAL

The therapeutic use of light has been known for ages; in fact, it belongs to a period so remote that we are unable to determine even approximately the time of its introduction as a healing agent.

In the Far East the earliest writings mention the use of light in the cure of disease, and in the comparatively more recent records of Central American aborigines we find accounts of miraculous cures performed by the Sun God. Even at the time of our early pioneers on this continent there are authentic reports of a custom practiced by many Indian tribes, in which treated wounds and pulmonary afflictions, rheumatism, neuralgia, etc., were exposed to the sun, so exposing the naked skin to the mid-day sun, allowing the rays to fall directly on the part afflicted. This custom was in vogue ages before the Spanish Conquest, and was common among the aborigines of America, from Yucatan to the Arctic Sea.

We have, therefore, historic proof that light rays have been used from time immemorial in the treatment of disease, and while modern science and modern methods have attained the same ends, they have not changed the principles known to primitive man—but have merely developed the art.

As light rays are the oldest and most universally accepted therapeutic agent, we naturally ask—how are they translated into terms of therapy by the human body? To which the answer is: thru the medium of vibration and penetrative force of quantity.

Light and electrical radiations are both wave motions that are projected thru space at the same velocity. They are identical in nature, in that one wave length or radiation may differ from another, the same as one sound wave may vary in length from another. There are two main classes of vibrations or vibrations of music. Yet all wave lengths, whether light or sound, produce their own corresponding vibrations and we therefore recognize all such vibrations in terms of light or sound.

In other proof of this existing vibratory theory we have color, which in reality exists only in the mind. For color value is dependent solely upon the number of vibrations impinging upon the retina of the human eye. For instance, when the retina is stimulated by a vibratory force that approximates 400 trillions per second, the impression produced on the brain is red. Below 750 trillions vibrations per second is interpreted by the brain as the color violet. And so on thru the scale of our visible spectrum. Yet, were the human eye sufficiently sensitive to receive and distinguish the many intermediate vibrations, it would see a variety of brain countless millions of tints and numerous values that lie between these two extremes.

When these countless millions of tints are all combined we see only white. And thru the prismatic interpretation white light as being white, still we know that it is not white; but the combined primary colors and their countless intermediate tints. This fact is easily proved by simply passing a beam of white light thru a prism, which will show the primary colors making up the white beam.

Light vibration without penetration, force or quantity is in itself therapeutically negligible. To have force, it should be direct, and to have penetration the source and quantity should furnish vibrations of practically uninterrupted intensity.

One source of light which fulfills the above conditions is our own sunlight, which penetrates every portion of the human body and even the brain, and suffuses its economy by oxygenating the blood, generating hemoglobin and producing red corpuscles. And when we become Sun-Dodgers we cannot expect any other physical condition than that which takes place in plants under like circumstances, and which entails on human nature the necessity of resorting to other means for making up the deficiency—generally drugs

Summing up therefore the laws that govern the therapy of light, we find that it has the same relation to chemical actions which are governed by the chemic response set up in the brain, not by the inherent quality of the ray; while all physical conditions are secured in direct ratio to the penetrative power, quantity and vibratory force of the light employed.

All light waves possess two main characteristics that differentiate the effect produced: the speed at which vibrations are produced in a given interval of time and second, the length of each oscillation or wave length.
Powerful Electro-Magnets Perform the Work of Many Men

The ordinary work of a man loading pig iron from the ground upon a railway car was from 12 to 13 tons per day. The lifting magnet, however, was rendered useless by this laborious work to be performed by human effort, and the results, as given in the unloading of the stove, Erwin L. Fisher, at Indiana Harbor, Ind., are given in brief below.

With a cargo of 4,000,000 pounds of pig iron, the time required to unload this vessel with twenty-eight men was two days and twenty-eight hours, which corresponds to about 3000 pounds per man per hour, or about 15 tons per day of ten hours. When the lifting magnet was introduced, the total time required for unloading was reduced to eleven hours and was done by two men, whose labor consisted in manipulating the controllers in the cages of the cranes. Thus two men and two magnets duplicated the work of twenty-eight men in less than one-fourth the time. Under these conditions the handling capacity of a man and a magnet was nearly one thousand tons in eleven hours, or about 900 tons per day of 10 hours. This is fifty times as much as was accomplished by hand labor, or twenty times as much as is possible even under scientifically managed manual labor. Furthermore, the operation was chargeless with less than one-fourth the overhead charges, while the vessels were enabled to double their number of productive trips.

The lifting magnet has been adapted for the handling of materials in all branches of the iron and steel industry. It is used for handling pig iron, scrap, castings, billets, tubes, rail, plates, crop ends; for loading and unloading cars and vessels, and for handling skull-cracker balls and miscellaneous magnetic material. In fact it seems to be axiomatic that wherever magnetic material, and especially raw material, is to be handled in any considerable quantity, a lifting magnet can be used to advantage and will be a profitable investment.

The accompanying illustration shows in a marked manner the practical application and efficiency of large electro-magnets used industrially. The first illustration shows a gigantic electro-magnet measuring 62 inches in diameter and swinging from a crane at the plant of the Crucible Steel Company at Pittsburgh. This mighty magnet has been photographed in the act of lifting 17 steel billets, each weighing 575 lbs., or a total of 8,925. It takes but a moment's reflection to readily conceive just how much man-power would be required to move this same weight of steel; not to mention the time occupied in moving it. A single operator, in this case the man operating the crane, lowers the magnet onto the steel bars and when in contact or nearly so, he closes the switch supplying the magnet with electric current. The magnet instantly becomes alive and exerts several tons of magnetic tractive power and holds the billets to its face securely, as pictured in the illustration. The crane may swing along for several hundred feet, carrying its suspended load, and as soon as it reaches the desired location the magnet is lowered, when the operator opens the switch the magnet instantly releases its 4½ tons of steel.

The second illustration shows a powerful electro-magnet at work in the yards of the Chicago, Milwaukee and St. Paul Railroad's West Milwaukee shop, the magnet measuring 43 inches in diameter and lifting in this case a locomotive drive wheel. This locomotive wheel is an attractive proposition today and not only appears in large sizes but in the very small sizes as well. The small hand type electro-magnet is particularly efficacious for picking up quantities of iron nails, screws, etc., in hardware stores and stock rooms and finds application in a thousand and one different ways daily.

**THE ELECTRIC HEATER FOR THE KITCHEN BOILER.**

The accompanying semi-sectional view of an ordinary kitchen boiler shows how a ready supply of hot water can be had by attaching a perfect electric water heater. This heater heats the water before you turn the faucet and not some time afterward. The tank is always charged with scalding water at any temperature you wish up to 200°F. (32°F. boiling point), or enough heat for about five baths—always on tap.

The heater has six steps—and the regulator is a six point current control. When no water is being drawn the heater will probably be cut entirely out so that no electricity is being used. Then as some water is drawn the regulator picks out that step of the heater which will pump back into the boiler the same amount of heat that is drawn from the faucet in the hot water. At the sixth step the regulator applies two full horsepower, storing heat at 100% efficiency. It is claimed that this particular electric water heater will operate on 15 to 30 per cent less energy than the circulation type heater, for the same monthly gallon production.

The present heater has been specially designed to make it self-cleaning. Under the intermittant operation of the thermal control there appears a slight but constant opening and closing of the split heating tube, which readily cracks off all scale and any precipitate形成的 on the tube. This deposit accumulating at the base of the heater is easily flushed out of the full size 1½-inch drain. This self-cleaning feature is, perhaps, next to efficiency in importance to the housewife to whom a burned out heater means not only needless expense but several days' interruption in the hot water service and a recent engineering report gives the external circulation type water heater four months in which to become absolutely choked with scale.

**CAN SINK SUBMARINES BY WIRELESS, SAYS INVENTOR.**

Theodore Eichholz, a young engineer and architect of Pittsburgh, has invented a wireless device that may be used to destroy submarines by causing an explosion of gases that are always present in submarines, he claims. For several years the invention was connected with the United States Corps of Engineers.

Mr. Eichholz stated that just recently a small experimental apparatus in his home on Westside Island sunk a small "dummy" submarine in the Ohio River, five miles away. The destroyed model was of steel and submerged to a depth of ten feet. The submarines while under water are propelled by electric storage batteries which throw off a gas that pervades the interior of the tank. This gas, Eichholz says, is detonated by the wireless current and destruction follows. The apparatus will be submitted to the U.S. Government at once.
NOVEL TELEGRAPH INSTRUMENT THAT RESPONDS TO VOICE.

Strange as the title may seem, yet the successful operation of such a device has been accomplished thru the researches of Mr. Christian Berger of New York.

The accompanying photograph shows the complete equipment of the electric voice-operated telegraph instrument. The operation of the device is not attained by the employment of a microphone of any kind, but by means of a sensitive sound-operated circuit-breaker, which controls a special relay and which in turn operates electrically either a sounder or recording instrument. The circuit-breaker is placed in a metal box which is seen in the center background of the photograph. This consists of a bent wire, properly balanced on an insulating block. The end of this wire presses lightly against the side of the box, which makes a permanent contact when it is not disturbed. The second connection is made thru the metal box and this is terminated with one binding post of a battery, while the bent wire is connected to one side of the relay electromagnet, the opposite side being linked to the other binding post of the battery. The electromagnet actsuates an armature which controls a cog-wheel by means of a projecting strip on the armature. On the same shaft with this wheel is placed a drum upon which a number of contacts are secured. These are alternately connected, so that one will complete the electrical circuit when desired and when moved to the next stud, the circuit will be opened. It is built on the lines of a step-by-step relay, which has been used some years ago, for controlling moving vessels by radio waves. The drum circuit and the horizontal brushes which touch the drum studs are connected in series with the recording instrument and these.

The operation of the apparatus is exceedingly simple as one must only be familiar with the telegraph code, but not experienced in handling a telegraph key, as the transmitting is done by calling out the dots and dashes to the instrument.

When a signal is made the sensitive sound actuated circuit-breaker opens the circuit which causes the armature of the relay to release it, giving a relayary connection to the cogwheel and in turn closing the recording instrument circuit. The complete equipment is very interesting when in action and possesses many diversified possibilities.

ICELAND'S ELECTRICAL PAPER.

Elektron is the name of an electrical magazine published monthly at Reykjavik, Iceland. The leading article is on the Iceland telegraphs and telephones, by Mr. G. E. Oftung, who has been there nearly a year or more ago and studied American telegraph and telephone methods. This article is printed in the Danish and English languages.

LOS ANGELES HAS WONDERFUL ELECTRIC FIRE TRUCK.

The electric equipment of a new fire-fighting apparatus recently built by the Los Angeles fire department has no equal in the country. This equipment is mounted on a ton and a half motor truck and was both designed and built by members of the fire department.

The equipment consists of five powerful searchlights, each rated at 250 watts, capable of throwing a brilliant beam of light over 400 feet away. At this distance work at a fire can be carried on with great efficiency. Yet these lights are so arranged with diffusing lenses that it does not blind the firemen, even a few feet away.

The lights are 16 inches in diameter. Three are permanent and two are portable, each being attached to 330 feet of heavily insulated cable wound on a reel which can be unrolled, permitting the lights to be carried thro' this distance into a burning building.

The handicap of a strange and bulky apparatus is overcome by the use of these portable lights. They will penetrate smoke to almost an unbelievable distance, permitting the firemen to light fires thru dense smoke with the greatest of ease.

Power is received from eight large storage batteries placed behind the seat. These batteries themselves are capable of furnishing current for the lights for seven hours. Also installed on the right foot-board is a generator of 50 amperes, 25 volts, 1.25 K.W. This is run by a silent chain drive off the main propeller shaft and is controlled by a separate clutch, shown in front of the switchboard seen in the photo. The generator may be cut in or out at will, by means of this clutch.

A perfectly equip switchboard is mounted on the right side immediately above the generator, having a marble back in an enclosed case with a glass front. It is equipped with a master switch for both the batteries and generators. Also an individual switch for each light and gages to show amperes and volts, a resistance cut-out and small lights to illuminate the board. Fuses of proper capacity are installed for each switch. To prevent damage to generator or batteries an under-load and an over-load switch is installed. This acts as a governor, the purpose of which is to automatically disengage the charging line from the generator when the rate of charge reaches a dangerous value or when the rate of charge is so low that there would be danger of the batteries bleeding.

The portable lights are adapted to be used on a tripod. They are mounted on the wagon on a swivel connection with a one-inch diameter stem projecting, which fits into a socket fastened with a nut. A similar socket is provided on the tripod and when the light is set on the tripod, a large hand nut is provided which holds it securely. The light mounted on the tripod can be readily moved from place to place by one man. As he carries the light to the fire the reel automatically unwinds.

Los Angeles, Cal., Boasts of Having One of the Most Complete Electric Fire-fighting Trucks in the United States. The Equipment Comprises Five Powerful Searchlights Which Are Supplied with Power from Either a Large Storage Battery or the Dynamo Shown in the Picture.

As a precaution against any one accidentally touching the foot throttle and speeding up the engine to too great a speed, when the wagon is standing at a fire, a special protective device has been provided, which consists of a hood which can be lowered and locked in a position, completely protecting the foot throttle from the curious.

Los Angeles, Cal., Oct. 22, 1917. (Exclamatory)

A wireless telegraph distance record of 11,200 miles was established by the steamer Sonoma, which picks up messages from Elbe, Germany, when two days off Australia, according to R. G. Thomeberg and C. H. Bowers, operators on the Sonoma. E. J. Smith, assistant United States radio inspector at San Francisco, said it was the greatest distance achievement in wireless telegraphy.

May, 1917

THE ELECTRICAL EXPERIMENTER
MONSTER MOTOR GREATEST EVER BUILT.

We are told that at one time this old world of ours was inhabited by gigantic monsters—mechanical ones—that are far more powerful than any of which our ancestors knew. Take, for instance, the mastodonic Westinghouse reversing motor here shown, which was specially designed for driving 35-inch reversing blooming mills in large steel plants. When we realize that it has a capacity of 15,000 horsepower, the largest electric motor ever built, we need no further proof—we know it is monstrous. Some idea of its size may be gained when it is stated that the man standing alongside the motor is six feet tall.

**ELECTRIC LIGHTS CHEAPER THAN KEROSENE.**

How much cheaper are gas mantles and electric bulbs than candles? The Society for Electrical Development, anxious to encourage a wider use of electricity for lighting, has prepared figures showing that both are much cheaper than kerosene if you provide an electric light, while it is much more expensive than light from a candle. It is much cheaper than light from an open gas flame.

A recent test of six candles showed that for one cent only 268 candle-power hours were obtained. If electricity for lighting costs nine cents for a kilowatt-hour a 20-watt lamp can be lighted for 50 hours for nine cents. The efficiency of a 20-watt incandescent is a candle-power for 1.17 watts. Thus a 20-watt lamp will provide about 17 candle-power. It will burn 50 hours for nine cents or 850 candle-power hours will cost nine cents. One cent will buy 94.4 candle-power hours, or 35 times as much light as can be obtained from a candle for one cent.

Ordinary kerosene lamps with kerosene at 15 cents will give 72 candle-power hours for one cent. Figuring electricity at nine cents a kilowatt-hour as above, we find 22 candle-power hours for one cent balanced against 94 for electricity, or a margin of 22 candle-power hours in favor of electricity. With an open gas flame and gas costing 85 cents a thousand cubic feet, one cent will buy 51 candle-power hours. For this price electricity will provide 94 candle-power hours. Thus balancing gas against electricity, we find the margin to be 43 in favor of electricity. Gas mantles have become very popular and with best mantles one cent will buy 201 candle-power hours.

**TRAVELING ELECTRIC SIGN FOR SHOW-WINDOWS.**

The traveling electric sign here illustrated is a new moving feature sign for window decoration that can be operated where heretofore the ordinary signs have been used. It displays the same amount of reading that ordinarily requires a 3 ft. length of space into a 3% ft. space. The wording can be changed as often as desired.

Four 10-watt lamps are used for illuminating the sign, and the motor which operates the signaling band uses only about 20 watts. Motor and lamps together use about the same amount of current as a 32-cp. lamp. During the daytime, when the motor only is working, it uses less than one-half as much and the sign is equally effective.

Any length of film from 6 ft. to 30 ft. can be used and changed in a few minutes. The sign can be either 100 to 120 volts direct current or 100 to 120 volts (60 cycle or less) alternating current by changing the connections at the terminal board.

The sign comes complete, ready for use.

**NEW VACUUM BULB RECTIFIER FOR BATTERY CHARGING.**

The latest novelty in small rectifiers for charging storage batteries rated at 2 to 6 amperes charging rate and from 7.5 to 75 volts is here illustrated. It operates on a new principle for this class of apparatus. The discovery that made it possible is the perfection of the small bulb similar to that of an incandescent lamp, in which rectification of the current takes place. This bulb is filled with an inert gas and contains a tungsten filament and a sulphur electrolyte. It screws into a lamp socket in the outfit. A black-japoned casing with perforated top furnishes the mounting and is bolted in place. The casing carries the bulb, a fuse to protect against reversal and other overload and the compensator which reduces the alternating current without wasteful resistance and excites the tungsten filament. For charging, the rectifiers need only be connected to a convenient lamp socket and the pair of leads attached to the proper posts on the battery.

The smallest unit is of 2 amp., maximum capacity. From a 115 volt, 60 cycle alternating current circuit it will charge three lead battery cells at 2 amp., six cells at about 1 amp., and eight cells at 0.75 amp. Between these figures the charging rate is proportionate. At 10 cents the kilowatt hour for current, the cost is about 1 cent the hour, including tube renewal costs. The weight is about 15 lbs. Medium size rectifiers have a capacity of 6 amp., 7.5 to 15 volts, and are designed primarily for charging three or six-cell automobiles starting or lighting batteries in home garages. This type is designed for 115 volts, 60-cycle current, but may be used on 105- to 125-volt circuits. The weight is about 15 lbs. The largest type is designed for use in public garages and service stations, and has a capacity of 6 amp., 7.5 to 75 volts. It will charge from one to ten three-cell storage batteries from a 115-volt, 60-cycle, alternating-current circuit. A compensator with five open taps is part of the device and a dial switch for instantly changing voltage according to the number of batteries to be charged. Amperage can be regulated between limits of 1 and 6 amp. A single three-cell battery may be charged by itself or any number up to and including thirty cells. The controlling devices, including ammeter, switch and regulating handle, are located on the front of the case as seen.
TO ALL RADIO AMATEURS.

HEINRICH HERTZ


Inventor of Wireless.

Dr. Heinrich Hertz was born on Feb. 22, 1857, in Hamburg, Germany. He received his early training in the engineering schools and at the age of twenty-one he decided upon an academic career proposed by the Berlin Academy of Sciences in 1879.

From 1880 to 1883 Dr. Hertz was an assistant in Von Helmholtz' laboratory, where he became an associate in Kiel. From 1885 to 1889, he was professor of Physics in Breslau, Germany. In 1889, he succeeded to the chair of Professor H. von Helmholtz in Berlin, where he was rector of the University from 1911 to 1917.

In 1887, Dr. Hertz began his researches in the physics of radio waves, and in 1894 he published his famous paper "On the Propagation of Electric Waves" in Wiedemann's Annalen der Physik.

His researches in the field of radio waves led to the development of the wireless telegraphy system, which was later patented by Dr. G. M. Marconi.

Dr. Hertz's work on wireless telegraphy and radio waves laid the foundation for modern radio communication.

The importance of Hertz's contributions to this subject is the subject of this article. Hertz's work is still of great importance to science today, as it forms the basis for the development of modern radio technology.

TO ALL RADIO AMATEURS.

GALAGHIS is a bone-like substance, similar in all respects to celluloid. It is manufactured from casein and formaldehyde. A solution of casein is obtained by treating skimmed milk with caustic alkali, after which it is precipitated and filtered. The water is then extracted under pressure and the product slowly dried over a period extending several weeks. The product obtained is casein plate, which is treated to produce a film of formaldehyde and casein on the surface.

Galahis is said to be an excellent insulating material somewhat transparent, although never completely so, and of a yellowish to brownish color, it is workable either in the hot or cold state. The casein is being softened by treatment in hot water, it is odorous, and much less inflammable than celluloid.

It cannot be made into thin sheets.

Senator Sheppard recently introduced an amendment to the naval appropriation bill calling for $50,000 to be expended in the erection of a radio station at Galveston.

Berlin laboratory, there are probably none who have become so world-famous as Heinrich Hertz. His qualities as an investigator were speedily recognized by Von Helmholtz, who urged him while still a student, to undertake the solution of the prize prob-
"Eddy Currents"

By C. M. ADAMS


I glanced up from reading this message, scrawled on a scrap of paper, to ask Parker what it meant, but he was not there. I heard him in the forward compartment issuing orders in his rapid-fire manner.

It puzzled me, this brief dispatch which Parker had translated from the muddle of code words that had come in over my wireless. Could it be that the great fleet of submarines now in mid-Atlantic, supposed to be torpedoing the enemy's fleet, was useless? Were the new powerful torpedoes, loaded with hundreds of pounds of high explosive, and the great mechanical fish which launched them, useless as far as defense was concerned? I wanted to ask Billy Parker these and many other questions but he was busy.

An hour after this message had come buzzing in we cast off our moorings and were slipping out thru the harbor dotted with hurrying navy craft. We did not attract any unusual attention, for submarines were quite common sights in these times. Soon we past Sandy Hook, thru the line of patrolling cruisers, then out into the open sea. Our turbines were purring smoothly and our driving motors were spinning like great smooth-running tops as we went out, thirty-two knots an hour, headed for the open sea.

As we went I picked up a message with my wireless which seemed to be related to the information in the code message Billy had received. It was a press dispatch and read:

"There is a report that the defensive submarine flotilla which was to meet the imperial fleet in mid-ocean, is helpless because of the excellent defense of the imperial fleet against torpedo attack. The report says that the submarines have discharged every torpedo aboard and have not damaged a single enemy ship.

"The imperial fleet was reported by aer scouts to be of sixteen battleships, together with eight destroyers and followed by our navy with its present equipment. How could we save our country from the invader? How could we stay off the defeat which seemed imminent when that wonderfully trained army got into action against our meager forces?"

I voiced these sentiments when, about nine o'clock, I found Billy standing beside the conning tower on the open deck, looking forward over the double wave that marked our bow.

I felt free to ask Billy Parker much, for we had been old classmates at the Tech. school before he went into his electrical engineering work and I drifted off into mine, not seeing each other until I dropped into this craft as its wireless operator when the call came to me from the navy.

Once again he called to start the alternator. The hum of the machine sounded and as before the switch was depressed. I timed it now and found that it was held down six and a half minutes.

Wireless operator was all I was good for, owing to my lame leg.

"What will happen now that our submarines are helpless?" I asked.

"It's up to the coast defense and the fleet if we can't stop them," he said, looking away across where the sea rolled under the faint stars.

Billy confided in me. His showing me the translated code message proved that. But this was a new turn.

"If we can't stop them?" I repeated blankly.

It had not occurred to me that we were going to try to stop them at all. I did not know why we were going, but it seemed obviously impossible for us to do anything that dire when the rest of the submarines had failed.

as it tried to approach our shores, had failed in its mission? Were the new powerful torpedoes, loaded with hundreds of pounds of high explosive, and the great mechanical fish which launched them, useless as far as defense was concerned? I wanted to ask Billy Parker these and many other questions but he was busy.

An hour after this message had come buzzing in we cast off our moorings and were slipping out thru the harbor dotted with hurrying navy craft. We did not attract any unusual attention, for submarines were quite common sights in these times. Soon we past Sandy Hook, thru the line of patrolling cruisers, then out into the open sea. Our turbines were purring smoothly and our driving motors were spinning like great smooth-running tops as
"Yes, if we can’t stop them," he repeated after us.

"Why, we won’t be any better than the rest of them. That torpedo defense is too good," said I, "I asked.

"Who said anything about torpedoes at all?" he demanded, wheeling and staring at me aggressively.

"Well, we’re only a submarine," I retorted.

"Does that mean that we’re necessarily better at using torpedoes?" he countered.

"Why, don’t we?" I asked.

"We haven’t a thing that resembles a torpedo on this boat except the shells for that three-inch gun under the deck, and they will be about as effective against a battleship as a birdshot against an elephant."

I stared at him a long time then. He was serious as I could see, even in the starlight, but he was not lucid.

"Well, how are we going to get them then?" I persisted, thinking that this natural question was expected of me.

"I’ll show you," he answered, and stepped down the ladder leading below.

I made to follow.

"No, stay there," he commanded.

I did, leaning against the steel conning tower. A moment later I heard the sound of mechanism close to my head and glancing up I saw something appear above the conning tower. I climbed upon the low rail and looked up to see what it was.

The steel plates had opened in the center and from the opening had emerged a box which was made of what appeared to be very heavy glass and measuring about three feet in diameter. Inside it was looked to be a small mechanical device which seemed to run on a small circular track.

I was busy examining the device when I heard Parker beside me.

"That," he said, "is the Feeler." "The Feeler?" I repeated, this was new to me.

"Yes, the feeler, a device that will locate any ship within ten thousand yards, without any part of our boat being seen."

He explained the device again and increased interest. I could not see anything distinctive about it.

"Don’t you see how it works?" Parker asked.

"No, I can’t say that I do," I admitted.

"Come on down in the control room and I’ll show you."

He led the way down the ladder and we went into the little box of a room under the conning tower where one is afraid to lean against the wall for fear of starting or stopping something necessary to the life of the boat.

I peered into the glass case from among the litter of instruments on the walls and pointed it out to me. It was not a very big case. In it were three dials, an electric light and below it were three small control wheels. It looked very much like the other dials and wheels so thick about me that the others were distinguished only by the word "Feeler" on the case.

"This device," he said, "works on the principle of electro-magnetic induction. You see what I mean that is, the setting up of a current in something that cuts the field of force caused by a magnet. Well, up there in that glass case which will stand any pressure the boat hull will, is a magnetic coil mounted on a revolving and enclosed carrier. This coil is shaped and wound so that its lines of force are kept within a very small area, in this case about one and three-tenths square feet. Consequently when a metal object passes thru this relatively intense field, the induced current in the metal object will be sufficient to make a difference in the load on the coil. You see that don’t you?"

I did. That was perfectly plain sailing, electrically.

"Well then, when this load comes on, the lamp lights up as a signal, and this dial here which is really a calibrated galvanometer, shows how far away the object is.

He pointed to one of the three dials which I had noticed was calibrated in yards.

"Then you can run under water without even a periscope exposed and locate the exact position of the enemy," I said.

"Exactly, you understand it perfectly," he replied.

"Then you can aim your torpedo with accuracy," I was told.

"Torpedo?" he snorted with an exaggerated fill.

"But, we have something to sink the enemy with, don’t you?"

"You have," he said, his face brightening hopefully.

"Well, what is it?" I asked, puzzled.

"Look here, Dick Hartman," he said in most seriousness, "I want you to tell me that after seeing this feeler work, you can’t understand how we could sink a ship? You, a graduate of the best technical school in the country, a well-trained electrical engineer, can’t understand that?"

I confess that I did not hate anyone who was asleep or hadn’t the least trace of imagination, he said, turning away in disgust.

"Well, how do you do it anyhow?"

"I’m not going to tell you. I’ll let you find out for yourself first," he retorted with a flash of his boyish curiosity, and walked into his room and left me wondering in front of the feeler dial.

But I could not follow his line of reasoning to its end. I thought of it as I tried to sleep that night, while the motors thrust us forward and our long hull swayed gently as we kept the course and fell into the hollows. I puzzled over it as I sat at my instruments and waited for my call.

Or anything else my receivers could pick from the ether or was this apparatus important but I could make nothing of it. I could see no way, no means by which we could sink an enemy ship with this curious little feeler device which with all was exactly accurate.

All that night we ran and all the next day. I did not ask Billy any more about our boat. Pride perhaps kept me from doing this, and impatience at my own lack of perspicuity and imagination. And then too I was busy with my own work and other things that came up, which had to be done in the crowded under-sea craft.

I pondered about it in what spare time I had, trying to see what I could between tricks at my table. I found that it was quite the usual large-sized submarine, of which the navy had one hundred not counting ours. It was driven by electric motors supplied by turbine driven generators forward. It was provided with the usual gas absorption system which made it possible to run under water with our steam power, without discharging any exhaust gases; this was the first important invention of the Naval Consulting Board.

But I found the forward torpedo room locked and none on board had gone inside, since they had been ordered by the chief engineer, Dickerson, a man from Parker’s own electrical company, which had built this curious feeler dial out.

(Continued on page 66)
118 VOLTS CAN KILL.
The Ontario Electrical Inspection Department of the Hydro Commission are out hot foot after delinquents who try to work in jobs without permits and convictions are being rendered every week, says a writer in the Electrical Safety Magazine.

One person is to come up before the board for refusing inspector admission to premises and others for not returning to remedy defects on jobs before expiration of inspectors’ notices.

In the City of Toronto, in the month of October, a young man, nineteen years of age, was in the bath-tub and, so far as his parents knew, he was enjoying the harmless and healthful pastime immeasurable. The sounds of splashing and rubbing emanating from the keyhole.

The happy sounds were suddenly interrupted by a deathly shriek, and his parents upon breaking into the room, found him doubled up with the coils of a long portable lamp cord wound round him and the portable lamp in the bath. The lamp was an ordinary brass desk lamp provided with the silk cord.

The cord was worn, showing bare copper spots. What he was doing with a lamp in the bath no one knows.

The bathroom was provided with a brass bracket where he had placed the bath with a portable socket.

Test revealed that 118 volts, 25 cycle current passed through the sides of the fixture itself clear of ground and well insulated from both the grounded and ungrounded sides of the circuits.

The investigations show that he was killed by coming in contact with brazed cord carrying 118 volts. 25 cycle current.

This proves two things: First, that 118 volts can kill, and secondly, that indifference to bare spots on cord is dangerous.

One card of a dollar spent on renewing this cord would have saved a young life, a doctor’s bill, an undertaker’s bill, and the parents’ grief. Is it not worth while? Safety First! Should be the slogan of every user of electric service, whether for half a dozen lamps or for a large institution. Again—when you stand on a damp or wet floor or in a bath-tub, don’t touch an electric switch or fixture!

A LINEMAN’S SHOE THAT WITHSTANDS 20,000 VOLTS.

A leading American maker of linemen’s protective devices, which for several years has been the_object of a marketing, protective shield to cover wires and cross-arms where men are working, has now developed an insulating shoe for electrical workers. Throught their entire life a pair of these shoes, the manufacturer states, will provide the wearers protection against circuits at pressures up to 20,000 volts and will not cause the discomfit of many of the rubber soles.

The short answer to this process similar to that used in making automobile tires. The shoes contain no cement and have no seams, but are vulcanized into a solid piece under high pressure on aluminum molds. No hand work is employed in the process. This method of manufacture makes it impossible for the completed shoe to peel or come apart and presents injury from oil, gasoline or grease.

In order that the shoes may, in the interest of safety and comfort, be all made exactly alike with brown heels, white soles, brown vamps and black tops. The white soles are made of a rubber composition like that employed in certain types of coal miners’ shoes, which have been found to give eighteen months of constant wear.

When this white sole wears thru, a layer of red rubber, which withstands a pressure of 20,000 volts, is exposed. The appearance of the red rubber is a signal or reminder to the wearer that, although his shoes still will withstand 20,000 volts, a new half sole should be immediately cemented on in place.

The brown rubber lining also rests under the white sole. It is this piece of material which is capable of withstanding high potentials. One of these shoes, when tested, was about seven feet above the locomotive, and current is sent thru them as a pressure of 11,000 volts, 25 cycles.

Directly over the engine, which was giving off a medium black smoke, the air seemed to flicker at the rate an electric light would if connected to a 25 cycle circuit. This was only noticeable when the quality of the smoke’s carbon element was just right. That this flickering was not due to the smoke observed in the air; it is clear that the Cresson linen and paper, which lights the western and contains a 55,000 volt pressure, was the flicker, which flickered and appeared.

The cause of this phenomena I attribute to the attraction and repulsion of the carbon particles in the smoke and as the current reversed they were drawn upward and downward for a very short distance, while being dissipated into the atmosphere. The effect was not noticed a few inches above the wire. The weather on January tenth was slightly hazy, with no sun at 3:30 p.m., when this effect was noticed. In bright sunlight it could not have been seen. If my explanation is in error I shall be pleased to have the views of some of your technically inclined readers.

MAKE YOUR PHOTO PRINTS BY ELECTRICITY.

The electric photographer printer illustrated has been brought out for both professional and amateur use. A feature of the device is an automatic switch which is operated only when full pressure is placed on the pad. The pressure pad is placed in position by a hand lever which controls the automatic switch, the light being turned on only when full pressure is exerted on the pad. The light is turned off before pressure on the pad is released, thus avoiding any blurring in the prints and assuring absolute contact. A locking device is provided which relieves the operator of the necessity of maintaining pressure on the lever during the exposing period.

With a slight grip on the release catch, the lever can be retracted. A locking device is also provided, permitting the white light to be turned on and the pressure pad elevated. This allows adjustment of masks or vignettes. In the light box of the smaller printer are one ruby and four clear incandescent lamps, and in the larger one there are one ruby and six clear incandescent lamps. The printers are designed to take 100-watt gas-filled lamps.

PECULIAR ELECTRICAL LIGHTS Used in SAHARA.

By Walter J. Howell.

While standing about one hundred feet away from the tracks of the New York, New Haven and Hartford Railway January 10, 1909 a 100,000 ton train of heavy freight train past at the rate of five to eight miles per hour. The railroad is electrified by overhead wires, which, at this point, were about seven feet above the locomotive, and current is sent thru them at a pressure of 11,000 volts, 25 cycles.

Directly over the engine, which was giving off a medium black smoke, the air seemed to flicker at the rate an electric light would if connected to a 25 cycle circuit. This was only noticeable when the quality of the smoke’s carbon element was just right. That this flickering was not due to the air; it is clear that the Cresson linen and paper, which lights the western and contains a 55,000 volt pressure, was the flicker, which flickered and appeared.

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The electrical lights used in the laboratories of the Edison Illuminating Company of Boston, under the direction of the Illumination Committee of the National Electric Light Association, showed the following characteristics.

"Side of shoe, dry; punctured at 31,500 volts, and again at 34,000 volts; sole of shoe between electrodes in oil punctured at 55,000 volts; 20,000 volts applied from salt water to salt water for one minute and 30,000 volts applied from salt water to salt water for forty-five seconds did not puncture the rubber."
The Washington’s Birthday Relay Prize Winners


by the writer, the necessary notices of which were published in this magazine. The writer did not hear about the Relay because you are not regular subscribers. Let this be a lesson—Get your name down so that you will receive your magazine promptly and regularly.

Now, here comes the sad part. You will see "by the papers," that on this night we had good radio weather as far as the Rockies, but the writer had studied the weather man and looked for trouble south-west and west, and we had it! A healthy young cyclone was dancing merrily over Texas, Arizona, New Mexico and California, and the tail end of a regular old-time "QRM" storm was making life miserable for the boys in the war west, but with it all, 6 EA got the message direct from 9 ZF. 6 DA, who volunteered to help 6 EA, put on full power and promptly blew the fields of his gap motor, leaving 6 EA to do the honors and, by golly, he did.

Seefred Bros. delivered this message to the Mayor of Los Angeles, and promptly received his reply, but QRM and QRN were so bad by this time that it was a physical impossibility to get it thru to 9 ZF. 6 EA stuck to his post, however, and got the message thru the next night, too late for 9 ZF to find anyone out of bed. 9 ZF then arranged for all eastbound amateurs to lie on the job, and the message came thru fine, being delivered to the Mayor of New York by Mr. Geo. E. Cannon, 2 ZK, the next morning early.

Lots of you kept me company by staying up all night waiting for the return message and now you know why it could not get back on schedule. The return message was as follows:

To the Mayor of New York City:

On behalf of the City of Los Angeles,

I return your greetings and wish you continued prosperity. Congratulations to Amateur Radio on the successful message. (Signed) Fred I. Woodman, Mayor of Los Angeles.

By counting up the total time consumed on each message, we call the race between Specials and Amateurs a tie, with the handicap of the low wave length of the amateurs, giving them a slight preference for a decision in their favor, but my former contention still holds—that the amateurs are not yet prepared to handle these transcontinental messages with as great a degree of certainty as the Specials, unless they can get together and have emergency stations in the long jumps.

I am not posing as an expert, but candidly believe that fifty miles, worked absolutely sure, with a great number of relay stations, is more reliable than a few with long jumps, working only when the conditions permit. This is what we propose to do now by organizing the "Q.R.M. League." In it, there will be a chance for all of you to help and not just a few thru-out the country who want to work every night, and who want you to shut up. You know, boys, this good old U.S.A. is a pretty big place and these Relays are run for your benefit, but there are some few in this country who

(Continued on page 61)
Electricity and Life

The Construction of High-Frequency Apparatus for Medical and Lecture Use.

By FREDERICK FINCH STRONG, M.D.
Lecturer on Electro-therapeutics, Tufts Medical School, Boston

In the March number of The Electrical Experimenter the author point- ed out that high-frequency currents, when properly tuned, acted as "Vital Boosters," increasing all the functions of the body and helping it to resist and throw off disease. This vitalizing effect is not due to the mere liberation of heat in the tissues, for it is produced by the very high-voltage ('Tesla') currents as well as by the heavy amperage ('D'Arsenval') currents from which the thermic effects are usually obtained.

When the writer demonstrated the first therapeutic Tesla coil and the first Vacuum Electrode—(in 1896 before a Boston Medical Society)—and suggested that this method was destined to come into general use as a vitalizing agent, he was laughed at by his colleagues; yet to-day there is scarcely a well equipped physician's office in this country or in Europe that does not contain some form of therapeutic high-frequency apparatus. Even the barber-shops of the present time have their small "Violet Ray" outfits; and these are not by any means "fakes" for they produce real results, such as the relief of headache, neuralgia, skin diseases, et cetera.

Unlike other forms of electricity, these currents may be administered to patients with perfect safety. In twenty years' experience in electro-therapeutics the author has never known of harmful results from the use of Tesla currents applied through a vacuum electrode. The heavy amperage ('D'Arsenval') currents, owing to their deep thermic effects, should be used only under the direction of a physician. The writer is a firm believer in the use of Tesla currents in the home—if each member of the family could receive ten-minute daily treatments from a small high-frequency apparatus, the general standard of health would be greatly increased. This has been demonstrated in hundreds of cases. The author has interviewed a number of the more prominent authorities on medical electricity and they agree as to the vitalizing effects resulting from daily high frequency treatment.

Anyone who possesses a ¼ or ½ K.W. wireless transformer, operating on 110 volt, 60 cycle A.C., can easily construct an efficient high-frequency outfit for medical or lecture use. The complete equipment includes a .01 microfarad glass plate condenser, Tesla coil, inductance, spark gap and electrodes.

The Tesla coil is made as follows: (Fig. 3) On a paper mailing tube 2½ diam. and 14" long wind 480 turns of No. 34 D.C.C. copper magnet wire. Set up the tube in the lathe, apply a coat of orange shellac, spin on the wire, apply a second coat of shellac and allow to dry thoroughly. The winding occupies twelve inches, leaving a margin of one inch on each end of the tube. Leads of light auto (ignition) cable are soldered to the ends of the winding. A strip of waxed, corrugated paper 3½ wide is wrapped around the center of the secondary tube and on this is wound the primary, consisting of four turns of heavy high tension auto cable and thoroughly secured by tape; at least a foot of cable should project from each end of the winding to form the primary leads. Place the coil in a wax tilt box made without nails and embed it in a mixture of four parts rosin and one part beeswax. It is safer to boil the coil for an hour in the insulating mixture before placing it in the box.

The greatest source of trouble in a medical high-frequency outfit is the spark gap; the one described below is the outcome of many years experience. If properly made it will run daily for months without deterioration. The spark takes place between two pieces of brass rod ¼ diam. and ¾" long, turned and tapped as shown. The sparking surfaces are turned in annular grooves with a 60 degree tool.

Fig. 1. View of the Strong Conical Oudin High Frequency Coil Delivering a Versatile Tree of Sparks Several Feet in Length.

Fig. 2. Another View of the Strong High Frequency Coil Producing a Perfect Sheet of Flaming Sparks to a Grounded Conductor. The Exciting Energy is but 1 Kilowatt. Your Lathe has an Automatic Cross-feed You May Set It to Twenty Turns to the Inch, and Turn a Spiral Groove Instead of the Annular Rings. After Finishing, the Brass Pieces are Heavily Silver Plated and Mounted in the Usual Manner as Shown (Fig. 4). For Currents over ½ K.W., a Plate of Silver Should be soldered to the Brass before Turning the Grooves. This Gap will also Give Greater Efficiency in Wireless Work as Compared with the Usual Stationary Gap.

The connections for the various parts of the apparatus are shown in Fig. 5. An important feature is the use of an external inductance or tuning coil "d" in series with the Tesla coil. It consists of 32 turns of No. 8 bare copper wire, wound on a frame 8" diam., with ½" between turns. Edgewise wound flat copper strip is better but more expensive. (Fig. 8.) This coil when used in series with the Tesla primary enables us to tune the oscillating system in perfect resonance when the capacity of the patient's body is added to the Tesla terminal. Effects are produced which are impossible with the method. The beautiful High-frequency Effect of brush-discharge, so valuable in treating pulmonary diseases, and which so few modern high-frequency machines can produce, is obtainable by the use of this series inductance. It may also be used, by short-circuiting the Tesla primary, as an auto-transformer from which may be derived heavy "D'Arsenval" and "Diathermic" currents as described in the next article of this series.

For stage demonstration and public lecture work the writer employs a large high-frequency resonator which produces a tree.
A.

IR expands when heated and becomes lighter in weight. If we have a confined body of air such as in a room, for example, and there is a source of heat in the room, the air near the source will expand and become lighter and the heavier air at the top of the room will fall, forcing the lighter air upward. Thus it is that the air near the ceiling is always warmer than that near the floor. This shows the necessity of opening a window at both the top and the bottom for best ventilation.

EXPERIMENT 19—

Fig. 15 shows very simple apparatus which can be made with practically any material available, for demonstrating the behavior of air near a source of heat. C is a box thru which holes have been cut to admit tubes (or glass lamp chimneys). B, A is a lighted candle. The arrows show the direction of the current of air.

EXPERIMENT 20—

An interesting experiment giving surprising results and having a simple explanation can be performed by the use of a spool and a visiting card. (If no visiting card is available, the one from a poker deck which you may have "coy your sleeve," will do very well.) Place the card up against the bottom of the spool as in Fig. 16-A, and then let go of the card. One would naturally expect that blowing against the card would blow it away whereas actually the card stays fast close to the bottom of the spool. Sometimes, when the conditions are not just right, the card slides off perpendicular to the direction in which one blows, but to avoid this a pin should be stuck thru the card's center and thru the hole in the spool (care being taken not to stick it into the wood of the spool). Fig. 16-B shows diagrammatically what happens. The air from the mouth goes thru the hole in the spool and out along the upper surface of the card. It is a well-known fact that the pressure is greatest where the speed is least and vice versa. The air underneath the card is practically still, while that just above the card is in rapid motion, and hence the pressure against the card from beneath is greater than that from above. Hence the card tends to get at close to the spool as possible and does not fall.

EXPERIMENT 21—

In the First Lesson we learned that at any depth in a liquid there is pressure due to the weight of the liquid above that depth. We also learned that air has weight and consequently we conclude that the air (at the surface of the earth) has pressure due to the weight of the air above it. The higher up we go, the less air there is above us and the pressure is less. If one sucks in at the stem of a pipe (see Fig. 17) at the bowl of which is stretched a piece of elastic, the pressure of the air above it pushes the elastic down. Suction is not a mysterious force; it is simply a removal of the air from one side so that the pressure from the other side can act without being opposed. Actually, when the air is entirely removed from the pressure above the elastic sheet is fifteen pounds on each square inch; i.e., the weight of the column of air from the earth's surface to the end of the atmosphere on each square inch of the earth's surface is fifteen pounds. A column of water thirty-three feet high and one inch square weighs fifteen pounds and a column of mercury thirty inches high and the same area, weighs the same (mercury weighs 136 times as much as water).

EXPERIMENT 22—

Seal one end of a narrow tube having a diameter of about one-quarter inch and about fifty inches long. Fill the tube with mercury and invert it carefully and place the open end in a cup containing some mercury. The mercury in the tube will fall until the height of the mercury in the tube is about thirty inches above the level of the mercury in the cup. The same level is kept no matter how long and how wide the tube is. The air pressure on the cup's surface acts against the mercury in the cup and holds the tube filled with mercury to the open end of the tube. Since the tube was filled with mercury and there was no air at the sealed end, we get the same effect as if air was there originally and was sucked out; i.e., there is no air pressure in the tube and the air pressure outside can hold up the mercury to a level of about thirty inches. If now the seal is broken the air rushes in and the mercury in the tube falls into the cup. (See Fig. 18-A.) The pressure of the atmosphere changes from place to place and from time to time. It is, therefore, impossible to tell from what locality a given reading of the barometer show how the weather conditions are. The barometer is nothing but an instrument to measure the pressure of the atmosphere. Obviously our Fig. 18-A represents a crude barometer. It has a great disadvantage is that when carried about from place to place one is likely to spill the mercury. An improved form is shown in Fig. 18-B. The same tube used in A is sealed again, bent at the open end and filled with mercury. The air pressure acting at the open end supports a column in the closed end, so that height in the closed section is thirty inches above the level in the open end. In the commercial form a scale (yard stick) attached so that one can read the levels directly. This form can be carried about more freely without danger of spilling the mercury but is nevertheless cumbersome and inconvenient. The aneroid barometer is much more compact (it can be had even as small as an ordinary alarm clock). Instead of mercury to be acted upon this instrument employs a diaphragm which is moved in and out by the atmospheric pressure just as the sheet elastic was in experiment 21. The motion of the diaphragm is magnified by a system of levers and is communicated to the pointer. (Continued on page 27)
The history of wireless telegraphy repeats once more the old story that is so often connected with great inventions. The world being possed of a new scientific principle, many minds in many parts of the world are simultaneously bent upon its practical application, with the result that the fundamental principle finds embodiment in various methods of accomplishing a similar purpose. The startling nature of the discovery of electric waves was bound to give rise to unprecedented activity in the field of experimental investigation, and such experiments as were particularly successful were bound to prompt investigators to seek patent protection on their modifications, and this in turn gave rise to several systems of radio-telegraphy.

A voluminous list of names could be given of those who have contributed to the advancement of radio-telegraphy in regard to both theory and practise. Among the best-known American investigators are Fessenden, Shoemaker, de Forest, Clark, Stone and Melissie. Each of these men has devised a system which bears his name. In England the work has been carried on by men of such unqualified distinction as Lodge, Alexander, Muirhead, Fleming, Thomson and Rutherford. Slaby, Arco and Braun are the names best known in Germany. The French are represented by Ducretet, Branly, Rochefort and Tissot, besides other men of lesser fame. Italy has contributed largely to the subject, principally through Marconi, Bellini, Tos}, and Righi. Denmark is represented by Poulsen. Spain, Austria, Belgium and Argentina have all produced systems which have been more or less used in their respective countries. The Japanese have also devised a system that successfully stood the test of service in the Russo-Japanese War.

The development of the art in the various countries has been carried on largely by representative investigators, and in many instances the governments have adopted a system exploited by their subjects. The United States government, however, has experimented with most of the prominent systems offered, and, as a result, the army and navy equipment are comprised of quite a variety of apparatus of different inventors.

Wireless telegraphy was the subject of earnest experimentation as early as 1888, but, as far as the public mind is concerned, the science began when Marconi sent his first message across the Atlantic from Cornwall to Newfoundland in 1902. This wonderful accomplishment had so much of the spectacular element in it that wireless telegraphy and Marconi became famous at once and, measured by results, he has eclipsed all other inventors.

Marconi first interested himself in the problem of wireless telegraphy in 1895. In the following year he took out the first patent ever granted in England for a practical system of wireless telegraphy by the use of electric waves. In 1897 he successfully communicated across Bristol Channel, a distance of nine miles. At the invitation of the Italian government, Mr. Marconi subsequently went to Spezia, where his system was put to practical test on board two Italian battleships. A station was erected on
land, and the ships were kept in constant telegraphic communication with the shore up to a distance of twelve miles. Returning to England he made further experiments and succeeded in communicating between Salisbury and Bath, a distance of thirty-four miles.

Mr. Marconi came to the United States in 1899, in connection with the America yacht cup race between Columbia and Shamrock I. In the same year a number of ships of the British navy were equipped with his apparatus. Early in 1901 telegraphic communication was established between two points more than 250 miles distant. In February, 1902, he received, on board the steamship Philadelphia, in the presence of the ship’s officers, good messages on a recording tape when at a distance of over 1,500 miles from the transmitting station. In December, 1902, he established a station at Cape Breton for transatlantic service, and maintained communication with the Cornwall station at Poldhu, transmitting inaugural messages to the King of England and the King of Italy, the London Times and others. A year later, during the voyage of the steamer Lucania, Mr. Marconi maintained communication between the ship and the Marconi station at Glace Bay, in Cape Breton, and Poldhu, in England, and a newspaper was published and issued daily to each passenger. A powerful station at Clifden, on the west coast of Ireland, was opened early in 1907, by means of which public communication across the Atlantic was established, which has been maintained ever since.

The importance of wireless equipment of sea-going vessels has been recognized by all nations, the United States law requiring two licensed operators on any ship carrying fifty or more persons and sailing between 200 or more miles apart. It is estimated that upward of 5,000 ships are now equipped, and a large number of freighters carry wireless for their own protection, although not required to do so by law. In fifteen years wireless has placed to its credit the saving of thousands of lives and property valued at several millions of dollars. It is an inestimable boon to mankind that we can go to sea with the knowledge that we are kept in touch with home and can summon aid in case of disaster by means of the S. O. S. signal.

Radio-telegraphy is a most potent factor for naval, military and airship use in the present war. On July 30, 1914, five days before the actual declaration of war, the English fleet, which had just left Portland, was recalled by wireless; and on August 4, 1914, Germany flung around the world on its chain of wireless stations this vital message to its mercantile marine: "War declared on England; make as quickly as you can for neutral ports!" This first dispatch unquestionably saved Germany many millions of dollars of property and secured for possible future use a fleet of passengers and cargo boats which may yet play a great part in her recovery from war's ravages.

As long distance wireless rang up the curtain on the greatest war the world has yet witnessed, so it has continued to play a great part therein. One of the most striking points in connection with wireless, which has been developed by the war, is that public attention has been directed upon it as never before; owing to the fact that so much of the official communications, particularly German information, has been brought to the notice of newspaper readers through this medium, owing to obstruction of the German cables.

One of the objections made against wireless telegraphy is in regard to the possibility of interference between various stations and the confusion likely to arise when a number of stations are simultaneously operated in the vicinity of one another. Atto this objection does rarely arise in practice with proper up-to-date stations and apparatus, yet even with the old instruments, when it did occur it was not by any means such a serious matter as generally appeared to be. In any case of disaster it would occur with the great majority of ordinary land wire telegraphs which work several offices by means of a single wire. In the case of wireless telegraphy it is often an advantage that any station should be able to pick up a message which may not be actually addressed to it, as, for instance, in the case of a ship in distress calling for assistance. The most practical method of isolating any particular receiver so as to make it sensitive only to signals coming from a certain station lies in the principles of resonance; that is, to tune the sending and receiving circuits in exact correspondence.

When the war broke out a German company had high-power stations in communication between Sayville, L.J., and Nauen, Prussia (3,202 miles), and between Tuckerton, N.J., and Elivese, Prussia (3,383 miles). In order to protect our neutrality the American government took over these stations and is now operating them in the interests of the owners.

The government has erected a high-power station at Arlington, within sight of the Capitol at Washington, with a range of 3,000 miles under ordinary conditions. It represents the first step of the Navy toward the establishment of a great chain of high-power wireless stations to girdle the earth and bring the Navy Department into direct communication with the fleet throughout the length and breadth of the sea. A ship at sea, vessel be in the Arctic, Antarctic or Indian Oceans, it will be at all times within the range of one or other of the 50 high-power stations, the other six of which are to be located at San Francisco, Honolulu, Manila, Guam, Panama and Samoa.

From the Arlington station messages can be sent to vessels stationed beyond the

(Continued on page 77)

Looking Up One of the Towering 450-Foot Tubular Steel Masts, Which Support the Immense Aerials Used to Bridge the Ocean-wide Signalling Spans.

500-horsepower Steam Turbines and Generators in Marconi Trans-oceanic Radio Station.
San Diego—Largest Radio Station in U. S.

By J. BASSETT

The new $300,000 wireless telegraph station at San Diego, Calif., has just been completed and officially put in commission January 26, 1917. It is the largest and most powerful radio station in the western hemisphere. It is capable of flashing messages 12,000 miles. Messages from 300 kilowatt transformers 2,800 pounds each.

Establishment of a distant control system will enable operators at any naval radio station on the Pacific Coast from Point Loma to Alaska to operate its sending instruments by a system of land telegraph lines. The radio apparatus is what is known as the Federal Poulsen arc transmitter and was manufactured by the Federal Telegraph Co., of San Francisco. The Poulsen arc employs a direct current arc of 600 to 1,000 volts, burning in a closed chamber of hydrogen, the terminals being placed at right angles in a powerful magnetic field. Electric current for the radio set is furnished by a 200 kilowatt—1,000 volt direct current generator, driven by a 300 horsepower 2,200 volt 60 cycle induction motor.

Six buildings costing $39,900, in mission style architecture, form the quarters for those on duty. Here we find a large, airy dormitory, gymnasium and well-furnished library. A silver plated telegraph key was presented to Commander Hooper after he had dispatched the first message. The following inscription was on the key: "High Power Radio Service. First Message, Commodore S. C. Hooper, Jan. 17, San Diego." At exactly 11.02 January 26, 1917, Commander Hooper called the station at Arlington and sent this message to the Mayor of San Diego to Secretary J. Daniels:

"In behalf of the citizens of San Diego I have the honor of extending to you the season's greetings and their good wishes and congratulations upon the completion of the new radio station at San Diego. Space has been completely annihilated and the Atlantic and Pacific seaboard are as one."

Arlington acknowledged the message at 11.03 o'clock. It was immediately transmitted by telephone to Secretary Daniels. His reply was returned at 11.38. It was thus:

"Your greetings and congratulations much appreciated. The Navy Department rejoices with San Diego that the completion of the new radio station at San Diego places Washington in closer touch with the Pacific Coast and particularly with the Navy's larger development at San Diego, it must be gratifying to California to know that the apparatus is the product of a California company."

This was followed by a message from Congressman Kettner. It was as follows:

"I congratulate San Diego, first port of call by wireless. Peculiarly, therefore, is the opening of the greatest radio station in the United States made possible by your esteemed firm, B. E. Daniels, Secretary Daniels and Adolph G. Daniels, vice-president of the Federal Telegraph Co., as follows:

"I accept with the felicitation of the Federal Telegraph Co. and myself personally upon the successful opening of this great radio station. It is a great pleasure to us to know that the first example of this remarkable advance in the radio art, which has been developed by us in San Francisco should be installed in San Diego, a sister city."

The radio plant is located in a section called Chollas Heights, ten miles from the business center of San Diego, on an elevation of land, reached by auto.

U. S. RADIO INSPECTORS USE CODE MACHINE IN TESTING APPLICANTS.

All applicants for U. S. Government Radio Operator's License must pass a test in receiving messages in the telegraphic code, i.e., in the form of dots and dashes. The accompanying illustration shows a new complete automatic telegraphic code transmitter, known as the Omigraph, complete with high-note buzzer and exciting batteries, which latter are contained in the base of the cabinet. There are three discs mounted on rolls, and a pin which impels a stylus at the center of each roll. These discs, which are properly notched on their peripheries to correspond with the dots and dashes of the different letters of the alphabet, are the key to the other hand on a rotatable drum or plate, which is driven by a strong spring motor provided with a suitable governor, in order that the discs may be caused to rotate at any desired speed.

The toothed disc makes contact with a special light spring held in the high-note buzzer circuit. Thus, as the discs slowly rotate, the buzzer circuit is broken in accordance with the long and short notches on the edges of the discs. This instrument has been used for a number of years by the government officials in examining applicants for Radio Operator's License and has been found very satisfactory. The messages may be signaled with this apparatus at any speed from 12 words up to 30 words, or more, per minute, thus giving it a wide range of usefulness.

A large variety of code disc are available and the machine may be set up to give different code combinations as often as desired.
WIRELESS OUTFIT ON MOVING VAN TRACES MESSAGE.

After a search of three months for an amateur wireless operator who sent out unsigned "SOS" messages in the neighborhood of New York and caused great annoyance to the New York Navy Yard and navy vessels the federal authorities recently arrested William F. Eckoff, nineteen years old, who had a wireless station on the roof of his home in Brooklyn.

When the messages were first heard there were reports in shipping circles of submarines operating near New York. After several of these calls stations nearby recognized them as the work of an amateur. The New York Herald's wireless station worked with the operators at the New York Navy Yard in an effort to locate the station. The log at the Herald's wireless station shows that these distress messages were sent at all hours of the night. The mysterious operator used the calls of the Navy Yard and naval vessels.

Louis F. Krumm, chief radio inspector of the Department of Commerce, engaged a moving van and installed in it a small wireless set which could detect messages within the radius of only a block. Operators had traced the messages to Brooklyn and, with the moving van, Mr. Krumm went about Brooklyn until he arrived in front of the Court Street house.

It is alleged that Eckoff used a United States code signal on the night of January twenty-first last, sending an "SOS" call which was picked up by the Herald station and relayed to the super-dreadnought Arizona at the New York yard.

Eckoff was arraigned before United States Commissioner Louis Bick and admitted he had been sending messages, but asserted that if he had used the United States code he had done it innocently, for he did not understand the code thereby enough to commit a nuisance.

The efficiency of such portable radio stations has been markedly improved in recent years by the advent of spiral aerials.

An Exceptional Amateur Radio Station

The accompanying photographs show the long distance, uncamped wave receiving set owned by Harvey L. Ganner, Electrical Engineer of Omaha, Neb., with which the amplification feature is obtained by the use of inductance and capacity in the wing circuit of an Audion, then a further amplification with two ordinary Audions and their respective coils and circuits as well as a micro-phone arrangement leading to the recording machine.

The large loose coupler was designed to tune to wave lengths up to 15,000 meters when used with this particular aerial system.

SECRETARY OF COMMERCE SUSPENDS ISSUING OF LICENSES

Issuing of licenses for amateur wireless apparature was suspended on March twenty-seventh by Secretary Redfield. Virtually none of the amateurs have sending equipment, so the military and naval authorities have not considered them a source of immediate danger, but Mr. Redfield decided that no more should be licensed for the present. Sending wireless plants are under the strictest possible surveillance now, and if a state of war is declared efforts will be made to locate apparatus of every description.

Many of the amateurs now licensed by the Government belong to the Navy radio reserve and will be called upon to perform certain duties in war.

TO TEACH GIRLS WIRELESS

At a meeting of the National Special Aid Society recently, a school offering a course in wireless telegraphy for young women was organized. Instruction will be given at the society's headquarters, 250 Fifth Avenue, New York City.

Miss Daisy Florence, chairman of the new branch, urges that all young women who would like to take up this class of work send in their applications. E. T. Bick, a New York radio expert, has been retained and will have entire charge of the classes. This new department, the society says, is the first of the kind.
How the Audion Repeater Repeats

A Twentieth Century Fairy Tale, Wherein the Mystery of the Audion Relay Is Explained for the Benefit of Radio "Bugs" of All Ages—From 9 to 90

You all remember that unlike polarities of electricity attract each other while like polarities repel, and so if the gridiron is made negative to the filament the electrons will be repelled by it and get thru between the slats; in fact, if the slats are too close together no electrons at all will hit the plate. The effect would be the same as tho the slats in Fig. 2 were entirely closed.

It is generally known how the sound waves produced by a speaking tube and telephone line; and you have only to imagine these pulsations of current coming to the induction coil "F" at the left side of Fig. 1. These pulsations are, of course, very weak because of the long line over which they have traveled and the purpose of the repeater is to amplify or strengthen these pulsations.

Now, while it takes considerable power to open and close the slats of a window blind, especially if you painted them yourself last spring, the operation of the electric shutter is facilitated by the experts and even the weak impulses of speech transmitted over 500 miles of line have sufficient voltage to give the desired results so that as each increase or decrease of current raises or lowers the negative potential of the generating "G" more or less electrons each with its infinitesimal charge of electricity get thru from the red-hot filament to the plate and give the exact same, but much stronger, impulses of current from the plate to the induction coil at the right side of the picture, and so on out on the line for another 500 miles, the amount of additional push put in the impulses, depending on the strength of the battery "F".

Now you are probably wondering why this apparatus is put in a glass case. The reason is that the scheme will only work in a very good vacuum because a clear space is necessary for the electrons to travel in. You must remember that everything, even an invisible gas, is composed of atoms, so that there is no air or any kind of gas in the space between the filament and the plate, the electrons would bump the atoms of the gas while the daemons might put a good many across, the number would not be constant from minute to minute, depending on how successful they were in dodging the atoms and the result of this would be a jerky current which would entirely mask the telephonic pulsations. Therefore, in order to obtain the required accuracy of control of the rate at which the electrons strike the plate, it is necessary to have a clear space between the filament and the plate every loose atom that is physically possible to get hold of is removed.

This is so important that our highbrows have developed an extremely interesting method of inducing daemons themselves to rally to the cause of science, but that is another story to be told when you have recovered from this one—"W. E. N."

The Above Illustrations Help to Make Clear the Most Simple Manner, the Action of the Audion—That Mysterious Radio-Electrical Device. Considering the Top View, Just Imagine That the Hot Filament Upon the Ladder (the Filament) Starts Throwing Pebbles Thru the Moveable Slats (the Grid) at the Target (the Plate). How Do They Get the Pebbles?—Oh! Well...Read This Remarkable Tale.
THE Ionic Radio System and Theory of Ionic Tuning

By Otto E. Curtis
Associate Member of the Institute of Radio Engineers

The Ionic Radio System is a development of the methods of Mr. Curtis, as Described Herein.

The apparatus illustrated in the photograph is made up as follows: The device shown in the upper left-hand corner is a Multi-sound-ionic pocket wireless set. The wooden base in the lower left-hand corner carries two of my Ionic detectors constructed as shown in Fig. 5, and as hereinafter described, the one on the left comprising a zinicite crystal and the one on the right a silicon crystal. The rectangular instrument in the center is a Weston relay, which comprises an extremely sensitive galvanometer having a very short needle which, when deflected, contacts one of the platinum-iridium points disposed on opposite sides of the needle. The instrument on the right is an E. I. Co. polarized relay of 1,000 ohms resistance which may be connected to an indicating or recording or other device such as a buzzer, tape recorder, motor, lamp or explosive device.

In the accompanying figures, Fig. 1 shows the circuit connections for the apparatus shown in the photograph, the various instruments being diagrammatically illustrated in the figure in the same relative positions as in the photograph for the sake of clearness. The antenna is connected to ground 2 thru the primary 3 of the Multi-ionic, or sound, transformer 4, of which is arranged to be connected to the Weston relay by means of double throw switch 5 either thru detector 10 or thru detectors 7 and 8. When the switch 9 is to the left, 7 and 8 being connected to the secondary 4 by leads which are not shown. The circuit connections as occurring when the switch 5 is in upper position, are shown in simplified form in Fig. 2, reference to which may be had in following out the operation.

The alternating current of radio frequency received by the open antenna circuit 1-2-3 is induced into the secondary circuit, where it is rectified by the detector 10 and conducted to the Weston relay 6. This produces a deflection of the relay 6 which in turn closes the local circuit containing the polarized relay 11 and source of e.m.f. 12. This actuates relay 11, which closes the circuit thru a second source of e.m.f. 13 and the indicating, recording or power apparatus 14. By employing one of my improved Ionic detectors at 10, very feeble impulses may be detected; and by employing a series of relays in the manner described, the feeble impulses may be magnified to any desired extent, each consecutive relay controlling a heavier current so that the last circuit 11-13-14 may comprise a power circuit carrying current of any strength.

When using the machine for lecture purposes, with the sender in the same room a "Hertz" line resonator is used instead of an aerial and ground, as shown in Fig. 3. This consists of two 3/4 inch brass rods fitted on adjacent ends with brass balls of equal size and separated a short distance, this distance being a direct ratio to the length of the spark gap of the sender. The free ends of the rods are fitted with the moveable metallic plates 15. Moving these plates together with the similar ones on the oscillator of the spark gap tunes the system. This "resonator" serves the same pur-
Receiving Marconi 300 K.W. Spark Stations with Oscillating Audion

By SAMUEL CURTIS, Jr.

It is a widely known fact that the Marconi Wireless Telegraph Company has in operation a number of 300 K.W. spark stations, used for the purpose of handling their enormous traffic between different countries. The stations of this character which are actively engaged, to my knowledge, in transacting business at the present time, are: Clifden, Ireland; Glace Bay, Nova Scotia; Boli- mas, California; Koko Head, Hawaii, and Funahashi, Japan.

The wave length used in transmission ranges from 4,000 to 8,000 meters, but the most common is 6,000; this is used extensively at the Koko Head and Bolinas stations.

In receiving the signals from these stations, any Audion receiver capable of attaining the wave length may be used, and it may be well to state that the undamped wave receiver described on page 575 of the May issue of The Electrical Experimenter has been used in this respect with marked success. The writer wishes to state, however, that since the publication of his article relative to this receiving set, a fixt condenser of .005 m.f. has been added to the circuit. This is hooked up across the telephones and high potential battery of the Audion, and by its use allows the bulb filament to be burned at a much lower brilliancy, and yet get strong oscillations therefrom.

It is, of course, easy possible to receive these stations on a crystal detector, but unless a very large antenna is available, this cannot be accomplished over any great distance. It has been found by experiment that a heterodyonic action on the incoming signals produces a remarkable increase in audibility, therefore making it feasible to incorporate the use of an oscillating Audion in this respect.

The series of graphs shown in Fig. 1 clearly illustrate the character of the momentary currents produced by a feebly damped wave train, in the circuits of a receiver during the process of heterodyning. In graph "A," we have the feebly damped wave train, such as is sent out by the above mentioned high-powered stations. In graph "B" we have the local or Audion oscillations, which are used in heterodyning the wave train of graph "A." These Audion oscillations are tuned to a frequency either higher or lower than that of the incoming or audible note, and the result obtained in the telephones. In graph "C" we have an illustration of the current produced, a direct result of the coincidence of the wave length of the one, with or, heterodyned each other. In graph "D," the frequency of the wave train is increased in some detail, that the tone of this current in the telephones is proportionate to the difference in frequency of the incoming wave, and the frequencies of the oscillations. In this case, a wave length of 6,000 meters would have a frequency of 50,000 cycles. In order to get an audible note of 500 cycle pitch, we would have to have an Audion frequency or a frequency of 49,500, or 50,500 cycles. This is assuming that we are heterodyning an undamped wave. Of course when a damped wave is heterodyned, it cannot be expected that a pure note will be obtained, owing to its irregular form. In actual practise the note obtained in heterodyning the Marconi signals is very near the same as that obtained by using a crystal, only a little distorted.

The beauty of the use of the heterodyne reveals itself in an astonishing increase in the amplitude of the telephonic current, as illustrated in sketch No. 2. It can be seen by observation of this sketch that the mere rectification of a wave train does not in any way amplify it. Now, if the same wave train is heterodyned, an increase in amplitude similar to that illustrated in sketch No. 3 is obtained. The reason for this is best explained by the fact that in the mere rectification of a damped wave train, only the first few oscillations are utilized, and the rest of the energy is hopelessly wasted away. In the heterodyned wave train, to heterodyne action practically all of the energy is utilized, manifesting itself in an enormous increase of audibility. To those who are more or less familiar with the action of the heterodyne, this brief explanation will suffice, but to go into a detailed discussion and graph would be out of the scope of this article.

It might be of interest for the reader to know that at the present time, at a certain experimental station on the Atlantic Coast, signals are being received daily from the Marconi station at Koko Head, Hawaii. The equipment of the station is described in the December issue of this journal with the single exception that an Electron Relay is used instead of the usual spheric Audion bulb for producing the oscillations. Glace Bay, Nova Scotia, comes in with remarkable audibility, while Bolinas, California, and Funahashi, Japan, have not as yet been picked up, but it is expected that in the near future Clliden will be copied, as this station is not nearly as far distant as Koko Head, who is read in the daytime in good weather. The aerial used at these stations is a damped wave train. A damped wave train has a natural period of 276 meters, and is none too elaborate.

The results made possible by the oscillating Audion in heterodyning waves are not however confined to such long waves as are used by the Marconi stations. With careful attention to the use of low restistance inductances, the Audion can be made to oscillate on 200 meters or less, depending of course upon the skill and perseverance of the experimenter.

No one can fully appreciate the efficiency of such a method of reception until he has actually used it himself. At the present time there are a number of "regenerative" receivers on the market. These instru-

ments are without a doubt the peer of anything in their line, but for many experimenters the price of such an outfit is prohibitively high, and the chances are they have to do without. One advantage, however, is that these receivers are not so intricately designed as to make it impossible

for the experimenter to make one for himself. This is being done with great success by the amateur operators throughout the country. If the reader cares to take the trouble to consult page 575 of the December issue of this magazine, he will see a neat little Auspernograph given in set "B" of the diagram on that page. Set "A" is used for long waves, and set "B" for waves from 200 to 2,500 meters.

[We are informed by Mr. Curtis that in some tests conducted in the laboratories of the General Electric Co., at Schenectady, Dr. White has succeeded in making an Audion oscillate (heterodyne action) on a wave length as low as 1/4 meter. Of course this requires some elaborate tuning and even more elaborate apparatus.—Ed.]

RADIO EXHIBIT AT NEW YORK AERO SHOW.

At the recent Aeronautical Exposition held in New York City, serious consideration was given to radio equipments for aeroplanes and balloons. A large space was set aside for the exhibition of different types of sets, such as are used now in the European countries for directing the artillery from aeroplanes, for interfering with stations and for long distance communication to be used by observers. Models of the different types of wireless equipments using direct and alternating current generated by small dynamos which get their power from the air by means of a small propeller were shown. The Marconi Company was invited to exhibit the set which was recently purchased by the Aeronautical Department for hydroaeroplanes. This instrument has one K.W. capacity and it is stated that it is capable of sending up to 30 miles will be obtained. That is to say, the apparatus has a range for a radius of 300 miles. The total installation will come within 100 pounds. Other sets made by the Sperre Gyroscope Company, De Forest Radio Telephone & Telegraph Company; William Dublier, Wire- Speciality Apparatus Company; Cutting & Washington, Indianapolis Electric Specialty Company and Mr. A. B. Cole. The wireless operators were supplied by the East Side Y.M.C.A. under the direction of Mr. Boehm.
Distributed Capacity and Its Effect

By SAMUEL COHEN

Distributed capacity may be defined as the capacity existing between turns of a helical coil. It may also exist in straight conductors where the electrostatic capacity is between the conductor and the earth, or between two adjacent conductors.

It can be shown by actual experiment that a difference of potential exists between adjacent turns. This potential difference creates an electrostatic field and energy is stored between the conductors.

A condenser is a device which stores electrostatic capacity. It is evident therefore that a condenser is formed, the plates of which are the adjacent conductor turns. The capacity is stored in the space between each turn of the coil and all turns, therefore the capacity is distributed over the entire conductor.

Referring to Fig. 1, it will be seen how distributed capacity is related to coils. Increasing the length of the coil, increases the distributed capacity as it is seen that the number of condensers are increased. Since increasing the number of condensers in parallel increases the capacity, therefore we may consider all the parallel condensers as one large capacity shunted across the inductance, as indicated in Fig. 2.

When capacity and inductance are linked in a circuit we have an oscillatory circuit, and the period of vibration of such a system is directly proportional to the square root of the product of the inductance and capacity multiplied by a constant. Expressing the above in an algebraic form we have:

$$n = \frac{1}{2} \sqrt{L \times C}$$

Here $n$ = period of vibration of the system. The wave length of the above current is:

$$L = 90.6 \times \frac{1}{\sqrt{C}}$$

Here $L$ and $C$ are the inductance and capacity.

It is evident therefore that since the coil has distributed capacity that the coil is an oscillatory circuit in itself, and it was found by actual experiment that when properly excited by a high frequency current, it will oscillate, the period of which depends upon the magnitude of the units of inductance and capacity.

The true wave length of a circuit containing a large inductance and shunted with a capacity is not the same when calculated with formula (2) but the exact wave lengths will be as expressed in the following relation:

$$L = 90.6 \times \frac{1}{\sqrt{C}}$$

where $C$ is the capacity of the shunted condenser and to it we add the distributed capacity of the coil $L$. Solving for $L$ we have:

$$C = \frac{L}{90.6}$$

Calling the total capacity $C_t$ equation (4) becomes:

$$C_t = \frac{L}{90.6}$$

It has also been found by actual experiment that whenever a large coil was excited by radio frequency current it will oscillate in its own period just the same as a coil shunted with a condenser and excited. The current and voltage relation of this coil is exactly the same as for a 1 hertz oscillator, where the current value is a maximum at its center and minimum at the ends, while the voltage is maximum at the ends and minimum at the center.

Fig. 3 shows graphically this relation of the coil.

The best means for determining the distributed capacity is by actual measurement. The essential instruments necessary for this kind of work are calibrated inductance and capacity which may be obtained from a wave meter, a high frequency buzzer and an additional condenser. The instruments are connected as indicated in Fig. 4. The coil under distributed capacity is to be determined, is placed in a single loop of wire $L$. Fig. 4, which is excited by the buzzer. Placing the wave meter inductance $L_y$ near the excited circuit the condenser $C_y$ is turned for indicating resonance. When the point of resonance is obtained the period of vibration of both circuits are the same $T = T$. Substituting the observed values in the equation,

$$C_y = \frac{L}{90.6}$$

Arrangement of Apparatus for Measuring the Distributed Capacity in a Coil. A Buzzer Serves for Excitation of the Coil Under Measurement. While a Wave Meter is Used to Ascertain the Wave Length of the Coil.

Where $L_y$ = the inductance of wave meter coil in centimeters.

$$C_y = \frac{L_y}{90.6}$$

It is advisable before starting to measure the distributed capacity of a coil, to determine beforehand the magnitude of the figures so as to enable us to procure approximately the proper inductance and capacity in the wave meter circuit. It can either be found by judging it from experience or else by actually calculating its value. An approximate formula has been derived by Drude for the calculation of the distributed capacity as follows:

$$C = \frac{h}{2} + \frac{h}{2} + \frac{\pi}{2} + \frac{\pi}{2}$$

Where $h$ and $\pi$ are the length and radius of the coil respectively. The constant $L$ is obtained from the following table, which is for air core coils.

<table>
<thead>
<tr>
<th>$h$</th>
<th>$K$</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>1.810.10</td>
</tr>
<tr>
<td>5</td>
<td>1.640.607</td>
</tr>
<tr>
<td>4</td>
<td>1.740.40</td>
</tr>
<tr>
<td>3</td>
<td>1.370.20</td>
</tr>
<tr>
<td>2</td>
<td>1.200.10</td>
</tr>
<tr>
<td>1</td>
<td>1.120.050</td>
</tr>
</tbody>
</table>

Having determined the distributed capacity of a coil, what are we going to do with this? The only thing that we are trying to do with it is to decrease its value in the coil as much as possible. There are several methods of decreasing the so-called dead-end effects in radio coils. The best and most practical way is to disconnect the portion of the winding which is not in use and this is what may be accomplished by employing a special switch arrangement on the coil. A highly ingenious switch which serves the purpose very nicely was described in the "Question Box".

(Continued on page 65)
A "WIRELESS" AUTO RADIATOR EMBLEM FOR AUTOS.

The base of this nifty and appropriate auto emblem is made from an irregular shaped piece of wood, 1½ inch thick and about 8 inches long, by 3½ inches wide at the broadest end. The rocky effect is ob-

ained by mixing thin glue and plaster of paris and water to a thick paste and moulding it on the base, which has several quar-

ter inch holes bored through it, to give the plaster a secure foundation. Papier-mâché is very good for the purpose as the base can very well be moulded from white metal or lead and afterward painted. The radio masts and connections will then, of course, have to be especially well insulated. The coil and condenser must be kept close to the spark gap.

One of the masts is 8 inches long and the other 4 inches long, made of 3/16 inch brass or steel. The longer one is sunk into the plaster about two inches and the shorter one about 1 inch. The spreaders, 1/8 by 2½ inches, are equally divided for the four wires which are No. 24 bare copper. The lead in rattle is soldered to the middle of the aerial. The insulators are made by mixing tinfoil and gums of silk cord are put on, also a station constructed of cardboard is placed at the base of the taller pole. The whole, except the aerial, is given two coats of enamel, the poles being white and the ground and rocks of

A Study of the Law of Response of the Silicon Detector

THE special form of silicon detector receiver designed by E. Merritt for use with short electric waves, and reported upon at the meeting of the Physical Society, Feb. 27, 1917, showed cer-

tain peculiarities which made desirable a further study of the device. The investi-

gation described in the following paper by Louis S. McDowell and Frances G. Wick in the Physical Review, includes, first, a study of the receiving device and the condi-

tions under which it can be utilized to best advantage, and, secondly, a study of the law of response of the silicon detector with a variation in the energy of the incident wave produced by the rotation of a screen of parallel wires.

The oscillator, receiver and screen were arranged as shown in diagram. The oscil-

lator S consisted of a small spark gap in kerosene, extended by two straight alumi-

num wires, 81 cm., and connected thru water resistances, H1, to the secondary of a small automobile induction coil, K, using about 6 volts. The water resistance was used to damp any oscillations from the coil which might have produced disturbances.

The receiver consisted of a silicon detec-

tor, D, in the form of a rubber or cardboard con-

denser, C, of 1 mf. capacity, and with a loop of wire, N1. The connections to this loop were made by mercury cups, J, and a sensitive galvanometer, Gal. Leeds & North-

rup type H, was shunted around the condenser. An aluminum rod, OP, acting as a resonator, was placed parallel and close to the outer wire of the loop. The length of the resonator was 44.3 cm., giving

the loop an inductance to the wavelength used, about 100 cm.

Between the receiver and the oscillator and parallel to them was placed a screen, EF, which could be rotated thru known angles. It consisted of iron wires stretched parallel to each other about 3 cm. apart, upon a wooden frame 2 metres square. An additional piece of tin and wire net-

ting, JAB, 3 metres high and 4 metres broad, completely divided the room, except for an opening, ABE, left in the center. The rotating screen was placed close to this opening, on the side toward the receiver, at distances varying from 5 cm. to 10 cm. for different sets of observations.

Merritt, in his experiments with the recei-

ving device, had noted that when the screen was placed parallel to the loop of the oscillator, the position which should allow no transmission, there was still con-

siderable effect upon the receiver, amount-

ing at the least to about one-fifth of the maximum effect, when the wires were verti-

cal (the position for complete transmit-

ting). The cause of this residual effect was unknown. He observed that as the screen was rotated thru 360 deg., there was a variation in the response in the different quadrants. Early in the present experimental work it was found that when the resonator OP, Fig. 1, was removed the receiving apparatus still re-

sponded, although weakly, to waves from the oscillator. The receiver was then studied in order to discover what changes in the design would affect the response without the resonator, and how it could be reduced to the minimum consistent with sensitiveness of the receiver as a whole. Also to discover the cause of the residual effect when the screen was in the position of no transmission. Experiments were made with the plane of the receiver both vertical and horizontal.

Receiver in the Vertical Plane.

The receiver was mounted on a T-shaped board and suspended by rubber bands from a cross-bar rigidly fastened to the ceiling. To prevent reflections, practically re-

movable metal walls were taken from the room and from the adjoining rooms. To reduce any difficulties arising from reflections from surrounding metal objects, the room was completely divided cross-wise by the first screen described above, and the ro-

tating screen was placed in front of the

Circuits of Miniature Radios System Used as Radiator Decoration for Autos. Be Sure to Show Your Credentials to the Village "Con-


Miniature Radio Transmitter and Receiver, Constructed by E. F. G. E. Larsen and By Which Means the Law of Response of the Silicon Detector Was Studied.

opening. The residual effect was then found to be considerably reduced.

The screen was then rotated thru 360 deg. and readings were taken every 20 deg. both with and without the resonator. From the observations made three curves were plotted, which represent the ordinates were galvanometer deflections and the abs-

issae the angles between the parallel wires of the rotating screen and the ver-

tical.

The curve obtained with the resonator had a maximum at 15 deg. and a minimum at 100 deg., whereas without the resonator

good maximum at the receivers, also, was obtained. Curves taken out of doors were similar in form to those obtained indoors.

To determine the effect of the design of the receiver upon the response without the resonator, series of observations were made with loops of various shapes and sizes. To determine the effect upon the receiver when the screen and the receiver were screened by a tin cylinder up to the mercury cups MM. To test the re-

sponse to the vertical and horizontal com-

(Continued on page 72)
Auxiliary Relay Break for Coherers.

While the coherer is used but little in modern radio-receiving sets, still, it is quite inculcable in making wireless demonstrations at lectures and for other radio control experiments.

The principal troubles developing in the operation of the filings coherer is that, it is so extremely sensitive to every little spark discharge in its immediate neighborhood and it is invariably found that the sparking at the relay contacts or at the decoherer contacts, will set up oscillations which will pass along the connecting wire of the coherer circuit and tend to act on it the same as an incoming wireless wave.

This trouble is overcome to a great extent by shorting the relay and decoherer contacts with high resistances, of the order of 2000 to 4000 ohms (wound non-inductively), and also by the insertion of choke coils in the lead wires between the coherer and main relay.

However, there is another scheme, not so well-known, perhaps, and which works very favorably indeed with the above purpose in mind. This consists of an auxiliary contact on the relay or decoherer, which so functions that the coherer circuit is opened as the relay or decoherer circuit "breaks," and thus the possibility of locally produced oscillations affecting the coherer are greatly reduced. Choke coils are not necessary with such an arrangement, but if used as an extra precaution, they can be made up of a hie, soft iron wire core 4 inches long by 1/2 inch diameter, wound with four layers of No. 20 gage insulated magnet wire, connected as shown in diagram.


This is a handy "hook-up" for those using an automobile ignition coil with three terminals, one of them being common to both primary and secondary. By using this connection scheme with an ordinary terminal of the coil to the ground wires; otherwise a severe shock will be received if the uninsulated part of the key is touched while sending.

Contributed by GÉO. F. HARRINGTON.


In the protection of radio frequency apparatus one of the most important points is the insertion of choke coils to localize properly the radio-frequency energy. I do not think it is as fully appreciated as it should be that multi-layered coils are almost useless for this purpose, says Benjamin Liebowitz in the February, 1917, Proceedings of the Institute of Radio Engineers.

Because of their large effective distributed capacity, radio frequency currents are propagated with great ease thru such coils, and often with disastrous results. Thus, in one instance, I employed as a choke coil an inductance of about 600 turns of number 18 B. & S. wire wound in 30 turns per layer, and burned out a generator in consequence. I replaced this coil by six single-layer spirals, about twenty-four inches (41 cm.) in diameter, wound over a wire spool having eighty turns of copper ribbon 0.50 by 0.01 inch (1.27 by 0.025 cm.) in section, insulated with paper ribbon of the same section. The single-layer coil series had somewhat less inductance than the multi-layer coil first used, but to currents less than 1000 amperes (A.) or so, they were an almost perfect barrier. It cannot be too strongly emphasized that distributed capacity is just as undesirable in choke-coils as it is in radio-frequency circuits.

A "Coin" Radio Detector.

Wireless Bugs, try this on your detector. Procure a ten cent piece; if not handy try five cent piece. Put either of the coins in the detector; pick up rod to adjust it for a sensitive spot, as you would with galena. If your are not satisfied with the results, try another coin.

The writer has experimented successfully with both coins, but prefers the DIME as it does finer work than the NICKEL.

(Evidently quality varied, dime's are said to be more expensive than nickels!) Next!!!—Editor.)

Contributed by WILLIAM MILLER.

Singing Spark Interrupter.

Many amateurs, like that King of long ago, have muttered "My kingdom for a real musical sound!" Combined with the stuttering, stammering interrupters usually attached to small spark coils, the mere note stamps them as beginners and the big fellows don't want to bother listening to the low-pitched code emitted from such stations.

But a great obstacle lies in their path in obtaining the oft wished for, high pitched note. Besides the mechanical difficulties there remains the fact that when the interrupter is speeded up, the range is shortened, due to the fact that the core of the coil does not become thoroly saturated with magnetism in the short time that the circuit is closed, with the result that the induced currents in the secondary circuit are not as powerful as they should be.

The interrupter described herewith does away with mechanical difficulties in a simple and effective manner, the only care for the above mentioned condition being to increase the voltage of the supply current, fly doubling the voltage very good results will be obtained with the following device.

The regular interrupter is removed from the spark coil and mounted on a conveniently sized base. Two uprights are cut from 1/8 inch thick brass 4 inches long. Both ends of these rods are drilled and tapt for an 8-32 screw. One-half inch from one end of each rod a 1/8 inch hole is drilled to pass the two small round rods illustrated. The square rods are mounted on the base as shown. The round rods put into place while screws, S, S, clamp the latter in position. The end of the interrupter spring is covered with small strips of mica held in place by thick celluloid. This mica is to insulate the spring from the length of German Silver wire which passes under the spring and is wrapped around the two small brass rods as illustrated. The wire used may be No. 26 or No. 28 Bare German Silver. The wiring under the base is shown in dotted lines. To adjust, turn the vibrator screw until it raises the spring slightly, press the key and slowly turn the vibrator screw down till the desired note is obtained.

The operation depends upon the expansion and contraction of the wire which takes place at an unbelievably high rate of speed. The note obtained is very musical and in connection with the higher voltage in use, will increase the range of the set.

A Drum Type Antenna Switch.

Hereewith is a diagram of an aerial switch for use in small stations. It is of the rotary drum type as seen. By referring to Fig. 1, it will be noted that the parts are numbered as follows: 1—binding posts; 2—electrode knob; 3—wooden cylinder; 4—brass segments on cylinder; 5—brass contact brushes; 6—box (wood or rubber 4x3x2 inches). The best job is made by using a hard rubber cylinder, supported on two small pins as shown at Fig. 2. The current for A and G is then carried thru the two shafts to segments 4.

Contributed by HarolDi Davie.
An Electrical Paradox or Selective Lamp Controller

BY ALBERT H. BEILER

THE average person is always interested in a puzzle. When that puzzle is electrical, it is certain to appeal to the amateur experimenter. Can any of you think of an arrangement by means of which a single pole, single throw, knife switch may be made to operate three different lamps individually, during three successive inter-

vals that the circuit is closed? For example, if the switch is closed once, light No. 1 will light and remain lit until the switch is opened again. It will then go out. If the switch is again closed, light No. 2 ONLY will light and remain lit until the circuit is again opened. Similarly with light No. 3.

To secure the result described, an arrangement is employed somewhat similar to that used on the automatic block signaling systems of single-track electric railroads, and elsewhere. A commutator is made to move from one contact segment to another every time an electromagnet draws its armature down (or up).

Referring to Figs. 1 and 3, when the circuit is closed, the magnets attract the armature, pulling it down. The hook C catches over a tooth of the ratchet wheel R. By noting the direction of pitch of the teeth, it will be seen that the movement of the hook will not cause the ratchet to move. The ratchet is rigidly attached to a shaft B, on which a gear wheel K is also firmly fastened (Fig. 1). This cog meshes with a smaller one, J, which is tight on shaft A.

A wooden cylinder, G, is fixed on A, which has brass segments fastened along its periphery as shown at E. It will be seen that E touches one of the brass strips L. This closes a circuit and lights a lamp. If some means could now be employed to move the wooden cylinder 1/8 of a revolution, another segment seen slightly under the middle brass strip would touch the strip, while the ratchet makes 1/12th of a turn, K will also turn 1/12th of a revolution. Thus the third of a revolution movement, which is necessary to bring each segment under its respective contact, is accomplished.

It is possible that the reader who has followed this explanation carefully will ask why the movement of the ratchet should be accomplished by the retractile spring T when the magnet exerts a greater force. In other words, why should not the segments change on the down stroke of the armature instead of on the up stroke? The answer is this: Suppose the commutator turned if a circuit was closed instead of when it was opened, then, for an instant the lamp would light which had just previously been lit. It is true that almost immediately it would go out and the required lamp would light but the result would very obviously be unsatisfactory. The time taken for the cylinder to commutate would be the time required for the magnets to pull the armature down. As this does not occur instantaneously, the above described result would occur. Another objection to having the commutator rotate on the down stroke of the armature is that a segment and a brass strip, each carrying current, would be separated from each other by the movement of the commutator and create a spark which would soon pit the segments and brass contacts and thus interfere with the satisfactory operation of the device. With the device arranged as just described the commutator moves an instant after the circuit has been opened, thus preventing any arc from forming.

The wiring diagram is shown in Figure 8. B B B are the strips 1 of Figure 1. C represents the commutator segments. M is the electro-magnet. R is the rheostat, made of salt water with carbon electrodes, or sulfuric acid, and carbon or lead electrodes. Two 100 watt lamps in parallel may be connected in series with the magnet instead of the rheostat. The magnets must receive from 1 1/2 to 2 amperes, since they have quite a pull to make. The smaller circles B show where the wires from the device are connected to the binding posts seen in Fig. 1.

Anyone sufficiently interested may make one of these contrivances by following the diagrams and instructions which follow.

Secure an old telegraph sounder of the sort that is generally sold to amateurs for practising telegraphy. Uncrew the parts from the base and mount the frame, mag-
nets and armature on 4 columns consisting of six ½ inch fibre washers, the whole being mounted upon a suitable backing of 9 inches by 6 inches oak (Fig. 3). The piece L is of ½ inch brass 8 ½ inch long and is threaded at both ends so as to receive the adjusting screw of spring Y at one end and a screw that holds L to the base at the other end. One small 8/32 inch stove-bolts, Q, hold the frame of the sounder to the base. The machine screws to hold the magnets must be 2 inches long in order to guide the wire thru the armature, so that the same may be shaped as in Fig. 2. A fret saw may be used to cut it out with, but any one at all handy with a file can shape the hook quite as well.

Now remove the armature of the sounder bypressing the embellishments outwards. Drill and tap a hole for an 1/8/32 screw ½ inch from the end of the armature shaft (Fig. 7). Slip an 8/32 machine screw into the upper hole of the hook and screw it into the armature so that the hook swings freely but has very little play. Lock the bolt on the other side of the armature by nut M. The armature is then as in Fig. 3.

The commutator is made from a small wooden cylinder having a hole bored thru it longitudinally. Brass segments are screwed round it, in a manner to be described. The author found considerable difficulty in securing a cylinder of suitable size, but he finally used one of the small wooden rollers on which the paper for adding machines is wound. Such a cylinder is ½ inches long, ½ inch in diameter and has a 7/16 inch hole thru it, and will answer very well for the purpose.

Cut a piece of 1/4 inch brass as shown in Fig. 9 and drill small holes near the centers as indicated. The brass is attached to the cylinder by small ½ inch brass screws. Screw one segment of brass down on the cylinder over one end, then bend the brass around the cylinder and screw the second segment on. A reference to E and G of Fig. 1 will serve to make this clear. Before screwing the last segment down, drill a small hole diametrically thru the roller to meet the central hole, and pass a thin wire thru it so that the wire is underlaid with the last segment. The other end of the wire should come out thru the last hole in the cylinder. It will now be evident that there is no chance for the protruding wire to every commutator segment.

The shaft for the commutator is made of 7/16 inch steel or brass. They are threaded at the lower end so as to be held down to the base by nuts. U should be about 3 7/8 inches high and Y, 2 1/2 inches. Eighty-eighths inch from the top of Y, drill and tap a hole diametrically thru it, to receive an 8/32 spring adjusting screw. On U solder a cross-piece which may be an adjusting screw and lock nut X in it. Place U so that when it is screwed down, X will touch the center of the base. The base is directly in front of the ratchet, but far enough away so as not to interfere with the ratchet's operation.

The parts are now ready for assembling. First put the armature shaft back into its supports. Then place the small bearing X in such a position that when the ratchet hook is put on the shaft and the shaft into the bearing the hook will engage a tooth of the ratchet, having the direction of pitch of the ratchet as just shown in Fig. 3 and not the reverse way. When the position of bearing and of the ratchet have been determined, put the latter on shaft B in the required position, and also solder cog K to B, about 1/16 inch from the end of the shoulder. Bearing X may now be screwed down.

After a little experimenting to place the bearings in such a position as to make the parts turn with as little friction as possible, screw bearing D and Y down (after shaft B is in position of course). Before screwing Y down, drill a small hole thru the base directly beneath it and pass a thin wire thru this hole so that the bearing will press on the wire. Connect the other end of the wire underneath the base to a binding post. It will now be noticed that contact is established from the binding post to bearing Y, from Y to the shaft A, and from there to the commutator segments E E E.

Place the oak blocks parallel to the commutator, at equal distances on either side of it and 3 inches apart. Drill 3 small holes thru the base at places to correspond with the 3 holes in one of the blocks. Then fasten the blocks down to the base with screws. (It must be clearly understood that the screws DO NOT go thru these holes, but thru other holes which may be bored for the purpose.) Pass a wire thru each of the holes in the base from the commutator to the binding post which happens to be touching that brush at the moment. Connect one of the wires from the magnet to a binding post and the other wire splices on to the wire coming from bearing Y. (Refer to Fig. 8.) Put a light brass spring S thru the hole in C and hook it over the spring adjusting screw in Y, so that it can be adjusted to any tension. The spring T is of fairly heavy steel, since it is its tension that really drives the

(Continued on page 37)
An Illuminated Stage Sulky

By HARRY S. TOWNSEND

SEVERAL years ago the author of this article had occasion to work up an illuminated scheme for a small two-wheel sulky and harness to be used in a stage act. Owing to the fact that the horse in this act performed many difficult tricks, with the result that the sulky was pitched at many different angles and also for other reasons, storage batteries were not allowable. The scheme shown diagrammatically herewith was successfully developed and applied and the results were very satisfactory, particularly when the display of the illumination, harness and vehicle was shown on a darkened stage before black velvet drop curtains.

Briefly considered, the battery comprised 36 dry cells of standard size, connected in series-parallel to give 18 volts. The feed wires in the battery box, which was painted white to correspond with the trimmings of the balance of the vehicle and placed beneath the seat, were led to the various circuits about the sulky body and wheels and also to the harness.

The harness display consisted of a number of 16 volt battery lamps connected on parallel, the terminal wires ending in a separable connector, so that it could be instantly detached from the vehicle when desired.

A small switch placed in one of the main battery leads and arranged on the side of the seat frame, enabled the driver to switch on the lights at the critical moment when the stage had been properly darkened.

One of the most difficult problems was to convey the current properly to the rotating lamp strips secured to the spokes of the wheels. This was accomplished by means of two brushes and a two ring commutator fitted to the side of each wheel. The commutator disk was made of fiber and not more than 9 inches in diameter so that it would be unnoticeable to those in the audience. The brush (facing the audience) side of the disk was painted white, the same as the wheels.

Three sixteen volt lamps were placed on every other spoke, and several lamps were also secured to the fiber disk on its rear face so as to form a circle in conjunction with the inner lamps of the spoke strips. Lamps were also spaced in between, around the rims of the wheels, as seen in the illustration. A detail of the round woven-wire brushes and brush holders is given in the illustration. The wiring was done with No. 14 rubber covered conductor for the main battery leads, and with No. 16 R.C. nature wire for the independent circuits.

This arrangement, as will be observed by the reader, does away entirely with the nuisance of a trailing stage cable, which many electrical acts are burdened with. Also not shown here, the various circuits were specially arranged so as to permit groups of lamps in parallel on 110 volt lighting circuits when the occasion demanded. This required 4 contact rings and 4 brushes. There is also a special disposition of the harness and vehicle circuits.

HOW TO MAKE CARDBOARD CYLINDERS.

Those radio-bugs who construct their own loose coupling (alcohol) inductances are generally hampered by not being able to construct suitable forms on which to wind the coil. The following method I have found satisfactory and it takes but a few minutes to construct a serviceable tube of any desired size and thickness.

Having the plus of the desired diameter ready, cut off a strip of thin cardboard slightly greater in width than the required length of the tube to be made. Now place the cardboard on the table and proceed to roll the plugs. After making one revolution spread glue liberally over the remaining part and finish rolling it up. If the tube is not as thick as desired, another strip of cardboard can be wound over the first. It is well not to have the tube fit too tightly over plugs, or troubles will be experienced with shrinkage during further treatment. The tube is now wound with tape or cord and placed in a moderately hot oven for fifteen minutes or more.

After removing from oven, trim edges carefully and while still hot give it a thoro coating of orange shellac inside and out. While the shellac is still fresh, take your blow torch and with a sweeping movement burn the shellac into the tube and repeat the process. It is well to make sure you are using pure shellac, not cheap glue, as some so-called shellacs are." (A make my own shellac out of orange shellac flakes dissolved in crude alcohol. If you do not have a blow torch handy, a good heating in the oven will do altho it requires more time. The appearance of the tube is greatly improved by blackening it. A thin paste made up of black aniline dye, dissolved in white shellac, gives a glossy black. A black looking luster can be made of lamp-black mixed with orange shellac. The freeer is preferable, having better insulating qualities than the latter.)

A little experience in tube making will soon make you proficient in the art. At a small cost moisture proof tubes can be made quickly, saving valuable time in waiting. Contributed by CHARLES M. FITZGERALD.

HOW TO FROST LAMPS QUICKLY.

Take the bulb and smear over thoroughly with a good library paste; after which dip into a cup of sugar or salt crystals. Then let stand for awhile. Do not use glue for an adhesive as this has a tendency to dissolve the salt or sugar. Contributed by JOHN T. DWYER.

TO USE OLD BATTERY ZINCS.

When the lower half of a battery zinc is eaten away by the action of the electrolyte, the remaining portion can be utilized by suspending it from a wire, so that the zinc is covered by the battery solution.

A very good electrical connection should be made between the wire and the zinc and the joint covered with melted paraffin. This last precaution is necessary as otherwise corrosion would soon occur from the action of the sal ammoniac or other chemical. The wire may be held at the top of the jar by twisting around a small piece of wood. Contributed by K. M. COGGESHALL.
THE ELECTRICAL EXPERIMENTER

UNIQUE INDICATOR SYSTEM WHICH ANNOUNCES THE ICEMAN AND GROCER.

A "step-saver"—that's just what this device is, for, when constructed, it will save Mother or the housekeeper many a fruitless trip to the door in response to the ever-ringing bell, because it enables her to know whether the milkman, baker, etc., and signal to them if their goods are needed or not—without requiring any more effort on her part than merely pushing a button.

The first thing required is a wooden frame or case, similar to that shown in Figs. 1 and 2. Inside of the same are arranged the indicator magnets and also the magnets controlling the automatic switch release (A in Fig. 1). This latter may be the armature and tapper rod of an ordinary battery bell, bent as illustrated in order to allow the extremity to act as a check pawl on the four-cam wheel, which is centered on a shaft manipulated by the switch handle. The current from the handle will be seen that this prevents the switch, when once set at the point desired, from falling back to its original position after pressure has been removed from the wheel, if not prevented from old clock works, can be easily turned out of wood by a jig saw or of brass in a lathe. By the same methods any other parts of this device may be constructed without much showing simplifies prevents otherwise. The carbon strip (another form of resistance may be used if this is not handy) can be cut out from the carbon electrode of an old battery cell and should be placed on the inside of the box directly over the groove, by means of which the switch makes contact with it. The partition B, in Fig. 1, should have two holes for the insertion of the core ends of the electromagnets M and M', which, on being actuated, raise up one or the other gravity indicators. Fig. 2 shows the indicator panel properly, which includes simply a low resistance galvanometer or ammeter, two push buttons, and a bell. If the reader cannot make such an instrument, he will find an admirable one described in the August issue of the E. E. Of course, it is understood that the scale card is no longer fixed off to amperes but instead into four divisions, numbered one from to four—each division representing the value of such tradesmen as call most frequently. The indicator device is also marked with corresponding numbers (see Fig. 2) and a printed card like that shown should be placed on it. It will be necessary to experiment for a while in order to have these numbers correspond; that is to say, when the switch is turned to Grocer, which is No. 1, the resistance traversed must be such as to move the needle on the indicator also to No. 1. Full electrical connections are shown in Fig. 4.

Assuming that everything has been completed, let us suppose the Milkman comes and turns the switch to No. 4. Such action allows more or less current to flow with the result that, at the same time the bell is rung, the indicator needle is turned also to No. 4 and all the lady of the house need do is to glance at the same ascertainment to be certain of the fact. If milk is not wanted, she has only to push the button designated—Nothing To-Day. The current set up actuates the electro-magnets controlling the lower signal and the latter is raised upwards, thus acquitting the tradesman with the fact that his goods are not required. At the same time, it will be noticed by following out the electrical diagram carefully, that the arrangement of the switch return mechanism is arranged to be attracted upwards, thereby releasing the check pawl and allowing the switch (which has a coil spring exerting tension upon it) to resume its original position. The device is then ready for the next caller.

Contributed by JOHN T. DWYER.

[Editor's Note—We would suggest the use of a low resistance relay in place of the vibrating bell, the local circuit of the relay being connected to a bell and battery. This permits the use of the INDICATOR system to be much more even and accurate. This change is brought out in supplemental diagram Fig. 4.]

AN EXPERIMENTAL SPARK COIL.

I have just designed a small "spark coil," of my own design, which embodies a special feature of regulation. The full strength of this coil, when the primary is all the way within the secondary, is 1½ inch heavy spark, and the minimum strength is 0", when the primary is drawn all the way out.

The diagram explains all details. The primary is made separate and complete from the secondary with hindering posts attached. The secondary is wound upon a spool, which also has hindering posts attached. The primary unit comprises an iron core 6 inches long by ½ inch diameter. The primary winding is of two layers, No. 18 S.C.C. insulated wire. This is covered with several layers of waxed paper. The primary terminals are mounted on a fiber disc, 2 inches diameter, as shown. The completed primary is soaked in molten paraffin wax. The secondary coil consists of 1½ lbs. No. 34 S.C.C. magnet wire, wound in layers onto a wooden or fiber spool, measuring 4 inches in length. The starting or inner lead of the secondary should be well insulated by passing thru a glass or rubber tube outside the wood or else by passing it thru a hole drilled radially down thru the spool cheek. The coils being made ½-inch thick or more for the purpose.

Contributed by CHAS. S. PORTER.

HOOK-UP FOR STARTING UP TWO MOTORS WITH ONE RHEOSTAT.

Emergency welding needs a method of limited equipment for connecting up two 10 horsepower direct current shunt field motors, with one starting. Use of the hook-up here provided to start up each machine and connect it on the main line.

The first step was to provide ample protection against overloads and failure of power, which was overcome by properly fusing as per diagram. When the T.P.D.T. switch in neutral or straight out position, connections to the motor are broken. Throw main switch in, then T.P.D.T. to other side to start respective motor. Bring rheostat lever up slowly to no-voltage release and lock; next throw in respective starting switch, when handle on starter should drop, thus connecting one motor on the line.

To start the second motor, throw T.P.D.T. switch to opposite side and start as before, after which close the proper starting switch. Both motors now on the main supply line; pull T.P.D.T. switch to neutral position.

I have had entire success in running both motors by this method for a period of 30 days, depending exclusively on the 30 ampere fuses for overload and manually opening the circuits in case of generator shunt-down or cutting off of the power.

Contributed by RAY J. BUTTON.

The GEW Men Folk Need Not Run to the Door for the Icemans and Grocer, When This Apparatus Is Installed. The Tradesman Turns the Switch Lever to the Proper Number; the Kitchen Helper Shows Who Is Calling and the Cook Pushes the Button Marked "Coming." The Indicator Is Labeled "Nothing To-Day."
THE ELECTRICAL EXPERIMENTER

May, 1917

A Simple Electric Motor-Attachment for Phonographs

By R. U. CLARK, 3rd

THE phonograph is without doubt one of the greatest of all pleasure giving instruments. This fact is amply demonstrated by the large number of machines which are in use at the present time. It is, however, like many other articles, appreciated most when new, and is little used after its novelty wears off, owing to the constant attention required to operate it. Winding up the spring to keep the motor going is the one thing which detracts most from the pleasure which should be derived from any good talking machine. By means of a simple electric motor attachment it is at once possible to do away with practically all the bother incident to the operation of the talking machine, with the exception of changing the records.

Most of the standard machines on the market today lend themselves very readily to the attachment of an auxiliary motor device, so that, by the employment of a little care and ingenuity, it is a simple matter to remodel a phonograph so as to run it by electric motive power.

The actual amount of power required to drive the turntable of most any phonograph at the proper speed is very small, although it may not appear so to the person who has to be continually winding up the ordinary spring motor. Just how little power will suffice depends more or less on the machine to be driven, but for most machines a universal electric motor of 1/40 H.P. will be found quite sufficient. These motors can be purchased new in most cases for as little as $4 complete, and can be attached by a flexible wire direct to the ordinary lamp socket, without using any extra resistance. The motor used by the author with considerable success was bought originally as a fan motor for $4; the fan, guard, and base which came with the motor were removed.

The motor mentioned above was designed to drive a six-inch fan at about 3,000 r.p.m. Under this load the motor does not claim it can be run at a cost of about 1 cent per 6 hours, the rate per K.W. being 10 cents. This motor is equipped with special patented bearings which require no oiling; for about 2 months, during which time the author's machine has been run a great deal, no oil has been placed on the bearings.

The use of such a small motor, as mentioned above, for such exacting work as running a large turntable, which is held at a constant speed by the governor with which the talking machine is fitted, may appear rather inappropriate, but, although some heating does take place in this motor, it is not sufficient to cause excessive wear or shorten its life materially. The actual method of driving the talk-

Illustrating How the Author Devised a Simple and Effective Electric Motor Drive for a Disc Style Talking Machine. The Old Governor Mechanism is Retained and the Motor Drives the Turntable by Means of a String or Cord Belt. (Fig. 1.)

motor, but does not affect the speed governing mechanism, which is left in place, for use with the electric motor, to control the speed in the usual manner.

After disconnecting the spring motor from the turntable shaft, the table should be removed and a small groove from 1/32 to 1/16 of an inch deep, the actual depth depending on the thickness of the turntable rim, should be made for the belt to run in around the rim. The groove should be about 1/8 of an inch wide, and should not be too near the top edge of the rim. On certain machines there is a narrow shoulder located under the rim, which in some cases will hold the belt.

As the phonograph is to be driven by a belt a small grooved wheel for the motor is necessary. This wheel is best made of metal with a small groove about 1/4 inch wide, either V or semi-circular in cross-section, and about 1/16 inch deep. The greatest diameter of the pulley should be about 1 inch or under. The author has used experimentally several sizes from 3/8 inch up to 1 inch, all with considerable success, but when a 1 inch wheel is used, the motor which then turns at about 800 r.p.m. seems to run the quieter, and with practically no belt slippage. Within the sizes mentioned the diameter of the pulley will have little effect upon the speed of the turntable, which is still controlled by its own governor as mentioned above, but of course the motor pulley-belt speed will be decreased by the use of a smaller pulley and increased when a large pulley is employed. A 10 cent pulley from a mechanical set is satisfactory.

The method to be used in mounting the motor will necessarily depend somewhat upon the type of talking machine used. There are two simple ways of attaching the motor, one of which should be applicable to nearly any machine made. Wherever the construction of the talking machine permits, the motor can be hung out of sight, from the top-board of the body of the phonograph, with the shaft extending thru this board about 1/2 inch, so that the pulley wheel can be mounted with ease from the top side of the board on which the motor is hung, as shown in Fig. 1. This method of mounting is possible only with a certain class of phonographs, mostly the larger sizes. For use with small machines, where the motor cannot be hung out of sight, it can be inverted and fastened to the top board, in such a manner that the pulley groove, which comes near the top position, is below, the shaft, with the hub near the outside end of the shaft, comes in line with the grooved portion of the turntable. (See Fig. 2.)

To use the method of attachment first described it is necessary to drill three holes in the top board spaced about 2 inches from the edge of the turntable. The center hole is made to accommodate the main bearing and shaft of the motor. The (Continued on page 76)
HOW TO MAKE IT

First Prize, $3.00
A Voltmeter for the Amateur Electrician.

Herein is described an easily constructed voltmeter, which will accurately register

\[
\begin{align*}
\text{a} & \quad \text{b} \\
\text{c} & \quad \text{d}
\end{align*}
\]

if properly constructed and adjusted. It is very simple and requires few materials, all of which are found around the experimenter's shop.

The base was made 5 by 1½ by ½ inches. The upright U was made from the same material 1 inch shorter. Next I cut out a piece of tin from a cocoa can in the shape shown in Fig. 1; 2 inches from 1 to 1, 1 inch from 2 to 2 and 1½ inches from 3 to 3. Two small holes are put one in each end. Then I bent it into the shape shown in Fig. 2, over a hammer handle. The pointer P was made from a piece of fine wire and soldered on. A large pin served as an axle. H. The piece of tin A, Fig. 3, holds one end of the pin while the other end is driven into the upright U. The magnet M was taken from an old bell and held in position by tin strips as shown. After putting the binding posts, P, on and fastening the upper and disk into position, the instrument was complete.

The best way to mark the disk is with a transformer: mark where the pointer stays in a natural position with an O. Then connect five volts to the binding posts and mark where the pointer stays with a S. Do the same with ten and fifteen volts. Mark off spaces of one volt each between the numbers. This arrangement will be an interesting as well as useful addition to the shop for measuring various voltages.

Contributed by FRANK M. JACKSON.

Gold Leaf Substitute for Electrosopes.

Coat lightly one side of a piece of tissue paper with lamp black and turpentine

using commutator for wind direction indicator

Many people find an electrical wind direction indicator both useful and practical. It is very convenient to have such an installation in the home, office or laboratory, so that by simply glancing at the electrical ammeter, one may know just how the wind is blowing, so far as its direction is concerned.

Most of those described in the "How-To-Make-It" columns of electrical journals involve the construction of a commutator or segmental switch. This difficulty is readily overcome by utilizing a small size motor commutator, which can be purchased at little cost from any electrical supply house or dealer, and having eight or more segments.

The commutator is made stationary on the shaft and one supporting the weather vane, while the moving lower part of the device attached to the weather vane proper, carries at its lower end an electrical contact brush (preferably a rolling ball or wheel contact) which of course will turn with the vane.

The moving part of apparatus should not be too stiff, and the best ones now in use are equipped with ball bearings. With a little ingenuity on the part of the builder, it will be found possible to incorporate the ball bearing feature with very little trouble and the vane will be many times more accurate and reliable than the ordinary one.

The circuit connections between the moving brush, commutator and flash lamp annunciator are shown.

Contributed by PETER BROWN.

Second Prize, $2.00
Using Commutator for Wind Direction Indicator.

What is a Safe Retreat During a Thunderstorm?

Place a mouse, a bird, an electroscope, and some gunpowder inside a wire gauze cover, such as is used for protecting meat.

To prove that a person is invariably safe from lightning when inside a metallic cage, Mr. Weinbrot places some powder, a mouse, and a bird within a metal cage. Heavy static sparks jumping to the cage from a Wilshurst machine have no effect on any of them.

The whole, being placed on a board is supported on four warm, dry tumblers placed on the top of a table.

Connecting it with a static machine and set it working. About an abundance of sparks may be made to play all over the outside, the living things, the gunpowder and even the electroscope will not be affected in the least.

From this experiment one may therefore deduce that the safest place in a thunderstorm is in the metal lined meat safe, provided, of course, that it is large enough. This also demonstrates the theory of Lodge regarding the design of lightning rods for protecting buildings. Lodge recommends for first-class protection that the edifice should be entirely enclosed under a perfect network of wires, resembling in effect an ordinary bird cage. Modern installations of lightning rods follow this theory as nearly as possible.

The important part to bear in mind is, that you should not touch the metal, otherwise fatal results will occur.

Contributed by E. F. WEINBROT.

Frosting Glass With Beer.

Secure ½ pint of lager (light or dark) beer, and to this add enough epsom salts, so that when aired up it will be the consistency of cream. Apply this cream to the glass to be frosted with a sponge. This frosting will not readily wear or rub off under any conditions.

Contributed by EUGENE RUCKIAN.

Gold Leaf Substitute for Electrosopes.

Coat lightly one side of a piece of tissue paper with lamp black and turpentine

with a brush. Cut a 2½x2½ inch piece of it for your electroscope. Electrosopes may be used to test insulators.

Contributed by CLARENCE MELOTZ.
HOW TO KNOW WHEN TOOLS ARE RETURNED.
Every experimenter knows that people who come in and borrow tools never, by
any chance, replace them in their proper place.
The accompanying illustration shows a very simple method of overcoming this
annoyance. The outlines of the tools are painted in white or black on the cabinet
wall in the positions which the tools normally occupy. When this is done a person
has only to glance at the cabinet and can tell immediately just where each tool be-
longs.
Contributed by
AN EXPERIMENTER.

A SOUND OPERATED MOTOR.
Take any telephone transmitter and re-
move the carbon granule cup, solder a plat-
uminum point to any metal piece and fasten
in place of the granule cup. Solder a plat-
uminum point to the center of the diaphragm.
The two platinum points should be as near
each other as possible without touching.
The battery motor is equipped with a wood-
en block fastened to the axle shaft. A
mirror can be fastened on either side of
the block. A beam of light can thus be re-
lected, which should prove interesting to
those experimenting with sound waves.
The motor and transmitter are placed in
a circuit with a battery.
Any word spoken into the transmitter
will vibrate the diaphragm, and cause the
mirror to spin around at different speeds, according to the words spoken.
Contributed by LEE A. COLLINS.

PRACTICAL HELPS FOR THE
AMATEUR.
Repairing Dry Cell Terminals.—A simple
method is to solder a 6-in. length of flex-
ible wire to the zinc container of the dry
cell for making connections. If a binding
post is necessary, solder a spring binding
post in place as shown. In emergencies
paper clips may be used, bending as shown
and slipping wire into them.
Shocking Machine from Alarm Clock—
Since a clock is generally used as an in-
terrupter best results can be obtained by
arranging a spring to press against one
of the wheels which revolve at fairly high
speed, when the balance wheel is removed.
A higher rate of interruption results, giv-
ing a constant tingle instead of a series of
jerks. The spring and gear are connected
in series with two handles, an electromag-
net and two to three cells.
Simple Time Signal.—The relay and re-
sistance shown in a previous issue of this
journal may be done away with by simply
reversing the time ball solenoid and horn as
shown herewith. This likewise does away
with an extra set of batteries. Key B
operates the electric horn and A controls
the semaphore.
Removing Enamel from Magnet Wire—
The easiest method is to use an ink eraser
for this purpose. The wire is cleaned
quickly and perfectly without excessive
abrasion. To do this easily, slit one end
of the eraser and run the wire thru
the slit several times.
Fuse Clips.—This fuse is in the same
class as the above hints, being made from
paper clips. Fasten to board with screws
or tacks and one fuse wire, fine copper
wire or tinfoil under clip.
Contributed by T. W. BENSON.

A CLEVER USE FOR SPEED INDI-
CATORS.
In constructing a metal pattern in order
to determine the amount of metal
needed for a wall, it became necessary to
find the perimeter of a figure similar to
that shown in Fig. 1. The work was held
up until a way of doing this could be found.
At last thought of the following device:
A brass wheel, 2½ inches in diameter, was
soldered on the shaft of an "Electro-
Speed Counter" as shown in Fig. 2. The
counter was then grasped in the hand
and the wheel was run around the edge of
the design. The diameter of the wheel was
multiplied by 3.1416 to obtain the circum-
ference of the wheel, which was then mul-
tiplied by the revolutions shown on the in-
dicator. This gave the distance around the
figure. The size of the wheel can of course
be altered to suit different conditions.
Contributed by J. C. GILLILAND.
Editorial Note.—Another useful dodge

A HANDY HEIGHT GAGE.
The sketch gives dimensions for making
this useful height gage. The micrometer
head is of Brown & Sharpe make and will
give a forced fit in the .375" hole. It will
be necessary to anneal the spindle end to
tap a No. 3-48 thread, so as to hold the
finger shown in detail at the right, also
the screw. The bottom surface of the base
is undercut 1/16 leaving a 3.16 foot all
around.
Harden the finger, screw and base, and
when finger is attached to spindle it is
moved all the way to zero on barrel: that
is, when tapping, base and finger are to-
gether, the micrometer head is set at zero.
all moving parts having a free sliding fit
with no shank.
This gage has one advantage over the
great number of other height gauges in that
you can scratch a line from 0 to any rea-
nonsible dimension.
Contributed by JAMES MCINTYRE.

in this direction consists of making a brass
wheel as shown at Fig. 3, having a small
groove in its periphery. In this groove is
placed (glued) a rubber band which
is slightly smaller than the wheel. Knowing
the dimensions of this wheel and noting
the revolutions on the dial, it becomes an
easy matter to measure railroad lines, state
border lines, conduit and pipe runs on blue-
prints, etc., by simply rolling the wheel
along these lines. In one of these devices
which we used some time ago, the wheel
was made so as to have a circum-
ference of 3 inches, or a maximum diam-
eter of about 1½ inches. The diameter
multiplied by 3.1416, gives the circumfer-
ence and the latter term, divided by 3.1416,
gives us the diameter.

Attachment for a Speed Indicator Making It
Available for Measuring the Perimeter of
Irregular Surfaces. Map Routes, etc.

www.americanradiohistory.com
ACIDS, BASES, AND SALTS.

In this lesson we shall take up the study of the various acids and characteristics. These form one of the most important studies in the realm of chemistry. A resume of the general properties of acids are briefly as follows:

1. An acid is a substance composed of hydrogen and a non-metallic element or radical, the hydrogen being replaceable by a different element, and all acids are soluble in water.

2. Acids usually have a sour taste.

3. If soluble in water, as most acids are, they turn blue litmus paper (or solution) red. They also change the color of many vegetable substances.

4. They react readily with a base to form a salt and water.

5. They react readily with some metals to form salts, liberating hydrogen.

6. Most acids are soluble in water.

7. They also have the power to decompose most carbonates, like limestone, liberating carbon dioxide which escapes with effectiveness.

The common acids are:

- Hydrochloric (HCl): Nitric (HNO₃);
- Sulfuric (H₂SO₄): Acetic (C₂H₄O₂); Oxalic (H₂C₂O₄);
- Tartaric (H₂C₄O₆) and Citric (C₆H₈O₇).

Of these common acids, Hydrochloric is a gas (the Hydrochloric or Murine acid of commerce is only the gaseous acid in solution); Sulfuric and Nitric acids are liquids; while Oxalic, Tartaric, and Citric acids are solids.

To illustrate the many familiar substances which are acids or contain them, we will take the following few:

- Vinegar, Pickles and Relishes, when Acetic acid is present, attests to the agreeable sour taste.
- Beer is simply a diluted solution of acetic acid, containing coloring matter and other substances, obtained by the acetic fermentation of poor wine or wort residues, of beer which has turned sour, and of other dilute alcoholic liquids.

The sources of fruits being due to the presence of citric acid, as in the lemon, grape, currant, raspberry, gooseberry, etc.

During fermentation many acids are formed, as in the case of sour milk, lactic acid is present.

**Experimental Chemistry**

By ALBERT W. WILSON

Twelfth Lesson

Nada water is a solution of Carbonic acid (Carbon Dioxide), and acid Phosphate is a solution of a sour calcium phosphate. Mineral waters frequently contain Carbonic acid. Hydrochloric acid is present in the gastric juice of the stomach, and performs an important part in the process of digestion.

From the above we can see that many acids are of importance, and many are used by us every day in some form or other. Without, therefore, see that all acids are not to lie scorned as dangerous, as doubtless many readers of this article have heretofore believed, when the word acid was mentioned.

**Nomeclature of Acids**

Oxygen is a component of most acids, and the names of these acids correspond to the proportion of oxygen which they contain. The best-known acid of an element usually has the suffix -ic, as Sulfuric, Nitric, Phosphoric. If an element forms another acid containing less oxygen, this acid has the suffix -ous, as Sulfurous, Chlorous, Phosphorous. Some elements form an acid containing less oxygen than the -ous acid; these acids are called the -ic and -ous, and have, also, the prefix Hypo-, as Hyposulfurous, Hypochlorous. The prefix hypo- is derived from the Greek word, meaning to under. If an element forms an acid containing more oxygen than an -ic acid, such an acid retains the suffix -ic and has, also, the prefix hydro-.

**Experimental Chemistry**

**Hom Apparatus Is Arranged in Experiment of Collecting the Product of Acetic Acid.**

**In Conducting Experiments With Various Acids it is Well to Keep to Place the Test Tubes Containing the Acids in a Wooden Rack. They May Be Suitably Labeled.**

**6X Fyr., as Persulfuric, Perchloric. The Latin prefix meaning beyond or over. The few acids which contain no oxygen have the prefix Hydro- and the suffix -ic, as Hydrochloric, Hydrobromic, Hydrofluoric. It should be noticed that these suffixes are not always added to the name of the element, but often to some modification of it.**

**Acids having the prefix Hydro- and ending in -ic form salts with names ending in -ate, [Final "e" dropped in simplified spelling.] All acids whose names end in -ous, form salts whose names are -ous or -ous, Hydrochloric acid, HCl; Form Chloride, NaCl; Sulfuric acid, H₂SO₄; Form Sulphate, CaSO₄; Copper Sulphate; Nitric acid, HNO₃; Form Nitrate, KNO₃; Sulfurous acid, H₂SO₃; Form Sulphites, K₂SO₃; Potassium Sulphite; Hydrobromic acid, HBr; Form Bromide, Acr.; Silver Bromate; Phosphoric acid, H₃PO₄; Form Phosphates, Na₃PO₄; Iron Phosphate; Hydrofluoric acid, HF; Form Fluorides, CaF₂; Calcium Fluoride; Chloric acid, HClO₃; Form Chlorates, KClO₃; Potassium Chlorate.**

**The nomenclature of acids is well illustrated by the s.r.ies of chloric acids:**

<table>
<thead>
<tr>
<th>Name</th>
<th>Formula</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hydrochloric</td>
<td>HCl</td>
</tr>
<tr>
<td>Hydrobromic</td>
<td>HBr</td>
</tr>
<tr>
<td>Hydrofluoric</td>
<td>HF</td>
</tr>
<tr>
<td>Hydroaromatic</td>
<td>H₂O₃</td>
</tr>
<tr>
<td>Hydrocarboxyl</td>
<td>H₂O₄</td>
</tr>
<tr>
<td>Hydroperoxide</td>
<td>H₂O₅</td>
</tr>
</tbody>
</table>

Not all elements form a complete series of acids, but the nomenclature usually agrees with the above principles.

An examination of the formulas of acids show that all do not contain the same number of hydrogen atoms. Acids are sometimes classified by the number of hydrogen atoms which can be replaced by a metal. The varying power of replaceability is called Basicity. A Monobasic acid contains only one atom of replaceable hydrogen in a molecule, as Nitric acid HNO₃. A molecule of Acetic acid (CH₃COOH) contains four atoms of hydrogen, but for reasons which are too complex to state here, only one of these atoms can be replaced by a metal. Dibasic and Tribasic acids contain two and three replaceable atoms, as Sulfuric acid (H₂SO₄) and Phosphoric acid (H₃PO₄). Obviously, monobasic acids form only one class of salts, dibasic acids form two classes, tribasic acids form three, etc.

**EXPERIMENT NO. 51**

Fill a test tube one-third full of either Hydrochloric Acid (diluted), or Sulfuric Acid (diluted). Fill another test tube one-third full of concentrated acetic acid. In some manner label the tubes for identification of the contents. Try the action of a drop of the acid on both red and blue litmus paper. Drop a small piece of zinc or other metal into each tube successively. If no chemical action results, warm gently. Test for the most obvious product (hydrogen) by holding a lighted match at the mouth of each tube. If no decisive action results, provide the test tube with a stopper and simple delivery tube, and collect any product in a test tube over water. This experiment will probably be unnecessary except with the acetic acid.

(Continued on page 52)
THE ELECTRICAL EXPERIMENTER

May, 1917

WRINKLES IN RECIPES
FORMULAS

EDITED BY S. G. N. S.

Under this heading we publish every month useful recipes, new ideas, etc., useful to the experimenter, which will be duly paid for, upon publication, if acceptable.

EXPERIMENTER’S APHORISMS

In the following, we wish to give to the Experimenter some hints as to the use of the different ingredients and how to work with them:

1. Always bear in mind that exact working is needed, in order to have the experiments successful.

2. Know what you are about, before you start experimenting.

3. “The History of Failure is the History of Constant Failure.”

4. Many times impure, wrong or deteriorated raw materials spell failure instead of success.

5. A great many of the chemicals and ingredients required cannot be obtained from drug stores; buy them at a reputable supply house.

6. Before condemning a formula, be sure the fault does not lie with the manner of handling it, or the purity of the ingredients.

7. Be sure to mix the materials comprising a certain formula in the proper sequence.

8. When starting to prepare a mixture, especially involving liquids and solids, ask yourself, “Is the specific gravity correct, as indicated by a hydrometer?”

9. “Is the temperature right? Is the quantity of hot water correct?”

10. Acids and water, when mixed, should be manipulated in the proper manner, i.e., the acid should be poured into the water, and not vice versa, as the solution is liable to be forcibly ejected from the containing vessel and into the mixer’s face.

11. The end of a systematic work, a floating thermometer and hydrometer, as well as measuring glasses and scales, should always be provided, as work is expensive and sometimes fatal.

12. Put labels on all bottles, boxes and packages; full description as to contents as well as to materials.

13. Remember that a beginner cannot expect to prepare a “DORHART,” which will compare with regular manufactured products.

CHEMICAL EXPERIMENTS

I have been experimenting a little and have found that an infusion of logwood chips and water will change color when other chemicals are added.

Take three glasses Nos. 1, 2 and 3 and prepare them as follows: Rinse No. 1 with strong vinegar; Rinse No. 2 with powdered alum; Rinse No. 3 with a solution of copper sulfate. The next step is to place the logwood in each; if the glasses have been prepared correctly the logwood in No. 1 will fade to a pale yellow; that in No. 2 will become almost black and that in No. 3 will change to a pale purple. This is the principal set of changes but following is a list of changes using No. 2, but not the order of the other chemicals. Some of them can be used as stated above but in the case of ammonia for instance, the odor would give it away.

Chemical action

1. Logwood, ammonia and copper sulfate give a yellow precipitate.

2. Logwood, vinegar and copper sulfate give a brown.

3. Logwood, alum and ammonia cause a red precipitate.

4. Logwood, vinegar and copper sulfate give a brown.

5. Logwood, ammonia and common salt give a light brown.

6. Logwood, copper sulfate, common salt, and alum mixed give a pink.

7. Phenolphthalein and ammonia gives a bright red (test for free ammonia).

8. Copper sulfate and ammonia gives a bright blue (test for copper sulfate).

9. Logwood and hydrogen peroxide gives a pale yellow.

10. Copper sulfate and caustic soda gives a pale blue precipitate.

These are the results as far as I have gone but I hope to continue my work and get different results.

Contributed by W. B. SPURRIER.

HANDY APPARATUS FORMED ENTIRELY OF WIRE

As shown in the accompanying sketches a number of useful articles of constant service to the experimenter may be constructed of ordinary wire with the aid of a few common tools.

Obtain a length of galvanized iron wire, or if the item of expense is not important, brass wire, 3 or 4 gage numbers are required, depending upon the size of the apparatus to be constructed.

Provide a pair each of flat, round and cutting pliers, some wood sticks about the dimensions of a lead pencil, and a few short lengths of tubing to aid in bending and forming the wire; after a few experiments you will be able to determine the size of the wire best adapted.

Cork Puller

Numerous Handy Devices for Holding Tests Tubes and for Filling will be found to be constructed from Wire with a Little Ingenuity.

CHEMICAL SUBSTANCES—THEIR TECHNICAL AND COMMON NAMES

Nearly all of the chemicals in common use to-day have more than one name, and the purpose of this list is to classify some of the most common of them, and to give the benefit of the amateur who sometimes become confused in the different names.

Aqua Vitriol — Sulfuric Acid or Nitric Acid.

Aqua Regia — Nitric Acid or Sulfuric Acid.

B. W. SPURRIER.

Spring Holders

Figures 4 and 5. — Use very thick and springy wire; will be found of service in holding articles to be soldered or cemented. It will be well to make a sketch that device in figure No. 4 holds by itself, while the reverse is true of No. 5 design. The ends of these holders can be made pointed or flattened.

Figure 6.—Holder for rubber tubes. Obtain a piece of thin wire. First bend it in two, then bend the ends over, as shown in sketch, to hold it in place. Then wind wire around a rod of proper size. Slip tube thru spiral formed. This device will not permit tube to kink or bend at an angle sufficient to kink or to fracture.

Figure 7.—Holder for articles to be soldered or cemented. The slight pressure obtained by allowing the straight bend to pass a little thru the ring will be found sufficient to hold the articles in a position convenient for working.

Figure 8.—Tripod to support retorts. This article is formed by twisting three wires together forming a stand as shown in sketch.

Figure 9, 10 and 11.—Battery connectors. Figure 10 can be formed by putting a screw or nail thru ring at its end. In the event of the contact jaws becoming loose they can be adjusted by drawing the ends of the connector. The line wires can be soldered to the connectors, and if desired the connection on figure 11 can be covered with insulating tape.

Figure 12.—Very light weights. Each bend increases 1 centigram or 1 decigram, varying according to the size of wire used.

Contributed by AN EXPERIMENTER.

www.americanradiohistory.com
THE ELECTRICAL EXPERIMENTER

April, 1917

WITH THE AMATEURS

Amateur Radio Station Contest: Monthly Prize, $3.00. This month's prize-winner.

RADIO STATION OF FRED DIETZ, PHILADELPHIA, PA.

I present here a flash-light photo of my station. The aerial is forty feet high, one hundred feet long, composed of three wires spaced six feet apart.

WALTER LITKE'S EFFICIENT RADIO STATION.

I have been reading your valuable magazine for the past two years, and have been greatly interested in the photos of amateur stations which you publish monthly. I submit two photos, one of my station and one of my aerial. My sending set consists of an E. I. Co.'s 3/4 k.w. transformer, a Murdock oscillation transformer, a Marconi key, straight spark gap, a photographic plate condenser consisting of ten plates, 8 by 10 inches, with tin-foil between cut 6 by 8 inches. The receiving set consists of an Arnold Navy type loose coupler of 2,500 meters. I own a 1/2 k.w. transformer, a Marconi type loose condenser, Murdock variable condenser, Bunnell detector, and an aerial switch. My aerial is made of seven strand copper wire with a twenty foot mast at one end and a thirty foot one at the other.

RADIO JOINS SAMOAN ISLANDS WITH UNITED STATES.

Construction of another government wireless plant, connecting the United States with its insular possessions, has been completed at Tutuila, placing the Samoan Islands in direct communication with the outside world for the first time since their acquisition by the U.S. The station at Tutuila, connects with Honolulu, where a great plant communicates with San Diego, Calif. Governor Poyer, of the island, retired naval officer, advised Secretary Daniels on February seventeenth of the completion of the plant and transmitted a message from the native chiefs.

LEONARD NIESSEN A COMING "RADIO-BUG."

The sending set consists of a one-half inch spark coil, plate and Leyden jar condenser, oscillation transformer, spark gap and key.

The receiving set consists of a Murdock loose coupler, first condenser, galena and silicon detectors, Brandes' 2,000 and E. I. Co.'s 2,000 ohm 'phones and a buzzer test.

The vertical rod seen under the center of the table is an automatic closing lightening switch, operated by a foot lever, the switch itself being outside on the wall of the house. Most of the apparatus is of my own construction. The aerial consists of six wires spaced two feet apart on twelve feet spreaders, fifty feet long and forty feet high.

I am a member of the Milwaukee Radio Association, also the Central Radio Association and hold a first grade Amateur License. Call "9AKC."

Have been a subscriber to The Electrical Experimenter for the last two years and have benefited greatly by reading it.

LEONARD P. NIESSEN.

Milwaukee, Wis.
The normal sending range is 50 miles. Although I have not been able to receive stations as far as Key West (1,200 miles distant), my call is 1HR. I have also increased the efficiency of my station by adding a Reciliation bulb, a new rotary gap and an oscillation transformer.

PAUL RALSTON.

Conneaut Lake, Pa.

550 WIRELESS MEN AVAILABLE IN PHILADELPHIA.

A trained body of 300 expert wireless operators now working on ships at sea or at foreign commercial or naval stations along the coast, and 250 amateurs capable of completing their radio studies within a few months, is being trained for immediate contribution to the nation in the important branch of wireless communication in event of war. In addition, forty students are now enrolled in the Philadelphia School of Wireless Operating.

This school was the first to be established in America. It was started with a few pupils having had some study in the field, but since that time has turned out more than 300 trained men, nearly all of whom are holding commercial licenses in the United States.

All licenses for wireless operating are issued by the federal authorities, so that the records at Washington constitute an index of the operating force of the country. In this respect Philadelphia is said to lead every other city with its 250 amateurs.

Although the operation of wireless stations is kept under government regulation, no order has been issued since the breaking off of relations with Germany to make regulations more drastic, and none is expected. In some respects the large number of amateur stations means better protection for the country. It is hardly one hour out of the twenty-four when some stations are not operating or listening. In addition, the station Walle, of Philadelphia, is guarded by three powerful stations, Wannemaker's, League Island and Cape May. Most of the commercial business of the city is handled over the plant on the roof of the Wannemaker store. This is rated at 100 miles, but its messages have been picked up in Ypsilanti, Michigan, as far as Florida. The plant is generally closed now at night, but should the need arise it could be kept in constant operation and could pick up messages far out of the considerable distance out in the Atlantic.

Amateur News

The Waco, Texas, High School Radio Club.

In September, 1914, the Waco High School Radio Club was organized with a charter membership of four. To-day the club has an active membership of fifteen. A fine 1,000-watt kilowatt transmitting set, two receiving sets—one an ordinary four-meter A. W. S. and the other a 2,000-meter receiving set), hot wire ammeter, wave meter, motor-generator, phonograph, gumograph and various other experimental apparatus.

The club meets each Friday after school. During the last meeting, the club had a fall hose parade and all members were permitted to use the Waco High School Radio Club. Waco High School, Waco, Texas.

Ypsilanti Radio Amateur News. A large number of amateurs have elected the following officers for the coming year: President, Donald Knight; Secretary, Alton Russ; Treasurer, James Orr; Sergeant-at-Arms, Louis Roberts.

The club participated in a local exhibit during America's Electrical Week.


A wireless club was formed by the pupils of the Russell Grammar School of Arlington, Mass., during the month of November.

The following officers were elected: President, Ernest A. Snow, Jr.; Vice-President, Richard Moraw; Secretary-Treasurer, Borden Polk. The club has a set installed and meets Tuesday evenings in the auditorium for the study of radio.

Dansville Wireless Association of Dansville, N. Y.

On December 28, 1914, a number of "live wire" radio amateurs organized the Dansville Wireless Association. The club has twelve members and the station is located within the school building and would like to get in touch with other active clubs and amateurs.

The officers of the club are James Welch, President; Robert Smith, Secretary and Conley J. Sheerin, Chief Operator.

Uper Sandsky, Ohio, Wireless Club.

The amateurs of Upper Sandsky, Ohio, have organized a club and have located in the business section of the town. The society consists of seventeen members. We are installing a 5 K. W. transmitter and expect to install an Audion set in the near future.

The following officers were elected December 1, 1915: Ralp carey, President; Robert Maier, Vice-President; Russell Selligman, Secretary and Hills Berkey, Treasurer.

Radio Amateur League.

The Radio Amateur League of Grand Prairie and Dalworth Park, Texas, was organized March 20, 1914, by President: Fred W. Stubbns, President: Arthur Bradshaw, Vice-President: Ivan Ferguson, Secretary and Treasurer: Joe Ward Edwards, Chief Radio Engineer and Press Reporter.

The "League" intends to construct most of its own instruments. We wish to communicate with other clubs and learn of their ideas. We have several ideas on the "Erection of Aerials" and the construction of other instruments which we will communicate to all clubs desiring this idea. All communications may be addressed to the secretary at Dalworth Park, or to the President, or Radio Engineer, at Grand Prairie, Texas.

Fifth District Radio Club Elects New Officers.

In compliance with the by-laws of the club, Mr. R. B. Goold, President; Karl Froehling, Secretary-Treasurer and George Deiter, Librarian, who will serve the club until July, 1917.

RADIO CLUBS ATTENTION:

We are always pleased to hear from young Edisonians and Radio Clubs. Send a wired message to club with photos of members and apparatus to-day to: Editor "Amateur News" Section, The Electrical Experimenter, 223 Fulton St., New York City.

GIVE COLLEGE RADIO OUTFIT.

St. Ignatius's college of Cleveland, 0. was presented with a new wireless outfit at an alumni smoker in the college gymnasium on February twentieth. The outfit was the gift of the alumni of the institution. Mr. Charles S. Howie, president of Case School of Applied Science, delivered an address.

HARRY WALLACE'S AMATEUR RADIO STATION.

I present here with a photograph of my wireless station, to be entered in your "Amateur Radio Station Contest." My set employs a 1 wire aerial 60 feet long. The receiving apparatus comprises a loose coiler, variometer, variable condenser, fixt condenser and a 50 tap tuning coil, which are all mounted complete in an oak-finished cabinet. The receivers are Trans Atlantic 2,800 ohm type. The sending outfit includes a 1-inch spark coil, helix, spark gap and a key. I hear 8 U E, R Y and B G L very clearly.

HARRY VANDE WALLE.

Cincinnati, Ohio.

The headquarters of the Club are in the rooms of the Y. M. C. A. Radio School. The club owns a moderate library and has the use of a fine receiving station, also a storage battery charging plant. Invitations are extended to all interested in the Radio Art. Meetings are held every Saturday night. Photographs of the club's set will be mailed upon request. We would also like some pictures from other clubs. Address all communications to Karl F. Trubing, 1252 Magazine Street, New Orleans, La.

Eureka, Illinois, Radio Amateur News. On the evening of March 7, the Eureka Radio Club was formed and ten members admitted. The following officers were elected: Allen Spencer, President; Glenn Dorcass, Vice-President, and Henry Klaus, Secretary-Treasurer.

All communications should be addressed to the Secretary-Treasurer.

Y. M. C. A. Radio Club of Springfield, Ohio.

Under the leadership of Mr. E. Hilitleine, the amateurs of Springfield, Ohio, recently organized a radio club, which promises to be one of the most successful organizations of its kind in the Widespread publicity was given in the local newspapers and it is reported that there are a large number of men and boys who are taking interest in radio. The club owns a complete set of receiving and provided instruments, but so far have been working at cross purposes with few people to talk to and no organization to further the work, so there is a need for a progressive club of amateurs.

The members of the club have placed a radio set, capable of sending two hundred miles and a long-distance receiver, receiving the radio-powered stations in this country and Europe. In organizing the club, Springfield becomes a center of activity for amateurs in the state. Many of the principal objects of the Club will be to teach its members the use of the Code and O. T. Nilline hopes to interest the Y. M. C. A. in the new work and in this way induce a far, more number of boys to participate. The temporary organization which was effected at the second meeting placed the following officers—Herald Borgerman, President; J. W. Fenton, Vice-president; E. J. Smith, Secretary, and J. W. Wright, Assistant Treasurer.

Address all communications to the Secretary, 121 Rose St., Springfield, Ohio.
EXPERIMENTAL PHYSICS.

From page 22-

A pointer which moves around and points to a circular scale which has been calibrated to read the same as the ordinary magnetic needle.

EXPERIMENT 23.

A thin bottle (preferably a Florence flask) is tightly corked with a rubber stopper, and the cork is connected with a glass tube. If this is inverted into a glass containing water to which a few drops of rosin have been added, the tube will rise, and the water will be heated, gently, the air in the bottle will expand and some will pass into the water (see Fig. 19). If now the bottle is allowed to cool, some of the liquid will rise in the tube. If the colored water rises above half way up the tube, some of it can be let out by raising the tube above the level of the water in the glass. This apparatus can now be used as a crude thermometer for obvious if heat is applied to the bottle, the air in the bottle will expand and push the water in the tube back toward the glass; if a colder temperature is used, the water will expand and the bottle will rise in the tube. The hotter the temperature lower the level in the tube and the colder the temperature the higher the level in the tube. This experiment was first performed by the great Galileo and was the first method of measuring temperatures.

EXPERIMENT 24.

If a little ice is gradually added to some water in a highly polished vessel (a piece of the kind used just anywhere the purpose) while the water is being stirred and a thermometer is kept in it, a temperature will be reached when the polished surface forms a circular film. This temperature varies according to conditions of the atmosphere and is called the dew point. It will be the same as the temperature at which the water vapor condenses from the atmosphere. We are all familiar with this phenomenon, having observed it every summer whenever the ice water is served. The explanation is as follows—moisture is continually evaporating into the atmosphere and when the atmosphere contains as much moisture as it can hold, it is said to be saturated. The same amount of air can hold more and more moisture as the temperature is increased and vice versa. Hence if the atmosphere is saturated and the temperature is decreased, some of the moisture will have to condense as the atmosphere cannot hold more moisture than as much as it can hold. Therefore if the temperature is not saturated cooling it will saturate it and further cooling will cause moisture to condense. The cooling of the grass, trees, stones, etc., at night more rapidly than the atmosphere itself cools, causes the formation of dew (a condensation of moisture in the atmosphere). If the air near the earth also cools, the condensation also takes place on the dust particles near the earth and this condensation is called fog. If this fog forms at some distance above the surface of the earth, it is called cloud. If a considerable amount of moisture in the cloud the drops become large and because of their weight fall as rain. Rain falls as condensation.

A ONE-MAN ELECTRIC SUBMARINE.

(Continued from page 6)

To make several short, quick trial maneuvers, until he bumps into the hull of the enemy vessel. Also he can see a distance of 30 feet under water waters by means of the powerful electric searchlight, and once against the hull of the enemy Submarine or Dreadnought, it is but the work of a moment to engulf the enemy magnets in the war-head which instantly grip the steel plates of the enemy vessel will properly, and will increase the war-head by means of the electro-magnetic clutches previously mentioned. The operator then disconnects himself of a minute speed, and he will only one quarter of an one-eighth of a mile away when the war-head explodes, he will be safe. In this event the gyroscopic and gasoline engine driving machines should both fail on his return trip, he can send out distress rockets through the rocket shuttle attached to the periscope, and rescued by a boat from the mother-ship or by patrol boats sent out from shore.

MAGNETIC INDICATOR FOR CIRCULATING TEMPERATURES.

The fact that steel loses its magnetism properties on attaining the critical temperature forms the basis on which has been designed an instrument which faithfully indicates the instant when a mass of steel has attained the decalcescent, or hardening point. The instrument consists of a contact box containing magnet and coils, mounted on a base which is provided with handles and heat shield. The other end of the coiled wire gives a fixed point, the meter of which indicates the gradual approach of the steel to its magnetic or critical point.

THE THERAPY OF LIGHT AND THE NEW "R-RAY." (Continued from page 15)

radiation is somewhat similar to the Ultra-violet ray, inasmuch as an arc is used; but it is a different and different apparatus is employed in this work. The arc is produced between an electrode composed of quartz and mercury with some electrode of ordinary arc carbon. Fig. 1 shows one of the complete arc lamps used in these experiments.

Assembled as a spectrograph the R-ray occupies one side of the Ultra-violet region and grades uniformly from the first octave or 393.3 inches, to the second octave or 393.3 inches. All so it is a finding of the analyst must have the care and matter to have such affinity that they are instantly absorbed, and investigation of their characteristics can only be conducted in a vacuum.

As resultant deductions of therapeutic interest in considering the properties of the R-ray, we find the following:

1. They are readily controllable and give penetrative therapeutic light of unlimited intensity.

2. They are rich in Ultra-violet rays of shorter wave lengths than the emissions from sun or arc.

3. They differ materially from X-rays in that they may be deflected and focused on any given area so as to combine their heat and x-ray rays and make their visible and invisible light radiations.

4. They are more readily absorbed by matter than any present known arc ray, and as such secure vibrations in deep-seated cellular organisms.

In order to show the position of the magnetic arc when the R-ray lies in one of the Angstrom units (one Angstrom unit is equal to 1/10 of a meter and this unit is abbreviated as A.U.). Thus the wave given in this example is used simply for the present and using here the language of the scientist. The Angstrom unit is equivalent actually to one ten-millionth of a meter, or 25.4 millionths of an inch or 0.0937 inches.

The chart indicates the wave lengths of radiations ranging from the visible part of the spectrum to X-rays and the Gamma rays of radium.

To fully understand this chart, the following notation is used: the numbers across the top give their magnetic wave lengths in Angstrom units (one Angstrom unit is equal to 1/10 of a meter and this unit is abbreviated as A.U.). Thus the wave given in this example is used simply for the present and using here the language of the scientist. The chart indicates the wave lengths of radiations ranging from the visible part of the spectrum to X-rays and the Gamma rays of radium.
Magnetic Drilling Attachment
(No. 1,219,195; issued to Henry S. Symes.)
The inventor here provides an electro-magnetic means of feeding a machine drill against its work.

An iron frame supports the drill spindle, which is driven by an electric motor. The spindle carries a suitable iron pole and pole-pieces which are acted upon attractively by powerful solenoid electro-magnets, tending to pull the iron pole-pieces within the coils. The current supplied the magnet coils can be varied to give various degrees of pull on the pole-pieces. For linear vertical action two or more sets of solenoids, one above the other, can be utilized as shown.

Electric Phonograph Recorder and Reproducer
(No. 1,218,799; issued to Herman G. Pape.)
A device for making phonograph records and combining in its makeup a suitable electro-magnet, a dial, and a means for causing the diaphragm to vibrate in response to electrical impulses in the electro-magnet—as from a microphone. Acoustic vibrations or sounds can operate the diaphragm as usual thru an open grid above it a stylus being connected to the diaphragm to vibrate with it.

Electric Voting Machine
(No. 1,219,053; issued to Marshall F. Thompson and Arthur L. Townsend.)
A novel scheme for producing high frequency oscillations for radio-telegaphy, radio-telephony and similar arts. Using alternating or high generated current as a source, the inventor provides choke coils 8 and 7, across which is shunted the special spark gap 4, 4, This gap is disposed by an oscillatory circuit comprising suitable condensers 9 and inductance 10. The first discharge wave of the condenser across the gap is quenched by blowing a high velocity 5,000 ft. per second jet of gas or fluid between the rapidly rotating spark discs 4, 4. Higher frequency is claimed and the production of an extremely high note, dead-beat undirectional discharges.

Precision Variable Inductance
(No. 1,317,348; issued to O. F. Mathen.)
The smallest part of the turn of the spiral may be accurately tuned in or out of the circuit by simply turning the central knob or handle. Spiral inductances of this type invariably have the defect that the slider will not follow the turns. Here the inventor provides a toothed rack on the slider arm which coacts on a feth central gear stud, so that as the handle is turned the slider arm is moved in or out accordingly and in a spiral path the complement of the helix. The pitch circumference of the stationary pinion is selected equal to the radial pitch of the spiral.

Electric Musical Instruments
(No. 1,216,629; issued to Henry S. Marriott.)
When an interrupted current of the frequency corresponding to any certain musical note is fed into the use of the Alexanderson magnetic amplifier 11, 11, with which to control by microphones, the output of a 100 K. H. radio frequency alternator. This R. F. current is passed (also modulated by secondary 11) thru a frequency changer 20, then thru a non-inductive oscillator 20. This is lighted and coupled to oscillator 21, supported at two points, as shown, and carrying a large metallic diaphragm 26, say 50 feet square.

Hearing Device
(No. 1,219,411; issued to Charles E. Williams.)
A specially sensitive electric telephone device to aid partially deaf people to hear better. Operating on the diode principle it comprises a super-sensitive microphone which is connected with a suitable telephone receiver and a high voltage battery. The battery comprises a plurality of cells and serves to reduce the high potentential by having an extra resistance wire between a terminal on one cell and a pole of another, with flexible connections between the external terminals to the receiver and microphone.

Radio Transmitting System
(No. 1,216,615; issued to George Selch.)
A radio transmitter operating on direct current, which is supplied to a quenched gap, thru suitable choke impedances and resistances. A suitable coupling is provided to enable the cutting off of oscillations in the closed primary oscillating circuit after the first burst of oscillations. The spark gap is designed to be short, and a very high dissipator, thus quenching the spark and giving rise to powerful, slowly damped free oscillations in the secondary or aerial-ground oscillating circuit and it is claimed that the two-coupled oscillations practically disappear. This system is adapted to radio-telephony, using a microphone in the ground lead.

Submarine, Subterranean and Aerial Telephony
(No. 1,212,202; issued to Reginald A. Fessenden.)
A new phase of the Fessenden system of setting up, transmitting and receiving powerful sound waves in the form of telegraphic and telephonic signals thru water, land or air. Prof. Fessenden here invokes the use of the Alexanderson magnetic amplifier 11, 11, with which to control by microphones, the output of a 100 K. H. radio frequency alternator. This R. F. current is passed (also modulated by secondary 11) thru a frequency changer 20, then thru a non-inductive oscillator 20.

D.C. or A.C. MAINS

COPIES OF ANY OF THE ABOVE PATENTS SUPPLIED AT 1¢ EACH

THE ELECTRICAL EXPERIMENTER
May, 1917
THE ELECTRICAL EXPERIMENTER

May, 1917

PHONEY PATENT OFFIZZ

AUTOMATICK BRAT HUSHER
C. U. SPIDOR OF PERAMBLATOR, CA.

Species Fikation of Patent Letters

Patent Buscated

Let It Be Known to All Fathers, Mothers, Parents, and Elders throughout the Land and the Seven Seas and Lakes, that I Constantine Ulysses Spidor of the City of Peramblator, in the State of Prolonged Coma, have imagined, conceived, designed and executed, at the Risk of my imperfect sanity, an apparatus which will revolutionize the baby industry and do away forever with the hand that rocks the cradle.

The sad result of the upshot is, that the annual total production of babies and brats has almost reached the vanishing point. It is also to be noted with significant significance, that altho everything else imaginable has gone up during the war, only the output of babies and brats has gone down! And this despite of the constant up.roar-ous roar of Teddy from Oyster Bay.

Happily, such disgraceful conditions need prevail no longer, due principally and solely to my marvellous Automatick Brat Husher. By using this inexpensive apparatus, parents may now tango or "movie" all night, if so desired, without in the least retarding the natural growth of their offspring. Also and most important of all, "Palm-pah" need no longer invent new forms of sudden strokes, cramps, colds, fevers, chills, etc., which make it impossible for him "just then" to leave a comfortable, warm bed, in order to perform the twice-nightly Marathons with an obstreperous brat, clutched tightly in his arms.

Having thus explained my invention in non-technical terms, I now refer to the patent drawing for further elucidation: 1. is a sensitive (but happily unfeeling) microphone. The first brat-yell jars its sensibility to such an extent that current begins to flow thru it at a terrific rate, which in turn operates electromagnet 2. This actuates pawl 3 permitting Thermos-bottle 4, containing the best imported Extract de Cow to con-descent downward into the brat's fists. Instinctively the Brat stuffs the nipple in its empty void and the land becomes quiet once more. But this is not the end of a perfect day. Simultaneously with the descent of bottle 4, a contact is made and electromagnet 5 attracts switch 6, usually held off by spring 7, which now actuates instantaneously motor 8. Gear 9 takes up the Q.S.T. (General Call) and Peramblator 10 now begins to perambulate viciously back and forward, being thus induced by arm 11.

Neither does this end the story. Brats as a rule, due to the cunning of nature are not satisfied with cow-juice and perambulating joy rides only. They wish to be talked to and sung to. Bearing this requirement in mind, when bottle 4 is empty and has ascended once more, thanks to coil-spring 13, electromagnet 12 releases victrola which begins to talk and sing lullaby to brat. This so bores the latter that he, she or it, falls to sleep at once.

11, perchance, the Brat should wake up once more and yell, 10 gets busy once more and perambulates at once. Spring 14 has reset reproducer 15 in the meanwhile, when mother's original selection issues forth anew. This so disgusts the Brat that he, she or it, falls to sleep instanter.

What I claim is:

1° A self-contained automatissick Brathusher.

2° A Brathusher making attending parents and nurses unnecessary.

3° A Brathusher supplying feed, lullabies and rocking simultaneously.

In subscribing to the above facts, I have therefore implanted my own facsimile otograph hereunder and forever on this 27th day of Monday in the 53rd year after the advent of the safety-pin.

C. U. SPIDOR.

By his Attorney

A. Bruce Browne, Norwich, Conn.

Witnesses:

S. H. Utup

Wade U. Givens

Fore F. Lusher

www.americanradiohistory.com
RADIO QUERIES.

1. Could I hear amateur stations with a loose coupler, galena detector, first condenser, and an Electro "Government" phone in connection with an aerial fifty feet high and thirty feet long? If not what other instruments would I need? A. 1. There is no reason why you should not receive amateur stations with the instruments you mention. A variable condenser shunted across the secondary of your loose coupler will increase the selectivity very much.

Q. 2. How can I drill holes in a marble slab so that I can mount a ground switch upon it?

A. 2. An ordinary steel twist drill should be employed which should be constantly kept wet by applying water to its boring surface.

Q. 3. Would I be violating the rules of the Fire Underwriters if I put a 1 inch coil, my outside ground switch and covered the ground wire with lath?

A. 3. Yes. The ground wire should be kept free from any surrounding objects.

POWER FROM PRIVATE PLANT.

1. What is the best way to use the output of a private lighting system in a radio sending set? The generator has an output of 30 to 45 volts and 13.3 amperes, and can supply a storage battery of 36 cells.

A. 1. The best way to utilize the electric power generated by your private plant is to employ a spark coil outfit, the size of the coil will depend upon the distance which you desire to cover.

Q. 2. Can I use it in connection with an open or closed core transformer, or is the spark coil the only way?

A. 2. Yes, providing that a mechanical vibrator is used in conjunction with it when using an open core transformer. This can either be directly operated by the transformer core or else you may employ an independent vibrator. We would advise that you employ a spark coil, say about a 4 inch coil, and you will find that it will give better service than if an open core transformer is used.

Q. 3. Could I not use the combined voltage of the generator and battery and have sufficient voltage?

A. 3. Yes; but the voltage will not be sufficient or of the correct character to operate a transformer without a mechanical interrupter.

UNDAMPED WAVE RECEIPTON.

1. Is it possible to employ a mineral detector in place of an Audion detector for the reception of undamped waves? If so, what connection of instruments should be used?

A. 1. It is possible to receive undamped waves by employing a crystal detector providing a "tikker" of some kind is employed in the detector circuit. The diagram of connections is given herewith and shows a circuit breaker incorporated.

Q. 2. Will you please publish a diagram of the connection of the instruments used in a simple inductive wireless telephone circuit?

A. 2. Our diagram gives the connection of a simple radio telephone employing the induction principle. The transmitting coil should be five feet in diameter while the receiving coil is four feet. Each coil is wound with one hundred turns of annunciator wire.

Q. 3. Is it advisable to employ a helix with a one inch spark coil?

A. 3. If you desire to bring your transmitting wave length to some definite value, you should employ a helix.

MOTOR STARTING QUERY.

1. How should a shunt motor be started?

A. 1. First, the field current is applied at full line voltage; then the armature current is thrown on at much less than line voltage, the voltage being held down or controlled by resistance in a starting box; ordinary lead resistance is cut out step by step until full line voltage is impressed on the armature. This is all accomplished by one motion of the handle of a well-designed rheostat or starting box. Most starting boxes are so arranged with a magnetic release or otherwise that the motor is automatically cut out of the circuit in case the line voltage should, thru any accident, be shut off.

Q. 2. What is an accumulatively wound compound motor?

A. 2. It is a motor whose series and shunt field windings are in the same direction and therefore as the load comes on the series field assists the shunt field and a stronger magnetization and increased torque, with slightly reduced speed, results.

STORAGE BATTERIES.

1. What kind of radio receiving circuit for undamped wave signals?

A. 1. What is the storage battery sometimes put in electric lighting or power stations?

A. 1. To carry the prob of the load, i.e., that excessive portion of the load which, for instance, in electric lighting stations has to be carried only for two or three hours a day. They carry the entire load at minimum hours; to act as equalizers or shunt motors.

Q. 2. How do Faure plates compare with those of the Plante type?

A. 2. They are much lighter and have a higher capacity, but have a tendency to shed the material from the grid, thus making the battery useless.

Q. 3. At what density is the resistance of dilute sulfuric acid at a minimum?

A. 3. At 1.260 Baumé.

MOTOR ACTION.

1. Why does the speed of a shunt motor increase when the position of the brushes is off neutral?

A. 1. When the brushes are shifted from the neutral plane, the reverse voltage between the brushes is decreased, the speed remaining unchanged. Accordingly, the pressure in the series winding force an increased current thru the armature, thus producing an increased armature pull, which causes the speed to increase until the reverse voltage reaches a value sufficiently large to reduce the current to the value required to supply the necessary driving power.

Q. 2. Can you tell me the existing mutual relations of motor torque and speed?

A. 2. The character of the work to be done determines only degree of the motor torque and speed required, but also the suitability of a particular type of

(Continued on page 52)
You then have everything in wireless and electrical supplies worth while at prices that mean a substantial saving to you. Our catalog is recognized by all experienced and advanced amateurs as the Beacon Light on what to buy. Ask your wireless friends. Great cost of catalog and low prices prohibit distribution unless upon receipt of 8 cents, which you may deduct on first dollar purchase.

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Every worth while feature is incorporated in this Regenerative Set. Initial tests in our laboratory and at the local Scott High School brought in with remarkable clearness amateur stations in Texas, Louisiana, Wisconsin, and all eastern states. Amplification and selectivity surpassed several other sets tested in conjunction with it. We have no hesitancy in claiming for this instrument no superior, and in fact we think far know of none that equals it. It is designed for wave lengths from 180 to 475 meters. Case 6½" x 11½" x 6½", hand rubbed mahogany finish. Panel, polished Formica. Set has variable coupling. This is essential for selectivity and the elimination of static, thereby insuring greatest possible range. Primary circuit adjustable by single turns. Grid inductance adjustable by 12 point switch. Special variable condenser included in circuit for close tuning.

$24.75
Prepaid.

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VARIABLE CONDENSER

This Condenser is similar to your commercially but is enclosed in an oak cabinet. It has 5 semi-circular aluminum plates. The maximum capacity is approximately 0.025 μF.
THE ELECTRICAL EXPERIMENTER
May, 1917

EXPERIMENTAL CHEMISTRY.
(Continued from page 43)

The test tubes, add fresh acid, and drop a piece of Calcium carbonate (marble) into each tube successively. Proceed in the same manner as with the metals in the foregoing experiment, only in this case the gas must be tested not only with a burning match but also with litmus paper. Dip a clean glass rod into lime-water, and hold it in the escaping gas. (The escaping gas is Carbon dioxide.)

It will be noticed upon the introduction of the litmus, that the blue paper (or solution) is turned red, whether the paper (or solution) has turned blue. This is a characteristic of all bases, and is employed as a test for them.

After testing as above pour out the contents and rinse the tubes.
If we arrange the symbols of the above bases we have:

\[
\begin{align*}
\text{HCl} + \text{NaOH} & \rightarrow \text{NaCl} + \text{H}_2\text{O} \\
\text{CuCl}_2 + \text{Na}_2\text{SO}_4 & \rightarrow \text{CuSO}_4 + \text{NaCl}
\end{align*}
\]


WIRING QUERIES.
(766.) W. H. Florence, Buffalo, N.Y., desires to know:

Q. 1. What are the disadvantages of open wiring?

A. 1. The wiring is not sufficiently protected from moisture and the effects of fire which will destroy the insulation of the wires; it is also liable to mechanical injury.

Q. 2. How far apart should the wires be placed if open wiring is used?

A. 2. We have installed in dry places and for pressures below 300 volts, the insulators should separate the wires 1½ inches from each other, and 1½ inches from any work or floor. For voltages from 300 to 500 volts the wires should be separated a foot and one inch from each other and one inch from the surface upon which they pass. When wiring in damp places or over metal ceilings the wires should be at least one inch from the surface.

Q. 3. How should the wires be protected when run vertically on walls?

A. 3. They should be boxed in or run in a partition. The latter should extend six feet above the floor.

RADIO-TELEPHONY.
(767.) Marion L. Brown, Orelia, inquires:

A. Please advise me as to whether the hook-up which I send you will work on 110 volts, alternating current, using an ordinary telephone transmitter. If this hook-up will not work, please send me a simple hook-up that will work on 110 volts A.C., using a telephone transmitter and that is inexpensive.

A. 1. The diagram of connections which you submit will not work satisfactorily and wish to inform you that in order to make a radio telephone operate on A.C. you must connect the transmitter in series with the primary of the oscillator transformer. An ordinary microphone, employing the telephone practice will handle more than one-half amperes, so that it will be necessary for you to confine your power below 1½ K.W. If more power is to be controlled, then several microphone transmitters will be required in parallel and their mouth pieces brought to a single mouthpiece.

WAVE LENGTH PROBLEM.
(768.) Wm. H. Mansfield, Jr., Putnam, Conn., desires:

Q. 1. What is the wave length of an aerial 144 feet long, 30 feet high and a 70 foot hanger? It is a three wire aerial.

A. 1. The wave length of your aerial is 330 meters.

Q. 2. What is the wave length of an aerial 6 wires 30 feet high and 35 feet long?

A. 2. The wave length of this antenna is 1600 meters.

Q. 3. What is the smallest sized spark coil an Oscillation Transformer can be efficient?

A. 3. This will depend upon the antenna system and the wave length which you desire to tune. It may be said in general that one wavelength of the largest number that the coil will require. The primary winding has less turns than those of the secondary.

(Continued on page 54)
LENZITE CRYSTAL DETECTOR
Patented May 2nd, 1916

A first class Wireless Detector is half the battle in the wireless game. Have you tried the best and most effective, The "Lenzite" Crystal Detector?

Why Is Our Detector Near Perfection?

Being a user of an Audion Bulb and having firmly, after due test and consideration of "mineral detectors," discarded them as unstable and unreliable and very inconvenient, being hard to keep in adjustment, I was very skeptical as to Lenzite, but glad to make the test and more than pleased that I did so.

I found that the reception of signals with Lenzite as a detector quite beyond any hopes that I may have had.

Inasmuch as the mineral in question (Lenzite) seems to be "sensitive" nearly all over its surface on all sides, which is a very great advantage as it makes it almost as easy to keep in adjustment as an audion, and brings in the signals, when proper arrangement is accomplished, in a very loud and positive manner, and I must add I was greatly surprised as it, without any question, has given me far greater results than any other sort of mineral detector I have tried, and I have tried to get all that I have been able to hear of.

Its clear, loud, readable demonstrations should make it very desirable to operators whether or not they use audions, which consume power which Lenzite does not, and it is quite as good for long distance work as well. I shall be glad to tell others of it.

Very truly,

HERBERT W. BRISCOE.
(61 H. U.S. License.)

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 Pasadena, California

VACUUM TUBE DETECTORS

Notice to Our Customers

Have you received our new circulars containing our guarantees?
Is the tube you purchased from us giving you absolute satisfaction?
Remember we live up to our guarantees.

This detector does not employ or incorporate an evacuated vessel containing three electrodes, namely, a filament, a plate, and a grid disposed between the filament and plate.

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THE STORY OF FLASHLIGHT MAKING.

All of us have undoubtedly found the electric flashlight extremely useful at some time or other, but very few people are privileged to know just how the flashlight is made. One of the leading manufacturers of these useful devices recently con

控制的机器在没有使用的情况下自动控制。这将使机器能够在任何时候进行积极的控制。

The only real solution so far to this problem involves the use of the gyroscope and the work done by Sperry. The line gives much light to the solution. Fig. 5 illustrates the Sperry automatic pilot which controls the pilot of the labor and drudgery in operating the controls of his machine. In the military aeroplane it renders it possible for the pilot to fulfill the duties of both pilot and observer. When dropping bombs it enables the pilot to bring the aeroplane laterally over the target, makes a reference plane of the aeroplane, which greatly increases the accuracy of bomb dropping, and creates a steady platform from which to fire and drop bombs.

The equipment consists principally of three units—the generator, servo motor and gyro unit—which may be likened respectively to the heart, muscles and brain of the human pilot.

The gyro unit which is placed in a metal case and shown in the background utilizes the gyroscopic effect of the four rotating gyro's which in maintaining a horizontal reference plane. Any departure of the aeroplane for its set relation to this gyroscopic reference plane causes an electrical contact to be made which completes a circuit to switch on the magnetic clutches in the servo motor. The case is equipped with a glass window to enable the operator to note the operation of the gyro unit. The power generated in the servo motor air turbine is now transmitted through the engaged clutch to one of the drums over which the control wire passes.

The generator which is seen in the foreground of the photograph supplies alternating current for driving the gyro and direct current for the servo motor clutches. It consists of a double armature, one winding of which is used for the generation of the alternating current and the other for direct current. It is driven by means of an aluminum propeller driven by the air current. The four leads are run from the rear to the generator.

By means of a special switching arrangement on the gyro unit the operator can set the aeroplane to any position relative to the horizontal which he may desire, by simply pressing a button located conveniently on the manual control and moving his controls as though no automatic pilot were installed on the machine. When the aeroplane reaches the desired altitude, the button is released and control is again given over to the automatic pilot, which will hold the machine at that altitude until altered by the operator.

Complete and unharmed control may be instantly resumed at any time by pressing on the manual control switches.

WAR CONFERENCE WITH TELEGRAPH AND TELEPHONE.

Messrs. Theo. N. Vail, president of the American Telephone and Telegraph Company; Newcomb Carlton, president of the Western Union Telegraph Company; Charles P. Bruch, vice-president of the Postal Telegraph-Cable Company; F. B. McKinnon, vice-president of the United States Independent Telephone Association, and N. C. Kingsbury, vice-president of the American Telephone and Telegraph Com

any, were in conference with war department officials at Washington on March 19 to perfect plans to insure the government rapid and efficient wire communication.

QUESTION BOX. (Continued from page 42)

WAVE MOTORS.

(260) G. H. G. Detroit, Mich., inquires as to the efficiency and practicability of wave motors:

A. 1. We do not know just now of any successful installation of such wave power plants as described in the February issue of this journal and while the initial cost of installing such equipment as we now have is not so prohibitive, there has always been more or less prejudice against them, owing to the fact that the power developed is so irregular.

There have been a number of attempts made by inventors to overcome this difficulty, but the fact of the matter remains that we have yet to see a practical installation of a wave motor on any large scale. The proposition to our mind seems to possess many practical and economic features, and it seems very likely that in later years a future generation may see the adaptation of wave motors to a very large extent.

You may obtain copies of the patents issued on this interesting subject by communicating with U. S. Patent Office, Washington, D. C., and with these before you, you will be in a better position to see just what has been done and what has been proposed in solving this problem.

CONDENSER IN AERIAL CIRCUIT. (270) Anthony S. Detrees, Hartford, Mich., asks:

Q. 1. Can a series condenser be used successfully in connection with a transmitting line, to reduce the natural wave length of an aerial from 325 to 160 meters?

A. 1. Yes.

Q. 2. Would such an arrangement result in low efficiency in transmitting?

A. 2. The addition of a condenser in series with the antenna circuit increases considerably the amount of losses and at the same time increases the decrement due to an increase in antenna resistance by the series condenser.

32 VOLT LIGHTING PLANT. (281) U. J. Grant, Apple Creek, Ohio, writes:

Wiring Diagram for 32 Volt Lighting Plant.
Q. 1. I would like to have a wiring diagram for a 32 volt isolated lighting plant with the following apparatus: 34 K.W. generator, 32 volt 60 ampere-hour storage battery, switchboard with voltmeter, zero-center ammeter showing charge and discharge, circuit-breaker, regulating rheostat for generator and proper fuses and switches.

A. 1. The accompanying wiring diagram gives the connections of a complete 35 volt lighting plant.

Q. 2. What is the wave length of my inverted "L" type aerial, composed of one wire 40 feet long, 70 feet high at one end and 40 feet at the other, with 30 feet lead-in and 20 feet ground (No. 4 copper wire)?

A. 2. The wave length of your antenna is 617 meters.

**Dynamo Queries.**

(772) George Leidy, Cleveland, Ohio, desires to know:

Q. 1. Can a 12 volt, 9 amperes dynamo, such as the "Electro" Hercules charge successfully two 6 volt, 100 ampere-hour storage batteries in series?

A. 1. Yes. They should be connected in parallel, however.

Q. 2. Can a 25 volt, 4 amperes dynamo be run in series with four 6 volt, 100 ampere-hour storage batteries to produce 50 volts?

A. 2. Yes, providing that the batteries are fully charged. It would be advisable to employ an underload circuit breaker in the storage battery side so that they will be disconnected when they are in a discharged condition, thus preventing the charging of the battery by the dynamo in an opposite direction, in this way preventing the plates from being ruined.

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**Thordarson Wireless Transformer**

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You benefit by mentioning "The Electrical Experiment" when writing to advertisers.
INDIRECT LIGHTING. (775.) J. Andrews, San Francisco, Cal., inquires:
Q. 1. What is meant by indirect lighting and what are its characteristics?
A. 1. Indirect lighting as the name signifies is that form of illumination in which the light comes to the working plane indirectly. The light of the lamp is directed at the ceiling by suitable reflectors, and from there is diffusely reflected into the room, making the ceiling a secondary light source. The enlarged low brilliance source of light, the ceiling position and diffuse, invisible, free from glare. Shadows are softened and merge gradually into the brighter areas. There is practically no glare or reflection from glossy surfaces. Recent tests apparently confirm the general belief that indirect lighting has a far more healthful influence on the intensity of illumination for comfortable vision and causes very low fatigue of the eye as a result of several hours' work.
Q. 2. What are the chief considerations in planning an adequate lighting installation?
A. 2. Planning a lighting installation is a complex problem, requiring due consideration of a number of factors. The intensity of illumination must be ample for clear comfortable vision; the distribution must be nearly uniform over the working plane. The color of the light must be suitable for the class of service and, to some extent, must fit the taste of the individual and the diffusion must be satisfactory for the class of service. The sources of illumination must be placed well above the range of vision and the intrinsic brilliancy reduced by the use of diffusing glassware or indirect reflector equipment; shadows on the working plane must be softened and toned down so as not to be too abrupt and for drafting rooms, operating rooms, etc.
B. Also objects capable of high specular reflection (glossy objects) should be removed from the range of vision.

POWER HOUSE PROPOSITION. (774.) Paul Wheeland, New Brunswick, Ga., inquires:
Q. 1. What types of power houses are used by large factories as we desire to equip our plant with an electric equipment?
A. 1. There are several types in common use. Single direct current of 125 volts is in some cases. However, 220 volts direct current is popular among steel mills. The larger ones sometimes use 500 volts. Alternating current is largely used, induction motors being employed to drive machines or line shafting. Cranes are mostly operated by direct current, although alternating current may be used for this purpose.
Q. 2. What arrangement of excitation is customary?
A. 2. Direct current generators are usually self-excited. Alternators usually require separate exciters and are built from a relatively small direct current generator. It is preferable that the exciters should have a separate prime mover if space economy is possible, the many exciters are driven by the same engine that drives the main generator.
Q. 3. What considerations determine the voltage of a generating line?
A. 3. The voltage of a transmission line is found by a careful study of the advantages of various voltages in permitting the transmission of a large amount of power on a small conductor; the advantages and disadvantages of voltages because of the greater ease of impressing the distance to be covered and the nature of the country thru which the line is to be run. Due consideration is also given to the first cost of power. If it is obtained from water power or from very cheap coal, it may be best to design for relatively high line losses. If coal is transported a long distance it is generally more expensive, and the line must be designed for low losses. Each case requires special study by experts.

INDOOR AERIAL. (775.) Mr. Shane, Grand Rapids, Mich., says:
Q. 1. Kindly let me know what an indoor aerial is made up of and the distance one can receive with such an apparatus.
A. 1. An indoor aerial is nothing more than an ordinary antenna which is erected indoors. The signal in some cases one can receive with such an antenna may depend entirely upon the sensitivity of the instruments used with this type of aerial.
A. 2. Kindly let me know where I can get full set of rules in reference to size and power receiving and sending set the Government will allow one to have and what is necessary to pass examination to allow a large set to be erected.
A. 3. We advise you to communicate with the Radio Inspector of your district who will give you all the information you desire.
Q. 3. Kindly let me know if it is always necessary to have a wire run all the way down to the earth to make a ground and if one is in a hotel on the ninth floor or in a building how can one make a ground without having to let a wire down to the street at the same time wanting it to be safe from all danger to property or in case of lightning and if the apparatus will be just as efficient in receiving.
A. 2. It is not necessary to run a wire down to the ground if a water or gas or even a radiator pipe is located near the station. However, in erecting a lightning ground it is necessary to wire from the lightning switch to the outside ground, which must connect from the ninth floor as in your case. The sensitiveness of the receiving outfit will not be lowered by this ground.

RECEIVING RADIUS. (776.) Harry Cate, Chattanooga, Tenn., inquires:
Q. 1. Can a loose-coupler, a tuning-coil and a loading-coil all be used together successfully?
A. 1. Yes; providing they are properly connected.
Q. 2. What would be the range of the following set with an aerial 45 feet long and 40 feet high if question (1) is correct?
A. 1. Small tuning coil (E. J. Co.'s "Electro" tuning coil), a small loose coupler (E. J. Co.'s "Electro" loose coupler); loading coil with wave-length 5000 meters, galena detector, 2 ft condensers and 3000 ohm head set.
A. 2. The approximate receiving range of your apparatus is 1.500 miles.

SERIES CONDENSER. (777.) John Huether, Sharon, Pa., inquires:
Q. 1. Is it necessary to use a series condenser with a transmitting set on an aerial 75 ft. long and 55 ft. high?
A. 1. A series condenser is not necessary if the set is tuned to its natural period of 200 meters as the condenser is for the aerial you possess it will not require a condenser in series.
Q. 2. Are you allowed to have an input of over 0.1 amperes on a 75 ft. aerial to the transformer to comply with Radio Regulations, or can you have whatever input the transformer will draw? (Operated from 110 volts A. C.)
A. 2. 91 amperes of current at 110 volts A.C. is just permissible. However, we would advise that the transformer should be operated on 9 amperes so as to be on the safe side.

HYDROGEN GENERATION. (778.) W. II. Allum, Quebec, Canada, asks:

Q. 1. Would it be practical to make a small apparatus to generate hydrogen gas by the decomposition of water by direct current if so, kindly send me a rough sketch of apparatus mentioned.

A. 1. The most practical and inexpensive method of generating hydrogen gas is by the decomposition of water by a direct current. In this work, it is essential not to employ too great a voltage, but a large current. There has been a large number of different types of hydrogen generators developed but the one described on page 547 in February, 1916, issue of this journal will be found most suitable for the making of a small machine. Not only will you be able to obtain hydrogen gas but at the same time and with the same current and water you will obtain oxygen gas.

Q. 2. Would hydrogen gas generated in this manner burn by itself, the flame to be used for the purpose of lead burning in connection with the repair of storage batteries and lead containers for the same? I have access to 125 volt D.C. up to 60 amperes.

A. 2. The hydrogen gas generated by this electrical method will be required to be combined with oxygen making the so-called oxy-hydrogen blow pipe. This oxygen will have been obtained from the same generator. The gas produced will be required to be collected in some reservoir chamber equipped with proper safety valves.

Q. 3. Has hydrogen gas any injurious effects upon metals, if so what metals are suitable for the construction of such apparatus.

A. 3. Hydrogen gas has no injurious effects upon metals, but when combined with oxygen and ignited they will be molten as it produces terrific heat, the value of which is next to that of the electric arc.

TRANSMITTING SET. (779.) F. Gibbons, Toronto, Ont., asks:

Q. 1. What instruments are required to make a transmitting set efficient? How do you connect them?

A. 1. The following instruments will be required and operated on 110 volts alternating current: 1. A 15,000 volt transformer, kick-back preventer shunted across the primary of the transformer, heavy key, high tension condenser, having a capacity of 450 microfarads, 2. Oscillation generator, 3. Oscillation quenched spark gap, oscillation transformer and hot wire ammeter used for indicating the amount of radiation in the antenna system. The connections of the instruments are given here. With the above mentioned instruments and an aerial composed of a wire 80 feet long and 60 feet high, you should have no trouble in covering a distance of 80 to 100 miles.
Finds Executives Instantly!  
**On the Dock On Shipboard**

On long, dimly lighted docks, piled high with merchandise, it is not easy to get into immediate communication with Superintendents or Foremen. On shipboard, too, Officers on tours of inspection or off duty may be wanted urgently — and no one knows where they are.

But the National Calling System will find such men at once. To illustrate: The telephone operator, having been instructed to find Mr. Smith, sets the small levers on the calling instrument for his code number and then gives the operating key a quick turn. Instantly, this code number is sounded simultaneously all over the dock or vessel, as the case may be, on electric chimes, horns, buzzers, or whatever signaling devices are in use.

Mr. Smith cannot get out of hearing of one of these signals, no matter where he goes. He gets his call instantly and immediately answers from the nearest telephone or reports in person.

No Executive or Officer on ship or dock can afford to be out of reach. The National Calling System enables him to go where he will because he can be found instantly at any time.

Send for Complete Information and Descriptive Booklet No. 34.

---

**RADIO WIRING DIAGRAM.**

(780.) *Experimental* Reader, Pleasant Plains, Ill., desires:

Q. 1. Please give me a diagram of the following instruments for both damped and undamped wave reception: Loose coupler, loading coil, Audionron bull, galena detector, buzzer and push button, two variable condensers, phones and a large loose coupler for undamped waves. Please give necessary switches for changing from damped to undamped for either detector, and for using the variables on either the damped or undamped set. Also the necessary loading inductances in the undamped circuit if there has to be any.

A. 1. We give herewith a complete wiring diagram of a damped and undamped receiver, showing the necessary switches.

Q. 2. Could this set receive music on the undamped wave? If not, please tell me how.

A. 2. Yes, providing the Audionron tube is set oscillating.

Q. 3. The capabilities of Congress putting a stop to, or shutting down the Amateur stations of the United States?

A. 3. The 1912 radio law provides that the President has authority to close all radio stations in case of war.

---

**AUTOMOBILE SPARK COIL.**

(781.) Leo Peterson, Thorsby, Ala., wants:

Q. 1. Would an automobile coil with three binding posts giving a spark 1/2 inch long work all right for wireless?

A. 1. It will work satisfactorily for transmitting a short distance.

---

**AERONEELE RADIO GROUND.**

(782.) George Sloan, St. Louis, Mo., writes:

Q. 1. I would like to know the address of Dr. Nikola Tesla.

A. 1. The address of Dr. Nikola Tesla is 8 West 40th St., New York.

Q. 2. How do aeroplanes get a ground for their wires.

A. 2. By suspending a wire from the aeroplane which trails behind the machine.

---

**RADIO ARC TRANSMITTER.**

(783.) Mr. E. G. Farmer, Pittsburgh, Pa., asks several questions regarding an article on an Arc Type Radio Transmitter by Mr. Gordon C. Farmer, which appeared in the May issue:

A. 1. Is it possible to obtain a fairly high note with such an arc transmitter, especially if the arc is shunted with a suitable tone circuit after the method of Von Lepel? You might use a 43 plate Murdock variable condenser or the equivalent, providing the plates are immersed in oil. The size of the plates in the arc would remain the same for mica instead of paper; paper has been found best for this.
purpose after exhaustive experimentation. The paper is pierced with a pin-hole at the center when assembling the arc gap, and also it is extremely important as to just what kind of paper is employed—one of the best papers for the purpose having been found to be a certain kind of water line bond. The editor of this column does not recollect just now as to who made this paper, but you can obtain the name of the concern supplying this particular writing paper by communicating with the Institute of Radio Engineers, New York City.

An arc may be started with 500 volts using a small gap of 1/10 inch or so, especially where the circuit is made and broken by a quick break switch. The transformer described by Mr. Farmer would be rated at about one-half kilowatt.

FORMULA AND RECIPE BOOK. (784.) Tom Otis, Cedar Rapids, Iowa, writes for information on a book containing formulas and recipes:

A. 1. You will find books containing several hundred different formulas listed in our Book Catalog, which we shall be pleased to forward you on request. We shall also continue to publish a number of these formulas monthly in THE ELECTRICAL EXPERIMENTER.

ELECTRICITY AND LIFE. (Continued from page 23)

like discharge three feet in diameter (Fig. 1), and gives a heavy arc over two feet in length. (Fig. 2.) This shows remarkable efficiency when it is considered that the resonator is excited by a "Type E" transformer drawing only 1 K.W. and a con-
Dynamo Motor
For Boys $ 6.25

For producing current for inductance coils, recharging storage batteries, elec
troplating and hundreds of other uses. Well constructed throughout, excep
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This gap has been designed to sell at a low price and to meet the demands of ama
ateurs for a good, enclosed and silent type. Finished in dull black, it will add to the
appearance of your set. It is made in one style only, for all motors up to 1.5 K.W.,
and can be mounted in almost any position.

The gap is enclosed in a circular case holding 6 inches in diameter and 2 3/4
thick, with removable cover (for inspection). The adjust
ment can be as close as desired between sparking points.

When in operation this gap is very quiet
Price complete, without motor, $6.50
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ONE-INCH JUMP SPARK COILS for WIRE-
LESS $3.25.

Guaranteed to jump as specified or money refunded.

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609-513 Cedar Street, Milwaukee, Wisconsin

connections of 0.3 m.f. each in series. Such a condenser would contain 108-8 x 10
inch plates, and would be expensive, bulky and very heavy. For this reason the writer has
found it much more convenient to use a single 12 plate (0.01 m.f.) condenser across the
transformer secondary and to replace it when it punctures. The large resonator was operated
for six months in lectures of experimental work before a condenser section broke down.

The core for the secondary of the large resonator is of brass paperboard and was
built for the author by Bicknell and Fuller of Boston. Its dimensions (see Fig. 6)
were suggested by Mr. Earle L. Ovington, the core being similar in shape to those
used by Mr. Ovington in the New York Electrical show several years ago. Any
amateur can make a core of this kind by superimposing strips of heavy paper, soaked
in paste, over a wooden framework. The secondary winding consists of turns of No.
27 D.C.C. copper magnet wire. Two parallel strands of wire are wound onto the
core, the adjacent turns in contact; after winding, one strand of wire is
removed, leaving a space equal to the diam
eter of the wire between each of the 400
turns. The core and winding is then treated
with several coats of "Araldite" (ordinary
shellac will not answer).

The primary consists of five turns of thin
copper ribbon 1 inch wide, 1/4-inch paper
board strips being placed between the
turns. The diameter of the coil is 24". When completed it is taped and rotated in
a pan of melted wax until thoroughly im
pregnated. The terminal shown in the pho
tographs is made from a large brass oil
can, the stem being removed and replaced
by a 3/8" brass "bed-ball." The terminal is
not attached to the cone but simply rests
on its upper surface in contact with the end of the secondary wire. The primary and
secondary are separately supported by
quarz wooden blocks; the coupling is rather
loose, the bottom of the resonator being at
least two inches above the primary. The
lower end of the secondary coil is attached
to the inner primary terminal and grounded.

You benefit by mentioning "The Electrical Experimenter" when writing to advertisers.

May, 1917

Oh, You Skinny!

Why stop this as a rule? You don’t have to stop it simply because you are not
as tall as the fellow in front of you. You may be 4 feet 10 inches instead of 5
feet 10. Nobody ever tries a square mile. Why stop, then? Stop whenever you
try to buy a square mile, but keep going as long as you can only buy 100
acres. There is no reason why you should not have a foot of the street.

Do you expect Health and Strength in Tantalum form—through pills, potions and
other expensed pills? You can’t do it, can’t do it. The only way to be in perfect health
is by taking a cure in the open air. Put your coat on and go out. If you are
putting on weight, go out and shovel snow. If you are putting on weight and
putting on snow, go out and shovel snow. Snow is good for you. If you are
just plain fat, go out and shovel snow. If you are too read, go out and
shovel snow. If you are too dull, go out and shovel snow. If you are
penetrating people, go out and shovel snow. If you are bathing in your
brain, go out and shovel snow.

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cheeky fellow who gets the best
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why you should not wait any longer to
be in the perfect physical condition
that is the proper way of life for all.

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true. All diseases are rooted in nervous 
affliction. Chiropractic has proven

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The magnetic power of the earth is
or the bones which have dislocated,
and is the proper treatment for the

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of diseases which are by nature
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Perfect resonance is obtained by varying the number of turns in the inductance coil in series with the primary. (Fig. 8) This tuning system enables us to perform many brilliant experiments in communication, such as illuminating wires stretched across a lecture hall, lighting an inverted umbrella, and many very spectacular experiments. In an article in the Nov. 25, 1916, issue of Electronics, extra ordinary, entitled “Methods of obtaining high-frequency currents in medical and lecture work,” the author is greatly indebted to Mr. O. K. Luscom. For advice and assistance which made possible the successful construction of the large resonators.

At a recent lecture before the Belfast Association of Engineers Mr. A. W. Brown suggested the transmission of power generated from the tidal rise and fall of the water at Strangford Lough and Laugh Neagh to Belfast. Thus at Strangford Lough there are twenty square miles of water available, the spring tides have a rise of 26 feet and the neap tides a rise of 11½ feet, with a range of 7½ feet. About 20,000 horsepower could be developed for a period of two and one-half years.

THE WASHINGTON'S BIRTHDAY RELAY PRIZE WINNERS.

(Continued from page 22)

The Washington's Birthday Relay Prize Winners live in a state that has as much real estate in it as is blown into the air in some of our larger states during every windstorm. These few think they are very important and if you don't do as they say, they will close you up waters. They say, "The Danger Signal is up." Did you ever hear of a good, red-blooded American Kid who could be bluffed? No! It is not a game of chance. The Government is only too anxious for you to perfect yourself in the art, and help it by joining the "Radio Reserves." PRIZES

This is a winner for who would like to give everybody that helped a price, but it can't be done, so I am going to ask the boys who acted as sending stations to consider that they are one of the family and help me by agreeing that the prizes should go to the boys who made the best records in receiving and delivery. The rest of the amateurs will be rewarded by having their names printed in this magazine, so that when you grow old and have a little one on each knee in front of the old log fire, some cold night, you may read to them about Daddy and what he did when he was a mere boy.

Before you all get busy reading about the prize winners, I want to call your attention to what I have already written. A part of the series, appeared in the first installment, was turned in the most complete reports, or "logs," of the relay, that the writer has ever had the privilege of reading.

Hoyt, of Hayward, California, 6 SI, who is also a prize winner, turned in the most complete report ever seen.

Hoyt, of Hayward, California, 6 SI, who is also a prize winner, turned in the most complete report ever seen.


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PARTIAL CONTENTS


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Chemicals and Apparatus for the Experimenters. We have just completed a price list of chemicals and apparatus for experimenters. Send 10c in coin or stamps for a copy of this list. It will be valuable to you.

THE PORTER CHEMICAL COMPANY

Department B.

Hagerstown, Md.
he is glad he wasn't aboard the good ship "Hardship," as they shoot men in wartime for sleeping on duty. He was right on deck tho, all the time, and the writer could clearly read his calls to 9 ZF and answers to the boys east.

The boys of the San Francisco Radio Club also made splendid reports, as did also our College Professors, who are always with us.

A perfectly legal report was also received from a staid old lawyer in Jacksonville, Fla., who prefaced his letter with the remark that he was not trying for a prize, but being a "Radio-Bug," he just could not keep still.

A well known D. D. S. in Elmhira, also sent in a very complete report and called it a great night's work. I just compared two interesting letters from one amateur.

1916. He was diligently stabbing a piece of gauze and complaining about his embiator sticking on his one inch coil. Said he did not get M.S.G. but thought he would report anyway.

1917. He sent me a list of stations he hears, as long as your arm, and he is now sporting a one K.W. and working as a star relay station, 1,000 miles being as nothing to him. I heard him from my station--clear, quick sending, prompt business-like signatures, and abbreviations that went clear over my head. The world do move!

PRIZE WINNERS.

Mr. E. B. Duvall and Mr. A. P. Smith are awarded the prize of the Electro Importing Company—their "Xauen POZ" Radio Receiving Set. These young men operate jointly the Radio Station, 3 AK, in Baltimore Md. This prize is awarded for the quickest delivery of both messages, and particularly in being on the job for the return M.S.G. No one but the sending stations east of 9 ZF knew when the east bound M.S.G. was coming thru. If this had been a real emergency call for Government help on 200 meters, these same fellows would have landed the message just the same. Congratulations to them.

SECOND PRIZE.

Mr. W. B. Pope, 4 AA, of Athens, Georgia, is awarded the Professional Hope Meter, donated by the Electro Importing Company of New York. It was awarded for long distance reception, prompt business-like signature, timing and marking both east and westbound messages, received in approved commercial style. From a study of the Q.R.M. map, he was seriously handicapped on both messages, and is heartily congratulated by the writer and all good radio "sports."

THIRD PRIZE.

Kenneth Briggs of Rochester, N.Y., 8 MZ, whom you all remember as almost catching up with C. E. Hughes, the presidential candidate, with a copy of the Relay Message on October 26th, 1916, is awarded the One K.W. Transformer, donated again by the Thordarson Transformer Company of Chicago, thru their Mr. Connors. Mr. Briggs is congratulated on his persistence, good receiving, prompt delivery and true American spirit, as he showed not the least jealousy toward several of his working against him. The Q.R.M. map showed marked interference, particularly on westbound messages, and he can thank the Q.R.T. of W. C. Ballard, Jr. at Cornell College. 8 Xu, for giving him the chance to win this prize. I hope he will perfect his sending apparatus, and line up with the Q.R.M. League.

FOURTH PRIZE.

Scott High School of Toledo, Ohio, is awarded the William B. Duck's celebrated Arlington Tuner: for long distance reception with moderate apparatus: diligent and persistent listening for the return message and very complete business-like report.

FIFTH PRIZE.

Leander L. Hoyt of Hayward, Cal., 6 SI, is awarded the Chambers No. 759 tuner for the reception of arc and spark signals. This prize is awarded for the long distance work and incessant effort to line the boys up in that neighborhood, and the realization that, for once, California would be put on the Relay Map. Mr. Hoyt, besides, turned in one of the most wonderful and complete reports on everything that happened, from the moment the westbound M.S.G. left New York, until the eastbound message arrived, and he can thank the Q.R.T. of W. C. Ballard, Jr. at Cornell College. 8 Xu, for giving him the chance to win this prize. I hope you will hear more on this later. Mr. Hoyt was sent much real courage for worry when listening in on the wave lengths from 6,000 meters up as he heard during the relay from 600 meters down. California is surely lined up now for good work with such "elbows" as 6 EA for sending L.D. and 6 SI for detail work. Mr. Hoyt will make a valuable addition to the Q.R.M. League.

SIXTH PRIZE.

Mr. and Mrs. C. Candler—8 NH, whom you all know and have heard, are located in St. Mary's, Ohio, but their "Sigs." do not stay at home. During the Presidential Relay, this station received many credit cards and later stated that their transformer was not working right. They surely proved this during the last relay, as their "Sigs." were extraordinary, and they had not been for this station, lots of stations south and west would never have received the westbound M.S.G. at all. Some who did not know 8 NH was supposed to help on relay, reported him as Q.R.M. When you all get your stations arranged so that you can Q.R.M. boys 1,000 miles away, you are sure on the trail of efficient long distance work.

This station is awarded the prize of the

"Geyser" Electric Water Heater

INSTANTLY
The Hot Bath is Ready

Continuous Flow of Water as Desired. Always Ready.

You only pay for electricity as used. All water that passes through the "Geyser" is thoroughly sterilized. The "Geyser" is perfectly insulated and is absolutely safe, no danger of short circuiting or electric shock.

Cold to Hot Water by Merely Turning Handle.

Both the water and the current act together and both controlled by the movement of the square handle. To secure hot water turn handle to the left, for cold water turn to the right, at the center both the water and current are shut off.

The Supreme Court has decided that we control the absolute right to the manufacturing of "Geyser" Electric Water Heaters. Others take caution, as we will prosecute any infringing on same. Write us today to send you full information.

FELDMAN MFG. CO., Inc. 1514 Times Building, New York
Perfection Radio Laboratory of Clinton, Iowa. *One Short Wave Amplifying Tuner.* The writer used a tuner of this make during the last season and found that it "signs" of 4 CL and 2 PM, very Q.S.A. It is a very small and compact affair and am sure $8 X11 will find it a most valuable addition to any home. The owner or maker of this apparatus calls it a "Cone Sucker." It is the most sensitive and reliable receiver the writer has ever used.

**SEVENTH PRIZE.**

O. R. Terry, Stoughton, Wis., is awarded the prize of the Minnesota Electric Supply Company of Chicago. This is a pair of 3000 Ohm Moistphono phones. They are excellent and the writer has been using them as a pair for the last month. Mr. Terry made a creditable report and great record for receiving thru Q.R.M. of the worst kind.

**EIGHTH PRIZE.**

The Phoenix Radio Club of Phoenix, Ariz., is awarded the donation of Mr. Philip E. Edelman of St. Paul, Minn. This is his latest book, "Experimental Wireless Stations," and it is a wonder how much useful information has been crowded into such a compact space. This book will put Arizona on the wireless map forever, and the writer is awarded for long distance reception, cooperation in the relay, and real genuine American patriotism in keeping quiet when necessary.

**INSTRUCTIONS.**

The prize winners may obtain these prizes by writing to the above Domes and giving your name and address, and referring to this issue of *The Electrical Experimenter.*

Q.R.M.

There is not enough space in this magazine to report all Q.R.M., but of some it was intentional, and the writer does not care to stir up any ill feeling by publishing it. If you are interested in knowing, however, who deliberately, Q.R.M. the stations in Connecticut and Massachusetts at 10:35 p.m., the night of February 24, 1917, write to 112—R. T. St. James, Great Barrington, Mass.

**PERFECT SCORES.**

Below you will find the names of the boys and stations that made "perfect scores."

**ARKANSAS.**

John M. Clayton, 5 BV, Little Rock.

**ARIZONA.**

R. A. of Arizona, 5 FD, Phoenix.

J. H. Glasgow, 6 IT, Arizona.

J. Girard, 6 EO, Phoenix.

R. Higgly, 6 DM, Phoenix.

**COLORADO.**

E. F. Doig, 9 ZF, Denver.

W. H. Smith, 9 ZF, Denver.

**CALIFORNIA.**

Seefred Bros., 6 EA, Los Angeles.

L. Lynde, 6 UG, Long Beach.

C. A. Mace, 6 AT, Berkeley University.

F. Terman, 6 IT, Stanford University.

L. L. Hoyt, 6 IS Hayward.

**CONNECTICUT.**

H. Haugh, 111, Derby.

S. J. Pasquali, 8 AT, New Haven.

M. Tuve, MT, Canton, S.D.

P. C. Green, PG, Aberdeen, S.D.

D. Galtom, DCL, La. Moore, N.D.

E. Worthington, DCL, Aberdeen, S.D.

E. R. Issak, 9 TZ, Eureka, S.D.

A. Shaw, AS, Parkston, S.D.

**FLORIDA.**

J. C. Cooper, JF, Englewood, Jacksonville.

C. M. West, U.S.N., St. Augustine.

**GEORGIA.**

D. L. Gaston, CWW, Commerce.

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**STANDARD VISIBLE UNDERWOOD.**

Perfect machinery, Standard Size, Keyboard of Standard Universal Arrangement, writing the full 84 characters—universally used in teaching the touch system. The entire line of writing completely visible at all times, has the inbuilt tabulator, with billing devices, the two-color ribbon—automatic reverse and key controlled and the built-in inbuilt flexible paper feed—automatic paper fingers the back spacer—roller bearing carriage return—fact every latest style feature and modern operating convenience. Comes to you with everything complete, tools, cover, operating book and instructions, ribbon, practice paper—nothing extra to buy.

You cannot imagine the perfection of this beautiful reconstructed typewriter until you have seen it. I have sold several thousand perfect latest style machines at my bargain price and everyone of these thousands of satisfied customers had the beautiful, strictly up-to-date machine in 60 days free trial before deciding to buy it. I will send it to you F.O.R. Chicago for five days' free trial. It will sell itself, but if you are not satisfied that this is the greatest typewriter you ever saw, you can return it at my expense. You won't want to return it after you have seen how this wonderful machine answers your needs.

**You Take No Risk—Put in Your Order Now.**

When the typewriter arrives deposit with the express agent $7.15 and take the machine for five days' trial. If you are satisfied that it is the best typewriter you ever saw, keep it and mail me the balance of $42.00. You will receive back your $7.15 and return the machine to me. I will pay the return express charges. This machine is guaranteed to you so that if you are not satisfied with the machine, I will return it. I will refund you the $7.15 and you never paid for the machine. This guarantee is valid for only 60 days from date of purchase. But if you have not decided after 60 days, you can keep it for only $42.00.

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**Name.**

**Address.**

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We have built 5000 of these outfits, consisting of a motor that will operate on a. c. or d. c., 5000 to 6000 r. p. m., 100 to 130 volts.

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Application for Membership in the Radio League of America

I, the undersigned, a Radio Amateur, am the owner of a Wireless Station described in full on the face of this application. My station has been in use since and I herewith desire to apply for membership in the Radio League of America. I have read all the rules of the League, and I hereby give my word of honor to abide by all the rules, and I particularly pledge my station to the United States Government in the event of war, if such occasion should arise.

I understand that this blank with my signature will be sent to the United States Government officials at Washington, who will make a record of my station.

Witnesses to signature:

Name:

City:

State:

Date: 191

Describe the apparatus of your station on the blank below.

In the event of national peril, you will volunteer your services as a radio operator in the interest of the U. S. Government?

This last question need not be answered unless you so desire it.

Description of My Station and Apparatus

Sending

Receiving

DISTRIBUTED CAPACITY AND ITS EFFECT.

(Continued from page 33)

of the June 1916 issue of this journal. For those who have not seen this copy, the accompanying reproduction is made, Fig. 5. The construction is very simple and the drawing is self-explanatory.

The effect of distributed capacity and lead-effect is more pronounced in long coils and it is advisable to wind such coils in sections as shown in Fig. 6. It has been found that a considerable amount of distributed capacity is eliminated by such a method of winding and it should be done in every case where it is possible, especially on secondaries of loose couplers. The reason for reducing the distributed capacity is self-apparent, as the capacity varies inversely as the thickness of the dielectric between the conducting mediums. Thus the capacity is reduced by increasing the distance between sections. It will be an ideal inductance if each turn of the coil is separated from its neighboring turn, say, one-thirty-second of an inch each. The distributed capacity of such a coil would be very small as compared to a coil with the wires close together.
EDDY CURRENTS. (Continued from page 21)

as one of the fleet when the war had broken out. I tried to ask him questions, but he was as clammy as Parker and I could get nothing out of him.

What was behind that locked steel door? Was the means of destroying the enemy's ships concealed? Was it this curious torqueless means? I wanted to ask Parker, but pride and shame at my own stupidity held me back. So I wondered and pondered and puzzled all that day.

Thought of the affair was dispelled when squadrons on the deck sighted an enemy's Zeppelin being towed along, dome of its Zeppelin, one of the most dangerous ships on the ocean. We immediately sank to the awash condition and then as the plane grew near, was swept down, with only our periscope showing. This we drew in as we noted the aeroplane sighted us and swooped down for a look. We ran submerged for a half hour or so and then cautiously poked up our periscope.

There was a sudden cry of warning from the man at the instrument, and we dumped again. There had been an enemy torpedo boat destroyer near, and even in the dusk it was not safe to come up when any of these craft were about. How had we sighted it, we wondered, for its searchlights made the water dimly transparent above us. But we submerged below the light and ran still east by north.

It was just after this that I noticed that Billy came to the feeder case. I heard him give directions that the small alterna-
tor which supplied the coil with current, should be started. Then he worked the two control wheels, and, pulling over his shoulder at the dials I saw that he was sweeping the coil from side to side, and frequently changing its inclination. By this means had he succeeded in an adjustment of the electrodes, or had this caused an alteration in the magnetic force which would indicate the position of any enemy ship within ten thousand yards.

"Hunting for fish?" I asked.

"Yes, I'm feeling for them," he answered, "and I believe the light of the horizontal gage, and the twinkle in his eye. Have you solved it yet?"

"No, I haven't," I admitted.

"You watch tonight then," he said. "We're about due to be in the enemy's fleet and we ought to have some experience at least."

The light on the case before him flashed suddenly red, and the dial needle marking distance jumped up to eight thousand and stopped there. He hurried and started the horizontal control wheel stationary a moment.

"We're in them now," he said. "There's the first one."

There followed a most wonderful piece of maneuvering. He turned the coil until we were sure of the direction of the enemy and then changed the course of our boat to correspond to his. Slowly we worked around, until the position of our eyes was exactly the same as the enemy's.

In half an hour we were making twenty-two knots and thirty feet under and running thirty feet under.

The enemy was off to starboard according to our indicator.

"He must be under," he said. "Twenty-two is too slow for anything else," Billy said.

I agreed and a moment later, with a final assurance that our courses were parallel, Billy pulled the trigger on the receiver. Several notes in rapid succession rang through the ship. The enemy had been separated from our boat, and then he gave the command to stop the after torpedoes.

What had he done? Had he depressed the button. The machine forward, the alternator, I thought, dipt several minutes in its work, and then the button was down for five or four minutes and then he let it up and gave the command to stop the after torpedoes.

What had he done? Had he depressed the button to slow down the mysterious new force, some wonderful ray, some hitherto undiscovered ethereal vibrations which could travel through water and destroy the enemy ship alongside us? What had he done when he pressed the button to depress the one, but again pride and chagrin stop me.

Instead I must use my instruments, thinking that I might perhaps hear the enemy's talk and hear something worth knowing. To this purpose I juggled my tuning knobs, making the dial go back and forth with rapid changing combinations with the sliding contacts.

It was while doing this that I heard a sudden loud buzz in the receiver. I held the receiver there a moment and heard several letters, apparently forming a foreign word. Then a sudden surge of the enemy's language was to the receiver. I wrote it down as it came. When it had stopt and I translated it, I had before me the following:

"The fire in the forward port compart-

ment No. 7, is in the oil tanks and is so hot that it has melted out a section of the hull plate. We have a heavy list to port, but are not in immediate danger. Good luck."

"Captain Von Heissburg."

that looked as if there was trouble in one of the enemy's ships. I showed the message to Billy.

He read it over twice and then glanced up with a gratified smile. "Pretty good, but not quite enough," he said. "Have to use more next time I guess," and he turned away to the feeder case.

I could make nothing of this remark and did not try. I was too busy watching him again.

Once more he was sweeping with the feeder. We were bearing off to the south and running slowly. Again the light flashed and he turned the feeder. I held the wheel until we ran parallel with the enemy, 43 yards away and off his starboard side.

Once again we swept with the feeder. The enemy had changed to running at twenty-two knots, which seemed to the speed of the fleet. As before Billy twisted the controls on the other and turned the feeder case to the after as the feeder case. Once again he called the order to start the alternator. The hum of the machine began, and as the button was pressed, I timed it now and found that it was held down six and a half minutes.

When we steered off to the south, slowing up and letting the enemy pass ahead of us.

I watched again intently but unsatis-

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button after having the alternator started. Fourteen more times it happened that night, while we maneuvered and changed our course to get into position. I did not get a chance to ask him that night. He was busy and the grained light was too strong in his face, and I knew from all signs that I would only encounter more meaning.

So I stood by and watched and wondered what mysterious force was being loosed when he pressed the button. Was the intensity of the wireless waves? I listened at my receivers once to make sure of this theory, but heard nothing. So I gave it up and watched and waited to let him tell me in his own way at his own time.

The next morning we cruised for two hours without catching anything in the wireless. The magazine was not in a hurry about to give the order to come to the surface when we picked up something off our port bow. We slowed down to fall in with it, since it seemed to be running slower than we. After a few moments we found that it was stationary. We ran around it three times, and then the waves were rolling several hundred yards away from it, Billy gave the order to come up cautiously.

The rising periscope flashed the picture, the scene that was there, spread on the water in the early morning light. I saw it over Billy's shoulder in the mirror.

It was a proud battleship, and had been, now leaning far over to port and surrounded by a bevy of small boats filled to overflowing with men. The great guns were pointing wildly seaward, and gave it a ridiculously helpless air as it lay there, rolling heavily in the swell of the sea.

"It's the Stoltzenfelds," Billy said, looking intently into the mirror.

Then I remembered the message from her captain which I had overheard last night. I was about to mention this when I saw that the captain had just sighted us and was now pointing to us and signaling to the battleship. One of the great turrets swung about drunkenly and then we dove. We ran under the ship and her boats and then away to the west.

"Let them go. They can't hurt anything with that leaky tub. That's the one we experimented on and didn't give enough to," Billy said.

We ran that morning with our periscope and breather pipes out of water, but ready to sink unseen if necessary. We saw nothing of the enemy, but about nine o'clock while the receivers lit up, I caught this message:

"Captain Rollins, U.S.N., Aviation Corps. Have sighted much wreckage and hundreds of enemy boats filled with men. Also life rafts and other floating objects with men clinging to them. Sighted the Stoltzenfelds leaking badly, and with many boats caught glimpse of few transports, but kept away by destroyers. Send cruisers and destroyers out at once. Battleships seem lost. Lieutenant Fletcher, Aviation Corps No. 7." This I knew came from the wireless of one of our big scoutplanes which had been sent out to watch the movements of the enemy fleet.

I showed it to Billy Parker. He read it and his face lit with satisfaction in spite of the fatigue of the sleepless night.

"Good," he shouted, "we got them all right, didn't we? We got 'em, the country's saved, we got 'em! We got 'em!"

He capered about in the mess room, in a manner quite unbecoming for an officer and a man of his years.

"But how did you do it?" I begged, following him about in his joyous antics, and daring to broach this subject again in the face of his good humor.

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"You poor, stupid blockhead," he laughed, slapping me on the back, "don't you see?"  

"No, I don't see at all," I admitted.  

"It is difficult to wireless the whole thing back to the papers. You understand how that feeder works?"  

It was, perfectly.  

"Well, if you look at the box, we have a big coil just like that, mounted on a universal joint so it can be raised or lowered or swung around at will. It is also perpendicularly or horizontally, except directly back. That coil takes about two thousand kilowatts of current which is supplied to it by a big alternator put in the motor torpedo room forward.  

He paused.  

"Well, I demanded.  

"Don't you understand?" he was asked.  

"No, I don't go on," I commanded.  

"Oh, man, you haven't a bit of imagination," he growled.  

Well, I was looking this coil around and sent a current thru it," he went on.  

"If an enemy ship comes within one hundred yards of you, it will happen that happens in an induction furnace. We can send enough eddy currents thru his hull to give him a whole sensation of the place.  

Now do you understand?"  

But I was at the key, pounding out the message.  

COMBATING THE TORPEDO.  

(Continued from page 17)  

hand on Detonator switch No. 1, he calmly 

waits. When the hostile torpedo is but 

ten feet distant from motor torpedo No. 1, 

he throws the switch and a terrific explosion 

and a huge column of water is 

thrown up several hundred feet into the air.  

Motor torpedo No. 1, now destroyed, finishes, so has 

the enemy torpedo. The ship for the time 

being safe. Instantly the crew has 

lowered a new motor torpedo to the place of the one just destroyed and 

long before it touches the water it has been 

electrically connected to the control board.  

But this would be necessary only for a 

large ship with a very valuable cargo.  

A small steamer would have enough 

torpedoes left to cope with the enemy. By this time, 

too, it is just necessary for the ship to 

alter its course and run in a zig-zag 

line, making it very difficult for a 

submarine commander to hit the 

fleeing vessel with but one torpedo.  

But in case of 

necessity the other motor torpedoes 

are "in the ring" to successfully grapple 

with the fleeing steamer. So, two 

torpedoes are sent simultaneously against the ship the scheme will work out satisfactorily.  

In that case the operator at the 

control-board simply has to work two 

radio-stats and two trigger switches instead of one and given a level head and a good eye for 

calculating distances and speeds, the 

work is not such a very difficult one.  

There are a number of firing 

positions and schemes and while as a rule only one motor 

torpedo would be required to destroy 

the enemy torpedo, Fig. 1 shows how two 

motor torpedoes could be brought close 

together (separated by as little as one inch) to 

accept the deadly missile. In that case torpe- 

do No. 1 and No. 2 would be fired sim- 

ultaneously and leave little chance for 

the enemy to escape.  

It is, however, not absolutely 

necessary to actually destroy the hostile torpedoes. Suppose submarine fires 

from a close range, and suppose that 

the selected motor torpedo cannot be speeded 

up fast enough—even by overloading 

its motor—then a beam of high 

voltage—to come closer to the enemy torpedo 

than, say, thirty feet. Even in such an 

extreme case—the quite possible in rough 

weather—the control operator fires his tor-  

(Continued on page 70)
Safetv-First Oil Can.

(144.) John Brent Marshall, Cincinnati, Ohio, submits a light dimmer which acts on the principle based upon the rotary potentiometer, the idea being to place a high resistance between supply wires and the light. Ans. This is a very good idea and we are quite certain that the device can be patented. We have never seen anything like it in the market and providing the device can be made cheap enough and incorporated in a lamp socket, there should exist a good demand for same. We would advise our correspondent to get in touch with a patent attorney at once.

Light Dimmer.

(145.) Arthur Norris, Delance, Ohio, has submitted a light dimmer which acts on the principle of operating a rheostat by hand and turns the light on and off. Ans. This is a very good idea and we are quite certain that the device can be patented. We have never seen anything like it in the market. However, we would advise our correspondent to get in touch with a patent attorney at once.

Spark plug.

(146.) Clarence Melotz, Florence, Neb., submits what he calls a soil-proof spark plug. The arrangement is such that the spark is supposed to keep a small cup of carrying carbon. Our advice is asked.

Ans. There does not seem to be anything new contained in this and at the present time there is a very similar spark plug on the market under the trade name of the "Soop-proof" spark plug.

Propeller.

(147.) Allison J. Kurther, Colorado Springs, Colo., encloses sketch and description of a propeller for oil boats. Instead of using a propeller, a certain perforated disc is used and our correspondent would like to know if we advise him to have it patented.

Ans. While this propeller no doubt works, it is impossible to determine its efficiency without actually testing it out in practice. It is very doubtful to our mind, however, if this propeller should be more efficient than the regular one. In the absence of actual tests, we would not like to finally commit ourselves and advise our correspondent to try out the device in practice before applying for patent.

Automatic Voice Recorder.

(148.) Joseph Prochaska, Chicago, Ill., submits to us drawings and specifications of a novel idea, particularly for use by physicians whereby it is possible for a patient to call up the doctor while he is not at home. Instead of the doctor answering, the phonograph does this for him, all automatically, without the patient knowing the doctor can be located or when he will return.

Ans. The device is well worked out and under these circumstances does not amount to a patentable device.

PikreNt

answering, not physicians whereby of ourselves and advise like demand submitted Ohio, Ans. The device will now be told.

Perpetual Motion.

(149.) Percy Muirhead, Dayton, Wash., submits a scheme of "Perpetual Motion" in which is utilized a Radiometer which as is known, works by light striking it. He wants our opinion of this scheme.

Ans. There is no such thing as "Perpetual Motion" and by using a Radiometer, this rule is no exception, for the simple reason that the Radiometer employs light which is a form of energy, and for this reason the scheme cannot be termed "Perpetual Motion" and no patent could be obtained on the idea.

Window attraction.

(150.) L. E. Summerton, Maryville, Tenn., has submitted to us a window attraction and he would like to know if it is worth while to try to get a patent. If there is a ready sale for such a device. The idea consists of an electrical arrangement whereby a small artificial bird acts as a woodpecker, pecking against a piece of wood every few seconds. Ans. This is a very good idea and by elaborating it a little more, we are quite certain there would be a good market for this sort of thing. By using a plurality of birds, a very interesting window attraction would be had.

Wave motor.

(151.) C. Mattison, Oakland, Calif., submits drawing and description of a wave motor to be used in the ocean to utilize the power of the waves. He wants to know what we think of it and whether it is practical.

Ans. There is nothing new contained in the idea, as it is not a good way of solving the problem. The first requisite necessary for a good wave motor is that it must automatically adjust itself to the various water levels as the tide rises or falls. Such an idea was shown in our February issue from which it will be readily seen that the device will only be necessary to have to be somewhat complicated for best results.

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COMBATING THE TORPEDO.  
(Continued from page 68)

torpedo anyway. The result is such a terrific as well as instant disturbance in the water that the enemy torpedo will be certainly deflected sufficiently from its original course so as to miss the intended target. This is what we want. For the enemy torpedo once it is spent, sinks automatically, because to leave it roam about the sea would constitute as much danger to its own submarine as to the attack vessel.

All the technical points have been worked out and tested while the basic idea can and will be no doubt improved upon, the reader can form his own opinion as to the practicability and effectiveness of the scheme.

The main point in its favor is that each torpedo can be built at a cost of less than $1,000. For ten units this makes a cost of less than $10,000 for a ship of 600 feet. This is pretty cheap insurance, considering that the cargo alone on such a ship nearly always is worth from three-quarters to one million dollars and often considerably more. The ship itself costs as much again. Besides, if the vessel is protected adequately, the maritime insurance is reduced largely and no big bonuses need be paid to the crew, as is the case now.

The speed of the ship is not reduced by the motor torpedoes either, as they run independently, nor is the power to operate them very great. Ten torpedoes will require but 100 to 150 horse-power—a trifling amount for a 600-foot steamer developing some 20,000 to 30,000 horse-power. Nor are the motor torpedoes used during the entire trip. Thus during a cloudy, dark night, during a fog, or in a very heavy sea there is no need for them, as a submarine cannot successfully torpedo a ship in such cases.

During these periods the motor torpedoes are hoisted out of the water by means of their steel covered cables and are lashed fast to the decks till needed.

As the torpedoes are fired by electricity, there is little danger from an accidental explosion, even if they should bump against the side of the ship occasionally, for instance during landing or shallow waters. The distance of 50 feet of the motor torpedoes from the mother ship is necessary, for if they are exploded at a range from 30 to 50 feet they will damage the ship.

That the submarine commander sees the brightly colored torpedoes does not matter so long as the crew learn that firing torpedoes at a ship thus protected is a waste of time and material. And then until something is done the submarines in warfare, to a large extent, will sink into a stalemate. And this is what we all desire.

A ship equipped with guns (to prevent the submarine from using its own guns) and equipped with motor-torpedoes as well stands little chance of being sunk.

It should be noted that our cover design is not strictly correct. First, the motor-torpedoes in practice run almost entirely submerged, leaving only the ends exposed. Secondly, the submarine is shown very much too close to the ship. These slight technically incorrect points were necessary to bring out the idea from an artistic standpoint.

GLADSTONE AND THE TELEPHONE.  

The mental fatigue which would follow the introduction of the telephone was foreseen by the late Mr. Gladstone, England's grand old man. When he was asked by Mr. Edison's representative whether he would like to have a telephone apparatus set up in his house, he wrote on a postcard: "Sir, my means of communication from without inwards are already equal to my needs and in excess of my desires."

MAGNETISM PRODUCES REMARKABLE PHOTOGRAPHS.  
(Continued from page 4)

like a line of latitude, no mere arrangement of the molecules of a magnet, can account for the result. There must be an explanation—currents of some type, for there is only ether under the receiver.

A detailed examination of the articles will strengthen this opinion. The articles are lettered somewhat in the order in which the impression is made on the plate. Note that at A, but little, if any, impression is made on the plate—the currents could not penetrate—while J and K hardly show at all because the currents past them flowed along the plate, and to pass thru or to penetrate there must be motion—currents. From A to K, it will be noted that the effect on the plate grows gradually stronger, showing that some are more penetrating than others and this degree of penetration implies motion. Note that D, E, and F are penetrated less than G, and that G is penetrated irregularly, plainly showing the location of the acid pits on the surface of the metal. The electric effect would be produced by light. Again, B and C are iron weights with cavities in the bottoms and openings thru the sides of these cavities. The weight cavities lie on the places so that the cavities were downward. Yet these cavities show plainly in the plate. Light could not produce this effect, for in any event it would produce a shadowy and enough light could not enter the small opening to effect the plate practically as much as the electric. But currents of electricity following the lines of the iron, as is the well known effect of iron in a magnetic field, could and did produce this result. More careful measurements show that the cavities are a little larger and the circumstances of the weights as shown in the plates are not quite equal, but currents of electricity following the lines of the iron produce exactly the same effect as the electric. Therefore, you see how the machine works and the only question remaining is, does the machine work? If no effect is shown on the plate that proves the machine works. If the effect is shown on the plate, then the machine works.

Furthermore, here is incontestable proof that the lines of force, lines of tension, mere lines of direction do not "emerge from (without motion) the North pole of the magnet, nor "pass to or enter" (again without motion), the South pole. The effect, the penetration, the currents are equal over both poles. These currents pass into both poles alike. They do not pass out from the poles for the plate is above the poles, both poles, with the sensitive paper up and they must pass thru the sensitive side of the plate above the poles.

If the currents were passing upward from either pole, there would be no impression on the plate over that pole, for the current would pass thru the sensitive film before reaching the objects. Instead, it shows plainly that the currents pass poleward equally over both poles, penetrated more or less the objects on the plate, affected the sensitive plate more or less according to

You bought "The Electrical Experimentaler" when writing to advertisers.
the amount of penetration, and then past up to the magnet. What then becomes of them will be shown later.

Still there are doubters. Could the result be due to stray light? Could it be due to phosphorescence? To radio-activity? Could the same result be obtained without the magnet? To answer these I placed a second wooden disc under the receiver, with the objects placed upon it exactly as before and used exactly the same precautions as in the first instance. The result was the same in the same room, far enough away not to effect the plate under the receiver. I placed a plate over the magnet with several objects upon it, but with out a receiver, placed a light-tight box over this, and covered the whole with heavy folds of black cloth. In this instance the room was not opened for twenty-two days. At the end of that time both plates were developed with equal care under the same conditions as in the first case. The plate over the wooden support under the receiver was a perfect blank! There was no impression on it. The result with the plate over the magnet in the air is shown in Fig. 4. In this A is a key, B and C are pearl buttons, and D, E and F are wooden buttons. The wooden buttons can be seen as in Fig. 3 showing that the penetration is the same here but the whole plate demonstrating that the result is somewhat less clear, as might be expected, in the air than under a vacuum. The difference in the penetration at D and at E and F is accounted for by the fact that E and F were almost directly over the poles of the magnet while D was at one side and the penetration was much greater at E and F—again proof of the currents and the effect of the magnet.

I have also produced Magnetographs, as I have chosen to call them, over an electromagnet and over a straight wire bearing a current, but I have not as yet secured clear results, owing to the difficulty of maintaining a steady current for sufficient length of time.

**Sources of Electricity.**

(Continued from page 12)

As might be suspected, the voltage produced by heating a single metallic couple, such as the above, is very small, and where a larger number is desired a large number of similar couples are mounted in a compact manner as possible, and all of the junctions are insulated from each other by gas or coal as shown in Fig. 5. The difference of potential for a bismuth-anthra- mony couple is about 117 microvolts for each degree Centigrade, when the junction is heated above the rest of the circuit. The total current produced by the massive compound circular thermopile shown in Fig. 6 is 80 volts and 4 amperes, which is sufficient to light a number of incandescent lamps.

**Dynamic Electricity:** The most successful and practical source of electrical energy as we know it today is the Dynamo. One of the most important which depends upon the cutting of magnetic lines of force by a rotating wire or inductor as it is called, is shown in Fig. 7. It was Faraday, who early in the 19th century discovered that if a circular copper disc be rotated between the poles of a strong steel magnet or an electromagnet, that there would be a current produced induced in that disc, moving copper disc, due to the cutting of magnetic lines of force. The current was found to be a shaft supporting the disc to the rim, or vice versa, according to the direction of rotation. This current was conducted away by wires, having sliding brush contacts, one of which was made to bear against the shaft, while the other made contact with the edge of the disc. It was found that the simple copper disc gave way to the more modern armature, which contains a large number of insulated copper wires and all of which coils, in consequence, are caused to rotate rapidly in the powerful field of an electromagnet. These rotating coils are properly connected to a series of metal bars, assembled in ring form and known as a commutator, against which contact brushes bear, leading the current from the armature to the electric apparatus, such as lamps, motors, etc. The dynamo is always to be driven by some external prime mover, such as a steam engine, water wheel, etc. In the dynamo we have the conversion of mechanical energy into electrical energy.

**Electricity from Coal.** One of the most successful forms of apparatus for producing electricity direct from coal is shown in Fig. 8. This particular type of coal-electric cell is due to W. W. Jacques. Here we have a carbon cylinder immersed in a fused caustic soda bath; this is placed in an iron vessel also which serves as the other electrode of the cell. An air pump is employed to blow a steam of air thru the caustic soda by means of a perforated drum under the carbon rod. By means of the coal furnace the whole cell is maintained at a temperature of 400°C. The air stream has the effect of causing the carbon to ox-

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idice to CO₂ which mostly bubbles up thru the caustic soda solution and escapes. This cell gives about 1 volt E.M.F. The action occurring in the production of electrical energy is believed to be partly voltaic and thermo-electric. The cell has an efficiency of about 8 per cent—compared to 12 to 15 per cent for modern steam boiler and engine plants, and the cost of raw materials to replenish it is said to be at least 34 times that for a good steam engine, while the residue or ash from such a battery would possibly weigh 12 times that from a corresponding steam plant.

**Plant Electricity:** It is not generally known that certain plants exhibit pronounced electrical activity, but such is the case. Perhaps the strongest, that is in the sense of electric vibrations, is the sensitive plant (Ulimosa podarz), shown in the illustration (Fig. 9). Others, such as iris, nicotiana, nasturtiums and practically all the meat-eating plants, such as the "Venus fly-trap" and the "sundew," afford splendid examples for experimentation. If any of these be placed in connection with a galvanometer by means of electrodes attached to leaves on different sides, and one side of the plant be exposed to sunlight while the other side is kept shaded, then within three to ten seconds after exposure to sunlight there will be a flow of electricity from the lighted to the shaded parts amounting to 0.05 to 0.2 volt. This continues for about five minutes, when the magnet begins to swing back and shows an opposite current of considerable magnitude. The manifestations are similar to those of "teranized nerve."

A better understanding of the electrical qualities of plants will, no doubt, explain many of the hitherto mysterious habits of meat-eating plants. Especially will this be true of such terrible and uncanny plant monsters as the "sundew" of South America and the mammoth Ulicularia, or fishing plant, which lures mynow and small animals into its voracious mouth, and suddenly, as if an elastic button were secretly prest, closes in upon its helpless prey. In other words, it fishes with a net electrically wired. Strange as it may sound, this plant safeguarded itself by means of its electrical currents ages before we used the electric battery, alter and door bell. Were it not for this protection, the plant could not live and hold its own in such an aerial-infested region as it needs for its fishing ground.

**Animal Electricity:** Altho not so commonly known, there are in the world several varieties of electric fishes and eels which possess quite remarkable power. Several species of these creatures inhabiting the waters of certain parts of the earth possess the power of producing more or less powerful electric discharges. Physiologically, the principal creatures of this class are the Torpedo, the Gymnotus and the Silurida. One of the most powerful electric fishes is the Rain Torpedo or Electric Ray, of which there are three species inhabiting the Meditteranean and Atlantic. This particular specimen is provided with an electric organ on the back of its head. The organ consists of layers composed of polygonal cells to the number of eight hundred or one thousand, or even more, which is supplied with four large bundle of nerve fibers. The under surface of this organ is negative, while the upper surface is positive. With the Gymnotus or Surinam eel, the electric organ extends the whole length of the body from tail to head. It has been recorded by Humboldt that a lively combat ensued between a number of electric eels and a herd of wild horses, which were driven by the natives unconsciously into the swamps inhabited by the Gymnotus. This particular specimen of electric fish is said to be able

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to give a most terrific shock, and proves a most formidable antagonist when it has grown to Its full length of five to six feet. In a word, the wire, in our Fig. 10, the electric current flows from head to tail. It has been shown by several scientists that many diseases, all kinds of muscular contractions of human beings are the seat of slight electrical currents. For one thing it has been shown that the beating of the heart really creates rhythmic electro-motive force.

Photo-Electricity: One of the most interesting and useful forms of energy also one of the most direct methods of production of electro-motive forces is found in the photo-electric cell. Simply explained the principle is this: When the cathode of a suitable tank is a strip of copper plates, one of which is perforated and blackened by oxidizing in an atmosphere, while the rear or second plate is polished, and both of which plates are placed in a suitable tank containing a salt-water solution. One side of the tank which contains the copper plates is fitted with a glass window and when sunlight, or any other source of light, is allowed to act upon a difference of electric potential set up between the front and rear copper plates. This particular cell as developed by Mr. Theodore W. Casse, was described in an article which appeared in the September, 1916, number of this journal. It was found possible with some of these cells to obtain a voltage of one-tenth and an amperage of two-tenths; the cell delivering a steady current as long as the light shown on it. It is of course possible to count the number of cells in series or parallel to obtain any voltage or current desired.

Radio-Electricity: It is generally conceded in scientific circles that the activity possessed by radium is fundamentally electrical in nature. Radium gives off three kinds of rays, alpha, beta, and gamma rays. It is possible to influence two of these rays (alpha and beta rays) by means of a magnet or an electro-magnetic field, which indicates that they are undoubtedly electrical in their fundamental structure. Another experiment, which any schoolboy can readily perform with a piece of radio-active mineral, is as follows: First, an electric charge is produced on a sensitive gold leaf electroscope, so that the dial of the instrument divides into three parts. Then piece of the radio-active mineral (some may be as fortunate as to possess a tube containing a small quantity of radio-active material) and having brought it into proximity with the metal ball or disc at the top of a charged electroscope. It will be noted that the latter loses its charge on the gold leaf almost instantly; its electro-active element of the radiation iodine or other radio-active substance used creating a change in the electrostatic field about the electroscope, apparently making it more conductive, so that the bound electric charge on the gold leaf escapes. This is the subject of "Radium" and the many electrical and other effects created by the greatest mystery of the science of today. We well to read the extensive article on this subject, which appeared in the September, 1916, number of \textit{The Electrical Experimenter}.

\textbf{RADIO ENGINEERS DINE.}


\textbf{THE IONIC RADIO SYSTEM AND THEORY OF IONIC TUNING.}

\textit{(Continued from page 31)}

The preferred type of detector used in this system is shown in Fig. 5, and comprises a small metal disc 1 and 17 mounted about two inches apart, center to center, on any suitable material as cast iron or brass. Fig. 19 a brass rod one eighth of an inch in thickness, is fitted a crystal of silicon 21, cut in the form of a truncated cone. Its base is glued to a copper rod, the electrical connection being made by wrapping the joint between the brass rod and the silicon with tin foil. A card of control 20 comprises three inches of flexible cord, scraped of its insulation, then bent double and tightly twisted, the loose ends being cut off evenly. If the end of the silicon can be ground smooth without destroying its sensitivity a polished brass rod may be used.

This method of construction costing about 35 cents to construct. It will have a highly finished appearance, exceptional reliability, unusual sensitivity and require very little adjustment. The apparatus now stands permanently in place. Those trying this form of detector resembling the early E. J. Co. Autocollimators should be well satisfied. After eleven years of experimenting with all forms of commercial detectors I have found this one the only type constant enough for quite accurate measurements.

Having described one set of apparatus adapted to be operated according to my new method of tuning, I will now briefly describe the characteristics of crystal detectors and the theory of operation of both thermo-electric and ionic detectors, in order more clearly to disclose the exact nature of my new method.

A Thermo Detector consists of a very fine point of metallic contact set upon a thermo crystal with a comparatively light contact. When an alternating current passes to and from the crystal, heat is generated in minute quantity.

This heat causes a "thermo-pile action" and generates a thermo-electro-motive force. Impulses set up in the detector in such direction that their direction is the same as that of the thermo e.m.f. are allowed to continue and pass on thru the thermo detector, while those of the opposite direction are opposed by the thermo e.m.f. and are suppressed or swept out. The impulses which reach our phones then are always in the same direction as the thermo e.m.f. Thus is accomplished the rectification by thermo crystal detectors. These crystals always require a metallic point and to this class of thermo crystals belong the following: copper pyrites, tellurium, manganese, chalcocite, pyrites, galena, iron pyrites, etc.

Ionic detectors are also rectifiers but perform their function in a different manner, these detectors being necessary and the form of contact being of relatively small importance. These detectors have no useful thermo e.m.f. A large polished plate of the crystal fitted, is set between two highly polished electrodes and it will work equally well, if not better, than with a point. I have taken my own detector and polished one-half inch in length and tacked it to a board with a tack at each end. It worked very well as a detector for this experiment. It was not especially sensitive but its operation was perfectly constant. On the contrary an ionic detector rectifies by the polarization of an ion being the combination of a number of positively charged molecules, with one negatively charged electron.
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GREAT NEED for Wireless Telegraph Operators. Many opportunities are open to those who are thoroughly trained in the art, and are allowed to continue. The impulses coming in the opposite direction, or against the points, meet a very high resistance and are converted into heat, being to all practical purposes thus suppressed or wiped out. To this class of ionics belong the crystals of 'silicon, molybdenite, pericline (copper pyrites and zincite), carborundum and titanium dioxide, titanium (TiO₂) occurring in various forms, viz., as the minerals brookite and anatase.

While thus both the thermo and ionics detectors convert alternating current into direct current, the thermo detector is superior by a thermal e.m.f. in one direction, while the polarized ions of the latter cause these crystals to conduct better in one direction than in the other.

My unique method of ionics tuning depends upon the following discovery, which I have made, viz., that the ratio of each chemical element or compound has a definite rate of vibration, the ionic groups of two elements or compounds having the same character. Thus each chemical element or compound is sharply distinguished from every other element or compound by its characteristic vibration rate.

A novel method of ionics tuning is based on this newly discovered principle and I make use of the principle in the following simple manner—namely, by employing the same chemical element or compound in receiving the radio impulses as in generating them. For instance, a wire may be employed both in the spark gap at the sending station and in the detector at the receiving station, passing a zinc-iron detector at the receiving station, a zinc spark gap may be used at the sending station, and there is no limit to the number of elements employed in this way. The device of selective tuning may be obtained in this manner, but the detector is far more sensitive to a sender employing the same material, thus permitting transmission over much greater distances.

This phenomenon I believe to be due to the fact that the vibration of the ions in the detector is much more easily affected by disturbances of the same basic character produced in the ether by a sender of the same material. On the contrary, when different elements are used in the sender and receiver respectively, as has heretofore been done universally, the use of a substance with the same vibration rate is in no way in opposition but is in dissolution.

In further experimentation along this line I intend more fully to study the effects of combining two or more elements in both the sender and transmitter in order to determine whether or not any material loss of efficiency or other disadvantage results from such combination and I suggest this as one of the many fruitful fields of research opened for future endeavor by my discoveries herein publicly disclosed for the first time.

It is stated that one result of the war in Germany has been the greatly extended use of aluminum for many purposes. Its use is one of the outstanding features of captured German motor construction, being used for crank cases, gear boxes and even cylinder heads, jackets and shafts. The Germans are said to be able to produce aluminum very rapidly, having developed the mining of coal in occupied French territory by forced labor. The cheap production of electric motor vehicles, which are now being run with nickel-iron batteries, owing to the shortage of lead.

An Electrical Paradox or Selective Lamp Controller.

(Continued from page 37)

The three lights to be operated and also the knife switch may be mounted on a suitable lamp board as shown in the photograph. The mechanism just described and also the rheostat may be hidden, and only the wires coming to the lamp board exposed.

It will now doubt afford the reader considerable amusement to play the device to some of his friends who think they are 'wiring sharks' and that nothing electrical can fool them.

A Study of the Law of Response of the Silicon Detector.

(Continued from page 35)

Of the components of this wave, loops were made with the length of the vertical and horizontal portions of the wire in varying ratios. Curves showing extreme variations were obtained. If it be drawn from these curves it is that the horizontal portions of the loop give a maximum response, while the vertical portions at 45 deg. and 135 deg. The receiver responds both to the horizontal and vertical components of the waves received, and the position of the maxima will vary with the particular form.

Receiver in Horizontal Plane.

Since for the study of the law of the detector it was desirable to eliminate as far as possible all the other component, the entire receiver was placed in the horizontal plane and suspended as before. The results obtained were unable to reduce still further the response without the resonator the short loop which had given the minimum effect was used. The screen was rotated through 360 deg. and the waves were taken every 20 deg. with and without the resonator as before. The curves obtained showed the effect without the resonator to be a much smaller fraction of the entire response than under the best conditions with the receiver vertical. As a further precaution, oscillators, receiver, and rotating screen were carefully centered. Curves obtained under these conditions both with and without the silicon detector were taken at 0 deg. and 180 deg., and their minima at 90 deg. and 270 deg., and the effect without the resonator was extremely small. The effect of the orientation of the rotating screen, the position of no transmission, was still to be considered. This was resolved by rotating the detector from 0 deg. to 180 deg. in 15 per cent. of the maximum, and indicated that with the screen used there were diffusion effects which, as might be expected, were not so strongly marked as in the resonator without than without. In order to investigate the diffusion the receiver was placed in a tin box. The response to the waves did not entirely cease until the tin cover was made completely to enclose the receiver; even a small opening in the cover produced a decided deflection of the galvanometer. That
the effect was due to the action of diffracted waves on the receiver was further shown by the fact that with the rotating screen in the position to allow no transmission a wave reflector back of the receiver at varying distances clearly indicated the presence of nodes and loops at distances apart which showed the wavelength to be that of the original wave. The average distance from node to node was found to be slightly more than 50 cm., making the wavelength approximately 100 cm.

Final observations were made with the receiver in the horizontal position at a distance of 225 cm. from the first screen, and with the oscillating component 5 cm. in the other the screen ranging from 120 cm. to 230 cm.

The Law of the Silicon Detector

Since for the final curves obtained the receiver was so adjusted as to respond only to the horizontal component of the transmitted wave, it seemed possible to use the data to determine the law of response of the silicon detector with a variation in the intensity of the incident wave. The data already obtained showed the response of the receiver for each position of the rotating screen. Since only the component of the wave at right angles to the wires of the screen could be transmitted, the amplitude of the transmitted wave varied as the cosine of the angle between the wires and the vertical. As the receiver was capable of responding only to horizontal waves, the transmitted component suffered a second resolution at the receiver, which again cut down its amplitude by the cosine of the same angle. Hence the amplitude of the component of the wave to which the receiver responded was proportional to the square of the cosine of the angle between the wires and the vertical. Thus the amplitude of the oscillations set up in the receiver for different positions of the screen was proportional to the amplitude of this received component, and hence to the square of the same angle.

In determining the law only those data were considered in which the values of the current obtained without the resonator were small. For each set of readings two curves were plotted, with the galvanometer deflections as abscissae and in one case the amplitude of the cosine of the other the fourth powers of the amplitudes as ordinates. On this one a graph it seems safe to conclude that the rectified current is proportional to the square of the cosine of the angle between the vertical and the wires of the rotating screen.

Since the amplitude of the oscillations in the receiver is presumably proportional to the square of the cosine, this result indicates that the rectified current thus the silicon detector is proportional to the square of the oscillating current in the receiver. Austin, in his study of the silicon detector, reached the conclusion that for alternating currents of ordinary frequencies and for oscillating currents of a frequency of 180-000 the rectified currents are approximately proportional to the square of the alternating currents. The results of the investigation of the writers confirm this law for a frequency of approximately 3 X 10^7.

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(Continued from page 40)

other two holes mentioned are intended to take the bolts that run through the motor. These bolts are lengthened, by the addition to their ends of a inch being used, as shown in Fig. 7, upper end of the motor, or are replaced by new bolts long enough to extend through the top board, so as to support the motor. In the motor itself, it was a simple matter to find two short binding posts which would screw on to the ends of the motor bolts. With these in place the motor shaft was inserted through the center hole, the binding posts slipping into the other two holes, and the through bolts which fit the top threads of the binding posts, were fitted with soft rubber washers, inserted in place and screwed up tight to hold the motor in place. The rubber washers mentioned above deaden the hum of the motor considerably, but if their effect is not great enough, two thin washers, made from banner felt, can be inserted between the motor top and the talking machine top, being held in place by the motor bolts and bearing as shown in Fig. 1 at a and b.

The belt should be crossed in order to drive the turntable properly; the electric motor motoring its driving terminals reversed if it rotates in the wrong direction. A simple white string belt, about 1/20 of an inch in diameter, was used for about two months with excellent results by the author, although at first several materials were tried experimentally, such as leather, rubber, tape and laquar (rolled leather). But being the simplest to obtain and make up, the string belt gave the best service, and is still in use, although the diameter is reduced about 30% by wear. The ends of the belt were simply joined by being tied in an ordinary knot. This belt is readily renewed.

When the driving mechanism has been completely assembled one end of a flexible lamp cord can be attached to the motor wires, after first being passed through the hole which formerly contained the crank handle, for winding the motor. The lamp cord may be connected to the motor socket and the motor controlled by the key switch in the socket, or if so desired a single push button can be connected to the cord near the machine, or else set into the body of the machine itself. The regular stop, with which the phono- graph is originated, can be released by means of a small tack or phonograph needle driven into the machine top to hold the lever at starting position.

The records can be readily changed without stopping the machine, provided the turntable is not held back too much by clumsy manipulation of the records. This practice, however, is not to be especially recommended, and is not at all necessary, as the machine with an electric motor attachment attached runs at full speed very quickly upon starting. The speed can of course be regulated in the manner already advised, by the ordinary speed lever.

WIRELESS TELEGRAPHY.

(Continued from page 27)

Azores, to the western shores of Europe, to Madeira, Cape Verde, the mouth of the Amazon, Panama, the Galapagos Islands off the western coast of Ecuador, and elsewhere into the Malayan waters, across the Bering Straits and Greenland, America at Chatham, Mass, and that of the English Marconi Company at Carnarvon, Wales. The signals received at Chatham from Carnarvon were from three to eight times as strong as those obtained from any other European station. These tests were successfully carried out on January twenty-ninth and thirtieth.

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**EXPERIMENTAL CHEMISTRY**

(Continued from page 52)

base, the metal of the base enters into the acid in place of the hydrogen and the hydrogen combines with the hydrogen and oxygen of the base to form water.

\[
\text{HNO}_3 + \text{KOH} \rightarrow \text{KNO}_3 + \text{H}_2\text{O}
\]

Nitrates, Permanganates, Sulfates, Phosphates, Persulfates, etc.

**NOMENCLATURE OF SALTS**

The name of the salts containing oxygen are derived from the name of the corresponding acid. The characteristic suffix of the acid is changed to indicate this relation. Thus, the suffix ic becomes ate, and the suffix -us becomes -ite.

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Sulfuric acid form Sulfates
Sulfurous acid form Sulfites
Nitric acid form Nitrates
Chloric acid form Chlorates
Hyposulfurous acid form Hypochlorits
Permanganic acid form Permanganats

The names of the replacing metal is retained, as, Potassium chlorate, sodium sulf-

Phosphorous acid form Phosphorits

The names of the salts containing only two elements, following the general rule for binary compounds, end in ide. This suffix is added to a modification of the name of the non-metal, giving the names Chloride, bromide, sulfide, fluoride, etc. The prefix Hydro- which is contained in the name of the acid is omitted. Thus, the name of the sodium salt of hydrochloric acid is sodium chloride: similarly, there are the names Potassium chlorid, Calcium fluorid, and Sodium iodid.

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