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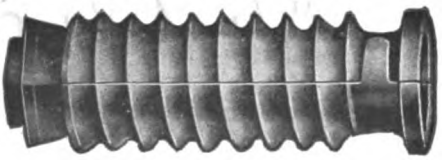

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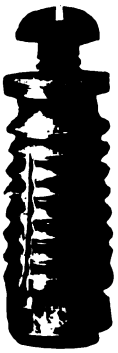

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Volume 28. **March, 1914** **No. 3**

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MODERN ELECTRICS and MECHANICS

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Modern Electrics and Mechanics

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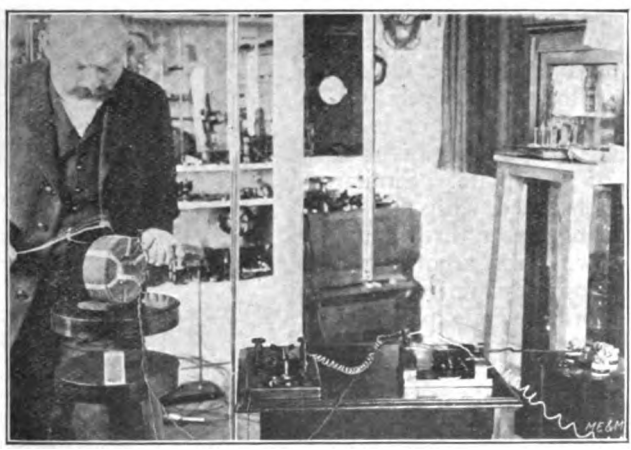
The Divining Rod Problem and Its Solution

The Recent Experiments Conducted in Europe Have Largely Contributed Towards Its Solution

By Dr. Alfred Gradenwitz

THE representatives of official science have long been inclined to exhibit in regard to any phenomena disagreeing with their own system, the same intolerance as was shown by the opponents of scientific investigation in centuries gone by; anything not immediately accountable by purely physico-chemical effects being only too often discarded as unreal.

There has, however, been of late a tendency to be more cautious in this connection, recent scientific work going to show that the realm of phenomena directly or indirectly accessible to our senses far exceed the present scope of physics and chemistry, and in place of the negative standpoint of former times, unprejudiced interest in all classes of phenomena is becoming more prevalent.

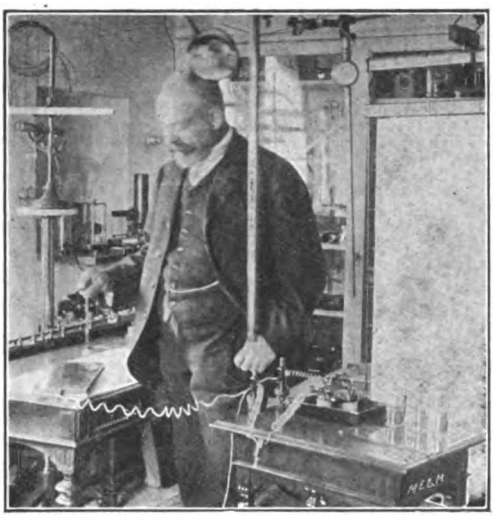


TESTING THE MAGNETIC CHARACTERISTICS OF A DIVINING ROD BY MEANS OF A COIL OF WIRE

A striking instance of the above is afforded by the divining rod problem: After being, until a few years ago, the object of universal derision, the mysterious rod of water seekers claims more and more the attention of scientific men, and the congress recently held at Halle, as well as the public demonstrations made a short time ago in France, are sufficient evidence of the importance now attached to the problem from a scientific and practical point of view.

For the same reason, the experiments recently made by a Swiss engineer, Mr. E. K. Müller, of Zurich, would seem to deserve of more than passing interest. While not yet solving completely the problem, they unmistakably point to the direction where its solution is to be

sought and bear out the hypothesis so often suggested that magnetic and electrical effects are mainly concerned; effects, it is true, which only those gifted with a peculiar susceptibility are able to respond to.



EXPERIMENTING WITH A BRASS PENDULUM AND CHARGED COPPER PLATE

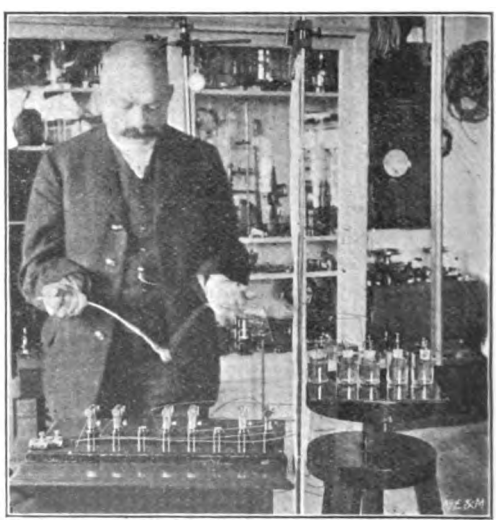
Mr. Jäggi-Perrard, architect of the Bernese Building Department, placed himself at the experimenter's disposal, and, in the first place, made the following experiment: A brass pendulum suspended by a string and held over a copper plate connected to a Daniell cell, was found either to be set vibrating or to be arrested, according to the negative or positive charge of the plate. Similar phenomena were observed with the divining rod, this being either thrown upwards or drawn downwards, according to the charge of the copper plate.

Jäggi then performed an experiment on two 5-franc pieces, which—singly or placed above one another—would repel his whalebone divining rod and set a pendulum (or watch and chain) vibrating. When the two silver coins were kept asunder by means of two matches, thus forming an electric condenser, the rod and pendulum failed to work, though a thin thread laid on top of the coins would counteract the condenser effect, restoring the above phenomena.

The following experiments on surface and edge effects were likewise interesting: Jäggi offered to ascertain by means of the divining rod from another room the height of a paper sheet invisible to himself. After bending one corner of a big paper sheet, he ordered a third person to keep it in the adjoining room at various levels above the floor, and was able to ascertain these levels to approximately an inch. As long as the rod was above the paper sheet, it would in fact be turned upwards, whereas below the paper, a downward deflection occurred. Jäggi, by the way, shows a similar sensitiveness in regard to flowers of various colors: When focussing his attention on a given color, he was able from the adjoining room to ascertain the level of the flowers of the same color to within half an inch of the correct height.

Another experiment consisted of determining by means of the divining rod or pendulum the position of magnet poles. When experimenting on a soft iron bar in place of a magnet, he, very much to his surprise, noted no pole effects at the ends and only reported a deflection of the divining rod in the middle of the bar —where he least expected it.

In order to further test Jäggi's sensitiveness to opposite electric charges, the experimenter placed before him a set of small glasses constituting a galvanic

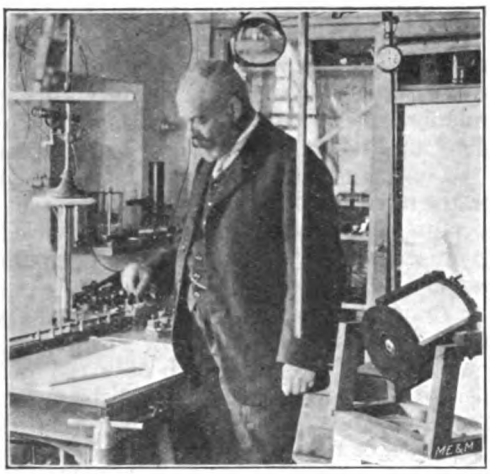


DETERMINING THE PRESENCE OF BATTERY CURRENT IN COPPER CONDUCTORS

battery. Though Jäggi did not know that the glasses belonged to a battery, the divining rod, on passing over them, would move up and down alternately. Another experiment was made by arranging the cell terminals out of view

of the battery itself and connecting them with the zinc and copper poles more or less at random, so that no regular alternations of positive and negative terminals were obtained. The divining rod nevertheless operated in exactly the same manner as before.

Jäggi then undertook to ascertain at which point of a paper sheet a silver coin had been placed in his absence: He even offered to find out any curve described in moving the coin over the paper. This experiment likewise was a perfect success, Jäggi determining with his divining rod both the original position of the silver coin and the curve in which it had moved over the paper sheet. This striking phenomenon is accounted for by the friction exerted in moving the coin and the electric charges thus produced on its way.



DETERMINING THE EXACT SPOT PREVIOUSLY OCCUPIED BY A SILVER COIN

In order finally to ascertain whether the subject responded to any kind of magnetic effects, regardless of the presence or otherwise of iron and steel, Müller used a coil of copper wire, generating in its neighborhood a magnetic field. Pulsating direct current of 5 amperes being applied to this coil, the divining rod held in front of the left-hand end of the coil was thrown down violently, this effect, at 160 centimeters distance showing no apparent reduction in intensity. Peculiar phenomena were also noted on closing and opening the current: As soon as the current was completed, the divining rod would be thrown downward most violently, this motion being counteracted quite as promptly on breaking the current—without Jäggi's knowing it. Similar, though more complicated phenomena were noted at the opposite end of the coil, and after inserting an iron core, the same effects were found to take place with increased intensity.

The above experiments strikingly show the nervous system in certain conditions of excitement—or that of especially susceptible persons—to be much more sensitive and to possess far greater faculties than had hitherto been assumed.

Moreover, the way chosen by Müller is bound to lead to the definite solution of the divining rod problem.

WIRELESS OPERATORS

We are informed by Mr. W. D. Terrell, Radio Inspector, Custom House, New York City, that he receives many requests for wireless operators, and for this reason he is desirous of securing a list of men who are in a position to operate a radio station—men who are not employed as wireless operators at present.

Applicants should either hold a first or second grade commercial license, or be capable of passing the examinations to secure either of these licenses. In their application, all particulars should be stated regarding past experience, whether the operator possesses a first or second grade license or can pass a test for either of these licenses, as well as the minimum salary that will be considered. All correspondence should be addressed to the radio inspector at the above mentioned address.

There are somewhat more than 500 recognized tree species in the United States, of which about 100 are commercially important for timber. Of the 500 recognized species, 300 are represented in the government's newly acquired Appalachian forests. All American species, except a very few subtropical ones on the Florida Keys and in extreme southern Texas, are to be found in one or another of the national forests.

A friend in need is a good friend indeed—but we usually avoid him then.

Recent Work of the Radio Service.

THE Radio Service of the Department of Commerce and Labor, the duties of which are to inspect radio stations and enforce the laws of the United States pertaining to radio communication, has been doing some very excellent work since its existence of barely one year.

One of the duties of the radio inspectors at the port of New York is to inspect the various vessels equipped with radio apparatus and pass upon the wireless apparatus which is found to be in good working order and in accordance with the regulations. Although in practically every instance the main wireless apparatus of vessels is found to be in excellent working order, it often happens that the auxiliary set has been used for many years and is very inefficient. However, these sets are usually able to pass the Government regulations and are therefore not replaced by up-to-date instruments.

A recent example of the vigilance exercised by radio inspectors in passing upon wireless sets is presented by the examination of the steamer *Cedric* of the White Star Line. The radio station of this steamer was examined on January 29th and fault found with the auxiliary transmitting set. A lead of this set was discovered to be disconnected and after that matter was adjusted, further trouble developed from leakage of current over the surface of the roof insulator. The apparatus failed entirely to transmit. Although the radio inspector went on board the *Cedric* at 11:45 and the vessel was due to sail at 12 o'clock noon, he informed the captain that the ship could not sail with the auxiliary set in this condition. The radio inspector offered to stay on board the vessel and be taken off by a tug when the vessel was off Staten Island. The vessel then left her dock. After a new roof insulator had arrived and was installed, the set again failed to operate. It was then thought by the radio inspector that probably the entire aerial would have to be taken down and be re-insulated. An officer was sent ashore with instructions to get repair men and new insulators from the Marconi Company. After continuous adjustment the operator finally succeeded in obtaining a spark from the auxiliary set at 1.30 P. M. and the radio inspector found that messages could be sent and that a radiation of 1.3 amperes was obtained in the antennæ. At 2.30 P. M. the tug came back to the vessel with the Marconi inspector bringing a full set of antennæ insulators which were left on board.

By this time, a heavy fog came up over the bay and held the vessel 24 hours before it could sail. This delay would have been avoided had the auxiliary set been in good working order.

Aside from the rigid inspection of radio apparatus, there is a law stating that two operators should be carried on all steamers. This law was a very wise and necessary one, since under the old arrangement the single wireless operator was on duty during the day-time and retired at night. This meant that calls of distress at night time—when most accidents occur—were not likely to be heard. Under the present regulations, two operators are carried, so that one or the other is on duty during every hour of the twenty-four.

The effectiveness of this requirement is shown in the recent *Volturno* disaster which occurred at night. When the signals of distress were sent out from the *Volturno,* all of the vessels within the range heard these signals and responded. Under the old arrangement of carrying single operators, the chances are that, probably none of the vessels would have heard the calls of distress, since all of the operators would have been asleep at that time.

Much praise is due Mr. Marriott, one of the radio inspectors at the port of New York, for the rigid inspection of radio apparatus on board steamers entering this port. The Washington authorities and the radio service as a whole are certainly entitled to great appreciation for what they have accomplished during the short time the radio service has been in effect.

More than 120,000,000 board feet of timber was given away free by the government last year to settlers and miners living in or near the national forests.

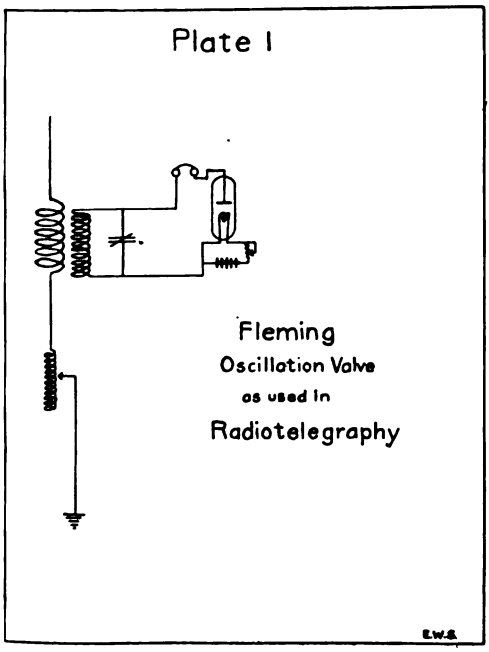
The Edison Effect in Wireless Telegraphy

Describing a Series of Experiments in Connection With the Adoption of this Phenomenon to the Reception of Signals

By Ellery W. Stone

Illustrations from drawings made by the author.

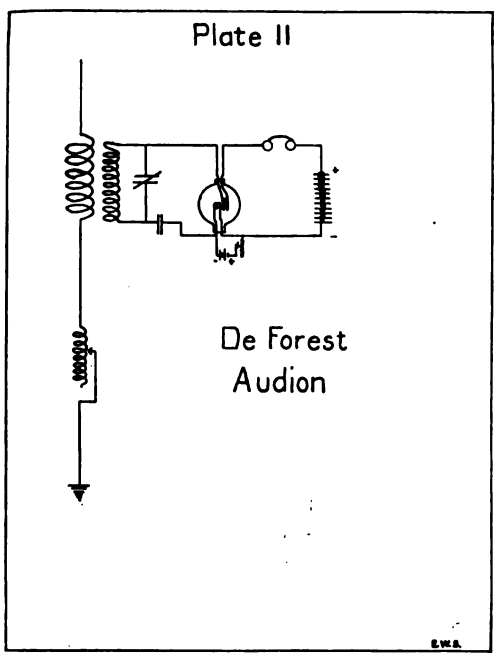
WHEN a lamp filament is heated to incandescence, as in the ordinary electric lamp, the filament radiates electrons. A proof of this is as follows: Take a common carbon filament lamp,



unseal it, and interpose within it a metal plate 1 cm. square. Reseal and exhaust the lamp. Connect this plate or isolated electrode to one side of a galvanometer, and connect the other side of the galvanometer to the negative wire of the d. c. mains supplying the current for the filament.

When current is sent through the filament, no effect on the galvanometer is noted. If, however, the galvanometer is changed from the negative to the positive terminal of the lamp filament, a large deflection of the galvanometer is observed. This indicates a difference in potential between the positive terminal of the lamp, and the sealed-in electrode. Since there is a difference in potential, the electrode must have received a charge opposite in sign to that of the positive terminal of the filament, and hence a negative charge. This is, of course, adequate proof that electrons or negative ions are given off from the filament when heated to a stage of incandescence.

The flow of negative ions across the vacuous space between the filament and the electrode corresponds to the flow of ions across an electrolyte, from cathode to anode, and just as these moving ions constitute the means of conduction of the electric current in an electrolyte, so



may the radiation of electrons in a gas be similarly utilized.

From the fact that negative ions are given off from the filament to the sealed-in electrode, it is obvious that a rectifying characteristic must be one of the ac-

companiments of this phenomenon. A flow of negative ions from the filament to the plate is equivalent to a flow of positive ions from the plate to the filament. Hence, it is seen that we can

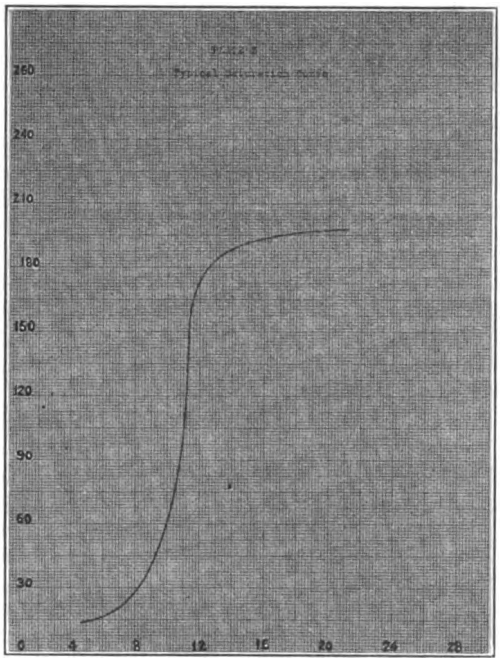


PLATE 3.—TYPICAL SATURATION CURVE

pass a much greater current from the plate to the filament, *with* the current of positive ions, than from the filament to the plate, *against* the flow of positive ions.

It is this property of the unilateral conductivity of such a lamp as previously described that has caused the adoption of the Edison effect to the needs of radio-telegraphy.

THE OSCILLATION VALVE.

The oscillation valve was invented by J. A. Fleming, of England, in 1904. Fleming discovered, as a very natural sequence to his investigation of the Edison effect, that the property of the unilateral conductivity of a stream of cathode rays could be utilized in the construction of a small rectifier of alternating currents of any frequency.

Fleming's valve consisted of a lamp with a carbon filament (metal ones were introduced later), and a sealed-in electrode of the type described in the first paragraph.

An interesting feature with regard to the pressure necessary for the best results may be mentioned. Lamp makers are familiar with the fact that when a current is passed through a filament as the lamp is being exhausted, a certain point of exhaustion will be reached where a blue light manifests itself between the two platinum terminals to which the filament is fastened. This is simply the establishment of a shunt circuit to the filament, the flow of ions caused by the Edison effect acting as the conducting medium. On decreasing the pressure, the light becomes more intense, indicating a greater Edison effect, then dies out, and as a high stage of exhaustion is approached finally dies out entirely. Hence, we see that at very low pressure, the Edison effect in a lamp is nil. This is because that at such a low pressure, there are not enough molecules of air present to be broken up into negative ions by collision with the electrons liberated by the incandescent filament.

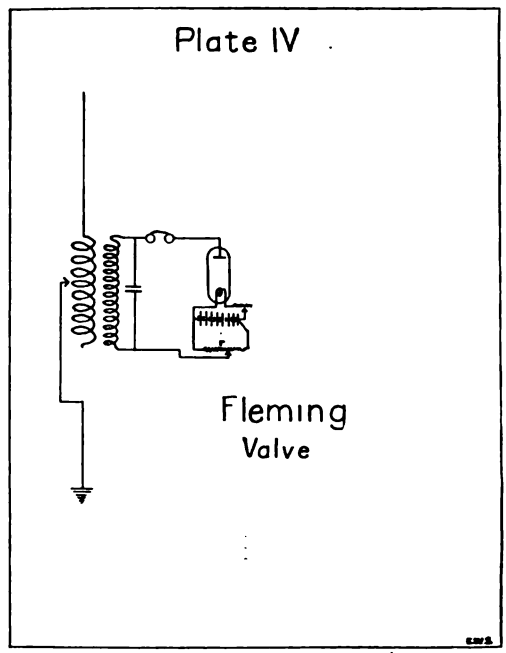


PLATE 4.—WIRING DIAGRAM FOR THE FLEMING VALVE

The fact that only a fairly low pressure is most suitable for a maximum Edison effect leads at once to a difficulty. Any lamp filament will suffer more or less disintegration from combustion

when heated to incandescence in anything but a very low pressure. Since a very low pressure is detrimental to a maximum Edison effect, as we have just seen, the manufacturer of an oscillation valve is accordingly forced to choose between sensitiveness and long life—usually it is the sensitiveness—hence the purchaser's pocketbook that suffers.

Returning to the Fleming oscillation valve. Plate 1 shows the method used in connecting this valve in the receiving set of a radio-telegraphic station, when using the valve as a rectifier.

The principle is this: If we superimpose electric oscillations on the valve, i. e., connect the source of oscillations to the filament and electrode, the rectifying properties of the valve will produce a pulsating direct current by destroying or greatly weakening one-half of every cycle. (In radio-telegraphy the "source of oscillations" is usually the secondary terminals of a high frequency transformer whose primary is connected to the earth and an antenna.) This pulsating direct current may be used to actuate a galvanometer, which would be insensible to alternating currents, or an integral effect may be obtained by utilizing the pulsating direct current from the valve to charge a small condenser which will discharge the total energy of the successive charges due to each train of incoming waves into a telephone receiver. One click or response of the receiver is heard for each train of oscillations. Thus, the frequency of the note heard in the telephone receiver is the train frequency of the waves, and this frequency is the frequency, in most cases, of the current used in the primary of the step-up transformer at the transmitting station.

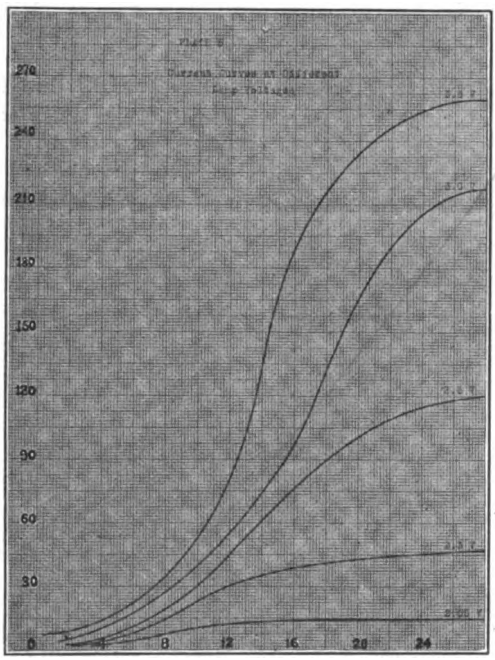


PLATE 5.—CURRENT CURVES AT DIFFERENT LAMP VOLTAGES

As is well known, this rectifying principle is utilized in almost all the various devices used as detectors of the electro-magnetic waves in radio-telegraphy.

Dr. Lee de Forest, of the United States, has modified the Fleming valve in an instrument known as the De Forest audion. Its plan of connection in a radio-telegraphic receiving set, which is shown in Plate 2, is seen to be somewhat different from that of the Fleming valve.

It has been already shown that the oscillation valve, having the properties of a rectifier, may be used as a detector of radio-telegraphic signals. On the other hand, we may employ it in another manner, depending on the fact that such ionized gas does not obey Ohm's law as a conductor.

It has long been known that the conductivity of rarefied gases differs from that of metal or liquid conductors. Suppose we have two electrodes in a rarefied gas, the negative electrode heated to incandescence. If we apply a low voltage to these electrodes and steadily increase it, we will find, on plotting observed data, that the current curve is not

linear, as would be the case if the conductivity obeyed Ohm's law, but, on the contrary, starts out slowly, then rises rapidly, then runs off on a flat curve. Such a curve is called a saturation curve, and the current represented by the upper or flat part of the curve is called the saturation current.

Plate 3 represents such a curve. The exact shape of the curve is, of course,

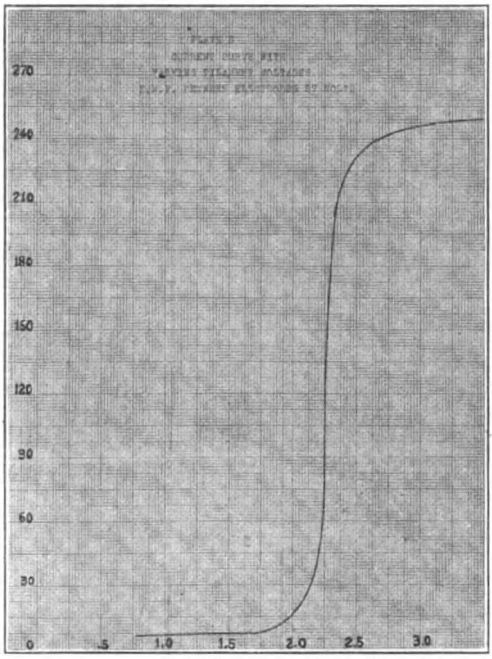


PLATE 6.—CURRENT CURVE WITH VARYING FILAMENT VOLTAGES, E.M.F. BETWEEN ELECTRODES 27 VOLTS

dependent on the conditions under which the data is taken.

The resistance of the gas accordingly may vary from a very high value to a fairly low one, depending on the temperature at which the negative electrode is maintained, and the voltage impressed between the two electrodes. It has been found that if the positive electrode is allowed to become heated by conduction and radiation from the negative one, the valve loses its property of efficient rectification, its rectification falling to 80 per cent. when 3 watts per candle is used in heating the filament—the negative electrode.

Examining Plate 3, we see that if the impressed voltage on the electrodes is maintained at such a value as to keep the current at a magnitude represented by that part of the curve just below the steep part, a very slight increase in the voltage would cause the current to rise almost instantly to the top of the steep portion of the curve. Hence, it can be seen that if we increase and diminish the voltage by small amounts, as by the application or superimposition of a small alternating voltage on the steady voltage, then the resultant current would be a considerable distance up the steep portion of the curve.

For radio-telegraphic use, then, we can impress this critical constant voltage in series with the valve and the radio receivers, and by introducing, by means of a small oscillation transformer, the high frequency alternating voltage of the received oscillations on the circuit, we would get a sound in the receivers representing the rise of the current up the curve.

Plate 4 shows the Fleming valve used as a detector when making use of

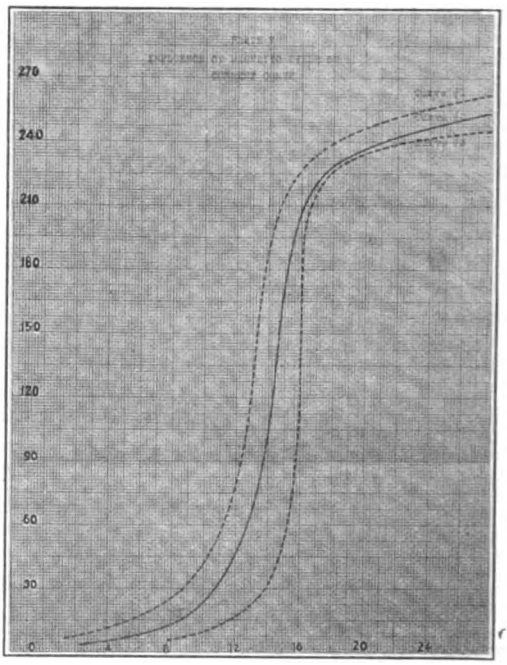


PLATE 7.—INFLUENCE OF MAGNETIC FIELD ON CURRENT CURVE
TOP CURVE—NO. 1, NEXT CURVE—NO. 2, AND BOTTOM CURVE—NO. 3

the fact that the current-voltage curve of the valve is non-linear. The high resistance, r, serves to vary the impressed steady voltage so as to bring the current to that part of the curve at which

a sudden change of curvature takes place. By referring to Plate 2, it will be seen that Dr. de Forest makes use of this property of the oscillation valve rather than of its property of rectification. In actual practice, it is quite customary to bring the current to the critical point on the curve by varying the voltage to the lamp filament, which, as can be seen, would have the same effect.

OBSERVED CURVES.

The writer set up such a circuit as shown in Plate 2 in the D. C. laboratory of the Mechanics Department of the University of California. It was not possible to read the current on any instrument calibrated in amperes or fractions of an ampere, so a galvanometer was used. In all the curves shown, the ordinates will be scale deflections of the D'Arsonval galvanometer in centimeters, which will be sufficient for showing the shape of the different curves.

Plate 5 shows several curves as observed, in which the abscissae are the voltages applied across the two electrodes.

Plate 6 is different from the curves of Plate 5 because in the latter, in each curve the lamp filament voltage was kept constant as the impressed voltage was varied. In Plate 6, the impressed voltage was kept constant at 27 volts, and the lamp voltage varied throughout. This illustrates the statement made previously that the filament voltage may be varied, keeping the applied voltage constant, to bring the current across the gas to the critical point on the curve.

It has been known for some time by radio operators using the audion, which is the only oscillation valve in common use in this country, that if a magnet were brought up to the valve, certain positions could be found where the sensitiveness could be increased to a surprising degree, while other positions of the magnet would have the reverse effect. The writer plotted some curves with the valve under the influence of a magnetic field, and these results are shown in Plate 7.

Let us proceed to an analysis of these curves from a physical, not a mathematical, standpoint. The middle curve, Curve No. 2, is the usual saturation curve with no magnetic field on the valve. Curve No. 6 shows the curve distorted by the magnet in one position, and Curve No. 3 shows the curve with the magnet in another position. It will be seen that Curve No. 1 is of practically the same shape as Curve No. 2, hence, since the sensitiveness of the valve depends on the steepness of the current curve, as previously explained, no gain has been realized by subjecting the valve to the influence of a magnetic field. The fact that the curve is displaced to the left of the middle curve throughout, simply means that it takes less applied E.M.F. to produce a given current across the wing and the grid,

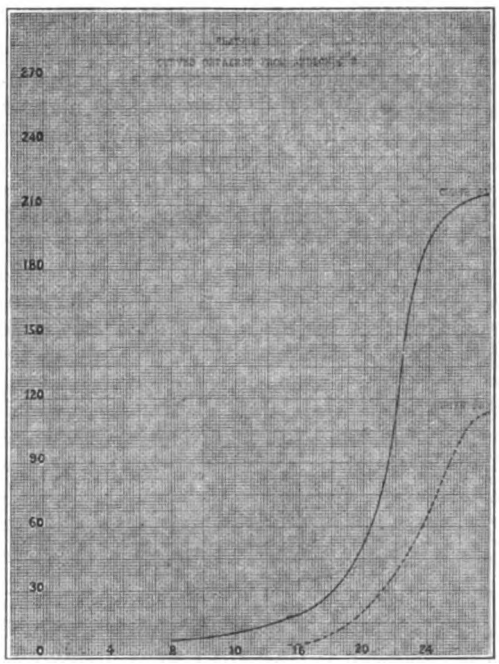


PLATE 8.—CURVES OBTAINED FROM AUDION NO. 2. TOP CURVE—NO. 1, BOTTOM CURVE—NO. 2

as the two electrodes of the audion are known. (Or, following the method of operation as set forth in Plate 6, the voltage to the lamp filament could be reduced, thus enhancing the life of same.) The significant point to be observed is that the sensitiveness of the valve has not been altered. The presence of the magnetic field has simply been to cause a greater concentration of the cathode rays, by deflection of same, to that space between the grid and wing, thus making the gas a better conductor, and hence increasing the current flow between the electrodes, as shown in Curve No. 1.

Curve No. 3, however, exhibits an en-

tirely different state of affairs. Here, the current flow across the gas has been materially reduced, but the increase in steepness of the curve shows how the sensitiveness of the valve has been increased. As set forth in the section entitled "The Principle of the Oscillation Valve," it will take a much smaller increase in voltage across the wing and the grid—the voltage of the incoming electro-magnetic waves—to produce a sound of given intensity in the radio receivers in Curve No. 3 than in Curve No. 2. Hence, the valve when subjected to a field which would cause its natural shape, Curve No. 2, to assume the shape of Curve No. 3, is much more sensitive.

The physical change has been undoubtedly the following: The magnet has deflected the cathode rays out of their normal path between the wing and the grid just enough to bring about a very critical state of affairs. There will be just enough electrons passing between the electrodes to bring the current to the critical point on the curve. In this condition, the magnetic field must be of so weak a strength that the slightest increase of the electric field across the electrodes, i. e., the addition of a small E.M.F., will cause the return to their original path of as many negative ions as possible. Thus, the curve will not only grow steeper, due to the natural characteristics of a saturation curve, but will, in addition, be made more steep by the return of the deflected electrons to their original course, since their return will of course greatly increase the conductivity of the rarefied gas.

The curves in Plates 3, 5, 6, and 7 were obtained from a valve belonging to the writer, which we will call, for brevity's sake, Audion No. 1. Another valve, belonging to Mr. R. B. Abbott, instructor in the Physics Department of the University of California, was also used in the experiments, and will be referred to as Audion No. 2. Both the audions were of the same design.

It had been previously noted by Mr. Abbott and the writer that a magnet in the presence of this valve cut down the intensity of received signals no matter where the magnet was placed. Plate 8 shows curves obtained from this valve. By comparing Curve No. 1 of this plate, which is the usual saturation curve without the presence of a magnetic field, with Curve No. 2 of Plate 7, it will be seen that for equal conditions of filament and electrode voltage, Audion No. 2 passes a much smaller current between the wing and grid than Audion No. 1. Curve No. 2 of Plate 8 shows the only type of curve it was possible to obtain from this valve when subjected to the influence of a magnetic field. (The audions were exactly similar in construction.)

We see from the shape of the curve that it has been lessened in sensitiveness, and that like in Curve No. 3 of Plate 7, a much smaller amount of current passes when the field is on the valve than before it was introduced.

We can see from the fact that a much smaller amount of current is passed by Audion No. 2 between the wing and the grid than by Audion No. 1 under the same conditions, that Audion No. 2 has not been properly constructed to obtain the maximum Edison effect. This may be due to the fact that the lamp was improperly exhausted, or the occlusion of gases by the sealed-in metals after the lamp has been sealed up. In other words, there are not enough electrons flowing between the grid and the wing, for some unknown reason, to serve as a conducting medium for the current. With a defective condition of affairs already existing, the presence of the magnet only enhances it, for after the electrons have been deflected from their normal path due to the feeble ionization of the gas, the introduction of a slight increase in the electric field is not sufficient to cause a return of the electrons to their original path. This is analogous to the setting up of the electric spark. If the gas between the spark dischargers is already fairly well ionized, the imparted velocity given to these ions by the strain caused by the presence of the electric field, i. e., the application of a high E.M.F. to the dischargers, causes them to collide with undissociated molecules of air, breaking them up into ions and finally forming enough ions to permit the passage of the current in the form of the electric spark. Thus, if the gas is poorly ionized at the start, it will take a much greater electric field to produce a given change in affairs than if

(*Continued on page 328*)

Modern Industrial and Military Explosives

A Brief Account of the Composition, Characteristics and Methods of Employment

By Charles Heilman

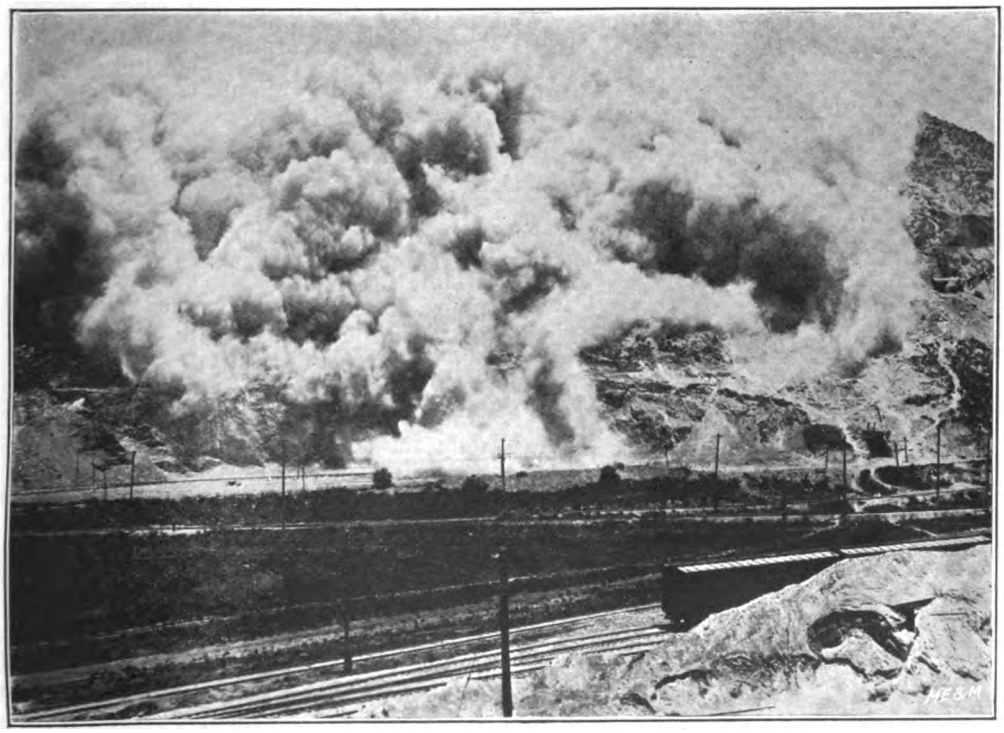
Illustrations by courtesy of the E. I. du Pont de Nemours Powder Co.

PART TWO

Blasting Gelatin:

It has been indicated before that dynamite, when placed under water, will lose about 6 per cent. of its power, since the nitro-glycerin is liable to be exuded or displaced; while, like nitro-glycerin, it freezes easily, and thawing out the frozen cartridges is a dangerous operation.

To obviate these drawbacks Nobel invented in 1876, blasting gelatin, especially adopted for submarine blasting and blasting in wet ground. This gelatinous material was obtained by the action of nitro-glycerin, either alone or with the help of solvents, on low grade or soluble guncotton. It was made by Nobel by incorporating 6 or 7 per cent. of low nitrated cellulose (collodion cotton or soluble guncotton) with slightly warmed nitro-glycerin. The result is a plastic, transparent material with a specific gravity of 1.5 to 1.6, which may be kept under water for a long time without appreciable change.



AN EXPLOSION OF TWENTY-EIGHT TONS OF DYNAMITE IN A GYPSUM HILL AT THE CEMENT FACTORY NEAR COLTON, IN RIVERSIDE COUNTY, CALIFORNIA

The power of the guncotton contained in the collodion adds to the

power of the nitro-glycerin, so that an equal weight and quantity of blasting gelatin is more powerful than ordinary dynamite and much superior to the liquid nitro-glycerin. But on account of the colloid contexture, it is less sensitive to detonations than ordinary dynamite and explodes only by means of an improved priming. Usually this consists of a priming of fulminate that explodes a small quantity of compressed guncotton which in turn explodes the dynamite.

Blasting gelatin also freezes and is sensitive to percussion in this state. Camphor and other substances have been added to blasting gelatin to render it more solid and less sensitive.

It was dynamite and blasting gelatin which made possible the construction

BORING A HOLE FOR BLASTING A TREE STUMP

of the St. Gothard and the Simplon tunnels in Switzerland. The St. Gothard tunnel was begun in 1872 and it required eight years to complete the work which was started at both ends. Two thousand five hundred workmen were employed daily and the cost amounted to over $11,250,000. It is 9¼ miles in length, 28 feet broad, and 21 feet high, and has a double line of rails. According to the engineers, the construction of this tunnel required 7 lbs. of kieselguhr dynamite, or 5 lbs. of blasting gelatin for every cubic yard of granite.

The Simplon tunnel is 12.4 miles in length. It was begun in 1898, and completed in 1905 at a cost of $14,000,000. It also has a double track, or rather consists of two parallel passages, separated by 39 feet of rock. The construction of the Simplon tunnel required 1,350 tons of dynamite, 4,000,000 detonating caps and bore-holes, and 5,300,000 yards of fuse.

Dynamite has been used to a great extent in the construction of the Panama Canal, and all other modern engineering feats too numerous to mention.

Other explosives:

The progressive steps made in chemistry have in the last fifty years greatly increased the number of explosives. Explosives of the dynamite variety are today facing competition with explosives consisting of two inexplosive ingredients, which, when mixed together, yield a compound capable of violent explosion. Most all of these explosives contain chlorates. They are much safer to handle than dynamite, as they can be transported to the place of operation separately and mixed only when needed. "Cheddite" is the best known of this class of explosives. Cheddite is in a certain way to chlorate of potassium as dynamite is to nitro-glycerin. Chlorate of potassium mixed with a combustible substance forms a dangerous explosive, which detonates at a shock. To deaden its sensitiveness it is finely pulverized in a kind of nitrated oil which congeals around the particles of chlorate (proportions: 80 per cent. pulverized chlorate of potassium in 8 per cent. of castor oil, and 12 per cent. of nitrated substances). The solid product thus obtained may be transported with safety, and explodes only under the action of a detonating cap. It is nearly as powerful as dynamite, costs less, and is less sensitive to cold than the nitro-glycerin products.

In this class may also be included the picric acid compounds, which consist of picric acid or tri-nitrophenol brought into a dense state by fusion and used as a filler for shells. These picric acid compounds are known as "lyddite" in England and "melenite" in France. Their composition is nearly identical. Melenite is obtained by dissolving guncotton in a mixture of 2 parts of ether and 1 part of alcohol, then adding picric acid.

The manufacture of dynamite has increased enormously in the last two decades, and while the total production in 1867, the year of its invention, was but 11 tons, today the yearly output amounts

to more than 65,000 tons in the United States alone. The largest dynamite factory in the world is situated near Ardeer, Scotland; and the most important factories in the United States are situated in the hills east of San Francisco bay.

Fulminates:

The preceding considerations furnish us with an idea of the security of ordinary explosives. An explosive might be compared to a powerful spring held in place by a small catch. If, at the least shock, the catch is released, the apparatus becomes dangerous; but if to loosen this catch a special mechanism must be used, the apparatus becomes inoffensive when the special mechanism is not present.

For dynamite, this special mechanism is the fulminate capsule. It is the detonation of this capsule which "liberates the spring," and thereby unshackles the forces of the explosion.

Let us study a little more closely this priming. Among the explosives there are some which, as we have mentioned above, at ordinary pressure and temperature, will explode by a phenomenon which seems instantaneous, as soon as one of their elements is lighted or shocked. These substances are called detonators and fulminate of mercury is one of them. Others, on the contrary, under similar conditions burn progressively faster or slower—they deflagrate. But they can explode if they are submitted to a high pressure and to a high temperature, or if their decomposition is brought about by the detonation of a fulminate capsule or some similar substance.

Explosives of the first kind are evidently too dangerous to be used in large quantities. They can be used only in a fragmentary state, in particles. But we could not do without them, since without their aid we would not be able to detonate at will less perilous explosives.

Mercury fulminates:

The chief ingredient in detonators and percussion caps is mercury fulminate. It was discovered in 1799 by Howard and first used as a filler in percussion caps about 1815. It is made by dissolving mercury in nitric acid and is a white crystalline substance that is almost insoluble in cold water. Like all fulminates, it is easily exploded and excessively sensitive to percussion. The explosion is very sharp because of the rapidity of its decomposition, but due to the small amount of gases given off the force exercised is not very great. The explosive force of mercury fulminate is not much greater than that of gun powder, but much more sudden in its action. The readiness with which this compound may be fired makes it an excellent means of exploding other substances, as it is essentially a detonating powder and is therefore a requisite for exploding guncotton, nitro-glycerin and its compounds, etc.

Fulminate of mercury is very poisonous like all quicksilver compounds, has a sweet, metallic taste, and is soluble in hot water and concentrated nitric acid.

SETTING OFF A BLAST ON A FARM

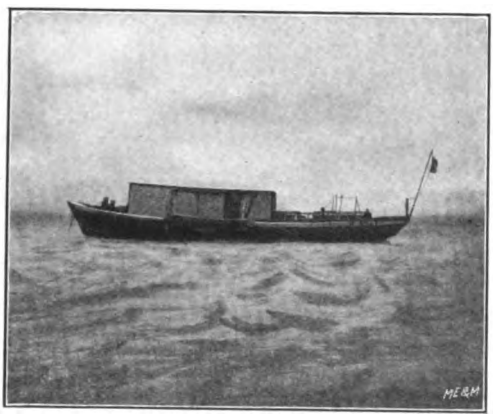
SMOKELESS POWDER

Guncotton:

Guncotton and nitro-glycerin were discovered about the same time and are related in their production and properties. Guncotton is an explosive substance obtained by the action of strong nitric acid on cellulose at ordinary temperature. The transformation of cotton fabrics, paper and other forms of cellulose into explosive substances by means of immersion in cold concentrated nitric acid, was discovered by T. J. Pelouze in 1838. He observed that the materials treated in that manner, though not altered in physical appearance, became heavier, and that after washing and drying they possessed self explosive properties. However, it was C. P. Schoenbein who in 1846 first converted cotton waste into the explosive body known as "guncotton."

Guncotton is made by immersing cleaned and dried cotton waste in a mixture of strong nitric and sulphuric acids. The cotton remains in contact with these acids for a period varying from two to four hours, at ordinary temperature, in which time it is almost fully nitrated. The acids are then slowly run off and the cotton washed and boiled.

Guncotton in an air-dry state burns with great rapidity—about eight times as quickly as gunpowder—but it does not detonate unless confined. It burns with a yellowish flame, almost without smoke and leaves little or no residue. The volume of gases formed is very large. The more closely it is confined the greater is the pressure set up by a small part of the burning charge and the more completely will the explosion of the remainder assume the detonating form. A small



A TYPICAL STORAGE BARGE FOR EXPLOSIVES

charge of dry guncotton will detonate the wet material and this peculiarity is made use of in the employment of guncotton for blasting purposes. A charge of compressed wet guncotton can be exploded even under water by the detonation of a small primer of the dry and waterproofed material, which in turn can be started by a small fulminate detonator.

The effect of guncotton in mines is very nearly the same as that of dynamite, for equal weights, but as above stated it requires a stronger detonator.

At its discovery, Schoenbein proposed to use it as a substitute for gunpowder. Many attempts were made to utilize it in that capacity but they all failed. The employment of guncotton as a propellant was made possible only after the discovery that it could be gelatinized or made into a colloid by the action of solvents, such as acetone and a number of like substances.*

Cotton-Powder or Tonite, which was introduced in the United States in 1881, and is manufactured by the Tonite Powder Co., of San Francisco, consists of finely divided or macerated guncotton compounded with about the same weight of nitrate of barita. This compound is pressed into candle shaped cartridges, formed with a recess at one end for the reception of a fulminate of mercury detonator.

Smokeless powder:

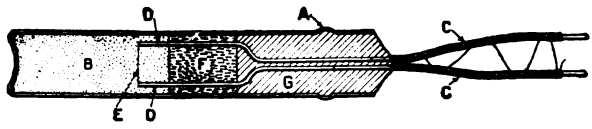
From the discovery of black powder till the middle of the 19th century, the art of powder making remained at a standstill, because it was the practice of alchemy rather than the principles of chemistry which may be said to have controlled the manufacture of all explosives. The science of warfare followed the progress of mechanics in improving the gun with a view of increasing the rapidity of flight and the penetrative force of projectiles. Gunpowders and all other explosive mixtures or compounds containing metallic salts must form smoke on combustion, and many were the attempts made to obviate these defects, but as stated above, it was only after the discovery that guncotton could be gelatinized, that the manufacture of explosives used as propellants was revolutionized.

Guncotton is converted into a gelatinous form by several substances, such as ethyl acetate or benzoate acetone and many benzene compounds, most of which are volatile liquids. On contact with the guncotton a jelly is formed which stiffens as the evaporation of the gelatinizing agent proceeds and finally hardens when the evaporation is complete. Whilst in a stiff paste it can be cut, moulded or pressed into any desired

*The so-called collodion-cottons are nitrated celluloses, but of a lower degree of nitration than guncotton. Characteristic differences between guncotton and collodion-cotton are the insolubility of the former in ether or alcohol or a mixture of these liquids, and the extreme explosiveness of guncotton, while collodion-cotton is only slightly explosive. Collodion-cotton has attained a greater importance than guncotton itself through its diversified employment, for instance, in photography (preparation of the exposed plate); in blasting (for the production of explosive gelatin from nitro-glycerin); in surgery (for uniting the edges of wounds); and in the manufacture of fancy goods (celluloid articles, as: combs, collars, cuffs, toilet boxes, etc.).

shape without any danger of ignition. Guncotton alone in the colloid state burns very slowly if in moderate sized pieces. All the smokeless powders, of which gelatinized guncotton or nitrated cellulose is the base, are moulded into some conveniently shaped grains, tubes, cords, rods, discs, or tablets, so that the rate of burning may be controlled as desired.

It is obvious that many advantages were to be obtained by using the new explosives instead of the old powders, chief among them being their smokelessness,* and the property of burning up completely without leaving any residue.



CROSS SECTION OF AN ELECTRIC BLASTING FUSE

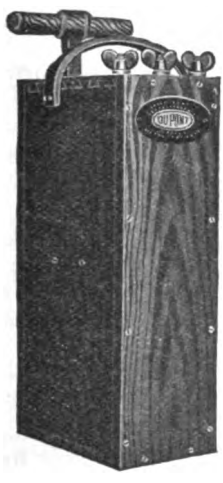
The present smokeless powder industry only dates from the invention of the Poudre B by Vieille, in 1886. This powder consists of a mixture of insoluble and soluble nitro-celluloses, its exact composition being:

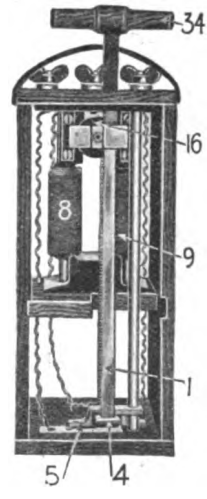
Insoluble nitro-cellulose....68.21 parts
Soluble nitro-cellulose.....29.79 parts
Paraffin ..... 2.00 parts

The addition of paraffin serves to diminish its sensibility to shock and to retard its rate of combustion.

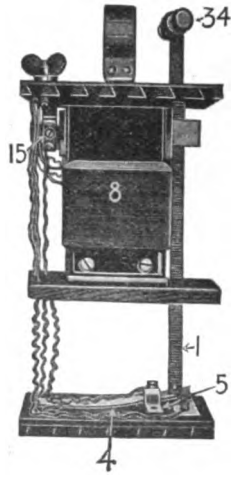
Poudre B is claimed to be almost absolutely smokeless. It leaves no residue in the gun, except a few unconsumed grains. It is of the consistency of hard rubber, honey yellow in color, and translucent. In the Lebel rifle (standard gun of the French army), a charge of 43 grains of this powder produces a muzzle velocity of 2,050 feet per second with 3,350 lbs. of pressure per square inch.

While Poudre B was used with great success in France, other countries were vainly trying to realize it. Nobel invented "Balistite," and about the same time "Cordite"—the name of the smoke-


A TYPICAL BLASTING MACHINE



INTERIOR FRONT VIEW OF BLASTING MACHINE



INTERIOR SIDE VIEW OF BLASTING MACHINE

*All of the present so-called smokeless powders produce a little fume or haze, mainly due to the condensation of the steam which forms one of the combustion products.

less propellant in use in the British army and navy—was produced. This material is made in the form of cylindrical rods or strings of varying thicknesses by pressing the material, whilst in a soft and pasty state, through dies or perforations in a steel plate, by hydraulic or screw pressure, hence the name cordite. The thickness or size varies according to the nature of the charge for which it is

(*Continued on page 366*)

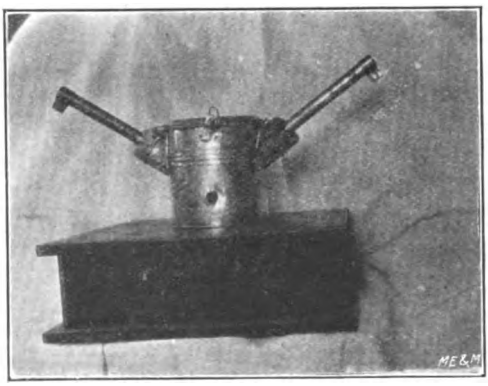
A New Arc Generator for High Frequency Current

By Philip E. Edelman

THE advantages of continuous waves for radio work are daily becoming more obvious. Any up-to-date textbook will cite at least six advantages for these waves, so we need not take up time for discussing them here. Of the various methods for their production, Poulson's arc generator is perhaps the best known, although high frequency alternators, notably the recent Goldschmidt embodiment, deserve at least equal attention.

At first sight the Poulson embodiment of Duddell's principle appears ideal, but when one comes to the construction and use of his arc there is a difference in opinion. Aside from the complicated arrangement, there are certain evident mechanical difficulties in using the gas supply in this device.

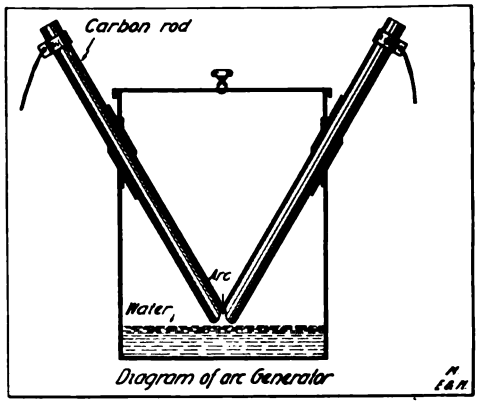
During some recent experiments the writer devised a new form of generator in which the need of a separate gas supply, gas tight joints, and a complicated construction are avoided. This generator, which is used in substantially the same manner as the usual arc, is shown



VIEW OF A READILY MADE ARC GENERATOR FOR HIGH FREQUENCY CURRENTS

in the accompanying diagram, in which the essential parts are clearly indicated.

It will be noted that the electrodes are of a material that generates its own gas as these electrodes are brought to incandescence. Flaming arc or magnetite electrodes are suitable for this purpose. They are also inclined at such an angle as to throw the hot gas upwards, thus drawing in a cooler supply that also contains some water vapor taken from the bottom of the container. The electrodes are maintained at a uniform distance by suitable means, and the device works continually as long as current is supplied at the terminals. The electrodes, too,



are of such nature that they burn several times as long as would similar carbon electrodes. The level of the water is maintained just below the arc, as shown, by means of a simple outlet and bypass, not indicated in the sketch. In experiments with modifications of this arc, foreign electrodes and cooled electrodes of other materials were tried, but the best results were obtained with the arrangement shown.

Experiments with this device have shown that it is suitable for very high frequencies, and in view of the novel features, including the simple design, it is suitable for the demonstration of radio-telephony and telegraphy, as well as for the treatment of certain ailments of delicate human organs in therapeutics. In all cases a very steady and dependable arc is maintained—a condition essential to successful work.

The forest service collected 40,000 pounds of tree seed last year for use in reforestation work. The total area reforested was about 30,000 acres.

If you mean "No," say "No"—unless you are a woman.

New Resistance and Heating Units

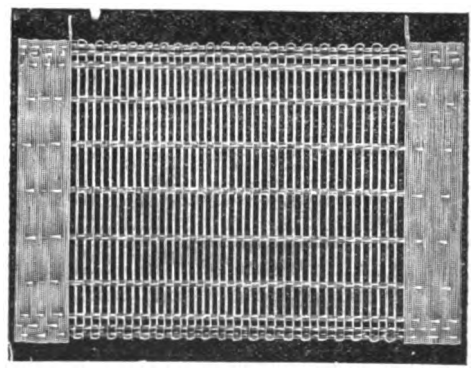
GREAT strides have recently been made in electric heating appliances while a reduction of the price of electric current in almost every city has rendered it possible for electric heating to become a universal convenience.

The most important part of any electrical heating or cooking utensil is the heating unit. Not only must the cost of this part be taken into consideration, but the extra cost of mounting and working the unit into various appliances, its efficiency for transforming electric current into heat, and other similar factors must not be overlooked in the manufacturing of heating and cooking devices.

In the accompanying illustrations is shown a new heating unit that has recently been tested out by some of the largest electrical manufacturing companies. Not only has this unit been adopted by many of them, but the experts of these concerns have pronounced it to be the best so far produced.

In order that any heating unit be rendered efficient, it is necessary to have it contain as little metal as possible. Under such conditions all the heat generated is imparted more rapidly either to the surrounding air or into the surface where the heat is to be transmitted. The unit described in this article contains no metal other than the wire itself and is therefore most suitable for electric stoves, electric radiators, car heaters, foot warmers, hot plates, incubators, and all varieties of electric warming and cooking devices. It is also especially adapted for meter testing work, motor starters, controllers, power stations and for other similar purposes. It is an excellent substitute for lamps inasmuch as it is unbreakable, portable and easily mounted, not to mention its lower cost. A 1,500 watt unit complete weighs but five ounces.

In one of the accompanying views is shown an electric unit composed of high resistance material. The material employed has a resistance of over fifty times that of copper. It is interwoven back and forth with pure asbestos cord. This construction insures the unit against becoming deformed as is often the case with resistance wound in spirals. Another feature gained by this design is the simplicity with which connections may be made every few inches, so that when this unit is employed in rheostats the connecting strips can be arranged in such a manner that the motor will start smoothly. These units are unbreakable and can be employed with great reliability and efficiency for all types of crane and railway controllers which are subjected to violent vibration. It is claimed by the manufacturer that these units are much cheaper than any others now on the market; this being accounted for by the fact that they contain less material and are therefore less expensive to manufacture. They are also very much lighter for they contain no metal outside of the wire itself.



ONE OF THE NEW RESISTANCE UNITS

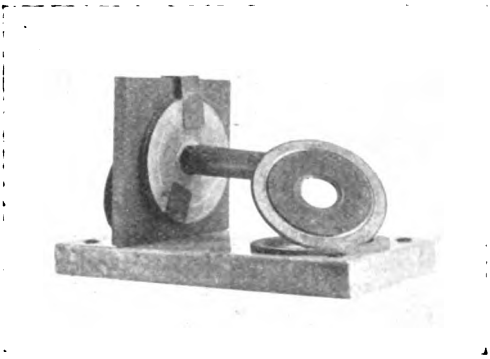
The new resistance units are made in many different sizes and in several styles. They can be made in any shape or size and for any carrying capacity up to 700 amperes. When made in the form of a band or cord, they are said to be far superior to spiral or grid resistances.

Among the many applications of these new heating units one of the most noteworthy is an electric radiator weighing but five pounds and which can be attached to any electric light socket.

Construction of a Quenched Gap

By Earle C. Hanson

THE Lepel arc, the Telefunken series of Lepel arcs and the Peukert gap in oil between a fixed and a rotating disc, are very efficient and practical forms of quenched spark gaps. All of these possess in common the characteristic of a very short spark gap provided with means for rapid cooling so as to effect a speedy restoration of the high resistance of the gap after the energy has left the primary circuit. The credit for foreseeing the importance of this requirement and of indicating means for attaining it belongs to Professor Max Wein.

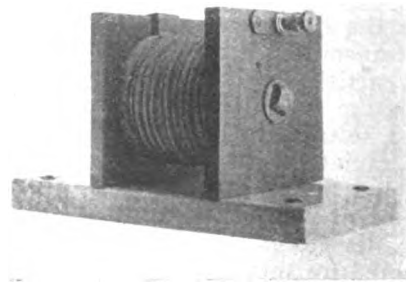


SOME OF THE PARTS COMPRISING A SIMPLE QUENCHED GAP

The quenched gap is economical in transmitting energy, practically noiseless, easy to control, emits a persistent train of oscillations, and has a low logarithmic decrement, thereby complying completely with the new wireless law. A quenched gap built according to the specifications of this article will fully repay the experimenter, by the increased efficiency he can obtain from his transmitting apparatus.

The two end pieces are cut from ½ inch fiber, 4 inches square. Through the center of each piece a ¼ inch hole is drilled. Twelve copper discs are turned down till the surface is true. The thickness being ¼ inch and the diameter of each 1½ inches. A ½ inch hole is next drilled through the center of each plate and a larger drill is then used to drill half way through from each side. One of the accompanying views shows the gap taken apart and clearly brings out the construction of the disc, also the outer groove and the thin rim of the plate that is used to prevent the current from sparking across on the outer portion of the disc where the rubber rings are placed. The rubber rings are cut from ⅛ inch material and the rim is ¼ inch wide. Two rubber plates 1½ inches in diameter and with a ½ inch hole through their center are used as end washers. The square end pieces have binding posts screwed to the fibre and are connected with the end copper discs by means of strips of copper. A 6 inch bolt, ⅛ inch in diameter is passed through one of the end pieces and then several layers of empire cloth are tightly wound on the bolt so as to just allow the twelve discs to fit over the bolt. The rubber rings are placed between each pair of metal plates. The other end piece is then placed on the bolt and a nut screwed on. The gap is then completed and placed on a marble base. The other illustration shows the completed quenched gap.

The writer has tried the Lepel gap with two of the plates used on the



COMPLETELY ASSEMBLED QUENCHED GAP FOR AMATEURS

quenched gap described above, obtaining highly satisfactory results.

From the two illustrations the reader can get a much better idea of the actual construction of a Telefunken gap than a drawing could possibly furnish. Any other dimensions can be used, but the main aim of the author has been to make it small, neat and reliable.

The quenched spark is well known in Europe and is fast taking its place in America in a variety of types. *Modern Electrics* published a most interesting article in the November, 1913, issue on this topic.

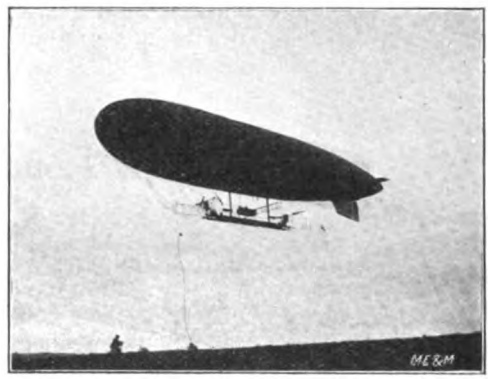
It would be well in closing to suggest that the experimenter read the work by George W. Pierce, *Principles of Wireless Telegraphy,* for a detailed description of the working of the quenched arc.

AN AUTO-SLED FOR THE YOUNG FOLKS

A. Arthur Jewett, of Skowhegan, Me., has recently perfected a double-runner motorcycle combination that is an object of envy among the youngsters about town. He removed the engine from a regular motorcycle and mounted it to the rear end of the bobsled. The engine is belted to a large pulley on a counter shaft, and the latter is connected by sprocket and chain to the driving wheel. The driving wheel is set in the rear end of a movable frame pivoted on the corner shaft so that it rises and falls readily to cover all inequalities in the road. The rim of the driving wheel is studded with sharpened steel calks to give a firm grip upon the snow. Mr. Jewett gets a speed of about 20 miles per hour. It will go up the highest grade that is found on the ordinary road at the rate of from 12 to 15 miles per hour.—*John E. Taylor.*

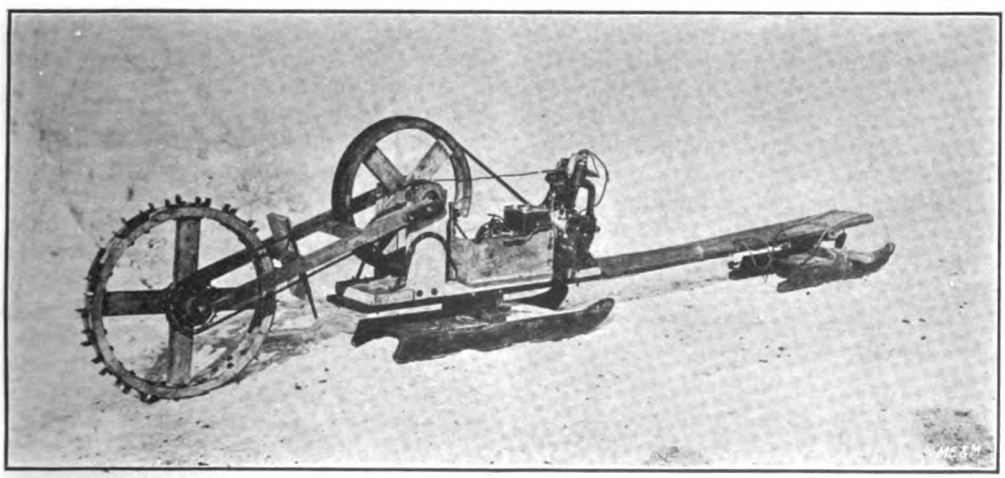
A 400 H. P. FRENCH AIR SHIP

The accompanying illustration shows the French dirigible airship "Commandant Coutelie," constructed at Puteaux by the Societe "Zodiac," and equipped with two six-cylinder gasoline motors of 190 h.p. each. These gasoline engines operate at a normal speed of 1,000 revolutions per minute. They drive two propellers, each 4.5 meters in diameter, at a speed of 500 revolutions per minute. The two motors are situated 24.5 meters apart and propel the airship at a speed of 62 kilometers per hour. The fuel tanks can hold sufficient fuel to operate both motors at normal speed and power for 20 hours.



FRENCH DIRIGIBLE AIRSHIP "COMMANDANT COUTELIE" IN FLIGHT

The total weight of the airship with two pilots, two observers and four me-



A NOVEL FORM OF MOTOR-DRIVEN BOBSLED, SHOWING THE MOTORCYCLE ENGINE, BELT DRIVE AND THE TOOTHED DRIVING WHEEL AT THE REAR

chanics is said to be 2,200 kilograms. This dirigible airship has a gas volume of 9,500 cubic meters and a fabric surface of 3,250 square meters. It has two balloonets of 3,600 cubic meters and a total length of 92 meters, with a diameter of 14 meters.

The envelope is made from double fabric caoutchoute with a wind resistance of 1,600 kilograms or 400 gramms per square meter. The framework of the car is 40 meters long and 2 meters high with a width of 1.3 meters. It is located at a distance of 5 meters below the balloon. The total height of the airship including the balloon and car is 21 meters. The balloon has proven very successful in many flights.—*Frank C. Perkins.*

The New London Radio Station

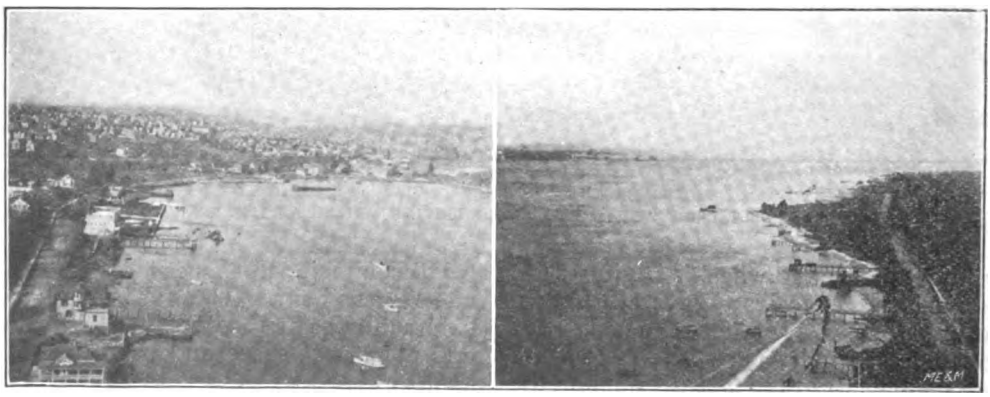
By R. A. Dio

WITHIN the past four months the signals from a new station have made themselves manifest over a considerable area and possibly the readers of MODERN ELECTRICS AND MECHANICS would like some first hand information regarding it. The station in question is that located at New London, Conn., the call letters of which are WLC.

The station is located about two miles from the city of New London, on the banks of the picturesque Thames River, not very far from the course where each year the Yale-Harvard crews battle for victory, and is about a mile from the open waters of Long Island Sound. It is privately owned, and was built for the owners in 1910 by the Massie Wireless Telegraph Co., of Providence, R. I., but has only been recently equipped for long distance work.

The initial purpose of building such a large plant was, and still is, to maintain a direct communication with the company's powerful wrecking steamer which is also equipped with radio-apparatus. The station is, however, open to public service, under the London Convention rules, and handles all the commercial business, at the East end of Long Island Sound, from the steamers equipped with the Fessenden System.

There are at present two complete transmitting sets installed here, which are both used as circumstances dictate. The principal set consists of a two kw., 500 cycle, synchronous rotary set, which is manufactured by the National Electric Signalling Company, under the Fessenden patents. It is similar to the sets installed on some of the steamers of the United Fruit Company and comprises a 5 h.p., 60 cycle D. C. motor, flexibly coupled to a 500 cycle A. C. generator, while on the same shaft with the rotor of the generator is mounted the rotary spark gap enclosed in an adjustable muffling case to which the fixed electrodes are fastened. The rotating wheel of the gap is a steel disc with copper sparking

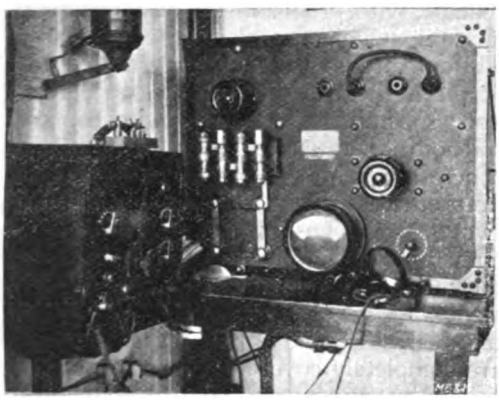


VIEWS FROM THE TOP OF THE AERIAL MAST: AT THE LEFT MAY BE SEEN THE CITY OF NEW LONDON, WHILE AT THE RIGHT IS THE MOUTH OF THE THAMES RIVER

points set in the edge. These points are made in the shape of a small wedge which approaches the stationary point broad side on; the discharge taking place from the sharpened end.

The transformer is of the open-core type, standing about four feet high and is fitted with protective gaps for excessive strain. The condenser is of the well-known compressed air dielectric pattern and a constant pressure of 250 pounds is kept on the plates at all times.

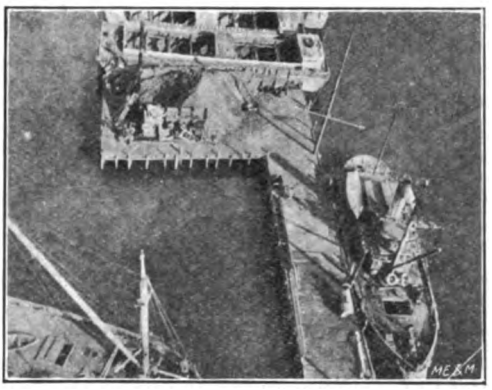
The switchboard which controls the large set stands about six feet high and upon the upper panel are mounted two circuit-breakers, an A. C. ammeter, a frequency meter and a voltmeter with interchangeable plug, in order that it may be used for either A. C. or D. C. machines. On the central panel are the controlling switches and the rheostats,



PRESENT RECEIVING APPARATUS AND SWITCHBOARD FORMERLY USED

while on the lower division is mounted the automatic starting device, by means of which the operator is able to start the generator by simply pushing a button besides the transmitting key.

This comprises the long distance set. The auxiliary set is a ½ kw., 60 cycle set which is operated directly from the street mains. The same condenser and oscillation-transformer are used on both sets. The rotary gap of the small set is operated by a small induction motor on 110 volts through an impedance coil and has a milled wheel of brass with eight sparking points. These, together with the inductance coils of flat copper strip wound on edge—of which there are three—besides the oscillation transformer which is made in a like manner, complete the description of the apparatus in the generator-room. It is to be regretted that no photographs could be obtained



LOOKING DOWN FROM THE TOP OF THE AERIAL MAST

of this room, but it is hoped that this description will give the reader a fair idea of the transmitting sets.

The combined receiving room and office contain the transmitting key and receiving apparatus, of which the accompanying view will give a good idea. It is the regulation Fessenden receiver and is very selective. The signals from Mare Island, California, have been recorded here and those from the Canal Zone and Guantanamo are continually heard with great distinctness. On the operating desk is a direct Western Union wire to New York and New England points.

LOOKING UP THROUGH THE CENTER OF THE AERIAL MAST

The tower supporting an antennæ of fifteen phosphor-bronze wires five feet

(*Continued on page* 344)

Electrical Equipment of the Panama Canal

Almost as Marvelous as the Canal Itself are the Centralized Control and Indicating Systems

Illustrations by courtesy of the General Electric Co.

THE electrical specification, design and manufacture of the Panama Canal centralized control system may properly be regarded as one of those undertakings which, from an engineering standpoint, not only arouse a lively interest, but also present an opportunity for much valuable instruction. The interest results mainly from the immensity of the canal project itself, and the instruction from a consideration of the methods employed to insure the passage of even the largest ships afloat across the isthmus with speed and safety. The complete operation of the canal locks, terminals and auxiliary equipment utilizes electrical energy throughout, with the present exception of the Panama Railroad, the electrification of which is under contemplation.

The specifications for the entire generating, lock controlling, and distribution system for operating the Panama Canal were prepared under the supervision of Mr. Edward Schildhauer, electrical and mechanical engineer, Isthmian Canal Commission, assisted by a staff of able electrical engineers, including Mr. C. B. Larzelere, who was closely identified with the lock control problems, and Mr. W. R. McCann with the generation and distribution of power. These specifications exhibited great care and painstaking engineering. They contained every safeguard that expert engineers could suggest, were exact and explicit in regard to the results required, yet gave proper range in the details of accomplishment.

GENERATION AND DISTRIBUTION

The power system for the operation of the locks, towing locomotives, lights for the locks and buildings, and motors not directly connected with the lock control, is composed of:

A 7500 kv-a, 2,200 volt hydroelectric power plant at the Gatun Dam;

A 4500 kv-a, 2,200 volt Curtis turbo-generator electric power plant at Miraflores for emergency, lately used to supply power for construction work;

A double 44,000 volt transmission line across the Isthmus, connecting Cristobal and Balboa with the two power plants;

Four 44,000—2,200 volt substations. stepping down at Cristobal and Balboa, and up or down at Gatun and Miraflores, depending on which of the two plants is supplying power;

Thirty-six 2,200—240 volt transmission stations for power, traction and light at Gatun, Pedro Miguel and Miraflores locks;

Three 2,200—220—110 volt transformer stations for the control boards at the locks;

Stations at Cristobal and Balboa for coal handling plants, machine shops and dry docks.

The system of connection throughout employs a double bus, double switch scheme, with provision for disconnecting any oil switch for cleaning or repairs without interrupting the circuit. In the power house and the four 44,000 2,200-volt substations, the oil switches are solenoid operated and are installed in concrete cells, above which are concrete fireproof compartments containing the two sets of buses. In the thirty-six transformer stations in the lock walls, the oil switches are hand operated. All 2,200-volt oil switches have disconnecting switches, so arranged that live parts are completely covered.

The instrument and control board for the Gatun generating station is of natural black slate, as are all the switchboards for the power system. It is totally enclosed by means of grille work with doors at each end. The switchboards for the transmission line substations are of the vertical type, with control apparatus and mimic connections symmetrically arranged on the middle section of the panels. The rear of the board is enclosed by means of grille work with doors at each end.

POWER SUPPLY AND CONTROL PANELS FOR LOCK MACHINERY MOTORS

Current for the lock machinery and towing locomotives is transformed from the 2,200-volt system in the immediate vicinity of where it is used. There are a total of thirty-six transformer stations, for all locks, each containing duplicate 200 kva. 3-phase 2,200 240-volt trans-

formers for power, and one single-phase 25-kva. 2,200 220-110 volt transformer for lighting. The stations, normally fed from the 2,200-volt buses in the 44,000 2,200-volt substations, can also be operated from the power plants; the stations at Gatun locks from the Gatun hydro-electric station; and the stations at Miraflores and Pedro Miguel from the Miraflores emergency steam plant.

To give an idea of the number and sizes of motors to be controlled in operating the lock machinery, the following table is interesting:

Machines and Operation.	Motors each Machine and H.P.	Number of Motors. Gatun.	Ped. M.	Mira.	Total.	Total Horse Power.
Miter gate, moving, each leaf.....	1—25	40	24	28	92	2300
Miter gate, miter forcing.....	1— 7	20	12	14	46	322
Fender chain, main pump.....	1—70	16	16	16	48	3360
Fender chain, operating valve.....	1— ½	16	16	16	48	24
Rising stem gate valve.....	1—40	56	24	36	116	4640
Cylindrical valve	1— 7	60	20	40	120	840
Guard valve	1—25	6	6	6	18	450
Auxiliary culvert valve.....	1— 7	4	4	4	12	84
Totals.....		218	122	160	500	12020

There are many motors not included above, as, for instance, those for the spillway gates, for the hand rails on the mitering gates, and for the sump pumps. The spillway gates are remote controlled from a special control board.

LOCATION AND OPERATION OF LOCK MACHINERY

From an operating standpoint the machinery was placed below the coping of the lock walls, thus affording a clear space for maneuvering ships and protecting the apparatus from the weather without erecting numerous houses.

The mitering gates consist of two massive leaves pivoted on the lock walls which operate independently of each other. A pair of gates is located where each change of level occurs and divides the locks into 1,000-foot chambers. In addition to these gates, at lake and ocean ends are duplicate pairs of gates used as guard gates. To handle the vessels of various sizes with the minimum use of water, mitering gates of the same description as those above are installed, dividing 1,000-foot locks into two compartments. These gates are termed intermediate mitering gates. When the mitering gates are closed they are what might be termed clamped in position by a device called a miter forcing machine.

On the top of all mitering gates a footwalk with hand rails is provided. When the gates are opened and in the recesses provided for them in the lock walls, these hand rails would interfere with the passing of the towing locomotives, except in the case of the lower guard gates. The hand rails are therefore made to be raised and lowered. This is done by a motor under the footwalk, controlled from the lock wall.

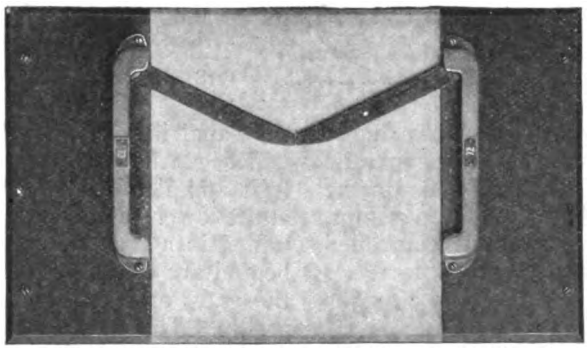
The chain fenders are stretched across the canal in front of all mitering gates which can be exposed to the upper lock level and also in front of the guard gates at the lower end. These chains are maintained in a taut position when the gates behind are closed, and are lowered when the gates are opened for the passage of a ship. The chains are raised and lowered by a method similar to that followed in hydraulic elevators, with the additional feature that if a ship approaches the gates at a dangerous speed and rams into the chain, the chain is paid out in such a way as to gradually stop the ship before it reaches the gates. Lowering the chain for the passage of a vessel and raising it again after the vessel has passed is accomplished by two motors: one driving the main pump supplying water under pressure, and the other operating a valve which controls the direction of movement of the chain. These two operations are combined in one, each motor being stopped automatically by a limit switch when the motor has performed its function.

The filling and emptying of the locks is accomplished by three culverts, one in the middle wall and one in each side wall, the flow of water being controlled by rising stem valves. They are located in the

culverts at points opposite each end of each lock so that the culvert can be shut off at any desired point for filling a lock with water from above, or upstream, or for emptying it by allowing it to flow out and down to the next lock. Lateral culverts conduct the water from the main culverts, under the lock chambers, and up through openings in the lock floors.

REASONS FOR USING THE CONTROL SYSTEM ADOPTED

As the flight of locks at Gatun, for instance, extends over approximately 6,200 feet, and the principal operating machines are distributed over a distance of about 4,000 feet, it can be readily seen that central mechanical transmission of control of machines would be almost impossible; and to control the machines locally would mean a large operating force distributed practically along the full length of the locks, which has invariably been the practice heretofore. Such a force would be difficult to coordinate into an efficient operating system. The situation therefore resolved itself into centralized electrical control, which reduces the number of operators, operating expense, and liability to accident. To accomplish this system of control, a control board for each lock was constructed which permitted having all control switches located thereon mechanically interlocked so as to minimize, if not entirely prevent, the errors of human manipulations.



INDICATOR SHOWING THE POSITION OF MITERING GATES

CENTRALIZED CONTROL AND INDICATING SYSTEM

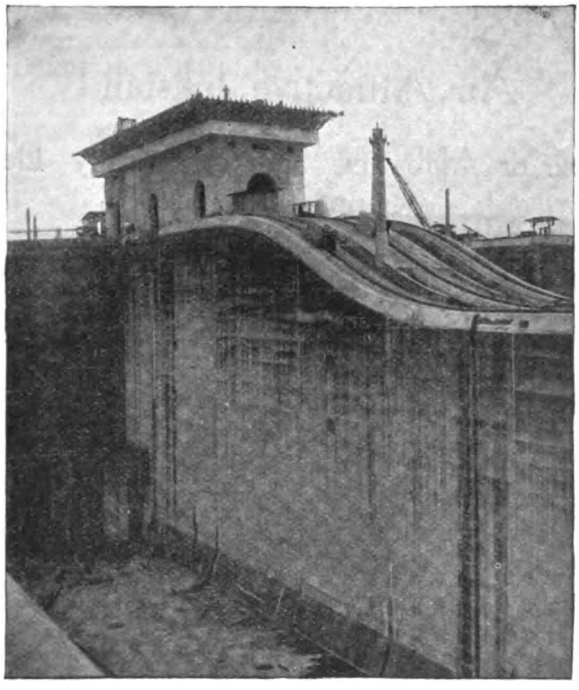
The control boards are installed in control houses located on the middle walls at points which afford the best view of the locks, although this view is not depended on to know the position of the gates or other apparatus, as all are provided with indicators on the control board. The control boards are made approximately operating miniatures of the locks themselves, and are arranged with indicating devices which will always show the position of valves, lock gates, chains, and water levels in the various lock chambers; and with the exception of such machinery as needs only an "open" or "closed" indication, the indications will be synchronous with the movement of the lock machinery.

For such indication, appliances with commutators, multiple contacts or ratchet mechanisms would not be suitable because of the many contacts and small pieces in their construction; and particularly because devices of this character move step by step and would not indicate all points in the movement of the main machinery, such indications being more or less approximate according to the number of steps in the indicating devices. The indicators on the Panama control boards were developed especially for this undertaking, and show accurately and synchronously every movement of the machinery to which they are connected, whether in the extremes of travel or at any intermediate point between the two extremes.

A complete synchronous indicator consists of a transmitter located at and operated by the machine in the lock wall, and a receiver operating an indicator at the switchboard in the control house. Both transmitter and receiver have a stationary and a rotating part. The stators have 3-phase windings with leads from three corresponding equidistant points brought out and connected together, but not connected to a source of power, the stator coils being energized by induction from the rotors. The rotors are bipolar and are connected in multiple and energized from a 110-volt 25-cycle single-phase source.

The movement of the lock machinery and with it the connected transmitter rotor produces a field in the transmitter stator polarized in the direction of the

rotor axis, which induces voltage in the stator coils. This voltage is transmitted by the 3-phase connection above mentioned, to the receiver stator coils and duplicates in them but in the reverse direction, the same conditions of polarity and voltage as present in the transmitter. The rotor of the receiver being energized by the external source in the same direction as that of the transmitter, is reacted upon by the polarized receiver stator until the magnetic axes coincide and the rotors of both transmitter and receiver are in the same relative position. Any difference in the position of the transmitter and receiver rotors causes a difference of potential between the stator windings with a consequent flow of current and resultant torque, which again moves the receiver rotor to the same relative position as that of the transmitter rotor. The receiver rotor follows closely and smoothly the movement of the transmitter rotor, and consequently imparts to the position indicator a movement identical with the movement of the lock machine, although on a scale reduced to the requirements of the control board. A brief description of the individual synchronous indicators follows:



CONTROL HOUSE AT GATUN, SHOWING TRACK FOR TOWING LOCOMOTIVES

In the case of the mitering gates, the vertical operating shaft is connected to a shaft which operates the transmitter machine. The latter shaft is threaded and carries a nut on which is mounted a rack. The rack engages a gear on the rotor shaft, and this turns the rotor as the gates operate. The mitering gate indicator comprises a pair of aluminum leaves, shaped to correspond to the plan view of the top of the gate, which travel horizontally just above the top of the board, the hinge ends being connected to shafts extending down through the surface of the board where they are geared to the receivers by means of bevel gears. When the miniature gates are completely opened, they are covered by shields to give the effect of the gates folding back into recesses in the lock walls.

For the chain fender, the position indicator transmitter is driven by the shaft which operates the limit switch that controls the stroke of the piston. The indication on the board is given by a small aluminum chain, which, like the large chain, is raised and lowered, each end operating independently, the large chain being lowered to the bottom of the lock and the small chain into a slot on the control board. The ends of the miniature chain are fastened to semaphore arms which are connected to segmental gears meshing with the driving gears in the receiver machines. As the receiver rotors turn, the chain is either lifted or lowered, the position of the large chain from the bottom of the lock being indicated by the angle of the semaphore arms.

As the rising stem valves occur in pairs, their position indicator machines occur in pairs also. The transmitter rotor is driven by a shaft and gearing similar to that described for the mitering gates. Each indicator is similar to a small elevator, a car being used to indicate the position of the valve gate. Both front

(*Continued on page 346*)

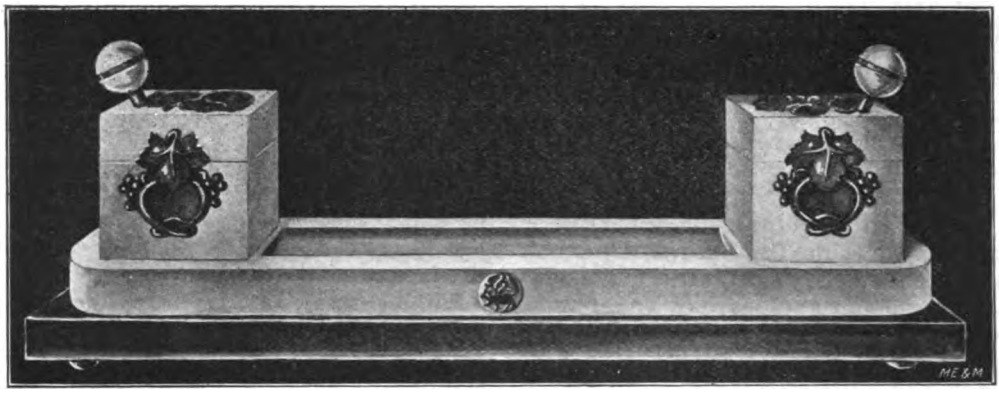


FIG. 1.—COMPLETED INKSTAND, SHOWING ITS ATTRACTIVE APPEARANCE

An Attractive Inkstand

Made in Marble or Alabaster and Artistically Decorated With Copper Mounts

By Geo. F. Rhead

Illustrations from drawings made by the author.

OUR illustration, Fig. 1, shows an inkstand for execution in Alabaster, or Pentelikon Marble. The former is one of the softest marbles and consequently easiest to work, though its soft and brittle nature necessitates especial care in handling. The marble work is enriched with beaten copper mounts, applied at the front of the ink-containers and also to the lids of same, with a small mount, but one productive of some considerable effect, applied to the centre of the base. The stand is supported upon a wooden base, preferably of ebony, to provide against fracture in moving. The ink-containers are made separately from the base, but are cemented thereto upon completion. They fit into shallow recesses cut to receive them.

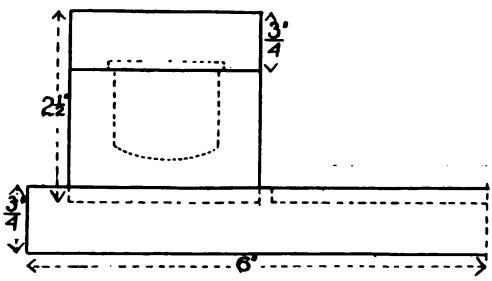


FIG. 2.—SIDE VIEW OF ONE OF THE INK CONTAINERS AND BASE

The plan and elevation of the inkstand with measurements are given in Figs. 2 and 3. From these it will be observed that to make it there will be required three pieces of marble; one measuring 12 x 3¼ x ¾ inches, for the base, and two 2½ inch squares for the two ink containers. These may be procured without any difficulty from any monumental mason at a trifling cost, who, for a little extra, will cut them to the necessary shape. This is, however, not a very difficult matter to undertake

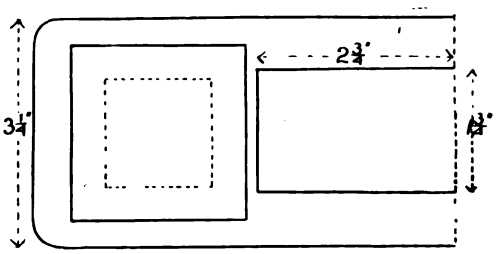


FIG. 3.—TOP VIEW OF ONE OF THE INK CONTAINERS AND BASE

oneself if necessary, for alabaster can be cut quite easily with an ordinary saw, and pentelikon marble can be cut similar-

FIG. 6.—BIT USED FOR BORING HOLES IN MARBLE

ly, providing a little patience is taken over the work. The marble requires to be firmly fixed during the operation, such as by wedging it between blocks of wood screwed to the bench. An old saw should preferably be used, as marble cutting is not likely to improve its cutting powers, but, of course, the sharper

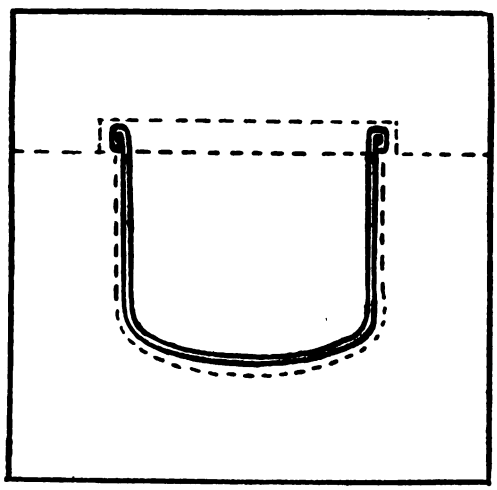


FIG. 7.—INK CONTAINER AND LID

it is the better. The cut should, from time to time, during the cutting, be fed with water, and care should be taken to cut vertically, or a great deal of work

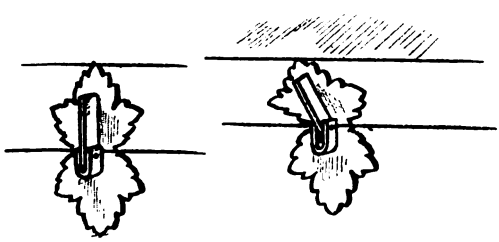


FIG. 8.—TWO VIEWS OF THE COMPLETED HINGE

will be occasioned afterwards with the chisel. Supposing a piece of marble has been roughly hewn to the size of the base, the first operation will be the trueing up of the under surface by chiseling off all irregularities in the way of projections, and rasping until a perfectly flat surface is secured. Two stone-mason's chisels are shown in Fig. 4: One is flat at the end like an ordinary chisel, while the other takes a curved form like

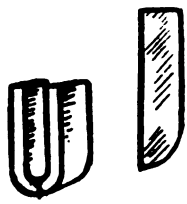


FIG. 9.—TWO PARTS USED IN MAKING THE HINGE

a gouge, the latter being the most generally used. It should be kept as sharp as a razor, and then the work will be found to go quite easily. During the chiselling, the marble must be kept perfectly rigid, and to effect this two pieces of wood are screwed at each side of the block, to an absolutely rigid bench.

In chipping, the blows are lightly given, the action of the chisel being to cut rather than to chip off pieces. When the surface is almost flat, finish by rasping until it is quite regular. Fig. 5 shows a useful form of rasp used by marble workers for the small corners and angles. The marble is then turned over and firmly secured, and it should be noted if

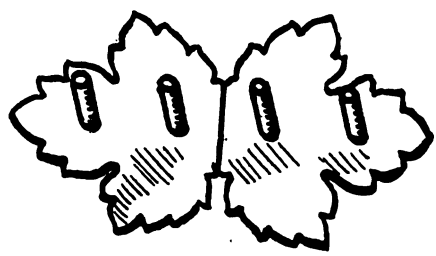


FIG. 10.—VIEW OF THE BACK OF THE HINGE

it lies perfectly flat on the bench, for should it not, it will be extremely liable to fracture during the chiselling of the hollow parts in the upper surface.

The simplest method of hollowing the shallow recesses in the base of the stand, would be to drill a series of holes the full depth of the recess along the center, in the deepest part of the recess. This depth should not be more than 3/16 inch as a deeper recess will only tend to weak-

en the stand. The method of working is to chisel round the edges of the holes and repeatedly enlarge them until the boundary lines of the recess are reached. This is always the best method to adopt if a recess has to be cut, whatever its shape. Drill a hole to the depth of the required recess, and enlarge the hole. A small chisel of curved section is the best to adopt for the early stages of the work, and it should be kept well sharpened. An ordinary archimedian drill-stock, with the form of bit shown in Fig. 6, will be found to do the drilling as efficaciously as any.

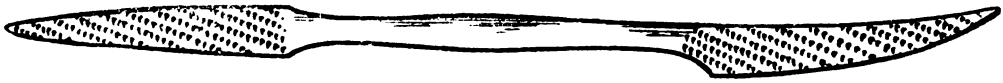


FIG. 5.—A TYPE OF RASP THAT WILL BE FOUND VERY EFFECTIVE IN WORKING THE MARBLE

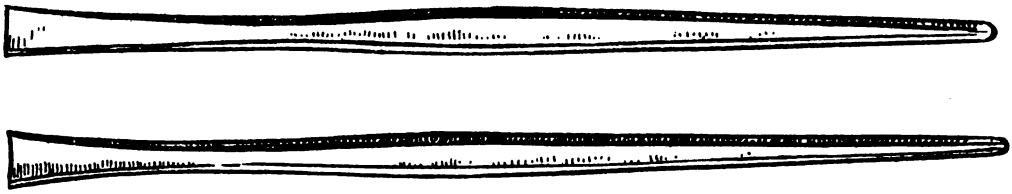


FIG. 4.—TWO FORMS OF CHISELS—THE UPPER ONE HAS A FLAT END LIKE AN ORDINARY CHISEL, WHILE THE LOWER ONE TAKES A CURVED FORM AT ITS END

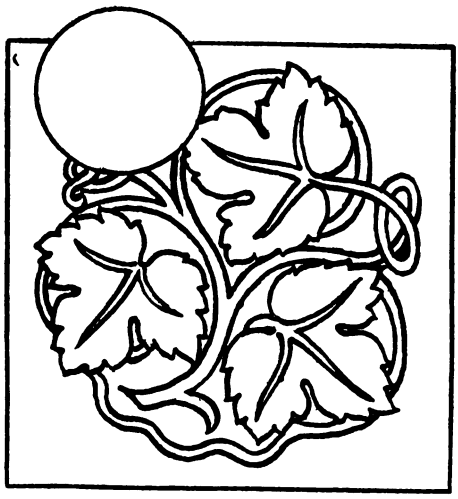


FIG. 11.—TOP VIEW OF ONE OF THE INK CONTAINERS, SHOWING DESIGN AND HANDLE

After the square of marble that forms each ink-well and cover has been trued and brought to a finished state with the rasps, its exact shape is set out on the stand, and a shallow recess accurately cut to fit each one. A line is then accurately marked around the sides ¾ inch from the top of each and a slice of marble sawn off to form the lid. The circular hole that forms the ink-well is then sunk in the larger piece, adopting the plan previously mentioned of drilling to the depth and enlarging the hole with chisels. Considerable care is necessary to avoid fracture. No heavy blows must be administered and any attempt made to hurry the work by removing large fragments will tend to cause a breakage. A shallow recess is cut in the lid as shown in the elevation, Fig. 2, to fit over the rim of the ink-container, (see Fig. 7).

An extremely simple form of hinge and one that is very suitable for the purpose in hand, is shown in Fig. 8. It consists of two pieces of metal, one bent into the form of a U and the other a

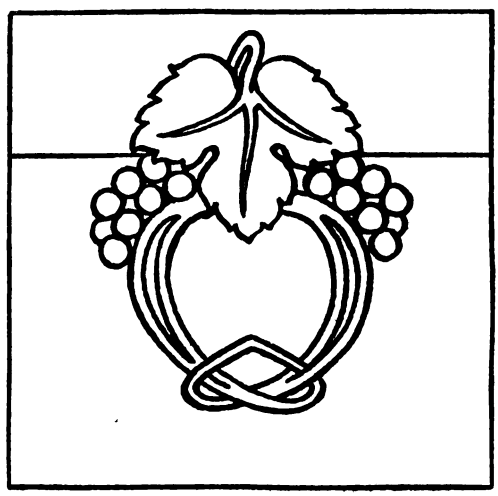


FIG. 12.—FRONT VIEW OF INK CONTAINER, SHOWING THE DESIGN WITH THE LID CLOSED

small flat piece which has one corner rounded off that fits into the U-shaped member, a metal pin being passed through the whole, and burred at the ends to keep it in place. Copper can be used for making these parts. Each section is soldered to a metal plate, Fig. 9, which can take an ornate form; a simple leaf shape being as good as any. Each plate has two pins soldered to the back that are inserted in holes drilled to the marble, Fig. 10. The holes should be slightly larger than the pins, so that a little cement may be introduced between them. A good cement for the purpose is plaster of paris and glue. Also, white of an egg mixed with freshly burnt lime to form a creamy substance, is an excellent one. The back of the plate and holes are covered with this, and then tightly brought together, when the surplus that exudes from the edges can be cleaned off. The handles of the lids need little description. To make one, a small piece of marble is brought to a globular form by rasping, and a hole drilled for the insertion of a stout piece of copper wire. The top of the lid is also drilled to take the handle at an angle, as shown in Fig. 1.

There only remain now the copper enrichments, the working patterns of which are given in Figs. 11 and 12. The leaf portion depicted in Fig. 12, as will be noticed, is separate and affixed to the lid, and thus, when the ink-pot is closed, overlaps the lower portion as shown in Fig. 13. The method of attaching these parts is by means of the small dowels previously referred to and illustrated in

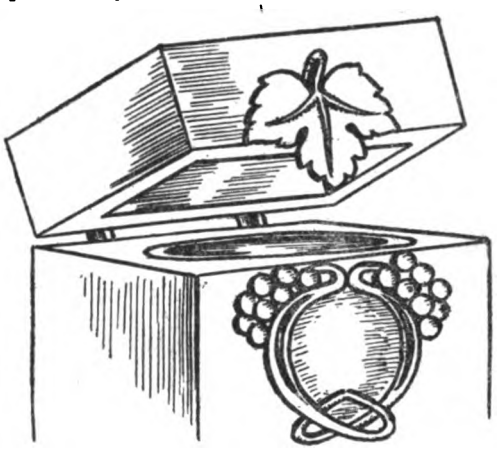


FIG. 13.—A VIEW OF ONE OF THE INK CONTAINERS WITH THE LID PARTLY OPENED

Fig. 9—*i. e.*, inserting the dowels or pins in holes drilled in the marble, and securing them with a liberal application of cement.

A very charming bronze-green color can be given to copper by the application of a solution of potassium sulphide which will be found to harmonize excellently with the color of the marble.

The Panama-Pacific Exposition and the Kahn Act

By George William Miatt

IN the January edition of this publication we had something to say about the Kahn bill, passed ostensibly for the protection of foreign exhibitors at the Panama-Pacific Exposition. As was anticipated, a storm of protest against the absurd incongruities, the impracticability and injustice of this law—conceived in ignorance and passed in haste, to be regretted at leisure—has swept over the country—the industrial portion of it at least—and indignation is unconfined. The bill was and is so clearly unconstitutional that no one seems to have given it serious thought at first, nor to have believed its passage possible. It is only another illustration of the lack of serious consideration bestowed upon legislation by the average politician in the absence of motives more sinister than the public welfare.

It would seem that the repeal of the act is inevitable; nothing short of that will suffice. Certainly it could never withstand the legal scrutiny of the Supreme Court of the United States, if ever submitted thereto. The defects of the measure are, however, so obvious that it is not likely to survive long enough to be subjected to such a crucial test. Already, efforts are being made to denaturize the bill by amendment, and while Bulkley's proposed revision would help matters in part, it does not strike at

the root of the evil, nor eliminate all of its absurdities. But it does seek to remedy the most undesirable feature of the original by stipulating that exhibits shall not enjoy the gratuitous protection provided in the Kahn act if they have been *"in public use or on sale in this country,"* or have *"become the property of another under the laws of this country."* Hence, the foreign exhibitor, if he desires to protect his product here, might as well apply for a United States patent in the regular way should the Bulkley amendment be passed, and the absurdity of attempting to prevent an American manufacturer from producing an article unpatented and unpatentable in this country, but patentable abroad, will be eradicated—the burden of proof then being imposed upon the foreign exhibitor of showing that a resident of the United States is an actual infringer. A foreign manufacturer who contemplates exhibiting his wares at San Francisco undoubtedly intends to do so mainly for commercial reasons, and if his object is to interest citizens of the United States in his product through the medium of the exhibition, and he wishes to maintain a monopoly thereof in this country for the legal period, the obvious and equitable course is for him to protect himself in the manner prescribed by the Constitution and the patent laws of this country. These are very impartial and generous, particularly where foreigners are concerned. Some excuse might be tolerated for the Kahn act if there existed any possible discrimination against foreigners; but from its very inception this country has set an example to the world in fully extending to aliens the same measure of patent protection accorded to its citizens. The Kahn act, if legal, would place the American manufacturer of an article or product unpatentable here at a disadvantage as compared with a foreign rival competitor holding a foreign patent—it would, in fact, put him out of business insofar as concerned that particular article or product, and virtually make American citizens subject to the vagaries and inconsistencies of foreign patent law and practice.

Why the exposition authorities should have been so overzealous for the protection of prospective foreign exhibitors as to father such a bill is a mystery. Foreign countries have never extended to exhibitors of other nations such exposition rights and privileges as those provided for in the Kahn act. Furthermore, it is deceptive and misleading in that it justifies foreigners, unacquainted with the *un*constitutionality of the act, in the belief that by exhibiting at San Francisco they can acquire monopoly in the United States in inventions or devices which would unquestionably be construed as public property here. If the law is not repealed what will be the feelings of such exhibitors, and what will be their remedy, if after seeking to benefit by the provisions of the Kahn act, they find themselves thrown out of court, and a laughing stock before the world? Will they not be apt to consider it a questionable Yankee trick—in short, a variation of the "con" game heretofore so prevalent and effective in this country? Would not the effect be to discourage confidence in this nation's sincerity, and put a quietus on the exploitation of future international exhibitions, of which the world has had a surfeit during the last two generations. As yet, not all the Governments of Europe have expressed official willingness to participate in and contribute to the success of the Panama-Pacific Exposition; and a farcial law like the Kahn imbroglio would be a deterrent rather than an incentive.

THE SAYVILLE WIRELESS STATION

The Sayville wireless station, located on the southern shore of Long Island, is said to be the largest commercial wireless station in America at the present time. It is owned and controlled by the Atlantic Communication Company, and employs exclusively the Telefunken system. The station not only sends out press messages to the Debeg stations, but also handles all the commercial business for ships equipped with Telefunken apparatus. The sending of press messages at night is only a small part of the work done by this station during every 24 hours.

Massachusetts is believed to lead all of the States in its percentage of motor-propelled vehicles.

Construction of Small Alternating Current Motors

Complete Working Instructions for the Building of Small Alternating Current Motors in Several Sizes

By A. E. Watson, E. E.

Illustrations from drawings made by the author

PART I*

Directions for constructing a single-phase alternating current motor of one-half horse power, supplied from 100 to 110-volt, 60-cycle circuits. Four poles, 1,800 rev. per min.

As the builder will be interested not alone in the general appearance of the machine itself but of its wiring and external starting accessories, a representation, partly actual and partly diagrammatic, is given in Fig. 1. Since at best the motor demands a large starting current,—two to three times the normal running value,—a separate circuit from the distribution center should be provided. Ordinary house wiring circuits are run with No. 14 wire, and these are supposedly sufficient in size to permit the operation of the full number of lamps, but not of the motor in addition. Insurance and lighting companies are likely to insist upon this separation of circuits, and the user, for his own convenience, should prefer it. For the case of 100 to 110 volts supply, the motor circuit

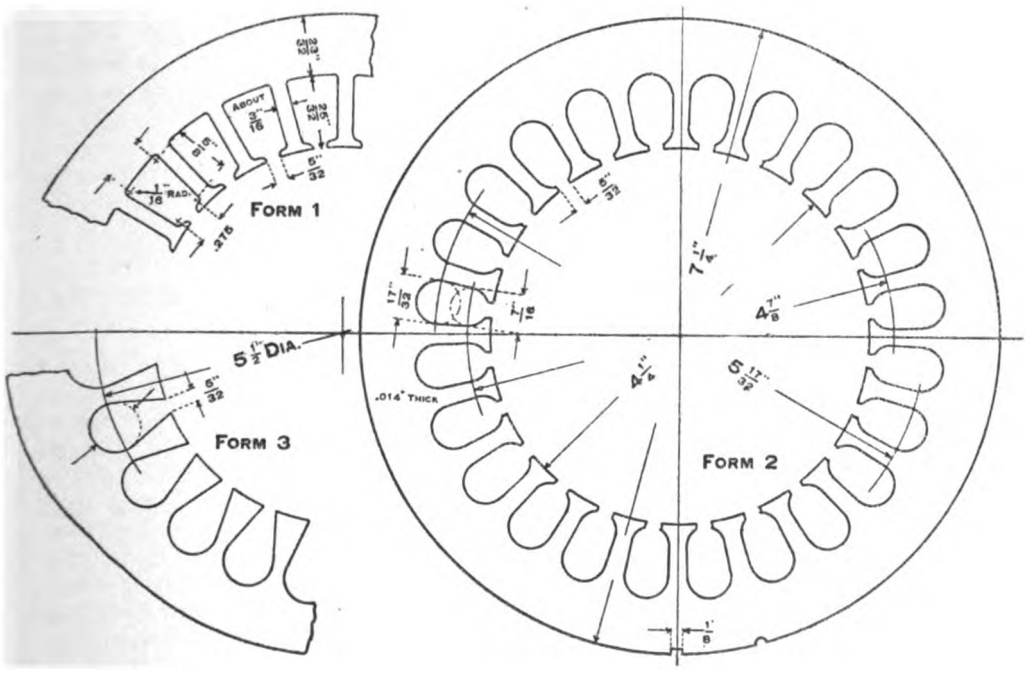


FIG. 4.—SHEET IRON FOR STATOR OF MOTOR SHOWING SEVERAL PRACTICAL FORMS OF SLOTS

should be of wire not smaller than No. 12. The energy consumed by the motor at full load will be considerably less than a kilowatt, therefore a single break switch will be permissible. In the diagram for the regular connections a dou-

* This series began in the February issue.

ble-pole, double-throw switch is shown, —the "baby" or a 25-ampere size being sufficient,—but it really has only the single break effect. By tracing the circuit

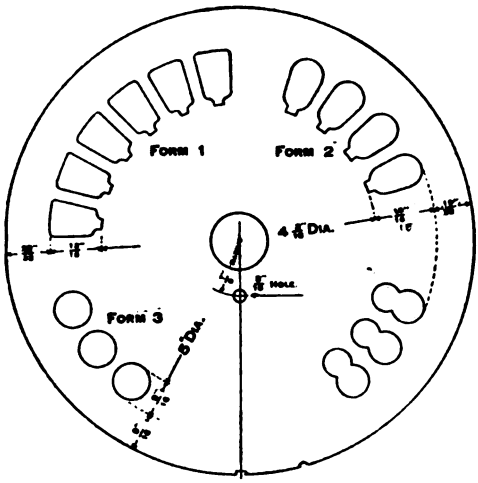


FIG. 5.—STATOR SHEET IN PARTIALLY COMPLETED CONDITION, SHOWING SLOTS AS PUNCHED WITH AID OF INDEXING MACHINE

it will be found that one line wire passes through a fuse directly to one side of the motor without entering the switch at all. If the supply system is of the "grounded" sort, this should be the grounded wire, as can readily be tested by finding that a lamp will not be lighted when attached between it and a water or gas pipe. Though this wire be permanently connected to the motor, it represents no "live" conditions. For this reason, in some cities, a fuse in this line would not be required or permitted. The other wire is certainly to be fused, and connects with both hinge contacts of the switch. When motor is not running, the switch is to be left open, straight out, and to prevent accidental closing in the lower or starting position, a spring should be arranged to press out the blades, and only when forced in by hand against the spring will the circuits be closed. Removal of the hand should at once be followed by automatic opening of the switch.

To start the motor the switch is temporarily to be closed in the lower position. Current will then flow in two circuits,—one through the reactance and the main windings of the motor, the terminals of which are at binding posts numbered 1 and 2; the other through the resistance and the starting windings, of which the terminals are at 3 and 4. With the connection between the two windings joining posts 2 and 4, as shown, the motor should start in a certain direction, and in a few seconds accelerate to about two-thirds speed, and then the switch should quickly be thrown into the upper position. This change results in opening the starting-coil circuit and short-circuiting the reactance. The motor then runs under normal conditions. If the other direction of rotation is pre-

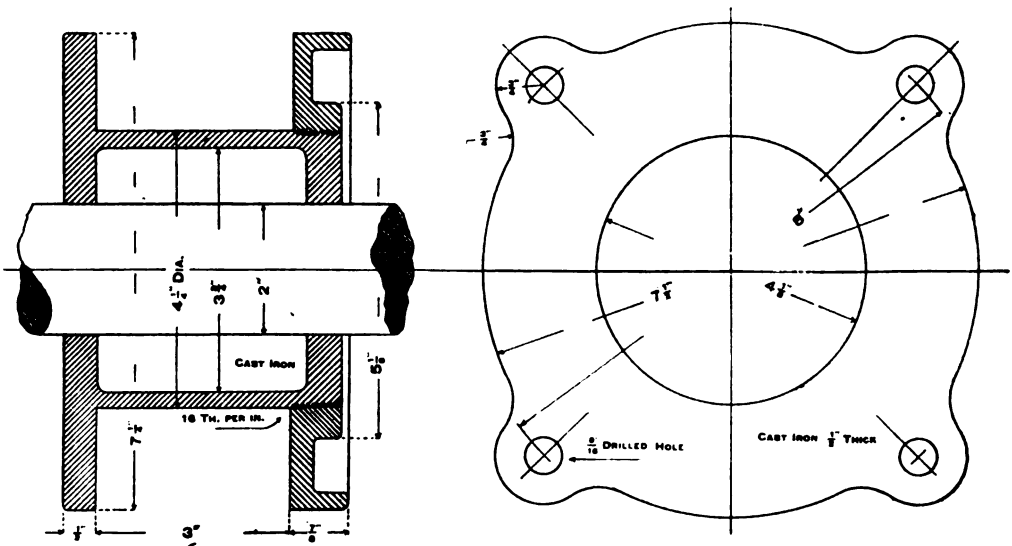


FIG. 6.—FIXTURES FOR USE IN PREPARING HOME-MADE STATOR SHEETS

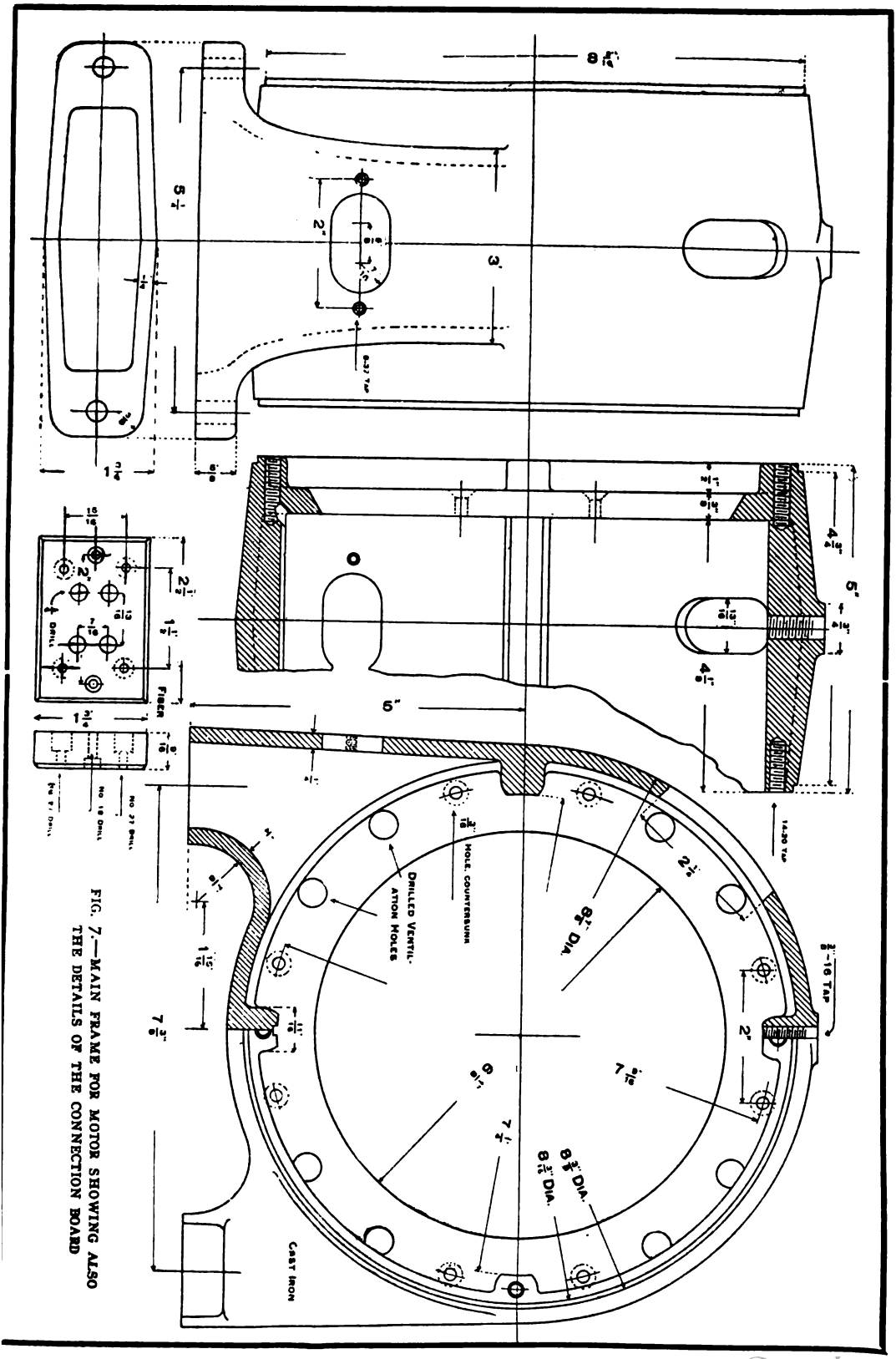


FIG. 7.—MAIN FRAME FOR MOTOR SHOWING ALSO THE DETAILS OF THE CONNECTION BOARD

ferred, binding posts 2 and 3 may be connected to the grounded side of the supply, 1 and 4 to the live side. The reader will understand that terminals 1 and 3 may as well be connected together and to one supply wire, and the two wires from other side of line be lead to terminals 2 and 4. If the double break effect in main switch is preferred, it can be secured by substituting one of the standard triple-pole, double-throw sort, two of the blades being connected as shown, and the third providing for the other side of the line, as shown in the diagram under "alternative connections." A two-bladed switch can still be used to accomplish the same result by providing

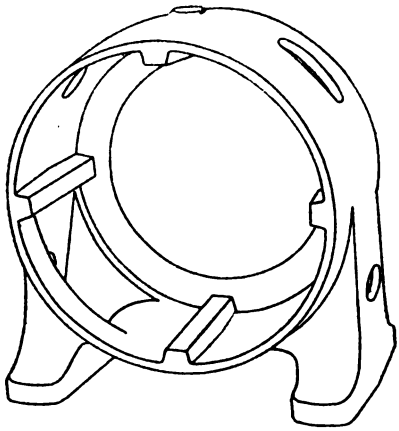


FIG. 8.—PERSPECTIVE VIEW OF FRAME CASTING IN THE ROUGH

an additional contact, as shown in the same diagram. Descriptions of the construction of suitable resistances and reactances will be given in the proper place, but details of the motor itself are evidently of first interest.

Fig. 2 shows a longitudinal section, representing both mechanical and electrical features. A cast iron frame, or housing, holds a mass of sheet iron discs between a fixed and a movable flange, each side of the stack being provided with a fiber sheet of identical shape, serving to hold the slender teeth of the discs and to prevent the wires from being brought into contact with sharp metallic edges. In the slots, in a manner to be described later, are wound first the starting coils, then the running coils. On both sides of the frame are fitted dish-shaped covers of cast iron which serve to hold the bearings. These latter are of the reliable oil-ring type, carefully designed to give copious lubrication without leakage or throwing of oil. The rotor is of the short-circuited, or "squirrel-cage" type, having an odd number of copper rods embedded in round slots near the edge of the discs and thoroughly soldered to copper rings at each end.

A few overall dimensions are given; completed, the machine weighs about 60 pounds. The pulley shown is only suggestive, for the builder would need to modify its dimensions to fit his particular requirements. An essential condition is that it be a good fit upon the shaft, provided with key as well as set screw, one end of hub being of sufficient length to serve as oil deflector and a limit to the end motion. In Fig. 3 is given an end view of the completed motor, bringing out the appearance of the rotor rods and one of the end rings, also the four groups of stator coils, though the actual courses of the wires are concealed by the protecting tape. The end castings are seen to be held by four equally spaced screws, therefore, at will, the bearings may be turned to fit floor, wall, or ceiling position of motor.

I.—SHEET IRON FOR STATOR.

Difficulty in getting sheet iron for the stator is likely to prove the first and greatest obstacle in the way of the builder. If the finished sheets are at all purchasable, and economy of time is any object, they should be bought, and even at an apparently high price will be cheap as compared with the laborious and wasteful methods of producing home-made substitutes. Possibly the builder will prefer to be independent and to desire the credit or experience of carrying out the entire construction. As a guide to these various selections, several alternative shapes of slots and teeth are shown in Fig. 4, the diameters of 4¼" inside and 7¼" outside being necessary for all. The material should be the softest sheet iron or steel procurable. What is known in the trade as "blue steel" is acceptable, as is also the grade used for tinware. Indeed, for a person living in the vicinity of a canning establishment, there should be favorable conditions for getting the iron of closely the right diameters. If the regular grades of transformer steels are available, that with

silicon alloy is now recognized as having the least magnetic losses. Whatever sort be used, it should be thin, not over .014", or about No. 28 gauge. A final stack measuring, when closely pressed, about 2¾" high, will be required, but when separated by tissue paper, the space occupied will be fully the 3" allowed in the design. If the sheets are separated with shellac or asphaltum varnish a little more iron may be used. If the thickness of stock is .014", about 200 discs or punchings will be required.

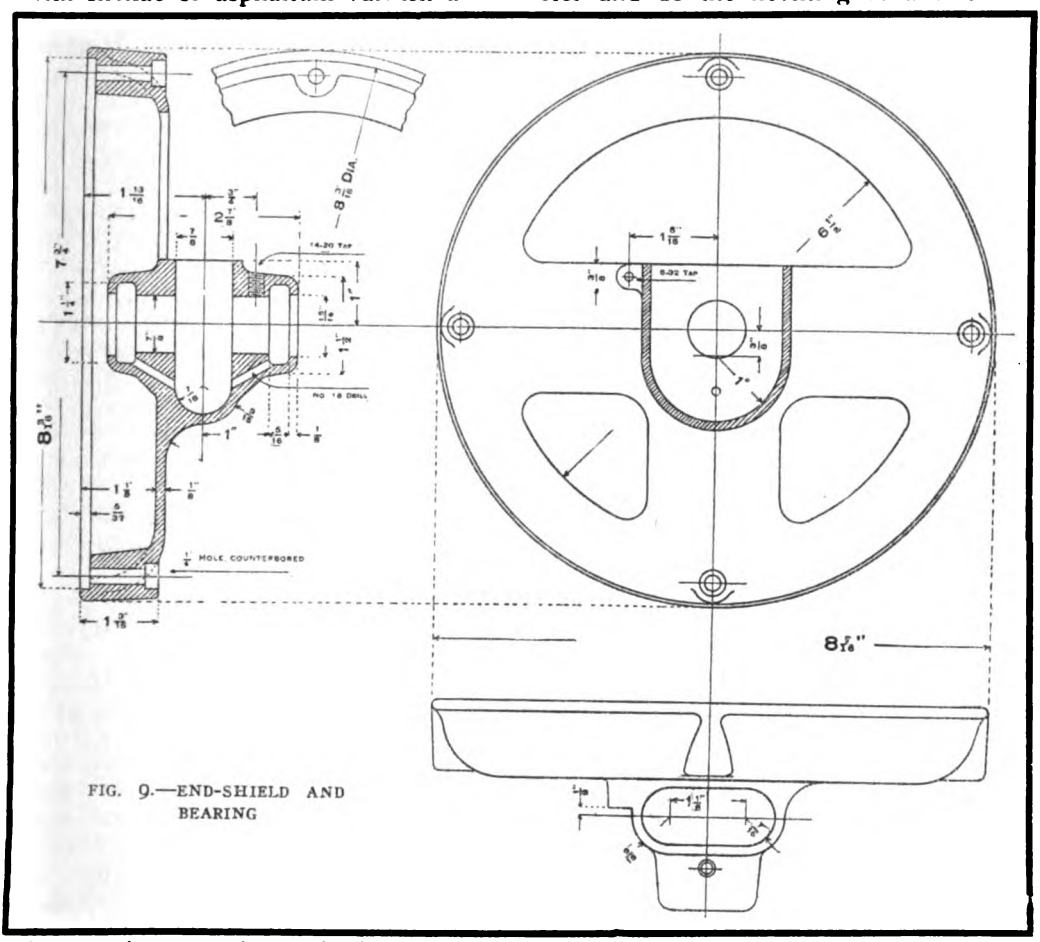


FIG. 9.—END-SHIELD AND BEARING

Form 1 represents the most desirable shape of slots, for this gives the greatest economy of material and room for wire, but unless the builder is unusually well provided with tools he may not be able to make this shape, though it is the sort to purchase. Form 2 is the next best shape, and can be made by use of two sizes of round punches and a moderate amount of filing. Form 3 is least economical, but maybe the most practicable shape for many builders, especially if a little less than one-half horsepower will satisfy the builder's desires; this shape can be obtained by drilling and hack-sawing.

For those who cannot or do not purchase the ready-made sheets, several procedures remain, one being to get blank discs of correct outside and inside diameter and do the notching in a suitable manner; a second to get blanks of full outside diameter, but having a central hole much smaller, such as might be adapted for the rotor. (See Fig. 5.) Using this central hole and a well-fitted pivot, the notching can readily be accomplished in some such simply made tool as was described in the *Electrician and Mechanic* in the February, 1907, issue. In the lack of such a tool or time to make one, a strong drill press may be brought into requisition. The die is to be securely clamped or screwed to the platen of the press and the die inserted by its taper

shank into the spindle. Any looseness in the direction of rotation can be taken care of by attaching a dog to the upper end of spindle, and pulled always to one side by a spiral spring. The index wheel cannot be over 4" in diameter, or it will interfere with the die. There should be a stud 7/8" in diameter on which it can turn, and a round pin to match a hole in the sheet and give definite location to all the slots. As it is practically impossible to make an index wheel so accurate as to permit matching in all possible positions, an additional mark should be put somewhere on the sheets to serve as a guide when punching, and finally for assembling in identical order. Such a mark is shown on one edge of the sheet, and should always be kept in the same relative location to the pinhole. It is possible to make the rectangular key-

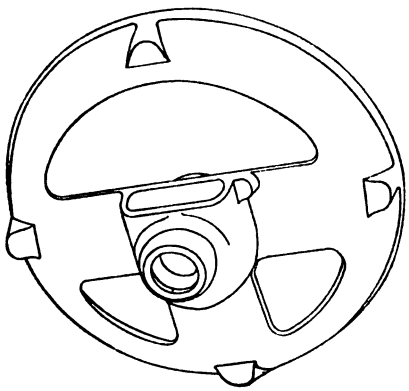


FIG. 10.—PERSPECTIVE VIEW OF END-SHIELD CASTING IN THE ROUGH

way serve sufficiently with the pin-hole for this purpose if only the two are not purposely placed on exactly the same diameter, for then if a sheet gets placed upside down, the failure of the two marks and slots to match will lead to a detection. Even when the blank sheets are at hand, a necessary preliminary operation will be to cut the pin-hole and keyway. One sheet at a time may be cut by providing a suitable fixture in a hand press, or in some other sort of device a stack may together have the hole drilled and the keyway filed or milled.

With a single setting of the central stud there may be punched 24 holes of the sample shape shown as Form 1, or Form 2 or Form 3, in Fig. 5, but with two different settings, the Form 2 shape of hole can be obtained with use of two different round punches, as already suggested, and the sides made straight by filing. The next step will be to have the central portion punched out to a diameter of 4¼", and the builder will be fortunate if he can find a shop that will do it. However, with the singly or doubly punched round holes, a lathe operation to remove the central portion will be practicable, and indeed with the other shape of slots, provided the narrow openings are not as yet attempted, but reserved for the operation of a hack saw and file.

In order to punch the slots in sheets that have the 4¼" central hole, a fixture must be provided for the punch press, or requisitioned drill press, that consists of a cast iron disc about 7" in diameter and of sufficient thickness to hold the die near one edge and permit the rotating on it of a ring that is at once the index wheel and holder for the sheet. This latter fits into a recess perhaps ⅛" deep, prevented from turning by engaging with a key. A distinguishing mark assures that the sheets once notched in a certain position can always be assembled in identical order.

If by either of these methods any suspicion exists that inside and outside holes are not exactly concentric, the sheets must be assembled on some such arbor as is shown in Fig. 6, and a chip turned off in a lathe.

In case that even the semi-prepared discs cannot be procured, but the builder is compelled to work them out of the raw material, the situation is not hopeless. The expense may be quite as great as if the finished pieces were purchased, for he must provide accessory castings and waste a good deal of stock. A standard size of thin sheet iron or steel of fine quality is 28" by 84" and .014" thick. Six such sheets will be required, and should first be cut into 7½" squares. Thirty-three will be obtained from each large sheet, the remaining strip 5½" wide not being wasted, for in addition to rotor discs, iron will be needed to provide for the core of the reactance yet to be made as well as for various experimental purposes to which the builder can with profit apply it. Two washer-like castings, about ½" thick, as shown in Fig. 6, are to be provided, between which the mass of sheet iron can be tightly clamped onto the face plate of a

stiff lathe. Care should be taken to see that the assemblage runs reasonably true. Now with a thread-tool so held in the tool post as to let one edge scrape against the side of hole in the casting, let a cut be taken through the first sheet. It will come out in a crumpled shape. Then cut through the next one, and so on. Frequent sharpening of the tool may be necessary, and rather a ragged appearance may result from the first passage. A regular boring cutter can then be substituted, and the final hole given a fine finish to exactly 4¼" diameter.

The next step will be to make a cast iron arbor, as also shown in Fig. 6, but for convenience it is to have a removable smaller arbor, but this latter can readily be found in any well equipped machine shop. A piece of shafting or even a piece of cast iron will suffice, but it must be specially trued for this use. If no punch-and-die work is to be performed, the flange of this large arbor is to be marked off in a circle 5½" in diameter, and carefully divided into 24 equal parts. If a milling machine is available for this dividing, it should be employed, but if not, compass methods alone remain, but by dividing first into quarters, then subdividing the quarters, a fairly accurate piece of work can be done. Prick-punch the locations and then drill through the flange with a small drill,—one of about the diameter that will match the point of a 9/16" twist drill. This small hole will help guide the larger drill.

Assemble the sheets upon this arbor, and proceed to cut off the square exterior with a thread-tool, carefully forcing the way through one at a time. As the pieces come off in rather wicked shapes, the hands must be kept well out of the way. By persistence, a fine looking exterior will finally be obtained, and this should be made closely 7¼" in diameter. The small arbor should then be driven out and the 9/16" holes drilled down through the mass in the 24 marked places. As soon as the first hole is drilled, a well fitting rod should be dropped in, such as will prevent shifting of the sheets during the remainder of the drilling. If not previously performed, the arbor can be restored and the rectangular keyway and some distinctive mark filed, milled, or sawed across the exterior edges of the sheets. The sheets can now be permanently removed from the arbor, but reassembled upon two rods or bolts, and by clamping in successive positions in a vise, the locations of the openings of the slots can be marked with a hack saw or file. If the builder has good courage, he can make the entire cuts with a hack saw, so as to obtain the shape of slots shown in Form 3, of Fig. 4, or after marking, the sheets can be cut, one at a time, 48 cuts per sheet, with the points of metal shears. This latter process is tedious and somewhat distorts the teeth, and when finally assembled in the frame of motor requires some filing to remove overhanging edges. The hack saw method, too, requires some embellishment with a file, but gives good results. The writer made his first alternating current motor in this manner, and while once is enough, he can attest its practicability.

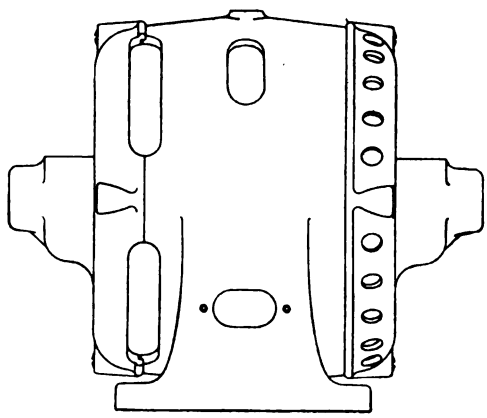


FIG. 11.—FRAME AND END-SHIELDS ARRANGED FOR INCREASED VENTILATION

An estimate of the cost of home-prepared stator iron may be of interest. The six large sheets will weigh about 55 lbs., and at a fair price of 5½c. per lb., the cost will be a little over $3.00. When reduced to the form of plain discs of proper outside and inside diameters, the weight will be 22 lbs. Therefore, except for the narrow strips that might be utilized, the builder could just as well afford to pay 14c. per lb. for such blanks. When the largest size of slots are cut the final weight of the stack of iron would be only 14 lbs., therefore, he could just as well afford to pay 22c. per lb. for the finished article. Added to this elevated price, which still represents only the raw material, he could well afford to pay enough

more to represent his own saving in time and cost of accessories.

Whatever be the method of procuring the ultimate notched sheets, they ought to be annealed, and this for the very last operation before painting and assembling in the frame. Unless means are at hand for accomplishing this in a proper manner, it may be omitted, for the owner cannot afford to lose any of the sheets by burning. A muffle should be used, but as a makeshift method one sheet at a time may be heated on a red hot piece of cast iron or boiler plate.

The thinnest material for separating the sheets, for preventing the flow of eddy currents, is thin asphaltum varnish. If used, it must be put on with a brush, one side only of the iron requiring treatment, and the sheets laid out flat to dry. If dipped and hung up, drops will form and harden on certain places, and seriously interfere with a proper assembling. In consequence of its cleanness, tissue paper is more attractive to use, but it occupies more space, and there is considerable difficulty in removing those portions corresponding to the slots. Burning out the superfluous paper is about the easiest method.

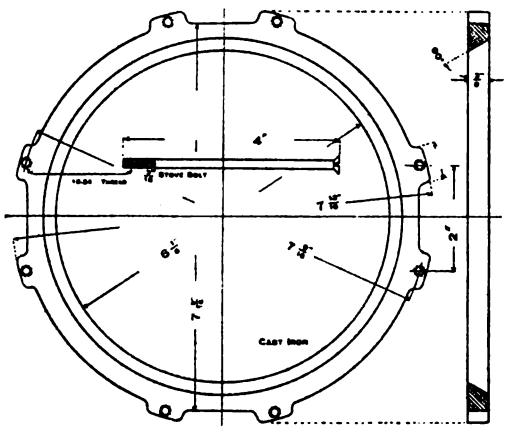


FIG. 12.—RING FOR CLAMPING STATOR SHEETS IN FRAME

Fiber end-plates have been mentioned, and their use is a great insurance against cutting of the insulation. An experienced winder may be able to devise substitutes in the form of wooden wedges, but the builder is urged to take every precaution to make his first machine a success. Not so much is at stake in subsequent machines, and in their making the builder will have devised his own reliable insulating methods, but at first he should take the fewest chances. The space occupied by the fiber may be begrudged, but when sharp edges of iron have cut through the insulation of bottom layers, there is no recourse but to rewind whole coils. To make these fiber discs from the large sheets, 7½" squares may first be sawed out and then held by a screw in each corner to a wooden face plate on a lathe. Inside hole may be cut to 4¼" in diameter, then outside cut to its size, the screws holding until the last instant. The location of the slots can be marked off by using one of the iron sheets as a pattern, and then large central holes made as suggested for the Form 3 style can be cut, using a carpenter's wood bit rather than a twist drill. The final enlargement of the holes to match the iron can well wait until after assembling in the frame, and then the familiar methods with hack saw and coarse file will be found effective.

2.—THE FRAME.

With the small clearance that is requisite between stator and rotor, good alignment and centering of bearings is of first importance. This result is best obtained by providing a cast iron housing, or frame, into which the stator sheet iron shall fit and be well clamped, and to which the end castings that contain the bearings may be properly attached. Such castings should be light, and due recognition given to the fact that curved lines and rounded external corners give a pleasing and symmetrical appearance. It is not much more trouble to make a good looking machine than one that is ugly. Certainly if a pattern is to be used for more than one casting, some expression of care and refinement in design may be tolerated and even expected.

In Fig. 7 are given several dimensioned views of a frame that will comply with these requirements. Fig. 8 shows the perspective appearance of the casting, in the rough. A hollow cylinder is cast with two legs, while four longitudinal ledges serve to hold the sheet iron centrally and against a flange near one end. Two ventilation holes are cored in the

(*Continued on page* 339)

Experimental Department

This department is maintained for the purpose of encouraging the experimenter to develop new ideas. Every reader is welcome to contribute to this department. Contributions should be written on one side of the paper only, using as many sheets as are necessary. Typewritten contributions employing double spacing are preferable. Good sketches are not necessary, as our art department can work up rough sketches that are clear enough to illustrate the idea. Sketches must be made on separate sheets from those containing the description. Return postage must be enclosed if return of unused manuscript is desired.

Three prizes of Five, Two and One-Half Dollars and One Dollar are awarded for the three best ideas published each month. Other contributions are paid for at space rates.

FIRST PRIZE

A D'ARSONVAL GALVANOMETER

The following is a description of a D'Arsonval galvanometer which I have constructed and which closely approximates those in use in laboratories and schools.

The permanent magnet shown in Fig. 1 is taken from a magneto. It is first annealed by heating, then the holes are drilled, as shown, and it is then rehardened and magnetized.

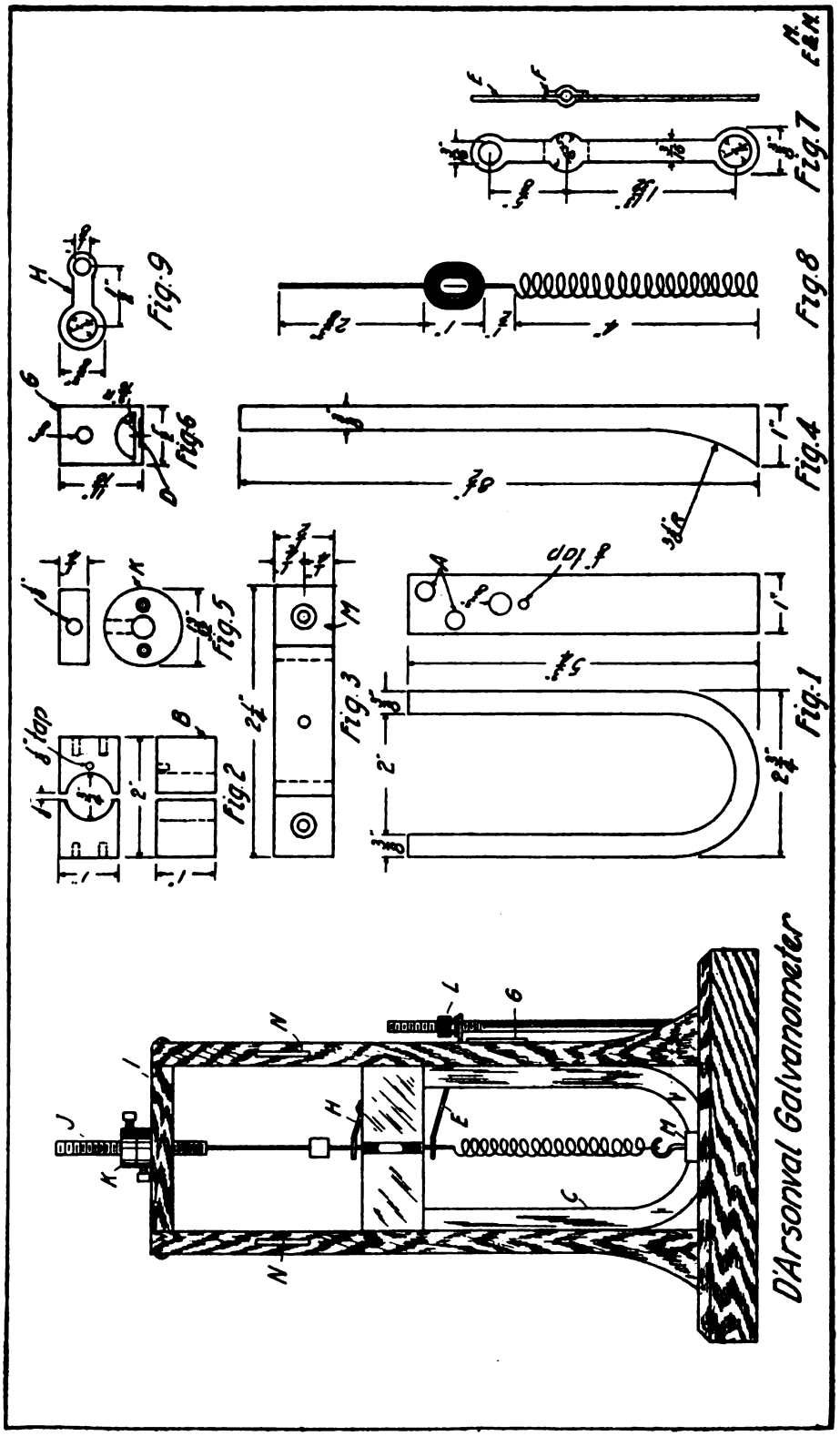
Next, a piece of wrought iron 1 inch square is cut just long enough to fit snugly between the poles of the magnet. In the center of this piece a ¾-inch hole is drilled, as shown in Fig. 2. Holes are drilled and tapped in the ends to correspond to those at Fig. 1, and it is then cut with a hacksaw, as shown at B, Fig. 2. These pieces are then fastened to the poles with four 3/16-inch round-head screws.

A base is now made, preferably of black walnut, 6½ inches in diameter and 1 inch thick. A slot is now gouged out in this block to receive the bottom of the magnet, as shown at C in the completed view. Three holes are drilled through the base, near the edge, at equidistant points, and tapped to take ¼-inch thumb screws. These are to be used for leveling. Two holes are also drilled near the front for binding posts.

The magnet is now placed in the slot and fastened to the base with a strip of brass shown in Fig. 3. This strip should be bent down to a right angle on the lines marked Y and up on those marked X. These lines are ⅛ inch apart. A very small hole is drilled in the center of this piece, and a piece of brass or copper wire inserted. One end of this wire is formed to the shape of a hook, and the other is riveted over and soldered. A piece of fiber paper is placed between this piece of brass and the magnet for insulation. The ends of the brass strip fit into recesses cut in the base and are fastened with two wood screws ¾ inch long. Before fastening it in place a piece of wire is soldered to the bottom of the front of the brass and run through the base to a binding post. In fastening the magnet care should be taken to have its sides perpendicular to the base.

Two uprights are now made of black walnut, as shown in Fig. 4, 1¼ inches wide at the top and 1⅜ inches wide at the bottom. These are securely fastened to the base alongside the magnet, as is shown in the completed view. Before placing the right hand upright in position a piece of brass should be made, as shown in Fig. 6. This piece is 1/16 inch thick, and its edge D forms a bearing over which the pieces E and F, Fig. 7, swing. These should be a fairly loose fit. The long end of the piece E is now inserted through the ⅜-inch hole in the magnet and the piece G is fastened to the magnet with a ⅛-inch round-head screw. The right hand upright must now be fitted over plate G and a ⅜-inch hole must be drilled to allow the short end of piece E to project through. This piece E, as well as the piece H, Fig. 9, is to hold the moving system when not in use.

A piece of black walnut, ⅜x1¼x2¾ inches with a 3/16-inch hole drilled in the center of the 1¼-inch side is now fastened with glue, and screws between the ends of the uprights.



Two pieces are then made from brass, as shown in Fig. 5. The wood screw holes may be omitted from one of these. The other is fastened with screws centrally over the hole in piece I.

A piece of brass rod, J, 3/16 inch in diameter and 2½ inches long, with a 1/32-inch hole, ⅛-inch deep, drilled in one end, is now passed through the pieces K and fastened, as shown, with ⅛-inch thumb screws. This supports the moving system.

The moving system consists of a coil of No. 40 B. & S. S. C. C. wire, and is shown in Fig. 8. It is wound over a core of wood ⅛x½ inch. The coil is wound about ⅞ inch long and about ¾ inch thick in the middle and tapers down at both ends. The more turns of wire on this coil as well as the stronger the magnet, the more sensitive the instrument will be. The core is then removed and the coil pressed together until it has a diameter of about ⅝ inch in order to swing freely between the poles of the magnet. When winding, be sure to leave ends about 12 inches long. From one of these, brought out at the top of the coil, the moving system is suspended, and the other is wound in the form of a spring ¼ inch outside diameter and 3 inches long, forming a connecting wire. Now starting ½ inch from the coil on the upper wire and proceeding very carefully, tap it with a light hammer until it is flattened to form a ribbon for a distance of 2½ inches. It is the torsional elasticity of this ribbon which returns the moving system after a deflection. The end wound as a spring is now passed through the ¼-inch hole in E and soldered to hook on it. Then piece H is passed over the ribbon and secured in place with a ⅛-inch screw, as shown. The end of ribbon is then fastened with solder in hole in J.

A small piece of mirror, about 5/16 inch square and 1/16 inch thick, is now secured to the ribbon ½ inch above the coil with sealing wax.

Two long right angle screw hooks are now screwed into the uprights 5¾ inches from the bottom. These are shown at N and should project 3½ inches or 4 inches from the uprights.

The scale, which these hooks support, is made of heavy paper 1 inch wide with 12 divisions reading both ways from center and having the numerals printed backwards.

A wire should now be run from piece K down the upright, through the base to the free binding post.

On the right side a 3/16-inch bolt, 6 inches long, should be run up through the hole in piece E. A thumb nut is then screwed on it, as shown at L and is used to free or tighten the moving system through lever E.

Two pieces of glass 8½x2¾x⅛ inches may be obtained and clamped to the front and back of the instrument, between the uprights, with small wood screws and brass washers.

This completes the instrument. If it has been carefully made it should detect the current generated by placing two pins in a drop of salt water. The deflection of the moving system is seen by looking in the mirror, when at rest, where the reflection of the scale may be seen. When not in use the thumb nut L should be tightened, clamping the coil between E and H.

Contributed by *M. F. Van Orsdale.*

SECOND PRIZE

A NEW FORM OF SECONDARY BATTERY

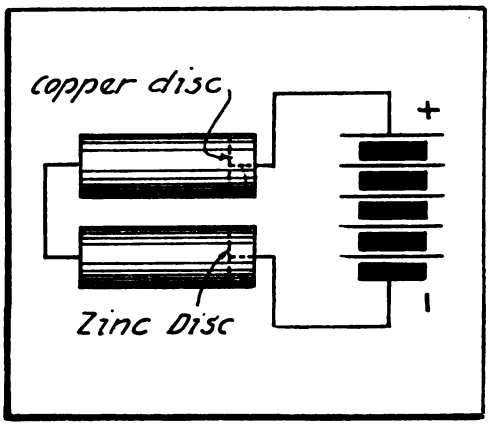
The writer in the course of his experiments has had considerable success with a novel form of secondary battery that is shown in the accompanying illustrations.

The battery is made as follows:

Procure as many straight lamp chimneys as may be necessary; one chimney being required for each cell of the battery. It is also necessary to procure for each cell four pieces of battery carbon, three discs of zinc and three of copper.

Prepare a paste of one part of sulphuric acid, five parts of sal-ammoniac and twenty parts of water, adding fine coke dust to thicken the paste. Then begin to assemble the cell in the lamp chimneys, as shown in the drawings. The four pieces of carbon rod are first placed in the center of the chimney and one-half inch of paste is packed in on both sides. By following the diagram it will be noted where the copper and zinc discs are to be placed. The drawing must be

followed very carefully if successful results are to be obtained. Brass strips should be used to make connection between the two end discs and the connecting posts. After the cell has been completely assembled, paraffine is poured in both ends, after which sealing wax is used to finish the cell.



In the other diagram is shown a method of charging this form of secondary battery from a group of primary cells.

Contributed by
Millard F. Padgett, Jr.

The type of secondary battery described above is unusual and certainly deserves consideration on the part of readers who are desirous of experimenting with new cells. The author has given only general directions and has left the details to the judgment of the builder.—*The Editor.*

In after years a barefaced lie grows whiskers and becomes a tradition.

THIRD PRIZE

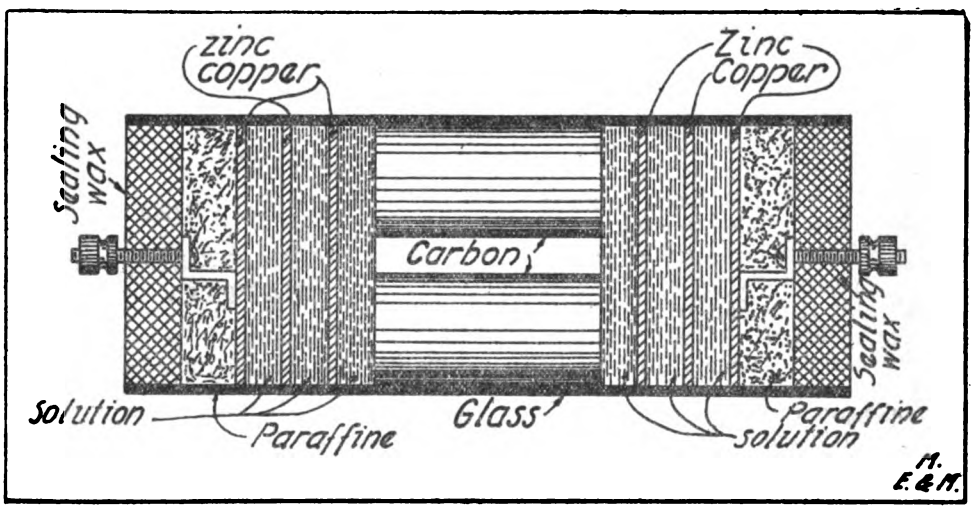
AN ELECTRIC WORM DIGGER

We have electric heaters, stoves, toasters and numerous handy things for almost everybody except the angler, so why not a worm digger?

While wiring a wireless station in Portland, Oregon, last spring, I did some experimenting with the grounded A. C. power system in use there.

By putting the ungrounded line wire in series with a 16 c. p., 110 v. lamp and the ground you will obtain a light of about one-half the normal candle power, and by putting your ground rod in a space clear of grass you will soon find that a whole tribe of worms will come swarming to the surface of the ground within a radius of a foot and a half of the ground rod. By leaving the lamp out of the circuit you will increase the speed with which the worms appear and also the number of worms which are caught, but the meter will go backwards about forty miles an hour and the power company will make things hot for you if they find you at it.

Contributed by *R. N.*



WIRELESS SIGNALS FROM WATER FAUCET

The phenomenon described below is certainly peculiar and I submit it for explanation to the readers.

One evening while sitting in the kitchen I noted a series of hissing sounds proceeding from the water faucet, which

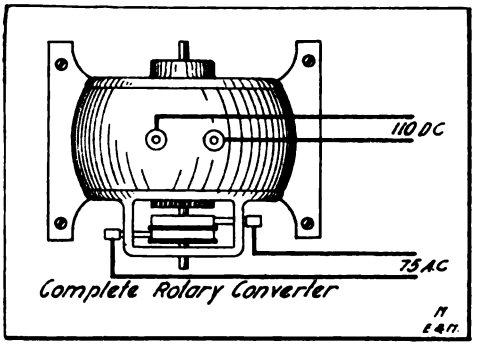
I soon recognized as signals in the continental telegraph code. Upon investigation, I found that these signals could be made very distinct by proper adjustment of the tap handle. The water pressure here is over 170 lbs., and when the faucet valve is almost, but not quite, entirely turned off a slight hiss is produced. The wireless signals manifested themselves by a considerable intensification of this sound, which was so pronounced as to be noticeable at a distance of 10 feet.

I have since noted this phenomenon almost nightly at about the hour of 10. The production of the hissing note appears to be dependent upon a high water pressure, as the manifestation ceased when the mains were partially closed a short time before.

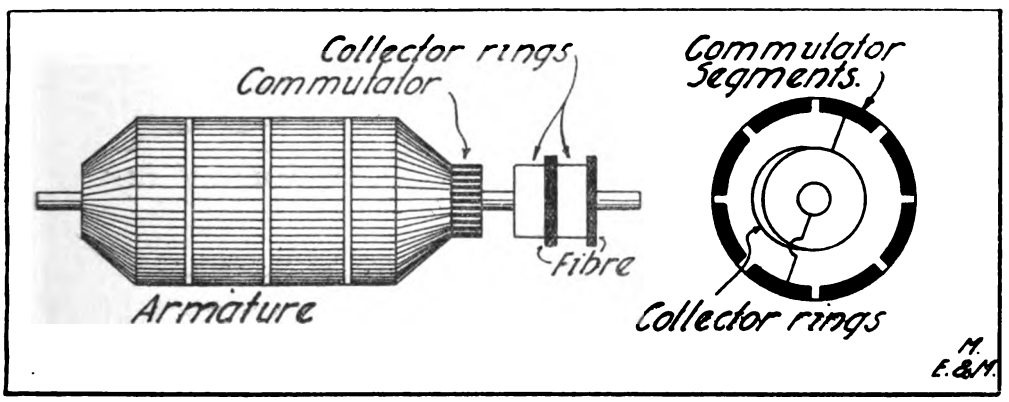
Perhaps some readers with more time and means at their disposal may be able to duplicate this phenomenon and determine its cause. However, any hypothesis on the subject would be interesting.

Contributed by *Oliver O. Frantz.*

The amateur can learn from the illustrations how the converter is made by adding a few parts to the motor, but I will describe the construction so as to make it clearer.



The only materials needed are a fibre rod and two brass rings which may be cut from brass tubing. Drill a hole in the fibre rod the same size as the shaft, then fit the fibre rod over same. Next,



MAKING A ROTARY CONVERTER FROM A MOTOR

Any amateur can make a rotary converter from a motor and use it for practical purposes. If the motor is over ¼-H.P. it should be shunt or compound wound to secure the best results. The writer constructed a rotary converter from a ½-H.P. shunt wound motor and used it for laboratory experiments, also for wireless purposes.

The frequency can be figured by the formula:

$$\text{frequency} = \frac{\text{RPM} \times \text{number of poles}}{60}$$

A frequency under 60 cycles would be impractical for wireless purposes.

cut two brass rings and place them snugly over the fibre rod, leaving a space between the rings of about ⅛-inch; bore a hole in the fibre rod under the first ring and solder a wire to one of the segments on the commutator and run through the hole in the fibre rod to the collector ring on the outside. Directly opposite the connection on the commutator solder another wire and run this to the nearest ring and solder. The armature is then ready to be put back into place in the motor. Fit the collector ring brushes on the motor, making sure that they are insulated from the frame.

Now start up the motor and you can get alternating current from the brushes on the collector rings. If you put in

110 volts D.C. you can figure on getting about 75 volts A.C.

Contributed by *H. B. Pearson.*

USING SPARK COILS ON LIGHTING CIRCUITS.

In the March, 1913, number of *Modern Electrics* a way was described by Mr. H. C. Hunter for working coils on 110 volts. The construction of the arc being rather difficult and the working of it uncertain, I modified the device to suit my own purpose.

The arc herein described and illustrated is like a quenched gap. The two discs are each six inches in diameter and the grooves two inches from the edge.

The arc may be struck in two ways. First, if the discs are made from hard, thin copper, they may be made to touch by a thumb screw pressing on one plate as illustrated in Figure 1. Then again, if the copper is too thick to permit of bending, by boring a hole in the center of one of the discs and by means of a pipette to place a drop of water in the opening, the arc can be started. Then close it by means of the thumb screw as in Figure 2. The joint should be made airtight.

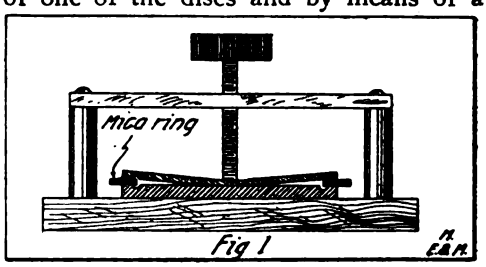


Fig 1

Figure 3 shows the hook-up which is less complicated than the original. Very good results may be had with this arrangement and as the law limits the power that may be employed, it would be advisable for some of the experimenters to try it.

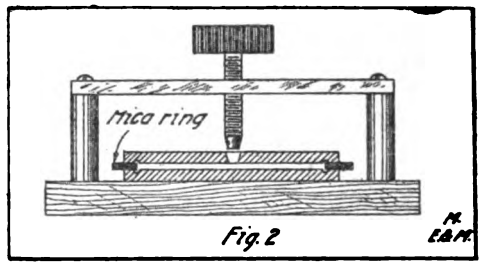


Fig. 2

Contributed by *A. R. Radom.*

A CONDENSER STUNT

When making tin foil condensers and soldering the ends to the wires or terminals, most all experimenters know that the tin foil melts very readily. I found by accident that this can be overcome very easily by placing a piece of sheet copper 1-32 inch thick by 6 inches wide and 10 inches long under the foil to be soldered. This prevents the foil from melting because it takes up the heat. This method always worked very nicely with me and a neater piece of work is obtained.

Contributed by *Jas. F. Lupton, Jr.*

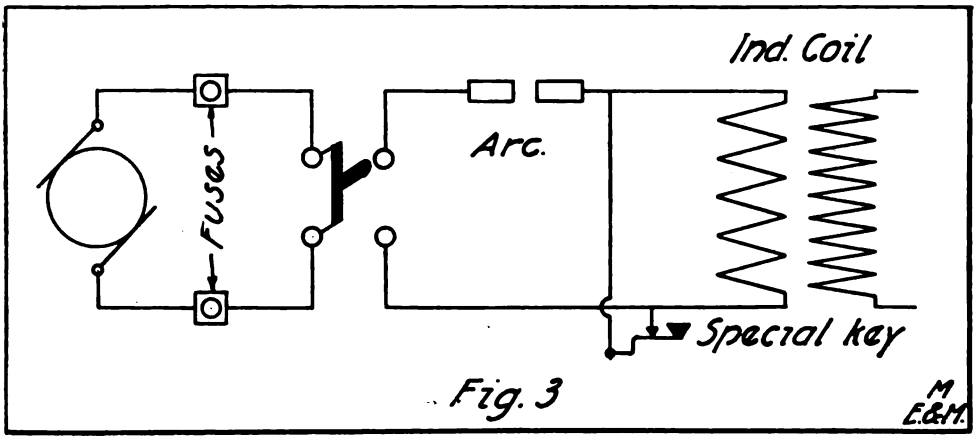


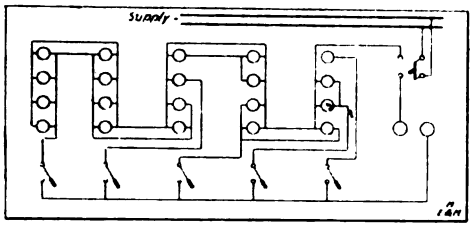
Fig. 3

AN IMPROVED LAMP BANK

By following the accompanying diagram the average experimenter can construct a very handy lamp bank.

A clear board, large enough to accommodate the twenty lamp sockets and five switches, is procured and painted. The sockets are fastened in the order shown and wired up to the switches.

Mount the board on a wall near a table and connect to electric light mains through switch. By closing the proper switches from ½ to 10 amperes may be drawn in steps of ½ ampere.

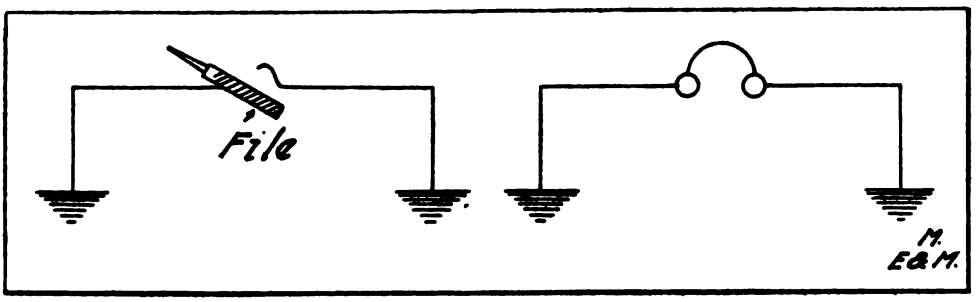


The cleanliness and simplicity of this method of control will appeal to anyone who uses a water resistance at present.

Contributed by *N. Richard Lusse.*

A SIMPLE EXPERIMENT WITH EARTH CURRENTS

This simple and interesting experiment serves to show in some ways the nature and manner in which earth currents are conducted. Place two wires 20 feet or more in length end to end. Ground the ends of each wire. In one circuit place a pair of receivers, in the other place some interrupting device such as a file and needle, as shown in the sketch. When the needle is scratched along the file it can be heard in the receivers. The distance between the wires may be increased to approximately twice their length. The experiment works best in a northeast to southwest direction as this is the general direction of most of the earth currents.



Contributed by *Page Haselton.*

There are sixteen maples in the United States, most of them being eastern species. The most valuable, not only because of the product of its sap but also for its lumber, is sugar maple.

AN AUTOMATIC ELECTRIC LIGHT SWITCH

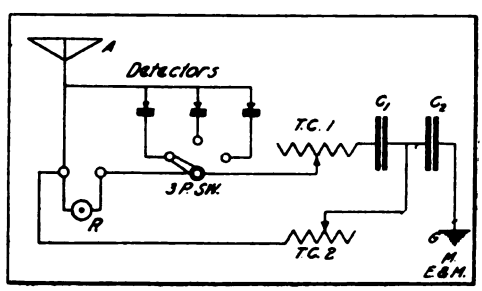
It is a hard, cold proposition getting up these chilly mornings at 5 or 6 a. m., and while yet half asleep, look around for the switch to turn on the electric lights.

I have devised the following scheme: Run an uninsulated wire from one end of the bed to the other. Make the wire one of the contacts of a circuit and the bed spring the other. The weight of the body in the bed will bring these two contacts together thereby forming a circuit. The circuit consists of a relay which has the points reversed, a gravity cell and the necessary wiring. The other posts of the relay are connected to the electric light wires that would ordinarily go to switch. When the weight of the body is removed from the bed, the relay opens and the lights are instantly turned on, thus rendering the entire action of turning on the lights automatic. Care should be taken to see that the bed spring is insulated from the wire.

Contributed by *Irving Vermilya.*

A NOVEL HOOK-UP

I have been troubled with static for some time. I have tried various hook-ups to prevent it and at last I have found the right one. This hook-up is also very good for close tuning. For this hook-up I use two fixed condensers in series.



Contributed by *Gale L. Moore.*

Practical Hints

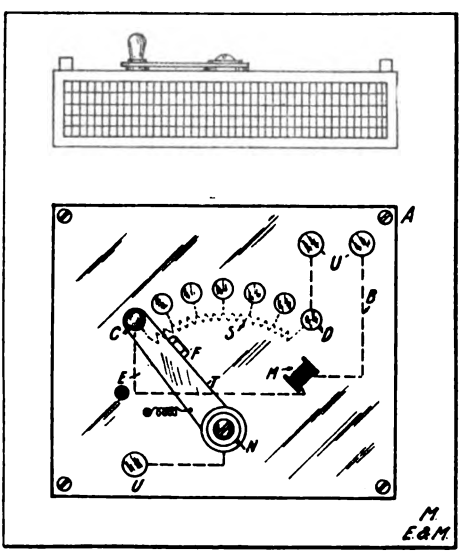
This department is devoted to contributions that deal with new tools, machinery, methods of simplifying different tasks and other similar subjects of interest to the electrician and mechanic in particular, and everyone in general. Contributions to this department should not exceed 200 words. A rough sketch is desirous in instances where the idea will be rendered more comprehensible by its use. All contributions will be paid for at regular space rates on publication.

A STARTING BOX WITH NO VOLTAGE RELEASE

Having a ½-horsepower motor and no starting box I made one as follows:

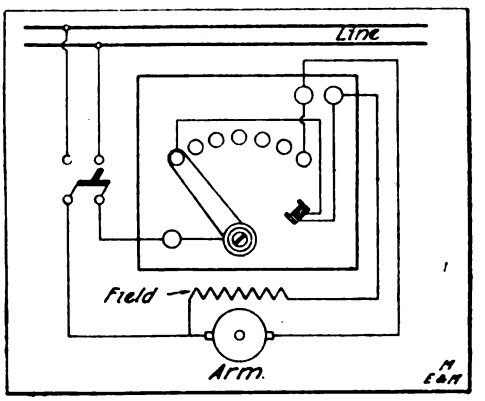
MATERIAL.

Hardwood box 10x10x4 inches.
Seven heavy switch points—D.
One brass strip, 6x½x¼, for arm—T.
A soft iron block to be fastened to arm at point it touches magnet—F.
A magnet with soft iron ends attached to core—M.
A bolt over which a piece of soft rubber tube has been slipped to act as stop—E.
A strong spring to return arm—O.
Any number of shade springs (in my case one dozen were used)—S.
Four binding posts—U.



Two dozen screw eyes to hold springs in box.

The top of the box is drilled as shown in diagram and the parts assembled. The arm T is fastened in place by means of a bolt and should be insulated by



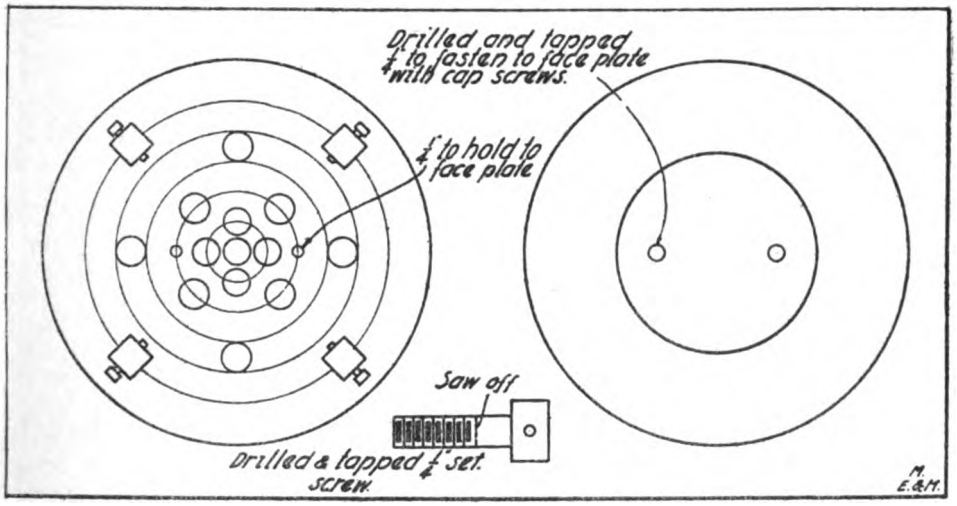
means of a fibre washer as should be the switch points. The magnet is fastened to the box by means of an iron strap which is bolted to the box. The magnet should be placed so it can come in contact with the soft iron block which is soldered to the arm. The spring S is fastened to the arm and the box so it will return the arm when there is no voltage. The stop E is inserted in the cover so as to stop the arm when it returns. The screw eyes are then fastened to the ends, on the inside of the box. The shade springs are fastened on these, care being taken that no two touch. They are then connected in series, taps being taken from every other joint to one of the switch points. The connections are then made as shown by the dotted lines. The connections with motor are shown in the diagram. To start motor, advance arm one point at a time until the last is reached where the magnet will hold the arm unless the circuit is broken. This box will prevent

the motor from running away with its load and thereby burning out the windings, and will prevent any damage to it. A circuit breaker can be used in series with it. This box may also be used as an ordinary rheostat.

Contributed by *Wm. Rademacher.*

AN ODD JOB CHUCK

The following is a description of an odd job chuck which can be easily and cheaply made and which will most likely appeal to a great number of readers who run lathes. I had a circular disc cast ½-inch thick and 4 inches in diameter, which I turned up and recessed to fit the face plate, by first drilling two holes and tapping for ¼-inch cap screws and fastening to face plate. After having performed this operation I reversed it



and turned off face and sides and scribed circles ¼ inch apart on face. This, I think, greatly facilitates centering pieces to be held. I then drilled sixteen ⅜-inch holes through chuck (see diagram) for studs. These I made from ⅜-inch square head cap screws, having drilled and tapped head at right angles to shank for ¼-inch set screws (cap screws should be sufficiently long to have shank blank to thickness of chuck plate as the threaded section must be sawed off).

This chuck will hold almost any shape by simply placing studs in holes nearest work to be held and tightening up set screws, care should be taken with finished work, by placing bits of sheet copper or other metal between work and set screws so as not to mar it.

Contributed by *F. A. Berger.*

ELIMINATION OF EDDY CURRENTS IN TRANSFORMERS

The principal objection to closed core transformers is the losses caused by stray currents, commonly called eddy currents. To overcome this, the writer employs a method used by all the standard motor manufacturers in the making of disc punchings for armatures.

The method is as follows:

Soak all parts of transformer iron or core in acetic acid or good strong vinegar until it is all evenly coated by the liquid. Then allow the parts to dry for forty-eight hours and they will be found to be rusted. The rust serves as an insulator.

Some experimenters have used varnish, but the objection to that method is that the core heats up and the varnish begins to melt, emitting a disagreeable odor.

This method may be used with the best of results and very little eddy currents will be noticeable.

Contributed by

Herman Lubinsky.

IMPROVING THE PHONOGRAPH

The appearance of decided tonal imperfections in a phonograph that has been in use for some time may often be traced to the reproducer. This part of the instrument is usually regarded with unnecessary awe, as it is quite simple and may often be repaired by the amateur in such manner as to considerably improve

its operation. Upon dissecting this device it will be found that the diaphragm is held in place by means of two rubber gaskets, which in time lose their resiliency. However, the old rings may still be used if coated to a depth of about 1-64-inch with rubber tire cement. In replacing them care should be exercised not to spread any of the cement across the diaphragm.

A second source of imperfect reproduction may lie in the records themselves. These often become worn just enough to produce an unpleasant harshness, but not sufficiently to destroy their usefulness. Such a condition may be detected by a slight discoloration along the bottom of the spiral groove. The composition of which records are made is soluble in kerosene, and by placing the disc in a pan of this oil for about 15 seconds and allowing it to dry thoroughly, the slight roughness which was the cause of the harsh note may be glazed over.

Contributed by *E. J. Badman, Jr.*

A SOFT NOSED HAMMER

A soft-nosed hammer for finished work can be made in the following manner, at almost no expense:

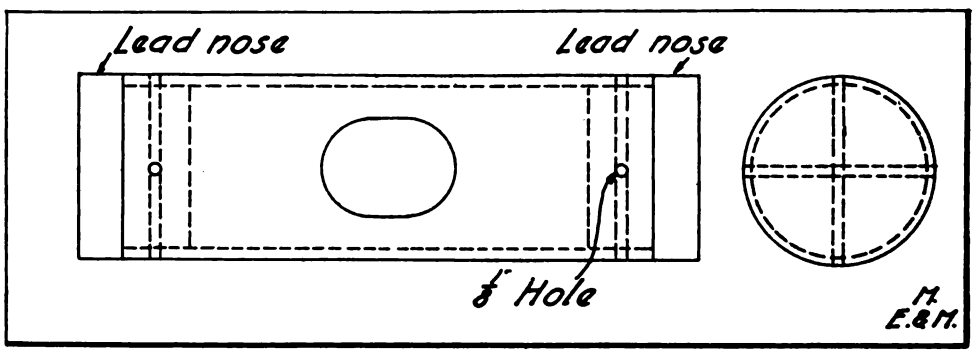
Take a piece of ⅜-inch iron pipe, 2 inches long, and drill ½-inch hole through the center and file it oblong in shape so as to take a handle. Then drill four holes, ⅛ inch in diameter, through the pipe, ¼ inch from each end, these holes being intended to act as locks for noses of lead.

Plug the hole for the handle with clay to prevent lead from filling. Then wrap a number of thicknesses of heavy paper around the pipe, permitting the paper to project about ¼ inch beyond the ends of the pipe. Now melt lead and fill each end to height of paper mould. Allow one end to set before turning over pipe to fill the other end and do not get lead too hot. Have the lead sufficiently heated to run. When finished, trim off ends with an old file, knock clay from the handle hole and fit a suitable wooden handle. When the lead ends become too battered up, melt out the lead and repeat. Thus, this hammer can be readily renovated whenever desired.

Contributed by *F. A. Berger.*

TO REMOVE THE EMULSION FROM PHOTOGRAPHIC PLATES

Old photographic plates can be put to a great many uses when the emulsion has been taken off. The glass is usually of good quality and free from bubbles. Due to the quality of the glass, it is especially adapted for use as a dielectric for condensers and for picture frame glass. In order to clean the emulsion off from photographic plates several methods have been devised, most of which take the larger portion of the emulsion off and leave the plate sticky and dirty. If the plates are placed in a solution of hydrofluoric acid (5 drops to 4 ounces of water) and allowed to stand for five minutes, the emulsion can be pushed off with the fingers and the plate will be left nice and clean.



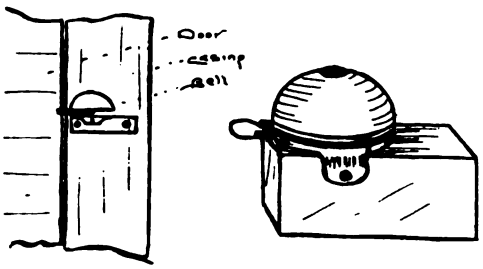
Contributed by *Davis H. Tuck.*

DOOR, WINDOW AND DRAWER ALARM

An ordinary bicycle bell, two wood screws, and a small block of wood, are all the materials required to make a good burglar alarm.

Unlike many alarms this one will ring with the opening or closing of a door.

It is to be attached to door casing so that when the door is moved it presses against the thumb-trigger which is allowed to project in the manner shown in the accompanying sketch. In the case



of drawers and windows, it is only necessary to alter the position of bell.

Contributed by *B. W. Verne.*

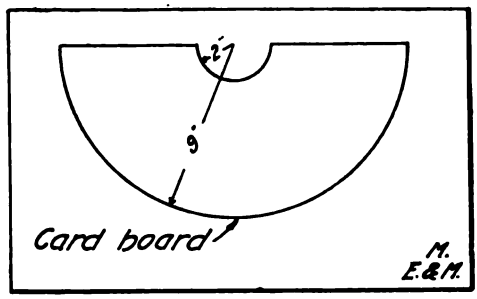
A SIMPLE FUSE BLOCK.

The accompanying illustrations represent the construction of a simple fuse block. The advantage of this block lies in the use of fuse wire instead of fuses, the former being much cheaper. The wire can easily be inserted into the block by pressing down the spring clip and slipping it through the eye screws.

Contributed by *Lawrence Dennison.*

A SIMPLE ELECTRIC LAMP SHADE

A very good lamp shade for an electric drop light can be made at practically no cost by following these directions. Of course, the dimensions can be changed, but those mentioned work very nicely. Take a piece of white or green cardboard (if green is used the inside should be covered with white paper) and make a half circle with a 9-inch radius. Make another half circle of 2-

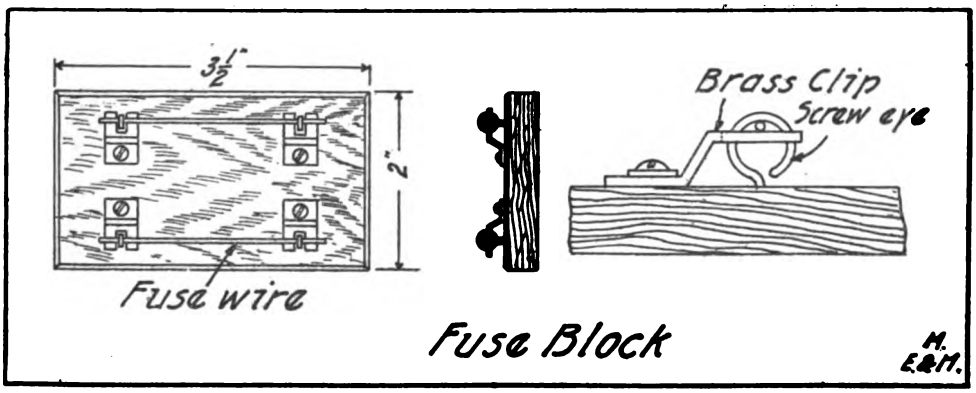


inch radius, using the same center, and cut out. After that is finished, make a cone-shaped object of it with the edges overlapping about ½ inch. These should be fastened (split pin paper fasteners work well) and the shade is finished.

Contributed by *Jas. F. Lupton, Jr.*

WIRELESS HINTS TO SECURE HIGHEST EFFICIENCY

Run your rotary gap slow and it will radiate more into the aerial with less imput in transformer.



Use as short lengths of wire and as heavy as possible, in connecting your sending instruments. It will make a great difference in radiation. Also do the same with receiving sets as it helps some.

—

Have as few instruments in a circuit or set as possible and learn to work them.

—

Don't use porcelain insulators on your aerial if you have a set of ¼ kw. or

over. If too expensive to insulate entirely with electrose, use one 10½ inch heavy electrose insulator between spreader and rope.

—

Don't try new connections on your receiving set every day. Get a standard hookup and learn to tune with it.

—

Use low voltage secondary side transformers, for then you only need small condenser capacity, which will balance up with your aerial of 200 meters.

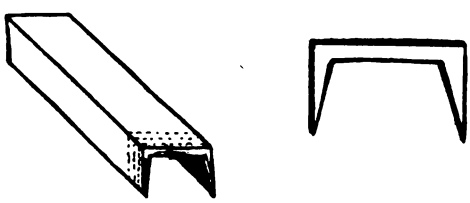
Contributed by

Derek Breitenbach.

HOME-MADE PINCH DOGS

Pinch dogs are quite necessary articles to have on the shop work bench.

Various sizes can be easily and quickly made by securing a short length of chan-



nel iron of a desired size, then, with the aid of a hack-saw, cut as shown in the illustration, file points, and the pinch dog is finished.

Contributed by *Bert W. Verne.*

THE EDISON EFFECT IN WIRELESS TELEGRAPHY

(*Continued from page 288*)

maximum ionization were present. In the oscillation valve, maximum ionization is present if the valve is constructed, as it should be, to produce a maximum Edison effect.

Thus, we can see that if a valve is properly made, the presence of a magnetic field will enhance its sensitiveness, while if defectively constructed, its action will be retarded when subjected to such a field.

It has been noted by users of audions, that if the voltage across the wing and the grid were increased much above 30 volts, a blue light formed in the lamp and the valve was not so responsive to feeble signals, yet greatly increased the intensity of strong or local signals. This may be explained as follows: When the blue light appears, the current is well up on the flat part of the curve. This was noted several times in obtaining the data for this paper. Obviously, we cannot be making use of the non-linear characteristics of the saturation curve of the valve here, since the part of the curve on which we are now operating the audion, instead of being steep is quite flat. The evident conclusion is that the rectifying properties of the valve are now being brought into play, and we can readily see how it would not be as sensitive for feeble signals as the critically delicate method of operation used in the other means. On the other hand, if we had a very strong incoming signal when operating on the latter method, the limit of the intensity of the sound in the telephone receiver would be represented by or be a function of the length of the steep portion of the curve. On the contrary, if we were operating on the flat part of the curve utilizing the rectifying properties of the valve, the only limit to the intensity of the signal in the receiver would be the magnitude of the incoming oscillations.

The presence of the magnetic field will invariably aid in the reception of signals by this method, since when receiving local signals, it may be used to concentrate the cathode rays into the space between the wing and the grid, thus increasing the conductivity of the gas and aiding the rectifying process, or when attempting to read feeble signals, it may be directed on the electrons so as to drive them out of this space, thus forcing the current back on the steep portion of the curve, extinguishing the blue light and returning to the other method of using the audion.

From a commercial standpoint, it is interesting to note that the Audion and the Fleming valve are the most sensitive receptors for radio-telegraphic signals that can be practically installed, yet due to the slight expense involved for the renewal of valves and the delicacy of their successful operation, they have not come into very wide adoption.

High Frequency Current Apparatus

A Series of Articles Covering the Theory, Making and Operation of High Frequency, X-Ray and Ozone Apparatus

By Frank Brewster

EDITOR'S NOTE:—This is the second instalment of the series on the construction and operation of X-Ray, High Frequency and Ozone equipments. The first instalment appeared in the February issue.

CHAPTER II—THE INDUCTION COIL (Continued).

THERE are numerous ways in which to operate the 12-inch spark coil for X-ray duty. The simplest one is that involving the use of a vibrator or interrupter actuated by the magnetic impulses occurring in the iron core of the coil itself, which are due to the making and breaking of the primary circuit.

A sketch of a vibrator of this type and designed for this coil when used on battery power, is shown in Fig. 6. It is so proportioned that it will have a long make or closing period and a sudden quick break or opening period; this fea-

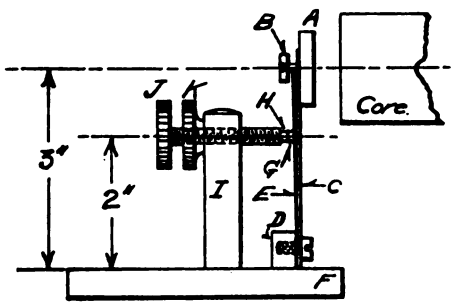


FIG. 6.—VIBRATOR INTERRUPTER FOR USE WITH INDUCTION COIL WHEN OPERATING ON BATTERY POWER

ture being essential to the production of a lively spark with no appreciable lag, which is an inherent property of all common single spring vibrators or rheotomes.

In the drawing, A is a soft iron armature or hammer ⅛-inch thick and 1¼ inches in diameter. B is a flat-head machine screw threaded into the centre of the armature and acting as a limit stop for the play of the contact spring E, so it will not be drawn away from the contact point H, until the armature spring C has attained a good start in its motion toward the core, thus allowing the magnetism in the core to reach its maximum value before breaking the circuit. The armature spring C is of clock spring steel 1-inch wide and 1-32-inch thick, secured to a brass support D about ½-inch high.

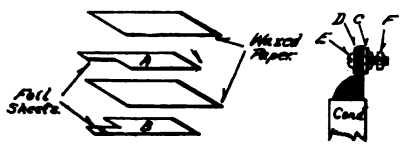


FIG. 7.—METHOD OF ASSEMBLING THE CONDENSER

E is the contact spring and is held on the same support as the armature spring, but is free to move by itself above the support. Two inches from the lower end of this spring is fastened the platinum contact point or rivet G, opposite the platinum point H, on the adjustable contact screw J. This screw is threaded through the upright column I, and carries the check nut K to lock it in any desired position. The platinum points

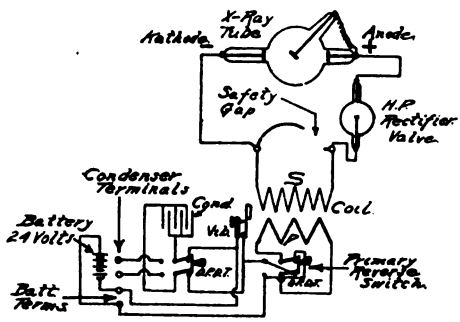


FIG. 8.—WIRING DIAGRAM FOR CONNECTING THE VARIOUS PARTS OF THE INDUCTION COIL

should be ⅛-inch in diameter and 3-32-inch long, with their contact faces filed perfectly flat and parallel.

It is a good plan to mount the complete interrupter on a hard rubber or fibre base as at F, so that the distance between the armature and core may be regulated for the best operation, the distance being in most cases from ¼ to ⅜-inch, or just so the armature does not hit the core while vibrating.

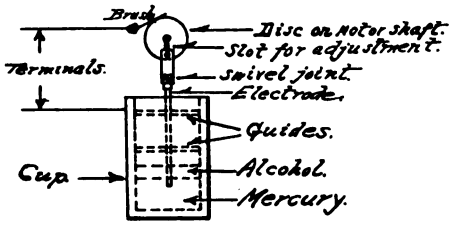


FIG. 9.—A SIMPLE FORM OF MERCURY INTERRUPTER FOR USE WITH INDUCTION COIL

When this form of interrupter is utilized, or any other slow speed make-and-break device, it is necessary to employ a condenser in conjunction with it. One terminal of the condenser is connected to the contact spring base, and the other condenser terminal to the contact screw pillar.

This condenser may be constructed of 5 or 6 mil paraffined paper sheets 1½ inches larger all around than the tin or aluminum foil sheets of which the condenser is built. The amount of active foil area required is 10,000 square inches, which may be divided up into say 168 leaves, each leaf 6 by 10 inches in size, and connecting 84 sheets to either side of the interrupter. The method of assembling the condenser is seen in Fig. 7, where A and B are the alternate foil leaves of the pile, the connecting strips of which are clamped together firmly by the two brass pieces C and D and screw E, the wire connection going under the nut F.

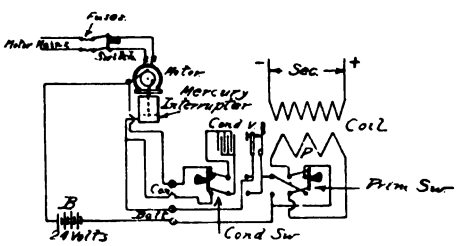


FIG. 10.—CONNECTIONS FOR INDUCTION COIL WHEN USING MERCURY INTERRUPTER

The coil can be operated very well with the parts here described for ordinary work. A diagram of the proper connections of the various parts of the complete coil is given in Fig. 8. The arrangement is for battery power, with switches for reversing the polarity of the primary and consequently the secondary current, and for switching the condenser from the coil interrupter to an independent or outside one when such is used, such as the mercury turbine.

Most every coil builder has ideas of his own in the mounting and finishing of his coil, and so no details will be offered here. A cut of a standard style of mounting a 12-inch spark coil was illustrated in the preceding instalment.

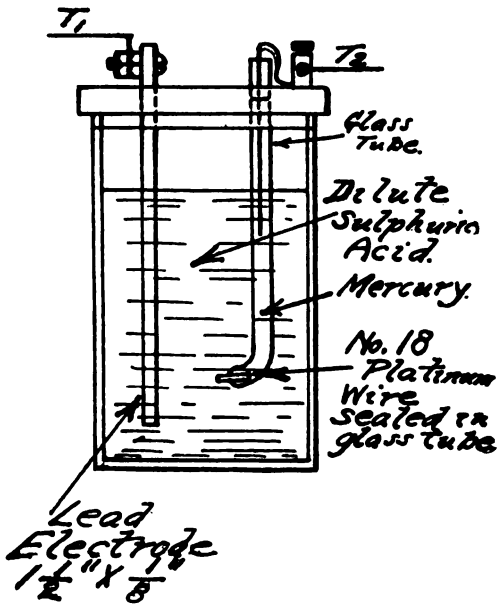


FIG. 11.—A SIMPLE FORM OF WEHNELT INTERRUPTER SHOWING THE ESSENTIAL PARTS

For those desirous of utilizing a mercury interrupter, a plan of the essential parts is shown in Fig. 9, which represents the simplest form of this type of interrupter. The brass or copper electrode is inserted in the mercury pool and removed with considerable rapidity, by means of a disc on a motor shaft, to which the point is attached as shown. The motor speed should be variable and reach a maximum of 2,500 to 3,000 revolutions per minute. As this is a slow speed type of interrupter, the primary coil condenser must be switched across it, a diagram of the proper connections in

this case appearing in Fig. 10. With the employment of such high speed interrupters as the Wehnelt or Caldwell of the electrolytic type, no condenser capacity in the primary circuit is necessary. The Wehnelt interrupter is suited to the operation of induction coils on anything over 40 volts, either alternating or direct current, and is extensively employed for X-ray purposes, the secondary discharge taking the form of a flame instead of a stringy spark.

A Wehnelt interrupter may be constructed similar to the sketch exhibited at Fig. 11, while Fig. 12 shows the scheme followed in the regular commercial product. In the operation of the Wehnelt interrupter, considerable heat is evolved, sometimes causing the electrolyte to boil. To offset this undesirable feature, the best plan is to place a small ⅜-inch lead pipe in the container, the

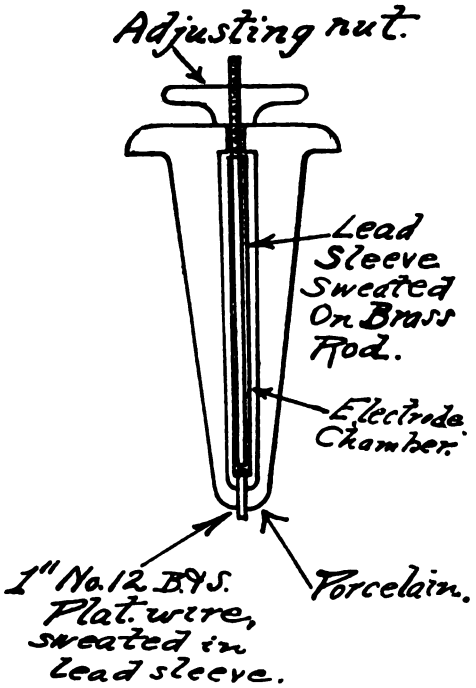


FIG. 12.—CONSTRUCTION DETAILS OF COMMERCIAL ELECTROLYTIC INTERRUPTER

pipe having five or six convolutions through which is circulated cold water. Two pieces of rubber hose attached to the ends of the cooling spiral, serve to conduct the water to and away from it. A cooling spiral is shown in Fig. 13.

If this interrupter is used with the coil, it sometimes happens that the results are not satisfactory. Insufficient primary inductance or "kick current" is the general cause of this trouble, which can be remedied by connecting in series with the primary coil, an extra inductance or choke coil, composed of a soft iron wire

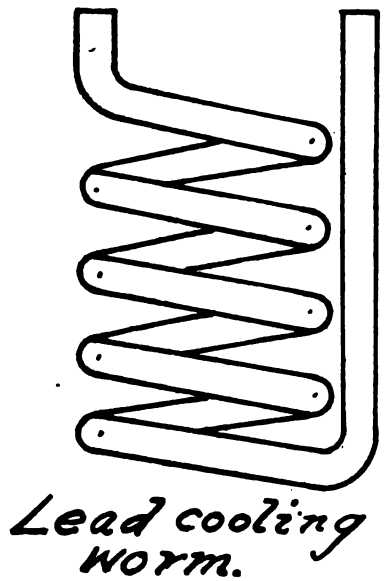


FIG. 13.—COOLING SPIRAL EMPLOYED IN SOME INTERRUPTERS

core 1½ inches in diameter and 12 inches long, over which is wound a coil of six layers of the same wire as on the primary, of course insulating the iron core with several layers of oiled linen or heavy shellacked paper. Taps for varying the amount of inductance are brought out from each layer, and connected to a six-point switch. To further improve the fineness of the inductance variation, the coil may be wound on a thin fibre tube, into which more or less of the iron core may be inserted, the highest inductance obtaining when the core is all the way in the coil, and the entire winding is cut into circuit.

If battery power forms the source of energy for the coil, sufficient cells should be used to furnish 24 volts; connecting the cells in series. The voltage of common dry cells is 1.5; Edison primary cells, .95 volts; storage cells, 2 volts.

For the illumination of the world's largest steamer, the *Imperator*, nearly 10,000 incandescent lamps are required.

Institute of Radio Engineers

AT the regular monthly meeting of the Institute of Radio Engineers, held on January 7, Mr. R. H. Mariott read an extremely interesting and valuable paper upon "Variations in Radio Range." He presented two sets of detailed observations of variations in the range worked through by two stations for the space of a year, one of these being in Denver, Colo., and the other at Manhattan Beach, Coney Island, New York.

In each case curves were plotted showing the variation in range throughout the day, month and year, both in sending and receiving. Some were even shown representing the variation from minute to minute, on a particular day, of the intensity of signals received at a station working with Manhattan Beach, with a constant state of affairs at the transmitting station. Corresponding to the range curves, a number of additional curves were plotted showing factors affecting the condition of the atmosphere at the time. These gave such data as temperature, barometric pressure, vapor pressure, humidity, hours of daylight, intensity of moonlight, and presence of close or distant static discharges. The personal equation was also taken account of, note being made when there was a change in operators, or when much interference did not give the operator a chance to try for long ranges.

The usual known facts that longer ranges were obtained in winter and at night than in summer, and in the day time, were confirmed; but one interesting observation was brought out by the speaker, which seemed to show that throughout the year the range varied directly as the vapor pressure. For this, a number of theories were advanced by the speaker, and also by those taking part in their discussion.

The value of the paper was largely in the mass of details which it furnished, which will probably make it a standard work in radio-engineering. Its delivery was much enlivened by personal episodes indulged in by the speaker in regard to the character of the sets he used (they were of the ordinary spark variety), and the operators who worked them. The paper was discussed by Dr. J. J. Stone, Mr. J. L. Hogan, Dr. De Forest, and Mr. Austen Curtis.

At the same meeting the regular election of officers for the coming year was held, and the following elections were announced:

President: L. W. Austin.
Vice-President: J. J. Stone.
Treasurer: J. S. Hammond.
Secretary: E. J. Simon.
Managers: Messrs. Weagant, Hogan, Hill and Marriott.

OREGON STATE WIRELESS ASSOCIATION

The Oregon State Wireless Association held their regular election of officers December 5, and the following were elected for the coming six months: President, C. L. Austin; vice-president, George Schwartz; secretary, G. E. Spencer, 446 6th street, Portland; treasurer, L. L. Leonard, and Sergeant-at-arms, W. A. McCrum.

This club has an active membership of twenty-five, most of whom own and operate their own stations. Any one owning a station or interested in wireless work in the State of Oregon, is eligible to membership.

Most of the stations of the club members are able to receive from San Diego, Cal., on the south, and Victoria, B. C., on the north, while the better stations have no trouble in hearing Honolulu and the Alaskan Government stations.

The club meets every Friday night in Room 421 of the Y. M. C. A. The members will be pleased to communicate with other clubs and individuals through the secretary.

DANGERS OF GRADE CROSSINGS

According to a record recently issued by the National Highways Protective Society, it appears that during the last year grade crossing accidents caused the death of 124 persons and injury to 140 in New York State. In the State of New Jersey, 54 persons were killed and 48 injured.

Simple Home-Craft Furniture

The Second of a Series of Articles Describing the Making of Various Pieces

By G. Lane

Illustrated from drawings made by the author.

THE piece of furniture chosen for this article is an arm chair, a large comfortable one, and yet simple enough so that it can be made by anyone who has a working knowledge of tools and the requisite skill and patience to make the many joints necessary. The wood most suitable for this chair is, of course, quarter sawed white oak, although plain sawed red oak may be preferred, owing to the fact that it is considerably cheaper and is also easier to work.

The next thing to consider is the bill of lumber, which is given below, combining all the pieces of one width and thickness together.

OAK.

Back posts	1 pc. 2″ x 4″ x 7′.
Front posts	1 pc. 2½″ x 2½″ x 4′, 6″.
Arms, front and back seat rails	1 pc. ⅞″ x 5″ x 10′.
Side seat rails	1 pc. ⅞″ x 3″ x 4′, 6″.
Lower braces	1 pc. ⅞″ x 2″ x 4′, 6″.
Back rails	1 pc. ⅞″ x 6″ x 30″.
Slats	1 pc. ⅞″ x 3″ x 9′.
	1 pc. ⅞″ x 4″ x 24″.

PINE.

Slats for cushion	1 pc. ½″ x 4″ x 6′.
Cleats on seat rails	1 pc. ⅞″ x 1½″ x 4′.

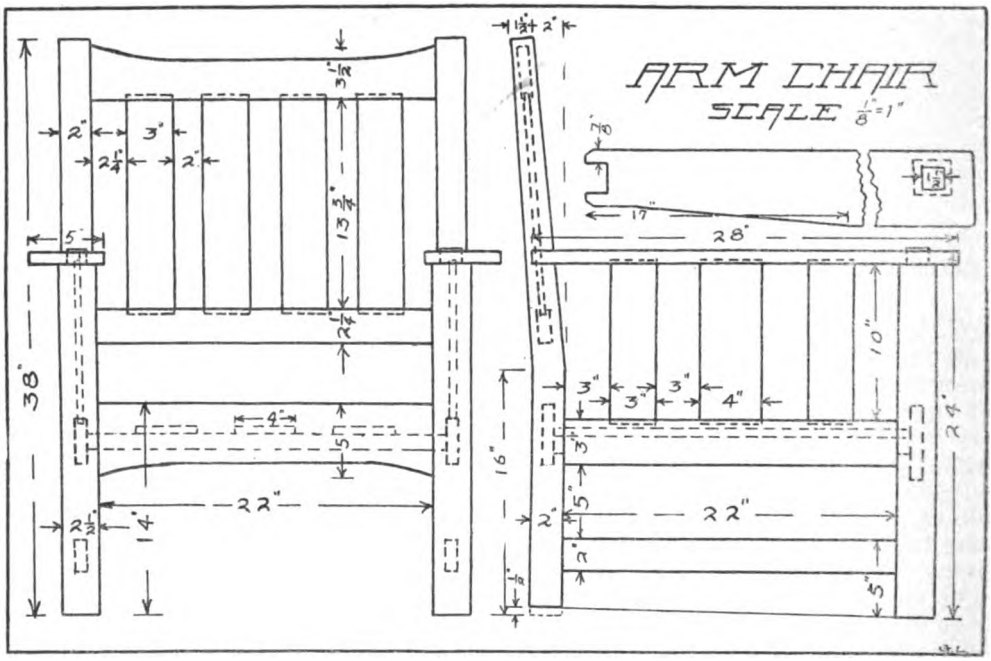
Before beginning work, be sure your smoothing plane and scrapers are in good shape—no one can do good work with dull tools. On ordinary grain, a few very thin shavings with a smoothing plane will take off any planer or sander marks on the wood. First smooth up the 4″ surfaces of the back posts. Then lay out with rule and straight edge the form of the back posts and saw out with rip saw, keeping on the waste side of the line. Smooth up these edges with smoothing plane, using spoke shave and scraper at low point on back of posts. Work both pieces together to insure exactly the same shape, being sure to keep the edges square. Take a very small bevel off from the top ends to keep the corners from being too sharp.

Plane up front posts and saw to proper length in mitre box and smooth up top end. In places where the kind of joint is not shown on drawing, the maker may choose between the mortise and tenon, or the dowelled joint. In the explanation, however, it is assumed that dowelled joints are to be made. In case the mortise and tenon joint is employed, add a proportionate length for the tenons. Remember that the ends of all pieces, in case the dowelled joint is used, must be perfectly square, while the shoulders of the mortise and tenon joints must be square.

Next plane up and cut the 2-inch and 3-inch rails for the sides, then lay out the arms, cutting on waste side of the line with rip saw and smoothing up with scraper and smoothing plane. Round all corners of arms with sandpaper. Smooth up and cut to length the slats for the sides and lay out on under side of arms and top edge of seat rail the mortises to receive the slats. These will not need to be mortised in very deep, ⅛-inch or ¼-inch will do, as there is no strain on these pieces. Lay out joints for rails and posts, using two ⅜-inch dowells, if dowelled joints are to be used, for each joint. Cut mortise in arms and tenon on front posts, allowing the posts to project through the arm about ⅛-inch above the arms, and bevel the end of the tenon back ⅛-inch. Put the posts together with rails, *without glue,* and measure exactly how far back to cut the notch in the end of the arm to receive the back post. Owing to the fact that the back posts slant back a little, the notch will have to be cut a little deeper on the under side of the arm. Now put the entire sides together, making sure that every joint comes together tight. Bore a ⅜-inch hole through arm and post, from inside, taking care not to bore all the way through to the outside. To insure a perfect joint here, it is well to have a clamp to hold the pieces together tight while the hole is

bored. Cut the dowells a little longer than necessary. Also, clamp the arm to the front post and put ⅜-inch dowell through the mortise and tenon joint, from the inside.

Although the sides might be put together with glue now, lay out and make joints on the inside of posts first, as it is much easier to make them while the chair is not yet assembled. So next prepare the front and back seat rails, noting that the back rail should be ½-inch longer than the front, as the back posts are narrower than the front. Get out the back rails, making joints carefully. Lay out on these the mortises to receive the slats, cutting carefully, making them



about ½-inch deep. Smooth up slats and cut to proper length. Put on inside of front and back rails the ⅞ x 1½-inch cleats to hold the slats for cushions, using 1¼-inch flat head screws.

Assemble the chair complete, without glue, making sure that the joints are tight. Now put just the sides together, using hot glue if possible, or the best cold glue obtainable. Have the furniture clamps all adjusted to proper length before applying glue, however, and have plenty of small soft wood blocks to put between the clamps and the chair, to keep from marring the surface of the wood. Glue the joints and clamp together quickly, using three furniture clamps for each side. Test each joint with a square.

After allowing the glue to set for twenty-four hours, remove clamps and scrape off carefully any glue that has been squeezed out of the joints. A good tool to use for this purpose can be made by heating and bending at right angles the end of a flat piece of steel, about ½-inch wide, and grinding an edge on the end. Draw a line with a straight edge from the lower corner of front post to a point ½-inch above the lower corner of the back leg (as shown on drawing). Saw carefully on this line both posts, and bevel slightly the corners. By sawing in this manner we give the chair a slight reclining position.

Now glue the rest of the pieces together, and be sure, before the glue sets, that the chair is not "in wind"; that is, be sure that all four corners touch the floor at the same time. After the glue has set, remove clamps and give chair the final inspection, scraping off any glue that remains, and sandpapering to remove any rough spots. Nail in the three slats to hold the cushion.

The chair is now ready for finishing, and as finishing was discussed at some length in the last article under this title, it will not be necessary to do so here. Remember you cannot get a good finish if your wood is not in proper shape. Apply the stain according to the instruc-

tions, and then the filler, afterwards applying whatever finish may be desired. Be sure to wait long enough between coats.

It is not necessary to make the cushion for the back of the chair, although it would, of course, add to the comfort of the chair. Several materials might be used for the cushion, and if imitation leather is employed, it is better to get the best grade possible. This grade has good wearing qualities and is not as expensive as real leather. A moss for stuffing the cushion may be procured from any upholsterer. If it is not advisable to make the cushion, any upholsterer can be called upon to do so.

In making this chair, it should be remembered that it is not necessary to follow the drawing exactly. If you do not wish to have the two rails curved, simply leave them 5 inches wide; or if you do not wish the chair quite so large, cut down one or two inches from the length of the rails.

ROLLER SKATES IN INDUSTRIAL PURSUITS

Whenever one thinks of roller skates it is invariably in connection with the pleasure that can be derived from them. However, a street railroad company in New Bedford, Mass., has found another use for roller skates.

In the stockroom of this firm are kept numerous articles, ranging from little bolts to heavy pickaxes. The room is over 170 feet in length. When orders are to be filled it is necessary for the clerks to go from one part of the room to another, necessitating the covering of a considerable distance each day. The firm has recently furnished roller skates to the stock clerks, who can now move swiftly and with less exertion to any part of the room. Although many of the boxes are located on high shelves, the ladders are so made that the clerks can climb them readily without removing the skates.

THE WORLD'S BUSIEST THOROUGHFARES

It is gathered from good authority that the two busiest streets in the world are the Mansion House Corner, in London, and the Place de l'Opera in Paris. Although the former has the greatest number of pedestrians, the latter has the larger share of vehicular traffic. Every week-day 500,000 persons walk past the Mansion House, while the number of vehicles is 50,000. Through the Place de l'Opera it is said that 450,000 pedestrians and 63,000 vehicles pass daily.

After these two most important streets, comes Broadway of New York, which is said to be traversed by 480,000 foot passengers daily. In all, over 700,000 pass through on street cars or automobiles. The next in importance is the Puerta del Sol in Madrid, Spain, which is actually the meeting place of several important streets. Over 360,000 people pass through it daily. The three remaining thoroughfares of leading importance are the Friedrichstrasse, Berlin, and the Vladimirski Prospekt, St. Petersburg, with 300,000 each, and the Graben, Vienna, with a daily average of 275,000 persons.

EVAPORATION

The rate at which vapor is formed depends on the temperature. For a given temperature it is not proportional to the area of the surface of the liquid, as ordinarily supposed, but to the linear dimensions of the surface; and in an open vessel evaporation takes place more rapidly near the boundaries of the surface than at the center. The rate of evaporation is thus not the same at all parts of the surface. This question has been examined theoretically by Stefan,* and he finds that for a circular vessel the quantity of vapor formed per second is proportional to the diameter, and further, that the lines of flow of the vapor from the surface are hyperbolas, of which the foci are on the bounding edge of the circular surface. The surfaces of equal pressure are the orthogonal system of ellipsoids; these are nearer each other at the edge of the surface than at the center, consequently near the edge of the vessel the vapor pressure decreases most rapidly, and it is here, therefore, that the flow is greatest.

The question has also been examined experimentally by Winkelmann,† and although he was unable to verify Stefan's theory very closely, he attributes the discrepancies rather to the mode of experiment than to any defect in the theory.

—*Jeffrey B. Macphail.*

* Stefan, Journal de Phys., 2 serie, tom. i., 1882.
† Wied. Ann., vols. xxxiii., xxxv., 1888.

THE EDITOR'S DESK

Another month has gone by and here we are again with a big, full-of-interest issue; one that contains a mass of information of all kinds. In this number all of the serial articles appear—an instalment of the article on small alternating current motors which covers the working directions for making one; the second article on the making of furniture, which deals with the construction of a comfortable and attractive arm chair; the second chapter on the construction of high frequency, X-ray and ozone apparatus, giving the remaining details regarding the making of an induction coil; and the conclusion of the article on modern industrial and military explosives. There are numerous interesting articles in this issue that deserve passing comment, among them the splendid article on the Edison effect in wireless telegraphy which represents extensive experimenting along original lines by its author. The leading article of this issue describes recent experiments with the divining rod—a topic that has been the subject of much derision in the past, due to the lack of proper investigation as to its merits. The article describing the construction of a marble inkstand should appeal to those readers who are handy with tools and desire to make attractive ornamental articles in marble and metal. It is our intention to publish more material along this line in the future. Space forbids the mention of the many other articles that possess perhaps equally commendable features.

We are again shocked by another tragedy at sea in the recent collision between the *Monroe* and the *Nantucket*, in which numerous lives were lost. Not the least important incident of the catastrophe was the bravery displayed by Ferdinand Kuehn, the wireless operator, who lost his life while aiding a woman passenger. Kuehn was a New York boy who lived in the Bronx with his mother and secured his early training in wireless with home-made apparatus. The experience he thus gained enabled him to secure a position with the Marconi Company about three years ago. In the beginning he was assigned to one of the Long Island Sound boats of the Joy Line, plying between New York and Boston. Later, he was transferred to the *Jefferson* of the Old Dominion Line. Over a month ago this vessel was laid up for repairs and Kuehn was then appointed operator on the *Monroe*. When the tragedy occurred, Kuehn was making his second trip on that vessel. According to reports, it appears that after the two vessels collided, Kuehn immediately began to call aid by wireless, but the apparatus soon became inoperative, due to the flooding of the engine room below. Seeing that it was useless to remain longer at his instruments, he placed a life preserver around himself and proceeded to aid passengers. He was last seen tearing off his life belt and placing it around a hysterical woman who had not taken any precautions to provide herself with one—thereby deliberately sacrificing his life by this unselfish action. There are many brave wireless operators who have sacrificed their lives in executing their duties, but none deserves greater veneration than twenty-year-old Ferdinand Kuehn. May his brave act always be an inspiration to others.

Ferdinand Kuehn, the wireless operator who lost his life on the steamer *Monroe* of the Old Dominion line, attended The Paine Uptown Business School from August 15, 1910, to January 11, 1911, in order to qualify in wireless operating.

The aim of MODERN ELECTRICS AND MECHANICS is a two-fold one. Every reader knows that our main endeavor is to provide carefully selected articles each month on the topics of electricity, mechanics and wireless. That is evident. But every reader does not know that we are also endeavoring to make MODERN ELECTRICS AND MECHANICS a veritable guide as to where different instruments, supplies, training, services, and other possible requirements can be procured. In every issue will be found the names and offers of various manufacturers, dealers, schools, institutions and others who can best cater to the needs of our readers. In most instances the names represent the leading firms in their particular fields. Readers need not hesitate in entering into relations with any of these advertisers since everyone is known to be reliable and the advertisements to be truthful.

There are many good things in store for the readers of MODERN ELECTRICS AND MECHANICS. For one thing, there will shortly be a new series of articles on pattern making—a trade that is most interesting and highly paid. This series will cover all the details concerning pattern making and will give every reader of this magazine a good foundation in the subject. Another excellent article is a short history of the steam locomotive, accompanied by many unusual illustrations depicting the early days of railroading, when horse cars were employed, up till the present-day huge passenger and freight locomotives. Most of the illustrations in this article have never appeared in any other magazine circulated in America. But we have not told you all! There are articles on cable telegraphy, new phases of wireless telegraphy, electro-chemistry, and many others, too numerous to permit of mentioning.

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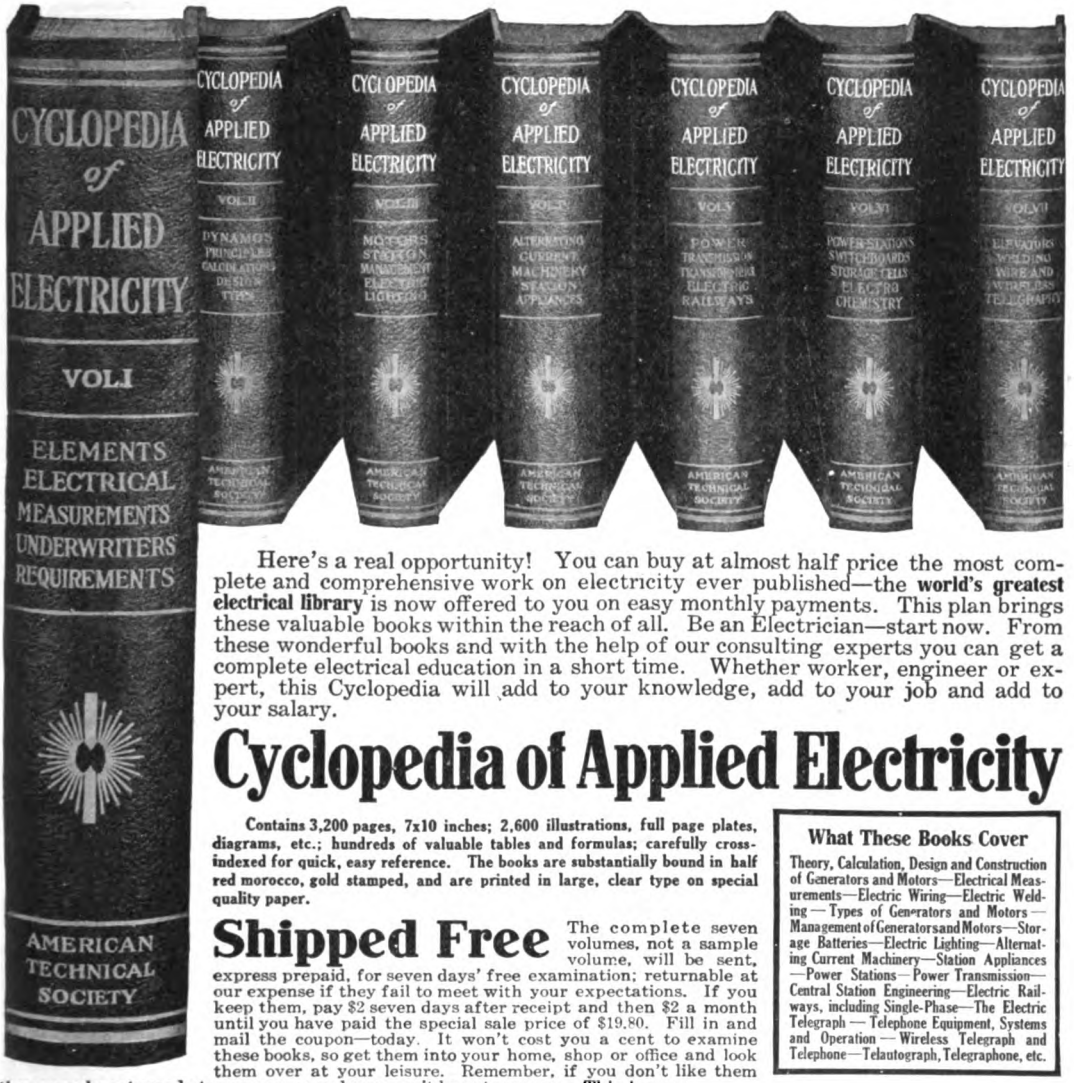

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As I have had no previous dealings with you, I refer you to

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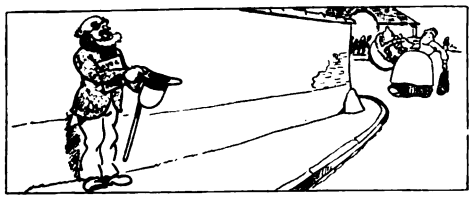
FLYING SPARKS

HE PREFERRED GUESSING

A traveling man was stopping at a small hotel that was recognized for its bad catering. A waiter presently asked him: "Will you have tea or coffee, sir?"

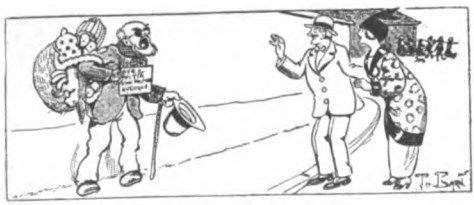
"Don't tell me which it is," replied the traveler, "Just bring it in to me and let me guess."

THE OBLIGING BEGGAR



Beggar—"Have pity on a poor blind man who has nothing to eat."

She—"Tell me, my good man, will you hold my basket, which is very heavy, while I go to the store."



Beggar—"Have pity on a poor blind man, who has nothing to eat."—*Le Pele Mele.*

SOME CHASER!

The fat drummer who wanted the 12.20 train passed through the gate at just 12.21. The ensuing handicap was watched with absorbed interest both from the train and the station platform. At its conclusion the breathless and perspiring knight of the road wearily took the back trail, and a "red cap" came out to relieve him of his grip.

"Mister," he inquired, "was you tryin' to ketch that Pennsylvania train?"

"No, my son," replied the patient man. "No; I was merely chasing it out of the yard."—*The Railroad and Current Mechanics.*

HE HAD ONE ALREADY

Salesman (stepping into the office of a prospective buyer): "I am introducing a brand new and wonderful invention—a combined talking machine, carpet sweeper and letter opener."

Prospective Buyer (very busy with numerous pressing details): "Got one already—I'm married."

NOT COLOR BLIND

A young mother, who had just returned from India, engaged a new nurse for her baby. The nurse came to her and said

"I don't know what's the matter, madam, but the little one cries and cries. I can do nothing to quieten it."

The mother thought a moment; then, brightening up, she said:

"I remember now. Baby's last nurse was a black one. You will find the stove polish on the third shelf in the kitchen."—*Tit-Bits.*

HE KNEW WHAT WAS COMING

Sandy was being entertained at a Soho restaurant, London, and the dinner consisted of rich and fanciful dishes.

"Well," he was asked, "what will you have next?"

"Ah!" replied Sandy, thoughtfully. "I think I'll hev indigestion!"—*Tit-Bits.*

CONSTRUCTION OF SMALL ALTERNATING CURRENT MOTORS

(*Continued from page* 316)

top of the frame, two others, over one of which the connection board may be placed, are near the bottom, while further communication with outside air can be provided by letting the machine stand on strips whereby the bottom openings are free. Additional ventilation holes may well be drilled through the internal flange, and for still better circulation of air, when circumstances require or permit, modification in the frame or end castings can be made as shown in a later figure.

If the builder demurs at the making of such a difficult pattern, he may be satisfied with a simpler construction, involving two identical castings that are merely rings, between which the sheet iron can be clamped. Such rings should have an outside diameter of about 8½", and the bolts so spaced as exactly to press against the sheet iron. Two projections can be cast on the flanges to provide bolt holes for securing the stator on a base. This latter part can be made to imitate direct current construction, having a large central seat and two smaller end ones that can be bored out to a diameter of 7¼". Into the central seat, with suitable portions removed to make room for bottom bolts, the stator can be secured, and into the end ones the bearings, the bottoms of which have been turned off to the same radius as the sheet iron. Such a construction will give acceptable alignment, accessibility and certainly good ventilation. Convenience of winding, too, is assured, for that interesting part of the making can be done while the stator is removed from the base.

If the builder is provided with a casting as shown in Fig. 7, his first step will be to bore out the interior seat for the sheet iron. This may tax the capacity of his lathe. If, however, a stiff lathe of not less than 14" swing over the bed is available, he may accomplish the task by bolting the casting to the face plate. He will thereby avoid the necessity of making a special boring tool with traveling head, as may otherwise be necessary,

and to the somewhat springy casting he will add the stiffness of the face plate itself. A specially stiff boring tool is desirable, and this can well be extemporized by putting a cutter into the end of a bar that will fill the tool-post slot. For convenience in bolting the casting against the face plate, it may be advisable to leave a projection at the top extending out as far as the overreach of the feet; three points of support will thereby be provided, and by a little filing or shimming, the piece may be readily centered.

The seat on the four ledges should be bored to 7¼", to fit the sheet iron, one of the sheets itself rather than the rule being used for measuring. There will be small need of turning off the inner face of the flange against which the sheets are to rest. If the builder wishes, he may next turn off the outer rim over which one of the bearings is to fit, but as the other rim must be machined by some other means, he may as well postpone this item until ready to do both.

If a large lathe is available and the face-plate method is not desired, the frame casting may be bolted directly onto the regular carriage, and with a simple boring bar between the centers, the cutting may be readily, though slowly accomplished. There will be solidity in taking the chips on the bottom and side ledges, but at the top some springiness will be experienced, whereby the size of chip will be limited. If conditions require a third method of boring, namely, by bolting the casting directly to the bed of the lathe, the case will be quite like that of boring an engine cylinder, the head of the boring tool making a slow advance at every revolution. If special cutters are then provided, the lips at both ends may then be cut, and if all this turning is accomplished at one setting, certainly an accurate alignment may be expected.

When the outer edges for supporting the bearings are to be turned at a separate operation, the casting must be mounted on a suitable arbor, and such a fixture can readily be provided by utilizing a pulley. Let the central hole be made as large as convenient, and a true arbor inserted. Rim of pulley should have about a 4" face, and while on its own arbor be turned to fit the 7¼" space in the frame casting. To drive the lat-

ter during the process of turning off the edges, it is well not to depend upon the "dog," but to insert a stiff bolt in the face plate that can directly push against some portion of the rim. The distance between the faced edges is to be made 5", but at this particular stage of the work, the diameters may well be left a little large, say 8¼" rather than the specified 8 3/16", whereby if a mistake is made in turning the end castings an opportunity will be reserved for correction.

Considerable drilling may next be done,—the hole for the eye-bolt at the top, four for the base bolts, two for the connection board, and those for ventilation. The four on each rim cannot as yet be located, for they are to be marked off from the holes as drilled in the end castings. Similarily, the eight holes for bolts that clamp the sheet iron can best be marked off from the drilling in the companion piece.

3.—END-SHIELD AND BEARING

Two identical castings of dimensions as shown in Fig. 9 are required, and they can well be as thin as stove iron. Fig. 10 gives the perspective view of a casting. The central portion, or hub, contains the oil reservoir and the housing for the removable bronze bushings or linings in which the shaft revolves. The castings are centered in a chuck or on a face-plate and the central holes bored and reamed to ⅞". A regular arbor that is reliably true, or one that has been specially turned for the purpose, should then be fitted to the hole and the rim turned to the dimensions shown, or until a satisfactory fit is made with the frame. This fit is an important one, and should be made with considerable care. While it is not essential that these two end castings be interchangeable with each other, there is no objection to machining them quite alike. The outer rim of contact will be sufficient, the inner surfaces being separated by as much as a sixteenth of an inch, as seen by inspection of Fig. 2. If it is of any consequence to be able to operate the motor, instead of in its usual position, on wall or ceiling, the location of these end shields must be interchangeable in a rotational sense, for certainly the oil reservoirs must always be at the bottom. To provide for this case, the four holes must be

exactly spaced. While the casting is still on its arbor, a thread tool can be used to mark on the outside of the four bosses scratches that will diametrically measure 7¾" apart. Lightly locate a prick-punch mark in the center of one of these bosses, then with compasses space the other three. When assured of the correct locations, they may all be deeply prick-punched. The holes can then be drilled and counterbored to fit the fillister headed screws that are to be used.

One of the shields can now be slipped onto the frame, and the ¼" drill run into the latter for a short distance. Now remove the shield, run in a No. 7 drill for at least half an inch further and tap it No. 14-20. Replace the shield, mark the other three holes, remove the cover, drill and tap as before. Similarly the other cover may be accurately located. A hole is to be drilled and tapped for securing the oil-well cover, but this should not be done until marked off from the brass casting itself, as shown in a later drawing. The two drip holes can, of course, be now drilled, also the one for the set-screw that fastens the lining in place.

NO NEED TO WORRY

The late Thomas B. Jeffrey, who built bicycles and automobiles, was a man of few words. One day he was on a railroad train when a traveling acquaintance called his attention to a big building in a town by which the train was passing.

"See that warehouse?" asked the traveler. "Well, ten years ago I could have bought that whole thing for seven thousand dollars, and now it's worth twenty."

"Did you have the seven thousand?"

"Oh, no."

"Well, then," said Jeffrey, "I wouldn't let it worry me."—*Chicago Ledger.*

THE LAW OF CHANCE

May Kissam—"I'm afraid papa would make a scene if he came home and found you here."

Jack Willing—"I just left him at the club; he won't be home very early."

May Kissam—"How do you know?"

Jack Willing—"He was two hundred in the hole when I left."—*Puck.*

Popular Educational Food Campaign

Eggs in wrong combination and an excess of starchy (paste making) and fatty foods make people sluggish and cause dull, splitting headaches, lack of memory and concentration, drowsiness and inertia. A complete change to "digestible" brainy foods (suitable meat, game, fish and suitable dairy foods, combined with suitable vegetables and fruits according to the new brainy food plan) produces the most marked improvements in a few weeks.

G. H. BRINKLER
Food Expert

Brainy Diet

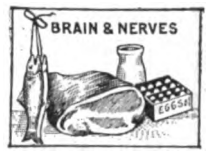
A thin man, after being out of work nearly a year through weakness, was restored in three weeks to hard work as a carpenter at full pay. In such cases the change from wrong combinations of foods, an excess of starchy, cloggy, death producing foods to energizing foods causes a literal transformation.

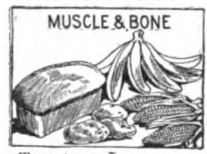
Another person, deaf in the right ear, owing to a discharge caused by an excess of mucus making foods (cream, butter, cheese, etc.) completely eliminated the catarrh thereby restoring his hearing by taking correct combinations of suitable foods.

A case of kidney and bladder trouble of ten years' standing was saved from a surgical operation, and the objectionable discharge relieved within ten days, because the loss of control was due entirely to the constant irritation from certain irritating foods and drinks.

Prurigo or "Itch," chronic, beyond the remedies of doctors and skin specialists completely disappeared within three months.

A chronic sufferer, weighing 415 pounds, unable to exercise, reduced over 150 pounds (in public life, under many witnesses), gained strength and firmer flesh, and lost rheumatism.





Tomatoes, Lemons, some fruits are solvents; Green Vegetables are laxatives; etc.

Over 100 similar cases certified by Official Investigating Committee

During nineteen years of personal experiments, I have learned to produce in myself **rheumatism, catarrh, sore throat, tonsilitis, constipation, double chin, swollen glands, kidney troubles, shortness of breath, rough scaly skin, dandruff, sores, boils, pimples with white pus, blackheads, rash, and other symptoms at will** by eating of different classes of foods in excess for several days or weeks according to the symptoms desired. AND I CAN RESTORE MYSELF TO GOOD HEALTH IN A FEW DAYS BY CORRECT DIET. The foods which cause expectoration, catarrh, cough, constipation, tumors, etc., are specified in my booklet which has taught many to cure themselves.

"The New Brainy Diet System" sent for 10 cents. Send Addresses of Sick Friends to

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When writing, please mention "Modern Electrics and Mechanics."

THE NEW LONDON RADIO STATION

(Continued from page 299)

apart, is constructed entirely of wood. It is two hundred and ten feet high and about five feet square. It is of uniform size all the way to the top and there is a ladder running up inside as may be seen from the photograph. To get the best effect from this picture the magazine should be held over the head, as the picture was taken at the bottom of the mast looking up the inside. The pictures taken from the top of the tower show the city of New London on one side and the mouth of the Thames River on the other. In the one of the river mouth may be seen one end of the upper spreader, which is galvanized iron piping about 20 feet in length. The length of the antennæ is approximately 150 feet. In order to give some idea of the height it may surprise the reader to know that there are about five hundred tons in the little coal pile on the end of the dock in the center of the picture and that the wrecking tug at the right is over one hundred feet long.

The transmitting range of the auxiliary set is something over eighteen hundred miles, this distance having been worked with ships of the South American lines. The range of the big set has never been thoroughly tested as this set is seldom used except to send the Block Island weather report and work with WCG at 8 P. M., on a wave-length of 1,800 meters. The note is high, clear and musical.

AN EDITOR'S TROUBLES

The editor of a daily paper appearing at Gary, Indiana, after attempting to satisfy the demands of his polyglot readers by publishing news in Italian, Czech, Croatian, Polish, Hungarian and English, was challenged to a three-cornered duel by two subscribers because he failed to print columns in Russian and Serb. Even in happy Indiana editors can't please everybody.—*Tit Bits.*

In Stockholm, Sweden, there are about 80,000 telephone subscribers for a population of a little over 400,000; or one for every five inhabitants.

ELECTRICAL EQUIPMENT OF THE PANAMA CANAL

(*Continued from page 303*)

and back of the shaft is fitted with opal glass marked with black lines for the ¼, ½ and ¾ positions. A small aluminum cage moves up and down in each compartment. A drum for operating the cord which raises and lowers the cage is located underneath the control board and is operated by the receiver through a suitable train of gears. To make the indications visible from points up and down the control board, the elevator shaft under each car is always illuminated and the portion above is dark.

WATER LEVEL INDICATORS

The specifications covering the water level indicators required an accuracy of 1/20 of a foot, or 1/10 of 1 per cent. in actual water level. In the transmitters and receivers for the machines described previously, the rotors turn less than 180 degrees with an inherent lag of 1½ per cent. between transmitter and receiver rotors in this distance, which obviously prevents this arrangement from being employed to give the water level indication.

It was found that if the rotors were revolved ten complete revolutions, the required accuracy could be obtained; but since this arrangement makes it possible for the rotors to be in synchronism every 180 degrees, or in twenty different positions for the entire travel, the indicators would not indicate correctly if for some reason the transmitter rotors were turned more than ½ revolution with the power off. Therefore, the required accuracy was obtained by two sets of transmitters and receivers, one set connected to a fine index in which the rotors make ten complete revolutions, and the other set connected to a coarse index operating less than 180 degrees.

The fine index is a hollow cylinder carrying a pointer, the length of the cylinder being such that when an aluminum ball representing the coarse index, which can be depended upon for coarse indication, is within the limits of the cylinder, the reading of the fine index is correct with-

in the limits specified. The scales are illuminated by lamps in both base and top caps of the indicator.

For water level indication, wells 36 inches square in the lock walls with communication to the lock by a small opening at the bottom of the well to dampen surges, contain a welded steel box float, 30 inches square by 9 inches deep. A non-slipping phosphor bronze belt transmits the movement of the float to a sheave fitted with pins on the transmitter mechanism, the pins registering with holes punched in the belt. The sheave shaft is carried in ball bearings with oil cups for lubrication and drainage cocks at the bottom of the bearings.

The position of the miter forcing machine is not indicated by synchronous indicators, but its open and closed positions are shown by red and green lights and a mechanical indicator on the control board representing the machine.

CONTROL BOARDS REPRESENT LOCKS IN MINIATURE

The control boards are of the flat-top benchboard type, 32 inches high by 54 inches wide, built in sections, with total lengths as follows:

Gatun .....64 feet
Pedro Miguel .....36 feet
Miraflores .....52 feet

The side and center walls of the locks are represented by cast iron plates and the water in the locks by blue Vermont marble slabs. The outer edge of the board is surrounded by a brass trim rail, and the sides are enclosed with steel plates which can be readily removed for inspection of the board. The control board is supported by a wrought-iron framework resting on base castings, which are in turn supported on the operating floor of the control house.

The control switch handles are mounted above the surface of the board and operate through an angle of 90 degrees. They are provided with name plates for the "open," "closed" and "off" positions. The space immediately below the flat top of the control board is occupied by the contact fingers of the control switches, mounted on the operating shaft, synchronous receivers, and their cable connections. Connection boards are provided for the cables, which are led up from each side, as are buses for supplying current to the control switches, receivers and

(*Continued on page 371*)

BOOK REVIEWS

Any book reviewed in these columns may be secured through our Book Department.

A HANDBOOK FOR PRACTICAL ELECTRICIANS

In reviewing the work entitled "American Electrician's Handbook,"* one cannot help but highly praise its author for the great service he has rendered to the electrician by placing at the latter's disposal a veritable storehouse of practical information. This book is strictly intended for the practical electrician and comprises a most excellent reference work.

The "American Electrician's Handbook" contains all the necessary information required by anyone engaged in electrical construction. It covers the fundamentals of electricity and electrical work, generators and motors, outside distribution, interior wiring, transformers, illumination, and contains a complete index for readily locating any desired information. All these topics are again subdivided into numerous items so as to cover every possible feature. Tables and formulæ are found in profusion while diagrams are given in every instance where they can aid in enhancing the description.

It is impossible to do justice to this work in a short review, for it must be examined to be appreciated. Its 711 pages of text comprise an electrical reference library that would be difficult to equal even if several books were gathered together. In all, the work is highly commendable to anyone interested in any branch of electricity.

* *American Electrician's Handbook*, by Terrell Croft. Published by McGraw-Hill Book Company, 239 West 39th Street, New York. Contains 711 pages and is profusely illustrated. Bound in flexible morocco leather with gilt lettering. Price, $3.00.

DESIGN AND CONSTRUCTION IN WOOD

Under the title of "Design and Construction in Wood,"* a most interesting work has been prepared for the teaching of designing and wood-working to beginners. The book is a companion volume to "Handword in Wood" and "Wood and Forest," by the same author, William Noyes.

The work has been well handled and attractively illustrated. Its opening chapter deals with wood, its qualities, characteristics and the various kinds of wood. Then follow chapters describing the designing of woodwork as well as the finishing of it, and the necessary tools, benches and other equipment for making the articles that are later described. The remainder of the book is devoted to the construction of various pieces, such as scrap baskets, letter trays, flower pots, picture frames, glass-bottomed trays, candlesticks, taborets, trays, rolling blotter holders, small boxes and lanterns. All the descriptions are quite clear and readily followed, while the illustrations comprise working diagrams and handsome halftones of the finished articles.

"Design and Construction in Wood" should be in the hands of all persons interested in wood-working as well as anyone desirous of making simple yet attractive pieces for the beautifying of the home.

* *Design and Construction in Wood*, by William Noyes, Assistant Professor of Industrial Arts, Teachers' College, Columbia University. Published by The Manual Arts Press, Peoria, Ill. Contains 159 pages and 204 illustrations. Cloth Bound. Price, $1.50.

RADIO TELEGRAPHY AND TELEPHONY

Perhaps no better book could be found for the beginner in wireless than that prepared by Mr. Alfred P. Morgan under the title of "Wireless Telegraphy and Telephony Simply Explained."* Although there are numerous works now available for students in radio communication, there are few as suitable for the layman.

The opening chapter deals with the simple principles involved in radio transmission and reception, followed by descriptions of receiving and transmitting apparatus, tuning and coupling, the application of wireless telegraphy to various purposes, wireless telephony, and finally, the conclusion in which Maxwell's theory, Hertz's discovery, electromagnetic waves, wireless telegraphy to-day, and other topics are discussed.

* *Wireless Telegraphy and Telephony Simply Explained*, by Alfred P. Morgan. Published by The Norman W. Henley Publishing Co., 132 Nassau Street, New York City. Contains 154 pages and 156 illustrations. Cloth bound. Price, $1.00.

SCIENTIFIC PROOFS OF ANOTHER LIFE

Although it must be confessed that works pertaining to the subjects that are remote from electrical, mechanical or wireless topics are foreign to the field of this publication, it was with much interest and pleasure that we reviewed a copy of a spiritualistic book entitled "Scientific Proofs of Another Life."*

The remarkable feature of this work—one that places it in a distinct field by itself and confers upon it the honor of being the first book of its kind—is that it has been entirely written by spirits of departed eminent persons, according to the statements of the publishers. In view of the continual exposure of imposters in spiritualism as well as the prevailing skepticism among the general public, it is rather a difficult matter for the average

(*Continued on page 363*)

How to cash-in on Your Ideas

NO inventor or Manufacturer can afford to be without these volumes —prepared by Patent Experts and sent to you anywhere without a cent of cost. If you have an idea these books show you how to protect it—if you have secured a patent they may help you to sell it. There are suggestions for ideas that you may work out and sell—and if you are seeking a profitable investment, many big, money-making plans are offered.

This library gives you a complete grasp of patenting and protecting the product of your brain. It explains every step—points out pitfalls—guides you to success. It tells you what to invent, what to do with it, how to make the most money out of it.

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It shows you how you may become famous and independently rich—how to turn your spare time into money—how to accomplish results at the least cost. It tells of Prizes offered — gives suggestions — explains every detail of the safeguards we place about your work. Every page is practical, helpful, profitable. **You** will be glad to know all these facts.

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"It gives me pleasure to state that I am acquainted with the firm of Randolph & Co., Patent Attorneys, of this city. and believe them thoroughly reliable, capable and exceedingly well equipped to look after the interests of their clients."

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"It has not been given to me to form the personal acquaintance of Randolph & Company, patent attorneys of this city, but as I have been frequently requested to recommend such attorneys to inquiring friends throughout the United States, it has become necessary for me to inquire with reference to the capacity and attention to business of this firm. I have learned that they are thoroughly up-to-date and have taken great pleasure in personally recommending them to inquiring friends."

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"Inventions Needed" tells of hundreds of inventions the world needs—that capital is seeking. Fortunes are awaiting men who can supply them. In 196 pages this interesting book points out the road to Wealth and Fame —tells you How and Why.

"How to Get Your Patent and Your Money" tells the experience and lessons of Inventors who have made good — shows you how to market **your** invention and **get the most money for it.** Its 132 pages contain a wealth of information—fully illustrated—that enables you to turn your ideas into money. It explains costs, ways, legal points—guards you against loss and disappointment.

"Millions in Patents," in 100 pages, reads like a fairy tale, but it is all hard, cold fact. It tells what others have done—what **you** can do—how, **with a** little energy and patience, you can join the few who have grown rich through successful inventions.

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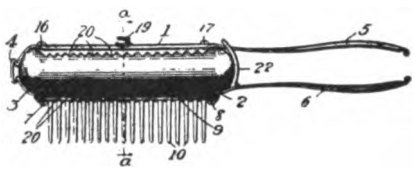
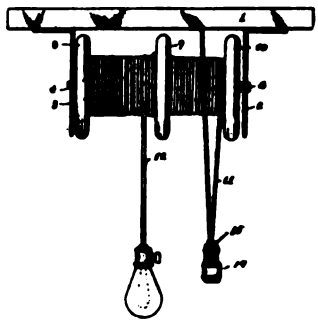
Recent Novel Patents

1,084,743. LIQUID-APPLYING COMB AND THE LIKE. Frank C. Jones, Sumter, S. C. Filed Feb. 17, 1913. Serial No. 748,982. (Cl. 132—8.)



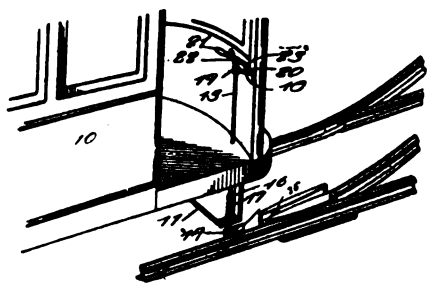
1 In a device of the character described, a main body portion of substantially U-shaped form, a hollow toothed comb and tank supported by said body portion said tank mounted directly above the toothed comb, communications between the tank and teeth of the comb, and handle portions carried by and extending beyond said body portion for compressing said tank.

1,084,960. LAMP-CORD REEL. Marion I. Randall, Bellingham, Wash. Filed Jan. 28, 1911. Serial No. 606,281. (Cl. 242—109.)



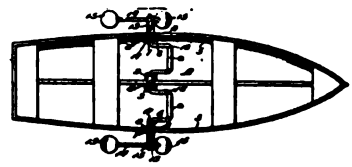
The combination with a support, of a lamp cord reel attached thereto and comprising bearing brackets, a spring retracted drum journaled in said brackets, said drum being divided into sections, a lamp cord extending downwardly from the support and then upwardly to form a loop, it being then wound upon one of the drum sections in one direction and oppositely wound upon the other section and adapted to depend therefrom, and a weight having a roller supported by the loop in the cord.

1,083,286. SWITCH-OPENER. Harry J. Lantz, Augusta, N. J. Filed Mar. 11, 1913. Serial No. 753,581. (Cl. 104—171.)



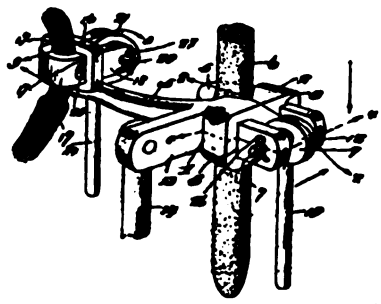
A switch throwing device for railway cars including a hanger, a spring controlled vertically movable rod mounted in said hanger, a switch throwing shoe on said rod, a substantially V-shaped bracket having an opening loosely receiving said rod, an arcuate fulcrum bar spanning the legs of said bracket, and a lever pivoted intermediate the ends to the upper end of said rod and having a terminal ring encircling said fulcrum bar.

1,084,798. ROWBOAT-PROPELLER. Joseph Granquist, Salt Lake City, Utah. Filed June 14, 1911. Serial No. 633,045. (Cl. 115—28.)



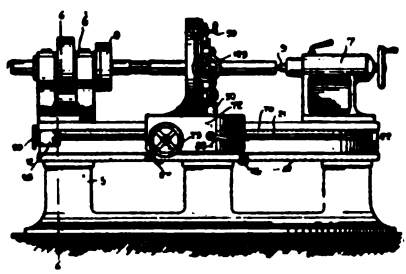
The combination with a boat, of a pillow post carried centrally within said boat, oppositely positioned journal bearings secured to the gunwale of the boat in alinement with said pillow post, two crank shafts each having one end revolubly held by said pillow post the other end of each shaft projecting through one of said bearings, a paddle head having a plurality of crosswise running apertures secured to the outer end of each crank shaft, a plurality of bars slidably held within each head aperture, and a curved paddle secured to each end of each bar.

1,084,879. SCREWLESS CARBON-HOLDER. William W. Wile, Bluffton, Ind. Filed Oct. 10, 1912. Serial No. 724,998. (Cl. 176—119.)



1 In a carbon holder comprising an arm terminating in a head plate provided with parallel spaced apart oblong openings and having a flat cam engaging surface between the openings, a U-shaped clamp having spaced apart arms oblong in cross-section adapted to fit and to be inserted in said opening, a pin mounted in the arms of said clamp, and a cam member mounted upon said pin adapted to engage the flat surface between the openings for drawing the arms through the opening, whereby a member terminal may be clamped between the crotch of the clamp and the head plate, said cam member having a surface parallel with the flat surface between the openings constituting means for equally drawing the arms through the openings.

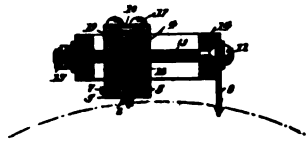
1,082,652. LATHE. Charles F. Roth, Pilot Grove, Mo. Filed May 24, 1913. Serial No. 769,751. (Cl. 82—20.)



1. In a lathe, a sliding carriage, a plurality of shaft cutting members mounted for radial movement upon said carriage, means for sliding the carriage, and electro-mechanical means for alternately moving the cutting members inwardly and outwardly toward or from the axial center of the shaft at predetermined times in the longitudinal sliding movement of said carriage.

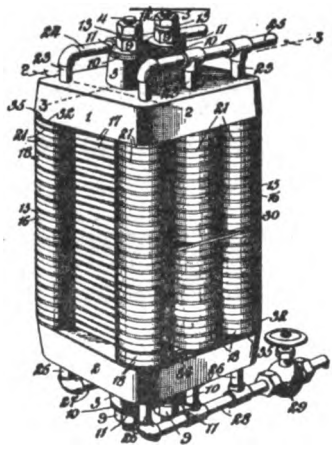
Recent Novel Patents

1,083,175. COMMUTATOR-SLOTTER. FRANK RUSSELL ALLEY, Seattle, Wash. Filed May 28, 1913. Serial No. 770,349. (Cl. 29—76.)



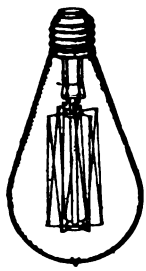
1. A commutator slotting tool comprising a body having transversely-extending guide-ways disposed parallel and spaced apart, a single rotating element in each guideway, a member engaged with each element and moved longitudinally thereof by rotation of the elements, a cutter mounted on the members and disposed below the same and below the body, and a guide adjustably mounted on the body and extending substantially parallel with the cutter.

1,083,191. THERMO-ELECTRIC GENERATOR. JAMES J. COOK, Jersey City, N. J. Filed Mar. 25, 1911. Serial No. 616,825. (Cl. 171—73.)



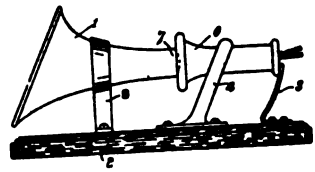
1. An element for a thermo-pile with the terminal portions alike and each having a passage therethrough for a temperature controlling medium, said terminals each being of the same thickness throughout from the mid line of the element toward both faces of said terminal portion.

1,082,933. TUNGSTEN AND METHOD OF MAKING THE SAME FOR USE AS FILAMENTS OF INCANDESCENT ELECTRIC LAMPS AND FOR OTHER PURPOSES. WILLIAM D. COOLIDGE, Schenectady, N. Y., assignor to General Electric Company, a Corporation of New York. Filed June 19, 1912. Serial No. 704,589. (Cl. 176—132.)



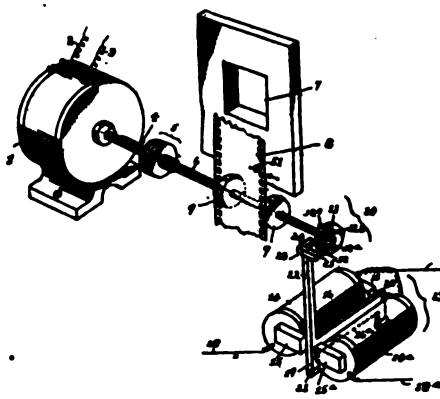
1. The process of producing tungsten having a fibrous structure which consists in repeatedly hot working a crystalline body of tungsten until the crystalline structure is broken down and a fibrous structure developed.

1,084,822. LOUD-SPEAKING ATTACHMENT FOR TELEPHONES. HENRY WAYMOUTH FRANCE, London, England. Filed June 25, 1913. Serial No. 775,698. (Cl. 179—182.)



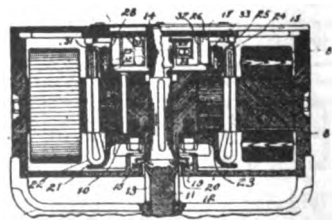
The combination, with a supporting base, and a trumpet secured thereto and having its main portion arranged horizontally; of an inclined guide secured to the base plate to the rear of the inlet opening of the trumpet and adapted to press the front end of a telephone receiver against the trumpet, a support secured to the base between the trumpet and the guide, and a telephone receiver supported horizontally and held in line with the inlet opening of the trumpet by the said support and guide.

1,083,498. SYNCHRONIZING PICTURE-EXHIBITING AND SOUND-RECORD MACHINE. ISIDOR KITSEE, Philadelphia, Pa., assignor to The Cort-Kitsee Co., a Corporation of New York. Filed Aug. 5, 1911. Serial No. 642,453. (Cl. 88—16.2.)



1. In mechanism for synchronizing the movement of sound reproducing and motion picture machines, operating means for the picture-carrier, a source of power tending to constantly actuate said operating means, and means controlled by the sound reproducing machine for intermittently interrupting the movement of the picture-carrier-operating means.

1,083,260. ELECTRIC MOTOR. RALPH E. NOBLE, Chicago, Ill., assignor to Morgan-Gardner Electric Company, Chicago, Ill. Filed July 2, 1910. Serial No. 570,102. (Cl. 171—206.)



1. In a motor or the like, the combination of a barrel wound armature, with a commutator extending wholly within the end turns of the armature winding.

NEW THINGS

Electrical—Wireless—Mechanical

HIGH GRADE WIRELESS APPARATUS

The Clapp-Eastham Company, 139 Main St., Cambridge, Mass., have recently issued a new catalog in which their latest types of wireless apparatus are described at length.

Among the apparatus mentioned in the catalog are: High Tension Magnetic Leakage Transformers, Type E Wireless Transformers, Wireless Keys, Hot Wire Meters, Helices, Transmitting Condensers, Adjustable Spark Gaps, Antennae Switches, complete Sending Sets," "The Hytone" Rotary Quenched Spark Transmitting Sets, Potentiometers, Receiving Transformers, Fixed Condensers. Tuning Coils, Detectors, Variable Condensers, Telephone Receivers, Wave Meters, and Complete Receiving Sets.

All of the apparatus is shown in elaborate illustrations, while the descriptions cover all the details that can prove of interest to prospective buyers of wireless instruments. The catalog contains 32 pages and considerable valuable information in the way of wiring diagrams and other instructive matter. Copies may be obtained by addressing the firm at the above mentioned address.

A SCHOOL OF TELEGRAPHY

Having outgrown its former quarters at 354 East 152d St., the Barrett's School of Telegraphy has recently opened a new school at 519-527 Courtland Avenue, New York City.

This school, although but a few years old, has done some notable work in turning out expert operators, both male and female, who

BUILDING OCCUPIED BY THE BARRETT'S SCHOOL OF TELEGRAPHY

are now engaged in various branches of telegraphy. Commercial, wireless and railway telegraphy are taught in Barrett's School of Telegraphy.

It is said that hundreds of dollars have been spent to make the new school a place where the students can be taught thoroughly and

VIEW OF A CLASS ROOM IN THE SCHOOL

prepared to qualify for good operating positions with any of the large telegraph companies or railroads immediately after leaving the school. Former students are now employed by both the Marconi and Telefunken Companies.

The new quarters are equipped with two complete sets of wireless apparatus—one a high-toned quenched set and the other a Telefunken set which is used for tuning purposes by the students in conjunction with a wavemeter. Special courses are given for those who desire to qualify for a first grade commercial license, providing they already have an amateur license. There is also a special electrical course for those who are already proficient in the code test.

Prospective students are cordially invited to inspect the new school and secure particulars regarding both the day and evening courses. Literature will be sent on request.

AN EFFICIENT TRANSMITTING CONDENSER

In any straight competition between home-made wireless apparatus and the output of the established manufacturer, the verdict is rarely in favor of the former. This is particularly true as regards transmitting apparatus and in no case is this more pronounced than in the ever vexatious problem of transmitting condensers.

The amateur who places his dependence upon home-made condensers frequently finds, to his sorrow, that his good intentions and his hard work end in temporary satisfaction, quickly succeeded by a catastrophe in which punctured plates and blistered foil are the outward evidences of his misfortune. Even if a total catastrophe be averted, it is reasonable

to assume that his completed condenser must snow the losses inseparably associated with the best condenser of the type which he can make.

The Moulded Transmitting Condenser, manufactured by the Wm. J. Murdock Company, is notable as a distinct departure from accepted forms. It is made in plate form, with interleaved sheets of foil and dielectric moulded under tremendous pressure into solid sections each of .0017 mfd. capacity.

Three distinct advantages are gained in this method of construction. In the first place, the solid section is physically so strong as to require a disruptive force exceeding anything of common occurrence to break it. Secondly, a condenser section, measuring approximately 6 x 6 x 1 inches has a capacity from 3 to 6 times as much per unit of volume as any other known form of condenser. This means exceptional economy of space. Lastly, the great pressure used in moulding the condenser so intimately connects the foil and the dielectric that all brushing effects are eliminated, and internal losses are reduced to a minimum. On actual test this condenser shows less internal losses in operation than any condenser made, excepting only the compressed air condenser, which on account of its great size and cost is out of the question for amateurs.

The Wm. J. Murdock Co. have recently completed exhaustive tests of the Moulded Condenser with rotary gaps on a 200 meter wave-length and have secured most satisfactory results, which they believe confirm their claim that the Moulded Condenser is the most efficient and economical type to use in this connection.

Those who may be interested in this condenser would do well to communicate with the Wm. J. Murdock Co., 40 Carter St., Chelsea, Mass.

A MODERN TRADE SCHOOL

In a large and handsomely prepared catalog, the Coyne National Trade Schools have clearly set forth their various courses as well as what they are accomplishing for their numerous students. This catalog contains many illustrations that show students at work in the various departments, officials and instructors, the equipment of the school and other interesting scenes.

The Coyne National Trade Schools teach electrical work, plumbing, bricklaying, mechanical drawing and moving picture operating. Not only are these trades taught from a practical standpoint, but the students are also trained in the technicalities of the various subjects. Many testimonials appearing in this catalog go to prove that the training secured in that institution is indeed a very profitable investment.

Anyone desirous of securing a copy of this catalog can do so by addressing The Coyne National Trade Schools, Dept. 1492, 51 East Illinois Street, Chicago, Ill.

WIRELESS APPARATUS OF ALL KINDS

The Haller-Cunningham Electric Company of 428 Market Street, San Francisco, Cal., has just issued a new wireless catalog in which

The Greatest Electrical Handbooks Ever Published - $1.00 to $4.00

Simply written and containing numerous illustrations, diagrams, formulas, etc., for home study and self-instruction.
They are of as great value to the experienced worker as to the beginner, and compose the most helpful, reliable and comprehensive series of Electrical Engineering handbooks ever before placed upon the market.

ELECTRIC RAILWAYS. By **James R. Cravath,** Western Editor, *Street Railway Journal.* 176 pp., 125 illus. Cloth binding. It covers every detail of the trolley and third-rail systems, their construction and operation, power generation and distribution, the electric locomotive, etc. Price, ... **$1.00**

THE ELECTRIC TELEGRAPH. By **Chas. Thom,** Chief Quadruplex Department, Western Union Telegraph Co., and **A. Frederick Collins,** Author of "Wireless Telegraphy, Its History, Theory, and Practice." 160 pp., 81 illus. Cloth binding. Simple apparatus; codes; the Morse code; messages; press service; cipher messages, etc.; abbreviated telegraphy; railway telegraphy; forms; junction stations; switchboard; batteries; systems; single-line repeaters; multiplex telegraphy; duplex; the quad; phonoplex; wireless telegraphy; construction of apparatus; wireless systems. Price.....**$1.00**

POWER STATIONS AND TRANSMISSION. By **George C. Shaad, E. E.,** Professor of Electrical Engineering, University of Kansas. 176 pp., 100 illus. Cloth binding. A manual for Electrical Engineers and Electrical Workers in general. Price.....**$1.00**

ELECTRIC WIRING AND LIGHTING. By **Charles E. Knox, E. E.,** consulting Electrical Engineer, and **George C. Shaad, E. E.,** Associate Professor of Electrical Engineering, Massachusetts Institute of Technology. 208 pp., 150 illus. Cloth binding. Price..**$1.00**

PRACTICAL LESSONS IN ELECTRICITY. By **F. B. Crocker, E. M., Ph. D.,** Head of Department of Electrical Engineering, Columbia University, Past President, American Institute, Electrical Engineers; **H. C. Cushing, Jr.,** Consulting Electrical Engineer, and **Lawrence K. Sager, S. B., M. P. L.,** Patent Attorney and Electrical Expert. 272 pp., 128 illus. Cloth binding. A practical guide for Electrical Workers. Price **$1.50**

DYNAMO - ELECTRIC MACHINERY. By **F. B. Crocker, E. M., Ph. D.,** Head of Department of Electrical Engineering, Columbia University, Past President, American Institute Electrical Engineers. 256 pp., 260 illus. Cloth binding. A complete and authoritative treatise on the theory, constructive details, calculation, and design of dynamo-electric machinery. Price **$1.50**

ALTERNATING - CURRENT MACHINERY. By **William Esty, S. B., M. A.,** Head of Department of Electrical Engineering, Lehigh University. 462 pp., 400 illus. Half Morocco binding. An authoritative and up-to-date work adapted to the needs of all classes of Electrical Workers. Price, **$3.00.**

TELEPHONY. By **Kempster B. Miller, M. E., and Samuel G. McMeen,** Consulting Electrical Engineers and Telephone Experts. 960 pp., 671 illus. A complete working guide to modern telephone practice. Price.....**$4.00**

Sent, postpaid, to any address upon receipt of price.

MODERN PUBLISHING CO.

231 FULTON STREET **NEW YORK CITY**

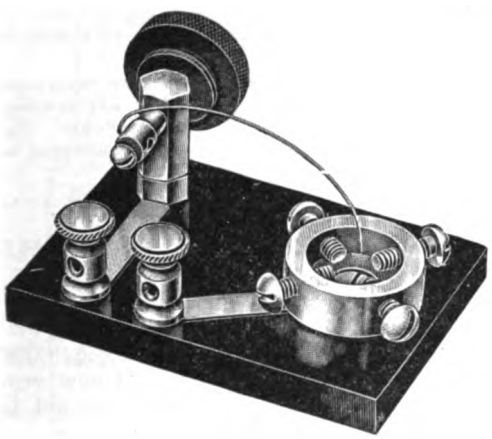
the entire line of "Halcun" wireless telegraph apparatus is illustrated and described.

Among the products listed in the catalog are: Rotary Condensers, Fixed Condensers, Wave Meters, Rotary Spark Gaps, Interference Preventers, Loose Couplers, Transmitting Condensers, Receiving Transformers, Sending Transformers, Detectors, Complete Receiving and Sending Sets of all kinds, Aerial Switches, Spark Coils, Hot Wire Ammeters, Break-In Keys, Telephone Receivers, and all the necessary supplies for erecting a wireless station. This catalog contains 32 pages and is profusely illustrated.

Several novel and striking features are offered in "Halcun" wireless apparatus, and anyone interested in either installing a complete wireless station or improving his present apparatus will do well to write for a copy of the catalog.

AN EFFICIENT DETECTOR

In the accompanying illustration is shown the new detector recently introduced by A. H. Grebe & Company, 10 Van Wyck Ave., Richmond Hill, N. Y.



NEW TYPE OF CRYSTAL DETECTOR

This detector permits of three adjustments—the tension on the wire touching the crystal can be varied, the wire can be moved from one side to the other, and the crystal cup can be rotated to any position. The unique feature of this detector is that friction bearings are employed so that any adjustment made will be permanent. The pillar holding the adjusting handle rod is pivoted in order that the wire may be moved from one side to the other on the surface of the crystal.

The detector has a genuine hard rubber base, and all the metal parts are made of brass, attractively and durably nickel plated. It is the result of considerable experience in the building of radio apparatus and is said to be mechanically and electrically perfect. This detector is endorsed by commercial wireless operators and is proving highly satisfactory wherever it is employed

This detector is being sold at the very popular price of $2.00, postpaid. Aside from this

instrument, the firm manufactures a large line of wireless apparatus, as well as special instruments to order. It will gladly quote prices on any special apparatus upon the receipt of specifications.

A HANDY TELEPHONE ARM

Anyone having occasion to extensively use a desk telephone will find the Equipoise Telephone Arm manufactured by the Holtzer-Cabot Electric Company, Brookline, Mass., unusually handy. This device keeps the telephone out of the way, yet holds the instrument within easy reach at any time. It has several important points that recommend its use, among which are:

No papers or inkstands disturbed or upset since the Equipoise swings over them. No tangled wires because the Equipoise supports the wires. No falling and damaging of instruments since the Equipoise holds the phone securely. No getting up or sitting down in order to speak in the telephone, since the arm will bring the instrument to any desired position. No holding or passing of the receiver —the auxiliary receiver holder being employed to hold the receiver. The Equipoise can be attached anywhere—on either side of a desk or on wall.

There are over 100,000 of these telephone arms in service to-day and they are proving popular in both the office and the home. For full particulars address the manufacturers as above stated.

NAVY EXPENSES FOR THE PAST YEAR

It is learned that the seven naval powers of the world expended $797,948,900 last year in the construction of new vessels. The United States was second in the list, with appropriations aggregating $140,800,643. Great Britain was first, with an expenditure of $235,713,489, while Germany spent $111,270,025. Japan was last, with an expenditure of but $48,105,151.

Great Britain has held her place as the first naval power, with a total tonnage of 2,591,291. Germany now ranks second, with a total tonnage of 1,228,208, while the United States has dropped to third place, with 921,844 tons. France is fourth, with 876,155, and Japan fifth, with 702,099.

Experiments in the use of aspen for shingles show that the shingles do not check in seasoning, and that they turn water satisfactorily, but that they are too easily broken in handling.

A NEW TYPE OF TELEPHONE RECEIVER

The recently introduced Grant receiver for wireless telegraphy is attracting considerable attention because of its many unique features. Instead of the usual method of placing the receiver parts in metal cases and mounting them on a headband so that they can fit close to the ears, the Grant receiver has the working parts mounted in a substantial case placed on a table and connected to the operator's ears by means of a flexible tubing. Inasmuch as the moving parts are not limited to any size or weight, as in the case of the usual receivers, it is possible to make them larger and provide suitable means of adjustment.

The Grant receiver is said to be the only instrument on the market to-day that has means for adjusting the magnetic field and permit the operator to set his instrument to any point desired so as to pick up the message in exactly the same tone in which it was sent. With the Grant receiver it is possible to use a head receiving set of very light weight—three ounces—which can be worn for hours without the slightest fatigue. This head receiving set is connected to the receiver by an insulated, flexible tubing, thus preventing any shocks from being experienced through accidental contact with the sending set.

The magnets of this receiver are unusually large and made from the best grade of magnetic metal, thoroughly seasoned so as to insure long life. The coils are wound with a special drawn wire, silk covered, and are treated to remove all air and moisture from them. This is a great factor for permanent maximum efficiency. The receiver case is made from a special compound, moulded in one piece and of very attractive appearance. The price of the Grant receiver is $9.00, complete.

Full particulars regarding this instrument may be obtained by addressing the manufacturers, The Grant Electric Company, 813 Prospect avenue, Cleveland, Ohio.

German pencil manufacturers are looking to California incense cedar for pencil wood. The establishment of a pencil factory in California is not improbable.

BOOK REVIEWS

(*Continued from page* 350)

layman to believe that such a work could be possible. But to one who has had the opportunity of witnessing simple spiritualistic phenomena that were positively known to be devoid of any trickery, such a work seems possible—and wonderful.

"Scientific Proofs of Another Life" comprises a large number of very short essays on topics of everyday life by well-known persons who have passed out of this existence. The opening chapter is in the form of a greeting and appears under the name of Frank Leslie; following are other essays credited to William Ellery Channing, David Crockett, Pontius Pilate, Virginia Dare, Abraham Lincoln, Moses, Napoleon III, G. Garibaldi, Herbert Spencer, U. S. Grant, Charles Darwin, Socrates, George Washington, Sir Isaac Newton, Leon Tolstoy, Daniel Webster, Oliver Wendell Holmes and many others perhaps equally famous.

Even eliminating the fact that the essays are said to be written by departed persons, they are full of interest in themselves and will form agreeable reading for anyone, inasmuch as all the topics are treated in a unique manner that is certainly out of the ordinary. For anyone interested in spiritualism the work is indeed a commendable one.

* *Scientific Proofs of Another Life*, compiled by Rose Levere, LL. B. Published by The Spiritual Science Company, 803 West 137th Street, New York. Contains 231 pages and is profusely illustrated. Cloth bound. Price, $1.00.

ELECTRICAL CIRCUITS AND DIAGRAMS

In this age of higher efficiency, briefness is a paramount requisite in technical literature. While a work must teach and teach thoroughly, the subject must be presented to the reader in the simplest and most expedient manner. In view of this fact, the work entitled "Electrical Circuits and Diagrams,"* second edition, is noteworthy in that it contains wiring diagrams for electrical instruments of all kinds in general use, rendered in the briefest and most comprehensible manner possible. Among the diagrams are those for alarms of all varieties, annunciators, automobiles, bells, generators and motors, gas lighting, storage batteries, street railways, telephones, telegraphs, wireless telegraph apparatus, wiring and testing. A short description accompanies each diagram.

* *Electrical Circuits and Diagrams*, by Norman H. Schneider. Published by Spon & Chamberlain, 123 Liberty Street, New York City. Contains 92 pages and 220 diagrams. Paper covered. Price, $0.25.

EFFECTIVE METHODS IN MECHANICAL DRAWING

As its title specifies, "Effective Methods in Mechanical Drawing"* is devoted to the geometry of drafting as well as simple kinks and short cuts that may be employed to facili-

tate drawings. The work represents the experience of the author covering a period of over ten years and the solutions given are those that have been arrived at after giving each problem many hours of diligent study. The unique feature of the book is that the explanations are given by drawings, accompanied by the briefest possible description consistent with clearness. This work* is essentially a reprint of selected sections of "The Drafting Room Series," which was reviewed in the February issue of MODERN ELECTRICS AND MECHANICS.

* *Effective Methods in Mechanical Drawing*, by Frederick H. Evans, M. E. Published by The Manual Arts Press, Peoria, Ill. Contains 44 pages and 22 illustrations. Cloth bound. Price, $0.50.

ELECTRIC LIGHT AND POWER WIRING

Under the title of "Standard Wiring for Electric Light and Power,"* a work has been prepared setting forth the requirements of various forms of wiring as approved by the Fire Underwriters. The book covers wiring in all its branches, such as for motors and generators, and inside and outside work. A list of approved wiring supplies is also included as well as numerous tables and formulæ. A section is devoted to treatment for electrical injuries.

"Standard Wiring for Electric Light and Power" has been written with a view to standardizing electrical work so that it will meet with the regulations of the National Electrical Code. It should be in the possession of all who are engaged in electrical construction work.

* *Standard Wiring for Electric Light and Power*, by H. C. Cushing, Jr. Published by H. C. Cushing, Jr., Pulitzer Bldg., New York City. Leather covered. Price, $1.00.

LIST OF RADIO STATIONS

The Department of Commerce has recently issued "Supplement No. 1" to the list of Radio Stations of the United States, Edition of July 1st, 1913, covering all additions and alterations up to October 1st, 1913. The new supplement contains 27 pages and may be secured by addressing Superintendent of Documents, Government Printing Office, Washington, D C., at ten cents per copy.

HOW TO MAKE AND USE A WIRELESS STATION

An instructive little book describing the building and operation of a wireless station has recently been published under the name of "How to Make and Use a Wireless Station."* This work describes the principles involved in wireless transmission and reception, the construction of the aerial, the securing of a good ground, arrangement of the transmitting and receiving set, as well as a short summary of the wireless law.

Of course, in this work the subject is somewhat hastily covered. But, for anyone desirous of securing a general knowledge of wire-

less telegraphy, the book will be found quite valuable. It is intended to interest the reader in reading a more advanced work, entitled "Experimental Wireless Stations," by the same author.

* *How to Make and Use a Wireless Station*, by Philip E. Edelman. Published by Philip E. Edelman, 2432 Lyndale So., Minneapolis, Minn. Contains 8 pages and is profusely illustrated. Paper covered. Price, $0.10.

ELECTRICAL SAFETY DEVICES

A most interesting work has been published under the name of "Fuses, Circuit Breakers and Other Electrical Safety Devices,"* which, as indicated by its title, discusses the various forms of electrical protective devices in general use to-day. Among the topics covered by the book are fuses, circuit breakers, lightning arresters, regulators, etc.

The work will prove of interest to anyone specializing in central station work, but it will also be useful to the practical electrician who desires to secure detailed information regarding protective devices.

* *Fuses, Circuit Breakers and other Electrical Safety Devices*, by James C. Peebles. Published by The Joseph G. Branch Publishing Co., Chicago, Ill. Contains 55 pages and 19 illustrations. Paper covered. Price, $0.50.

MODERN INDUSTRIAL AND MILITARY EXPLOSIVES

(*Continued from page 293*)

intended. As first devised in 1891, this explosive consisted of:

Nitro-glycerine .....58 parts
Guncotton .....37 parts
Mineral jelly (vaseline)..... 5 parts

This powder gave to projectiles, at half the weight, the same velocity as Poudre B, but the erosion of the gun was very great, and in 1898 a modification was made in the composition of cordite, and at the present time its composition is:

Nitro-glycerine .....30 parts
Guncotton .....65 parts
Mineral jelly..... 5 parts

The advantages of this last named explosive, known as Cordite M. D., are: slightly reduced rate of burning, higher velocities, more regular pressure in the gun and lower temperature, consequently less erosion.

Cordite is a waterproof substance and shows considerable elasticity. Its density is about 1.56. Ignited in the air, it burns with a yellowish flame.

The smokeless powders at present known can be divided into three classes:

1. Powders in which guncotton, either the so-called insoluble or the soluble variety, alone is used, which, by

aid of a solvent, has been converted into a horny substance and then is formed into flakes or cords.

2. Powders in which a mixture of nitro-glycerine and either di- or tri-nitro-cellulose is transformed into a similar horn-like substance, either with or without the aid of a solvent.

3. Powders which contain nitro derivatives of the aromatic hydro-carbons, either by themselves or in connection with nitro-cellulose.

Smokeless powder as used in the United States Navy is essentially a nitro-cellulose powder, consisting of a mixture of insoluble and soluble nitro-cellulose, to which is added the nitrate of barium and potassium and a very small percentage of calcium carbonate.

The proportion of these ingredients in case of the six-inch rapid firing gun is as follows:

Mixed nitro-cellulose (insoluble and soluble).....80 parts
Barium nitrate.....15 parts
Potassium nitrate..... 4 parts
Calcium carbonate..... 1 part

The mean nitration strength of the mixture must show 12.75 per cent. of nitrogen. The solvent used in making the powder consists of a mixture of

Ethylic ether (specific gravity 0.720) ..... 2 parts
Ethylic alcohol (95 per cent. absolute by volume)..... 1 part

This powder produces a little smoke and some bore deposit.

The United States, France and Russia use exclusively nitro-cellulose powders; while England, Italy, Sweden and Japan use powders consisting of a mixture of nitro-glycerin and nitro-cellulose. Germany, the only country which has studied these two powders systematically, uses the first mentioned in their small calibre guns, the last named in their large calibre guns.

In the case of the old gunpowder, the most dangerous manufacturing operation was incorporation. With the modern colloid propellants, the most dangerous operations are the chemical processes in the preparation of nitro-glycerin, the drying of guncotton, etc. After the gelatinized solvent has been added, all the mechanical operations can be conducted practically with perfect safety.

However, black powder, a mineral mixture, may be kept for centuries without any appreciable change in its chemical composition. But smokeless powders in time will decompose and if enough heat is accumulated by this decomposition, a spontaneous combustion with all its dangers may result. There are three factors which hasten this decomposition: Variations in the temperature, humidity and the presence of an excess of the solvent. To retard the decomposition, stabilisators, which absorb the vapors produced by the acids, are used. The one in general use is the German stabilisator, the "diphenylamine."

To conclude, let us cite once more the different explosives actually employed at the present time.

1. Mixtures, the ingredients of which may be non-explosives, (gunpowder and some chlorate compositions).

2. Compounds, used singly, as guncotton or nitro-glycerin (in the form of dynamite).

3. Picric acid (lyddite or melinite).

4. Mercury fulminate and other fulminates.

5. Combinations of some explosive compounds (cordite and the smokeless propellants in general use for military purposes).

6. Blasting and detonating or igniting compositions.

METHODS OF BLASTING.

Since the advent of black powder, the most common method of setting off a charge of this explosive was by the use of a fuze that was ignited and burned slowly so as to enable the workmen to retire to a safe distance before the explosion took place. Fuzes of this kind are still used for many purposes but electrical blasting is now recognized as the safest method.

In blasting a charge of black powder by means of a fuze it is only necessary to insert one end of the fuze into the charge and ignite the other end. However, with explosives that require detonation, it is necessary to fasten a blasting cap at one end of the fuze and insert it in the charge. In the latter case, when the spark of the fuze reaches the blasting cap, an explosion takes place which imparts the necessary shock or detonation to the charge which then deflagrates violently. Fuzes are obtained in many diversified brands for employment in different kinds of blasting. Fuzes may be

obtained for either dry or wet work and from fast to slow in action.

The many disadvantages of firing blasts by means of fuzes have caused the introduction of electric blasting in which an electric current fires the charge. For firing black powder or a similar explosive that requires heat to bring about the explosion, an electrical device known as the "electric squib" is employed. The electric squib consists of a heavy paper cap containing a charge of powder. When the electric current passes through the fine wire contained in the electric squib, a flame spouts out from one end, causing the main charge of powder to be ignited. For blasting by means of the high explosives such as dynamite, blasting gelatin and others requiring detonation, an electric fuze similar to that shown in one of the accompanying illustrations is employed. It consists of a shell of copper, A; a chamber containing the explosive charge, B; the insulated copper wires entering the cap, C; the bare ends of the copper wires, D, that project into the charge; the small platinum wire, E, or "bridge," soldered to and connecting the two ends of the copper wires, which is heated by the electric current; the composition plug holding the fuze wires firmly in place, F; and the filling material, G. When the electric current passes through such a fuze, the platinum wire becomes heated and ignites the charge which in turn explodes violently and imparts the necessary detonation to cause the explosion of the dynamite or other explosive.

The foregoing mentioned electric fuzes may be operated from any source of electric current, but the most popular method now in use is the employment of a small portable generator that can be operated by either pushing, pulling or turning a crank. This generator will furnish current to several electric fuzes at the same time so as to cause the simultaneous blasting of many bore holes at a time.

Aside from the electric fuzes previously mentioned which cause the explosion of the charge the moment the electric current is sent through them, there are other electric fuzes that will not explode the charge immediately. These are known as "delay electric fuzes."

Electro magnets are being installed by treasure hunting ships for the recovery of submerged hulls and their contents.

ELECTRICAL EQUIPMENT OF THE PANAMA CANAL

(*Continued from page 348*)

the lamps that illuminate the scales of indicators. The receivers, transmitters and lamps are operated at 110 volts, while the control circuits are 220 volts, both using 25-cycle alternating currents.

MECHANICAL INTERLOCKING SYSTEM

In order to make it necessary for the operator to maneuver the control switch handles always in a certain order, corresponding to a predetermined sequence of operation of the lock machinery, and to prevent the operator in control of one channel from interfering with the machinery under the jurisdiction of the operator controlling the other channel, these control switches are provided with interlocks. The interlocks are in two vertical racks under each edge of the board and some distance below, so that they may be inspected and oiled from a floor which is about seven feet below the floor on which the switchboard operator stands. The latter floor does not extend across under the board, this space being open so that all parts on the underside of the board are accessible from the floor below.

Vertical shafts operated by connecting rods from the control switch shafts extend downward past the electrical parts for the operation of the interlocks.

SPECIAL CLIMATIC REQUIREMENTS

To withstand the humid atmosphere of the isthmus, every insulated part, such as solenoid, relay, circuit breaker, and other coils, was impregnated with non-hygroscopic compounds. All small parts were made either of brass, copper, Monel metal, bronze, or of sherardized iron or steel. Mica and treated asbestos lumber were used largely in place of fibre or wood.

There is promise of a large turpentine industry in the west and southwest, the raw product being supplied by the resinous gum of western yellow pine.

When a man celebrates his birthday he takes a day off. When a woman experiences a similar happening she takes a year off—from her age.

Wireless Telegraph Contest

The Wireless Station and Laboratory contest is a regular monthly feature. The best photograph submitted each month is awarded a first prize of Three Dollars; second best, Two Dollars; third best, One Dollar.

The description of a station should not exceed 250 words. Write on one side of the paper only, using as many separate sheets as are necessary. Descriptions should be written in ink—not pencil. Typewritten descriptions using double spacing are preferable to any. It is advisable to send two prints of the photograph whenever possible—one toned dark and the other light—in order to permit of choosing the one best adapted for reproduction. Prints should be sharp and distinct.

This competition is open to all, irrespective of whether they are subscribers or not.

FIRST PRIZE

Herewith is a time exposure of my wireless station, which is the outcome of several years' work along this line.

My aerial is composed of four strands

WIRELESS STATION OF H. B. ELVERSON

of aluminum wire, each a hundred feet long, and about fifty feet from the ground

The transmitting set consists of a 1-inch spark coil, zinc gap, and a glass plate condenser. Power is furnished by either dry cells or a dynamo.

The receiving set comprises a loose coupler, silicon, and perikon detectors, fixed and variable condensers, H. C. 2,000-ohm receivers, and the usual buzzer test. A "United" type change-over switch is employed.

The instruments are all of my own construction with the exception of the receivers, spark coil, and dynamo.

In addition to the wireless set, I have other pieces of experimental electrical apparatus, including a small spark coil, Geissler tubes, two electric engines, five small motors, ammeter, magneto, bells, lamps, buzzers, a miniature telephone to a neighbor's, and a line telegraph which is part of a system that connects with six other amateurs within a radius of two blocks.—*Harold B. Elverson, Camden, N. J.*

SECOND PRIZE

I am presenting herewith a photograph of my wireless station which I wish to enter in the Wireless Contest.

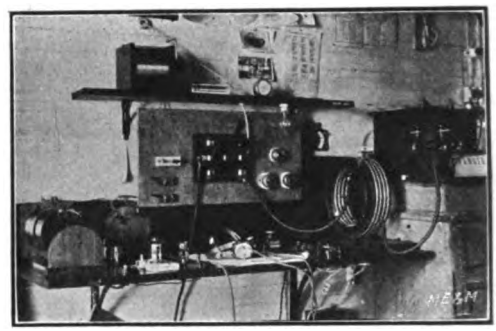
My station is situated at the foot of a large hill, but nevertheless I have had very good results, having heard NAR, and other stations nearly as far.

My aerial is about 100 feet long and 60 feet high, and is stretched between six-foot bamboo spreaders. I am using aluminum wire for my aerial at present, but hope to have a stranded phosphor bronze wire aerial before long.

My receiving set consists of the following: Loose-coupler, "Blitzen" variable condenser, galena and universal detector, and a pair of Brandes' Superior phones. I find galena very sensitive, but very difficult to keep in adjustment.

My sending apparatus consists of: A 5-kw. closed-core transformer, an os-

cillation transformer, a rotary spark gap, and a condenser of the glass plate type made from heavy tin foil and ordinary window glass. I use a high frequency



WIRELESS STATION OF WM. S. GRAVES

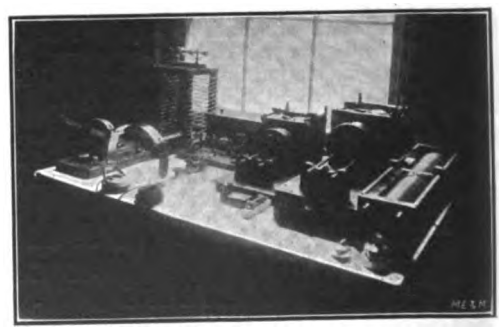
buzzer for sending around town. I made the buzzer from a description in a recent issue of MODERN ELECTRICS.—*Wm. S. Graves, Sunapee, N. H.*

THIRD PRIZE

The accompanying view shows the apparatus comprising my wireless station.

The sending set consists of a one-inch spark coil, a zinc spark gap with cooling flanges, a helix, glass-plate condenser, and a wireless key. I use an aerial and lightning switch.

For receiving I use a small and large loose-coupler in connection with a triple-pole switch, which allows me to use either loose-coupler I have a 2,000-



WIRELESS STATION OF I. WEINSTOCK

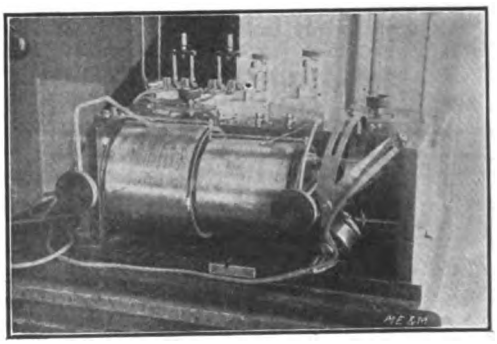
ohm set of Brandes' receivers, a fixed condenser, the usual buzzer test, and employ perikon, silicon, and galena detectors with the necessary switch. I use a

variable condenser in the base of the large loose-coupler, as well as a loading coil which has proven of great value in tuning. A fuse is placed in series with the aerial. My receiving range is about 2,000 miles at night. My aerial is 80 feet high, and 80 feet long, composed of six No. 14 aluminum wires. All instruments are finished in oak and are entirely made by me, with the exception of the coil and phones. I am a steady reader of MODERN ELECTRICS AND MECHANICS. which I enjoy immensely.—*Isadore Weinstock, Philadelphia, Pa.*

HONORABLE MENTION.

I submit herewith a photo of my wireless receiving set.

My aerial, of the inverted "L" type, is 66 feet high, 130 feet long, and consists



RECEIVING APPARATUS OF E. H. TERRILL.

of six No. 14 aluminum wires on 16 foot spreaders, each wire being continued nearly to the instruments.

The receiving instruments, mounted in a sort of cabinet form, consist of the following: Clapp-Eastham receiving transformer, two ferron detectors of the same make, one of which is used for galena, two 31-plate rotary variable, and one fixed condenser, 2,000-ohm Western Electric head set and buzzer test. Two "Blitzen" loading coils may be thrown in by the two double-pole switches seen on top, thereby permitting of tuning up to 5,000 metres.

Almost perfect insulation has been secured by mounting all instruments, with the exception of the receiving transformer, on the sheet of hard rubber seen just behind it.

The set is very efficient. I can get the Arlington time signals and weather reports on any clear night, and have also picked them up in day time. In addition, I hear quite a number of the stations around the Lakes, together with a number of those further east and northeast.

I am greatly indebted to MODERN ELECTRICS for my success, and am greatly pleased with it.—*E. H. Terrill, Vandalia, Mo.*

HONORABLE MENTION

I herewith submit a photograph of my radio station.

My aerial is of the inverted L type, and is 90 feet long and 45 feet in height. It is composed of 4 seven-strand copper wires on 10-foot spreaders.

The receiving set is mounted in a birch cabinet, and is composed of the

WIRELESS STATION OF CLARENCE GUNDERSON

following instruments: Loose coupler, 2 variable condensers, 1 fixed condenser, cat-whisker detector, and a pair of Brandes superior phones.

The wires of the receiving set do not come in contact with wood at any point, being mounted on hard rubber throughout.

I have found galena to be the best mineral for long distance work.

I can hear all the lake stations very clearly with this equipment.

The sending set consists of 2 Leyden jars, helix, gap, and a spark coil operated by storage batteries. This outfit is used to work with an amateur in this city, there being no other within a 40-mile radius.—*Clarence Gunderson, Albert Lea, Minn.*

Questions and Answers

Questions and queries pertaining to electrical and mechanical subjects and of general interest to all readers, will be answered in this department. Name and full address of the sender should accompany all inquiries. Questions that are not deemed by the editor to be of general interest, will not be published and no answers will be given by mail.

WAVE-LENGTH FORMULAE

(23) Charles Noble, Ind., asks:

Q. 1.—Does the tin coating on the wire detract from its value for wireless work?

A. 1.—Not appreciably.

Q. 2.—Please give me the formulae for calculating the wave-length of helixes and loose couplers.

A. 2.—If you are not familiar with mathematics to a wide extent you will have difficulty in attempting to calculate the total inductance of a loose coupler under its varying conditions. Fleming in "Principles of Electric Wave Telegraphy and Telephony" deals with this subject at some length. There are also several references in the form of Bulletins of the Bureau of Standards to which you might refer.

WAVE-LENGTHS.

(24) Walter A. Kilbury, Ohio, asks:

Q. 1.—Does the Arlington wireless station send out its time signals by exact Greenwich time of its longitude, or by Eastern Standard time? At what wave-length?

A. 1.—The Government station at Radio, Va., sends out the time signals at noon and ten o'clock in the evening by Eastern Standard time. A 2500 meter wave-length is used.

Q. 2.—If a loose-coupled receiving station employs only one variable condenser, is it preferable to shunt it across the primary or the secondary of the receiving transformer when receiving long wave-lengths?

A. 2.—This would depend on the construction of the loose-coupler. For most types it is preferable to put the condenser across the secondary because it is an easy matter to add a series loading coil to increase the wave-length of the primary. On long wave-lengths it is not usually necessary to use the condenser as a means of tuning out interference.

Q. 3.—In estimating the natural wave-length of an aerial as by the chart in the January issue, what must be allowed for the lengths of the aerial and ground lead-ins, where they are more than absolutely necessary?

A. 3.—The chart is made so as to include the length of the lead-ins. This will introduce a slight error for variable lengths.

DIRECT CURRENT DYNAMO.

(25) W. M. S., Brantford, Ont.:

Q. 1.—He has a laminated field structure 5 inches in outside diameter, 1¾ inches thick, with two poles. Armature has six round holes each ⅝ inch in diameter. He asks what winding should be used to give an output of six volts and three amperes, at a speed of 1,250 revolutions.

A. 1.—While such laminated structures are entirely acceptable for motors, they are really too good for generators, for they retain no "residual" magnetism, therefore fail to start. If you will make some thin iron castings of the same shape as the sheets, and clamp the sheets between them, you will avoid the trouble. You will probably have to leave the armature core the same length as at present. If you have insufficient room for the cast iron plates for the field magnet, leave out some of the sheets. Of course the machine will always generate if the field magnet is separately excited, and if you are to charge batteries, you can first start the machine as a motor, or leaving off one of the brushes, get the field excited from the battery before closing the armature circuit.

Q. 2.—What is the best way to wind the armature? Field is to be a shunt.

A. 2.—A diagram is really not so clear as directions. Wind slots 1 and 4 half full of wire, passing half of the turns on one side of the shaft, the rest on the other side. Leave out a loop, twisting it close up to the armature core, and without cutting the wire, wind a similar core in slots 2 and 5; leave out a second loop, and wind in slots 3 and 6; leave out a third loop, and wind a coil in slots 4 and 1—directly on top of the wires already there; this coil will provide a fourth loop, and coils and slots 5 and 2, and 6 and 3 will provide two more, the last being formed by twisting together the very beginning and end of the entire winding. The six loops are to be soldered into the six commutator segments. No. 20 wire will be a good size to use on armature, No. 23 on field, as much as you can get on. As for the other questions you ask—about the rectifier—you should address the dealers.

POLARITY OF COMPASS NEEDLE.

(26) Edward Grieb, Ohio, asks:

Q. 1.—If two north poles repel each other, how, then, is the north pole of a compass needle attracted by the north pole of the earth?

A. 1.—There is often much misunderstanding on this subject by the incorrect name of the end of the compass needles. The so-called north pole of the needle should be called the north seeking pole of the needle. With respect to what is usually considered north magnetic pole of the earth the end of the compass needle pointing in that direction may be considered to act as a south pole and accordingly points north. It is far better to use the more accurate term of north seeking pole and so avoid all chance for confusion.

Q. 2.—In the L type aerial, is the one in which the outer end is connected together as good as one where the outer end is open?

A. 2.—There is very little difference in these two types, but practise seems to favor the open end.

SAYVILLE RADIO STATION.

(27) Marquis Bryant, New York, asks:

Q. 1.—What does Sayville mean when he sends the letters NR 1 before each radiogram? Sometimes he sends other numbers besides 1.

A. 1.—This is the number of the message. The NR is the abbreviation for number and the numeral that follows is the message number.

Q. 2.—What does Sayville mean when before sending the press dispatches he says: "S. P. NR 1. To Debeg ships only"?

A. 2.—This is the number of the press dispatch and the words that follow limit the stations who may copy the dispatch and make it public. If this limitation were not used, any station could use the dispatch. Amateurs would do well to note this heading of the dispatch, for some day someone may wake up to the fact that he is liable to a fine of $250 for publishing some news item he copies from Sayville.

Q. 3.—Where can I obtain a copy of the book on Wireless written by Commander Robinson?

A. 3.—You can obtain a copy direct from the United States Naval Institute, Annapolis, Md., by remitting $1.50. The correct title of the work is "Manual of Wireless Telegraphy," by Commander S. S. Robinson, U. S. N.

ALTERNATING CURRENT MOTOR.

(28) J. F. H., Olive, Cal.:

Q. 1.—Sends a sketch of a small machine, and asks certain questions as to the winding that will enable it to operate on a 110-volt circuit. The field magnet is to be of cast iron.

A. 1.—Solid iron, whether cast or wrought, is entirely unsuitable for use in alternating current machinery. The structure must be of thin sheet iron, and the sheets reasonably well separated by use of asphaltum varnish or tissue paper. Solid iron results in the production of very large eddy currents, which means not merely a waste of power, but a ruin of the insulation by scorching. The dimensions you have shown are about those

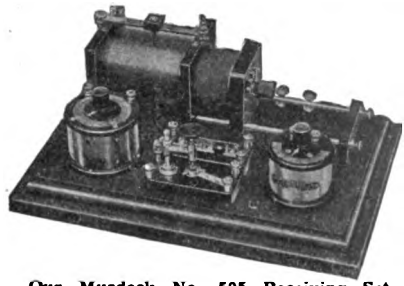
(*Continued on page 386*)

OK! LISTEN!

IN GOLD

TO THIS MAGAZINE that will take the pains to read and following conditions.

we fail to make good on such an unusual offer at 100 cents on the dollar, and we therefore ask your indulgence to read the conditions of this amazing offer and see if you are entitled to $5.00 in gold.



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5. To any subscriber to this magazine that will conscientiously write us and show that our catalog does not contain 4/5 of all the first-class dependable wireless instruments advertised in the January number of this magazine, WE WILL GLADLY GIVE $5.00 IN GOLD.

6. To any subscriber to this magazine that will conscientiously write us and show that in any other three catalogs published (and this means the three best catalogs after ours) he can purchase a greater variety of first-class instruments and accessories than are found in our catalog, WE WILL GLADLY GIVE $5.00 IN GOLD.

7. This proposition is most cheerfully open to all our competitors.

Secure This $5.00 in Gold Mean?

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Fifth. As a necessary corollary to what we say in No. 4, our catalog is, therefore, a Beacon Light and Guide to the inexperienced in wireless as to what is best to purchase. Our justly earned reputation for selling only such instruments that we can unqualifiedly guarantee, insures our patrons a square deal.

Sixth. It also necessarily follows from No. 4 and No. 5 that *transportation charges are greatly reduced* and *prompt service obtained* by purchasing your wireless instruments from the only concern that can in practically every case satisfy all your wants.

Seventh. All our wireless instruments and electrical goods, with the exception of our high power sets and special instruments, *are sold on approval*, we allowing our patrons to be the sole and absolute judges as to whether or not they have received exactly what they expected to receive. This proposition is printed on the inside cover of every catalog.

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The New Compressed Air Spark Gap. Increases the efficiency of any spark coil or transformer from 50% to 90%. Sold on a money back guarantee. Read the article in the January number of MODERN ELECTRICS concerning this wonderful instrument.

(*Continued from page 382*)

given for Watson's ¼ horsepower direct current motor, but even if you made the field magnet of a stack of sheet iron in place of castings, you would fail to get a satisfactory operation on alternating currents—the sparking would be furious. The series of articles on alternating current motors now appearing in this magazine will explain the proper construction of quite a variety of machines.

Q. 2.—Can a magneto generator be used as a motor on direct current supply?

A. 2.—The magnetos you describe have regular direct current windings with numerous commutator segments, and should operate well as direct current motors. Possibly your failure has been due to defects in the winding, or perhaps the brushes are not in the right position. They should touch segments that connect with coils lying midway between the poles.

TENSILE STRENGTH.

(29) F. J. S., Worcester, Mass., asks for:

Q. 1.—Data as to the values for wood, rope and iron.

A. 1.—For California redwood and white pine, the tensile strength is about 7,000 pounds per square inch of section when with the grain, and about 500 pounds across the grain. White oak has values of 10,000 and 2,000, respectively. A Manila rope ¾-inch in diameter will break at a pull of 4,000 pounds, a 1-inch rope at 7,150, a 2-inch rope at 28,600. Wrought iron has a strength lying between 47,000 and 62,000 pounds per square inch of section.

SOLENOIDS.

(30) W. J. S., St. Louis, Mo.:

Q. 1.—Asks for directions for making two such appliances for operating in combination with a float valve to give automatic control to a pump motor.

A. 1.—As we do not know the exact sizes of the parts you already have on hand, we cannot as yet propose any specific dimensions. In general, the two solenoids would have quite different characteristics, for one is to work through only a short distance and with small pull, the other, for a long distance. We would suggest that you procure a copy of Underhill's book on "The Electromagnet." It gives a good many illustrative calculations for such coils.

ELECTRIC AUTO HORN.

(31) Charles S. Martin, Virginia, asks:

Q. 1.—I have on my automobile an electric auto horn which I am operating from a five-cell storage battery. I would like to change over and put it on the magneto used for the spark plugs. Can I do this by putting resistance in series with the magnets of the horn?

A. 1.—If the magneto is a high tension one, as it appears to be from your letter, it will not be possible to operate the horn from the magneto. The magneto would not deliver sufficient current for this purpose, and in addition, the voltage is far too high to be running around on a push button circuit to the horn.

TRANSFORMER EFFICIENCY.

(32) H. M. Read, Texas, asks:

Q. 1.—I have been informed that an open core transformer takes about half of the power to transmit a mile that a closed core does. Why is this, because I always thought that the closed core type was the more efficient?

A. 1.—There seems to be some peculiar features about the operation of open core transformers which are not entirely clear. In general the closed core is the more efficient type, and for transmitting long distances less power is required for the closed core than for an open core to cover the same range. Where spark-coils are used over short distances many records have been made which could hardly be even approached by a closed core transformer of the same power consumption. The figures on the subject vary widely and there is great doubt why this reversal should occur. In general, about 10 watts per mile is allowed. This is, of course, a very variable figure and at the best is only a rough approximation.

MOTOR LOAD.

(33) G. M., Elgin, Ill., asks:

Q. 1.—Would a series wound fan motor, operated on a 110-volt circuit, be injured by holding it from rotating, the current being kept on?

A. 1.—It certainly would burn out. While it is true that such small motors have a high internal resistance, thereby making them to some extent "fool-proof," there would be sufficient heat produced to destroy the insulation in a few minutes. When a motor rotates, a counter electromotive force is set up, and it is by this action that the current is kept to a proper value. If you hold the armature, or even if loaded to an undue amount, the counter electromotive force is thereby annulled or reduced, and ruinous currents will flow Even in motors of ½ h.p., the c.e.m.f. is likely to be 90 per cent. of the applied, and in larger machines still higher. It is the difference between the applied and the counter e.m.fs. that determine the motor current. In the case of the fan motor you have very inefficient conditions, and even if running free, it will get very hot. If you remove the fan and substitute a pulley, and try to drive some machinery, although you use no more current, the motor may burn out, for in the absence of the usual cooling action of the fan, the internal temperature will be much greater.

ELECTRICITY ON PLANTS.

(34) Emil J. Stiber, Chicago, asks:

Q. 1.—Will you please tell me how electricity is applied to plants to make them grow?

A. 1.—This subject is very much in the experimental stage and there is relatively little published on the subject. We would suggest that you write to the Bureau of Agriculture and see if they have any publications on the subject. The publications will be sent free or for a very small charge. The method of using the electricity is to use a very high potential and frequency and obtain a brush discharge along wires erected over the plants.

WATER HEATER

(35) Thomas Slattery, Chicago, asks:

Q. 1.—How can I make an electric water heater which can be used to heat the water in a bath tub?

A. 1.—This is a very practical problem, especially if the fire in the regular heater is out, but it is not solved as easily as one would like to have it. Because of the high specific heat of water it will take a very large amount of energy to heat the water. At least a consumption rate of 10 kilowatts would be necessary to heat sufficient water in half an hour. In addition to this the heater should be in a water tight receptacle, and yet capable of readily radiating its heat. If you desire such a heating device we would recommend that you correspond with the Simplex Electric Heating Co., at Cambridge, Mass.

TUNING COIL.

(36) Orville Drake, Indiana, asks:

Q. 1.—What are the best proportions of the length to diameter of a single slide tuning coil?

A. 1.—It is considered good practice to have the length about four times the diameter.

Q. 2.—Would number 18 S. C. C. copper wire be a good size to wind such a coil with?

A. 2.—Yes, it would do very well. It would be better if you could use bare wire.

Q. 3.—What is the best mineral to use for a detector?

A. 3.—For a long time it was considered that the combination known as perikon was the best, but later results have shown that galena using a fine wire for the contact is superior to perikon.

IMPROVING THE CONDITION OF EMPLOYEES

It is gratifying to note the increasing number of firms that are sharing the profits of the business with their employees. A few years ago such an action would have been very uncommon, but to-day there are many firms that grant annual bonuses to their employees. In fact, it is a sign of the times—a forerunner of an era of better understanding between Capital and Labor.

Although the business transacted by the L. S. Starrett Company of Athol, Mass., suffered a depression during the latter part of the past year, due to the general poor business conditions, the firm again declared a bonus of 2 per cent. to each employee of the total wages paid him during the past year. The firm also granted a similar dividend in December of 1912.

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WOULD LIKE TO EXCHANGE A BRAND NEW 1913 Reading Standard bicycle with coaster brake and non-skid tires, double trust frame; good as new; spring saddle, all complete, for a 1 kw. transformer or ½ kw. transformer with rotary or rotary quenched spark gap. J. G. Le Clair, 40 Irving St., Worcester, Mass.

"CONSTRUCTION OF INDUCTION COILS AND Transformers" is a valuable book, containing 100 pages and 72 illustrations, by H. W. Secor. You cannot afford to be without this book, which is the latest work on construction of induction coils and transformers. $0.25 postpaid. Modern Publishing Co., 231 Fulton St., New York City.

WILL EXCHANGE A 12-PLATE STORAGE battery, 6 v., 60 a.; one camera, No. 2 Brownie; one 20-ohm sounder; one snap switch, and a lot of cardboard tubes and rough stock. Want a typewriter or motorcycle, parts of any kind, or make me an offer. Charles Brown, 125 Bergen St., Brooklyn, N. Y.

SIXTEEN POUNDS NO. 20 SINGLE COTTON-covered copper wire, in two eight-pound coils. Will exchange whole or part for variable condensers, audion, antennium or stranded aerial wire, a. c. motor, a. c. voltmeter or a. c. ammeter—the latter preferred. Also have coarser wire and about 30 lbs. transformer iron. B. R. Mackey, 311 East Lancaster Ave., Wayne, Pa.

WILL EXCHANGE ½ KW. TRANSFORMER FOR a loose coupler; also other instruments. What have you? F. W. Henvis, 336 East Broad St., Richmond, Va.

I HAVE TWO BICYCLES AND A BUGLE with calls to exchange for a 2½-inch spark coil, helix, loose coupler, variable and fixed condensers, or any other wireless instruments. The bicycles are worth $20. Charles R. Green, 14th and Pebble Sts., Fremont, Neb.

WILL EXCHANGE A GOOD PUNCHING BAG and 100A switch blade and jaws for a rotary variable condenser, pair of 100 ohm phones or other receiving apparatus. Write, describing instruments, to D. H. Baker, 707 Monterey St., East Bakersfield, Cal.

WANTED IN EXCHANGE FOR A ½ KW. transformer coil: one pair Brandes "Superior" 2000 ohm phones and an electrolytic detector. Carroll M. Dunlop, Manchester, Iowa.

FOR EXCHANGE—LOOSE COUPLER, LOADING coil, perikon detector, 2000 ohm phones with double head bands, 2 Midget fixed condensers and 10 volt, 60 ampere storage battery. Want variable condenser and audion instruments. Charles Cohn, 203 Hart St., Brooklyn, N. Y.

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HAVE FOR EXCHANGE: FIXED CONdenser, 50c; potentiometer $1.25; tuner, $2; battery motor, $1.25; a few pieces of galena; 4 ohm telegraph outfit, $1.75; Scientific American Reference Book, $1.50. What have you in the wireless line? Prefer one-inch spark coil. Kenneth Bailey, Southington, Conn.

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WILL EXCHANGE FOR A MURDOCK PERIkon detector, Brandes head phones, Clapp-Eastham loose coupler, or any other instrument of quality, the following: Marlin repeater, 22 caliber; one set of "Encyclopedia Telegraphy and Telephony," and one Collins' Wireless Telephone Inductance System. Address all communicatons to John Hoff, 604 Communipaw Ave., Jersey City, N. J.

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TO EXCHANGE—ONE 150-OHM RELAY, LEGless key, one-wire switchboard, one desk telephone, two transmitters, two receivers, eight 2 m.f. condensers, one home-made loose coupler, a 5-inch Geissler tube, a 6-volt motor, a small sending and receiving wireless outfit, a 6-inch, 4-jawed independent chuck, and a brass 3-chime whistle for air or steam. Want ¼ Blitzen transformer, Blitzen rotary receiving transformer, or alternating current motors 1-30 to 1-4, 110-60 cycle, or small gasoline engine, or what have you. C. I. Ways, 10 Hanover St., Cumberland,, Md.

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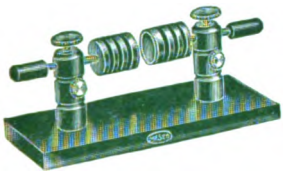

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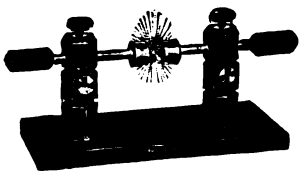

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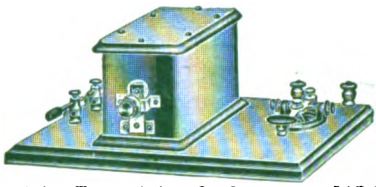

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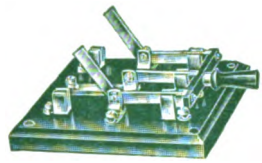

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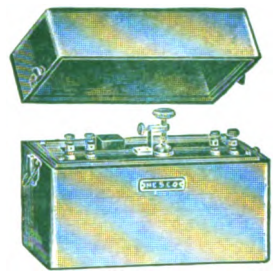

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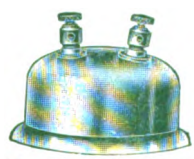

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The Postal Life Insurance Company was organized that same year to help work out this very reform.

It has accomplished its part by demonstrating that the business of life insurance can be done **direct;** it has thus transacted business successfully for **more than eight years;** it does not employ agents at all but **gives its policyholders the benefit of the saving thus effected.**

THE FIRST YEAR, policyholders receive a **guaranteed commission-dividend** corresponding to what other companies pay their agents, less a moderate advertising charge.

This dividend ranges up to

40%

of the premium on whole-life policies

In **subsequent years** policyholders can deduct the **entire agents' renewal commission of 7½% and an office-expense saving of 2%,** making up the

Annual dividend of

9½%

guaranteed in the policy

AND, IN ADDITION, the Postal pays, **every year after the first,** the usual **contingent dividends** earned by the policy.

Agents, of course, find it hard to compete with the Postal; they fight it and get certain easily-influenced insurance periodicals to help them.

The public is therefore warned not to take the word of any such agents or to believe the "framed-up" articles that may appear in such periodicals.

The Postal Life is a highly-accredited institution and enjoys the confidence of the well-informed insuring public throughout the country.

POSTAL LIFE BUILDING

Write and find out the exact sum the Company will save *you* at your age on any standard form of contract—Whole-Life, Limited-Payment Life, Endowment, Joint-Life or a Monthly-Income Policy.

Call at the Company's office if convenient, or write for full official information. Simply say:

Mail me insurance-particulars as per advertisement in

MODERN ELECTRICS & MECHANICS for March

In your letter be sure to give:

1. **Your full name.**
2. **Your occupation.**
3. **The exact date of your birth.**

No agent will be sent to visit you: the benefit of his commission goes to you because you deal **direct.**

STRONG POSTAL POINTS

First: *Standard policy reserves,* now nearly $10,000,000. *Insurance in force nearly* $50,000,000.

Second: *Old-line legal reserve insurance*—not fraternal or assessment.

Third: *Standard policy provisions,* approved by the State Insurance Department.

Fourth: Operates under *strict State requirements* and subject to the United States postal authorities.

Fifth: *High medical standards* in the selection of risks.

Sixth: *Policyholders' Health Bureau* arranges one free medical examination each year, if desired.

Postal Life Insurance Company

WM. R. MALONE, President

35 Nassau Street NEW YORK