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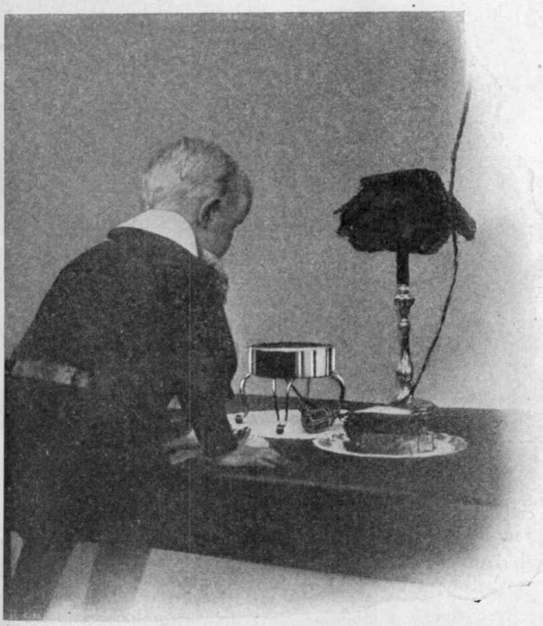

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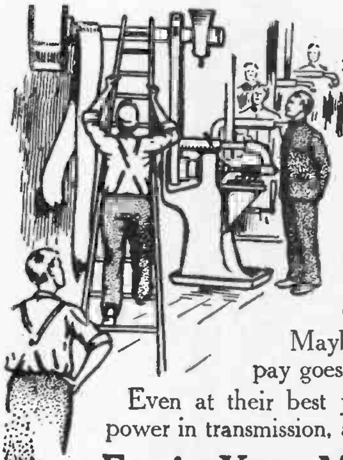

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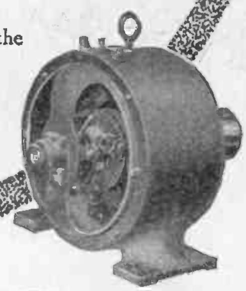

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IN PLAIN ENGLISH

HENRY WALTER YOUNG, Editor

Vol. II — JANUARY, 1910 — No. 9

CONTENTS

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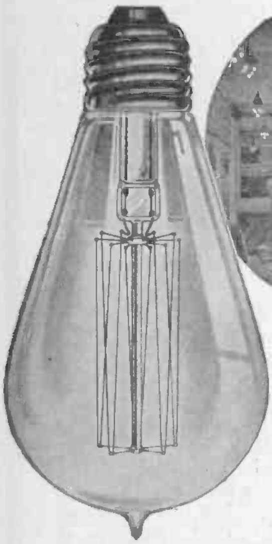

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14 Draws Trade
15 Helps Advertise
16 Signifies Success
17 White Light
18 Steady Light
19 Always Ready
20 Makes Home Attractive
21 Welcomes Friends
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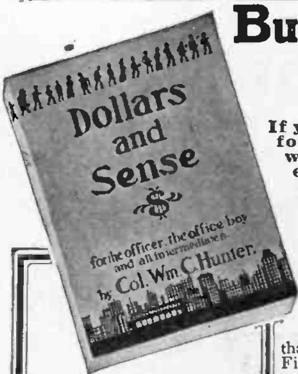

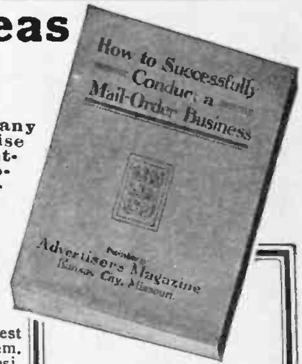

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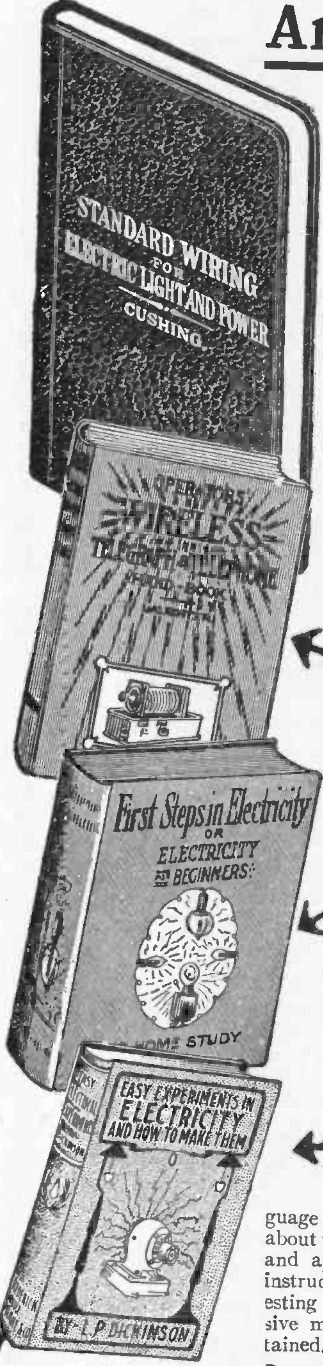

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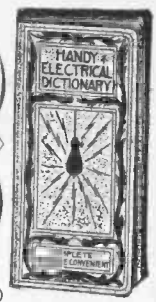

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A VERY GOOD IMITATION OF MOONLIGHT PRODUCED ON THE STAGE BY THE FORTUNY SYSTEM

POPULAR
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VOL. II JANUARY 1910 No. 9

How Daylight and Moonlight Are Imitated

By DR. ALFRED GRADENWITZ

The crude simplicity of stage decoration at the time of Shakespeare has been gradually superseded by an ever increasing wealth of decorative details tending more and more to produce a perfect illusion of reality. In stage lighting perhaps the greatest difficulty has been encountered in the simulation of daylight. Ordinary daylight, so far from striking the objects from one side only, is, in fact, dispersed in the air so as to illuminate everything almost uniformly from all sides, except where submitted to the direct rays of the sun. This could obviously be imitated only approximately, even by an illumination coming from a large number of conveniently distributed electric incandescent lamps.

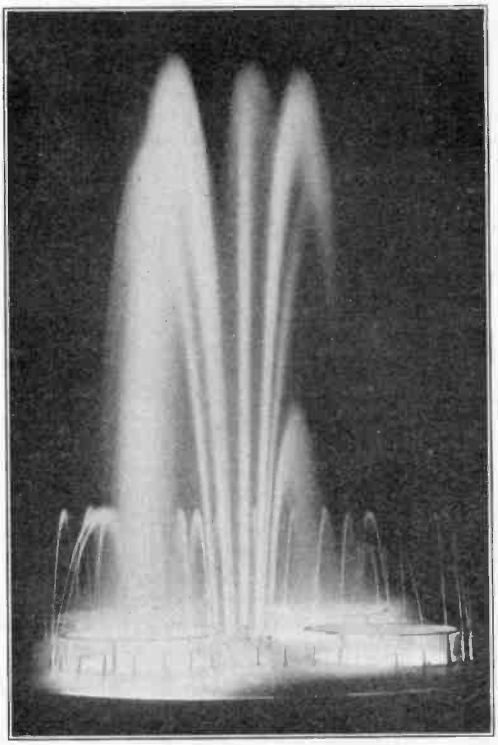
A system recently invented by a Spanish engineer, Mariano Fortuny, is able to produce a practically perfect illusion of natural daylight by avoiding any marked shadows as effected by direct lighting, the rays of white electric arcs being thrown on sheets of silk susceptible of being moved to and fro on rollers, from which they are reflected as real dispersed light. The Fortuny system also comprises a half hemispherical sky lined with white cloth, which is an excellent substitute for painted skies ordinarily used. The diffused white arc light, in fact, is caught in the vault of this artificial sky so as to fill it up with a soft brilliant mist, producing the illusion of a white unlimited expanse. Any decoration objects set up under this vault therefore are uniformly lighted as by real daylight.

In order to fill up the artificial sky with colored light, strips of colored cloth instead of white are carried over the rollers, while in certain cases, when specially powerful color effects are desired, colored glass disks are placed in front of the arc lamps.

Another invention, due to the same engineer, allows the painted clouds so far in use—which during the performance must be kept quite immovable—or the clouds made up from special sheets of cloth carried along over the sky, to be replaced by perfectly natural plastic mist formations. These marvels of theatrical engineering are produced by mirrors with painted-on clouds which are exposed to arc light radiation. By conveniently turning these mirrors the clouds are made slowly to move over the sky. In connection with colored silk strips, this arrangement allows quite unexpected effects and metamorphoses to be produced. Thunderstorms can, for instance, be imitated with startling faithfulness, to be followed up immediately by moonlight nights, the charm of which is reproduced only imperfectly in the picture shown in the frontispiece. The first stage lighting plant on this system was recently erected at the New Royal Opera House, at Berlin, where the picture was taken.

Apart from its artistic perfection, this lighting system far exceeds the old method also from an economical point of view; in fact, photometrical tests have shown the light intensity in the case of the Fortuny system to be five times higher than that of direct lighting, the same amount of current energy being expended. Furthermore, there is a considerable saving in decoration pieces as the arrangement above described allows an infinite variety of effects to be produced immediately.

The operator is comfortably seated in a small cabin in the amphitheatre, so as to have a perfect view of the stage. From this cabin he controls and regulates, merely by means of electrically operated switches, all those various cloud pictures, cloth sheets, colored disks, and other accessories.



AN ELECTRICALLY OPERATED LUMINOUS FOUNTAIN

Another interesting lighting effect is here reproduced, showing a powerful electrically operated luminous fountain in the most recent palatial hotel building at Berlin, lighted up from underneath by four 50-ampere arc lamp projectors.

What Five More Years Will See

B. E. Blanchard, electrical inspector for the Chicago Board of Fire Underwriters, predicted, in a recent address before the members of that organization, that the next five years would see the majority of modern homes equipped with electrical household appliances. He stated, furthermore, that contractors are more and more coming to specify electrical appliances as a means of preventing fires.

Killing Moths in Vineyards

United States Consul William Bardel reports that various experiments have been made recently near the French city of Rheims for discovering the most effective methods of destroying the moths of the pyralid and the cochylis, which insects are so harmful to the vineyards. The plan is as follows:

The best results have been attained by electric-light traps. The trap consists of a portable post holding a five-candle electric lamp with an enameled reflector, from which, attached to three thin metal chains about eight inches long, is suspended a round tin plate dish of about 15 inches in diameter. The dish contains water with a top layer of petroleum.

During the first test the traps were placed in three rows running parallel at a distance of about 200 feet, the distance between each lamp being about 75 feet. On the first clear evening late in July the lights were turned on about 8 o'clock and remained burning until an hour or so after midnight. Soon after the lights were burning the moths commenced to swarm toward them and were rapidly killed, either by the fumes of the coal oil or by the coal oil itself. The same operation was resumed the next clear night, only the lamps of the two outside rows were placed about 25 feet closer to those of the center row, and this was repeated in each of five subsequent clear nights, so as finally to bring the three rows within about 50 feet of each other. During the succeeding six or seven clear nights the movement was reversed in the same manner, so as finally to return the lamps to their position of the first night. As to the position of the lamps, numerous experiments were made during these trials, and it has been proved that those which were placed so that the petroleum dish was elevated only a few inches above the ground were more effective in killing the moths than those placed higher.

These experiments were witnessed by representatives from a number of leading champagne makers, and this method proved so successful that it is highly recommended to all wine growers who can avail themselves of the services of electricity for this work.

Telephone Exchange in Chinatown

One of the most unique telephone exchanges in the world is located in the Chinese quarter of San Francisco. The Oriental style of architecture has been adhered to in every detail. The roof is built with three pagodas following the design of palaces seen in China.

In the interior, materials similar to those used in China were employed. The woodwork is in rough cut material finished in ebony, the walls being paneled with glazed tile. The decorations are brought out in highly colored fresco harmonizing perfectly with the dark woodwork of booths and switchboard. Public offices and operators' quarters are provided. The telephone equipment is of the latest type and the switchboard is designed to take care of 3,500 telephone stations.

TELEPHONE EXCHANGE IN CHINATOWN

The office is under the management of Mr. Loo Kum Shu, an American-born Chinese, whose efficiency and fidelity to telephone interests are demonstrated by his constant association with the company for the last ten years. He is assisted by one chief operator and a corps of Chinese young ladies who handle the business of nearly 800 subscribers.

Chicago Electrical Show

Chicago sets the pace for electrical expositions. Since this great manufacturing and distributing center inaugurated its first electrical show five years ago New York has given two, Boston has just held one, San Francisco is preparing for its first, Omaha has given two in years past, and several of the smaller cities throughout the country have given expositions in proportion in size and scope to their importance in the world electrical. Chicago's show has always been a leader—always a big success from every standpoint. Preparations are now well under way for its fifth annual exposition which will take place as usual in the Coliseum from January 15 to January 29.

Electrical invention and development is moving with such marvelous strides, working out such wonders, that the field gives an opportunity for display of greater interest, of more novelty, of things that are new and worth seeing, than is offered by almost any other trade or industry of enough importance to be reflected in a show. This year's display will be no exception to the rule.

It will show everything that the hand of invention has created or improved upon for the industrial world, for lighting and heating, for the office and the household. Wireless telegraphy and telephony will be featured and the housekeeper will be shown the thousand and one things electrical that today contribute to the adornment, the comfort, the convenience and the sanitation of the home.

One hundred leading manufacturers, jobbers, light and power corporations, electrical engineers, and others of the allied trades have already contracted for space in the January show. One of the startling features of this annual exposition has always been the decorative scheme, and it is understood that the plans for the coming show are more brilliant, beautiful and novel than anything ever disclosed in the big Coliseum building.

It is the aim of the management to make these annual shows educational for the general public and at the same time assemble displays which will have a tendency to directly interest men in all lines of industry in the advantages of motor driven machinery and the use of electricity in home and business life.

Elementary Electricity

By PROF. EDWIN J. HOUSTON, PH. D. (Princeton)

CHAPTER XXI.—ELECTRO-MAGNETS—CONTINUED

In accordance with his hypothesis that the magnetism of permanent or steel magnets is due to the presence of minute electric currents flowing through closed circuits within the molecules, Ampere constructed a solenoid coil, such as shown in Fig. 135 in Chapter XX. He had then practically invented what might be regarded as an electro-magnet; that is, a magnet produced entirely by the passage of an electric current. As we have seen such a magnet would have an aeric magnetic circuit, or a circuit in which the magnetic flux passes through air only.

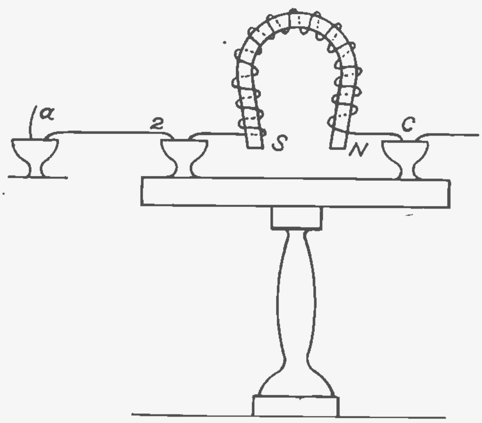


FIG. 137. STURGEON'S ELECTRO-MAGNET

But an aeric magnet does not begin to compare in strength with an aero-ferric magnet, since the amount of flux added by the aligned or structural magneto-motive-force is much greater than that of the prime magneto-motive-force of the magnetizing current. It has been generally agreed, therefore, to limit the term electro-magnet to a magnet with a circuit in which the flux passes both through air and iron, that is, a magnet of the aero-ferric type.

It was only necessary to introduce a soft iron core into the solenoidal coil of the preceding figure to convert it into an electro-magnet. While it might not seem to require much actual invention to effect this combination yet a marked difference exists in the two devices, since in one the strength of the magnetism is generally feeble, while in the other it is strong.

The invention of the electro-magnet was made in 1825 by an Englishman, Sturgeon. This predecessor of the electro-magnet took the form represented in Fig. 137. It consisted of a core of soft iron in the shape of a horseshoe and was provided with a single layer of insulated wire wrapped around it as shown. As we shall shortly see, Sturgeon's magnet, like all electro-magnets; i. e., magnets containing cores of soft iron, possessed the valuable property of almost instantly acquiring its magnetism on the passage of the magnetizing current and almost instantly losing it on the cessation of that current.

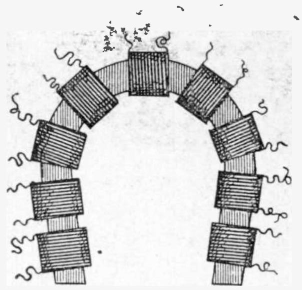


FIG. 138. HENRY'S EARLY FORM OF HORSESHOE MAGNET

Sturgeon's electro-magnet was greatly improved in 1828, by Henry, an American, who produced the form represented in Fig. 138. Here, a number of separate magnetizing coils, in this case nine, were placed as shown on a horseshoe-shaped core of soft iron. As will be seen, the ends of the separate magnetizing coils were not permanently connected. Henry had recognized the ease with which an electro-magnet might be employed for transmitting power to a distance. In Henry's time the only available source of electric current of any considerable strength was the voltaic battery. He, therefore, conceived the idea of constructing an electro-magnet in such a manner that he could readily obtain variations in the strength of the current passing through the magnetizing coils by so connecting them as to alter their resistance; for, as already explained, if these coils were arranged in multiple or multiple-series their resistance would be less than when arranged in series or in series-multiple. Consequently, by such arrangement, he could vary the current passing and, therefore, the strength of the electro-magnet.

It is no longer necessary to divide the magnetizing coil into a number of separate coils so as to readily vary the strength of current passing through them. Electric currents are now generally obtained from dynamo-electric machines, or from the mains employed for incandescent lighting. In either case, it is simpler to alter the current strength by connecting the circuit to the mains and varying its resistance, by the introduction of a variable resistance or rheostat.

Electro-magnets for laboratory or lecture purposes, however, are still made with separate windings so as readily to illustrate the effects produced by varying the strength of the magnetizing current as well as by varying position of the magnetizing coils on the cores.

The most valuable property of an electro-magnet is the rapidity with which it becomes magnetized on the passage of the magnetizing current and loses its magnetization on the breaking of the circuit. While it is true that where the cores of electro-magnets as well as their armatures consist of large masses of soft iron, residual magnetism occurs; yet, electro-magnets, when properly constructed, are promptly magnetized and demagnetized on the making and the breaking of the circuit respectively.

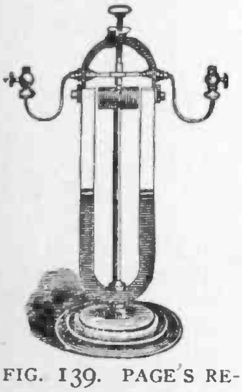


FIG. 139. PAGE'S REVOLVING ELECTRO-MAGNET

Some idea can be formed of the number of times it is possible to magnetize and demagnetize an electro-magnet by studying an old form of apparatus known as Page's revolving electro-magnet, a soft iron wrapped with magnetizing coils, and mounted on a vertical axis, so as to be capable of rotating between the poles of a permanent horseshoe magnet as shown in Fig. 139. When a battery current is connected with the positive and negative binding posts the current passes through the magnetizing coils when, as shown in the figure, they are in a position at right angles to the two permanent magnet poles. The electro-magnet is magnetized and is attracted or drawn towards the poles of the permanent magnet. When the electro-magnet assumes the position shown in the figure the magnetizing circuit is automatically opened. The momentum of the moving coil carries it past this position when two contact springs, resting against the contact pieces on the vertical axis, again complete the circuit. In this way a rapid motion of rotation is given to the electro-magnet. So great is the rapidity with which it is possible to magnetize and demagnetize the movable electro-magnet that it is set into rotation at a rate requiring 4,000 changes or reversals of polarity per minute.

It is upon this peculiarity of the electro-magnet that its value as an electro-receptive device so largely depends. The fact that an electro-magnet placed in any different part of a circuit that may be many hundreds of miles in length instantly acquires magnetism on the completion of the circuit by the closing of a distant key, and instantly loses this magnetism on the opening of the circuit, renders it possible to obtain motions of various kinds by the movement of an armature.

It is in this way that the operation of the electro-magnetic telegraph is made possible. In a similar way the operation of the electric bell, the electro-magnetic annunciator, the burglar alarm, indicator, etc., is obtained. So, too, the operation of the speaking telephone is due to the to-and-fro movements of a magnetized diaphragm under the influence of the electric currents that pass through the magnetizing coils. Their strengths are caused to vary by the sound waves of the speakers' voices falling on the diaphragm of a transmitting instrument.

Electric motors, another important class of instruments, depend for their operation on the rapidity with which the magnetic flux produced in magnetizing coils or electro-magnets can be made to appear or disappear. The electro-magnets employed in them are made in various forms.

An electro-magnet best fitted for some of the above electro-receptive devices would be less suited for others. It will be well, therefore, briefly to describe some of the different forms that have been given in practice to electro-magnets.

The simplest form of electro-magnet consists of a straight core of soft iron wrapped with a single magnetizing coil. In this form, if the direction of the winding remains the same throughout the coil, the polarity of the ends of the straight bar will be north and south respectively. As to which of these ends will be north and which south will depend on the direction of the winding. In a straight bar electro-magnet of this type the amount of leakage flux is great, since the magnetic circuit outside of the core consists of so great a length of air path. Moreover, such a magnet possesses the disadvantages of its poles being so far apart, that it is difficult to ensure the action of more than one of the poles on a receptive device.

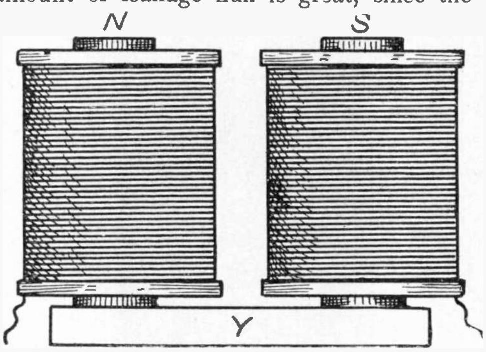


FIG. 140. FORM OF HORSE-SHOE ELECTRO-MAGNET USED IN TELEGRAPHY

It is because of the difficulty above referred to that the long straight core magnet is seldom employed, being generally bent in a U-shape or horseshoe form. Since, however, some difficulty exists in winding separate coils on the two legs the plan is generally adopted of employing two straight core magnets, slipping the coils on them separately and then connecting one set of ends of the cores with a mass of soft iron known as a yoke.

The above form of construction of electro-magnet is very common in the horseshoe magnets employed for telegraphic apparatus generally. Here, as shown in Fig. 140, the two magnetic cores are connected at one set of ends by a heavy yoke or a bar of soft iron (Y) brought into close contact, thus leaving an air gap only between the two free poles or ends (N) and (S).

In a horseshoe magnet of the above type, care must be taken so to connect the separate magnetizing coils on the two legs or branches that the direction of winding shall continue the same throughout. In other words the connection must be just as if the two separate cores were placed in a straight line, end to end, and wound continuously in the same direction, until all the wire is in place. One of the free ends of the magnet will possess north polarity and the other south polarity. The flux will pass continuously from the north pole (N), through the air-gap between (N) and (S), or through the armature that is generally provided for this part of the circuit; then, entering at the south pole, it passes through the core of (S), yoke (Y) and core of (N).

Instead of wrapping the magnetizing coil directly on the core, it is found more convenient in practice to wind the coil on an insulating spool of hard rubber, fibre or wood and afterwards slip the spool on the core. In this case a rim or edge is provided at each end of the spool, or hollow cylinder, so as to keep the coils in place.

A certain length of the core of the electro-magnet is left unwound for convenience of permitting the armature to move towards or from the poles under the respective influence of the magnetic attraction and the opposite attraction of a spring or weight.

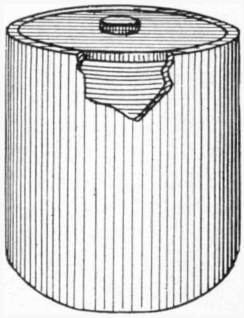


FIG. 141. IRON-CLAD ELECTRO-MAGNET

Another method of bringing the opposite ends of a straight bar electro-magnet near each other, and thus decreasing the magnetic leakage, is found in an ingenious device known as the iron-clad magnet. Here, as shown in Fig. 141, one of the poles of a straight core magnet is brought near the opposite pole by a casing of soft iron placed outside the magnetizing coils and extending, as shown, to the extremity of one end of the spool on which the magnetizing coil is wound. In order to do this, it is, of course, necessary that the opposite pole be brought into firm magnetic connection with a piece

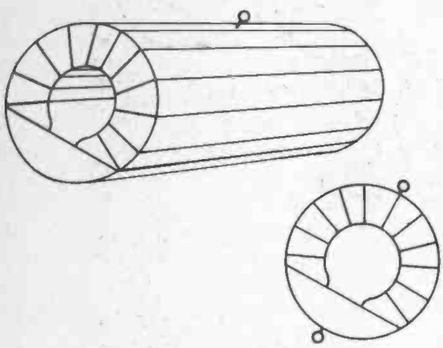


FIG. 142. JOULE'S CYLINDRICAL HORSESHOE MAGNET.

of soft iron connected with the end of the soft iron cylinder.

A variety of electro-magnet known as Jules' cylindrical horseshoe magnet is shown in Fig. 142. It consists of an electromagnet whose core has the shape of a cylinder. A gap has been formed in the cylinder by cutting a portion away as shown. This gap is then provided with an armature shaped at its upper surface so as to come into intimate contact with the polar surfaces, and its lower ends have the general cylindrical shape of the magnet.

Jules' cylindrical horseshoe magnet is difficult to wind. It possesses, however, the advantage of a great extent of polar surface that is brought into contact with the opposing surfaces of the armature.

Electro-magnets can be divided into two general classes, according to whether the work they are designed to perform is to carry a considerable weight by exerting considerable pull on their armatures, or to exert a magnetic attraction or repulsion over a considerable distance. Magnets of the first type are known as attractive magnets, and those of the second, as portative magnets.

It can be shown that the amount of attraction a magnet exerts on its armature depends:

(1) On the area of the attractive surfaces and,

(2) On the quantity or intensity of the magnetic flux that passes through them.

These attractive surfaces or areas are called polar areas. If the magnetic intensity is equal throughout the entire area, then by doubling the polar area there will be a doubling of the attracting force. If besides this we double the amount of magnetic flux passing through the surface we increase the attractive force four-fold. In other words, the attractive force between two polar surfaces increases directly as the surfaces, and as the square of the magnetic intensity at these surfaces.

Examining Jules' horseshoe cylindrical magnet again, it will be seen that it has a great extent of polar surfaces and therefore should possess considerable portative power.

Another form of electro-magnet, known as the zig-zag electro-magnet, consists as represented in Fig. 142. Here, a number

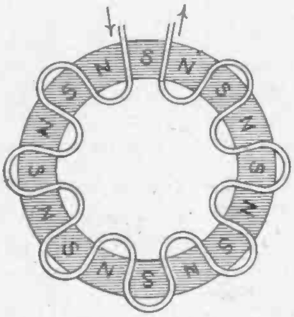


FIG. 143. ZIG-ZAG ELECTRO-MAGNET

of projections forming a part of a ring-shaped core, are wound with a magnetizing wire in the manner shown. Since this wire constantly changes its direction, when an electric current is sent through it, in the direction indicated by the large arrows, the projections acquire alternately north and south polarity as marked.

Since the strength of an electro-magnet depends on the quantity of magnetizing flux, and the quantity of magnetizing flux on the number of ampere-turns, in order to produce powerful electro-magnets it is only necessary to place a great number of windings on a sufficiently large mass of soft iron and send a powerful current through them.

A very large electro-magnet was constructed some years ago at the United States Torpedo Station at Willett's Point, Long Island Sound. The core of this magnet consisted of a sixteen-foot cannon, weighing approximately 50,000 pounds. The cannon was wrapped with a huge magnetizing coil

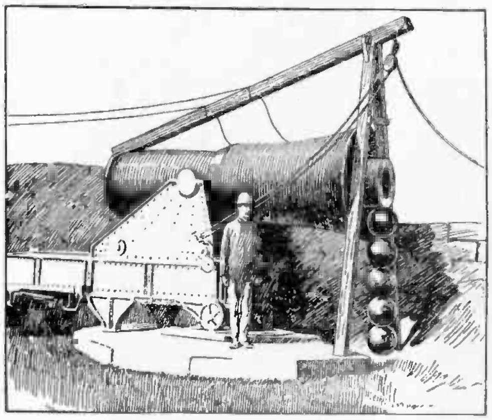


FIG. 144. CANNON MADE INTO AN ELECTRO-MAGNET

consisting of ten miles of insulated copper wire. This coil had 5,250 turns, so that when a magnetizing current of twenty-one amperes was sent through it, it produced an M. M. F. of 21x5250=110,250 ampere-turns.

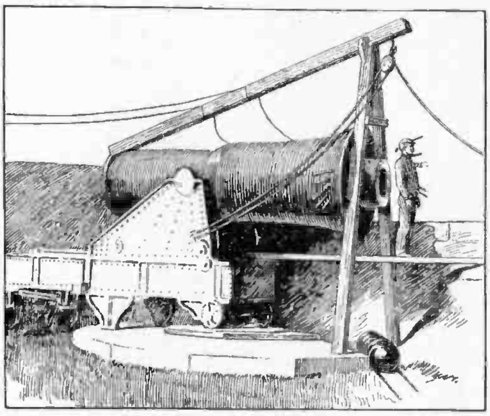


FIG. 145. THE MAGNETIC FLUX PASSED THROUGH THE MAN'S BODY

Under the powerful flux thus produced magnetic effects of an exceedingly striking character were obtained. The gun exerted a magnetic attraction at a distance of seventy feet from its poles equal to that of the magnetic attraction of the earth. It was capable, as shown in Fig. 143, of holding a chain of five cannon balls each of which weighed 230 pounds.

When a soldier was placed in front of the pole, the flux passed through his body in sufficient amount to hold in place heavy spikes of iron, as shown in Fig. 145 on this page.

Powerful electro-magnets are now employed for loading and unloading mag-

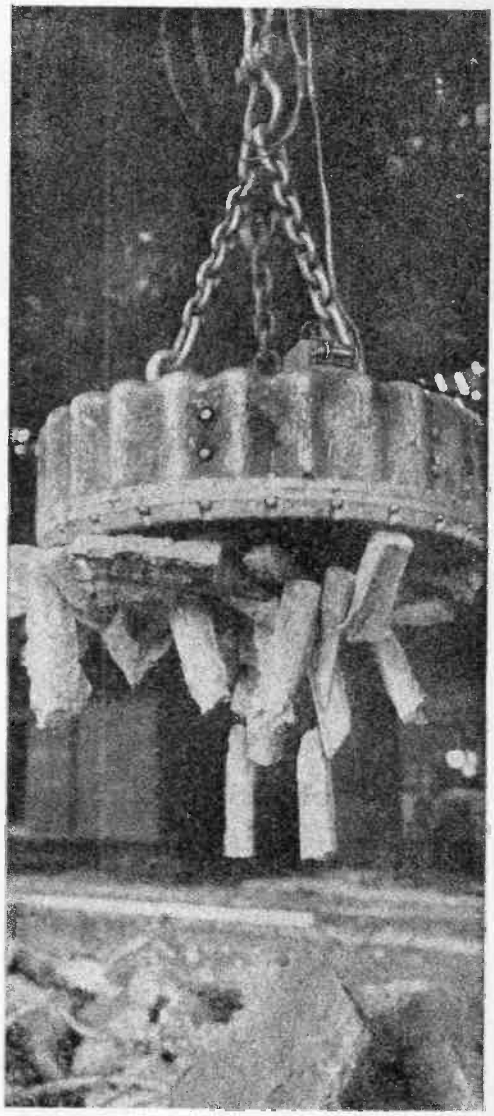


FIG. 146. ELECTRO-MAGNET LIFTING PIG IRON

netizable material, such as pig iron, scrap tin, bundles of iron wire, etc.

By the use of magnets of this character the cost of loading and unloading is considerably decreased.

Fig. 146 shows a magnet of this type employed in lifting pieces of pig iron.

(To be continued.)

The Latest in Telephone Systems

A distinctly new type of telephone system, which partakes of some of the features of both the ordinary manual system, with its girl operators, and the automatic system, which does not require a human operator, is the "Automanual" system. Ashtabula, Ohio, has the distinction of being served by the first commercial exchange equipment of the automanual type. This equipment has been in operation six months.

In the automanual system all cords and plugs have been dispensed with at the telephone switchboard, the only piece of apparatus in the operating room being a desk equipped with keys having much the appearance of an adding machine.

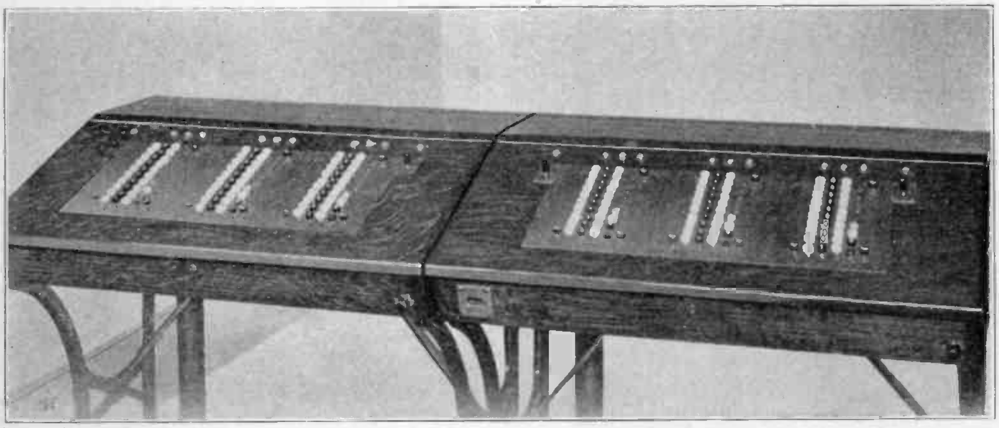
ALL CORDS AND PLUGS ARE DISPENSED WITH

All calls received are indicated upon this desk by the lighting of a lamp. The operator by depressing a button is connected to the calling subscriber's line. The number of the party wanted is ascertained from the calling subscriber and this number is set up on the keys, a starting button is pressed and the call is handled from then on by automatic switching equipment. The operator's key set is immediately released and it is impossible for the operator to go in on the line after the call is once set up. This insures secret service.

In an exchange of sufficient size where it is necessary to employ a number of operators, any call coming into the exchange is immediately placed before an operator who is not busy, so that all calls are answered and handled promptly.

The connection during the conversation is under the control of the calling subscriber. After the conversation is completed all switches are restored to normal position by the act of hanging up the receiver.

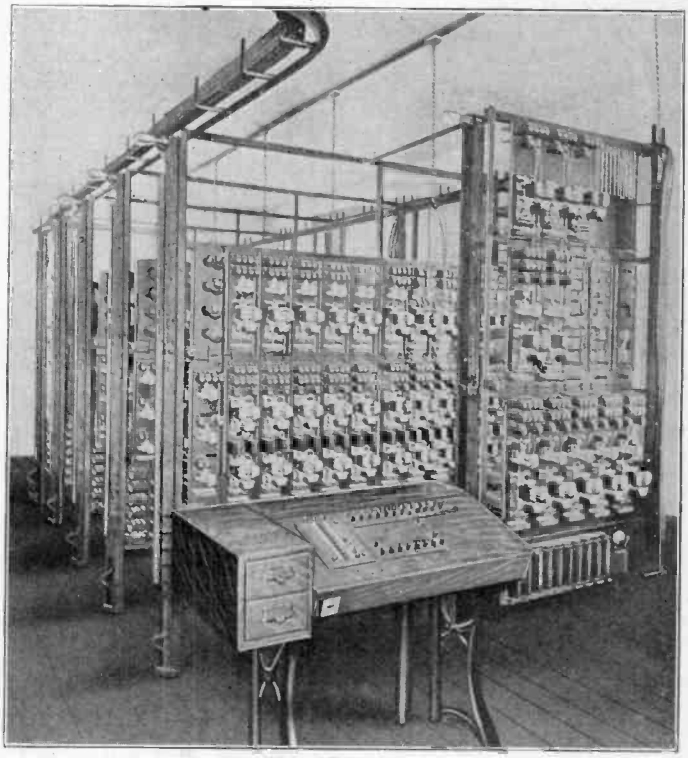
The telephone at the subscriber's station is a simple telephone of the common battery



THE DESK OF THE AUTOMANUAL IS EQUIPPED WITH KEYS AND LOOKS LIKE AN ADDING MACHINE type. A call for the exchange is indicated by the act of removing the receiver from the hook and the number desired is spoken into the transmitter in the usual manner.

The chief advantages of the system are prompt and accurate secret service, and the small number of operators required. With the automanual system one operator will handle as many calls as can be handled by five or six where the manual system is employed.

In this system it is not necessary that the operators be located in close proximity to the switches. A large city installation can be divided into many branch switching stations and the operators can be located at but one point and accomplish all interconnections with the same rapidity as could be done if the switches themselves were located at one point.



THE AUTOMANUAL SWITCHING EQUIPMENT

The electric impulses which actuate the switches originate from what is called the "sending machine," which, when a call is made, delivers impulses corresponding in number to the keys depressed by the operator. One sending machine is sufficient for an entire exchange.

After much experimental work every previously known condition to be encountered in actual practice has been provided for in the automanual system, and it goes one step further, for the automanual operator never knows the source of a call and is obliged to treat all subscribers alike.

First Municipal Electric Plant

Wabash, Indiana, boasts of being the first town to adopt electric light for general illumination. A beginning was made on March 31, 1880, when four of the old Brush arc lamps of 3,000 candlepower each were suspended on the flagstaff of the Court House. A seven horsepower dynamo supplied the electricity and the contract called for a light equal to a gas burner at a distance of 2640 feet from the lamps.

All Energy Comes From the Sun

The ancient fire worshipers were not so far out of the way, for they worshiped the visible source of all energy which keeps us alive here on earth. All plant growth is dependent upon the rays of the sun, and it is upon plants and plant eating animals that we depend for the food fuel which keeps our bodily engines going. For fuel to produce heat and mechanical energy we again depend upon vegetation either of today or in ages past, the latter stored up in the earth in the form of coal. Wind power is simply another manifestation of the energy of the sun, which by unequal heating of the air strata causes different densities, and the winds are the result—nature re-establishing an equilibrium. Water power we have in plenty, but every drop of water which ever flowed over a water wheel was first evaporated by the rays of the sun, and condensed to clouds and then rain in the upper regions of the atmosphere.

Largest Self-Cooling Transformer Ever Built

A transformer, as, perhaps, all the readers of POPULAR ELECTRICITY may not know, is a device for raising or lowering the voltage or pressure of alternating current. Fundamentally it consists of two coils of insulated wire wound around an iron core, the coils being thoroughly insulated from each other. One of these coils has a great many turns of wire while the other has comparatively few turns. If alternating current of a given voltage is sent through the coil having few turns there is generated in the other coil, though the two do not come in contact with each other, a current of less volume, but of higher voltage, the voltage in this secondary coil being of the same ratio to that impressed upon primary coil as the number of turns of wire in the secondary is to the number of turns in the primary coil. This is known as a "step-up" transformer. A step-up transformer is usually located at the power station to step up the pressure or voltage of the current generated by the dynamos so that it may be forced through the long transmission line of small wires.

THE LARGEST SELF-COOLING TRANSFORMER

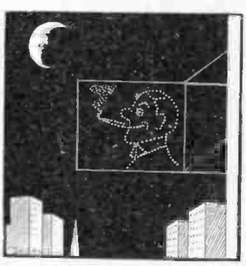
At the distant end of the transmission line is a substation in which is located a similar transformer only in this case the transmission wires terminate in the winding of many turns, which then becomes the primary and current of a low voltage is taken from the coil of few turns which in this case is the secondary. The transformer is then known as a "step-down" transformer and it gives from its secondary winding current of a voltage sufficiently low to be safe for the consumer to use, or at least low enough to be carried to small transformers on the electric light poles or in factories, etc., where it is again stepped down in pressure till it is suitable for use in lighting lamps and running motors.

In the picture herewith is shown the largest self-cooled transformer ever built. It steps down 100,000 volt current to a voltage suitable for distribution. Its coils are capable of continuously transforming an amount of energy equal to over 1,000 horsepower. In making the transformation a great deal of heat is developed in the transformer which must be dissipated in some way, in order that the transformer windings may not be injured. This is what the vertical pipes are for—to present a large radiating surface to the air in order that the heat may be absorbed by the surrounding atmosphere. At the same time they add stiffness and strength to the cast iron casing which encloses the coils.

The city of the future may not be horseless but the great business of the warehouses, merchants, manufacturers and wholesalers will be transacted on electric trucks and most of the pleasure vehicles will be driven by electricity; the work will be done by electricity; we will be kept warm in winter and cool in summer by electricity and nearly everything in this life of work or pleasure will be owing in a measure to electricity.

Talks With The Judge

"Just look at those electric signs!" exclaimed the Judge. "Talk about Art! If there is any mechanical or electrical means by which an effect can be produced which you might designate by that dignified title, the electric sign is it. I have walked up and down this street hundreds of times in the evening and I have seen the flags of all nations waving in the breeze, fountains playing in every color of the rainbow, human figures performing all sorts of stunts, skyrockets, smoking cigars, steaming cups of coffee, popping bottles of Budweiser, men playing billiards and women beating rugs. Why, there is hardly anything that you can name that we haven't seen worked out in these wonderful, restless signs. I know every bit of it is done by electric lights—but how? That's what gets me. If you can give me a little insight into their operation and how they got those effects I will be thankful."


Almost Human

"We'll have to acknowledge that they're almost human, Judge. But, after all, they are most of them but modifications of one or more of a comparatively few schemes or systems."

"Now-a-days the electric sign wizard gets an order something like this: 'Sign 18 by 25 feet—Chef mixing dough made from XXYZ flour—alternately grinning and sober—figure on and off six times per minute, alternating with company name in red.' The sign wizard, by the way, is a specialist. There are only two or three of him of note in the country and the most noted of any, who produces some of the brightest and most scintilating effects, is named Dull.

"As I said the sign wizard gets a very peculiar order, perhaps accompanied by a crude sketch to show the idea to be brought out in lamps. The chances are that the idea may be worked out by one of a series of standard types of sign flashers with a few modifications as to details; and this brings us to the flasher—a little machine which is at the bottom of all the marvelous sign effects which we see.

"The main types of sign flashers are known as 'Single pole,' 'Carbon,' 'Chaser,' 'Series,' 'Flag,' 'High speed,' 'Lightning,' 'Script breaker' and 'Combination.'

"When you see a sign which spells out a word, one letter at a time, it is operated by a single pole machine, which is nothing more than a number of switches which are raised

The Electric Sign Wizard gets Very Peculiar Orders

and lowered by a series of cams on a revolving shaft. This shaft is run by an electric motor, and the cam-operated switches close the circuits to the lamps comprising each letter in the proper sequence to spell out the word.

"When you see a sign flash first on one side and then on the other, the letters all coming on at once, it is a 'Carbon' type of flasher that does the work. The circuits leading to all of the letters on each side of the sign are opened and closed by very large motor-operated switches having carbon contacts. The reason carbon contacts are used is because each switch carries a large volume of current, owing to the many lamps on the circuit, and the ordinary small knife switch would be burned or fused by the arc which would be formed on opening the switch sud-

When a Sign Spells Out One Letter at a Time denly. In case the sign is very large it is not practicable to open the circuit at one point, even with carbon contact switches, so the 'Series' system is employed. This system is so arranged that a number of switches open the circuit at different points simultaneously.

"Sometimes you see signs in which the lights chase themselves around a border with an undulating motion like a snake. These are operated by the 'Chaser' type of flasher. In this case individual wires must be run to all of the lamps in the border. The flashing machine as it revolves closes switches which keep a certain number of lamps on all the time. If this number is 10, say, as the switch for the eleventh is closed the switch for the first is opened. Reduce the number to one or two and the lamps will give the appearance of a flea hopping about.

"One of the most beautiful sign effects is that of a waving flag or pennant. This effect is produced by the 'Flag' flasher, quite similar to the 'Chaser' or snake machine. The flag or pennant is, of course, done in regularly arranged rows of lamps. The vertical rows of lamps are caused to light and go out in succession across the flag, folds of darkness running down through it. This is what gives the waving effect. The folds nearest the pole or staff are short and thick, becoming attenuated as they near the outer end.

"The most spectacular effects, such as revolving wheels, fountains, falling water, smoke, etc., are produced by the 'High speed' machine. It is built much like the single pole machine only it must go much more rapidly, the switches making and breaking the circuit sometimes as high as 250 times a minute. A slowly rising cloud of smoke from the end of a cigar will not require over 100 breaks a minute, while a stream squirting from a seltzer bottle will require 250.

"The 'Script breaker' gives the appearance of a script sign being written out, one lamp at a time—an invisible hand writing the name in fire. It is a machine nearly like the single pole and chaser machine.

"Lightning is made by a special flasher which is required to give rapid progressive motion across the sign. The same device is also used to illustrate such things as shooting a billiard ball across a table, throwing bombs into the air, etc. It is similar to the chaser and runs at very high speed.

"Combination machines embody two or more of the previously described machines and by their use almost any effect desired may be obtained."

A New Departure in Electric Cars

Although no trolley pole and wires are visible and there is no "third-rail," the car which you see in the picture is nevertheless an electric car—but one which secures its power in a very peculiar manner. Mounted

A NEW DEPARTURE IN ELECTRIC CARS

out of sight between the axles is an enclosed gas engine which is not, however, connected mechanically with the driving axles. Instead it drives a dynamo which in turn furnishes current for the motors which are connected to the axles in the usual manner. The gas engine can thus be made to run at constant speed regardless of the speed of the car, which is the most efficient mode of operation.

This car has been constructed for the Third Avenue Railway Company of New York. It resembles in general appearance the short cars on many of our smaller city railways.

Early Lamp Filaments

Among the first carbon filaments prepared by Mr. Edison for electric lamps was one made of a thread enveloped in a paste of lampblack and tar and carbonized at a high temperature. This carbonized thread, though far from satisfactory, gave sufficient encouragement to warrant further investigation in the same direction. This resulted in the trial of a number of other substances and it was determined upon, for a time, that the best of all was paper, plain paper without lampblack or other applications. Bristol board was used in the making of these paper filaments.

X-Rays In Dentistry

Whereas X-rays have found so many valuable applications in medicine, the manifold possibilities opened up to the dentist by the use of these wonderful radiations have been only recently appreciated. In fact, Roentgen rays afford a most welcome means of exact examination, allowing the condition of the teeth and jaw to be ascertained more quickly, safely and accurately than by any other process, so that even the most minute alterations in this condition can be detected without any difficulty. Fractures of the jaw, and all kinds of inflammatory processes can be investigated in every detail, and borings, fillings, bridges and regulations in the position of teeth are readily checked by means of X-ray pictures. The most valuable results may, finally, be expected from examining infantile teeth, ascertaining the position of permanent teeth in relation to the milk teeth, and any anomalies during the changing of teeth.

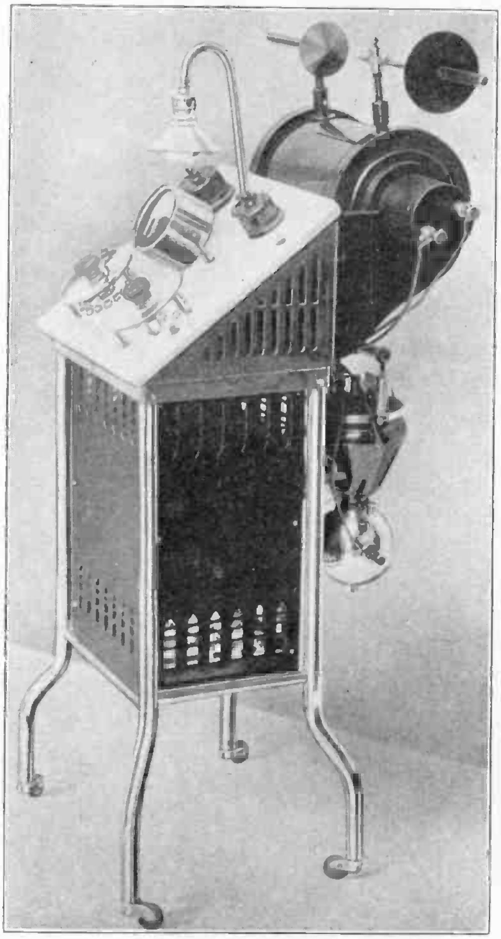


FIG. I. X-RAY OUTFIT FOR DENTISTS

X-rays, it will be remembered, are generated by means of high-tension electric currents led into an exhausted glass bulb containing convenient electrodes. These high-tension currents are produced by an induction coil.

The working of the induction coil is controlled by adjustable resistances, as well as by adapting the interrupter to the conditions of the case. A new German outfit used in this connection is represented in Fig. 1. It is designed either as a wall switchboard or as portable cabinet.

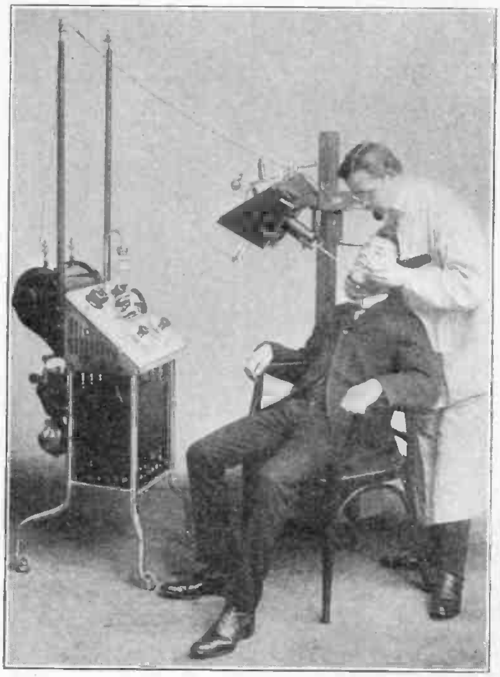


FIG. 2. X-RAY DENTAL OUTFIT IN USE

The X-ray bulb as shown in Fig. 2 is connected to the terminals of the induction coil. As a current of sufficient tension is passed through the bulb, there are produced inside the latter, what are called cathode rays. These cathode rays, which consist of negatively charged minute particles moving at an enormous speed, possess the faculty of heating any solid object struck by them, the greater part of them being converted into Roentgen or X-rays. Now, these Roentgen rays are known to traverse solid bodies, according to their atomic weight and thickness, more or less freely (e. g., flesh better than bone), and to exert strong chemical effects, so as to act on the photographic plate. They also cause certain salts, such as barium-platinum-cyanide, to become more or less intensely luminous, according to the more or less strong absorption they undergo on their way. On the photographic action is based the process of radiography and, on the luminosity of salts, the use of Roentgen rays for examining the human body by projection of the image on a luminous screen.

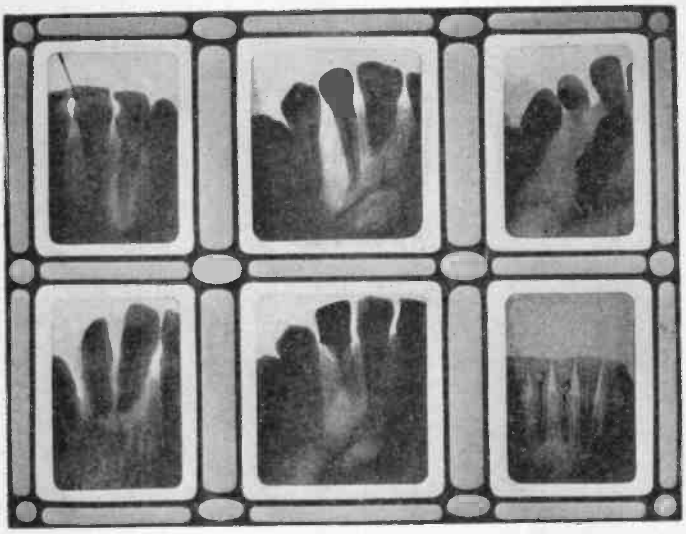


FIG. 3. X-RAY PICTURES OF TEETH

For the purposes of dentistry, the photographic records are the more important and these can be taken without darkening the room. Some specimens of diagrams showing various affections of the teeth are represented in Fig. 3.

The penetrating power of X-rays is tested by means of an apparatus containing a lump of wax of about the same permeability as the muscular parts surrounding the jaw. The degree of vacuum is gauged by means of a "radiometer," comprising a strip of thin sheet metal and a wedge-shaped aluminum block arranged in proximity to it.

A most important point in using X-rays in dentistry is to provide a convenient diaphragm which may eliminate any secondary rays.

This outfit, as represented in Fig. 2 is carried on a support allowing of a vertical and horizontal adjustment, which is very important in taking teeth radiographs.

Brazil Thrives on Electric Power

Many of the industrial establishments in Brazil, notably those in and around Rio de Janeiro, are rapidly changing to electric power, as a result of the development of hydro-electric energy from a river near Rio de Janeiro. There are similar notable establishments near Sao Paulo, and to some extent near Bahia. The availability of this power is gradually working a revolution in present industrial establishments, changing them from small power, often purely hand work, to modern power establishments.

The availability of electricity also is doing away with the general power problem, which has always been in the way of industrial development in Brazil. Power from fuel in Brazil has always been expensive. The country has no coal deposits worthy of the name, or able to compete with imported fuel, and imported fuel after a 7,000-mile haul is costly. Transportation and other elements added to the high cost of fuel have prevented that measure of industrial development in the country which might naturally have been expected as a result of its own local demand for products which are of ordinary manufacturing possibility in this country. With the advent of electricity much of this unfavorable condition is modified. The matters of transportation, raw materials, and cheap and efficient labor are yet to be disposed of, but some of these problems are gradually being solved.

"In The Beginning"

By JOSEPH E. HINDS

Statement of facts in Mr Hinds article is substantially correct.

Thomas A Edison

Mr. Hinds is one of the few men who were on the spot when the first incandescent electric lighting plant in all the world was put into operation on a commercial basis. It was through his youthful enthusiasm that he induced Mr. Edison to grant to his firm the privilege of the first practical demonstration. Twenty-nine years have now passed since the wheels of this plant first turned and few of its parts are still in existence. It is therefore Mr. Hinds' desire that permanent record be made of the details of this plant and the incidents connected with its installation and early operation, and it is with pleasure that we here print his narrative word for word as he has written it, which was his express desire.—Editorial Note.

Very naturally we all take the world as we find it and in this age of wonders the aeroplane excites no more surprise, probably not as much, as did Fulton's clumsy boat lumbering up the Hudson a hundred years ago. We turn to a little instrument on our desk and talk to our friends miles away. We have yesterday's news from the remotest parts of the earth with our morning coffee. We look at the pictured movements of things that happened months ago in far-away lands and think only of the interest which the action excites. We touch a button in the wall and a hall or a room or a whole house is flooded with a brilliant, pleasant light or in an instant a section of a city is brought from midnight darkness into almost midday glow.

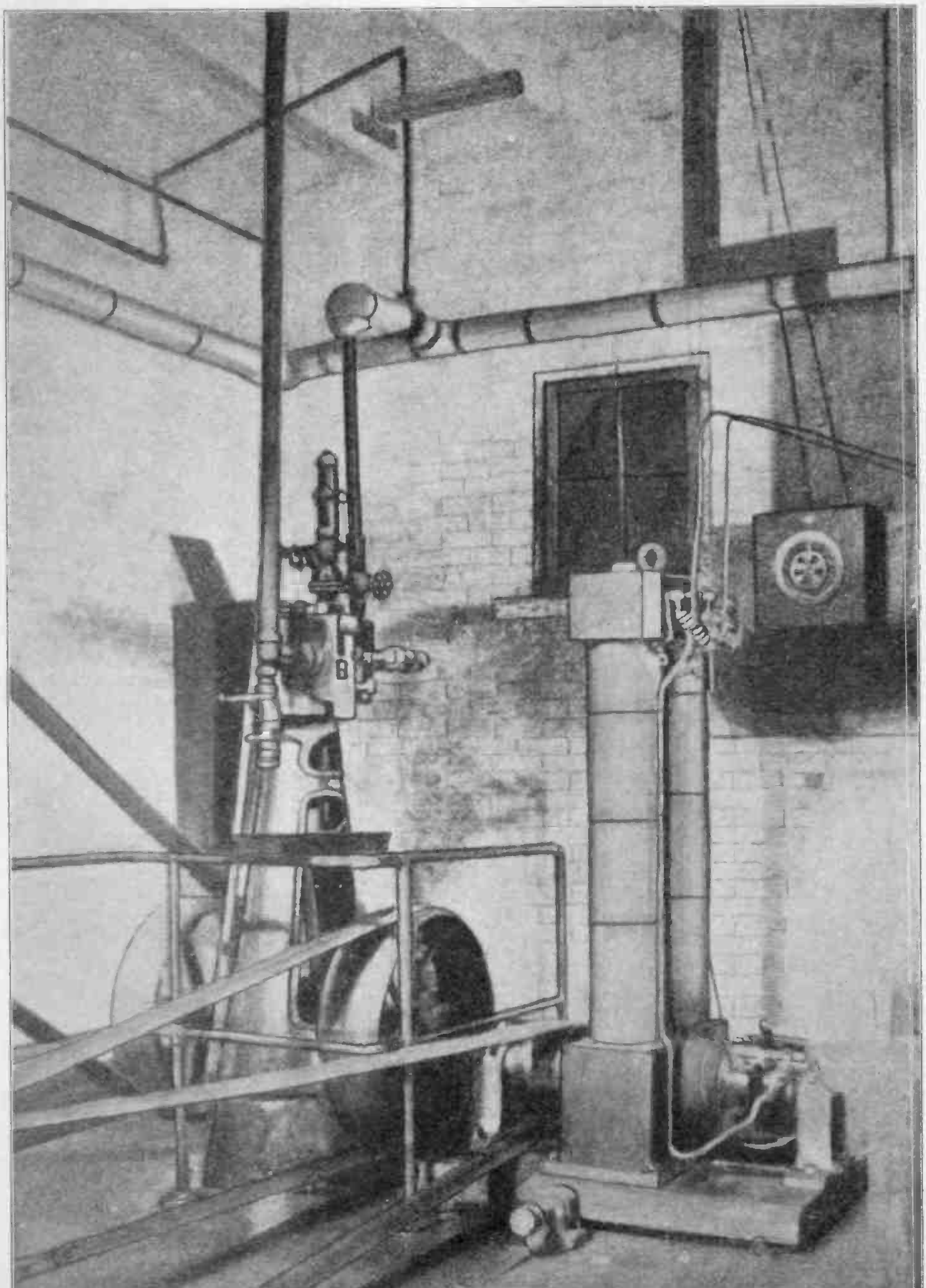
I say we take these things as a matter of course but it was not always thus, little children! No, it was not always thus! Your fathers and your grandfathers can remember the time when the best light obtainable in many places was provided by candles or whale oil lamps. And when this was succeeded by kerosene oil as an illuminant and some genius invented what was called the "sunlight burner" it created far more excitement and wonder than has the advent of the recently perfected tungsten lamp.

One could talk almost forever about the discoveries and developments of the past few decades in mechanics, chemistry, photography, navigation, heating and lighting, but in nothing has the development been more practical and progressive than in the matter of lighting.

Without pretending to possess any technical or practical knowledge on the subject, my purpose is to relate in as few and simple words as possible the story of the establishment of the very first plant in the world whereby a building was illuminated for practical purposes by incandescent electric lamps and without the aid of any of the agencies that had been used for that purpose up to that time.

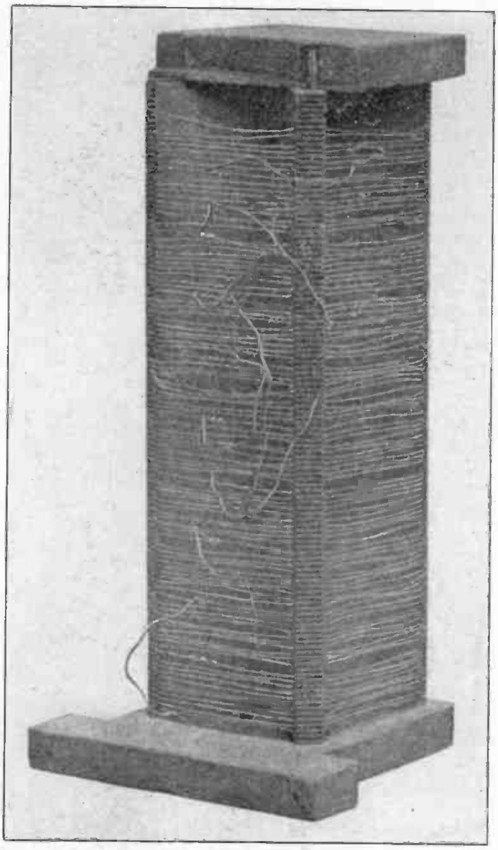
In the year 1880 my firm, Hinds, Ketcham & Co., was engaged in the business of color printing at 104 Fulton Street, New York City. This was in the very heart of the busiest section and probably the most congested manufacturing and business district on the continent.

In the month of October in that year we were visited by a gentleman who was gathering statistics regarding the number of gas lights in use and the cost of same. Upon inquiring into his purpose we were informed that he represented Mr. Thomas A. Edison, who was experimenting with a new system of lighting at his laboratory at Menlo Park, New Jersey. We were not entirely unfamiliar with this fact, as the newspapers had occasionally printed items about the "Wizard of Menlo Park" headed "Lightning over the Snow," etc., and stating how, on certain nights a number of lights had mysteriously sprung into existence apparently without any human agency, and of other strange happenings. At that time my firm was erecting a factory building at 449 and 451 Water Street in New York City and being anxious to have it equipped with every modern appliance, the agent was asked as to the possibility of having that building fitted out with the new lighting system. He stated that nothing of the kind had as yet



FIRST ELECTRIC INCANDESCENT LIGHTING PLANT IN THE WORLD. IT WAS PUT INTO OPERATION IN DECEMBER, 1880, AND MARKED AN EPOCH IN THE WORLD'S HISTORY been done and expressed his doubts, but at his suggestion I went to Menlo Park and saw the entire system in operation. Mr. Edison was then, as now, a very busy man and no respector of persons. As I left the train I saw two men waiting on the railroad platform and afterward ascertained that they were the two best known financiers of New York who were returning after vainly seeking an interview.

After three or four visits I succeded in meeting Mr. Edison, presented my request to him, pressed the matter upon him with youthful enthusiasm, told him that if he would give me the light I would promise not to enter any gas into the building, depending for light entirely on his plant and much other argument of the same import although I felt that I was taking great chances in making this very radical condition. While this may not have affected his decision in the least he finally told me that he would comply with my request and shortly afterward we received at our new factory a dynamo which had been taken out of the laboratory works. This was known as an "Edison Z dynamo," 55 volts, capacity about 150 eight candle power lamps. This was set up and connected with a small upright engine of about ten horsepower so geared as to drive the dynamo at 1700 turns per minute. The wiring throughout the building was done by a man whose only previous experience had been with electric bells and similar work, and as no insulated wire of the necessary gauge was obtainable, the original trunk line was of naked copper wire fastened directly to the walls or girders by double pointed tacks. The joints and connections were not soldered but merely scraped and twisted together. At first there was no automatic apparatus of any kind; not even safety plugs, and on one occasion, when the lights suddenly turned a dull red and the engine labored heavily, a disaster was averted by the discovery of a large file which an intelligent plumber laid across the two lines of wire. On reporting this incident the trunk lines were cut at intervals and the ends bent over, links of lead wire being inserted in the spaces.

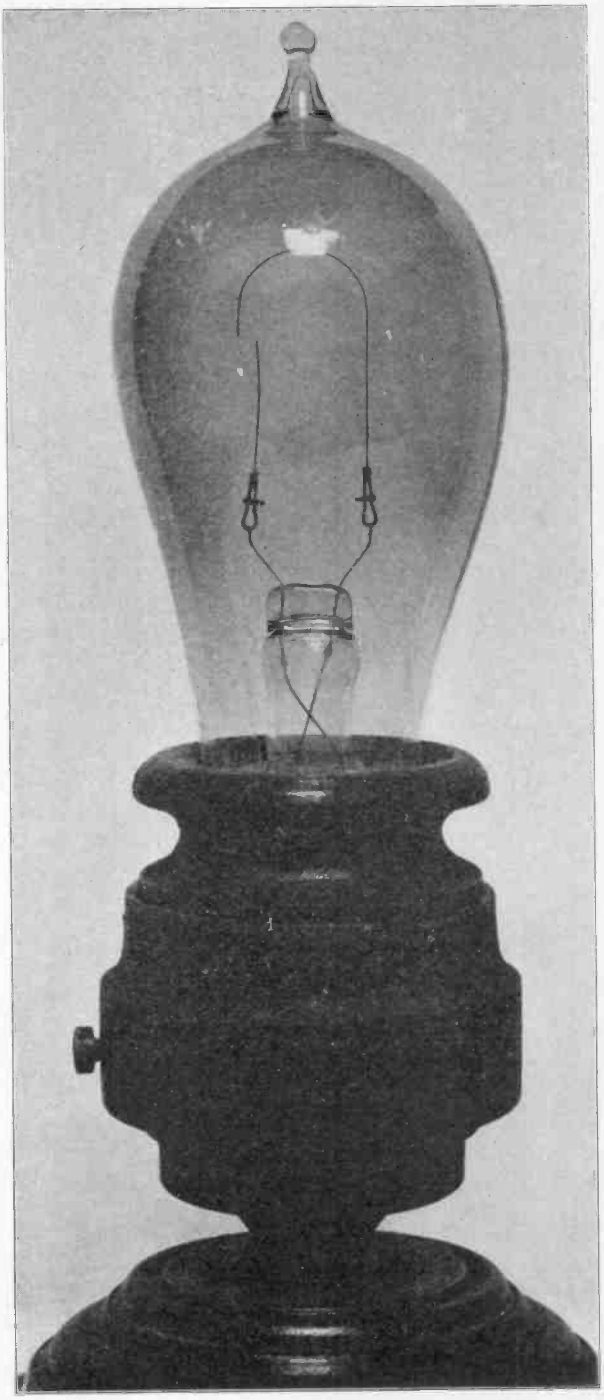


THE FIRST RHEOSTAT, REAR VIEW. THE ORIGINAL WAS ABOUT 20 INCHES HIGH

Upon our request for a revision of our insurance rates a careful survey was made and for the reason that no gas was used in the building a material reduction was made to us.

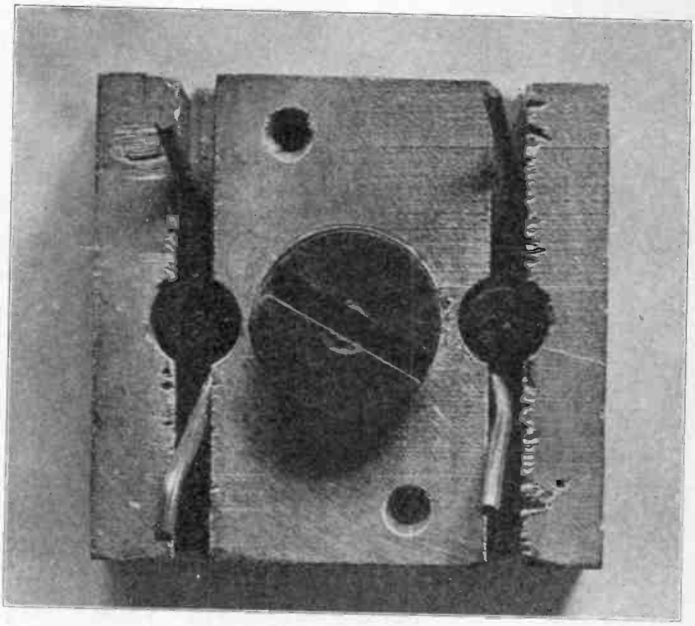
Some months after this we received the first rheostat, then called by some other name. (The accompanying cut is about as it looked, allowing for wear and tear.) The safety plugs were the same in principle as those now in use. The cut of safety plug here shown includes a part of the trunk-line wires that were in actual use.

In the first type of lamp received the ends of the carbon were held by small German silver clamps fitted with watch screws. These lamps were very short lived. The bulk of metal caused the current to often spring an arc and the average life of the lamps was not many hours; some of them not many minutes, as the voltage was constantly varying, not being under control. These lamps were keyless and could only be extinguished by loosening them in the socket. When the plant was first installed



THE FIRST TYPE OF LAMP (FULL SIZE) OF EIGHT CANDLEPOWER, THE SOCKET AND BASE BEING OF WOOD. IT CONSUMED .94 AMPERE AT 55 VOLTS OR 6.46 WATTS PER CANDLEPOWER WHEREAS THE MODERN TUNGSTEN LAMP CONSUMES ONLY 1¼ WATTS PER CANDLEPOWER.

a full complement of lamps was supplied with some extras, but these were soon exhausted and several boxes of lamps were sent us at short intervals, the shipments being increased to barrelfuls, each lamp being carefully packed in straw. These lamps were necessarily very expensive. I was told that the cost was $5 to $10 each and when I spoke to Mr. Edison on the subject and expressed my regret at our apparent extravagance in the matter of lamps he said, "Don't mind that. We are improving them all the time and you and I will live to see the day when lamps will be made for less than thirty cents each and will last several thousand hours." Which prophecy has been fulfilled.



SAFETY PLUG, 1881, SHOWING PART OF THE ORIGINAL LIVE WIRES. REDUCED ONE-THIRD

Just at this time my firm issued a circular containing this statement:

NEW YORK, February 1, 1881.

We are pleased to announce that having found it necessary to materially increase our facilities to provide for the great and rapid growth of our business, we have removed the manufacturing departments to our new factory,

Nos. 449 and 451 Water Street, New York City,

where we have the largest and best equipped establishment of its kind in the United States. Our building is 40x160 feet, 4 floors, lighted on all sides and fitted throughout with

EDISON'S INCANDESCENT ELECTRIC LIGHT,

operated by a special dynamo electric machine on the premises. We are the first manufacturers in the world to put into practical operation this great triumph of American genius (which is a true substitute for daylight, showing all colors in their natural hues), and our friends are invited to call and see the operation of Prof. Edison's wonderful subdivision of the electric current and the vacuum lamp.

We have in constant operation fifteen steam presses and are supplied with every modern appliance connected with our business, including Hinds' patent drying machine, for drying printed and varnished sheets in an incredibly short space of time.

Our salesroom will remain at the old stand, 104 Fulton Street, and is connected with factory by direct telephone.

Thanking our friends for the liberal patronage and support bestowed upon us during the past year and soliciting a continuance of the same, we remain,

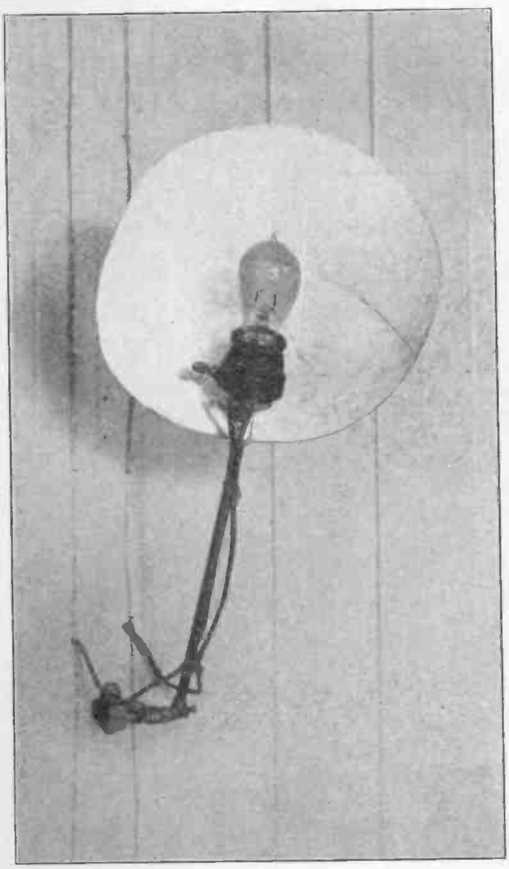
Very respectfully,

HINDS, KETCHAM & CO.

This circular was sent to all parts of the country and the result was that our little factory was crowded with visitors every night to marvel at the features of the new light which could not be blown out and would burn under water, and we were repeatedly called upon to demonstrate this latter fact. Not the least attraction were the fixtures and shades. The fixtures were ordinary gas pipe and fittings, the only material available at the time. The "Electrolier" came along much later. These were probably the first un-ventilated lights that many had ever seen. The shades were of my own design, made by a neighboring tin smith, painted white inside and green outside. This, with some modifications in size and shape, is still the prevailing fashion in such things.

The night in December, 1880, when all was ready to switch on the current for the first time to light up the building with this mysterious agency, was to mark an epoch in the world's history. It nearly marked one for me, for in the excitement of the moment, standing beside the engine, which was running at full speed, and leaning over to throw on the switch, my coat caught in the belt and I was thrown violently to the floor, happily without any other injury than a temporary disappointment. A few moments later, in the presence of my partners and our principal employees, the little lamps were illumined with a dull red glow which gradually brightened into what seemed a dazzling light and we stood speechless with wonder in the presence of the greatest marvel of the century.

The first public display of the new light was made in a spectacular play at Niblo's Garden in New York City when a "Grand Electric Light Ballet" was given. The beautiful coryphees each carried a property branch of foliage in which were set three or more of the little eight candle lamps. The stage was darkened, the gas all turned down, when suddenly the verdure was illuminated by the brilliant spots of light revealing thick ropes of wires leading along the floor to the side, and the audience sat in open-mouthed astonishment. The program stated that "The whole is produced under the personal direction of Professor Edison," but I doubted that statement then and I doubt it more now.



LAMP, FIXTURES AND SHADE. SHOWING PLAN OF TRUNK WIRES AND CONNECTIONS

I believe that no other isolated plant was installed, except at the Edison works in Goerck Street, and it was, perhaps, a year after this event before any other lamps were in practical use and the current for them was supplied from the first central station in Pearl Street near Fulton Street in New York City. This plant was erected under Mr. Edison's personal supervision and several times, on his way down town, he stopped into our little place to look for "bugs" as he called it. That his pathway and ours was not lined entirely with roses at that time is apparent from the following letter, which speaks for itself:

THOMAS A. EDISON,
No. 65 Fifth Avenue.
NEW YORK, 7th Nov., 1881.

Messrs. Hinds Ketcham & Co.,
 # 228 South Street, City.

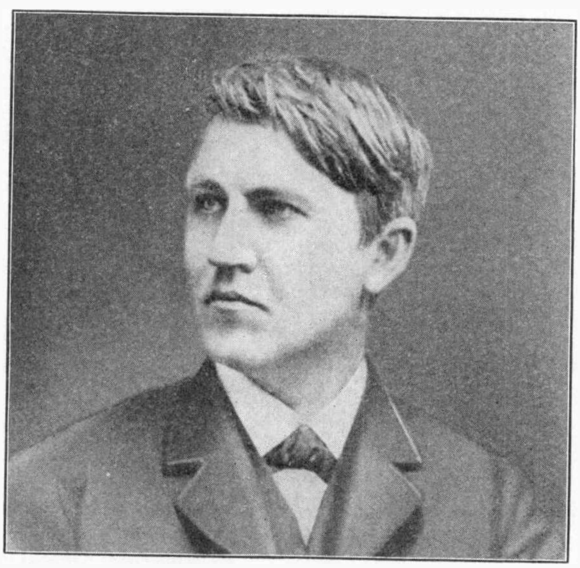
DEAR SIRS:

The discrepancy between the number of lamps per horsepower which we claim and what you obtain is due entirely to the extra friction on the belting and shafting when the extra load comes on. As we have indicated at least 25 different kinds of engines varying from one hundred and eighty horse power to ten horse power and never got less than 12 to 14 lamps of eight candles each by the indicator card and as these engines have been indicated by many different persons who have figured the thing out both in the old manner and by planimeters and have found our figures are correct, we are absolutely certain the fault is at your works and not in our lamps and machines. In my mind the whole trouble is due to the failure to recognize the fact that there is an enormous loss of power when transmitted through several series of belts. Were you to put in a small Armington engine and connect the dynamo directly with it, you would doubtless get the desired result. In fact I will guarantee twelve eight-candle lights per indicated horse power if such an engine is used and that you will have no further difficulty in the matter. If you find it inexpedient to put in a small engine, we will take the dynamos back and be just as good friends as ever.

Any night this week if the gentleman who has indicated your present engine and made these calculations has time he may come to Goerck St. by informing me one day ahead and I will put up 150 eight-candle lights on a small engine and if we do not get twelve lights per indicated horsepower, I will agree to eat engine, dynamo, lamps and all.

Yours very truly,
THOMAS A. EDISON.

This plant, with occasional improvements and changes, continued to run in the same building for nearly four years thereafter, when it was removed to Brooklyn and the dynamo again set up as an auxiliary and was run up to a few years ago when a vandal hand consigned it to the junk heap. In the pressure of other business this matter was lost sight of and gradually the remnants of the plant have disappeared, until now only a few individual specimens remain. Of the first type of lamp that was in actual use only three specimens are in existence: One in the National Museum in Washington, one in the hands of an enthusiastic collector and one in my own possession of which is presented a halftone illustration on page 573. Of all the events of a long and busy life nothing has given me more intense satisfaction than the one which I have tried to describe. It brought me into personal contact with the greatest genius of all time, who is also a most genial, lovable, manly man. Edison is too near the focus of our vision at the present time for us to form an estimate of his greatness, but the eye of the future will have a broader horizon and the vastness and complexity of his genius and achievement will then be more apparent.



FROM A PHOTOGRAPH OF THOMAS A. EDISON, TAKEN IN 1881 OR 1882

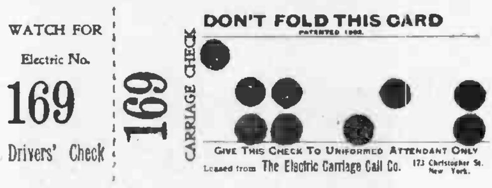
Electric Carriage Call

Electric light has played an important part in modern "society functions," from the time when it was first introduced, brilliantly illuminating the ballroom and theater, and adding beauty to decorative effects at dinner parties and receptions. The electric carriage call is an application of the incandescent lamp that serves a useful purpose at some of the theaters and opera houses in our big cities.

Before this system was introduced, the dispersal of a Grand Opera audience, for example, was often the occasion of much delay and annoyance. The "carriage folk" attending the performance, especially ladies wearing costly evening gowns and jewels, naturally wished to step directly from the door into their conveyances, and in inclement weather the prompt appearance of each party's carriage became still more important. The custom formerly was to call the carriages by shouting loudly at the door for the coachman. This primitive method of summoning one's conveyance, whether hired or private, was a time-honored one dating back to the period before the introduction of wheeled vehicles, when "chairs," slung on poles and carried bodily by burly servants, were in vogue. But the resulting din and confusion, often made more vociferous by the necessity of repeating the name or number down the long line of waiting carriages, was a serious offset to the pleasure of the performance that had just been enjoyed.

ELECTRIC CARRIAGE CALL IN FRONT OF THE THEATRE

The electric carriage call obviates all this annoyance, saves the time of the patrons of the house, and greatly facilitates the work of the attendants and police. It is not an audible "call," but a purely visual system; that is, it operates by displaying one carriage number after another, outlined in incandescent lamps in a panel electric sign placed over the carriage entrance where all the coachmen waiting in line can see it. There are usually three panels, each consisting of a group of lamps so arranged that any figure from 1 to 9, and 0, may be formed by lighting up certain lamps of the group. The sign is operated by the doorman, from an ingenious switchboard which is connected to the sign by a cable of wires.



PERFORATED TICKET FOR OPERATING CARRIAGE CALL

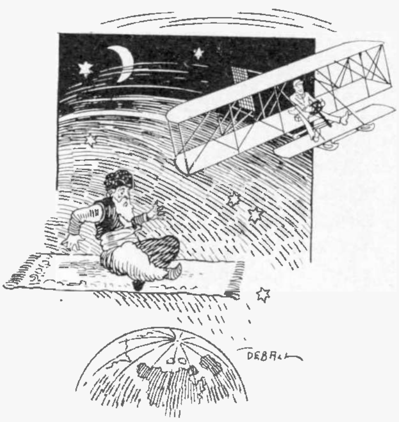
The operation of the system is simple. At the switchboard, the wires coming from the sign—one wire for each lamp—terminate in a set of movable contact pins. By means of a lever, the entire group of pins may be brought into contact with a copper plate which completes the circuit to the lamps. But by the use of a pasteboard "ticket," punched with holes, certain particular pins only are allowed to make this contact, the arrangement and location of the perforations in the ticket allowing certain lamps to light. Each ticket used is punched in a different way, so as to cause a different number, of one, two or three figures, to light up in the sign, and this number is printed on the ticket and on a stub which may be detached.

One of these tickets is assigned to each carriage as it drives up to the door before the performance, the doorman tearing off the numbered stub and handing it to the coachman as a memorandum of the number that will be shown on the sign to call him.

A Trick Elevator

By ALBERT WALTON

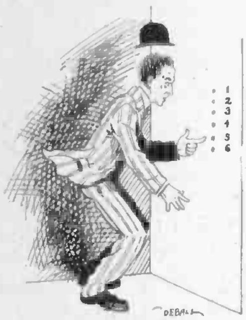
Aladdin has been outdone—and in the Western Hemisphere at that. The flying rug that would travel whithersoever its owner desired was but a crude affair to the Wright Brothers' aeroplane; the blades of Damascus were not half as wonderful as a dollar safety razor, and Aladdin's lamp itself was but a smoky affair that gave such a feeble glow



The Flying Rug Was But a Crude Affair

that a forty-watt tungsten would make it cast a shadow. But crude as we have shown the fabled old Orientals to have been by our modern methods we have always rather admired the way they could cause various beings to arise from the under-world by a mere clapping of the hands. But even this pales to the commonplace beside the "near-human" elevator that is being used in certain places in this country today.

A few days ago I had occasion to call on an engineer on the fifth floor of the new office building of a large factory in the East. I was known to the doorman and was expected so I was directed at once to the elevator. The car was on the street floor with the door closed and there was no attendant in sight. While I hestiated there was a whirr and a click and the car gently rose to heights above and disappeared. In a few seconds I heard doors open and close and the car started down again. It stopped to let its passenger out at the second floor just within view and the doors were shut again. I had been impatiently pushing the button at intervals and now expected to see the car brought down for me. When I saw nothing was occurring toward that end I pushed again and, with another whirr and click, the Genie awoke and down came the empty car. Somewhat astonished, but emboldened by this more friendly attitude I opened the door and entered. On the car wall was a row of buttons, one above the other, marked "Basement," "One," "Two," "Three" up to "Six". That was simple and with much gusto I prodded number five and waited and prodded again and then had an inspiration and pushed three times more to make five for the fifth floor and again I failed to soar as I had reason to expect. I scratched my head. What must I do to appease this mysterious and very particular Genie to again become his master? Remembering the Arabian Nights Tales I repeated "Abra-ka-dabra" and "Open Sesame" and such phrases in a half hearted sort of a way and then disconsolately looked about me. The door was open just as I had left it. Open? Of course! What self-respecting Genie would run an elevator up with the floor door open? Much chagrined at my oversight and awed at the unerring intelligence and unfaltering faithfulness of my slave I unconsciously exclaimed "Excuse me!" and after shutting the door again pushed the fifth button with great hope of results. This time came the whirr and click again and up I went "alone but with unbated zeal." Gently I passed the second floor without a tremor of hesitation. "Good," I said, "you had sense enough to know I did not want to stop there." Likewise at the third but I did not say "Good!" I looked for the "Stop" button and could not find it. "Very pretty and very nice, so far, Mr. Genie, but do not forget that the roof is just above and good elevators never go up on the roof even in the hot summer." Things did not look as prosperous as they had and I thought of the accident policy I was to take out soon. I wished I had it. I did not feel quite so brilliant about having closed that door and so on. I was alone still, but not with so much unbated zeal when the fourth floor glided by while I, thinking almost anything was better than inaction, began to push all the buttons in rotation and then in pairs and groups. Now what the Genie would do or think I could not imagine and did not try to imagine. I rather expected to see the car part in the middle and go both ways trying to obey all orders at once and was debating which half I would stay with when that welcome whirr and click sounded and we stopped exactly at the fifth floor. "Well, I guess you'll do!" I said as I opened the fifth floor door and got out, closing it behind me and expecting to see the car go down again at once. But though the Genie was willing, he never worked uselessly. He was waiting further orders apparently. I set down my grip and walked down one flight of stairs to the fourth floor and pushed the button there. Sure enough, not only did the empty car start down but it stopped exactly at my floor! Now I was interested. I got in and pushed "five" again, went up and got out at the fifth floor and called on the engineer I came to see. I made him come out and put the machine through its paces. He got in alone and pushed No. 6 and began to ascend. Immediately I pushed the button on the fifth floor expecting to call him down again but he finished his ascent and got out and closed the door and came down the stairs. The elevator pays no attention to conflicting orders. Would that we had office boys who were worked by buttons and would not be diverted until they had done what we sent them to do.



Began to Push All The Buttons in Rotation

Would that Office Boys Were Worked by Buttons

We pushed our button again and got in and pushed "Basement" but as we neared the third floor we saw some one approaching and desiring to go down. Mr. Engineer pushed number three, stopped and took him on. So, you see, the Genie, while knowing but one master at a time, is broad enough to allow an error to be corrected or an order to be changed, provided the change comes from within the car. The change of instructions cancelled the "basement" order so another was issued by pressing number one where our passenger alighted, after which we pressed the basement button again and went on down, getting out and closing the door behind us.

In a wire cage in a dark recess behind the shaft we found the wonderful devices that worked these miracles of modern engineering. A semicircle of magnets and contacts, a moving arm, a few small wires and a number of magnetically operated water-valves made up the entire apparatus. A button is pressed; a magnet jumps and thrusts forth a contact piece; a small valve opens, and the arm starts to move around the dial. The small valve lets water into a pipe that operates another valve that opens the main plunger valve and puts the pressure on the elevator so as to raise or lower it as may be required. The arm continues to move until the raised contact piece is reached and then another magnet is operated, valves are opened and water pressure is applied to close the main valve, and the whole device is at rest again with the elevator standing still at the desired floor, the time required for the moving arm to reach the raised contact having been adjusted properly to allow the car time to get to its destination. And the parts are electrically inter-locked like the switching circuits of a railroad switch tower so that only one thing can be done at a time. It is most ingenious, yet simple enough to be commercially practicable and successful, despite the apparent mystery and complexity of it when viewed from the floors above or from the car itself.

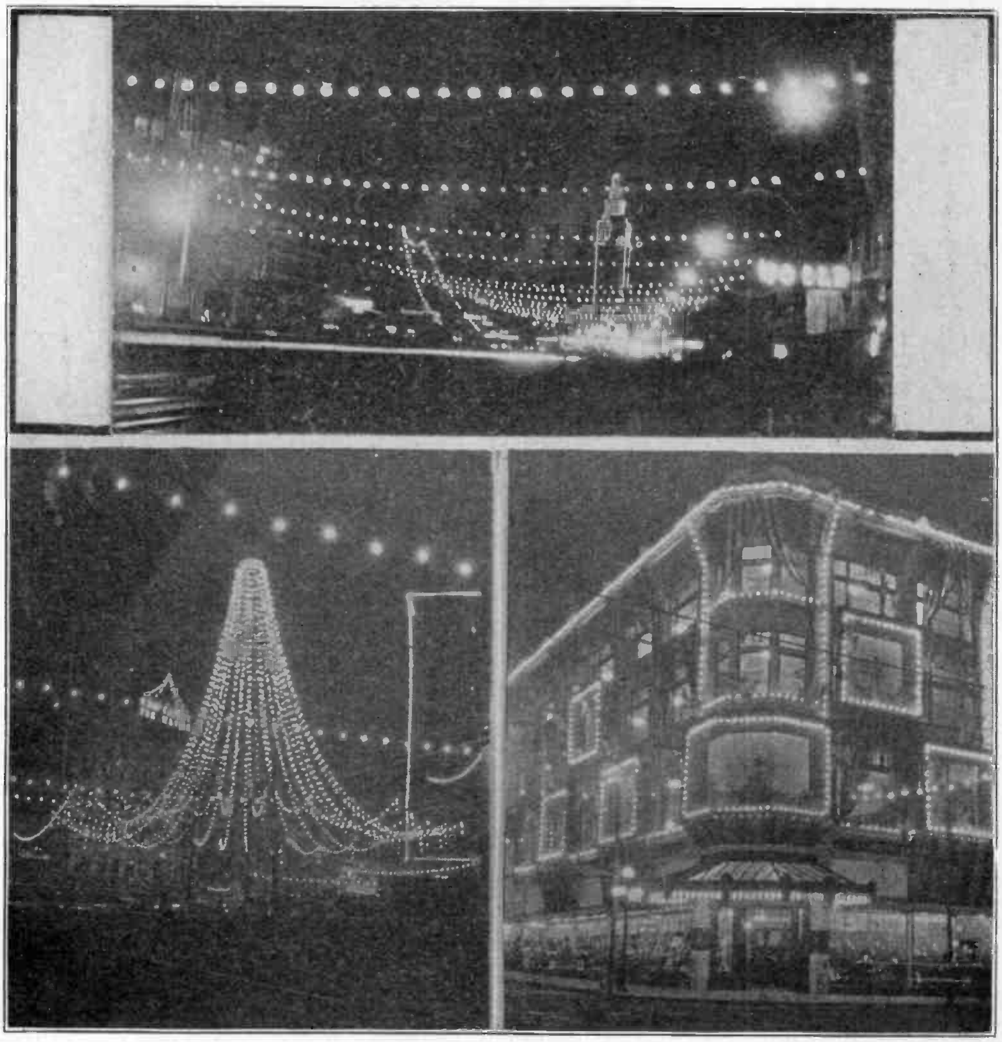
New Steel Making Process

German iron and steel manufacturers are excited over what is said to be the successful solution of the problem of making steel directly from iron ores by electricity. This has occurred at Dommeidingen, in the Duchy of Luxemburg, where an electrical furnace has been producing steel for a short time. Although the ores used are low grade and contain a considerable percentage of phosphorus, the furnace yielded a steel fully equal to the best grade made from Swedish ores. The success of this invention is expected to have a very far-reaching result.

Portola Illuminations

If Don Caspar de Portola had returned to earth any night from October 19th to 23d, last, and chanced to come out upon the bay of San Francisco as he did one hundred and forty years ago, a far different scene would have presented itself to his astonished gaze, a scene in which the most brilliant electrical illuminations played an important part. Rebuilt San Francisco had taken upon herself the task of holding a great Portola Festival to commemorate the discovery of her beautiful harbor by the hardy Spanish explorer.

The lighting features of the festival were spectacular in the extreme and the special illuminations extended out in all directions from a great bell at the intersection of Market, Kearny and Third streets. This bell contained 2,000 16-candle power lamps and rose to a height of 125 feet above the street. The central supporting platform weighed a ton and was suspended by cables from nearby buildings—a span of 180 feet. From this festoons of lamps were carried to a lower ring 120 feet in diameter. One of the illuminated stores is seen in the illustration. This took first prize for decorative lighting in its class. The upper picture shows



SCENES AT THE PORTOLA FESTIVAL

Market street looking toward the Ferry Building.

The electrical floats in the evening were symbolical of scenic California. They included one of the falls of the Yosemite with running water brilliantly illuminated by 1200 lights. Shasta and Mossbrae Falls were similarly reproduced. The Santa Barbara Mission, within whose arbor an electrical fountain played, was outlined in thousands of colored lights. A huge redwood log, apparently hauled by two horses, was beautifully brought out by electric incandescent lamps.

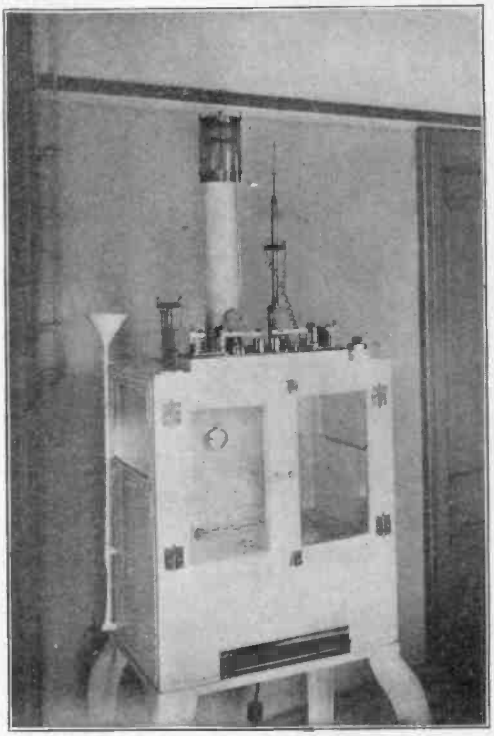
Infant and Bacteriological Incubators

By W. W. WETHERLA, M. D.

One of the uses to which electricity has only recently been applied is the artificial heating of infant incubators for the rearing of prematurely born children, and for the heating of bacteriological incubators or ovens used in the culture of germs. Because electric heat may usually be applied so that nearly, if not quite all, of the heat produced is utilized in work, it is as cheap, if not cheaper, than gas for incubator heating.

The disadvantages of gas heating as applied to incubators, are danger of the flame being blown out and thus filling the room and incubator with gas, and lack of constant gas pressure and therefore a variation of temperature in the incubator, at times ten degrees or more.

The advantages of electric heating are clean heat, that is the air is not vitiated or contaminated; variation of heat in the incubator is only slight; very little attention is required after once adjusting heat regulator; pure air may circulate through the incubator.



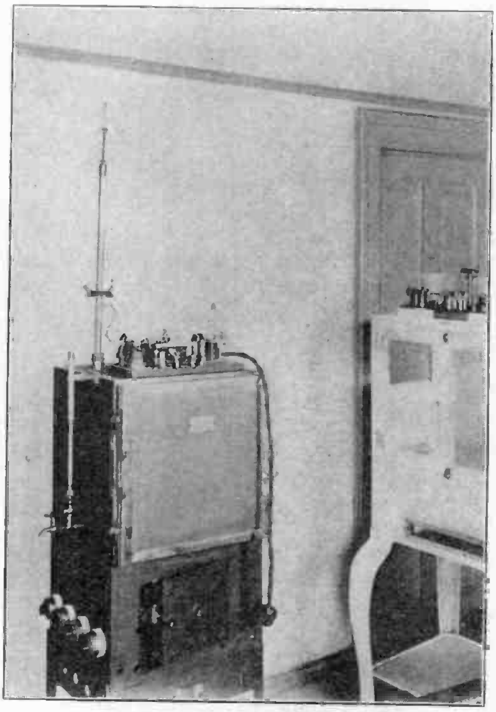
ELECTRIC INFANT INCUBATOR

The novelty of the infant incubator is due to the fact that both the heat and the moisture are generated and effectually controlled by the electric current, which may be either alternating or direct. The working of the machine is automatic, and when once properly adjusted it will continue in operation for months at a time with practically no attention. The variation of temperature is less than one degree; the variation of moisture is less than two percent, and the system of ventilation is all that could be desired. The air supplied to the infant can be filtered through absorbent cotton or gauze filter placed over the air inlet, and this air can be taken from the room in which the apparatus is placed or directly from the outside by means of tubes. The revolving wheel in the chimney indicates the perfect circulation of air.

The automatic electric cut-outs for both heat and moisture are large mercury cups, which have proved far superior to and more reliable than platinum point contacts, and much cheaper. Platinum point contacts frequently fuse together when carrying a heavy current, thus heating the apparatus to an undesirable and dangerously high temperature. Both the thermostat and hygrostat are of new construction, acting through mercury contacts or cups having no platinum points to fuse together when heat is on or off the heating chamber.

A hygrometer placed in the chamber records the atmospheric conditions as to humidity. A thermometer whose bulb in the chamber and whose stem projects outside and on top of the apparatus indicates the temperature.

Both incubators are heated by incandescent lamps or by resistance coils placed in the base and over the air inlet. The cold air passes in and around the lamps or coils and is thereby heated to almost any temperature. Lamps have proved more easy and simple of management than wire resistance coils, especially when under the management of an unskilled nurse. When a lamp burns out it can be replaced by anyone. An ordinary incandescent lamp of 16 candle power has an activity when in operation, of about 50 watts. Of this activity about 48 watts or 96 percent is expended in producing heat radiation, and four percent in light radiation.



ELECTRIC BACTERIOLOGICAL INCUBATOR

The moisture for the infant incubator is derived from a tank of water located in the the base of the apparatus, and in which is placed a water heating coil of 440 watts activity. This water may also be heated by lamps, but not so effectively.

The bacteriological incubator is designed for physicians' laboratories, for colleges and hospitals, and is made in various sizes to suit the purpose for which it is intended. It is made of copper and consists of an interior or incubating chamber enclosed by a second copper wall providing the water bath or jacket, which outer wall is covered by a non-conducting material. There is an inner door of glass and an outer door of the same material as the incubator. A strip of felt on the inner door forms an air tight fit. The outer wall is covered with linoleum, which is bound at the edges by copper trimmings.

Particular attention is given to the precise regulation of the temperature, as the maximum and minimum temperatures, between which many bacteria may be successfully incubated, are but a few degrees apart.

Five 16 candle power lamps furnish ample heat to maintain the desired temperature in the chamber of this incubator, which is for ordinary work 37°C. This temperature is maintained for any length of time with but a half degree variation.

Before the Electric Age

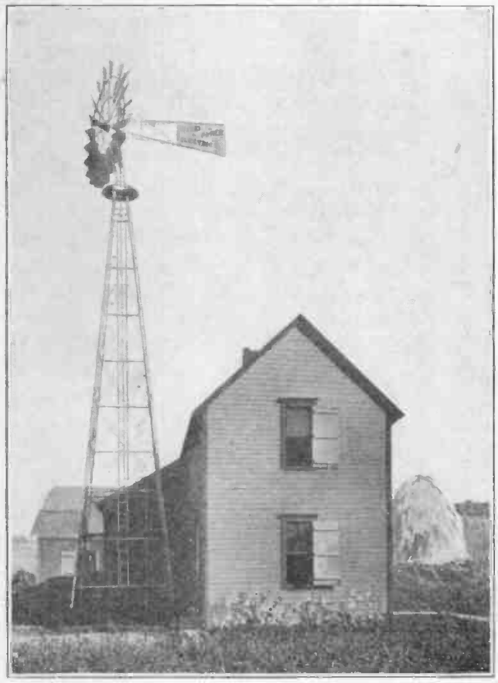
"A light, there, maids, hang out your light,
And see your horns be clear and bright,
That so your candle clear may shine,
Continuing from 6 to 9,
That honest men that walk along
May see to pass safe without wrong."

Less than 200 years ago the watchmen of London town, carrying horn lanthorns and halberts, dressed in long coats and knee breeches, walked up and down the cobbled streets of the world's largest city chanting this verse, says the Springfield (Mass.) Union.

It is beyond our comprehension and imagination in these days of flaming arc lamps and brilliantly lighted streets to picture the streets of London in that lawless age when only a candle with a cotton wick was hung out here and there on dark nights. It was an age of lanthorns, of flambeaux and ink-boys, when every one made his will and prepared for death when he ventured out at night. It is so written that it was a common practice in that city for a company of a hundred or more to make nightly invasions upon houses of the wealthy to kill and rob and it is recorded "that when night was come no man durst venture to walk in the streets."

Making Electricity by Wind Power

No one can estimate the millions of horsepower of wasted energy which is represented by the winds which blow over the habitations of mankind. As with the waves and the tides of the sea and the rays of the sun this

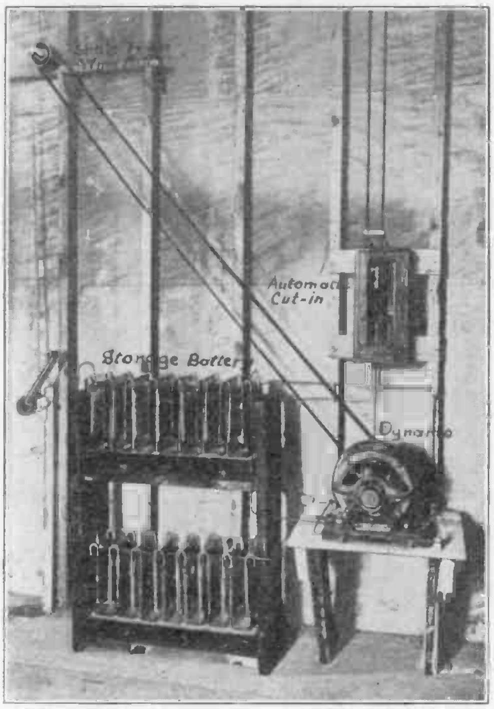


WIND MILL POWER PLANT

energy will, no doubt, be largely utilized some day, when fuel costs shall have risen to an unbearable degree. Wind mills are, of course, a common sight. Throughout the West and Middle West they may be found on nearly every farm. So far, however, their application has been mainly to the farm pump and in some instances to the operation of small grinding machines. But now that the farmer has his telephone and has his mind set on the electric lights and motors of his city brother, how can wind power be made to generate electricity? Although the question is not exactly a new one, it has never been answered satisfactorily unless a new system, which has been developed during the last year should turn out to be just what the farmer is looking for in the way of wind power generating apparatus.

Heretofore the chief obstacles encountered have been the variability of wind velocities and the intermittent character of the winds themselves. To utilize the wind mill to drive the dynamo direct introduces complicated speed governing devices, and the whole outfit is of course of no avail when the wind doesn't blow.

This naturally resulted in the use of storage batteries to store up the energy against periods of calm and also to maintain the voltage of the system constant, which the dynamo couldn't do when running at variable speed. But here the mistake was made of trying to adapt storage batteries and dynamos previously designed for commercial purposes under far less stringent conditions. The new system embodies specially designed apparatus of this



INTERIOR OF THE WIND MILL PLANT

sort which actual tests under service conditions have proven to be effective.

The complete windmill plant consists of a storage battery, an electric generator for charging the battery, a wind mill for driving the generator, and an automatic cut-in for controlling the current to and from the storage battery, together with the necessary lamps and wiring. The pictures show a typical farm lighting plant where the wind mill is used for the driver. Notice the neat, convenient and compact arrangement. The horizontal shaft of the wind mill is shown entering the room at the upper left hand corner. The shut-off windlass is shown just below. The automatic cut-in at the right, just above the generator, is provided with lock and key, thus preventing interference by meddlesome persons. The two wires leading upwards from the cut-in are the main feeders for the lighting circuit.

The lamps are in all cases burned direct from the battery, which is important for two reasons: first, current for the lights can be had at any hour, day or night, even though the generator be idle; second, the light is always steady, which is not the case when the current is derived direct from a dynamo driven by a wind mill or other varying power. The dynamo is used for charging the batteries and for this purpose, with a rugged battery the voltage need not be so constant as for lighting lamps.

The battery consists of 14 cells arranged on an open rack, in two tiers. These can be located in any convenient place, such as cellar or kitchen. About the only precaution that is necessary is to place them where they will not freeze, and where they will be reasonably clean. As the cells are perfectly clean and do not give off any disagreeable odors, there could be no objection to having them in the house.

The dynamo or generator is specially arranged for this class of work, so that with a varying speed, such as will be produced by a windmill, the battery will be charged at a certain uniform rate, even though the generator may be run at a speed more than twice normal. As this constant charging is obtianed without the use of any speed regulating device or electrical resistance it is the most efficient method possible.

In any storage battery system it is necessary to provide means for interrupting the circuit, between the generator and battery whenever the generator is idle or running at too low speed to provide sufficient current to charge the battery. When such provision is not made, if the speed of the generator falls below normal so that it no longer furnishes current to the battery, current would reverse and flow from the battery into the generator, thus converting the latter into a motor, waste current and perhaps injure the battery as well as the generator.

The cut-in is provided for this purpose and is very positive in its action, always connecting the battery with the generator at the proper time and automatically opening the circuit as the speed falls to a point where the charging current is nearly zero, and before it can reverse back onto the generator.

Old Electric Light Bulbs

To the Editor of Popular Electricity:

The electric fixtures in the Columbia, Missouri, Presbyterian Church were being put in order for a special occasion last week when the writer noticed two sixteen-candle-power carbon filament lamps in the center chandelier that gave out only a red dull light in comparison to the surrounding bulbs.

On examination it was found that these two lamps were some of the original bulbs put in when the church was built sixteen years ago and have burned ever since during church services.

There is no doubt about them being that old. A short time after the installing of these lamps the Edison Electric Company sued the maker and stopped him from making any more after that time. The bulb is a peculiar shape and the name of the maker appears plainly on the inside of the glass.

These two lamps hung at nearly right angles to the fixture, and notwithstanding this and their great age, one of them gives a clear reddish light, burning on a 105-volt current.

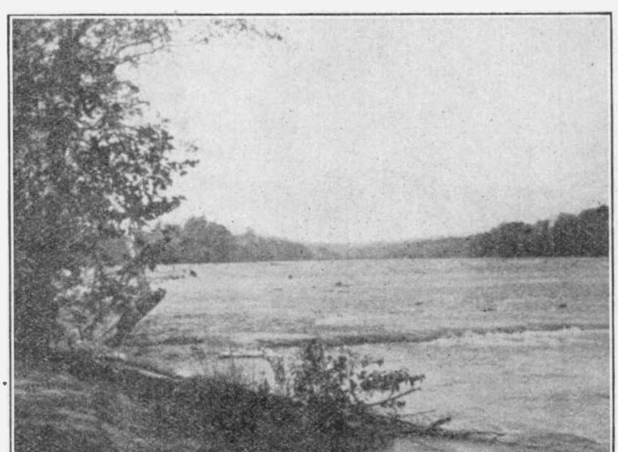
Electric light lamps as a general thing are allowed to burn too long. They grow dull. Some light consumers continue to use them after their usefulness as a light is gone and then complain to the electric light company that their current is too weak. The electric plant management can only hold the current at a voltage or pressure or strength to suit the lamp and after long use the light from the bulbs grows gradually less on account of the increased resistance of the filament as the lamp grows older, and if the glass is not broken or the light destroyed in some other way it is only suitable to be put in some out of the way place where only a glimmer of light is needed.

To prevent light consumers from using old bulbs after they have grown dim, a manufacturer of incandescent lamps is now making what they call a suicide lamp. This is a lamp that will burn only so many hours and then commit suicide, or in other words, "bust," necessitating the consumer getting a new lamp. This might save the electric station manager some abuse, but it is doubtful; other causes for such will surely arise incidental to the introduction of such a lamp.

JAMES M. SHERMAN.

Using the Energy of Our Rivers

In line with the plans of the Conservation Congress, a wise use is being made of the latent energy in our rivers of the South. All rivers in the Piedmont section of the South which rise in the Blue Ridge Mountains, have a rapid fall during the first 150 miles, so that when the latent power of these streams is fully developed, and transformed into electrical energy it is claimed that every cotton mill and almost every factory in the South can be run by hodroelectric power.



LATENT POWER POSSIBILITIES

Work has been begun on a thirty-foot dam which will span the Catawba river at Horseford Shoals near Hickory, N. C. This power site will produce fully 6000 horse power.

From this point on the Catawba river the power will be carried three miles to the city of Hickory, where it will supply the necessary power for the new cotton mill which will be the largest mill of its kind in the South under one roof, requiring about 4000 horse power to run it.

In addition, there will be sufficient power derived from the same hydro-electric plant to run every factory in the city of Hickory.

The location of the South Atlantic states is unique, in that they all extend from the Blue Ridge mountains to the ocean. The distance from the watershed to the sea averages about 250 miles, while the difference in level is fully 2000 feet. Hence, a tremendous amount of energy can be secured from the many swift rivers of these states. In addition, these states contain the cotton fields and most of the remaining hard wood timber. These raw materials, when manufactured by cheap electric power, will undoubtedly bring great prosperity to this section.

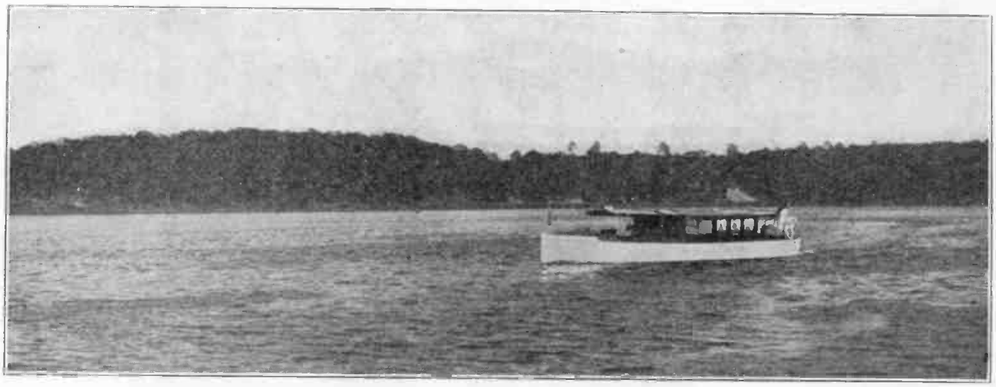
How the New York Edison Started

The installation of the plant of the first district of the Edison Electric Light Company in New York was about completed in May, 1882. The district was nearly a square mile in extent and was bounded by East River, Wall, Nassau and Spruce streets. The station was at 257 Pearl Street and included four boilers, with an aggregate capacity of 1,000 horsepower and six engines driving six dynamos. Today they wouldn't go far as exciters in a big station. This plant was expected to consume 1,680 tons of coal in a year—today the big steam turbine plant of The Commonwealth Edison Company in Chicago will consume 250 tons in an hour.

There had been laid at that time 155,000 feet of mains in underground conduits and 18,000 feet remained to be laid. A total of 946 buildings had been wired. The number of lamps in these buildings was 7,916 "A" lamps (16 candle power) and 6,395 "B" lamps (8 candle power). Today, in a single city office building, there may be as high as 20,000 16 candle power lamps.

The Japanese telephone exchanges are 206 in number, of which 122 were installed in 1908.

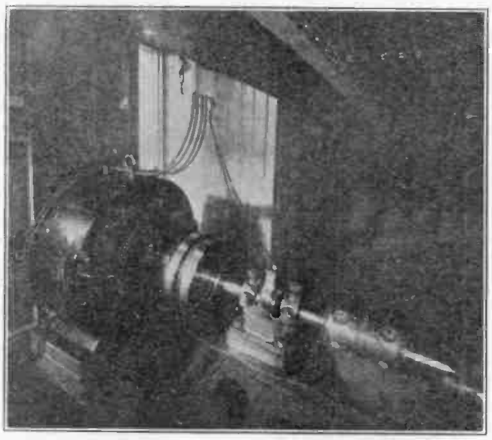
German Electric Power Boats



THE ELECTRIC YACHT ELLEN

Electric storage battery boats have been utilized for practical business service in Germany to a greater extent than in any other country, electric launches and electric motor boats usually being employed only as pleasure crafts.

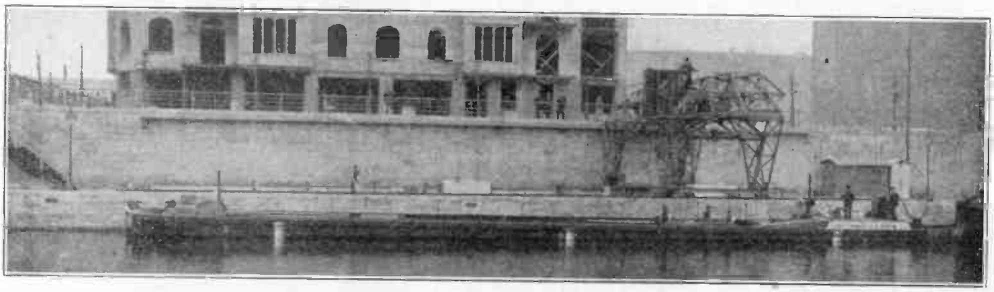
For transport service, where speed is not a factor the Germans have built a type of boat shown at a loading station in one of the pictures. This boat has motors of seven horsepower capacity which are supplied with current from a storage battery installation of 160 volts pressure. Another illustration shows how this current is applied to the propeller shaft by means of an electric motor. This motor has a normal capacity of three horsepower at 100 revolutions per minute, but is capable of developing seven horsepower without difficulty at a speed of 125 revolutions per minute and a pressure of 160 volts.



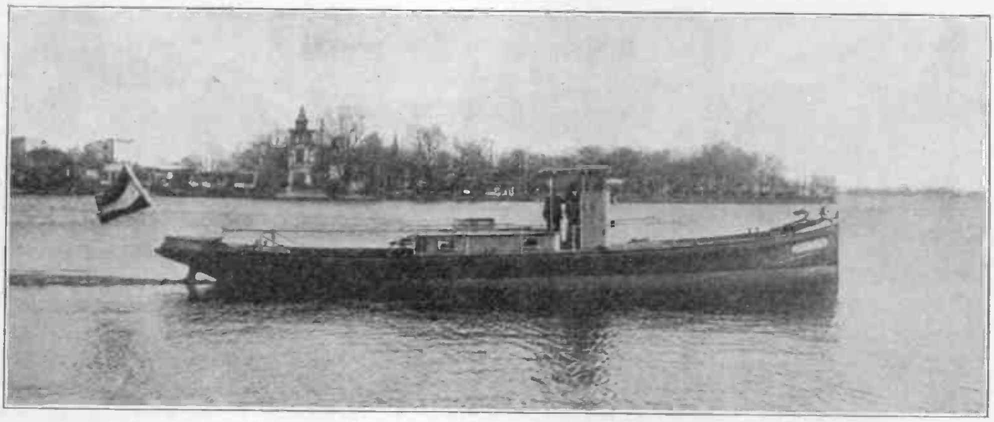
HOW POWER IS APPLIED ON THE TRANSPORT BOAT

The storage battery of this boat is capable of supplying sufficient current for operating the craft a distance of 65 miles without recharging the battery.

In another illustration is shown the electric tug boat "Tetlow" which has a hauling capacity or pulling power of 2,200 pounds and has a maximum motor capacity of 60 horsepower. Boats of this kind are not found on this side of the water.

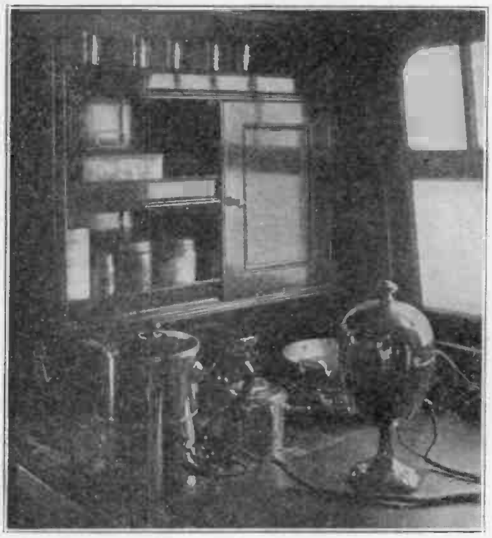


GERMAN ELECTRIC TRANSPORT BOAT



THE ELECTRIC TUG "TETLOW"

In the line of electric pleasure craft, also, German ingenuity has turned out some very satisfactory boats. The German electric yacht "Ellen," for instance, is of special interest as it is not only propelled by electric power but is provided with electric lights, electric fan motor, cigar lighter and other devices for the comfort of its owner and his guests, and there is also a complete outfit of electric cooking apparatus on board as shown in one of the pictures.



ELECTRIC COOKING ON BOARD THE ELLEN

The electric chafing dish, electric coffee and tea pots and broilers as well as other electric cooking apparatus in the pantry and kitchen of this novel craft are supplied with current from the storage battery which drives the propellers. The storage battery is capable of operating the motor boat at a speed of seven miles per hour and has a radius of action of about 40 miles without recharging.

Christian Science Healing by Telephone

Christian Science healers sometimes make use of the telephone for the so-called "absent treatment" of patients. A report from Los Angeles, Calif., states that the use of the telephone for this purpose has reached such proportions as to cause a noticeable increase in the telephone company's business. Healers in Los Angeles and Pasadena are said to give treatment by wire to patients in Riverside, Santa Barbara, San Bernardino and other southern California points. It appears that a patient would call up a healer and hold the connection in silence, while the long distance treatment was being administered. The telephone operators would cut in on the line and getting no response to questions would pull down the connections. As a result of these broken connections on what appeared to the operators as non-busy lines, complaints began to come in to the managers leading to the discovery of the silent use of the telephone.

The question is: Could the connections have been pulled down without the healers or the healed being aware of it, would the treatment have been effective or not? The question is non-electrical and we can't answer it. It couldn't even be put under the head of electrotherapeutics.

Where Electricity Stands in The Practice of Medicine

By NOBLE M. EBERHART, A. M., M. S., M. D.

CHAPTER I.—THE ACTION OF THE VARIOUS MODALITIES

Electricity has made great strides in all lines, and medical electricity has progressed as rapidly in proportion as commercial electricity. It has made especially rapid progress since the discovery of the X-ray, which gave it an extraordinary impetus.

Prior to that time considerable prejudice had existed against medical electricity because it had been a favorite field for charlatans and fakers. It lent itself readily to their requirements because of the many mysterious phenomena attendant upon its production and use.

Notwithstanding this prejudice it has become recognized more and more as investigation has shown its real value, and at the present time it bids fair to become our most popular method of treatment.

The application of electricity to the recognition of disease is called electro-diagnosis; its application in the treatment of disease, electrotherapy. Under medical electricity I include all electrically operated apparatus used in the recognition or treatment of disease, thus taking in vibration, the Finsen light, the X-ray, etc.

Until a few years ago there was very little instruction given in electricity in our medical colleges and that little was limited principally to teaching how to test for the reaction of degeneration. Thus it is that the majority of physicians being unfamiliar with the subject have been inclined to neglect it entirely. On the other hand a few have become so enthusiastic over its use that they have believed that it should be used to the exclusion of all other means. Both views are equally wrong. There is no question whatever of the value of electricity in diagnosing or treating certain ailments, while in others it is useful merely in connection with other methods and in some instances it is positively harmful and should not be used.

Again, physicians have often by familiarity with one certain method of electrical treatment become of the opinion that this particular form of electricity always should be used to the exclusion of all other electrotherapeutic methods. For instance, if he was well-posted in the use of the galvanic current he used it under all circumstances and for all cases, or if he was accustomed to using a static machine, he employed static electricity for every patient that came to him.

Now this is as absurd as it would be for the physician to start out to practice medicine with only one drug at his command. No matter how valuable it might be it certainly would be limited in its sphere of usefulness, for the world has not yet encountered, nor is it likely to, a panacea for all ills.

Good judgment and common sense are very essential in properly selecting and applying the most suitable form, in fact as Pope has aptly said: "Fine sense and exalted sense are not half so useful as common sense," and this is true whether it be in everyday life or in the practice of medicine.

In this series of articles I shall attempt to show the physiological action and the indications for the use of the various forms of electricity in order that their application may be readily inferred by the medical readers of POPULAR ELECTRICITY; following this by considering some of the more important diseases in which electricity has been found especially useful with suggestions concerning the form or forms to be employed.

Although intended primarily for medical men I shall try to make the matter plain enough to be comprehended by the lay reader, for increased knowledge on the part of the layman enables him to co-operate better with the physician, as the old idea of making medicine an awe-inspiring subject, shrouded in mystery and hedged in with Latin terms is fast disappearing.

I have decided to take up this subject in a different way from that which ordinarily is employed, and in order further to assist the reader a glossary is appended at the close of each installment.

The custom has been to consider under galvanism the diseases benefited by the galvanic current; under static electricity, those favorably influenced by this mode of treatment, and so on through the list.

I propose to outline the principal features of the various currents or modalities, and then to take up individual diseases and state which form or forms may be employed and why one may be preferable to another.

The reason for this is that the patient comes to the physician for treatment for a certain disease, or symptom; and the problem confronts the physician of selecting the most suitable remedies for the case in hand. Therefore, I will take up the selection of electro-therapeutic methods from this standpoint.

By comparing the action of the various forms of treatment, it will be noted that the same property is possessed frequently by two or more of them, and it then becomes a question as to which is preferable for a given condition. This I shall try to bring out in considering the various diseases.

As the author sees it the principal medical uses of the various modalities are as follows:

The Galvanic Current.

1. Electrolysis, or breaking a part up into its elements by electrical action, (electrical analysis). The galvanic current is thus employed in the destruction of moles, warts and other growths; in removing superfluous hair; etc.
2. Cataphoresis or driving a remedy into the tissues by means of the electric current.
3. Effect on the caliber of blood-vessels through influence on the nerves controlling the muscular fibers surrounding the vessels (called vasomotor effect).
4. The production of muscular contractions after irritability to the faradic current has been lost; and also its influence on growth.
   a. In treating paralyzed muscles.
   b. In testing for the reaction of degeneration, or to ascertain the vitality of a muscle.
5. The galvano-cautery for burning or destroying tissue through the heat evolved by the electric current.
6. Lighting diagnostic lamps.

In producing muscular contractions, except in testing for the reaction of degeneration, the galvanic current is inferior to the faradic current, but in electrolysis, cataphoresis, cautery uses and in the illuminating of diagnostic lamps it has no competition.

The Faradic Current.

1. Produces muscular contractions, and thereby stimulates muscular cell growth.
2. Vasomotor effects (especially in effusions).
3. Relief of congestion in deep-seated organs by production of hyperemia in the skin.
4. Massage effects.

The Sinusoidal Current.

1. Produces painless contraction of a muscle or group of muscles, sometimes affecting muscles where the faradic current has failed.
2. Increases metabolism and nutrition.
3. Relieves pain.
4. Ideal massage effects.
5. Increases the elimination of urea, sulphates and phosphates in the urine.

Static Electricity.

1. An equalizer of the nervous forces (tonic or sedative according to method of application).
2. Increases blood pressure.
3. Accelerates the circulation.
4. Increases the functional activity of secretory organs.
5. Restores disturbed functions.
6. Eliminates waste products such as urea, carbon dioxide, etc.
7. Produces ozone.

The High Frequency Current.

A. Local application (unipolar, with vacuum or other electrode).

1. Produces local increase in blood-supply (hyperemia).
2. Relieves pain and itching.
3. Has germicidal properties.
4. Liberates ozone.
5. Increases nutrition.
6. Under certain conditions exerts cauterizing or electrolytic properties.

B. General or bi-polar application as in auto-condensation.

1. Produces painless contractions of the individual cells making up the various tissues. (Cellular massage.)
2. Usually lowers blood-pressure.
3. Increases the oxygenation of the blood.
4. Increases bodily heat.
5. Increases nutrition and metabolism.
6. Increases the elimination of urea, carbon dioxide, etc.

THE X-RAY.

1. Remarkable value in diagnosing certain conditions, such as broken bones, dislocations; the presence of needles, bullets or other foreign bodies, etc.
2. In small doses it stimulates cell-growth; in larger doses destroys it by over-stimulation; therefore, its final effect is destructive.
3. Cumulative properties. (Stores itself up in the system and then may exhibit the result of the combined dose.)
4. Relieves pain and itching.

THE FINSEN LIGHT, THE ARC-LIGHT, THE INTENSE WHITE LIGHT, ETC.

1. Radiant heat effect.
2. Effects from the chemical rays contained.

MECHANICAL VIBRATION.

1. Stimulates or soothes the activity of nerves or nerve-centers accordingly as it is applied a shorter or longer time. (Stimulation and over-stimulation, inhibition.)
2. Relieves pain.
3. Regulates the circulation through the vaso-motor centers.
4. Increases elimination, especially through the lymphatics.
5. Favorably affects metabolism.
6. Vibro-massage effects.

OZONE.

1. Increases nutrition.
2. Increases the oxygenation of the blood.
3. Possesses bactericidal properties.
4. Destroys odors.

Some of these measures possess properties which I have not enumerated in this list, but which will be brought out as occasion requires.

With this preliminary consideration, which constitutes a foundation for the work which follows, I shall enter directly upon the value of electricity in various diseases, and on account of the great interest at present manifested therein, the first disease considered, n chapter 2, will be tuberculosis.

GLOSSARY

Bactericidal.—Destroying bacteria (vegetable organisms, microscopic in size).

Bi-polar.—Connected to both poles of the generating apparatus.

Carbon Dioxide.—The poisonous gas eliminated through the lungs. Carbonic acid gas. The chemical symbol is CO_2.

Cataphoresis.—Carrying a medicine into the tissues through the unbroken skin by means of an electric current.

Congestion.—An excessive or abnormal accumulation of blood in a part. Hyperemia.

Cumulative.—Some drugs and other agents (such as the X-ray) have the property of gathering in the system, each dose adding to the previous one, without apparently affecting the individual, to be followed by the sudden action of all of the combined doses, the result often having the effect of an over-dose.

Diagnosis.—The art of distinguishing one disease from another.

Diagnostic.—Aiding in or pertaining to diagnosis.

Effusions.—Fluids escaped from an organ or part into other parts or tissues.

Electrolysis.—Breaking up a chemical compound by means of electricity. Electric analysis.

Elimination.—Carrying of a substance out of the body. Used in this article with special reference to the expulsion of urea, carbonic acid gas, and other poisonous products from the body.

Function.—The natural or normal action of a part or organ.

Germicidal.—Destroying germs.

Hyperemia.—An increased or abnormal amount of blood in a part.

Inhibition.—The soothing or finally paralyzing effect of over-stimulation. Arresting a process through the nerve controlling it.

Lymphatics.—A system of glands and ducts extending throughout the body which take up the nourishing particles from the digested food and finally enable them to reach the blood and tissues. The lymphatics also carry off broken down tissues and waste products.

Metabolism.—The change produced in a substance by the action of living cells upon it. Converting an inorganic matter into living cells.

Modality.—A method of treatment. Each form or mode of using electricity is known as a modality.

Nutrition.—The process of assimilating food.

Ozone.—An antiseptic and disinfectant form of oxygen, produced by the passage of an electric spark through the air.

Physiological.—Natural or normal.

Reaction of Degeneration.—The muscles contract to the opening or closing of the electric current in a certain manner and when this occurs contrary to the usual custom it is a sign of disease and is called the reaction of degeneration.

Secretion.—The process of separating various substances from the blood as performed by various glands, such as the kidney, the salivary glands, etc.

Secretory.—Pertaining to secretion.

Stimulation.—Increasing the activity of a function or organ.

Therapeutic.—The application of any substance or method to the treatment of disease.

Unipolar.—Connected to one pole of the generating apparatus.

Urea.—A poisonous substance eliminated through the kidneys.

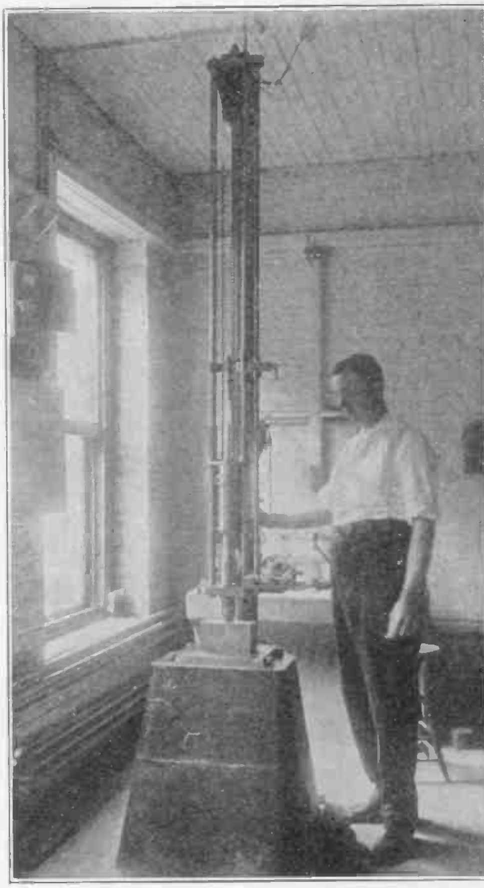
Vasomotor.—Nerves and muscular fibers which control the size of the blood-vessels.

(To be Continued)

Electricity in Testing Road Materials

By WALDON FAWCETT

Electricity is being used exclusively as a motive power in the mechanical testing of paving substances and road materials by the United States Government Office of Public Roads. This institution, a branch of the Department of Agriculture, is rapidly becoming one of the most important under the national government owing to the immense and widespread interest in the cause of good roads throughout the United States. One of the principal functions of the Office of Public Roads is to conduct experiments and tests designed to demonstrate the most advantageous materials for road construction in any given locality, and in furtherance of this policy there has lately been established in Washington very important laboratories for testing all kinds of road materials. These laboratories, which are the most complete of their kind in the world, include in their equipment all the well known standard machines and also much apparatus that is unique and has been manufactured especially for this institution. Every one of the testing machines is operated by an individual electric motor.

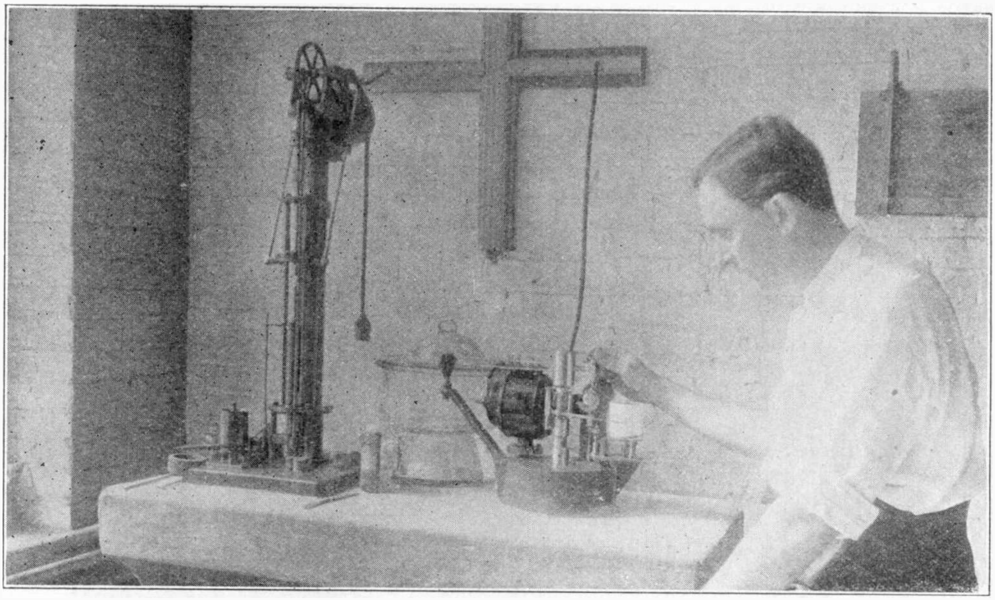


ELECTRICAL IMPACT MACHINE

One of the most interesting features of the equipment is the apparatus for the abrasion test. This consists of an electrically operated machine, the essential parts of which comprise four cast iron cylinders, each closed at one end and furnished with a tightly fitting iron cover for the other. These cylinders are mounted on a shaft at an angle of thirty degrees with the axis of rotation. In the cylinders is placed the rock to be tested, it having been previously broken in pieces as nearly uniform in size as possible. About fifty pieces constitute a test sample and a test consists of ten thousand revolutions at the rate of between thirty and thirty-three per minute. The amount of wear that the rock has undergone under this action indicates its abrasive qualities.

For the test for hardness a cylindrical core is cut from a specimen of the rock with an electrically actuated diamond core drill and the test piece thus obtained is held perpendicularly against a revolving cast iron disc under a constant pressure of 275 pounds while standard sand is fed on the disc as the abrasive agent. At the end of one thousand revolutions the loss in weight is determined and the test repeated with the specimen reversed. The average loss in weight from the two runs is used to determine the hardness of the rock.

What is known as the impact machine, Fig. 1, has been especially designed in order to chronicle the resistance of various road materials to impact. The machine is equipped with a plunger which rains blows on the specimen under test and these blows approximate as nearly as possible the blows of traffic on a roadway. The test piece is held to the base of the machine by a device



ELECTRICAL RECORDING DEVICE ON TESTING MACHINE

which prevents its rebounding when a blow is struck by the hammer. The hammer is raised by a sprocket chain and released automatically by a concentric electro-magnet. The fall of the hammer is increased with every blow until the test piece goes to pieces and the number of blows required for this represents the toughness of the specimen.

Somewhat similar equipment is used for the cementation tests. As a preliminary to this latter test the material is placed in a ball mill together with water sufficient to produce a stiff paste after grinding. This mill contains two steel shot weighing 25 pounds each and is revolved at the rate of 2,000 revolutions per hour. The material is taken from the mill at the end of 5,000 revolutions. The material is made into briquets, five briquets being made from each sample and allowed to dry twenty hours in air and four hours in a steam bath. After cooling they are tested by impacts in a machine shown at the left in Fig. 2, of special design very similar to the impact machine above described. Attached to this machine is a recording device which records the movement of the plunger during and after each blow of the hammer. This recording device embodies a constantly moving paper roll operated by the electric motor seen near the hand of the operator. Upon this a pen traces the record of the test in the form of an irregular curve which is readily interpreted by the operator.

First Outdoor Trial of Incandescent Lamps

In order to subject his system of incandescent electric lighting to a test under out-of-door conditions Thomas A. Edison had erected in Menlo Park, N. J., in 1880, a plant embracing 500 lamps distributed over an area one mile long and one-half mile wide. His laboratory, on a slight eminence, overlooked the whole area. The lamps were of 16 candlepower and were supplied with current by nine dynamo-electric machines. A writer at the time says: "The lamps were absolutely steady, shining with a mild and serene effulgence which is exceedingly pleasing to the eye. The sub-division of current is complete and economical, and the entire system of lights can be turned up or down, off or on, as easily as one can regulate the flow of gas." It is interesting to note the use of the term "sub-division of electric current" which seems to have been prevalent at that time and referred to the passage of current through the many small filaments of the electric lamps connected to the circuit. As applied to lamps in parallel or multiple arrangement this term would appear to be very apt.

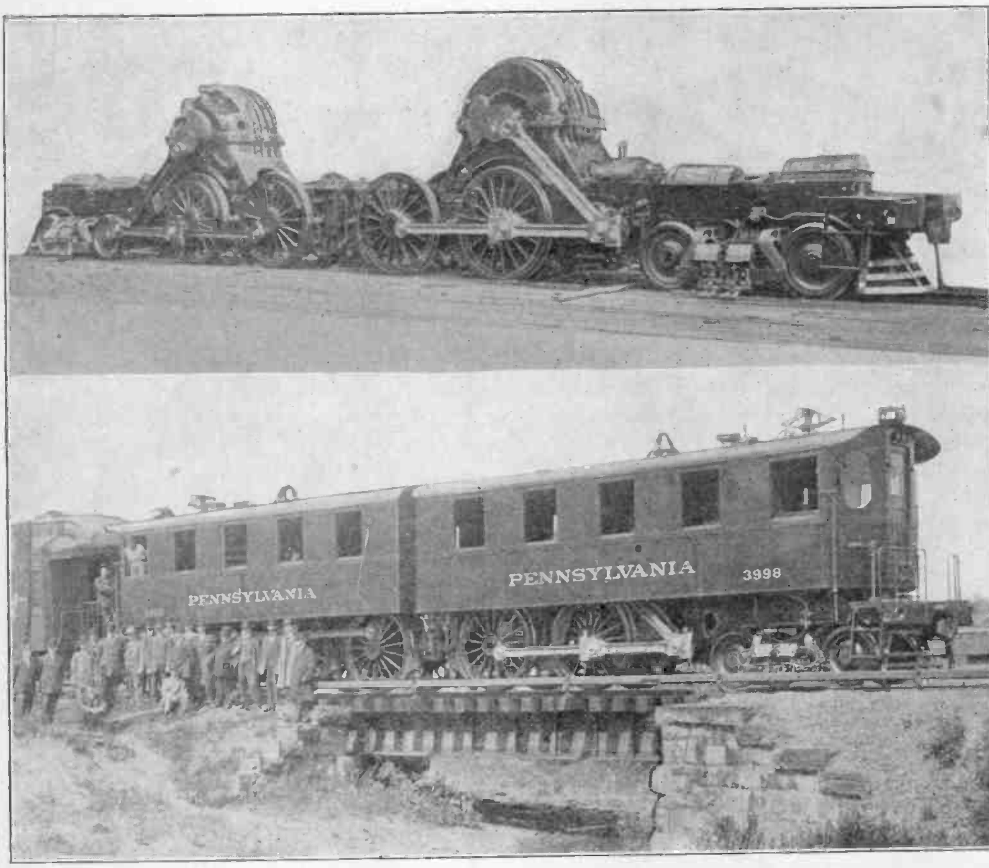
Giant Electric Locomotives

Weighing 166 tons apiece and each exerting a tractive force of 4,000 tons, equal to that of three freight engines of the largest size, the electric locomotives which the Pennsylvania Railroad is building for use in its tunnels in and about New York City are the biggest things of their kind yet to figure in the history of railroading. Several already have been completed and work is under way on enough more to make a total of 24, which will be kept busy hauling passenger trains under the metropolis as soon as the new terminal is ready for service.

Each locomotive is built in two sections; that is, there are two cabs, enclosing separate motors, and two sets of motors. Each section has eight wheels, four of which are drivers, 68 inches in diameter, and four truck wheels, 36 inches in diameter. The sections are coupled, back to back, to obviate the necessity for turning them around, as the engines run equally well in either direction, and all manipulating levers are duplicated in each section and so connected that one man can control the operation of both sets of motors.

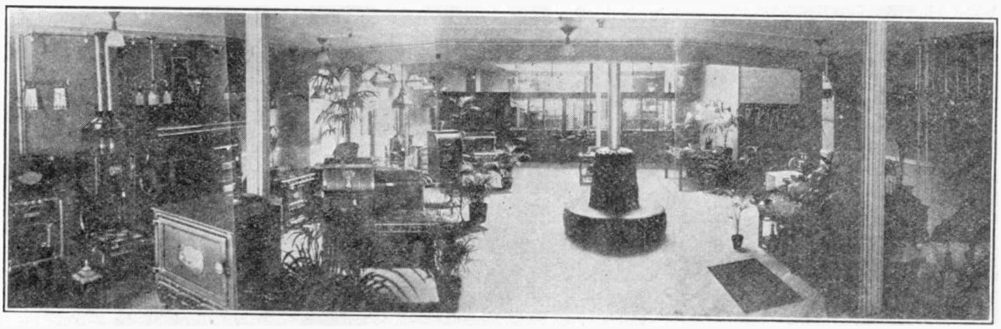
The driving wheels are coupled in pairs to crank shafts, in line with the driver axles, which, in turn, are coupled to motor crank shafts, to each of which a single motor delivers all its power. The cranks are 90 degrees apart so that there can be no "on center" position, and, distinctive from steam practice, all rods and moving parts have pure rotation only and are thus counterbalanced for all speeds, thereby delivering no more shock to the track and roadbed than a passenger car of equal weight.

Each single motor weighs, without gear, 45,000 pounds and in weight and power



TWO VIEWS OF A 166 TON LOCOMOTIVE

they are the largest railway motors ever constructed. The electric supply will be obtained from a conductor, or third rail, through four contact shoes on each locomotive, while contact shoes on the roof of the locomotive, arranged to be raised and lowered by compressed air, will be available to take current from overhead wires in such parts of the railroad's yards as it will be impracticable to use the third rails. Steel construction is used throughout in each locomotive, some of the dimensions of which, not given above, are: Weight of electrical parts, 62 tons; weight of mechanical parts, 103 tons; maximum draw bar pull, 60,000 pounds; maximum speed, 60 to 70 miles an hour; weight on drivers, 14 tons; length over all, 65 feet.



Electric Light Companies and the People

More and more are electric light and power companies coming to realize that the fullest measure of success can only come by cultivating the intimate acquaintance of their customers and prospective customers. Expression to this feeling is given in the advertising, and also in the display rooms which are maintained by most of the up-to-date companies. The display rooms are particularly efficient in helping the consumer to become better acquainted with his central station company and to learn of the really wonderful things which electricity may be made to do in the home and in business. These rooms are fitted up simply or elaborately according to the company's means and the people are gradually learning to go there to supply their electrical wants as they would to their grocer or their department store for everyday necessities. For instance, perhaps you want some tungsten lamps, if as you hear they are current savers; or you want to find out about the cost of a sewing machine motor and how much current it would take; or may be you desire information on electric cooking, Christmas tree lighting, electric vibrators, etc. One place to go, and a very good one, is to your lighting company. Yet it is surprising how few, comparatively speaking, think to do this.

As an example of the attractiveness of central station display rooms we reproduce herewith a photograph of one which has been fitted up by the Easton (Pa.) Gas & Electric Company. The Easton Company is one of the most progressive in the country and has the entire confidence of its patrons. Entering the main door to the recently remodeled offices the visitor finds himself in a spacious sales and display room. Electroliers of every conceivable pattern are hanging about and there is a wonderful collection of hall and den lamps. On one side of the main room there is a smaller dark room fitted up to show the night effects and colorings of lamps and shades.

In addition there are electric bread toasters, hair curlers, waffle irons, milk warmers, shaving mugs, chafing dishes, electrically operated coffee percolators, a tailor's goose iron, heating pads for the sick room, heater connections for bath room fixtures and many other things.

A cook stove connected for the use of electricity is also a prominent feature.

ELECTRICITY IN THE HOUSEHOLD

A Marvel of a Modern Mansion

By EMILE RUEGG

Electrical mansions, though not unknown, are far from being common; that is, mansions as completely and wonderfully equipped as this one in Paris of which I am about to write.

I had the honor of being invited to the home of the well known millionaire Mr. Georgia Knap and what I saw there was so startling that I could not restrain from asking the favor to take photographs, which he generously permitted me to do on a later occasion. With the beautiful illustrations which I obtained it will be now possible for me to describe that unique evening in a striking manner.

ENTRANCE TO THE VILLA FERIA-ELECTRA

It was just eight o'clock when I arrived at the portal of the Villa Feria-Electra. Everything seemed quiet and abandoned. Looking in vain for a handle to open the gate I perceived a small illuminated push button. A gorgeous array of light on the inside answered my call. Presently I heard a voice of a loud speaking telephone asking my name, which I gave. A low humming noise was heard, the gate was thrown open, and I found myself standing in a sea of light. Out of a horn there came a voice welcoming me and telling me to advance. Looking back I found that the door had closed and locked, and that I was a prisoner in a marvelous garden of light effects.

Wherever I walked I was accompanied by electric lights which extinguished as I left them behind me. Here and there I beheld huge flowers of all colors, but mostly bright, all grown gigantic by a special method of electric culture. Thus walking in amazement I arrived at the front entrance of the house, always alone. Again a voice was heard from above me—"Glad to see you." But although I was seen, I could see nobody. By simply stepping on a carpet a brush rapidly cleaned my shoes and almost immediately the door was flung wide open and I stood right before Mr. Knap, who welcomed me with his usual smile. When I wanted to give way to my astonishment, I was led into the dining room, where the other guests were already waiting. Quickly gazing around me I saw an electric piano, an electric self-winding clock, an electric apparatus to purify the air by ozone, an electric thermometer regulating the temperature of the room automatically, etc. I stepped to the window looking at the beautiful curtains. Mr. Knap quickly touched a button, then another, and the curtains opened automatically and before they were quite drawn I saw the gardens in all the splendor which electric illumination can afford. Two quick touches; the lights in the garden were out and the curtains slowly cover the scene.

IN THE ELECTRIC EDEN

After a short introduction to the guests we were all seated around a table of rare and happily chosen form. Lights were everywhere but rather subdued; electrically illuminated flowers in the center of the table and a crown of smaller flowers along the rails of the "table railway."

At the head of the table there was a hole covered by a nickel plate. A reflecting mirror above so clearly showed the whole scene to those in the "serving room" below that all could be directed from that point Thus the soup traveled around the table stopping at each place where there was a service. In like manner the bread was handed around. When everybody had finished some kind of high basket came up, stopping before Mr. Knap, who put in his plate and the spoon in a pocket at the side. After its round it disappeared in some manner through the table. Everything was served on electrically heated plates. Twice during the meal the electric thermostat changed the air when it was getting too hot.

The other guests seemed to be equally as anxious as I to see the room below after dinner, which had been served so delightfully. Our host, who seemed to guess at our thoughts, asked if we would not like to see the silent and obedient waiter who seemed never to lose sight of us. The piano meanwhile played a few familiar tunes as we smoked our electrically lighted cigars.

In the center of the serving room we found a rail leading to the table above in the dining room. The starters were on the left rail, and there were all kinds of indicators, clocks, telephones, switches and machinery for directing all "manœuvers" in the dining room.

Next to the "expeditor" there is the "prepairor" of all the good things—the kitchen. Here we found three switch-

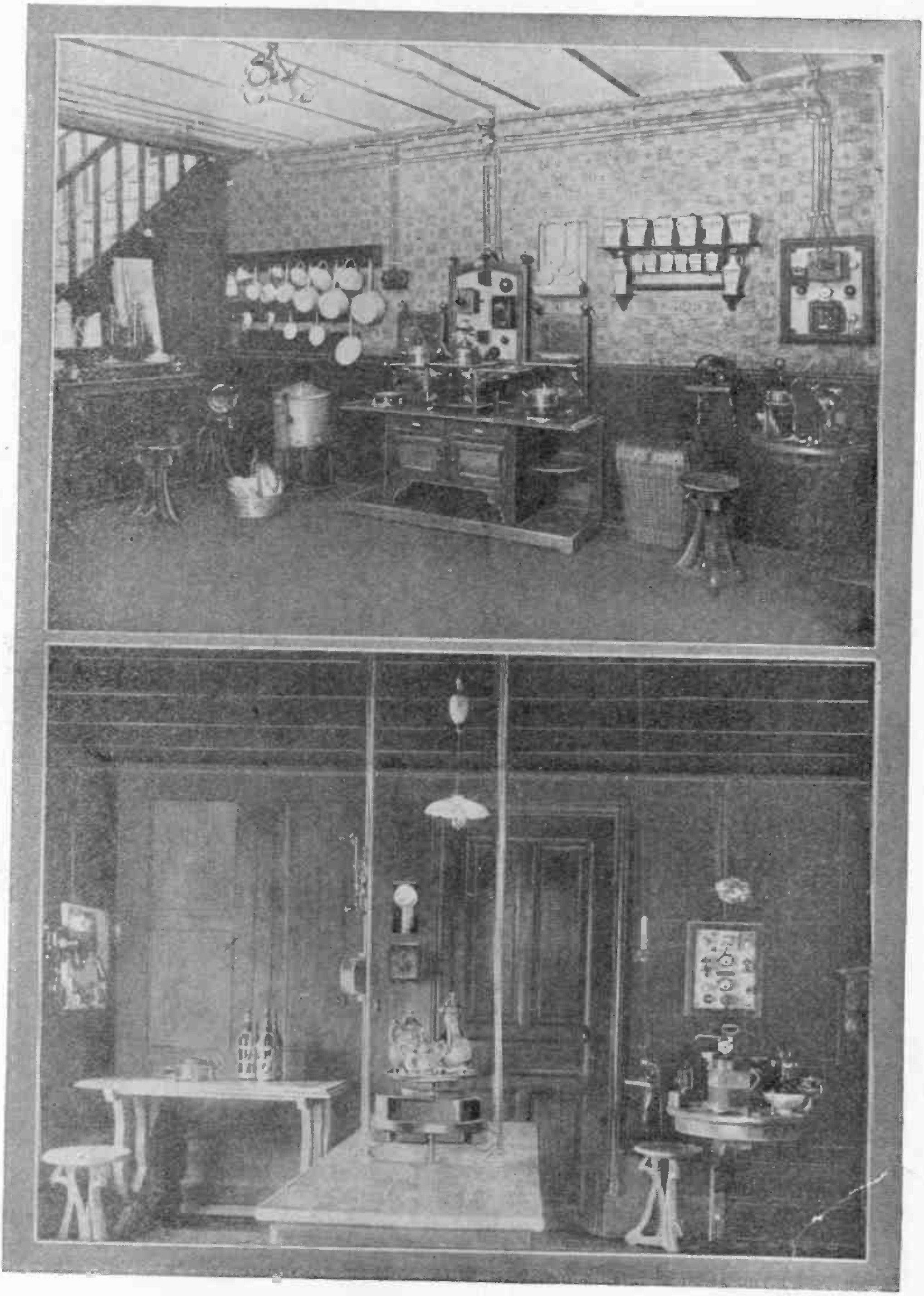
A TABLE OF RARE AND HAPPILY CHOSEN FORM

boards, two of which are shown in the illustration. All the devices had an electric time switch; that is, an instrument which cuts the current after one, two, five or ten minutes, etc. It has to be set to the number of minutes which a certain action needs and after that time has elapsed the current is cut off.

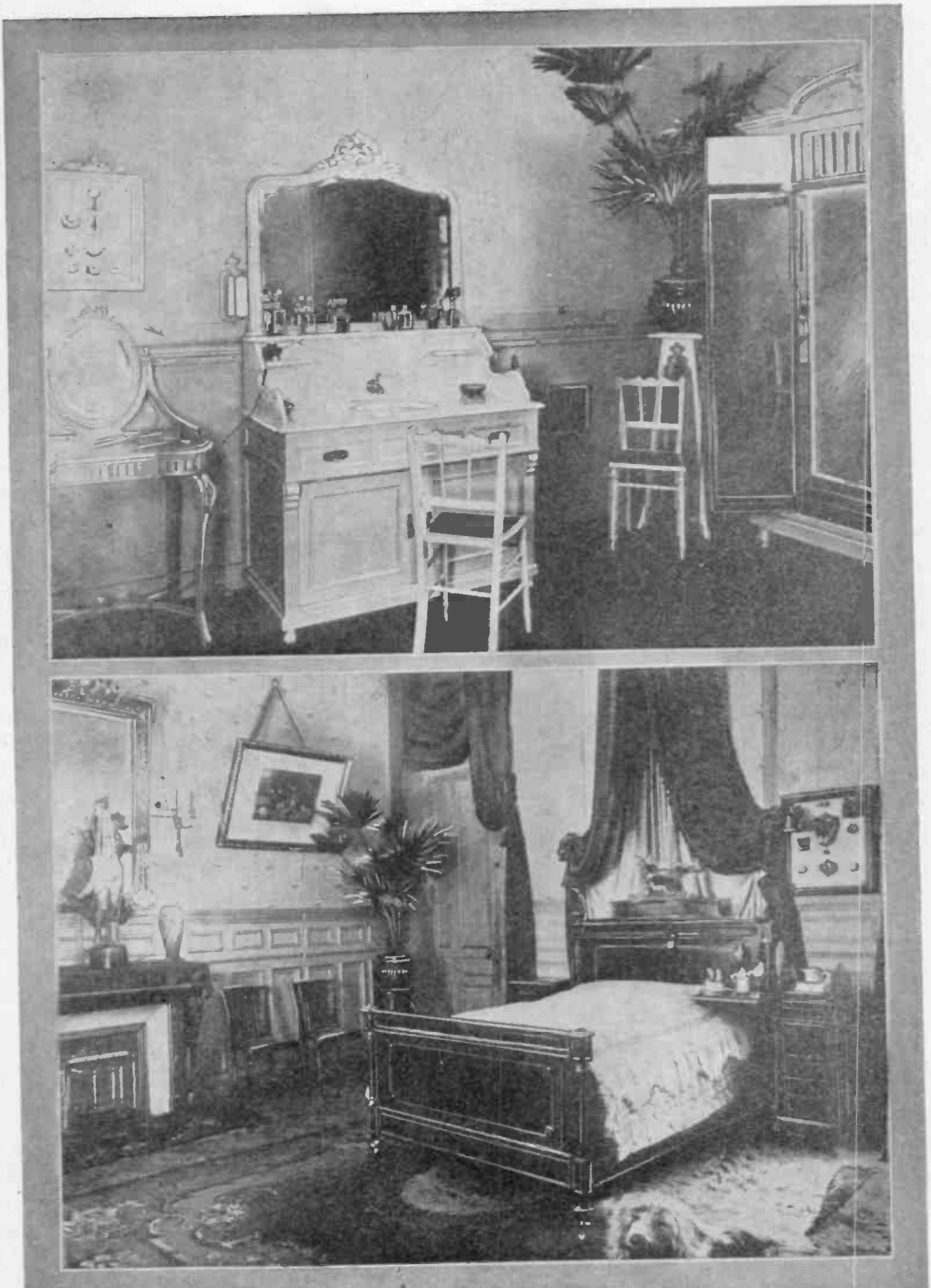
At the left in the picture of the kitchen we see electrically heating dishes. There was also a dish washer which cleaned all the dishes of a dinner, like the one of which we had just partaken, in three minutes without the need of being dried by a towel. Almost indefinite combinations may be performed with the electric stove in the center at the wall. I was informed even, that chickens and all roasts start cooking from the inside by the action of the violet rays of which so much has been heard already. The temperature may be regulated to any degree with absolute certainty.

"Boiled eggs" are not boiled with water but simply placed on the roast and the clock-switch cuts off the current for soft or hard boiled eggs as may be desired, by first pulling the handle at the switchboard. At the right of the picture there is shown a small motor which grinds coffee, makes butter, beats eggs, mixes pastry, etc. On the opposite wall there is an apparatus for purifying water by ozone, one pint per minute.

Having been shown around the kitchen we are asked to enter the bedroom, which, like the rest of the rooms, looks very much like a mystery to us. One night-table, at



HOW THE GOOD THINGS WERE PREPARED AND SERVED AT VILLA FERIA-ELECTRA



BEDROOM AND DRESSING ROOM IN THE VILLA FERIA-ELECTRA the right of the bed, is hollow and has rails like that in the serving room. Thus the tea is served, the mail, and anything which might be desirable. Breakfast ended, everything disappears below. Curtains are drawn from the bed by simply touching a button. The bed is warmed by electricity and kept at any regular temperature that may be desired. Electrically driven vacuum cleaners are used to keep the carpets and curtains clean. Burglar alarms indicate the approaching of anyone who is not wanted in the house. The lights in the center of the room can be reduced to almost less than one candle power if a person is sick and needs subdued light all night long.

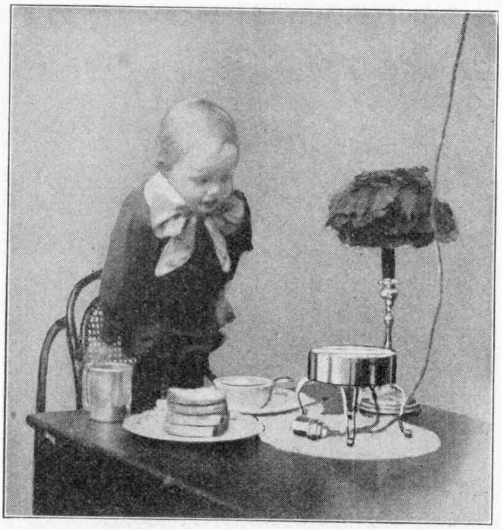
Leaving the bedroom we entered the dressing room. Here we find electric curling irons, electric combs to stimulate the hair and scalp. Hot and cold water can be drawn at any degree desirable. By opening the lower door of the lavatory a footbath may be taken, regulated by a switch to any temperature. An apparatus for drying towels instantaneously is shown at the right of the dresser. The lights in this room are all indirect because this is the most convenient way to make proper use of the mirrors.

Wherever we go we find two, three and four way switches. Thus we may, for instance, light the front entrance and garden from the bedroom and extinguish from outside or the vestibule, etc.

Having been afraid all the time to touch anything, Mr. Knap was anxious to convince us that there was absolutely no danger of being shocked by the current, all the current being supplied by a storage battery of a tension not exceeding 28 volts. These batteries are charged by the city alternating current which passes through an arc rectifier.

When I asked Mr. Knap how it was that no trace of all those wires and machines could be seen I was informed that the house was built on the plan of "double walls" which, he said, will be the future way of building houses which are kept entirely by the service of electricity.

The Electric Toaststove



Truly this is one of the most fascinating applications of electricity. Its brilliant incandescence on the dining table attracts and warms one. It is *so* cheerful. The spirally coiled heating element—just beneath the grid, literally radiates cheer, brought about by the turning of a simple switch One can't resist it

And so convenient! The "Toastove" gives the heat equivalent of an opening or burner of the range—in a super-attractive form, compact, readily movable, available for instant use at any time or place throughout the house, and for many uses as well as those which are characteristically its own.

An Electrical Laboratory for Twenty-Five Dollars

By DAVID P. MORRISON

There are no doubt a great many boys, reading Popular Electricity, who would like to be the proud possessor of an electrical laboratory, in which they could perform electrical experiments. The average boy, however, feels that he can never have such a laboratory, because it would cost a great deal more than he could have to spend. This limited financial condition, however, may be looked upon as your good fortune for the following reason. If you had all the money needed to fit our your laboratory complete with ready made apparatus, you would know practically nothing of its construction and operation and it is the opinion of the writer, judging from his own experience, that anything made at home, although it may not look or work quite so well as something you could buy will, nevertheless, be a great deal more instructive and the pleasure and satisfaction to be derived from the same will exceed that of the purchased article. It is the purpose of this series of articles to aid the boy, with ordinary ability and rather limited means, in building such apparatus as will be very useful in an amateur's laboratory. Practically all the tools that will be needed, with a few exceptions, are those to be found in every home. The following list may be useful to those who desire to purchase everything new. The prices of the various articles are not standard but will depend upon quality and where purchased.

Small iron plane	$ .40
22-inch medium tooth saw	.30
6-inch metal square	.25
6-inch compass	.10
½-inch wood chisel	.20
Medium weight hammer	.30
8-inch screw driver	.15
Two files, one medium and one fine	.25
Breast drill and set of bits	1.25
Pair 6-inch pliers	.25
Hack saw	.25
One 12 inch rule and straight edge	.10
Small iron vise	.50
Cold chisel	.20
	$4.50

First of all I would suggest that you get the privilege to use a certain space or room all the time so that your work will not in any way interfere with other people. You will find this quite convenient as you can go into your laboratory any time during the day that you have a few minutes and work, and then leave without having to put everything away, which will mean a great saving in time. Often there is a vacant room in the house, or a room can be partitioned off in attic, basement, or barn, that will serve your purpose very nicely. In selecting your laboratory you must bear in mind that you will want to take current from the lighting or power circuit, if there be one in the building.

Having decided upon the location of your laboratory you are ready to commence work inside. First of all you will need a work bench. This can be made from an old table that has been discarded, or you may be able to purchase one from a second hand furniture store for a small sum. If you are not able to obtain a table that is suitable, you can make a bench from lumber obtained from large dry goods boxes. In some cases a shelf may be fastened to the wall that will do as well as anything; but it is not always advisable because you are likely to damage the wall in nailing up your

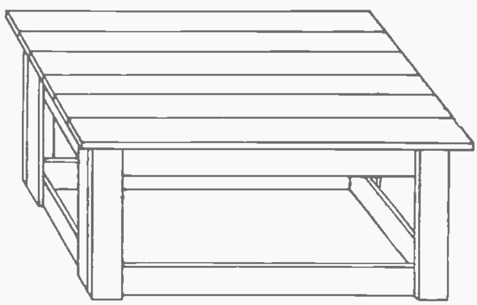


FIG. 1. THE WORK BENCH

brackets. The construction and dimensions of the bench will be left entirely with you, as the size of your room, lumber available, etc., will in a measure determine this. The bench shown in Fig. 1 will serve as a guide however. I made a bench of this kind when I was a boy and found it very convenient. I boarded up the back and two ends and made two doors in the front (not shown in figure) also placed a shelf about midway between the floor and top of the table. With this arrangement I was able by means of a hasp and small padlock to keep all my tools and material under lock and key.

Practically every experiment you will want to perform will require some source of electrical current and you had better next consider the various ways of producing and regulating this. Before you turn your attention to the means employed in producing this current, it might be well to make a very brief study of the electrical circuit and the various quantities that you will have to deal with.

The quantity of electricity passing in a given time through any circuit depends upon the electrical pressure or force that causes the electricity to flow and the resistance the circuit offers to this flow. The pressure or force that causes the flow of electricity is called the electromotive force, meaning, electricity moving force, and is usually represented by the letters E. M. F. or simply E.

That property of the circuit which resists, or opposes the flow of current, is called the electric resistance and is represented by the letter R and the current is represented by the letter I. An eminent scientist by the name of Dr. Ohm discovered that the electric current, the electric resistance, and electromotive force, were related to each other in the following manner and the simple equation expressing this relation is known as Ohm's Law.

$$\text{Electric current} = \frac{\text{electromotive force}}{\text{electric resistance}}$$

or

$$I = \frac{E}{R}$$

The value of the electromotive force is measured in volts, the current in amperes and the resistance in ohms. A dry cell has an electromotive force of approximately 1.4 volts. If this cell is connected to a circuit whose resistance is 3.5 ohms the current in amperes flowing in the circuit will be given by the following simple relation

$$I = \frac{E}{R} = \frac{1.4}{3.5} = 4 \text{ amperes}$$

If the electromotive force acts always in the same direction and remains constant in value, and at the same time the resistance of the circuit does not change, the current in the circuit will always flow in the same direction, and will not change in value. Such a current would be termed a steady direct current and may be represented by line (AB) in Fig. 2. The distance of line

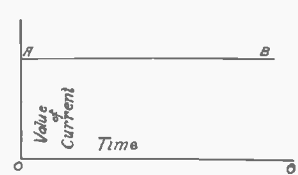


FIG. 2. DIRECT CURRENT MAY BE REPRESENTED BY A STRAIGHT LINE

(AB) above (oo) at any particular time stands for value of current. If now the electromotive force still acts in the same direction but changes in value, the electric resistance remaining the same, the current will no longer be constant but will change with the electromotive force. Since the current still flows in the same direction, but changes in value, it is termed a variable direct current and may be represented by line (AB) in Fig. 3.

When the electromotive force acting in the circuit rises and falls all the time, starting at zero and increasing, then decreas-

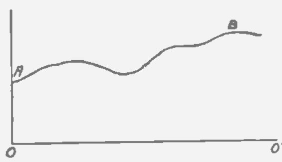


FIG. 3. VARIABLE CURRENT MAY BE REPRESENTED THUS

ing again to zero, in a certain time, repeating the set of values for each following equal interval of time, the resistance remaining constant, the current in the circuit will be called a pulsating current. Such a current would be represented by a line (ABCD) in Fig. 4.

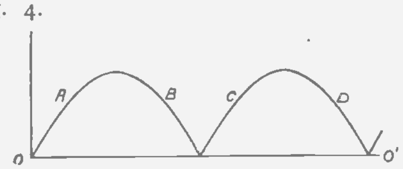


FIG. 4. PULSATING CURRENT IS REPRESENTED THUS

If the electromotive force acts for one interval of time in one direction and for the next interval of time in the opposite direction, the resistance remaining constant, the electric current is called an alternating current, since it is continuously reversing in direction. An alternating current

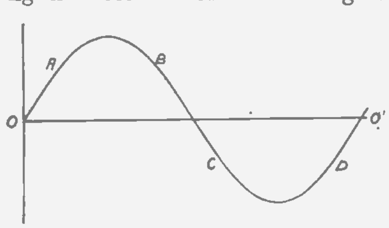


FIG. 5. CURVE REPRESENTING ALTERNATING CURRENT

would be represented by line (A B C D) in Fig. 5. The position of (A B C D) above (O O′) means current is in one direction while position below (O O′) means current is in the opposite direction.

Application will be made of the above discussion of different currents from time to time as you proceed with your work. Perhaps the easiest and most familiar means of producing a current of ordinary value is that of some form of battery. In quite a number of your experiments you will want a source of electromotice force that will produce a steady current of moderate value. The electromotive force of most batteries will remain practically constant (for a reason able time unless they are overloaded, or until they are exhausted) which will produce a steady current through a constant resistance.

All battery cells may be considered as belonging to one of two main groups. These are called primary and secondary cells. The construction of the secondary cell will be left until a later time. A primary cell consists of two dissimilar metals immersed in a solution of any acid or salt which is capable of dissolving one of the metals more rapidly than the other. In some cells there is a wasting of the materials all the time whether there be a current flowing from the cell or not. Such a cell is called a closed circuit cell; those in which the action in the cell ceases as soon as the circuit is open or there is no current flowing are called open circuit cells. There are hundreds of different kinds of primary cells but I am going to show you how to build a few of them. The following table gives some of the more important combinations.

Name	Materials Used	Solutions	E. M. F.
Edison Lalande	Zinc and copper	Caustic potash	.8
Daniel	Zinc and copper	Zinc and copper sulphate	1.08
Gravity	Zinc and copper	Copper sulphate	1.08
Leclanche	Zinc and carbon	Sal-ammoniac	1.4
Bunsen	Zinc and copper	Sulphuric and nitric acid	1.8
Grove	Zinc and platinum	Sulphuric and Nitric	1.8
Bichromate	Zinc and carbon	Potassium bichromate and sulphuric acid	2.0

The gravity or crow foot cell perhaps is one of the most common forms in use. It is used mostly in telegraph and signal work where the circuit is closed, or current is flowing from the cell practically all the time. In other words, it is a closed circuit type of cell. To make this cell we will first need a glass vessel about six inches in diameter and eight inches high. If such a vessel is not easily obtained you may be able to get some large round bottles from your druggist and have the tops cut off, which will make an ideal jar. You will next secure from the tin shop a piece of very thin copper about one and one-half inches wide and fifteen inches long. To one end of this strip solder or rivet a piece of No. 16 or 18 rubber insulated copper wire about fifteen inches long. The insulation should be removed a short distance from each end and the wire thoroughly cleaned before attempting to fasten the wire to the copper strip. The free end of this wire is to form the positive terminal of the cell. Now coil up the strip of copper similar to a clock spring and place it in bottom of jar.

You will now secure a heavy piece of zinc about one-half of an inch in thickness or

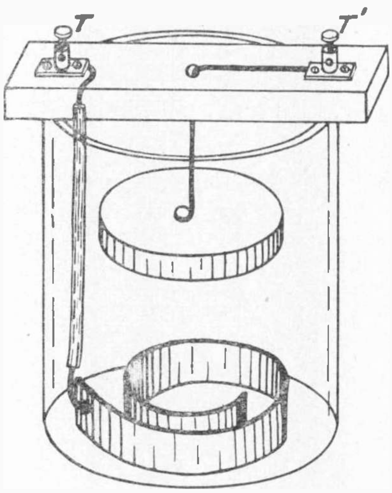


FIG. 6. THE GRAVITY BATTERY

more and four or five inches in diameter. To the center of this disk you can fasten by means of a rivet a piece of No. 16 or 18 copper wire. It might be well for you to heat the zinc plate and melt just a small piece of paraffin over the rivet which will prevent the zinc being eaten away at this point and destroying your connection. Care should be taken that paraffin does not flow over a large area of the zinc as it will destroy the action of the cell to a certain extent. The zinc can be held in place by passing copper wire, attached to it, through a piece of wood cut to fit the top of the jar as shown in Fig. 6. A sharp turn should be made in this wire on the upper side of the cross piece, to prevent the zinc from dropping down and coming in contact with the copper.

The distance between the zinc and the top of the copper strip should be approximately three and one half inches. It might be well for you to dip the top of the glass jar in melted paraffin to a distance of one or one and a quarter inches, this will prevent the solution from creeping over the upper edges. You can also boil a piece of the wood that forms the top of the jar in the hot paraffin for a short time and greatly increase its life and insulating properties. The terminals of the cell may be formed by fastening the ends of the two wires under two binding posts (T) and (T′) as shown in Fig. 6.

You are now ready to prepare the solution or set up your battery. Such a cell, as just described, will require about three pounds of copper sulphate, or blue vitriol, as it is more commonly known. Having placed your copper strip in the bottom of the jar pour the copper sulphate in and then put your zinc in place and fill the jar with rain water until the zinc is well covered. Your cell will not be ready for use for ten or twelve hours, during which time it should be allowed to stand short circuited. To short circuit it you simply connect the two terminals (T) and (T′) by means of a short piece of No. 18 copper wire. After this the cell should not be allowed to stand with no resistance between its terminals as its successful operation depends upon the fact that it should always be supplying a small current. A resistance of about 50 ohms or 300 feet of No. 32 copper wire wound on a spool should be connected to post (T) and (T′) when not in use. When the cell is operating properly there should be a blue solution in the bottom of the jar and a clear one in the top the dividing line being between the zinc and copper.

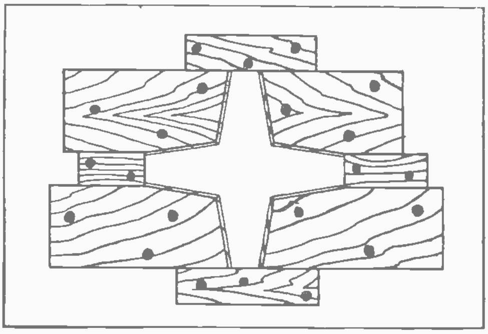


FIG. 7. MOULD FOR CASTING BATTERY ZINC

Quite often you may not be able to secure a piece of zinc of the dimensions given and if this be the case you can cast your own zinc elements. Assuming the distance across the inside of your glass jar is at least five inches, you can make a mold to cast your zinc out of pieces of pine as shown in Fig. 7. If the jar is smaller you will have

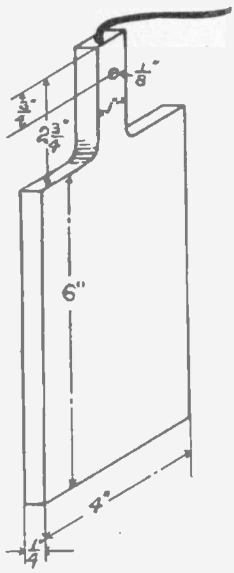


FIG. 8. ZINC BATTERY ELEMENT

to decrease the size of the mold. The pieces forming the mold should be cut so that your casting can be easily removed; that is, dimensions of the mold should be less at the bottom than at the top. The depth should be about one and a quarter inches. You can secure scrap zinc at any tin shop and this can be melted in a small iron kettle in an ordinary fire, it melting at approximately 750 degrees Fahrenheit. The mold should be thoroughly dried and a piece of bare copper wire of good size placed in the center and you are ready to pour in your zinc. You must be careful in pouring the zinc, not to have your face too near the mold, as any moisture in it may cause the zinc to be thrown out. The writer met with very good success in making zinc elements in this way when he was a boy. All impurities that collect on top of the molten zinc must be removed before it is poured into the mold.

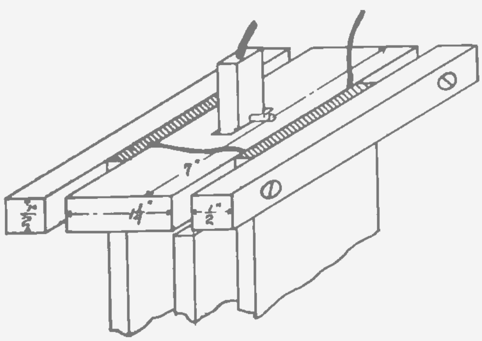


FIG. 9. HOW TO SUPPORT THE ZINC ELEMENT

With all the care you can use there wil be quite a bit of foreign substance in the zinc. This will reduce the efficiency of your cell, but its effect can be reduced by amalgamating the zinc in the following way. Place a few drops of mercury in a small saucer and pour on it a little dilute sulphuric acid. Now by means of a small rag tied on the end of a stick, rub the surface of the zinc with the sulphuric acid and mercury until it has a very bright appearance. The resistance offered by a cell itself to the flow of current when connected to a circuit, is

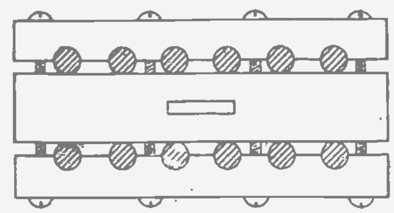


FIG. 10. HOW THE CARBON ELEMENTS ARE SUPPORTED

called its internal resistance. The internal resistance of the cell described is high, ranging from one to six ohms, hence you will never be able to obtain a very large current from it on this account.

The following directions are for the construction of a Bichromate cell, which has a very low internal resistance ranging from .2 to .5 ohms and a high voltage, approximately two volts. The containing jar for this cell will want to be of the same dimensions as that for the gravity cell. The elements are zinc and carbon. Your zinc element should be of the dimensions given in Fig. 8 and can be cast from scrap as in the

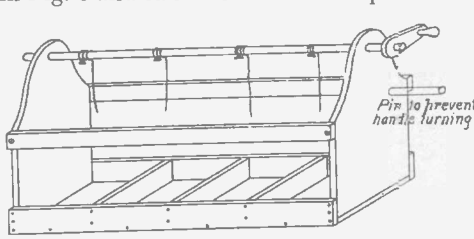


FIG. 11. DEVICE FOR REMOVING BATTERY ELEMENTS FROM THE SOLUTION

previous case. If possible you should secure two pieces of carbon approximately 4 by 8 by $\frac{1}{4}$ inches and fasten them to the piece supporting the zinc element as shown in Fig. 9, the distance between the carbon plates and the zinc being about one-half inch. If the carbon plates cannot be obtained you can use the common electric light carbons placing six on each side of the zinc and holding them in place as shown in Fig. 10. The zinc and carbons should be so fastened that they will be about one-half of an inch from the bottom of the jar when placed in position. If the electric light carbons are copper coated, this must all be filed off of that part that will be in the liquid and they should be connected by means of bare copper wires, twisted about each and their free ends soldered together. The wires may be soldered, however, to copper coated carbons. Two binding posts may serve as the terminals of the cell by connecting your wire from the zinc under one and that from the carbons under the other. It would be best for you to immerse the supporting strip for the elements, after they have been fastened in place, in boiling paraffin to such a depth that the paraffin extends a short distance up on carbon and zinc. They should be allowed to drain in an inverted position to prevent the paraffin from flowing over the surface that is to be in the solution. The solution for this cell is made by dissolving $\frac{7}{8}$ pound of sodium bichromate in a gallon of boiling water. After this has cooled add one pound of commercial sulphuric acid, and fill your jar to within $1\frac{1}{2}$ inches from the top. In making one cell you will not need this large quantity of liquid and it can be reduced by taking a proportionate part of each. When this cell is allowed to stand on open circuit there is a chemical action going on which tends to destroy the zinc. For this reason means should be provided for removing the elements from the solution when not in use. This can be accomplished as shown in Fig. 11, there being room for four cells. You will find this a very satisfactory cell to use when you will want a large current for a short time. If the cell seems to weaken more acid may be added.

NOTE: The next article will take up the construction of the dry cell and also the construction of an electrolytic rectifier and transformer as used in changing alternating current to direct current.

Motor Controller and Reversing Switch

By GEORGE STOCKHOFF

This piece of apparatus will be useful for controlling small battery motors and when built up according to directions has much the appearance and action of a street car controller.

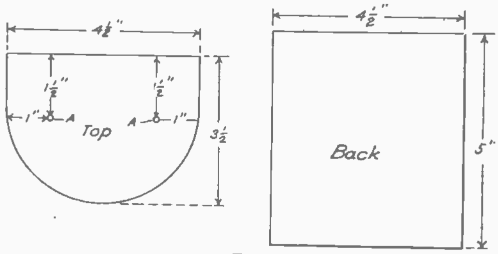


FIG. 1

The frame should be made first, preferably of hardwood. The dimensions are shown in Fig. 1. At (A) and (B) in the top piece drill five-sixteenth inch holes. The bottom is made the same except that the holes (A) and (B) are drilled only half way through, the wood being $\frac{3}{8}$ inch thick. When this is done nail the bottom on the $4\frac{1}{2}$-inch edge of the back piece.

After you have done this get a window shade roller $1\frac{1}{2}$ inches in diameter, cut the two pieces $4\frac{1}{2}$ inches long and bore a 5-16-inch hole in the end of each, about an inch deep. Then get a 5-16-inch dowel and cut two pieces $1\frac{1}{2}$ inches long. These two pieces are hammered into one end of each piece of roller, as shown in Fig. 2. You will need a short piece of No. 10 or 8 copper wire.

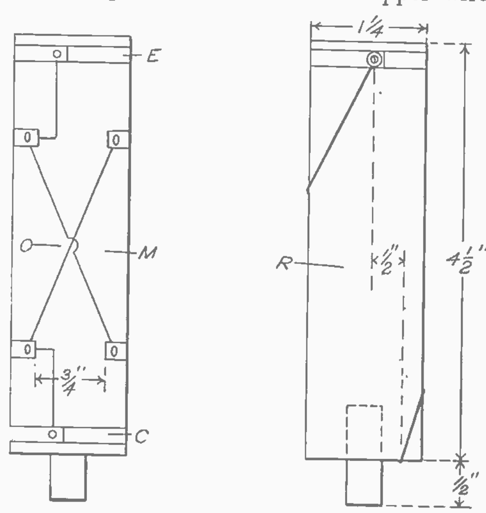


FIG. 2

This wire goes around roller (R) and is fastened at the top by a brass strip, (E) that goes around the roller. The wire

FIG. 3

should not go all the way around but should leave a half inch space as shown, Fig. 2. The wire should be laid in a groove, but not entirely below the surface, as the brushes are to touch it. Two strips of brass are fastened around roller (M) at the ends (C) and (E). Four other short strips are fastened as shown. They are one inch long and cross connected by No. 18 wire. They should not touch at (O).

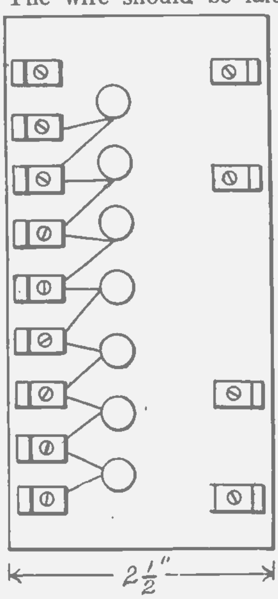


FIG. 4

Thirteen springs of brass are needed, $\frac{1}{4}$ inch wide and four inches long. They should be bent into the shape shown by Fig. 3. A hole is drilled in each at (L).

Cut a piece of wood five by $2\frac{1}{2}$ inches and $\frac{3}{8}$ inch thick. Now cut seven pieces $\frac{1}{2}$ inch long off of the dowel and drive a $\frac{3}{4}$-inch nail through each. After you have done this get five feet of No. 36 insulated copper wire, cut it into seven lengths, double each piece and wind it around the pieces of dowel as shown in the right in Fig. 3, forming resistance coils. They should be shellacked in order to hold the wire in place. The springs and resistance coils should then be nailed in place on the piece of board as shown in Fig. 4. Cut two pieces about two inches long off the 5-16-inch dowel and hammer into the top of both rollers. Now set the roller in and nail on the top. Then the board containing the springs and coils can be nailed in also. The springs must press firmly out the rollers. The top part of the dowels that project through the top must be squared to receive the controller handles.

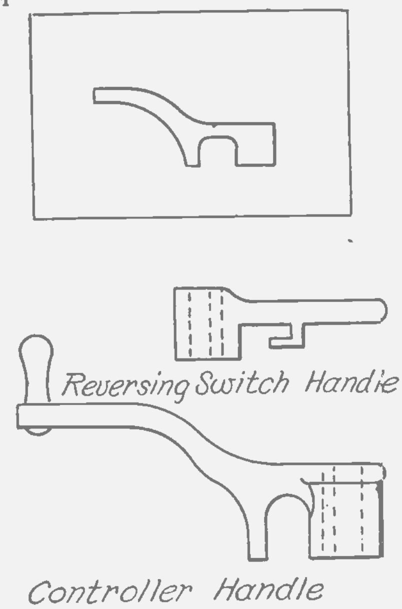


FIG. 5

The controller handles can easily be made of lead and then finished as in Fig. 5.

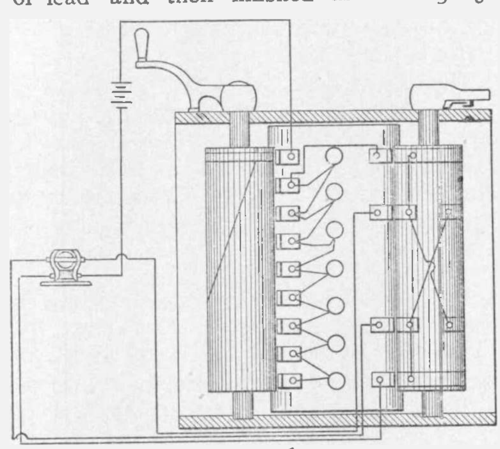


FIG. 6

Arrangement and the connections for a series motor may be seen in Fig. 6. By studying it you will see that as the controller switch is moved around the current is carried from the battery through the spiral wire through more and more of the resistance coils, cutting down the current of the motor. As the reversing switch is moved from one position to the other the current is reversed through the armature only, reversing the direction of rotation.

POPULAR ELECTRICITY WIRELESS CLUB

Membership in Popular Electricity Wireless Club is made up of readers of this magazine who have constructed or are operating wireless apparatus or systems. Membership blanks will be sent upon request. This department of the magazine is devoted to the interests of the Club, and members are invited to assist in making it as valuable and interesting as possible, by sending in descriptions and photographs of their equipments.

Naval Wireless as a Young Man's Opportunity

By A CHIEF ELECTRICIAN, U. S. N.

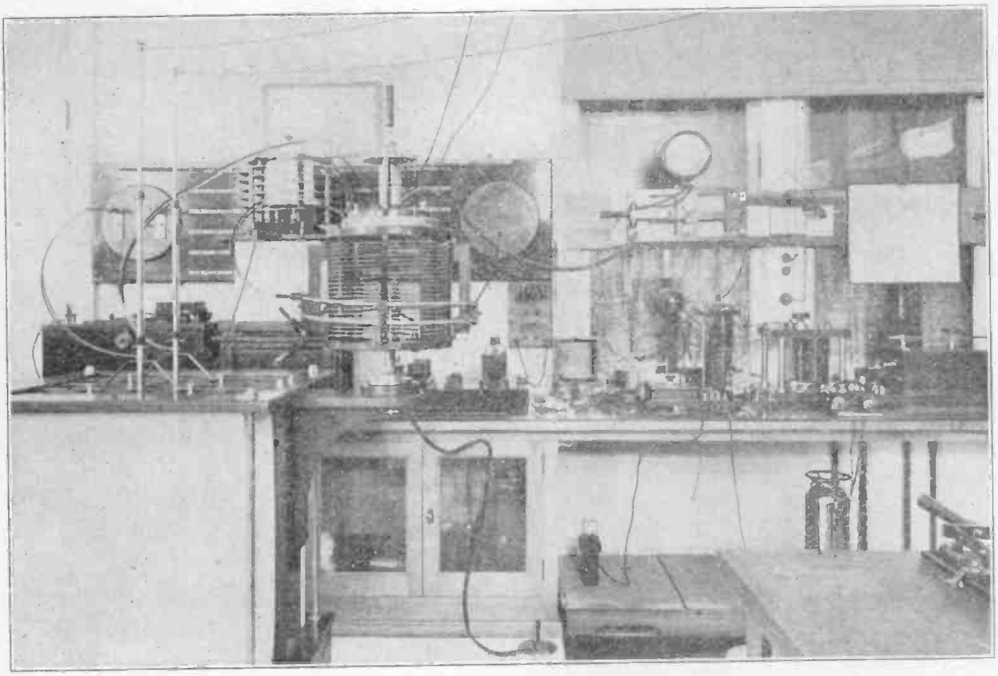
Good inducements are offered to the young man who desires to enlist in the electrical branch of the United States Naval service, and this includes wireless. To best illustrate the manner in which a position may be obtained as a wireless electrician in the navy, and the work after the position is obtained, we will take the case of a young man say in the neighborhood of twenty-two years (for he must be of age) who has had some experience in wireless or general electricity and who is about to present himself at one of the numerous navy recruiting stations for enlistment. But before doing this, if he is the kind of a young man who is most likely to succeed in the navy, he will have considered thoroughly his intended action and endeavored to learn the disadvantages as well as the advantages the service offers.

We will suppose he has been fortunate enough to find some one who has truthfully told him about navy life in general and he will have learned that all electricians below the chief electrician wear the regulation sailor uniform; that he is liable to do duty in any part of the world, and that he will at all times have implicitly to obey orders given lawfully from those his superiors in rank. But on the other hand he will be well cared for physically, and every inducement will be given him to work his way up if he is industrious and conducts himself properly. He will have ample time to study and get experience, as a rule in all branches of general electricity along with the wireless. With this understanding he presents himself at the recruiting office. There he will receive an elementary examination in electricity, being required to know about dynamos, motors and electricity in general. If he is enlisting especially for wireless work he will also show that he can send and receive at a fair rate of speed.

If he answers the questions asked satisfactorily and after being examined by the doctor is found in a good physical condition he is enlisted as a third class electrician with the pay of thirty-three dollars a month and found.

In the course of a few days he will be sent either to the receiving ship Hancock at the New York Navy Yard, or to the Receiving ship Pensacola at the San Francisco Navy Yard (depending usually upon which is the nearest) for instruction at the electrical school and to get acquainted somewhat with navy life. He will be quartered on board either the Hancock or Penascola with the other electricians attending the school and receive a complete outfit of clothing valued at sixty-five dollars.

The electrical schools at both the New York and San Francisco yards have commodious quarters and competent instructors and the course is from four to five months. The course is divided into three parts and all are required to take the same. The first month is spent in the machine shop where he learns to run lathes, shapers, drills, etc. The next two months are spent getting acquainted with the complicated naval appliances used on board naval vessels, and the last month or month and a half is spent in



MODERN NAVAL WIRELESS EQUIPMENT

the wireless department, where he becomes acquainted with the different types of wireless installations used in the navy, and receives practice in sending and receiving. The book to study and all material is furnished by the government and the course is thoroughly practical in every respect. Each week there is an examination and upon these examinations and his conduct depends his marks, and at the end of the course if the marks he has received are within 75 per cent of the possible he will be graduated from the school as a second class electrician and his pay will now be forty-four dollars a month.

If he has enlisted for wireless duty or if it has been decided at the school that he has shown marked aptitude for wireless work he will be transferred in the course of a few days to one of the shore stations or to one of the ships. The navy now has forty shore stations and nearly every ship of any importance has wireless installed. The shore stations rate from three to four operators with a chief electrician in charge and the ships rate from one operator for a sea going tug to four or five operators, including a chief for the battleships. Only shore stations and battleships rate a chief electrician; other classes of ships usually have a first class electrician in charge.

On shore the operators have wireless duty, only, but on the ships they are often given charge of the interior communication circuits of the ship in addition to their wireless duty. The navy department tries to give operators duty both on shore and at sea so that they will become thoroughly familiar with the work in all details.

The outfits at the shore stations and on the ships are up-to-date installations, and the operators are encouraged to use their own ideas within reason to improve the set and keep the plant up to the highest working efficiency. There are also a great many different tests carried on that are both interesting and instructive.

After serving one year as second class, and if his conduct has been good, he is allowed to take the examination for first class electrician, which if he passes successfully will increase his pay to fifty-five dollars a month. At the end of another year if there is a vacancy he can take the examination for acting chief electrician and which he should have no trouble in passing if he has taken an interest in his work and spent some of his spare time studying. His pay as acting chief electrician will be sixty-six dollars, being increased to seventy-seven dollars upon obtaining his permanent appointment as chief electrician. In the capacity of chief electrician he will have direct supervision of the station and be responsible for its conduct.

All of course do not make chief electricians in their first enlistment, although a great many do. But even if he has only been able to obtain first class he will have received in his four years a training and obtained experience that will be of the utmost advantage to him in following up his work in civilian life in case he does not care to reenlist.

A Variable Coupling Tuning Coil

By A. B. COLE

Early forms of tuning coils had either only one winding, provided with sliding contacts whose purpose was to vary the number of convolutions of wire in use, or had two windings, of which the secondary was provided with taps so that the number of sections into which the secondary was divided could be varied at will. In the latter case the primary and secondary were wound in much the same way as transformers for alternating current lighting circuits are made, and were immovable with respect to each other.

Nowadays, however, when several stations within each other's receiving range are liable to be transmitting simultaneously, more exact tuning is required than when there was little interference.

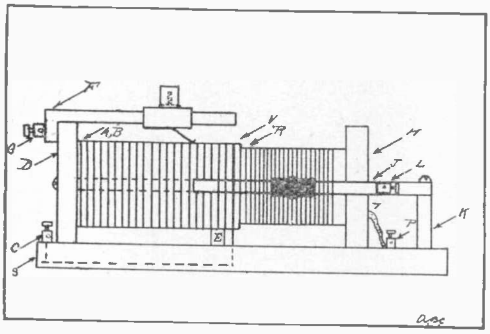


FIG. I. VARIABLE COUPLING TUNING COIL

The instruments which are considered most important at the present time for close tuning are the variable coupling, often called "loose coupling" tuning coil or receiving transformer, and the variable condenser. In this article we shall endeavor to show how a tuning coil of this type may be built.

The variable coupling tuning coil consists essentially of two windings, a primary and a secondary, each provided with one or more sliding contacts, which windings may be moved with respect to each other. Generally one of the windings has a fixed position, and the other may be moved so as to cut more or less of the lines of force developed by the fixed coil. Our coil will be composed of a fixed primary coil and a movable secondary coil. The dimensions will be given here in order to avoid confusion in the drawings.

The primary is wound on a round wooden core $4\frac{1}{2}$ inches in length, and three inches in outside diameter. The core is solid at one end for one-half inch, and is hollow the remainder of its length, with an inside diameter of $2\frac{3}{4}$ inches. The wood used for the core should be well seasoned oak or maple. The core is screwed to a suitable end, (D) Fig. 1, of oak, mahogany or maple, and (D) is screwed to the base (S). (D) is four inches square, and $\frac{3}{8}$ inch thick. The corresponding end of the secondary coil is of the same dimensions. End (V) of the primary is supported by a wooden block (E). The wire used on this coil is No. 18 double cotton covered copper, and is wound on evenly in one layer. This will require about 80 feet of wire. End (A) is fastened to a small nail (B) driven into the wooden core, and is not therefore connected electrically to anything. End (V) is connected by a No. 18 wire under the base (S) to bindings post (C).

Slider rod (F) is of brass, $\frac{1}{4}$ inch square, and $5\frac{1}{2}$ inches long, bent 90 degrees at one end, as shown, and drilled by a $\frac{1}{8}$-inch drill for the screw of binding post (G), which holds (F) in place, and also makes electrical connection with it. The sliders for both primary and secondary are of square brass tubing, each $\frac{3}{4}$ inch long, slightly more than $\frac{1}{4}$ inch square, inside dimensions. To one side of each slider is soldered a phosphor bronze or brass spring, $\frac{1}{4}$ inch wide, tapering to $\frac{1}{8}$ inch wide, and $1\frac{1}{2}$ inch long for the primary, and $1\frac{7}{8}$ inch long for the secondary. These springs are bent into the shape shown in Fig. 1. To the opposite side of each slider is soldered the head of an 8-32 machine screw. A hard rubber or fibre knob, $\frac{3}{4}$ inch long by $\frac{1}{4}$ inch in diameter is drilled and tapped for this thread. The knob is then fitted to the projecting shank of the screw.

The core of the secondary coil is of seasoned oak or maple, $2\frac{1}{2}$ inches in diameter, and $4\frac{1}{2}$ inches long, and wound to within $\frac{1}{2}$ inch of the end (H) with a single layer of No. 24 double cotton covered copper wire, of which about 120 feet are required. A hole $\frac{1}{4}$ inch in diameter is drilled through the center of both primary and secondary coils. Through these holes a brass rod of the same diameter passes, and is tapped at one end for an 8-32 machine screw. The other end of the rod is supported by a brass standard (K), as shown in Fig. 1, $\frac{1}{4}$ inch square and $1\frac{7}{8}$ inches long. Binding post (L) makes electrical connection with slider rod (J). A short length of flexible cord (T) connects end (R) of the secondary to binding post (P).

Fig. 2 shows the connections for the variable coupling tuning coil. (P), (J), (G) and (B) represent the same parts as in Fig. 1. By moving the primary slider, the inductance, and therefore the wave length, of the aerial and ground circuit may be varied. By moving the secondary slider, the inductance and wave length of the detector circuit may be varied, and these may be very closely adjusted by means of the variable condenser (VC).

To operate, move the secondary coil into the primary coil, and adjust the variable condenser to the maximum capacity. Adjust the primary slider until the signals from the desired station reach a maximum intensity. Then adjust the secondary slider to obtain best results. Next move the secondary coil along the rod away from the primary until undesired stations are eliminated as much as possible. Now adjust both primary and secondary sliders to the points which give strongest signals. This adjustment will be

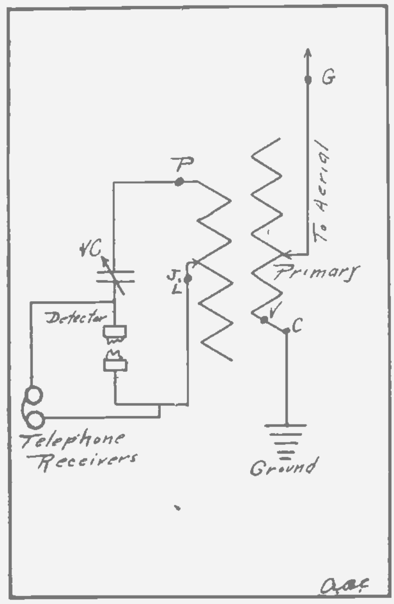


FIG. 2. CONNECTIONS OF TUNING COIL

very small. The final close adjustment is made by varying the capacity of (VC). This brings in the desired station to the exclusion of all others whose wave length differs by only a few percent.

The variable coupling tuning coil in connection with a variable condenser provides as close an approach to selective tuning as it is possible to obtain at the present time, and for this reason it has been adopted by nearly all commercial companies. The beginner must not become discouraged if at first he seems to get results which are not as satisfactory as expected, for all beginners with this type of coil have this experience. After a little practice, however, he will become able to get excellent results with it, and would not exchange it for any other type of tuner of the present time.

Condensers in the Receiving Circuit

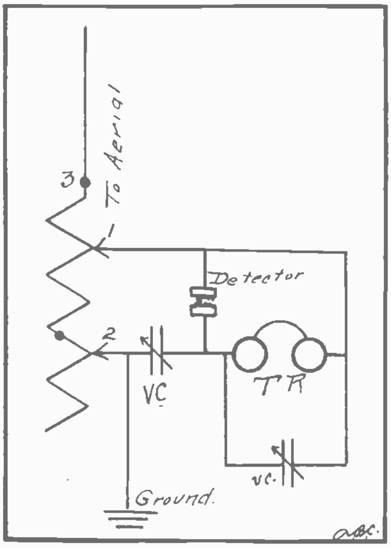
Although many of our readers use fixed and variable condensers in the receiving circuits of their wireless outfits, a considerable number do not fully understand the purposes of these condensers. To appreciate their uses, we must go back to the fundamental idea of tuning. In order to have two stations in tune, we must adjust the instruments so that the wave length of one station is the same as the wave length of the other. By the wave length is meant the effective wave length, resulting from the connection of the various instruments to the aerial.

If we are using a double contact tuning coil, as shown diagrammatically in the drawing, we have two receiving circuits to consider: that including the aerial and the active wire of the tuning coil between the end (3) and the lower contact (2), and continuing to the ground; and that including the wire between the contacts (1) and (2), the detector and the variable condenser (VC).

Suppose, now, that a certain station is transmitting, using a wave length of 400 meters, and that of the aerial which we are using is 250 meters. We wish to adjust our receiving apparatus to the 400 meter wave length. This is done by moving slider (2) until an inductance (wire on tuning coil) has been added, sufficient to give our aerial circuit (aerial, tuning coil, ground) a wave length of 400 meters. This condition is obtained when the signals desired reach a maximum intensity in the telephone receivers (TR). In order to obtain best results, it is necessary to have the detector circuit (tuning coil, detector, condenser) in tune with the aerial circuit. This is accomplished by moving the contact (1) to the most advantageous position. The fine adjustment may now be made by changing the capacity of (VC). A fixed or variable condenser (vc) is often used across the telephone receivers to increase the intensity of the signals. The action of this condenser is supposed to be that it absorbs energy from the detector circuit until a certain critical voltage is reached, when the total energy is discharged across the telephones.

The wave length of any circuit is dependent upon its inductance and its capacity. We may therefore vary the wave length by means of the tuning coil, or the condenser, or both. It will be found easier, however, to adjust approximately with the tuning coil, and then adjust closely by means of the variable condenser, since a very slight movement of the sliders of the coil corresponds to a considerable change in the capacity of the comparatively small condensers used for receiving tuning purposes.

The variable condensers (VC) and (vc) may have a minimum capacity of about



CONNECTIONS WITH VARIABLE CONDENSERS IN CIRCUIT

.0005 and a maximum capacity of about .003 M. F. The exact capacity is not required to be just these figures, but these capacities work very well in practice. Fixed condensers may be used in place of the variable type, but it will be seen from the above explanation that with them tuning is not nearly so close, since it must all be done by means of the tuning coil. Fixed condensers are, however, much less expensive than variables, and for this reason are used quite extensively in amateur stations. A very satisfactory fixed condenser may have a total surface of 150 square inches and be made of two strips of tin foil $1\frac{1}{2}$ inches by 50 inches, the strips being separated by a sheet of paraffined paper $2\frac{1}{4}$ by 55 inches, and rolled up into any convenient form. The condenser should then be soaked in hot paraffine, and when nearly cold should be pressed, so as to bring the sheets of foil as close together as possible. Copper wires make connection with the foil sheets.

Construction of an Electrolytic Detector

By ARTHUR O. BEHRENS

As is well known to most wireless experimenters, the electrolytic detector has been on the market for some time past and is the favorite of many stations, for it is reliable, and if well regulated, is one of the most sensitive known. By reason of this fact, it is the desire of many amateurs to possess one. The constructional details following will enable any experimenter, who is at all acquainted with the use of tools, to construct one of these detectors with very little expense.

The materials required are few and easily procured, the main article being a piece of fine

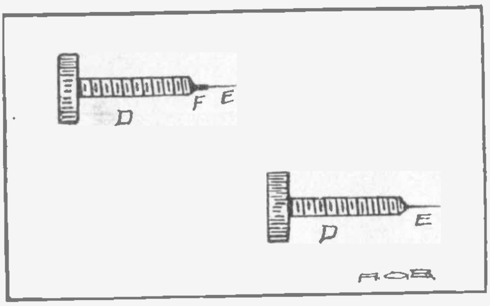


FIG. I

platinum wire about ½ inch long and from 0.005 to 0.0005 inch in diameter. Any of the sizes, between the two diameters given, will make an admirable point for the detector, when soldered to the 6-32 brass regulating screw shown in Fig. 1. Here (D) is the screw mentioned, and (E) is the fine platinum wire.

I might here conveniently state that the platinum wires, of such small diameters as those set forth, when received from the manufacturers, are covered with a comparatively heavy coat of silver, thus making them many times their own thickness and consequently enabling the user to handle them with greater ease. After the platinum-silver wire has been affixed to the regulating screw, it is dipped into a solution of nitric acid, which immediately attacks the silver coating and decomposes it, in this way exposing the platinum wire. This is exactly what we desire.

But to those who do not care to bother with so fine a wire as that just mentioned, and who do not require so sensitive a detector, I have the following suggestion to make. Procure a miniature battery lamp (a burnt-out one will do) of about 10 volts and in that will be found pieces of fine platinum wire which will take the place of that mentioned above. In breaking away the glass from around the wires, take great care that they are not injured or separated from the leading-in wires for these are utilized in soldering to the regulating screw. The finished screw is shown in Fig. 1, at the top, in which (F) is the leading-in wire and (E) is the platinum point. But be it understood right here that the finer the point the more sensitive the detector, therefore, where possible, I advise the use of the beforementioned fine platinum wire.

The cup to hold the electrolyte is to be made from a piece of hard carbon rod, ¾ inch in diameter and about one inch long. In one end drill a ⅜ inch hole to a depth of ½ inch. For a base to receive the carbon cup, select a piece of brass rod 1⅛ inches in diameter and one inch long, and in one end drill a 23-32-inch hole to a depth of ½ inch. In the other end drill and tap a hole to receive a screw to secure to the base. A 6-32 screw is about the right size. Into the 23-32-inch hole snugly fit the carbon

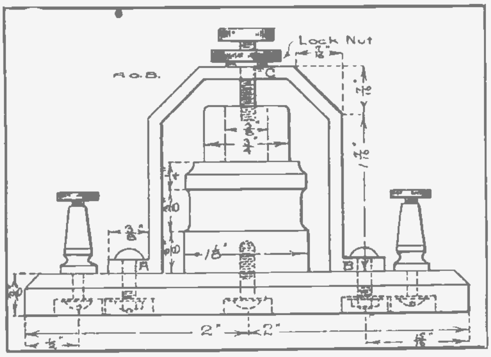


FIG. 2

cup, previously constructed, with the ⅜-inch hole outward. It must be a very tight fit, otherwise there would be a bad connection, and consequently loss of current.

For the yoke procure a piece of ⅛-inch stock sheet brass, ½ inch wide and bend into the shape shown in Fig. 2, in which (A) and (B) are No. 25 drill holes by which the yoke is fastened to the base. (C) is a hole drilled and tapped to receive the 6-32 brass regulating screw with fine platinum point. Of course it is understood, that if the amateur thinks he has a better idea for the yoke than that set forth in the preceding lines, he may substitute it, providing he does not alter the general plan to such an extent, that the platinum point does not reach the electrolyte when screwed down all the way, for, if such a state of affairs existed, there would be no connection between the antenna and the earth, and consequently no signals in the receiver.

For the base get a piece of hard black rubber 2½ inches wide, four inches long

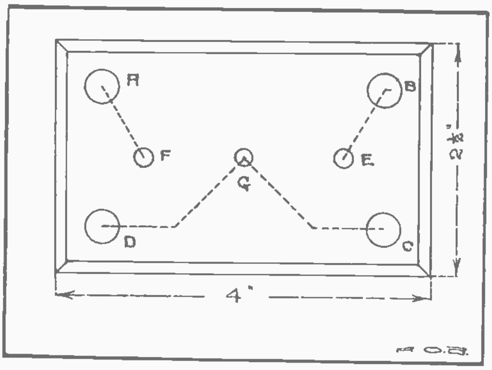


FIG. 3

and ⅜ inch in thickness. I might here again suggest, that if the amateur has not the hard rubber at hand, he may substitute some other material, but it must be a good non-conductor. Drill seven holes in it, with a No. 25 drill, as shown in Fig. 3, in which (A), (B), (C) and (D) are binding-posts; (E) and (F) are for screws to fasten the yoke to the base and (G) is for a screw to secure the brass support of the carbon to the base. All these screws are also made use of in making connections which are shown in dotted lines in Fig. 3, (A) and (B) being connected to (F) and (E) respectively, and (C) and (D) to (G).

Having proceeded thus far in the construction, the next thing to consider is the assembling of the finished parts, and the mode of connecting up the complete detector with the other receiving instruments. The former point, I believe, has been made clear enough throughout the article so that the experimenter will experience little difficulty on that score. It need be said, however, that to complete the detector an electrolyte is necessary. This is an acidulated solution, that is put into the carbon cup, and is prepared by adding one part nitric acid to four parts pure water. Be sure to add the acid to the water in all cases and not vice versa for the latter operation would be dangerous.

As for the second point, that of making receptor connections, a standard plan is shown in Fig. 4 in which are to be found receiving tuning coil, condenser, electrolytic detector just constructed, telephone receiver, potentiometer and local battery, switches, of course, being put in by the amateur where desired. As regards the condenser, I would suggest that this be of the variable type. With this style condenser the operator is enabled to give a louder tone to the messages that he receives.

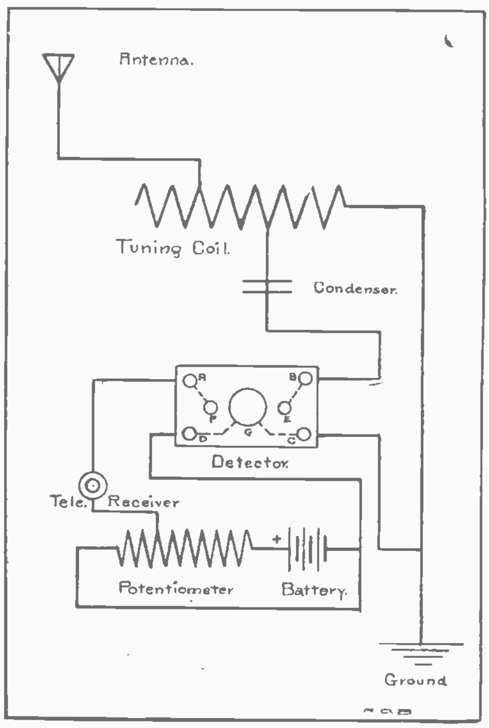


FIG. 4

The telephone receiver used with the electrolytic detector should be as sensitive as possible. One of a 1000-ohms resistance will do very well.

The potentiometer is simply a variable resistance coil, generally made with fine German silver wire, about No. 26 B. & S. gauge, and is used to choke back the surplus current of the local battery, only allowing enough to pass through to satisfactorily work the telephone receiver. The potentiometer should have a resistance of about 300 ohms.

The local battery is made up of from two to three dry cells and is connected with the potentiometer, telephone receiver and detector as shown in Fig. 4. Observe carefully, that the positive pole of the battery goes to the base of the yoke and thus to the regulating screw with the platinum point; the negative pole goes to the brass base of the carbon cup. In other words, if directions have been explicitly followed, the positive pole of the battery runs to (A), Fig. 4, and the negative to (D).

For receiving, the platinum point should just touch the electrolyte. The best results are obtained by manipulating the sliding contact of the potentiometer in such a way that the hissing noise, which is at first heard in the telephone receiver, just dies out. If the hissing noise is allowed to remain it will drown out other sounds and consequently destroy any signals that may be coming in.

The working theory of the detector is as follows: The acidulated electrolytic solution, coming in contact with the positive pole of the battery, which, in this case, is the platinum point, is decomposed to such an extent, that a minute quantity of hydrogen gas is formed on the point. This gas is an efficient barrier to the battery current, preventing it from passing. But the electricity received from the sending station by means of the antenna and ground is of an oscillatory character and it breaks down, with little trouble, this wall of gas, thus enabling the battery current to flow and work the receiver in accordance with the dots and dashes received.

In conclusion, I would suggest that the operator, when through receiving, should raise the platinum point from the solution. I also think it would be a good idea for him to keep on hand a small amount of the electrolyte ready mixed so that once in a while he can replace that already used. By following the foregoing instructions, I am sure the experimenter will be enabled to construct a detector, that, in its working capacity, will amply repay him for his labor and make him realize that his time was not spent in vain.

Receiving and Sending Radii

What will my receiving radius be with such and such apparatus? How far can I send with the following equipment? Over and over again these questions are asked us and over and over again we are obliged to answer that we do not know. Why? Because the terms are simply relative ones and when you give us only one side of the question we are helpless. For instance you have, say, a very good receiving outfit with high-resistance telephones, sensitive detector, good tuning coil, etc., and you ask us over what distance you will be able to receive. Obviously this depends as much upon the sending apparatus at the distant sending station as it does upon your receiving apparatus. If the other station has a four-inch spark coil and is 50 miles away, you would hear nothing. If it has a quarter kilowatt transformer the chances are the signals will be plain. Away off several hundred miles there may be a big commercial station of several kilowatts capacity and you may hear it. Along side it there may be a one kilowatt station from which you will never get a click.

It is the same with the sending radius. You might be able to disturb the ether one hundred miles away. Is there a receiver within that radius which is capable of detecting and determining your signals?

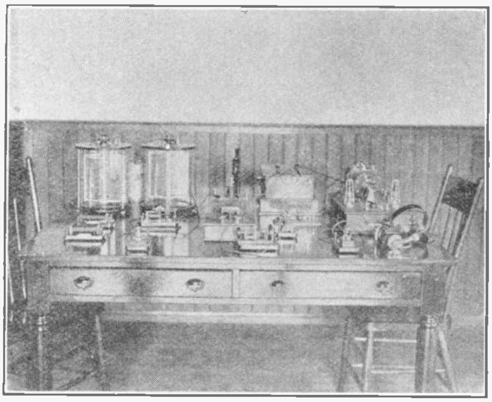
If you were to put the question to us like this: "My receiving apparatus contains such and such devices. Fifty miles away is a station equipped so and so. Can I hear it?" Then we might be able to give you an answer with some degree of accuracy, tempered of course by local conditions, such as overland and over-water transmission, day and night signaling, etc.

You who make use of the "Wireless Queries" department in the future, please remember the above.

As we said before, the terms are only relative. Some day these things may be standardized to a more or less degree. We may perhaps in the future have standard A-type, B-type and C-type transmitting equipments and so on, having certain capacities. And we may have standard A-type, B-type and C-type receiving equipments. Then if you were to have a receiving outfit conforming to the A standard type you might be told that you could hear a standard A transmitter at 100 miles, a standard C transmitter at 500 miles, and so on, governed, of course, again by local conditions.

The Study of Wireless

One of the most convincing proofs of the advancement of wireless and the increasing demands upon its practical application is the inauguration of schools for the teaching of this new art and the establishing of wireless classes in nearly all of the principal public schools of the country. We reprint herewith photographs from the American



GROUP OF RECEIVING DEVICES

Wireless Institute and a synopsis of its method of teaching. The general scheme is the same as that adopted by all the leading scientific institutions by which the student is carried by easy stages from a raw recruit to a practical wireless operator and engineer. The first period of learning is the memorizing of the telegraph code followed by actual practice in sending and receiving, by means of special devices that train the ear to receive wireless buzzer signals instead of clicks. Interspersed with this practice are lessons in elementary arithmetic, lettering, drawing of all wireless circuits, etc.

After thoroughly learning to send and receive wireless signals at the required speed the pupil is advanced into the wireless telegraph and telephone classes where he is taught the practical and theoretical construction and operation of the various instruments comprising the different systems. Thorough instruction is given on selection of station sites, building of proper grounds, antennæ, etc., to meet all demands, together with drawing and making of blue prints, calculating capacity of condensers and coils by the mathematical method, and by experimental means. Cross section paper is used

STUDENTS PRACTISING AT SENDING AND RECEIVING

for plotting various calibration curves of coils, etc.

One illustration shows a group of receiving apparatus representing all the known detectors. A very interesting experiment is conducted by the students in receiving four or five messages at the same time with the one antenna. Each set of instruments in a booth comprises a different system. Students are made to design and construct some type of wireless instrument, and the inventive ability displayed by some occasional "Tesla" is remarkable indeed.

The second illustration shows a group of students practicing at sending and receiving.

A Useful Detector Stand

One of the most desirable features of the amateur's or experimenter's wireless detector is that quick change from one crystal to another should be easily made, in order to compare various crystals for their receiving qualities. A detector stand for this purpose has recently been introduced which holds four different crystals if desired, and allows both quick change from one to another and also a wide range of pressure applied to the active crystals.

Fig. 1 shows the detector stand with hard rubber base and nickel plated metal parts. The cup (F) is stationary and is held rigidly by the thumbscrew of the standard. This cup holds the various crystals which the experimenter may be using. The crystals are held by rose metal or solder. Cup (E), which holds a single point of brass, or other metal, is carried on a rod (G) Fig. 2, and may be revolved by the hard rubber handle (B). A shoulder (D) on rod (G) is under pressure from a spring, the other end of

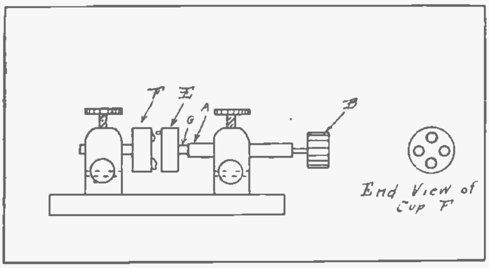


FIG. 1

which presses against a plug (H). Now if (A) is moved toward (F) it is evident that as soon as cup (E) meets cup (F) the spring (C) will be compressed, and will give a greater pressure on shoulder (D) and consequently greater pressure of cup (E) on cup (F). As soon as the desired pressure is

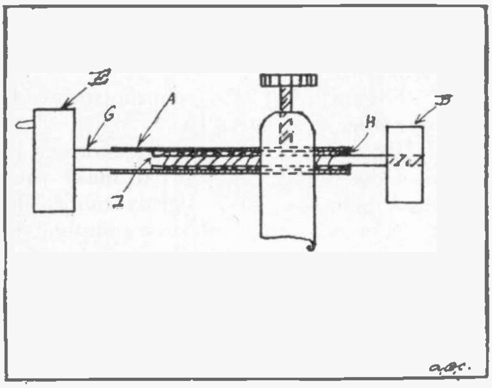


FIG. 2

obtained the thumbscrew on the standard holds (A) rigid. Now by turning (E) around by moving (B), the point in (E) may be made to touch any of the crystals in cup (F).

By virtue of its selectivity of crystals and variable pressures as shown above this detector stand will appeal especially to the experimenter. It is similar in most respects to that used by the Wireless Club of Columbia University in all long distance tests and has been found to give excellent results.

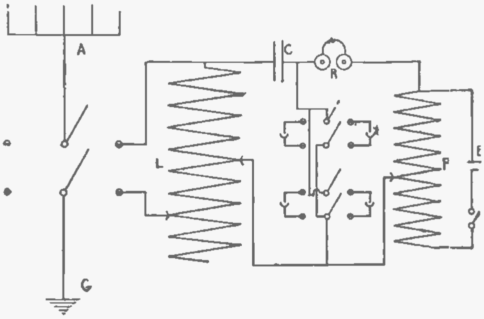
WIRELESS QUERIES

Answered by Valentine B. Seitz

Wireless Apparatus and Connections

Questions.—(A) Please give diagram of connections for operating wireless instruments including two D. P. D. T. switches, one S. P. S. T. switch, double slide tuning coil, fixed condenser, silicon, pericon, electrolytic and carborundum detectors, potentiometer, D. P. D. T. aerial switch and one pair 2000 ohm receivers, silicon and pericon detectors to be used without battery or potentiometer. (B) What would be my approximate receiving radius with the aerial 50 feet long, 75 feet high and five wires? (C) How do the above detectors compare as to sensitiveness?—R. L. H., Wayne, Pa.

Answers.—(A) See diagram.



CONNECTIONS OF WIRELESS APPARATUS

(B) From 150 to 200 miles.

(C) The electrolytic is the most sensitive detector when properly adjusted. You will probably find the pericon the most satisfactory of the above named detectors, as it is easy to adjust and compares very favorably with the electrolytic as to sensitiveness.

Potentiometer; Wave Length

Questions.—(A) Can I make a potentiometer by winding No. 34 German silver cotton covered wire around a wood core? (B) Show diagram of connections. (C) How can I find the wave length of my aerial?—P. P., Arkansas City, Kan.

Answers.—(A) Yes. By winding 100 turns around a three-inch drum, you will get a coil having about 350 ohms resistance.

(B) See diagram on page 458, November, 1909, issue.

(C) The best way to find the wave length of your aerial is by means of a wave meter. If one of these is not available, you can get a fair idea, by having some one compare your tuning point with that of some other station having a known wave length.

Determination of Wave Length

Questions.—(A) How is the wave length in meters of a sending helix calculated? Of a receiving helix? (B) Why should a sending helix be made with the larger wire and fewer turns than the receiving helix if it is to transmit waves of the same length as the receiving helix is to pick up? (C) Please give directions for making carborundum and molybdenite detectors. (D) What is the shortest and greatest wave length in meters of an antenna 75 feet from the ground and 60 feet from the double pole double throw switch? The sending helix has 20 turns of metal ribbon ½ inch wide, spaced ½ inch apart and 8 inches in diameter. There are also connected 10 leyden jars 3 by 6 inches, zinc spark gap and ½ inch spark coil. (E) In question D if a one inch spark were used for the same instruments would it make the wave length shorter or longer? —C. E. M., Louisville, Ky.

Answers.—(A) The wave length of a sending helix can best be found with a wave meter, as the calculation requires the use of advanced mathematics.

(B) The wave length does not determine the amount of current flowing and therefore would not govern the size of wire used. The amount of energy received amounts to only a small fraction of that sent out, therefore the receiving instruments do not have to be built as heavy as the sending.

(C) See the description of silicon detector in Nov., 1909, issue, page 543. Use carborundum or molybdenite in place of silicon.

(D) You will have a range from 100 to 550 meters wave length.

(E) The wave length will remain the same.

Aerial Height; Potentiometer Connections

Questions.—(A) Is a four-wire aerial, 100 feet long, too long for an inch and a half spark coil? If so what length should be used? (B) Show diagram illustrating how potentiometer described in July 1909 issue should be connected with a tuning coil and condenser. (C) What is the purpose of a secondary on a tuning coil?—O. H. R., Salt Lake City, Utah.

Answers.—(A) No. An aerial about 150 feet long would be even better.

(B) The potentiometer mentioned has not enough resistance to be very practicable for wireless work. Would advise the use of the cylinder wound type connected as shown in diagram in answer to J. S. C., this issue.

(C) A tuning coil having a secondary winding is generally called a receiving transformer. Great selectivity can be obtained with an instrument of this type, the advantage being shown in receiving weak signals through interference.

Resistance Wire on Tuning Coil

Question.—In constructiog a tuning coil could I use resistance wire on the spool in place of copper wire?—C. O. G., Pittsbugr, Pa.

Answer.—Resistance wire should never be used on a receiving coil or transformer.

Connections of Wireless Equipment; Transformer Operation

Questions.—(A) What would be my receiving radius with an aerial 57 feet high at one end, 40 feet at the other, double 1500-ohm receivers, variable condenser, electrolytic detector, double slide tuning coil, potentiometer, fixed condenser? (B) Please show best diagram for connecting both instruments? (C) What advantage have "gold" diaphragms over the ordinary ones? (D) How can I make the above outfit more efficient? (E) When you connect an ordinary spark coil for 110 volts, 60 cycles alternating current with the vibrator screwed down you get no spark, but if you let the vibrator move you get a fat spark. Please explain this. (F) Will you get more spark from a ½ k. w. open core transformer running it in series with an electrolytic interrupter (110 volts A. C.) than running it directly on 110-volt alternating current? —H. B., Martinez, Cal.

Answers.—(A) With favorable conditions you should be able to receive high powered stations at a distance of 200 miles.

(B) See diagram, answer to S. K., November issue.

(C) They will not rust from moisture collected while wearing.

(D) By using a receiving transformer in place of the tuning coil you can make your set more selective, also slightly more efficient. The advantage of loose coupling in a receiving transformer does not show up on loud signals or damped waves, but is very marked with weak signals on fine tuning. Interference can also be cut out to certain extent.

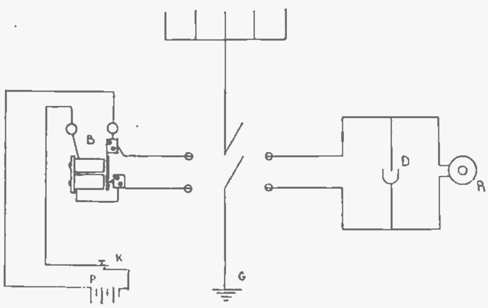
(E) An ordinary induction coil with an interrupter attached is not designed to work on alternating current without an interrupter, therefore when the interrupter is screwed down, very little spark will be obtained at the secondary, unless a very large amount of current is used.

(F) An open core transformer if properly designed will work on alternating current without the use of an outside interrupter. Several people have been advertising one-half K. W. open core transformers, but advise the use of an interrupter. These are not transformers as generally spoken of in wireless work, but really are nothing but small induction coils greatly overrated and worked at a very low efficiency.

Short Distance Wireless

Question.—What apparatus would be necessary to construct a simple wireless telegraph to carry three or four blocks?—H. B. H., Milwaukee, Wis.

Answer.—The apparatus for sending and receiving wireless signals over a short distance, need not be very elaborate and will cost but a very little. The sending apparatus consists of a buzzer or bell, four dry cells,



BUZZER WIRELESS SET

a key and a double point double throw switch. For receiving a good detector and a telephone receiver are required. A double receiver with a head band will be found the best, as all outside noise will be kept out. For a detector the Perikon, Ferron and Silicon can be recommended, preferably one not requiring a battery. The instruments should be connected up as shown in the diagram.

G—Ground	B—Buzzer
D—Detector	K—Key
R—Receivers	P—Batteries

Single Slide Tuning Coil

Questions.—(A) What are the dimensions of a standard single slide tuning coil? (B) How many pounds of No. 24 enameled wire are required for winding same? (C) How many pounds of No. 24 enameled wire would be required for a core 10 by 10 inches?—S. T. F., Delavan, Wis.

Answers.—(A) No standard size of tuning coil has ever been adopted, different sizes of wire and cores being used by different makers. A good coil can be made by using a core 4½ inches in diameter by 4½ inches long, wound with No. 28 wire and having a space the width of the wire in between turns. If the coil is wound in this way and a space ¼ inch wide is left at each end, about ¼ pound of wire will be required.

(B) If No. 24 wire is used in the above coil, about 6½ ounces of wire will be required.

(C) One pound 4 ounces if wound in the same manner.

Receiving Radius

Questions.—(A) What kind and size of wire is best for a loose coupled tuning coil? (B) How many feet of wire should be used on a sending helix and what will be its wave length? (C) How is the wave length determined? (D) How far ought I be able to receive with a receiving transformer (primary ¼ lb. No. 22 wire, secondary ¼ lb. No. 32 wire) two 75-ohm receivers, aerial 40 feet long and 40 feet high (5 wires about No. 16)?—L. C., Chicago, Ill.

Answers.—(A) No. 28 bare copper wire wound with a space the width of the wire in between turns.

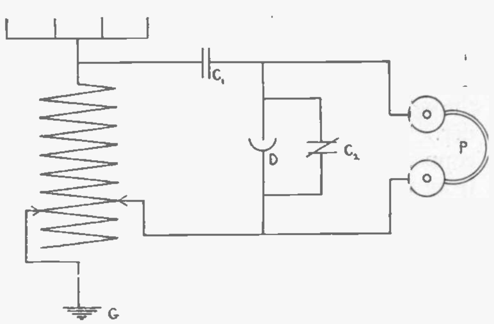
(B) See answer to L. R. page 324, September, 1909, issue.

(C) By means of a wave meter.

(D) As you do not give enough information in regard to your apparatus cannot very well answer the above question.

Connecting Tuned Set

Questions.—Please give diagram for connecting the following apparatus: double slide tuning coil, fixed and variable condenser, silicon detector, 1000-ohm head receivers.—J. S. C., Los Angeles, Cal.



CONNECTIONS OF TUNED SET

Answer.—See accompanying diagram.

QUESTIONS AND ANSWERS

Readers of Popular Electricity are invited to make use of this department. State your questions as clearly and concisely as possible. No consideration will be given to communications which do not contain the full name and address of the writer

Grounds on Three-Phase Circuits

Question.—With two phases of a three-wire, three-phase system in good condition what would be the effect of a ground on the third phase.—R. F. S., Steelton, Pa.

Answer.—A single ground has no effect. A ground on either of the other phases besides, would result in a short circuit.

Crowfoot Battery; Amalgamating Zincs

Questions.—(A) Please tell me the best way to keep a crowfoot battery busy during the day, as same is used only during the evening. (B) How do you amalgamate zinc?—A. J., Milwaukee, Wis.

Answers.—(A) Connect the battery to a 25-ohm coil or relay during the day.

(B) Dip the zinc into an acid bath, which will remove impurities from the surface, then pour mercury upon it rubbing this into the surface with a rag. The zinc should have a silvery appearance when done. You can also amalgamate zinc by dipping it in an acid solution of mercuric nitrate.

To Make a Gordon Cell

Question.—Kindly explain how to make a Gordon cell.—A. C. H., Milwaukee, Wis.

Answer.—Provide a porcelain or glass jar, having a fibre or porcelain cover. For the negative plate, suspend by a metal rod from the center of the cover, a perforated tin cylinder. In this cylinder place black oxide of copper, a depolarizer. About two inches from the bottom of this cylinder and on the outside of it attach three porcelain supports. These are to hold and insulate a zinc cylinder resting on them, this cylinder being the negative element. From this zinc run a rubber covered copper wire to and through a hole in the cover for the negative terminal. The metal rod at the center of the cover is the positive terminal. For the electrolyte use 1½ pounds of caustic soda and six pints of pure water, or this proportion of water and soda. Use water free from lime. Paraffin oil may be poured on the surface of the solution to prevent evaporation.

Arc Lamp Cut-outs; Transformers; Current Consumption; Street-Car Motor

Questions.—(A) Please explain automatic cut-outs used with arc lamps. (B) What is meant by transformer ratio? (C) Please give some transformer diagrams. (D) What determines the amount of current any device will take. (E) How does the street car motor tend to check the speed of the dynamo and engine?—W. C. S., Bilow, Miss.

Answers.—(A) Cut-outs on arc lamps serve several purposes. In all series lamps a device is provided which gives a path for the current in case the carbons fail to feed, or if they are used up. A cut-out used when the carbons are consumed is usually a contact attached to the carbon rod holder and making connection with another contact on a fixed part of the lamp. A lever is provided by which this contact may be made manually. If two lamps are run in series the automatic cut-out must also cut in a resistance equal to the drop in the lamp whose carbons are consumed.

(B) One coil of a transformer usually has more turns of wire than the other. If the primary coil has few turns and the secondary more, the transformer takes much current at a low voltage, and delivers a small current at a higher voltage. This transformer is called a "step-up" transformer. If, on the other hand the primary coil has many turns, and the secondary has few turns, the transformer takes little current at high voltage and delivers large current at low voltage. This transformer is called a "step-down" transformer. The relative voltage in the primary and secondary coils in each case depends upon the comparative number of turns in the coils, and is called the ratio of the transformer. For example, a transformer having 55 turns on the primary coil, and five turns on the secondary would step 110 volts on the primary down to 10 volts on the secondary and the ratio of the transformer would be 11 to 1.

(C) See May and August, 1909, issues, also article in September issue.

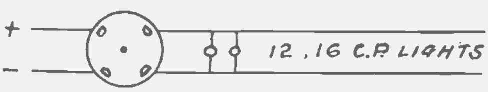
(D) Its resistance, and in the case of motors the counter electromotive force also.

(E) By requiring, when the car is started much more energy than when in motion.

Single and Double Pole Snap Switches; Lighting Circuits

Questions.—(A) A single pole snap switch is to be replaced by a double pole snap switch, owing to there being sixteen 16-candle-power lamps on the circuit where there were formerly only five. Please give diagram showing connections to be made in putting in the double-pole switch, and also state how many amperes it would have to carry. (B) Please tell how amperage for cutouts and switches is figured. (C) I have a combination switch and cutout which I want to place in my house to take the place of a knife switch, but I do not know what size plug fuses to put in. There are twelve 16 candle-power, 110-volt lamps in the house. (D) What current does a 110-volt, 16 candle-power take? (E) In my house there is a five-ampere snap switch for one 16 candle-power light, and in the building where I work there is a ten-ampere snap-switch for one such light. Will you please explain why the difference.—V. W. Sudbury, Ont., Canada.

Answers.—(A) You violate the National Electrical Code by allowing more than 660



CONNECTIONS OF DOUBLE POLE SWITCH

watts or the equivalent of about twelve sixteen candle-power lamps on one branch lighting circuit. The diagram shows how to connect a double pole switch to your circuit. See answer to J. W., Sept., 1909, issue regarding requirements as to where single and double-pole switches are needed.

(B) Switches must have a rating equal to the current required on the circuit they supply. Cutouts should have a capacity of not more than six amperes on a branch lighting circuit. Cutouts on power circuits should protect the wires of the circuit they supply by not being of a current capacity larger than the National Code rating for this wire.

(C) Use six ampere plug fuses.

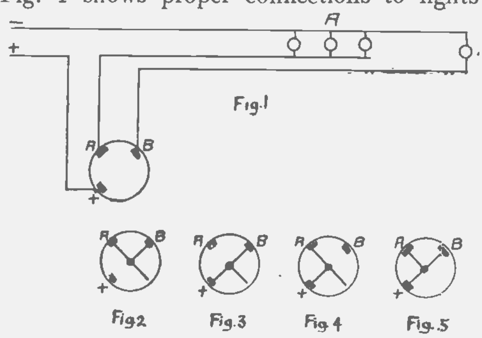
(D) One-half an ampere.

(E) A three-ampere switch would be satisfactory, or a half-ampere device, but the latter is not manufactured. The difference is probably due to the fact that the switch most readily at hand was installed.

Controlling Two Sets of Lights from the Same Snap Switch

Question.—Will you please explain by diagram how a light may be controlled at the end of a circuit by a switch having more than one light on it.—E. C., Haswell, Colo.

Answer.—If we understand your question, Fig. 1 shows proper connections to lights



CONTROLLING LIGHTS

(A) and (B) using a rotary snap switch having binding posts and blades as shown. Such a switch is sold by supply houses. Its operation is as indicated in the figures: Fig. 2, both lights (A) and (B) off; Fig. 3, light (B) on; Fig. 4, lights (A) on; Fig. 5, lights (A) and (B) both on.

Magneto Capacity; Primary Induction; Simple Rheostat

Questions.—(A) Will a magneto excite coils, run small motor, or light miniature lamps? (B) When my spark coil is connected with one side of the secondary grounded I feel a shock when I touch the primary. Please explain. (C) How can I make a simple rheostat for battery circuits of 6 to 10 volts?—L. M., New York, N. Y.

Answers.—(A) The ordinary telephone magneto has a capacity of only $2\frac{1}{2}$ to 5 watts, and is entirely unsuited for these purposes. High power magnetos, such as are used for gas engine sparking, may be used for lighting small lamps and exciting coils, but are not suited for running motors.

(B) The ground is induced back on the primary, and the shock you feel is the "extra" current induced in the primary by the make and break.

(C) Wind German silver wire in tight, slightly separated spirals around an insulating rod about the size of a lead pencil, and arrange a slide to move along the rod. One wire is connected to one end of the resistance wire and one wire to the slide. The finer the wire the more resistance you will get, but the less current it will carry. Heavier and longer wire will give the same results, and carry more current. Iron wire may be used if you cannot get German silver but the contacts are liable to be poor.

Magneto Bells and Battery Bells

Question.—Please explain the difference between a bell rung by a magneto and one rung by a battery. —A Reader.

Answer.—A battery bell is one used where a considerable amount of current can be supplied to it. The coils are wound with heavy wire. The armature is arranged so as to be attracted towards the magnet, when current passes through the coils, and at the same time break the contact which opens the circuit. The armature then springs back against the contact and is thus kept vibrating as long as current is applied. A magneto bell is arranged to work on a comparatively high voltage and very little current and the coils are wound with fine wire to a high resistance. The armature is pivoted in the middle and a permanent magnet is fastened to the ringer frame. The north pole of this magnet induces a south pole in the middle of the armature, the ends become north poles, the cores of the ringer magnets become south poles and the armature will s ck to either core indifferently. Current passing thronugh the coils will tend to cause one end of the core to become a north and the other a south pole; as both ends were already south poles one will be neutralized or reversed and the other end will be greatly strengthened thus causing one end of the armature to spring towards it. The next instant the current is reversed, causing a reversal of the poles and movement of the armature.

Voltage to Kill Rats; Batteries and Dynamo in Series; Water Rheostat; Bronzing

Questions.—(A) How many volts are necessary to kill a rat? (B) Would batteries connected in series with a dynamo have their voltage added to that of the machine? (C) Explain the action of a water rheostat. (D) Please give formula for bronze plating.—A. A. W., No. Chicago, Ill.

Answers.—(A) See the Oct. 1909 issue.

(B) Yes. But the current from the dynamo should not be more than the current output of the batteries.

(C) A water rheostat is used to introduce a resistance into the circuit, frequently as a load in testing machines. By Ohm's law, $C = \frac{E}{R}$, this resistance, R, will vary C, according as it is made large or small by moving the plates farther apart or closer together; or by leaving the plates stationary and introducing salt or sulphuric acid into the solution, R is made less and less.

(D) There are several solutions with which brass may be bronzed by simple immersion. Four are as follows: (1) Water, 1 pint; nitrate of iron, 5 drams; color given, brown and every shade to black. (2) Water, 1 pint; nitrate of iron, 16 drams; hyposulphide of soda, 16 drams; color, brown and every shade to red. (3) Water, 1 pint; tersulphide of arsenic, 30 grains; pearl-ash solution, 6 drams; color, yellow to red. (4) Water, 1 pint; hyposulphide of soda, 20 drams; color, blue. Further information may be obtained from a standard work, "Electro-Deposition of Metals" by Dr. Geo. Langbein.

Series Telephone Lines and Lightning Protector

Questions.—We have a metallic circuit of seven series phones 10 inches above a four phone bridged circuit running 15 miles over hilly country on 12 foot poles. The phones are protected by fused lightning arresters. For three months each year the series phones are nearly always out of service due to lightning during heavy rains. (A) Is it necessary to have fused protectors? (B) How can I protect the line? (C) If I decide to change the series line to bridging phones is No. 12 E. B. B. wire large enough.—H. J. M., Chihuahua, Mexico.

Answers.—(A) You do not want fused arrestors at all unless your lines get crossed up with light or power circuits. A lightning arrestor must ground the line, not open it. On your lines cut out all fuses. If you are bothered by power or light wires, arrange them so they cannot interfere with the telepone wires.

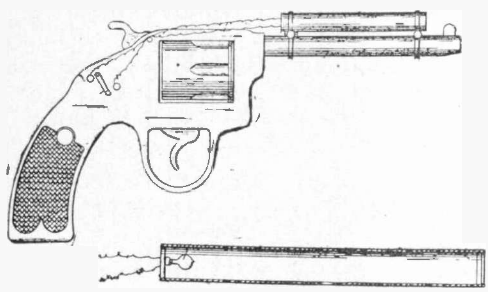
(B) Use common carbon arrestors, not fused, on each side of the line at each phone. Connect the ground plate to a good ground. Use mica separators between the carbons and you might double them if the discharges are very heavy. Instruct the parties to keep the carbons clean, but to leave them alone during a storm. Keep the line free of grounds and you will always have some of the phones in service.

(C) Yes. Might add that we sympathize with your troubles. It is a telephonic crime to install more than four series phones on a circuit. Cannot you remodel them by simply changing the ringers and rearranging the line.

NEW ELECTRICAL INVENTIONS

Accurate Aim Flashlight

This unique device consists of a tube, containing a miniature incandescent lamp, mounted on top of a revolver barrel. Upon

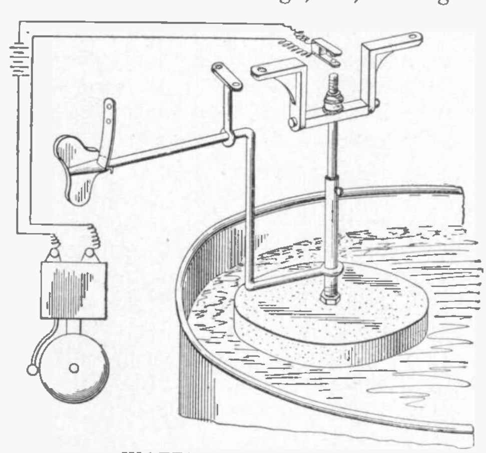


ACCURATE HEAD FLASH LIGHT

closing a switch in the battery circuit the sight is illuminated. The inventor is Dosier H. Mosteller of Chicago, Ill.

Water Level Alarm

This electric alarm, invented by Frank S. Dombrowski of Chicago, Ill., is designed

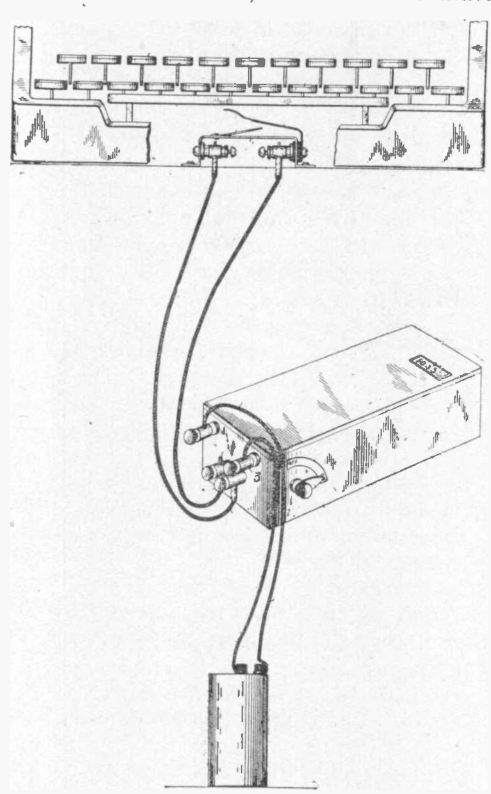


WATER LEVEL ALARM

to be used with water tanks. It rings an electric bell when the level of the water in the tank reaches a predetermined point. There is a float in the tank which rises with the water and the vertical rod affixed to it closes the bell circuit as shown in the illustration.

Word Meter

The word meter is an electrical attachment for typewriters. Every time the spacing bar of the machine is pressed down at the end of a word, an electrical contact

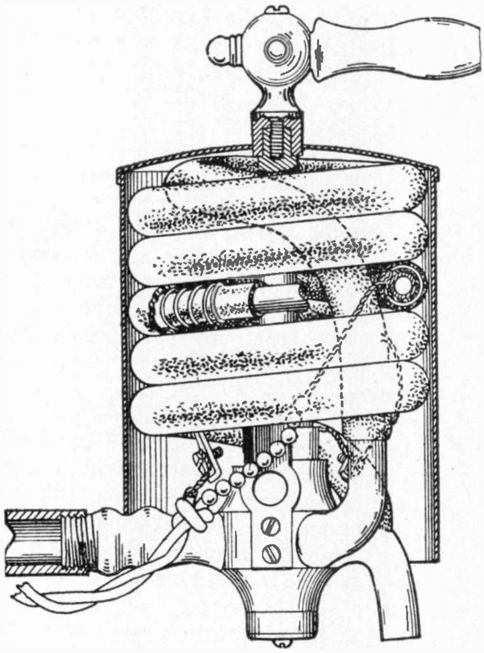


WORD METER

is closed which allows current from the battery to flow through little electromagnets within the box which in turn operate the counter. The numbers, being always visible on the dial, enable the operator to see at any moment the total number of words written. Herbert I. Watts of Winchester, Ind., is the inventor.

Instantaneous Water Heater

In this instantaneous electric water heater, which is the invention of Frank A. Robinson of Pittsfield, Mass., there is a cylindrical casing which contains a coil of pipe. One end of this coil is attached to the water service pipe and the other terminates in a

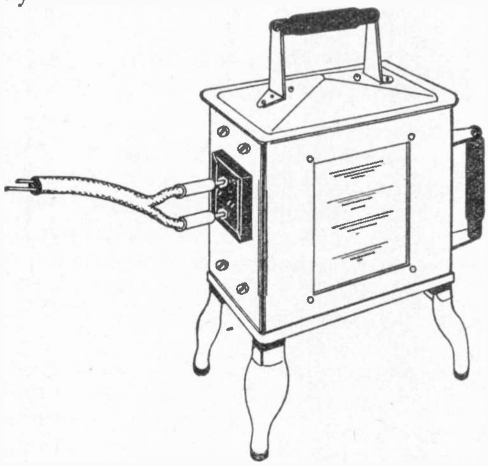


INSTANTANEOUS WATER HEATER

discharge nozzle. Around the pipe and insulated from it are a great many turns of resistance wire, connected to the lighting service. This wire heats up very rapidly, as a current of electricity is sent through it and in turn heats the water in its long path through the convolutions of the pipe coil.

Electric Toaster

This electric bread toaster embodies a casing provided with a removable cover and a heating element located in the casing. The latter is formed of a continuous resistance wire wound around or about a bread receiving rack in such a manner as to heat both sides of the bread simultaneously, and so arranged that none of the crumbs can fall on the wires to clog or affect their heating capacity. The ends of wire are then electrically connected to suitable terminals on the casing which lead to a suitable source of supply, such as an ordinary lamp socket, by a flexible cord.



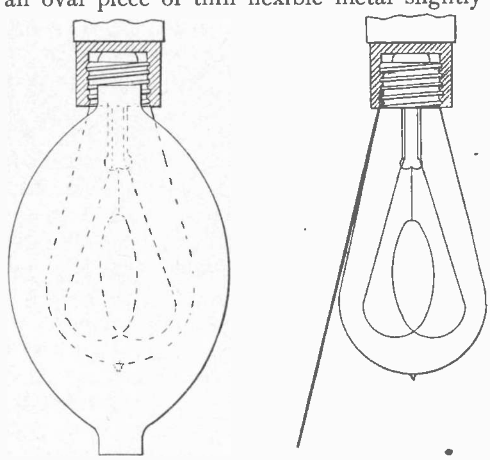
ELECTRIC TOASTER

An essential feature of the toaster is that the casing is provided with one or more windows through which the condition of the bread may be observed while toasting.

The inventor is Harold E. Bradley of Apponang, R. I.

Lamp Shade

John De Yongh of New York City has taken out a patent on a simple electric lamp shade designed to shut off the light from one side of the lamp. It consists of an oval piece of thin flexible metal slightly



LAMP SHADE

larger than the globe. At one end is a little tab or ear which screws into the lamp socket along with the lamp. The illustration shows two views—back and edgewise.

Notes on Patent Infringement

By OBED C. BILLMAN. LL. B., M. L. P.

Specific Acts of Infringement—Making, Using, or Selling Patented Invention in General; Experimental Making or Using; Repairing or Reconstructing Worn-out Article; Contributory Infringement.

General Rule.—Three exclusive rights are secured to a patentee by his letters patent, viz., the right to make his invention, the right to use it, and the right to vend it to others to be used. Broadly speaking, it is an infringement to invade anyone of these rights.—Tuttle v. Matthews, 28 Fed. Rep. 98. See also Birdsell v. Shaliol, 112 U. S. 485.

Making.—The prohibition against making is as applicable to machines as to the composition of matter. It is an infringement to make for use, although the invention is not used, or is not used by the maker; or to make for sale, though no sale is actually effected; or to make for sale abroad.—Butz Thermo-Electric Regulator Co. v. Jacobs Electric Co., 36 Fed. Rep. 191; Haselden v. Ogden 3 Fish Pat. Cas. 378, 11 Fed. Cas. No. 6,190. Bloomer v. Gilpin, 4 Fish Pat. Cas. 50, 3 Fed. Cas. No. 1,558; Ketchum Harvester Co. v. Johnson Harvester Co., 8 Fed. Rep. 586.

The Manufacture of a Part of a Patented Article During the Term of a Patent with the intent of incorporating it in the patented article immediately upon the expiration of the patent is not an infringement, since infringement cannot take place until the thing is completed; but the sale after the expiration of a patent of an article illegally manufactured while the patent was in force is an infringement.—American Diamond Rock Boring Co. v. Sheldon, 1 Fed. Rep. 870.

Using in General.—The unauthorized use of a patented invention is an infringement even though it was made by a third person.—Breshnahan v. Tripp Giant Leveller Co. (C. C. A.) 102 Fed. Rep. 899. Where articles containing infringements of a device patented in England were imported from a foreign country and stored temporarily in England before being exported to Scotland, to which company the patent did not extend, it was held that there was a user in England amounting to infringement of the English patent.

By Foreign and Domestic Vessels.—The use by a foreign vessel in a United States port of a patent article lawfully procured in a foreign port does not infringe the United States patent;—Brown v. Duchesne, 19 How. (U. S.) 193. But in the case of an American vessel, the unauthorized use on the high seas, even, of an article patented in the United States, is an infringement.—Gardiner v. Howe, 2 Cliff (U. S.) 462, 9 Fed. Cas. No. 5,219.

Selling in General.—An unauthorized sale is an infringement, although the article was made by another person.—Haselden v. Ogden, 3 Fish. Pat. Cas. 378, 11 Fed. Cas. No. 6, 190. But the sale of materials for a patented machine is not an infringement, unless it is for the purpose, and with the intent, of violating the patentee's rights.—Steam Stone Cutter Co., v. Sheldons, 21 Fed. Rep. 875.

Patented Article Purchased Abroad.—It is an infringement to sell in the United States a patented article purchased in a foreign country from one not claiming under the United States patentee, even though the purchase was made from a person authorized to sell in such foreign country.—Boesch v. Graff, 133 U. S. 697; But the sale in the United States of an article purchased abroad from the United States patentee is not an infringement, unless the purchase was coupled with a restriction forbidding use or sale in the United States.—Dickerson v. Matheson, (C. C. A.) 57 Fed. Rep. 524, affirming 50 Fed. Rep. 73.

Product of Patented Machine or Process.—A patent for a machine or process alone is not violated by a sale of the product of an infringing machine or process.—Welsbach Light Co. v. Union Incandescent Light Co. (C. C. A.), 101 Fed. Rep. 131, nor does the sale of a device infringe a patent for its use.

Goods Embodying Patented Design.—The sale during the life of a design-patent of goods to which an infringing design has been applied, is an infringement even though the goods were manufactured or the design was applied thereto before the granting of the patent.—Pirkl v. Smith, 42 Fed. Rep. 410.

Experimental Making or Using.—The experimental making or using of a patented invention for the sole purpose of gratifying curiosity or a philosophical taste, or for mere amusement, is not an infringement.—Bonsack Machine Co., v. Underwood, 73 Fed. Rep. 206. This rule, however, cannot be invoked for the protection of one who uses a patented invention in the ordinary course of his business, or who derives a profit from the result of its so-called experimental use.—Frearson v. Loe 9 Ch. D. 48; Poppenhusen v. New York Gutta-Percha Comb Co. 2 Fish. Pat. Cas. 62, 10 Fed. Cas. No. 11,283, even though the patentee has publicly offered to sell licenses. Indeed, if the use is of advantage to the user, it need not necessarily be profitable in order to fall without the rule permitting experimental use.—United Telephone Co. v. Sharples, 29 Ch. D. 164.

(Specific Acts of Infringement Continued in next issue.)

BRANCH'S CHART BOOK SERIES. By Joseph G. Branch. Chicago: The Branch Publishing Co. 1909. 75 pages with 9 illustrations. Price, 50 cents. In cloth 75 cents.

The first of the series, devoted to the dynamo, is intended for the use of students, high schools and colleges. It tells in a few concise paragraphs how Faraday discovered the principle of the dynamo by his series of immortal experiments. Step by step the principle of the dynamo is made clear and the various parts which go to make up the modern machine are explained. Large full page diagrams in two colors enhance the value of the work

HANDY MAN'S WORKSHOP AND LABORATORY. Compiled and edited by A. Russell Bond. New York: Munn & Co., 1910. 465 pages. With 370 illustrations. Price $2.00.

Every practical mechanic has been confronted at one time or another with unexpected situations calling for the exercise of his own ingenuity and resourcefulness. Many who have met and overcome these obstacles are not adverse to making their methods public, for the benefit of others who may find themselves in the same predicament. A department for the use of such practical workers has for some time appeared in the Scientific American and the book under consideration is a careful selection and compilation of the most valuable of these ingenious ideas, wrinkles, "kinks," or whatever we may call them.

The suggestions came originally from men in all walks of life—resourceful men who showed their aptness in doing things about the house, in the garden and on the farm. Electricians, physicists and chemists furnished another tributary to the flood of ideas. Automobiles, motor boats, motor cycles and the like aroused the ingenious natures of many men who could before never be induced to touch a tool, and this class of self-found mechanics contributed its share. Taken altogether, therefore, this is an intensely practical book embodying the best ideas of hundreds. Start to read it and the chances are you will find your hands itching to get hold of some tools and go to work in a shop of your own even as Abdul Hamid, lately deposed ruler of the Turks.

National Electric Light Association Proceedings

To record all the papers and discussions, committee reports, etc., of the Atlantic City convention of the National Electric Light Association held last June requires three large volumes known as the "Proceedings." To electric light men, these three books, containing about 2,500 pages, are a compendium of interesting and valuable information bearing on all phases of the manufacture and distribution of electric current.

Mr. T. C. Martin, the new executive secretary, reports that since the Atlantic City convention the association has had a remarkable growth and its membership today is over thirty-seven hundred. But this growth will not stop, for in Mr. H. H. Scott, chairman of the membership committee, the association has an aggressive and persevering individual who is even now laying extensive plans to follow up every "prospect" and keep hammering away until that prospect becomes a member.

The National Electric Light Association is now a great national organization of immense good to an industry which is among the greatest. The annual convention is the great event of the year to its members who later on are able to digest at their leisure all that took place, through the medium of the "Proceedings" published at considerable expense for their benefit.

ON POLYPHASE SUBJECTS

Electric Light and Power for Country Homes

The need of electric lamps in isolated localities not reached by central station service has long been felt and has been one of the deterring influences in the trend of population from city to country. The safety, cleanliness and convenience of electric current not only for lighting but also for general power purposes is fully recognized by those living in the country, and there is every incentive to make it universally available. Along with his telephone and daily mail delivery the farmer is bound sooner or later to have electricity on his place, and in answer to his strenuous demands various systems are being developed and placed on the market for his approval.

Windmills suggest themselves at once as a cheap source of power. But there are certain inherent disadvantages in the operation of dynamos by wind power which have never been overcome unless it should be by the new wind power plant of the type which is fully described in this issue. In a comparatively few localities farmers are able to make use of current sold to them by electric railway companies with lines running near the farms. Such cases are the exception, however. Again, other farmers have developed small water-powers on their places and still others have used steam engines for the purpose. But for all these various methods country lighting plants were few and far between until the gasoline engine was perfected sufficiently to make it a factor in the problem. Then the situation changed and it now appears that the small gas engine electric plant is going to bring to the door of the farmer another of the things which were long supposed to be "citified" luxuries.

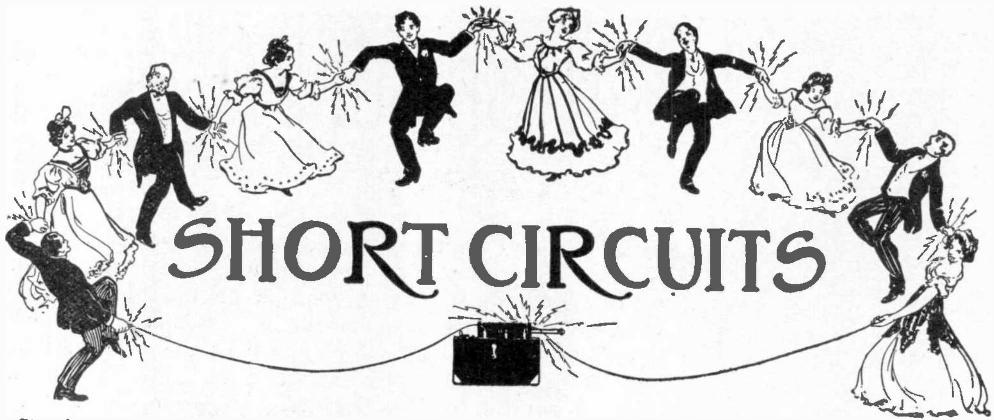
A great many readers of Popular Electricity live in rural communities, or are city dwellers having country homes, and for their benefit we are going to offer an article by a competent authority on the subject of "Electric Light and Power for Country Homes," which will begin in the February issue. This article will first explain the nature and operation of the gasoline engine, the dynamo and the electric storage battery, the three prime requisites of such a plant. It will explain how to estimate the size of plant which will be required for various conditions, how to select the machinery, how to determine the size of the battery, how to do the wiring and finally point out a few of the hundreds of uses to which electricity may be put in country homes.

The Navigating Compass

Most of us think we know pretty much all about a compass. But connected with that simple instrument, which was among the first practical applications of electrical scientific knowledge, there is much that is of historic interest, and not without its dramatic features as well. "The Navigating Compass" will therefore be the subject of an interesting narrative in next month's issue from the pen of Brother Potamian, who is professor of physics in Manhattan College, New York, and possessor of a particularly pleasing style in his writings upon scientific subjects.

The Patent Article Series

To make the best magazine possible we must have the co-operation of our readers; that is, they must not be backward in telling us what they think is good and what they think is otherwise. Happily the Popular Electricity following is an enthusiastic one and we have been able to follow pretty well the trend of their likes and dislikes from the hundreds of letters which each mail brings. Now we are going to ask your opinion on one particular thing: What do you think of the "Notes on Patent Infringement"? We began this series some months ago with a view to benefiting those who are working on inventions of their own and who would like to post themselves in a general way upon those things bearing upon patent law which they would be sure to run up against sooner or later. Now perhaps the proportion of such readers is too small to warrant us in continuing the series indefinitely. Let's have an expression of opinion. Is it thumbs up or thumbs down?



SHORT CIRCUITS

Stymie (who had dallied too long at the Club House)—Hello, old man! Whatchuch wanter tee up two balls for?

Green (ditto)—Tha'sall right, old chap, can't you see I'm driving with two clubs?

* * *

Waiter (placing the soup on the table)—Looks like rain, sir.

Guest—Yes, it does, and tastes just like it, too. Take it away.

* * *

Good man—Do you know where little boys who smoke cigarettes go?

"Billy" Andrews—Yep; dey goes to de woodshed.

* * *

Pat was sick. A physician who had scarcely any sleep for two days was summoned. He said the patient was suffering from pneumonia. Sitting down in a chair beside the sick man, he bent his ear to his chest to hear the respiration, calling upon Pat to count.

The doctor was so fatigued that when the patient had counted up to ten he went to sleep with his ear on the sick man's chest. Awakening he heard Pat still counting: "Tin thousand an' sivinty-six, tin thousand an' sivinty-sivin."

* * *

A citizen of Memphis, Tennessee, lost a valuable scarab which he had been wearing on a watch-fob. He advertised his loss in the daily papers and offered a generous reward for the return of the trinket.

Early the next morning he received a call from a colored boy leading a miserable yellow cur. "Say, boss," said the boy, "I seen yo' ad in de papeh. Am dis yo' scarab?"

* * *

He had finished his dinner in a grouch and then buried himself in the evening paper.

"Hum, I wish they'd invent a new expression occasionally," he commented as he read the account of a wedding. "It's always the 'blushing bride' nowadays."

"Well," came the quick retort from the other side of the table, "when you consider what sort of husbands most girls have to marry, you can't much wonder at their blushing."

* * *

A small boy went into a telegraph office that displayed a sign, "Boy Wanted."

"What kind of boy does yer want?" he asked of the manager.

"Why, a decent boy," said the manager. "One who is quick, doesn't swear, smoke cigarettes, whistle round the office, play tricks—"

"Oh, say, boss," interrupted the boy. "Yer don't want no boy; yer want a goil."

One evening when Irving was playing Macbeth he worked his audience into an unusually high pitch of excitement. He was in his best mood and had just reached the point where Macbeth orders Banquo's ghost to leave the banquet table.

"Hence, horrible shadow! Unreal mockery, hence!" declaimed Irving in his most tragic manner, as with convulsive shudder he sank to the ground and drew his robe over his face.

On the withdrawal of Banquo, a high-pitched, sympathetic voice shouted from the top gallery,

"It's all right now, 'Enery; 'e's gone!"

* * *

Willie Jones went to visit with his cousin who was a little girl. Unexpectedly it became necessary for him to stay over night, and very reluctantly he consented to wear his cousin's nightie. Next morning he seemed to feel worse about it than ever and he remarked to his aunt who was dressing him: "Before I will wear a girl's nightie again I will sleep raw."

* * *

"Is there anything wrong with that egg?" snapped the boarding house mistress. "Nothing actually wrong," sighed Mr. Fourper, "I was just looking for the wishbone, that was all."

* * *

The following is the latest to be credited to George Ade:

A song-and-dance comedian was working in a cheap vaudeville house where a performance was given hourly. The tired performer had made nine appearances and had fallen asleep on his trunk, when the manager poked him in the ribs and said:

"Hey, you; wake up! It's time for you to go on again."

"Say," retorted the performer "I can't go on again. What do you take me for—a film?"

* * *

In a Southern police court one morning there was much disorder because of an unusually large attendance. In the confusion the magistrate, new to the position, lost his temper.

"You, there!" he cried, pointing his finger at an old negro in front of him, "are you the defendant?"

"No, suh, I ain't," denied the darky. "I'se got a lawyer man to do the defendin'."

"Then who are you?" demanded the magistrate.

"I'se de gen'lemun dat stole de chickens," was the calm reply.

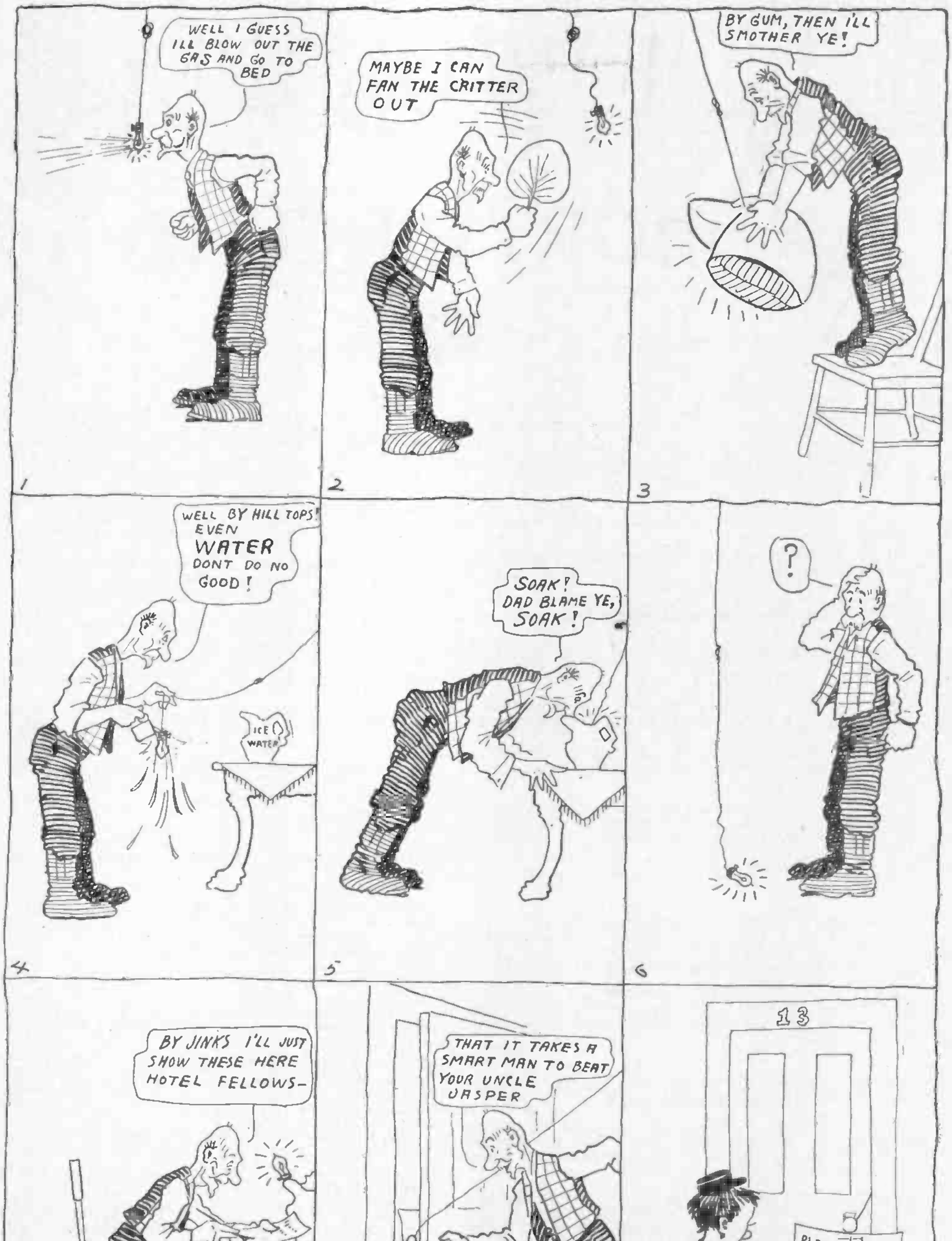
* * *

Teacher (to pupil): When Washington was your age he was a surveyor.

Pupil: When he was your age he was President.

* * *

Teacher: Did Shakespeare write all his plays?
Pupil: I don't know.
Teacher: How will you find out?
Pupil: When I die I'll go to Heaven and ask him.
Teacher: Suppose he isn't there.
Pupil: Then you ask him.



WELL I GUESS I'LL BLOW OUT THE GAS AND GO TO BED
MAYBE I CAN FAN THE CRITTER OUT
BY GUM, THEN I'LL SMOTHER YE!
WELL BY HILL TOPS! EVEN WATER DONT DO NO GOOD!
ICE WATER
SOAK! DAD BLAME YE, SOAK!
?
BY JINKS I'LL JUST SHOW THESE HERE HOTEL FELLOWS-
THAT IT TAKES A SMART MAN TO BEAT YOUR UNCLE JASPER
13
PLEZE OBZERVE THE DODGAST THING IS OUT BY HEC!
C. DEBALL

ELECTRICAL DEFINITIONS

Below are defined a few of the most common electrical terms. They are reprinted from month to month and will be of assistance in understanding the magazine text

Accumulator.—See secondary battery.

Alternating Current.—That form of electric current the direction of flow of which reverses a given number of times per second.

Ammeter.—An instrument for measuring electric current.

Ampere.—Unit of current. It is the quantity of electricity which will flow through a resistance of one ohm under a potential of one volt. The international ampere is the current which, under specified conditions, will deposit .001118 gram of silver per second when passed through a solution of nitrate of silver in water.

Ampere Hour.—Quantity of electricity passed by a current of one ampere flowing for one hour.

Anode.—The positive terminal in a broken metallic circuit; the terminal connected to the carbon plate of a battery.

Armature.—That part of a dynamo or motor which carries the wires that are rotated in the magnetic field.

Brush.—The collector on a dynamo or motor which slides over the commutator or collector rings.

Bus Bars.—The heavy copper bars to which dynamo leads are connected and to which the outgoing lines, measuring instruments, etc., are connected.

Buzzer.—An electric alarm similar to an electric bell, except that the vibrating member makes a buzzing sound instead of ringing a bell.

Candle Power.—Amount of light given off by a standard candle. The legal English and standard American candle is a sperm candle burning two grains a minute.

Capacity, Electric.—Relative ability of a conductor or system to retain an electric charge.

Charge.—The quantity of electricity present on the surface of a body or conductor.

Choking Coil.—Coil of high self-inductance which retards the flow of alternating current. See self-inductance.

Circuit.—Conducting path for electric current.

Circuit-breaker.—Apparatus for automatically opening a circuit.

Collector Rings.—The copper rings on an alternating current dynamo or motor which are connected to the armature wires and over which the brushes slide.

Commutator.—A device on a dynamo shaft for gathering the circuit from the various coils of the armature and sending it out over the line as direct current. On a motor it takes current from the line and passes it on to the armature coils.

Condenser.—Apparatus for storing up electrostatic charges.

Cut-out.—Appliance for removing any apparatus from a circuit.

Cycle.—Full period of alternation of an alternating current circuit.

Dielectric.—A non-conductor.

Dimmer.—Resistance device for regulating the intensity of illumination of electric incandescent lamps. Used largely in theaters.

Direct Current.—Current flowing continuously in one direction.

Dry Battery.—A form of open circuit battery in which the solutions are made practically solid by addition of glue jelly, gelatinous silica, etc.

Electrode.—Terminal of an open electric circuit.

Electromotive Force.—Potential difference causing current to flow.

Electrolysis.—Separation of a chemical compound into its elements by the action of the electric current.

Electromagnet.—A mass of iron which is magnetized by passage of current through a coil of wire wound around the mass but insulated therefrom.

Farad.—Unit of electric capacity.

Feeder.—A copper lead from a central station to some center of distribution.

Field of Force.—The space in the neighborhood of an attracting or repelling mass such as a magnet or a wire carrying current.

Fuse.—A short piece of conducting material of low melting point which is inserted in a circuit and which will melt and open the circuit when the current reaches a certain value.

Generator.—A dynamo.

Inductance.—The property of an electric circuit by virtue of which lines of force are developed around it.

Insulator.—Any substance impervious to the passage of electricity.

Kilowatt.—1,000 watts. (See watt.)

Kilowatt-hour.—One thousand watt hours.

Leyden Jar.—Form of static condenser which will store up static electricity.

Lightning Arrester.—Device which will permit the high-voltage lightning current to pass to earth, but will not allow the low voltage current of the line to escape.

Motor-dynamo.—Motor and dynamo on the same shaft, for changing alternating current to direct and vice versa, or changing current of high voltage and low current strength to current of low voltage and high current strength and vice versa.

Multiple.—Term expressing the connection of several pieces of electric apparatus in parallel with each other.

Neutral Wire.—Central wire in a three-wire distribution system.

Ohm.—The unit of resistance. It is arbitrarily taken as the resistance of a column of mercury one square millimeter in cross sectional area and 106 centimeters in height.

Parallel Circuits.—Two or more conductors starting at a common point and ending at another common point.

Polarization.—The depriving of a voltaic cell of its proper electromotive force.

Potential.—Voltage.

Resistance.—The quality of an electrical conductor by virtue of which it opposes the passage of an electric current. The unit of resistance is the ohm.

Rheostat.—Resistance device for regulating the strength of current.

Rotary Converter.—Machine for changing high-potential current to low potential or vice versa.

Secondary Battery.—A battery whose positive and negative electrodes are deposited by current from a separate source of electricity.

Self-inductance.—Tendency of current flowing in a single wire wound in the form of a spiral to react upon itself and produce a retarding effect similar to inertia in matter.

Series.—Arranged in succession, as opposed to parallel or multiple arrangement.

Series Motor.—Motor whose field windings are in series with the armature.

Shunt.—A by-path in a circuit which is in parallel with the main circuit.

Shunt Motor.—Motor whose field windings are in parallel or shunt with the armature.

Solenoid.—An electrical conductor wound in a spiral and forming a tube.

Spark-gap.—Open space between the two electrodes of a spark coil or resonator.

Storage Battery.—See secondary battery.

Thermostat.—Instrument which, when heated, closes an electric circuit.

Transformer.—A device for stepping-up or stepping-down alternating current from low to high or high to low voltage, respectively.

Volt.—Unit of electromotive force or potential. It is the electromotive force which, if steadily applied to a conductor whose resistance is one ohm, will produce a current of one ampere.

Volt Meter.—Instrument for measuring voltage.

Watt.—Unit representing the rate of work of electrical energy. It is the rate of work of one ampere flowing under a potential of one volt. Seven hundred and forty-six watts represent one electrical horse power.

Watt-hour.—Electrical unit of work. Represents work done by one watt expended for one hour.

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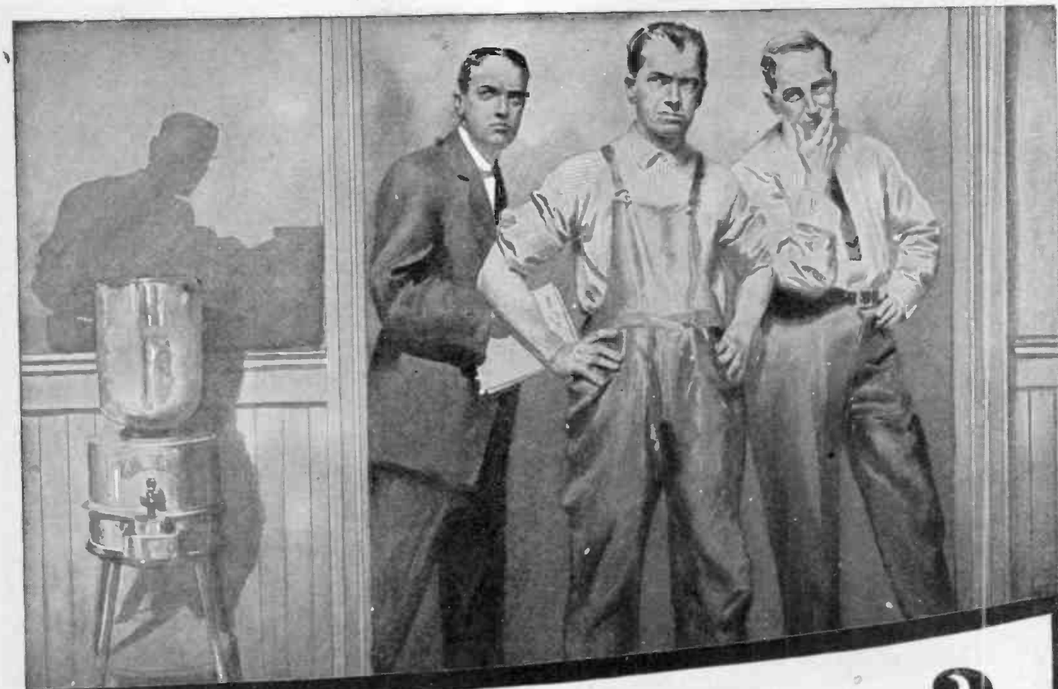

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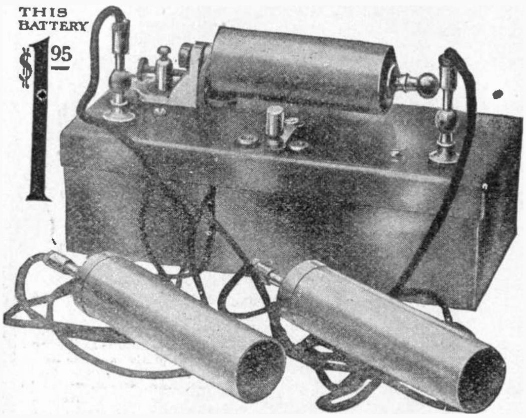

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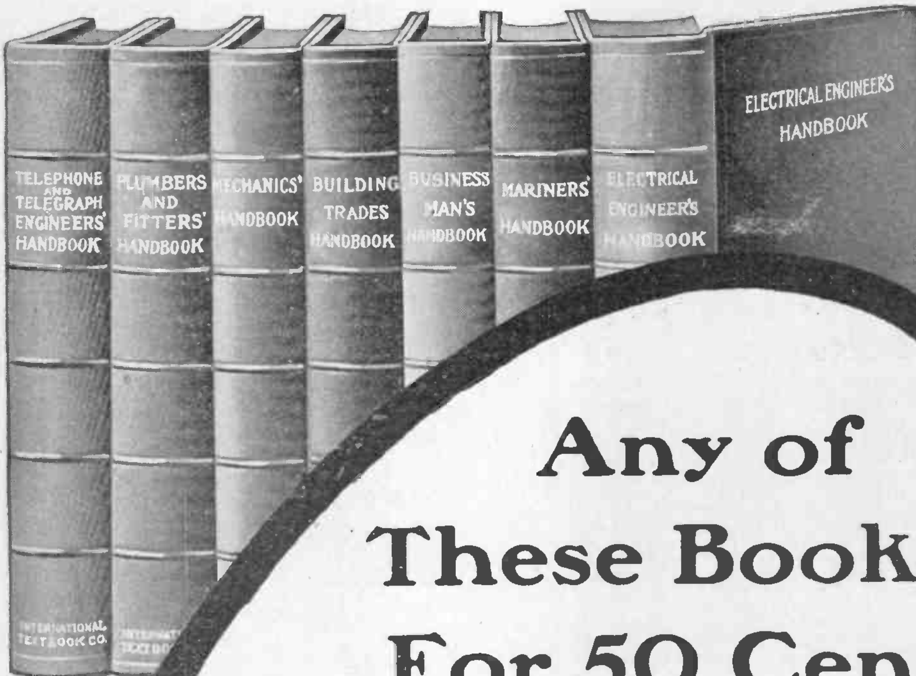
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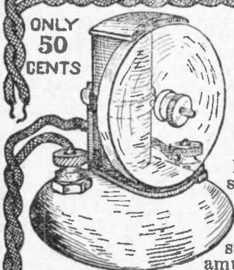

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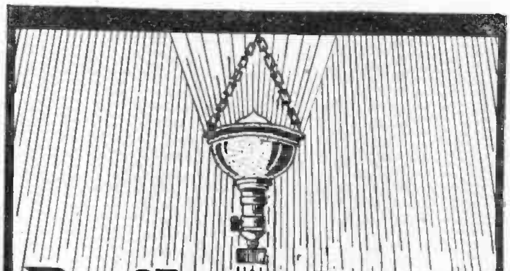

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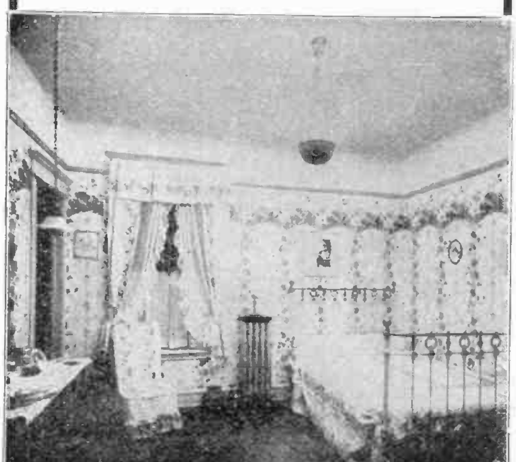

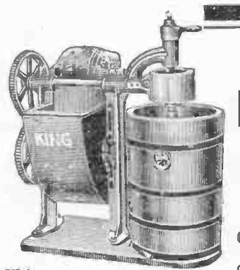

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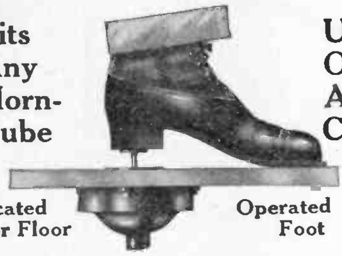

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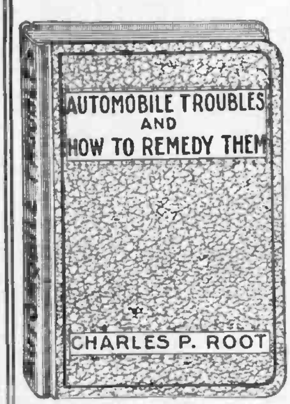

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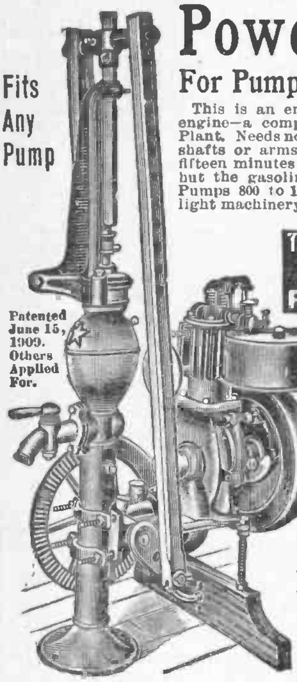

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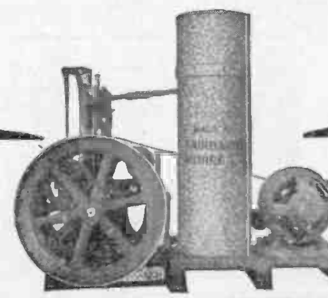

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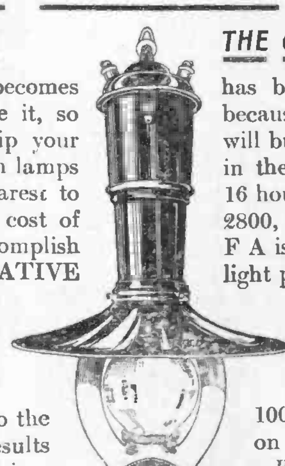

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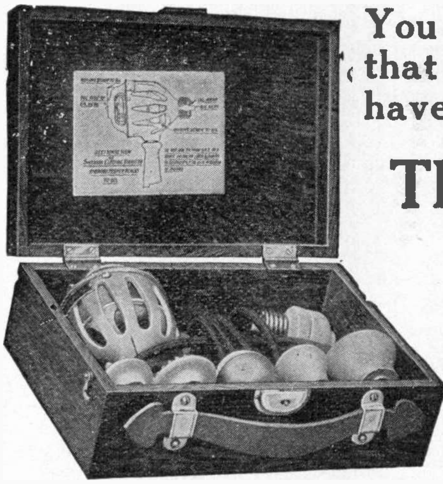

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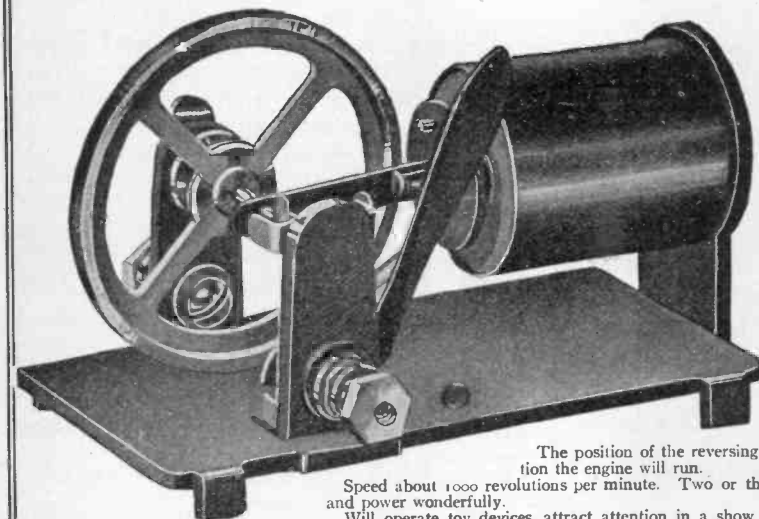

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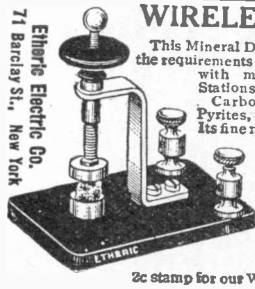

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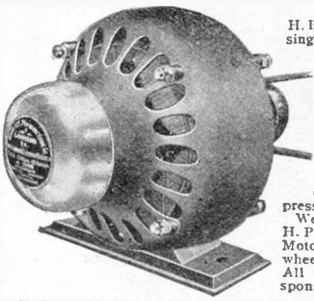

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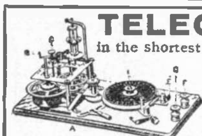

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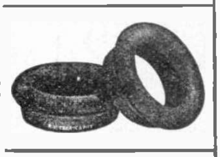

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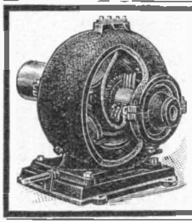

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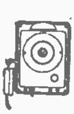
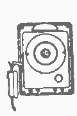

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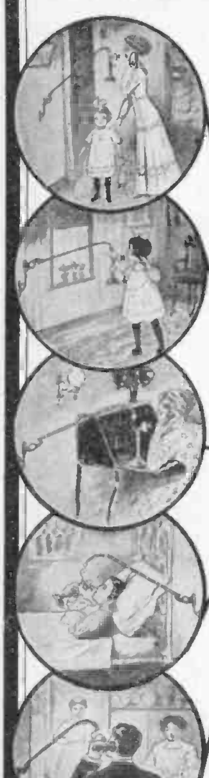
THE RADIO TELEPHONE HOLDER

IS INDISPENSABLE

in the Home or in the Office

The Radio is a positive boon to every one who has a telephone—either in the office or the home. It is adaptable to any make of telephone and can be fastened to roll or flat topped desk — to table —wall or floor. It keeps the desk or table clear, the telephone up, out of the way. Its flexible construction permits the telephone to be used from any angle and any position — sitting or standing — anywhere within a radius of four feet. The slightest touch will move it up, down, sideways or in a complete circle.

The Radio is simple and strong and remarkably handsome. Anyone can install it in five minutes without disturbing either the telephone cords or the wiring. The suspension joint is ball-bearing — insuring ease of motion. All parts are malleable and non-breakable. It is beautifully finished in fine enamel and oxidized copper.



How the Radio Works

The telephone can be used in a standing position by a person of any height.

It permits a child to use the telephone with perfect ease.

Sitting or standing, you can adjust the telephone to exactly the position desired.

It permits telephoning in a recumbant position from any angle.

In the dining room—permits telephoning at the table. Not in use is up—out of the way.

Price, $3.50

It is never in the way but always ready for instant use sitting or standing.

It permits you to adjust the telephone to your position.

Your caller on the opposite side of desk can telephone without either of you getting up.

It permits one telephone to serve three or more people perfectly.

The telephone can be tilted at any angle. Released it resumes its normal—vertical position.

Sent on Ten Days Trial

The price of the Radio Telephone Holder is $3.50—but a small part of its real worth. Send us the price today and we will send you the biggest convenience ever offered to telephone users. Try it ten days—and if not more than pleased—tell us so and we will give you your money back.

Swedish - American Telephone Company

Branch
115 W. Sixth Street
Kansas City

Long Distance, Local, Rural Party Line, Hotel, Portable and Inter-communicating Telephones, Switchboards and Complete Systems. Electrical Supplies of every description. Buy from manufacturers direct and save two or three profits.

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