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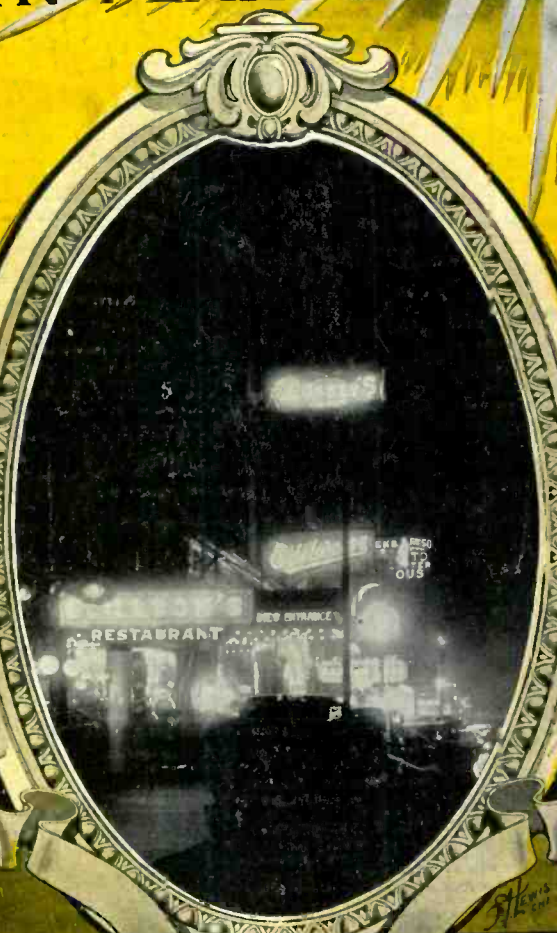

Vol. 1. JANUARY 1909 No. 9

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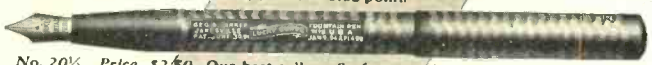

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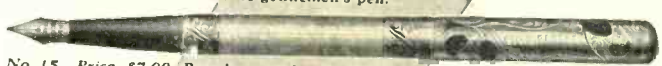

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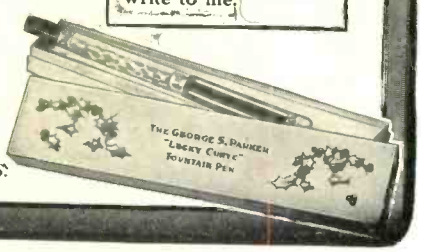

POPULAR ELECTRICITY

IN PLAIN ENGLISH

H. W. YOUNG, Editor.

Vol., 1. JANUARY 1909. No. 9,

CONTENTS

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PUBLISHER'S PAGE

AN INVITATION

Those who are fortunate enough to visit the Electrical show to be held in Chicago on January 16th to 30th, are cordially invited to visit our booth in the Coliseum; make yourselves at home and use our headquarters as a meeting place for yourselves and friends. Come in and rest, watch the crowds, share in the enthusiasm which everyone feels who attends this great educational exhibit.

Electrical Shows, or Expositions as they should rightfully be called, are the outgrowth of a remarkable development in a great industry. This is primarily the Age of Electricity and even now this wonderful agent is at the disposal of nearly all, except those who live in the most sparsely settled communities. The foremost object of an Electrical Show is to foster the "Popular Electricity" idea and to educate the people in the manifold uses to which electricity may be put in the home, in shop or factory, in the store, office, on the farm—everywhere in fact.

A good time is promised to those who attend the show. Everything will be humming. Gay crowds will throng the brilliantly lighted hall—the largest of its kind in the world. There will be new devices and new developments to interest the more technical visitor. There will be artistic and spectacular features for the entertainment of the casual visitor. Electrical appliances will be exhibited which will increase the economy and efficiency of almost any line of business. New ways to apply electricity to domestic science and to light and heat the home will be shown. Electric toys and novelties to delight the boy will be there. In short, it is an exhibition to interest everybody all the time.

We want to meet as many of our friends as possible on this occasion, and again extend an invitation to you to come and make our quarters your quarters.

FREE TRIPS TO CHICAGO ELECTRICAL SHOW

We have a pleasant surprise in store for our agents. The Chicago Electrical Show, to be held January 16 to 30, is the great event of the year in electrical circles, and we are going to give the five of our agents who secure for us the most subscriptions between Dec. 15 and Jan. 15, a free trip to Chicago, including their hotel accommodations and free admission to the Electrical Show for three days.

This contest is for our agents only, but any reader of the magazine, who desires, may become an agent by writing to us and securing the necessary outfit, and stands as good a chance as anyone of obtaining one of the free trips. We allow all of our agents a liberal commission. The free trips will be in addition to such commission so that all entering the contest will be well paid for their efforts.

In order to give those living at a distance from Chicago an equal opportunity, all subscriptions for the contest received in envelopes post-marked the 15th of January, will be included in the count and sufficient time will be allowed after the 15th for such mail to reach us.

Now take hold. If you wish to enter the contest and are not already an agent, send in your application at once, and we will enroll you and furnish you with the necessary supplies. Here's a splendid opportunity to secure an enjoyable trip and visit one of the greatest educational exhibits in the country at no expense to yourself. The prizes do not depend upon luck but upon energy and intelligent work.

POPULAR ELECTRICITY WIRELESS CLUB

On another page of this issue announcement is made of the organization of a club among the readers of this magazine, to be known as the Popular Electricity Wireless Club. The step has been taken in order to bring into closer relations the hundreds of enthusiastic workers in this line of electrical endeavor. The Club will furnish a medium for the interchange of ideas, so essential to the development of any art. All those who can qualify for membership, as outlined in the announcement, are invited to join.

A GERMAN TYPE OF ELECTRIC LOCOMOTIVE USED IN THE STEEL MAKING INDUSTRY.

A large steel manufacturing company in Germany owns its own electric railway, 24 miles in length, which is used for hauling coal, coke and limestone from the company's mines to the plant. The trains are drawn by electric locomotives. The cars are of steel and can also be used to transport molten slag.

POPULAR ELECTRICITY
IN PLAIN ENGLISH

VOL. I JANUARY 1909 No. 9

ELEMENTARY ELECTRICITY.

BY PROF. EDWIN J. HOUSTON, PH. D. (PRINCETON.)

CHAPTER IX—CHEMICAL EFFECTS OF ELECTRIC DISCHARGES.

Chemical effects, or the decomposition of the molecules of matter, and the setting free or re-arrangement of the atoms, are among the more important effects produced by electric discharges. Chemical effects are especially observed during the passage of an electric discharge through certain conducting liquids called electrolytes.

All liquids are not decomposed by the passage through them of electricity. Some, such as alcohol, bi-sulphide of carbon, turpentine, and possibly pure water, are not electrolytes. Indeed, they practically do not conduct electricity at all. Some other liquids, such as mercury and molten metals, generally conduct electricity in the same manner as do copper or the other ordinary metals. It is such liquids as the alkalies, acids, and saline solutions generally, that are true electrolytes and conduct electricity only by being decomposed or electrolyzed, the electricity being carried through the liquid by positive and negative charges that have collected on the two different parts into which the molecules have been decomposed.

All matter consists of particles, molecules, or atoms. Particles are small masses or assemblages of molecules that are more or less bound together by the force of molecular attraction or cohesion. Though very small, particles consist of a great number of molecules and atoms. In gases and liquids, the molecular attraction acting on the molecules is so weak that the molecules can move towards or from one another freely. Although the molecules are also capable of moving towards and from one another in solids through short distances, yet they are generally held together with such strength that considerable force must be exerted in order to pull them apart, or to overcome the tenacity of the substance. Sometimes, as in the case of steel, this force may be considerable; i. e., in the neighborhood of 120,000 pounds to the square inch.

The atoms are so small that they are invisible under the most powerful microscopes. Moreover, they are so hard that it was at one time believed they could neither be altered in shape or size, or broken or separated into small parts. Indeed, up to within a comparatively recent date, it was believed that the atoms were the smallest forms in which matter could exist. This view is no longer held. We now believe that under certain conditions, it is possible for the atoms to have minute fragments broken from them, thus producing fragmentary atomic matter called corpuscles. Notwithstanding this view, yet as a matter of convenience, especially in chemistry, it is still common to regard the atoms as the ultimate particles of matter. When considering the effects of electric discharges on the molecules, we will, therefore, still retain the old view that the atoms are unalterable in size, shape or mass.

The almost innumerable kinds of matter that compose the earth consist of different solid, liquid or gaseous substances that are either elementary or compound. Elementary substances are those that have never as yet been broken up or separated into more than one kind of matter. Compound substances are those that are formed by the combination of two or more elementary substances.

All these substances consist of molecules that are held together by the force of molecular attraction; most powerfully in the case of solids; least powerfully in the case of gases, and with intermediate power in the case of liquids. There are, therefore, as many different kinds of molecules as there are different kinds of substances. There are not, however, as many different kinds of atoms. On the contrary, there are only in the neighborhood of some eighty different kinds of atoms or chemical elements. It is by various combinations of these atoms with one another that the great variety of molecules that form different substances are produced. Let us, therefore, briefly discuss the peculiarities of molecules.

The molecules of matter consist of various combinations of atoms bound together by their mutual attractions. The force that draws the atoms together is known as the force of atomic attraction or chemical affinity.

It can be shown that when the atoms unite to form the molecules the combination always takes place between whole or complete atoms. The atoms do not appear to combine as fractions of atoms, but as whole atoms. If, then, we can ascertain the exact proportions in which the smallest quantity two chemical elements can combine with each other, these proportions will represent the relative weights of the atoms of these elements; or, as it is called, their atomic weights. In this way, it has been discovered that the weight of any atom of the same element is always the same, but that the weight of the atoms of different elements vary. For example, if the atomic weight of hydrogen be taken as one, the atomic weight of the oxygen is sixteen; or sixteen times as great. In a similar manner, the atomic weight of sulphur is thirty-two; the atomic weight of iron is fifty-six; of iodine one hundred and twenty-seven; of fluorine nineteen; of magnesium twenty-four; of sodium, twenty-three, etc.

It will of course be understood that the atomic weights do not represent the actual weights of the atoms, but only their relative weights.

The atoms of the different chemical elements not only possess different atomic weights, but they also possess different combining capacities. Sometimes they combine atom for atom; at other times, a single atom of one element is capable of combining with two atoms of another element; that is, its combining capacity, or, as it is also called, its atomicity or valency, is twice as great. For example, the combining capacity of oxygen is twice as great as that of hydrogen, since an atom of oxygen is capable of replacing two atoms of hydrogen in chemical combinations. In other cases, a single atom of a chemical element can combine with or replace three, four, or even a greater number of hydrogen atoms. In other words, the atoms of the different chemical elements possess a different valency, combining capacity or quantivalence. Atoms whose combining capacity is one are called monad atoms; those whose combining capacity is two are called dyad atoms; those whose capacity is three, triad atoms; four, tetrad atoms, etc.

When the atoms combine to form the molecules, it is believed that they do not touch one another, but are held together in more or less fixed positions by their mutual attractions that are concentrated at certain points called bonds.

The atoms of the different chemical elements are represented in chemistry by symbols consisting of the first letter of the English or Latin name of the element. Thus H not only represents hydrogen, but also one atom of hydrogen; H_2 or H_3 represent, respectively, two or three atoms of hydrogen. O represents one atom of oxygen, and O_2 and O_3 represent, respectively, two and three atoms of oxygen.

In a similar manner S represents one atom of sulphur; I, one atom of iodine; F one atom of fluorine; Fe one atom of iron. Here, since the first letter I of the word iron has already been employed for iodine, and F, the first letter of the

Latin word for iron, *ferrum,* has been employed for fluorine, it is necessary to employ the first two letters Fe of the Latin word to represent one atom of iron. In a similar way Na represents one atom of sodium or *natrium,* the Latin word for sodium.

It is easy by chemical symbols to indicate the chemical composition of a molecule. For example, since the molecule of water consists of two atoms of hydrogen, combined with one atom of oxygen, the symbol H_2O indicates that two atoms of hydrogen have combined with one atom of oxygen to form one molecule of water.

In order to form some idea of the extremely small size of the molecule, and the still smaller size of its constituent atoms, it may be remarked that Kelvin has concluded that if a single drop of water were magnified to the size of the earth, each of its molecules would occupy a space smaller than that of cricket balls. Nevertheless, each of these molecules consist of two atoms of hydrogen combined with one atom of oxygen.

It is convenient to represent the atomic capacity or combining power of the atoms by lines called bonds attached to the symbol. Thus hydrogen, whose combining power is one, and which therefore has a single bond, is written thus: H—; oxygen, whose combined capacity is two, thus: —O—. When an atom of oxygen unites or combines with two atoms of hydrogen, the arrangement of the atoms in the molecule is represented thus: H—O—H. It is of course not certain that the arrangement of the atoms is as above represented, since we cannot see the atoms. The method of representation by the use of bonds is, however, convenient, and is generally employed in chemistry.

The compound H—O—H forms a molecule of water. Here the combining capacities of the elements hydrogen and oxygen are completely satisfied. Were one of the hydrogen atoms removed; that is, if H—O—H becomes H—O—, the compound is no longer water. The smallest quantity of water that can exist is H—O—H. Consequently, we can define a molecule as the smallest quantity of any substance that can exist.

A group of unsatisfied atoms such, for example, as H—O—, does not form a molecule, but what is called a radical; that is, an incomplete or unsatisfied group of atoms. Since atoms may also exist with their bonds unsatisfied, atoms may also be regarded as radicals. There are, therefore, two kinds of radicals; i. e., elementary radicals as H— or —O—O, etc., and compound radicals as H—O—.

The atoms of any element may combine with themselves. Thus H—H represents a satisfied group of hydrogen atoms, and O=O represents a satisfied group of oxygen atoms. Since the bonds are completely satisfied in these groups, they form molecules of hydrogen and oxygen respectively. There are, therefore, two kinds of molecules; i. e., elementary molecules and compound molecules. Elementary substances consist of elementary molecules and compound substances of compound molecules.

Electricity produces chemical changes in the molecules by breaking them up into atoms or radicals. These may either remain separated, or may afterwards recombine with other atoms or radicals to form different molecules.

The force of atomic attraction or chemical affinity that draws the atoms or radicals together to form the molecules is now generally believed to be the unlike electric charges they possess. The atoms of all the chemical elements naturally possess either positive or negative electric charges. They may, therefore, be divided into two great classes; electro-positive atoms or elements, and electro-negative atoms or elements. Since, too, the radicals are unsatisfied atoms or groups of atoms, and the open bond may either represent a positive or a negative charge, all radicals must be either electro-positive or electro-negative. Without going into details, it is sufficient to state that hydrogen and most of the metals form electro-positive radicals; while oxygen, chlorine, bromine, iodine, fluorine, sulphur and many other of the non-metallic elements form electro-negative radicals.

Since the atoms of a simple molecule are held together by the opposite charges of its atoms these atoms must be respectively electro-positive and electro-nega-

tive. When, therefore, electricity breaks up this combination, and sets the atoms free, the electro-positive atoms or radicals must appear at the electro-negative terminal of the decomposing electric source, and the electro-negative atoms or radicals at the electro-positive terminal.

The decomposition of molecules by electricity is called electrolysis. In the electrolysis of water, since pure water is not a conductor of electricity, it is necessary to render it electrically conducting by the addition of a small quantity of sulphuric acid.

A convenient form of apparatus for

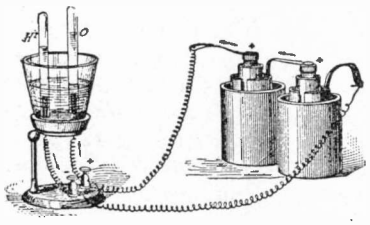


FIG. 69. APPARATUS FOR THE ELECTROLYSIS OF WATER.

the electrolysis of water is represented in Fig 69 (Houston's Dictionary of Electricity). In this case the electricity employed for producing the electrolysis is obtained from a battery of two series-connected voltaic cells. Wires from the battery pass in at the base of a vessel containing the acidulated water, where they are connected to two plates of platinum inserted in two glass tubes (H) and (O) closed at the top, but open at the bottom, also filled with acidulated water, and held in a vertical position over the platinum plates. On the passage of the current, the molecules of water are decomposed, the hydrogen collecting in the tube (H), and the oxygen in the tube (O). In other words, the electro-positive atoms of hydrogen appear at the platinum terminal connected with the negative pole or terminal of the battery at (H), and the atoms of oxygen at the platinum terminal connected with the positive terminal of the battery at (O).

It is true that the electrical decomposition of water is not as simple as above described. The oxygen is the result of a secondary reaction taking place in the molecule of sulphuric acid added to make the water a conductor of electricity. For simplicity, however, we may safely regard the decomposition as taking place exclusively in the molecule of water.

The electro-positive and electro-negative atoms or radicals into which a molecule is broken up by electrolysis, are known as ions, and are called the electro-positive and electro-negative ions according to whether they are liberated at the electro-negative or the electro-positive terminals of the electrolyzing source.

In order the more readily to describe what takes place during electrolysis, it is convenient to employ certain electrical terms. These can best be defined in connection with Fig. 70. Here (A) represents a voltaic cell or source producing the electrolyzing current. This cell consists of plates (Zn) and (C) of zinc and carbon respectively. The positive terminal of the cell is connected with the carbon plate, and the negative terminal with the zinc plate. (C) represents a simple decomposition or electrolytic cell similar to that represented in the preceding figure. The positive terminal of the voltaic cell is connected with a plate of platinum inserted in the tube (O), and the negative terminal with a platinum plate inserted in (H).

When an electric discharge passes through the acidulated water in the cell (C), oxygen gas begins to collect in the tube (O), connected with the positive terminal of the voltaic cell (A), and hydrogen in the tube (H), connected with the negative terminal. After a given time, sufficient gas will have collected to show that the volume of the hydrogen is twice the volume of the oxygen.

As will be seen by an examination of the above figure, the name anode is marked on that terminal of the decomposition cell which is connected with the positive terminal of the voltaic cell, and that the same name is also marked on the carbon plate that projects from the liquid of the voltaic cell, which is the positive terminal of the voltaic cell. It will also be seen that the name cathode is marked on the negative terminal of the decomposing cell, as well as on the negative pole or electrode of the voltaic cell; that is, the end of the zinc plate that projects above the surface of the

liquid of the cell. Moreover, it will be seen that the electro-negative ions or radicals appear at the anode, and the electro-positive ions or radicals at the cathode.

The terms anode, cathode, anion, and cathion, are of such importance that we will define them separately.

The anode is the terminal or plate of a decomposition cell that is connected with the positive terminal of a battery or other electric source.

Or it is that terminal of an electric source out of which the current flows into the liquid of a decomposition cell.

Or, it is the positive terminal or pole of a battery or other electric source that is employed for electrolysis.

The electro-negative atoms or radicals of a molecule, or the atoms or radicals that appear at the anode or positive terminal of a decomposing cell are called the anions.

The cathode is the terminal or plate of a decomposition cell that is connected with the negative terminal of a battery or other electric source.

Or, it is that terminal of an electric source into which the current flows from a decomposition cell.

Or, it is the negative pole or terminal of an electric source that is employed for electrolysis.

The electro-positive atoms or radicals of a molecule; or, the atoms or radicals that appear at the cathode or negative terminal of a decomposition cell are called cathions.

(To Be Continued.)

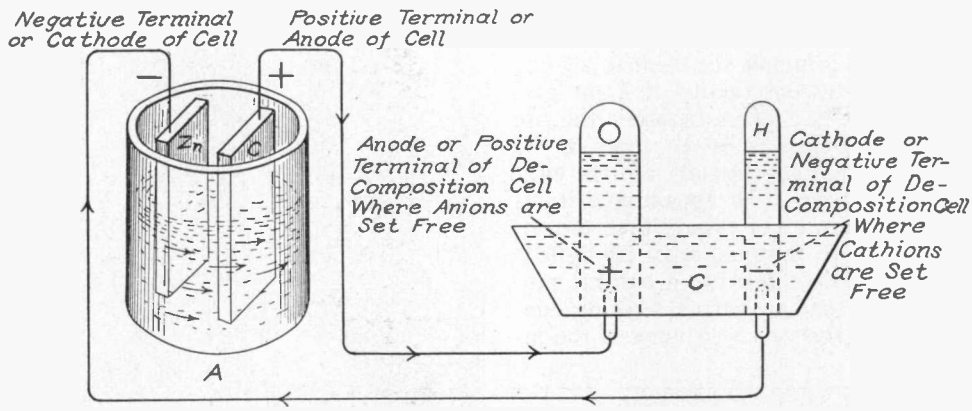
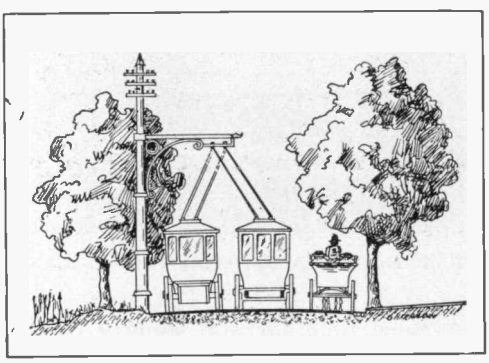


FIG. 70. ELECTROLYTIC DECOMPOSITION OF WATER.

RAILLESS ELECTRIC TRACTION.

Railless electric vehicles, or trackless trolleys, as they are sometimes called, are not exactly a new departure, having been tried out in an experimental way in a number of installations. The system originated in Germany, where several short lines are now in use. As announced in the Journal of Electricity, Power and Gas, the Italian government is considering the adoption of the system on a large scale for general transportation on the public highways.

The principal feature of this new system is a guidable car, driven directly upon the street or country road, without rails. Two trolley wires, strung above the street, supply the power—one feeding the motor, the other returning the current, thus completing the electric circuit. The trolley pole allows the car a lateral freedom of motion in either direction, similar to that of an automobile.

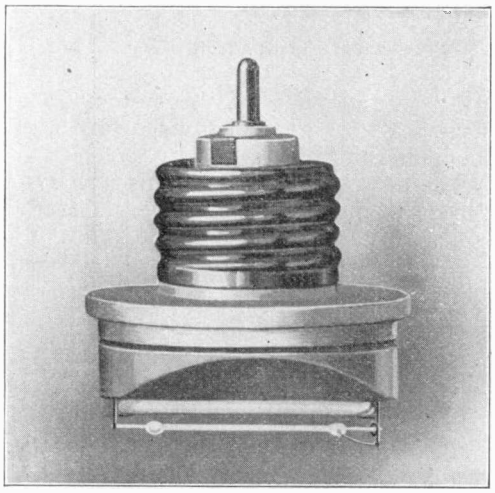


RAILLESS ELECTRIC TROLLEY.

THE NERNST LAMP.

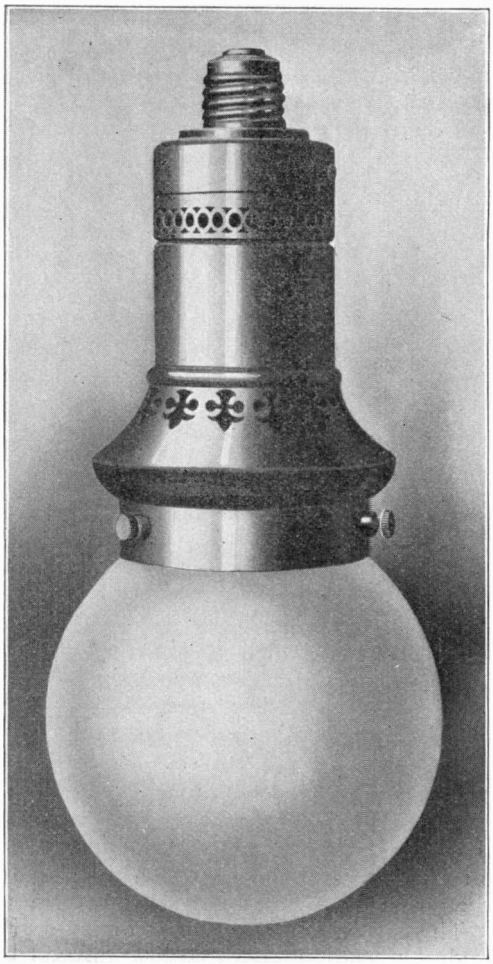
The Nernst lamp is really a member of the incandescent family, though it differs from all other members of the family in one very important particular; it burns in the open air, while all other members of the family require a vacuum and become things of the past as soon as the vacuum is destroyed. Hence, if the countryman of comic paper fame were to try to light his cigar with a Nernst lamp he would have the laugh on the comic paper.

Though in principle the Nernst belongs to the incandescent family, in light giving power it is a cross between the arc and the incandescent, with units in its wide range that successfully replace either of these types. In appearance it resembles the arc more closely than the incandescent. In the quality of its light it resembles neither, but has a natural sunlike warmth that presents a striking contrast to both the yellowish tone of the incandescent and the blue white of the arc.



SCREW BASE BURNER FOR NERNST LAMP

A short time ago the window of the Nernst Lamp Company's office in one of the large cities was fitted up with two separate compartments to show the contrast between the incandescent and the Nernst. Both compartments were painted white with paint out of the same can. The boss of the painter who did the work happened to pass a few evenings later and after looking at the two compartments for some time, came in to apologize. He couldn't understand, he said, why his best painter had done such a fool thing as to spoil the demonstration by using two different kinds of paint, but he would have him around early next morning to do the job over. The lamp man did not explain, but suggested that he come around himself the next morning. This he did, and was dumbfounded when he saw by daylight that the paint in both compartments was the same shade after all.

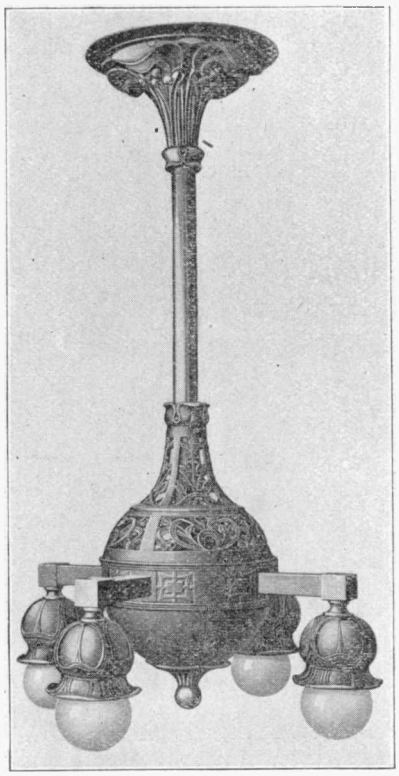


SINGLE GLOWER NERNST LAMP.

The Nernst lamp was invented by Dr. Walther Nernst, of Gettingen, Germany, and was first exhibited in this country about ten years ago. Mr. George Westinghouse at once recognized its great possibilities and secured the American rights. Mr. Westinghouse proceeded to

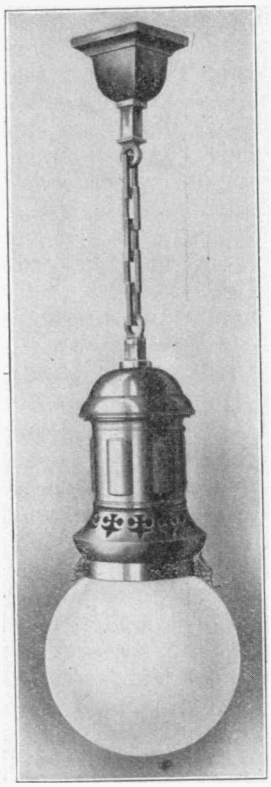
develop it into a commercial proposition and organized the Nernst Lamp Company for its manufacture. The light is a favorite with merchants who handle colored goods on account of its daylight quality, and Nernst lamps are in use in many of the finest stores in the land. Perhaps the best known installation is that in the great Marshall Field store of Chicago, whose 38 acres of floor space are beautifully lighted by Nernst lamps in special fixtures.

The distinguishing feature of the



ART NOVEAU DESIGN NERNST LAMP ELECTROLIER.

Nernst lamp is the glower which corresponds to the filament of the incandescent lamp. It is composed of a mixture of rare earths, worked into a dough, pressed through a die and baked. Platinum terminals are added and it is ready for service. The glower is an insulator when cold, but becomes a conductor when hot. Hence an auxiliary device termed a heater, consisting of platinum wire held in place and protected by a refractory paste, is required to bring it up to the proper temperature. As soon as this is accomplished, the current is disconnected from the heater by means of an automatic cut-out. The raising of the glower to the proper temperature for incandescence requires several seconds, and so the light does not come on instantaneously when the switch is turned. The other important part of the lamp is a steadying resistance termed a ballast. This consists of a fine iron wire mounted in a glass tube and somewhat resembling a miniature incandescent lamp. These parts can be renewed from time to time



MULTIPLE POWER NERNST LAMP WITH SQUARE CANOPY AND CHAIN.

as required and enable an old lamp to be renewed for further service the same as an arc lamp, and in contrast to the incandescent which is generally thrown away when it gets out of order.

A new type of Nernst lamp developed last spring is made for both alternating and direct current circuits of 110 or 220 volts. When the Nernst system was first introduced it was designed for alternating current circuits only, but a successful direct current lamp was developed

some time ago and all the types of lamps now on the market are designed for both circuits. A distinguishing feature of the new lamps in 66, 88, 110 and 132-watt sizes is the screw base burner. This embraces the glower and heater mounted on a suitable base which is screwed into place the same as incandescent lamps. The easy renewal which results has made the lamp quite popular for residence lighting, whereas before it was confined to store and other commercial lighting. This feature also enables the other parts of the lamp to be placed at any desired distance and is accountable for a new line of artistic chandeliers with the mechanism concealed in the ornamentation and the visible light sources smaller and neater than is possible with any other system. As an illustration, the 132-watt burner which gives as much light as seven 16 candle power carbon filament lamps, measures only 4½ inches in length and 3 inches in diameter. Nernst lamps are designated according to the number of glowers they contain, that is, single, two, four and six-glower lamps.

THE DICTAPHONE.

The Dictaphone is a machine for recording speech. It is an improvement on the commercial graphophone or phonograph and like these, records the dictator's words on wax cylinders.

Speech or sound consists of waves or vibrations of the air. These passing from the speaker's mouth through a flexible tube strike on a diaphragm supported on a traveling "carriage." This diaphragm vibrates and carries beneath it a sapphire cutting point. This point as the carriage travels the length of the machine cuts a helix or spiral on the hollow wax cylinder revolving beneath.

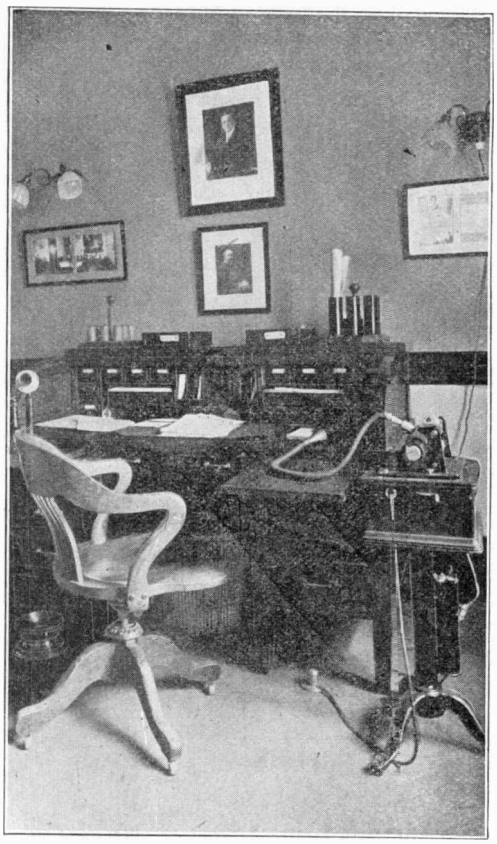
The helix is a V-shaped groove which extends the whole length of the cylinder. A finished wax cylinder looks somewhat like a screw 2½ inches in diameter with many threads to the inch. Each thread has little indentations on its sides.

These irregularities are those produced by the slight vibration of the diaphragm above mentioned and are the registration of the sound to be recorded.

A slight pressure of the foot or finger starts the cylinder in motion. The cylinder is supported on a metal mandrel. This is driven by a motor in the machine. The electric current for the motor can be drawn from any electric light socket.

When the dictator is interrupted, stops to refer to papers or hesitates for a word this pressure is released and the cylinder stops. If in doubt what has been said the machine will repeat it for you. A completed cylinder is called a "record."

After a record has been partly or completely finished the carriage carrying the

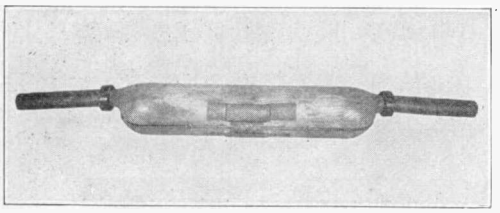


THE DICTAPHONE IN THE OFFICE.

diaphragm and its sapphire point can be slipped back to any desired point on the cylinder. Now start the machine and the sapphire will follow along the groove, fit into each little indentation and make the diaphragm vibrate exactly as it did when recording. This vibrating diaphragm starts the air in vibration and we have the original dictation faithfully reproduced by the Dictaphone. This enables any competent typist to transcribe it on a typewriter, as the machine will repeat as many times as necessary.

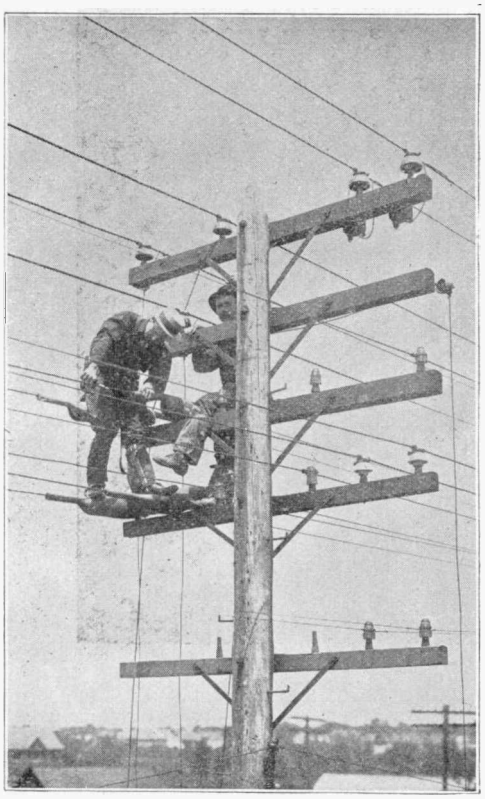
PROTECTIVE DEVICE FOR LINEMEN.

A device for the protection of linemen working on high tension wires is shown in the accompanying illustrations. As will be observed, the device is simply an



LINEMEN'S PROTECTIVE DEVICE.

easily applied extra insulation in the form of a rubber trough, called the "shield," which covers not only the "live" wires, but also the "tie" wires, and taps, if there are any. In the use of the shield each wire which a man may touch



LINEMEN'S PROTECTIVE DEVICE IN USE.

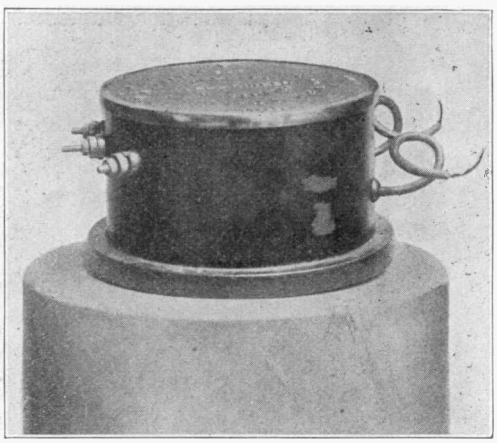
must be covered with a shield excepting only the wire on which he is working.

In placing the shield over an insulator the lineman grips it by rubber handles attached to the outside for this purpose, so that the shield is between his hands and the wire. He then slips a hard rubber split ring (having an opening of one-half inch or so to admit the wire) over each end of the shield. These rings clamp the shield firmly to the wire and preclude any possibility of its becoming dislodged and falling, to the danger of passers-by.

Each shield is tested in water up to 30,000 volts, and allowing a factor of safety of 3 to 1 it is perfectly safe when used on circuits of 10,000 volts.

BELL RINGER THAT DOES NOT USE BATTERIES.

The device shown in the illustration, known as the Rollinson bell ringer, will operate buzzers, door bells, hotel calls, elevator calls, automatic gas lighters, etc., from an ordinary 110-volt lighting



BELL RINGER THAT DOES NOT USE BATTERIES.

circuit, without the use of batteries. Where the premises are wired for direct current a small rotary converter is added which consumes less current than the ordinary 16-candlepower lamp.

The bell ringer is made in three sizes, all three taking 100 to 130 volts from the line and changing it to 6-13-19 and 8-16-24 volts respectively for supplying the bell circuit. Using alternating current, the device may be said to operate without cost for current, as the amount of current is so small that it will not register on any meter.

PLAYING A PIANO BY ELECTRICITY.

The finished technique of a great artist and the genuine feeling of a true lover of music may now be duplicated at the piano by any one, even if he does not know one note from another and cannot with his fingers play the scale of C. This is only another of the wonderful accomplishments of electricity—the Tel-electric piano-player does it.

All are more or less familiar with the pneumatic piano-player which is operated by foot power. One must be more or less of an athlete to operate one of these machines, and when it is attached to the instrument the latter is not available for playing by the ordinary method. The electric mechanism which operates the keys in the electric piano-player, on the other hand, is all contained in an inconspicuous box-like cabinet under the keyboard and when the piano is not being played electrically it can be played with the hands in the usual manner. Duets can even be played, the electrical apparatus playing one part and the human performer playing the other part.

The apparatus which controls the flow of current to the key-striking devices on the piano is contained in a neat cabinet which may be placed in any part of the room and even in a distant room in the house. Wires run from it to the key operating mechanism on the piano.

PLAYING A PIANO BY ELECTRICITY.

The principle of operation is simple. In the transmitter cabinet, run by a motor, is a roll or strip of perforated brass. The perforations correspond to the notes of the composition, as in the paper strip of the pneumatic piano player. These

perforations allow electrical contact to be made and broken in the various circuits controlling the individual key-striking devices at the piano. Thus electricity does all the work and the operator has only to look out for expression.

Expression is governed by two little attachments or knobs on the transmitter cabinet which regulate time and tone. Protruding from the front of the transmitter, convenient to the left hand, is a small knob. This controls the speed of the music roll. The slightest turn to the left or right alters the time of the music. By the merest turn of the wrist, one is master of all tempos, from the fiery presto to the solemn largo. Differences in the volume of tone are the other chief means of musical expression. Convenient to the right hand is a corresponding knob extending from the transmitter. This controls the force of the electric current which acts upon the piano keys. By the simplest movement of the wrist, the performer controls a force ranging from eight volts to twelve volts, and thus commands every gradation of tone, from the whispering pianissimo to the most thunderous fortissimo.

Every piano is equipped with two pedals, commonly referred to as the loud pedal and the soft pedal. In the center of the right hand expression knob on the transmitter is a small push-button similar to an electric bell button. By pressing this ever so slightly with the thumb, which lies conveniently over it, electric power is brought to bear upon the soft pedal at the piano, resulting the same as a pressure of the pianist's foot. It is the same with the sustaining pedal. Thumb pressure upon a corresponding push-button in the center of the left hand expression knob, brings the sustaining pedal into action by electrical force, not physical labor.

This electric piano player can be attached to any style of piano, upright or grand. The music rolls being of metal are practically indestructible.

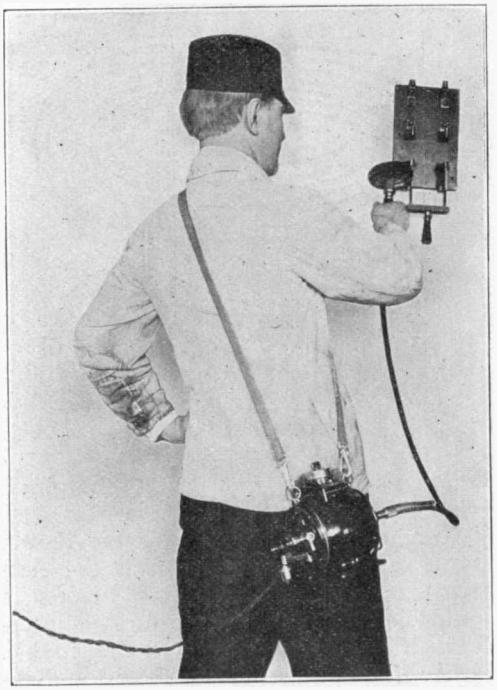
The electric furnace is capable of attaining a heat of 7,200 degrees. This is a fearful temperature, and will melt almost every solid known to man. In comparison with this heat a red-hot bar of iron would be called cold.

ELECTRIC DRIVEN POLISHING OUTFIT.

BY FRANK C. PERKINS.

A novel electrically operated polishing machine is shown in the accompanying illustration which is particularly valuable about an engine room, an electric power plant, in office buildings or on shipboard where brass signs, railings or other brass work requires polishing at frequent intervals.

As will be seen by the illustration this electric polishing outfit consists of a

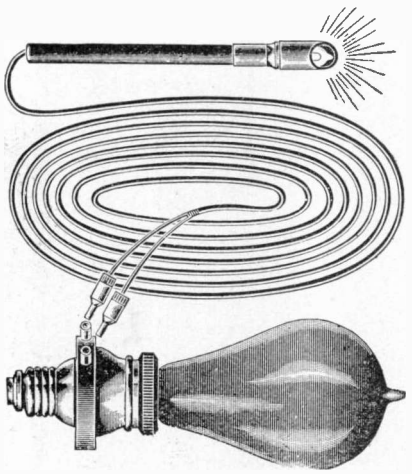


ELECTRIC DRIVEN POLISHING OUTFIT.

small electric motor with switch mounted on top and straps for swinging it over the shoulder of the operator. On the armature shaft of the motor a flexible shaft is provided at the end of which the polishing disk is revolved, with a convenient handle for holding it in any position desired. By means of this equipment a vast amount of work can be accomplished in a short space of time and much more economically than by hand labor. This unique labor saving device is provided with a long flexible cord and an attachment plug so that it can be connected with ease to any electric lighting fixture.

PRACTICAL ELECTRIC APPLIANCES FOR THE PHYSICIAN.

In the practice of medicine and surgery there are hundreds of ways in which electricity is now applied, not only as a curative agent but also as a mechanical aid in the diagnosis and treatment of disease. It is the purpose of this article briefly to describe a few of the latest appliances in this line, a



DIAGNOSTIC LAMP.

subject of interest not only to the physician and surgeon but to the laity as well.

In diagnosing diseases of the throat, nose and even of the stomach, the electric incandescent lamp has become a valuable assistant, permitting the insertion of a light at the seat of the trouble. One of the illustrations shows a diagnostic lamp and a rheostat for operating it from the ordinary 110-volt alternating or direct current lighting circuit. The large lamp in the illustration forms the rheostat and is screwed into an ordinary lamp socket. Current comes from one light wire, flows through the lamp rheostat, whose high resistance cuts down the strength, then through one strand of the cord to the little incandescent lamp in the end of the tube, and then back through the other strand of the cord to the other side of the light circuit. In this way the small diagnostic lamp burns brightly without being burned out as would be the case if the rheostat were not employed.

The diagnostic lamp may then be inserted in the nose and throat cavities, or in a little different form may be swallowed by the patient, cord and all, to light up the interior of the stomach, enabling the physician to make observations through the body tissues.

The therapeutic lamp is designed more especially for the benefit of those who desire to test the value of concentrated light and radiant heat as a therapeutic agent without investing in one of the large and more expensive lamps. There seems to be no doubt but that light in this form is distinctly beneficial in many conditions and it has been recorded as a specific treatment by some authorities in some few conditions. Necessarily the essential features of an outfit of this kind

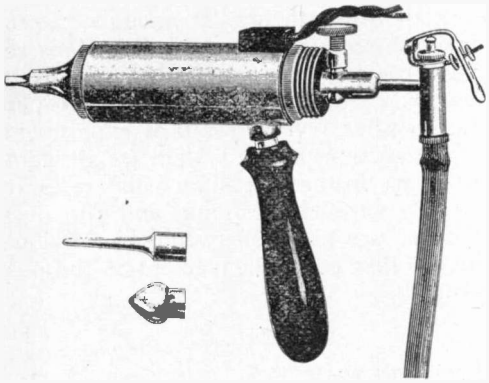
THERAPEUTIC LAMP.

must be the source of light and the means for concentrating it at the point desired.

In the case of the lamp illustrated, the light is supplied by an incandescent lamp of special construction, designed to give the greatest possible volume of light from a filament occupying comparatively small space. The rays given off by this little lamp have the same germicidal power as those given off by the largest lamp that could be made, though of course the area which can be covered at one time is more limited, and all other known effects of concentrated light may be looked for with certainty.

It is now generally acknowledged that superheating the medicated air used in

the treatment of certain diseases of the ear and nose greatly enhances its value as a curative agent. The electric air heater was therefore devised for this purpose. The heating tube which is enclosed in the outer casing is so constructed that the air passes not only through it but around it. The heating tube can be quickly and easily removed and replaced by a new one at small expense, although, with ordinary use, a tube will last for two years or more.

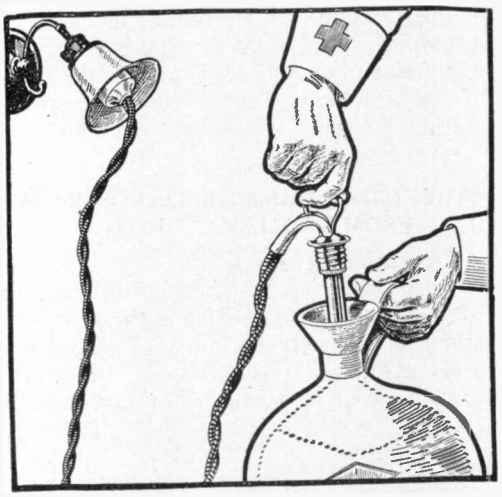


ELECTRIC AIR HEATER.

A medicator or receptacle for medicated felt or cotton is embodied in the heater, so placed that the air is passed through it on its way to the heating tube. Access to the medicator is had by unscrewing the back cap or cover. A heat radiating device is interposed between the back of the heater and the valves, to prevent the metal parts that come in contact with the operator's hand from heating to an uncomfortable degree.

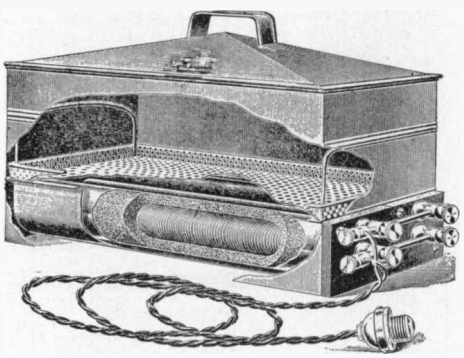
Obviously the therapeutic value of the hot water bottle depends directly upon the temperature of the water, which should be kept at a constant temperature of about 135 degrees Fahrenheit. This is accomplished by means of the little electric heater, without the trouble and annoyance of constantly changing the water after the water bottle is once in place. This device consumes but nine watts of current and the cost per day for operating it is negligible.

The heater passes through a water tight screw stopper calculated to fit the ordinary water bottle. Each heater is supplied with attachment plug and conducting cord. Simply fill the water bottle with hot water, screw the heater into the bottle in place of the stopper, attach to nearest electric light socket and it is in operation. It works on either direct or alternating current.



WATER BOTTLE HEATER.

Every instrument used by the surgeon must be absolutely asceptic. This is not a hobby but a necessity if operations are to be successful. The electric sterilizer is highly satisfactory for this purpose. The heat is electrically generated in two heating tubes, extending the full length of the sterilizer. Either one or both of these tubes can be put into service. The resistance wire is wound around porcelain tubes, then covered with porcelain and baked, this construction insuring the greatest possible durability, and in ordinary service these heating tubes should last not less than two years. Owing to the construction



INSTRUMENT STERILIZER.

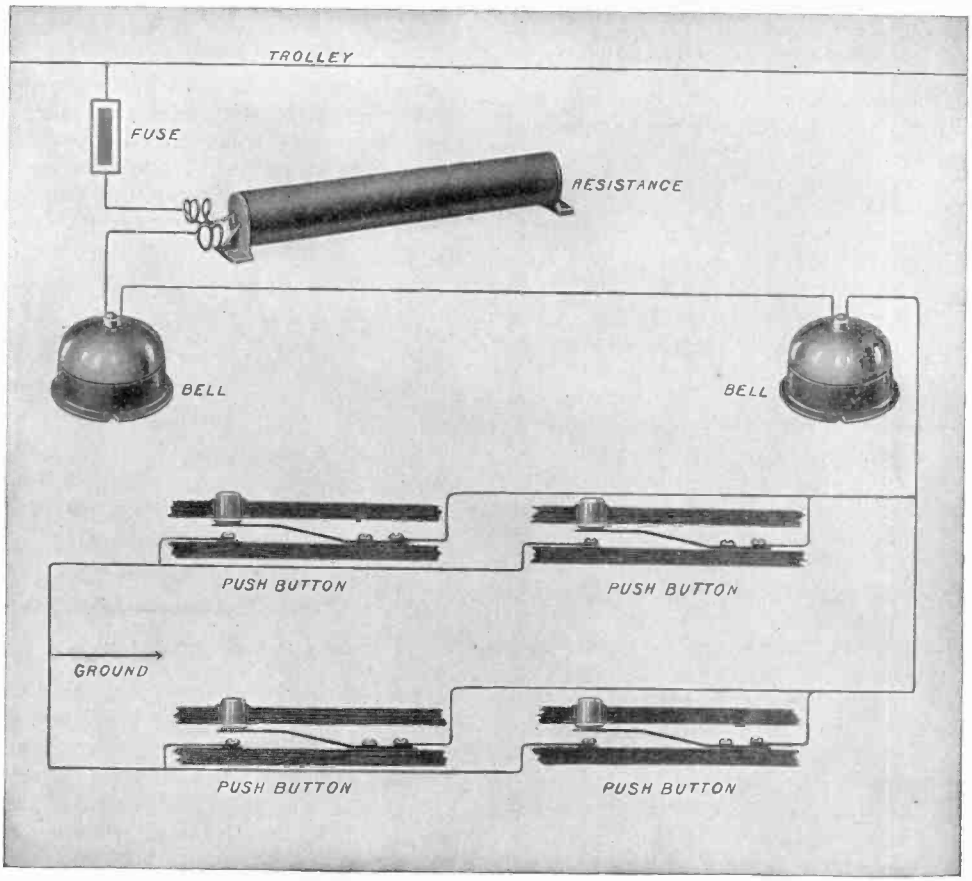
and method of installing these heating tubes the water is brought to the boiling point quickly and with a small consumption of current. The containing vessel is of heavy copper, tinned on the inner surfaces, the exterior being left in polished copper. The usual removable tray is provided. The outfit is supplied with attachment plug and cord, and is all ready to be attached to either direct or alternating current.

STREET CAR SIGNAL BELLS OPERATED FROM TROLLEY CURRENT.

Operation of signal bells on street cars by dry batteries is often unsatisfactory because of the short life of the batteries and the necessity of constant inspection and renewal. It is advisable, therefore, to provide some means whereby the bells may be operated from the trolley current. Such a system is shown in the cut herewith, which is said to result in marked economy over dry battery installations.

The usual trolley voltage is between 400 and 600 volts direct current. This high voltage, if applied directly to the bells would of course burn them out, so a suitable non-inductive resistance had to be worked out to insert in the bell circuit in order to not let enough current through to burn out the bells. This resistance coil constitutes the important feature of the system and was only perfected after several years of experiment.

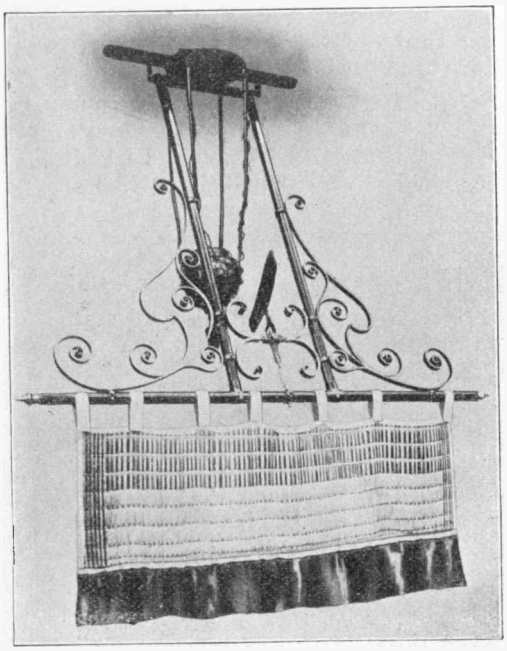
Connections of the system are all plainly shown in the cut. The bells are located one in each vestibule and the push buttons are placed between the windows or in other places convenient to the passengers.



WIRING OF STREET CAR BELLS FROM TROLLEY.

AN ELECTRIC PUNKAH.

The punkah wallah is known to every traveller in the East as the indispensable native servant who sits and (except when he falls asleep) continually jerks the rope connected with the swinging curtain fan, called the punkah, which



AN ELECTRIC PUNKAH.

hangs from the ceiling in the well regulated Indian household. Well, the days of the punkah wallah are numbered. An electric punkah has at last been invented.

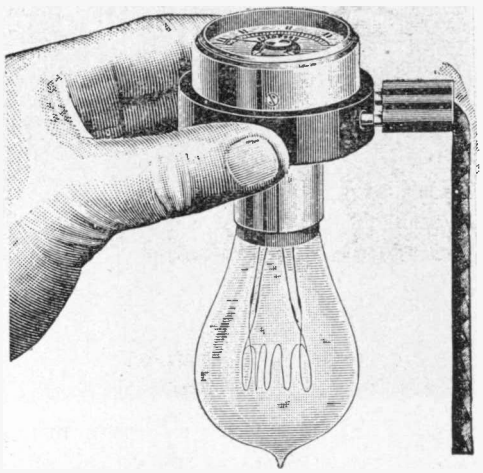
The reason that all mechanical devices for this work have failed is that the pleasant breeze that the hand worked punkah gives is due to a turn of the fan that the wallah gives by jerking the rope at each turn. In order to obtain a "flick" similar to that given to the hand worked fan, the inventors of the new electrical punkah have devised an ingenious piece of mechanism.

A motor is hung vertically from the ceiling by four supports and on the lower end of the vertical shaft is a conical body barely discernible in the picture. The frame which carries the fan or curtain swings down past the motor on hinged arms. To this frame is attached a leather covered friction member shown directly in front of the motor. As the frame swings downward the friction piece rubs against one side of the revolving cone, which throws the frame out in one direction. As the frame swings back the other side of the friction piece engages the other side of the cone and throws the frame sharply out in the other direction. This movement is kept up as long as the motor runs, the ends of the friction piece being beveled so that it strikes on opposite sides of the cone at each throw.

WATTMETER FOR TESTING INCANDESCENT LAMPS.

Since the development of the recent new types of high-efficiency incandescent lamps, lamp users have been interested to know the efficiency of the new lamps as compared to former types. The small pocket wattmeter shown in the cut is designed for this purpose. It is a simple instrument for measuring the current of any incandescent lamp.

The instrument may be used on direct or alternating current circuits with-



A MINIATURE WATTMETER.

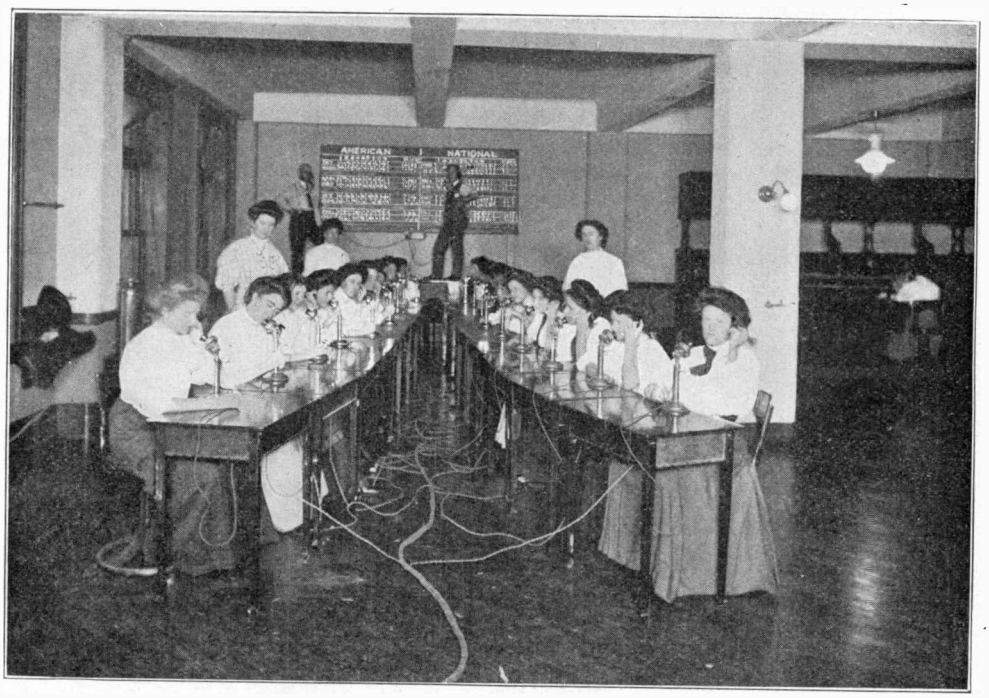
in the range of its calibration, which is up to 150 watts at 118 volts. Suppose, for instance, it is desired to compare the current consumption of an ordinary carbon filament lamp with that of a tungsten lamp. Simply attach the lamp cord terminals as shown and screw one of the lamps into the base of the wattmeter. The number of watts consumed is shown on the dial. Then remove the first lamp and test the other in the same manner. Thus an accurate comparison is obtained.

THE "BULLETIN SQUAD" IN A TELEPHONE EXCHANGE.

The active interest that Detroit takes in baseball was never more clearly demonstrated than it was in the main office operating room of the Michigan State Telephone Company during the last two weeks of the baseball campaign last fall. Not only the general importance of the campaign, but also the relative importance of each game was clearly demonstrated. The importance of a deciding game of a certain series in relation to other games, and finally the superlative importance of that last deciding game of the campaign might all be mathematically proportioned from the telephone traffic records. As graphically described by the Michigan State Gazette, on that last and pennant-winning Tuesday, when the cork finally flew out altogether and enthusiasm spilled all over the city in unmeasurable volumes, the fuse on the main discharge circuit blew out altogether and for 45 awful seconds the "Main Exchange," like the city, was "baseball mad."

The normal "discharge" from the storage batteries to take care of all signals and transmitters for ordinary traffic is 225 amperes. The "peak of the load" is, of course, slightly higher. But on that baseball Tuesday the ammeter simply jumped with a bang to its limit of 350 amperes, and a 400-ampere fuse melted like soft butter on a hot stove. So it was easy to guess, with the engineers and the fans, just how much current was used and how much enthusiasm was burned when Detroit won the pennant.

The operating room was almost the busiest place in Detroit. Line lights twinkled in and twinkled out like a carnival of fire-flies in a June meadow. Nimble fingers flew from answering jack to calling jacks like parts of swift machinery—and they were. The Michigan Central Railroad private branch exchange lines showed no less than 19 trunks plugged in on "baseball operator" at one time.



"THE BULLETIN SQUAD."

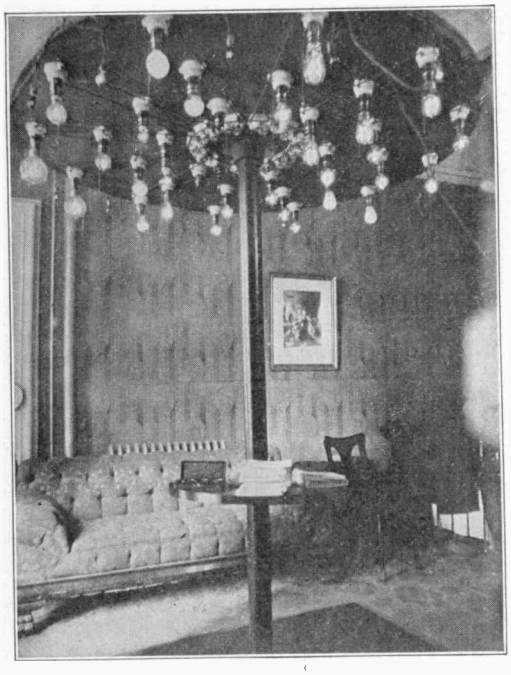
The young ladies whose pictures are shown herewith answered 7,000 calls an hour for the main exchange alone—at least they counted up to this number, and then had to give it up for a bad job—

each girl is sure that she answered all of this number alone, even in less than an hour, when it got "real busy."

All "bulletin service" of the Detroit exchange is handled by the equipment and arrangement of special operators shown. The operator's sets are cut in at the bottom of the multiple panels on adjacent strips to the sub-exchange, long distance and chief and information operator circuits. Calling subscribers are therefore directly and instantly connected with the bulletin operators by the regular exchange operators, and contrary to the popular supposition, regular operators do not give out the information, but are left free to handle the regular traffic.

A UNIQUE LAMP EXHIBIT.

At the recent convention of the Association of Car Lighting Engineers, held in Chicago, a very unique and interesting display of incandescent lamps designed especially for car lighting was

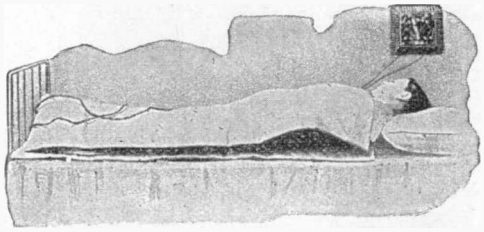


UNIQUE LAMP EXHIBIT.

made by the Columbia Incandescent Lamp Company. The exhibit is shown in the accompanying illustration and was arranged under a large umbrella-like canopy. All of the incandescent lamp family were represented; beginning with the carbon filament lamp and on up through the metallic filament and tantalum to the tungsten lamp, the newest feature in incandescent lighting. The lamps of the various classes were all on separate circuits, so that the brilliancy and light giving power of each could be studied separately.

ELECTRIC SWEATING BLANKET.

The great benefit derived by the direct application of high temperatures in a moderately dry atmosphere, is being recognized more and more by the leading physicians. To meet the needs of hospitals and private families for an appli-



ELECTRIC SWEATING BLANKET.

ance which would immediately supply this heat without much expense, an electric sweating blanket has been devised which is illustrated herewith. These blankets are now used in the treatment of pneumonia, pleurisy, rheumatism, enlarged joints, and oftentimes in connection with mud bath treatments, to keep the mud at a high temperature.

The patient is wrapped in sheets, covered with heavy woolen blankets, and placed between the electric sweating blankets. The current consumed is about 800 watts, but it may be regulated by the rheostat shown in the illustration. The treatments usually last about thirty minutes, and the results are satisfactory to patient and user alike. Inasmuch as the blankets are light and flexible, the heat is easily controlled, and is applied to every part of the person.

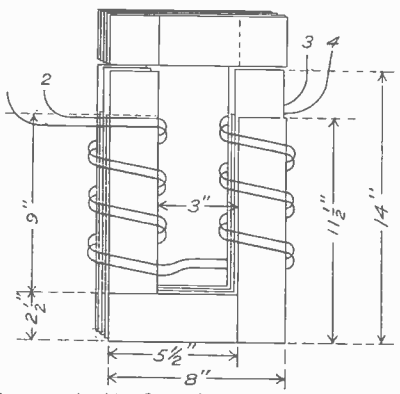
These blankets are cleanly; are covered with rubber cloth, and are practically indestructible. They are made for all voltages up to 250.

HOW TO MAKE A HIGH FREQUENCY APPARATUS.

BY H. L. TRANSTROM.

Many readers of Popular Electricity have been interested in an article which appeared in August in which I described the general principles of an outfit producing high frequency currents, and in response to requests to give the details of construction of such an outfit this article has been written.

A transformer is needed, giving ten or 20,000 volts to charge the condenser. To construct one it is necessary to make a core from soft sheet iron strips, with a cross-section 2½ inches square, built in



Connect No. 2 and 4 together for series connection and for parallel No. 1 & 2, And also 3 and 4.

FIG. 1. TRANSFORMER FOR HIGH FREQUENCY WORK.

the shape of a rectangle 8 by 14 inches outside dimensions and 3 by 9 inches inside (see Fig. 1.)

Cut from the sheet iron, strips 2½ by 5½ inches and 2½ by 11½ inches, sufficient to make a mass five inches thick of each size when compressed in a vise.

Then take three strips at a time and build a core of the dimensions given in Fig. 1, leaving the top section unfinished until the secondary coils are placed in position.

To hold the core in shape after it is assembled, take two pieces of dry wood 12 by 3 by 1½ inches and bore a hole in the ends of each, nine inches apart. Put one board on each side of the bottom section and place in a vise, when the six-inch bolts can be drawn tight and then the core will be rigid.

On the vertical sections wrap tightly two or three layers of friction tape to within 2½ inches from the top. Over this wrap a couple of layers of Empire cloth.

The primary consists of 110 double turns wound in a single layer over the Empire cloth, the conductors being two No. 12 cotton-covered copper wires placed side by side, 55 double turns on each vertical section (see Fig. 1.)

Over the primary winding next wind tightly 15 layers of No. 7 Empire cloth 9 inches wide and we are ready for the secondary winding.

In winding the secondary much care must be exercised, as a transformer's insulation is no better than its weakest spot. This secondary consists of 20,000 turns of No. 32 single cotton-covered copper wire wound in eight coils of 2,500 turns each, which are connected in series, four coils on each side.

The coils are rectangular in shape 1¼ inches wide, four inches square inside and six inches square outside dimensions. They are wound on a form 1¼ inches wide and four inches square, the lateral edges being slightly rounded off to facilitate winding. This form is carefully centered and a metal rod about six inches long of any convenient size is passed through, with a small crank fastened on one end. To keep the coil from sliding out of shape make two disks seven inches in diameter, and when centered screw one on each side of the form.

Set this form between two supports and begin winding, first a layer of Empire paper and then a layer of wire alternately, until the 2,500 turns are on. It will be found very easy to wind this fine wire in layers if it is allowed to slide over a rod a foot or so away and guided with one hand while winding with the other. Leave a margin of ¼ inch in each layer.

All coils should be tested to see if there are any bare places or if the wire is in one continuous piece. If not, do not attempt to use it as it will surely

burn out when run a short time. When all coils are completed they should be dried in an oven, not too hot, and then laid flat in hot petroleum and boiled for several hours, and then left to cool in the mixture until set, which will take quite a long time.

When thoroughly cold, take carefully out of the mixture and after taking the surplus off the coils, assemble on the core over the primary, four on each side. To keep the coils insulated from each other, cut 36 squares of Empire cloth 7 by 7 inches and cut out of their centers a hole that will fit snugly over the Empire cloth on the primary. Use six thicknesses between adjacent coils, there being only six places to use these separators.

The coils should all be connetced in series as though it were one continuous wire beginning at the top of one section and ending at the top of the other. (See Fig. 1).

Connect all coils so that they have the same relation to one another as the turns in the primary. Keep the coils one inch from the bottom of the core by inserting narrow strips of birch wood across the binding boards and cover with several thicknesses of Empire cloth.

When all the coils are assembled and connected properly, the top part of the core may be completed. A sheet of micante 9 by 4 by 0.1 inch should be used to separate the vertical sets of coils. Make a box of close-grained hardwood 7 inches wide by 15 inches high by 14 inches long inside measurements and coat thoroughly with hot paraffine to make it perfectly tight.

When the transformer is set in the box it may be fastened by screws to the bottom binding boards.

Bring the ends of the primary wires to one side of the box and the secondary to the other side where they can be connected to proper binding posts. The secondary wire should be kept clear from the core and be led out through hard rubber rod binding posts. The four primary wires should be arranged so that they can be easily connected either in series or parallel.

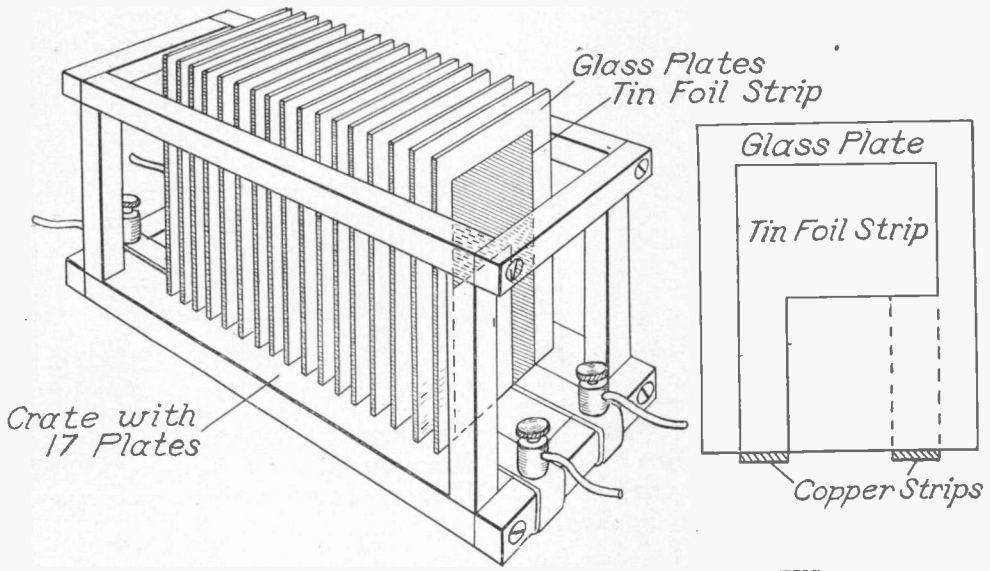


FIG. 2. CONDENSER FOR HIGH FREQUENCY APPARATUS.

Boil 40 pounds of extra amber petroleum and fill the box to the top and screw fast the cover and the transformer is complete.

Next we construct an adjustable condenser of 17 plates of double thickness window glass 10 by 12 inches. Coat all the plates with tin foil 5 by 6 inches on both sides. Leave a margin of two inches on top and sides and five inches on the bottom. On eight of these plates paste a strip of tin foil on the lower right hand corner to reach the bottom and on

the other nine paste them on the lower left hand corner of the foil. These are the connectors which rest on two copper strips laid parallel four inches apart on the bottom of the crate with binding posts on each end. The strips are fastened on and insulated from the bottom of the wooden crate, with slots in the sides to receive the plates. (See Fig. 2.)

The Tesla coil consists of a primary of seven turns of No. 6 bare copper wire and a secondary of 180 turns of No. 22 bare copper wire wound in a single layer on a drum 6 inches in diameter and 14 inches long made of dry birch boards glued together in a circle and then turned off in a lathe. The turns of wire are carefully spaced apart 1-16 inch when winding, and leave a margin of ½ inch on the ends. The primary is wound on a wooden drum 8 inches in diameter and 4½ inches long, the turns being carefully spaced apart and fastened. The secondary coil is set on top of the primary coil and the base fastened to the bottom drum.

Give the secondary winding a coat of orange shellac, being careful not to disturb the turns while doing so. A nice turned top can be added for appearance, and a brass rod 4 inches long and ⅜-inch thick driven tightly in the center of the top and well rounded off, will be the discharge rod, being connected to the top end of the secondary wire.

The lower end of the secondary terminates in another binding post.

On the primary a binding post is fitted at only the upper end, while the other connection is a sliding contact.

For a spark gap take a glass jar about 6 inches in diameter and 8 or 10 inches in height and make a hole in the bottom ¼-inch in diameter. To do this take clay or putty and lay a thick layer over the center of the bottom of the jar. Make a ¼-inch hole in the clay down to the glass and fill with hot solder. The glass will fali out the shape of the hole in the putty or clay.

Make a cover from some nice hardwood to fit tightly in the top of the jar, and boie a hole in the center, in which fasten securely a threaded ¼-inch nut which is connected by a wire to a binding post on one edge of the cover.

A ¼-inch rod threaded the whole length is fitted with a hard rubber handle ¾ by 3 inches long. This is screwed in the threaded nut. The length of rod depends on the height of jar used. Another rod is fitted with a metal ball ¾-

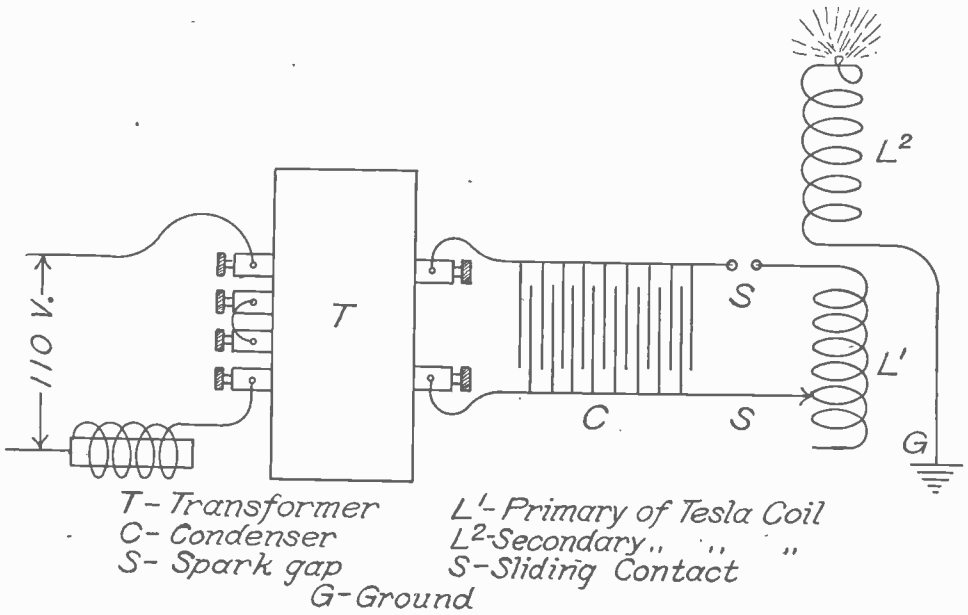


FIG. 3. CONNECTIONS FOR HIGH FREQUENCY APPARATUS.

inch in diameter and inserted in the hole in the bottom and then through a base of hardwood on which a binding post is placed.

Now to operate the completed apparatus connect as per diagram, Fig. 3.

Connect the lower terminal of the secondary of the Tesla coil to a good ground with stranded wire as a stranded wire is a better conductor for high frequency currents than is solid wire.

Although I obtained the results shown in the August issue by using the primary in parallel on 110 volts 60 cycles, consequently 20,000 volts secondary voltage, yet I have obtained as good results with better control by using the primary sections in series and an adjustable choke coil in series with them. The choke coil can be made from a mass of sheet iron 2½ by 2½ by 8 inches, which is inserted in a hollow coil of No. 10 copper wire of 110 turns.

By inserting the core in the coil the current can be varied according to the depth inserted. This outfit is for the unipolar or single pole method of generating high frequency currents. If all connections are correctly made the spark gap should be turned until the spark will just jump easily, then on the primary of the Tesla coil move the sliding contact on the second turn from the top. If the coil does not do as shown in the picture in the August issue move the contact on the next turn and so on until it does.

To light a lamp use the fourth or fifth turn and slide the lamp along the side until the brightest light is obtained.

Always disconnect the primary of the transformer before attempting to adjust the different parts.

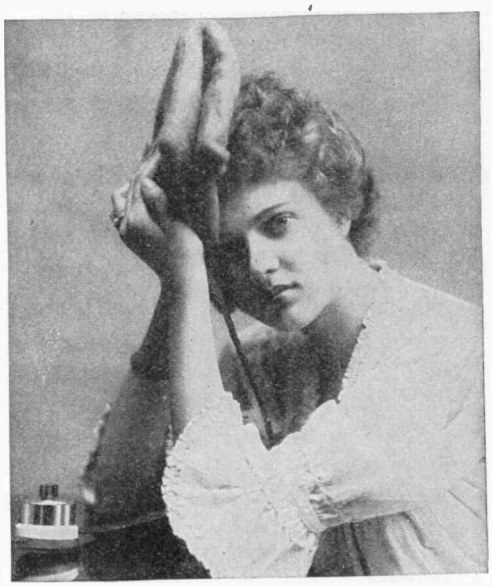
By adding condenser plates or taking them out of the crate, one by one, the coils will be brought in tune under certain conditions.

In an article in the December issue of this magazine under the title of "Telephone Line Over the Alps," it was stated that the line under consideration is situated at the greatest altitude of any telephone line in the world, being 11,962 feet above the sea level. From later information obtained, it would appear, however, that the record of high elevation belongs to the United States, there being a line at Camp Bird, Colorado, which is 13,000 feet above the sea level.

ELECTRIC WARMING PAD.

The electric warming pad illustrated below takes the place of the old style cumbersome hot water bottle. It has numerous advantages over the water bottle, as it is very light, is flexible and may be bound around a limb or over a shoulder, and gives a very mild and beneficial dry heat.

The heating element is inclosed in an asbestos covering and is very flexible.



ELECTRIC WARMING PAD.

Outside of this is a covering of canvas, and an eiderdown casing, which may be removed and easily washed.

In the exact center of the pad is located a thermostat which automatically cuts off the current when the temperature rises to the proper degree. In this way the pad may be put into service and left all night long, without any danger of burning or setting fire to the bed clothing.

The pads are equipped with a three-heat switch which enables the patient to obtain either a minimum, mild or full heat, as desired. Usually the full heat is used when starting the pad, and it is

then turned down to mild heat, and left for the remainder of the treatment.

The pads are furnished complete with ten feet of cord, and may be had in either eiderdown or rubber covering, as desired. In cases where hot poultices are to be applied and maintained at a high temperature for a long time, the rubber covering should be used, and the pad placed immediately outside of the poultice. In this way the patient receives the beneficial effect of the poultice, together with that of heat.

It is said by some that the presence of an electric field in the pads has a soothing effect upon the nerves, and that all pain is relieved a few moments after the pad is applied.

POPULAR ELECTRICITY WIRELESS CLUB.

Ever since the appearance of the first number of Popular Electricity, last May, we have been impressed by the remarkable interest displayed by our readers in the subjects of wireless telegraphy and telephony. Every day our correspondence contains letters from experimenters asking questions relative to the design and construction of apparatus and describing equipments that they have built, and this or that device which they have found useful in the operation of their systems. If wireless communication does not become a great commercial success, it will not be because of any lack of enthusiastic supporters, for the subject is one which interests thousands—amateur and professional.

In order to bring these widely scattered workers in close touch with each other, so that their experiences may be mutually beneficial, we will make the "Popular Electricity Wireless Club" a feature of this magazine. Those experimenting in wireless telegraphy or telephony, who have actually built or are building a wireless equipment, are eligible to membership in the Club, and the department will be made a clearing house for their ideas.

No expense will be attached to membership in the Club, but each member will be required to fill out a blank, giving his full name and address and some brief information concerning the nature and scope of his equipment. A file will be kept of this data and from time to time revised lists of the names will be sent to each member.

The success of the Club and of the department in Popular Electricity devoted to its interest will depend largely on the members. They can contribute to this success by sending in descriptions of the apparatus they have constructed, the difficulties they have encountered and how they were overcome.

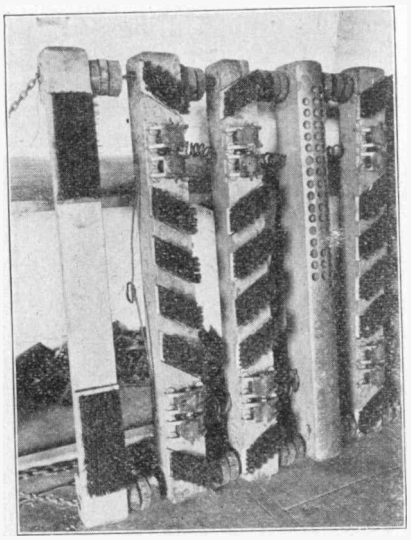
Questions regarding wireless work will be answered in this department instead of in the regular department of questions and answers, which appears elsewhere in the magazine, and articles of an interesting and instructive nature written especially for Popular Electricity will appear from month to month in the pages devoted to the doings of the Club.

In short, it is our intention to make this department of the magazine a complete index to the developments which are constantly taking place in the rapidly widening field of wireless communication. As a member of "Popular Electricity Wireless Club" you can help in this work.

Application blanks will be sent to those who wish to secure membership, and a neat Club button will be given free to each member. From the interest manifested in wireless work this membership will reach a thousand inside of twelve months. Let your name be one of the first.

ELECTRIC SHIP SCRUBBER.

The problem of the protection of the sheathing of ships from the innumerable enemies that attack it while the vessel is at sea is an old and difficult one. Hundreds of patents have been taken out on devices to clean the ship without the necessity for dry docking, and devices have been introduced for keeping the enemy from fastening to the ship's bottom. But none has been successful. Barnacles and weeds will attach themselves to the bottom of the vessel and these must be laboriously cleaned off whenever the ship is so handicapped by them that its speed is hindered.



ELECTRIC SHIP SCRUBBER.

An electric scrubber has just been invented in England that, it is claimed, solves the problem satisfactorily and simply. The scrubber works by being dragged up and down under the hull of the ship by ropes. By the use of electricity it is made to cling to the steel sides of the ship like a magnet.

The mat of the scrubber is a series of battens carrying the brushes and magnets. Position chains are passed around the ship at the bow and stern and between these hauling hawsers, carrying the mat, are moved fore and aft by a steam winch.

When the mat is hung over the ship's sides and into position the current is switched on. In that condition the apex of the curve of each magnet touches the ship's side, but the brushes do not touch. When hauling begins the battens cant, thus bringing the fore edge of each brush into contact with the ship; at the same time the fore side of the magnet becomes engaged. The backs of the battens are so contrived as to ensure this canting or rocking. Since the mat has to travel forward and aft, the arrangement has to be double ended, thus each leading batten has its back made with one bevel on its outer edge, but each middle batten has both edges bevelled.

The current can be supplied from the ship itself, if necessary. The scrubber can be manipulated by a few men, and it has been demonstrated that an 18,000-ton battleship can be scrubbed in 12 hours. The cost of cleaning a ship by this method is small. It is said that a 4,000 ton ship can be cleaned in about eight hours, at a cost of $100.

REGULATING CLOCKS BY WIRELESS.

An Austrian inventor has perfected a system for the regulation of clocks by energy transmitted through space, on the principle of the wireless telegraph. For three years his plan has been working on a limited scale in Vienna with great success, and it is proposed to start a regular time-keeping service to be run from a central official clock, by wireless.

This system automatically sets the clock once every minute and has operated successfully through heavy rain storms, lightning and hurricanes. It is possible by it to regulate accurately any number of clocks within a radius of many miles at a very small cost, as the expense of wiring is entirely done away with.

ELECTRIC SHOCKS FOR PERVERSE CHILDREN.

A novel cure for naughtiness and general perversity in children is advocated by Dr. Elbert Landone, a noted authority on child culture. He maintains that a few light shocks of electricity, judiciously applied, are the most effective means of punishment. In one instance a child of five was thoroughly broken of obstinacy within three days from the beginning of the treatment.

TESTING STREET CAR FENDERS AND WHEEL GUARDS.

The New York Public Service Commission of the First District recently carried out a series of tests to determine the most efficient types of street car fenders and wheel guards. The Parmenter fender and wheel guard, submitted by the Elmer P. Morris Company, met with the highest approval of the commission, and several views of it, and of the tests are shown herewith. The tests were carried out by using a series of life sized dummies to represent an adult man, adult woman and a boy.

The male size was five feet eleven inches tall and weighed 170 pounds. The bodies were made the exact dimensions of a male person, being jointed the same as a human being, and weighted on the interior in the same proportion as a human body. The dummies were made of wood, wrapped with adhesive tape to prevent splitting, and then sheet lead was fastened to the various parts of the body to conform to the weight of a man. The same general construction was used for the female and the boy. The weight of the female body was 120 pounds, height five feet seven inches. The weight of the smallest dummy was 60 pounds and it was made to represent in size a nine-year-old child.

These bodies were placed in the following positions on the track: Standing up facing the car; standing up back to the car; standing up side to the car; lying down straight across the track; lying down diagonally, head on; lying down feet on track; lying down parallel with track, head on; lying down parallel with track, feet on; lying on track head on with arm on rail.

FIG. 1. STREET CAR FENDER AND DUMMIES USED IN TESTING.

Each one of the dummies was given a test by the various fenders at eight miles per hour on the cobble stones, and eight miles per hour on asphalt. The Parmenter fender is shown on the right in Fig. 1, which also shows the types of dummies used. Fig. 2 shows the wheel guard as used on the pay-as-you-enter cars in New York City. Fig. 3 shows

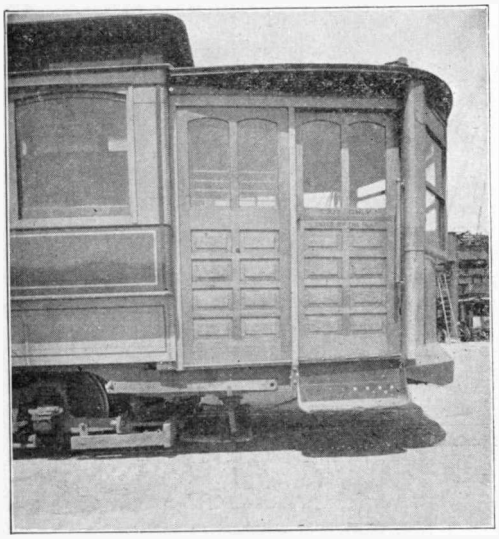


FIG. 2. IMPROVED WHEEL GUARD.

the wheel guard in the act of picking up a dummy.

It was thoroughly demonstrated by the tests and was the opinion of all railroad men present that a wheel guard placed

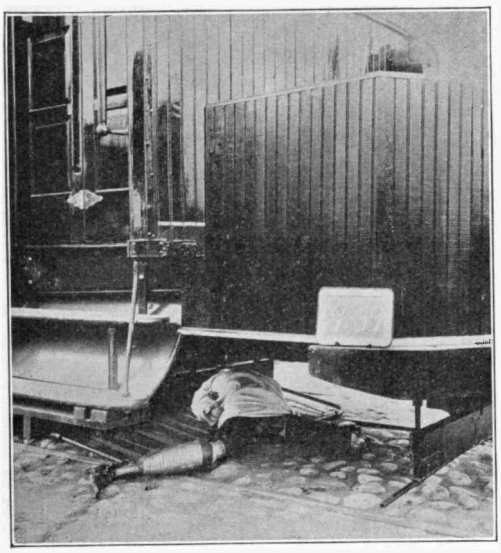


FIG. 3. WHEEL GUARD PICKING UP DUMMY.

immediately in front of the wheels is the only safe and practicable device to be used in cities where the traffic is heavy, while the fender is most efficient on the front of cars used on interurban lines or in small cities.

INSULATING A HIGH TENSION TRANSMISSION LINE.

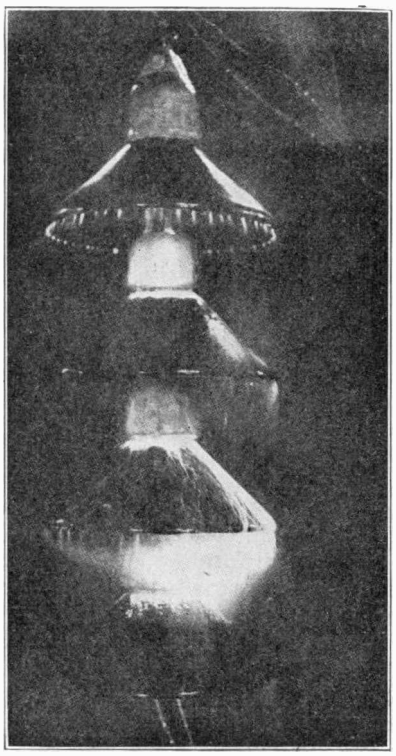
Few people outside of the engineering fraternity realize the precautions that must be taken in the construction of a modern electric transmission line. Two or three wires strung on a line of poles is all that it means to most of us. But years and years of experiment and thousands of tests and trials have been necessary to make possible the transmission of current at 100,000 volts and even 110,000 volts which is now an actual accomplishment. Why are these enormous voltages necessary? It is simply a matter of dollars and cents. Suppose electric power were to be delivered from a power plant to a point 200 miles away. This could be done by a current of 500 volts or even less. But the plan would not be practicable because such a puny voltage or pressure would not be sufficient to force the current through 200 miles of wire unless the latter were so large (to decrease the resistance) that the cost of the copper would be more than that of the plant, and would represent an investment the interest on which would eat up all profits of the undertaking. Consequently, as the distances of transmission have gradually been increased, year by year, the line voltage has been increased correspondingly until, as stated above, it has in one instance reached 110,000 volts.

How to generate these immense voltages has been by far a more easy problem than how to insulate the line so that the electricity will not jump or leak to the earth. Little glass insulators did at first, then small porcelain ones, then larger ones. Then petticoat after petticoat were added in the design until finally the insulators became so large and expensive that it was impracticable to go further with this design, which was carried by a pin. So finally, when engineers were studying how they could insulate 100,000 or 110,000 volts some one hit upon the plan of making a suspended type of insulator made up of several sections, one above the other. Such an insulator is shown in the picture under test in the rain and carrying 200,000 volts.

From the point where the insulator is suspended to the point of attachment of the wire is perhaps two or three feet, but note the way in which the electricity

"slops" over from section to section, following the rain drops and the surface of the porcelain. This insulator finally broke down under the strain of 200,000 volts, which of course was higher than it would be called upon to carry under working conditions.

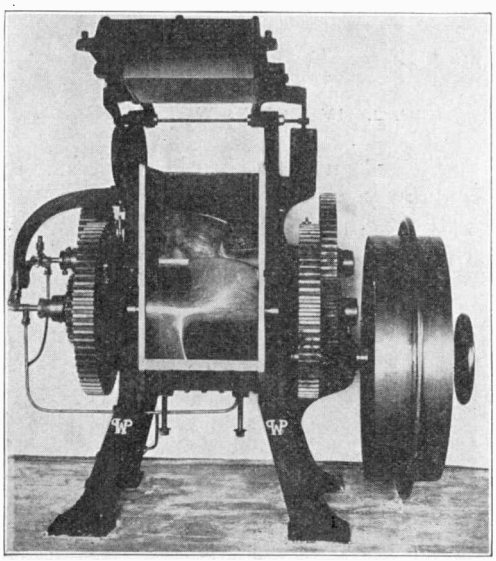
These insulators are made of a special high-grade porcelain, ingredients for which are brought from the far ends of the earth. They must be absolutely flawless, for one weak place, like the proverbial weak link in a chain, means the destruction of the insulator. They must be carefully glazed so that dust will not accumulate on the surface, or if a small amount does collect it will be readily washed off by the rain. The petticoats must not be too flat or they will collect dirt. They must not be too steep or the edges will be close to the center and the electricity in its tendency to climb up will find too short and easy a path to jump from one petticoat to the edge of the next. In short the design must be "just so" and on this feature alone many engineers and designers spend their whole time trying this shape and that, designing them theoretically at first and then building samples and trying them out practically.



TESTING A HIGH TENSION INSULATOR.

ELECTRIC MASTICATOR FOR THE MANUFACTURE OF CHEWING GUM.

Electric driven masticators are important accessories in the manufacture of chewing gum and are used for kneading and malaxating the constituents of the gum. One of the machines is shown in the accompanying picture. The peculiar kneading blade revolves in two hollow semi-cylinders, intersecting in each revolution successfully every point on the surface of the surrounding cylinder, so that no particle of material can escape getting in the axle of the blades. The apparatus is arranged for reversing so that the blade may be made to revolve forward or backward, thereby accelerating the process of mixing and the discharge of the material.



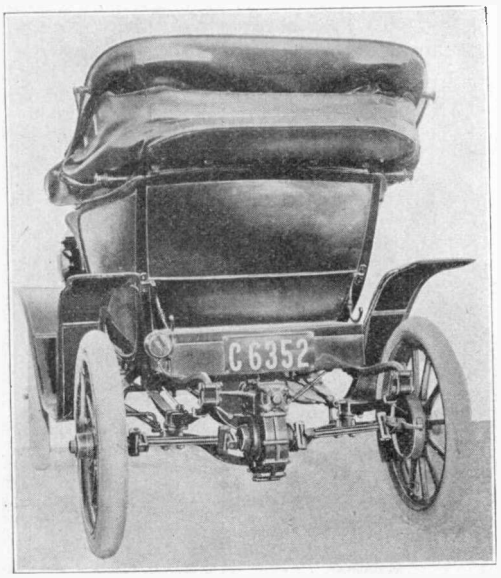
THE ELECTRIC MASTICATOR.

An electric motor of six to eight horse power is required for operating this machine at a speed of 100 revolutions per minute. It has a capacity of 46 gallons of material weighing 380 pounds, and the total weight of the machine is about 2½ tons.

NEW POWER TRANSMISSION FOR ELECTRIC AUTOMOBILES.

An innovation has been made in the design of electric automobiles which is somewhat similar to that made by the introduction of the chainless bicycle in days gone by. It consists of a worm wheel drive which does away with chains, chain housings, strut rods, etc. The latest type of Maxim-Goodrich car has this distinguishing feature.

The motor, suspended from the rear of

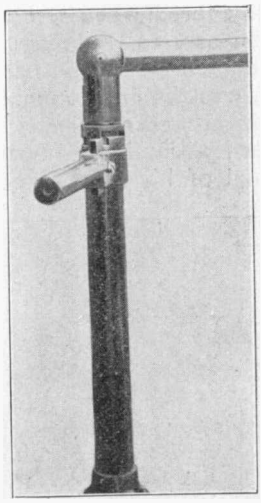


NEW POWER TRANSMISSION MECHANISM.

the chassis in a fore and aft position, has its armature shaft extended backward. Upon the extension is directly mounted the worm. This meshes with its wheel, which is supported in a separate housing attached directly to the end of the motor. All of the power producing and transmitting mechanism is thus confined to one compact unit as shown in the rear view of the car.

A solid rear axle carries the weight of the rear of the vehicle, passing in front of the motor and transmission unit. The rear wheels are driven through universal jointed shafts, which connect the stub shafts of the differential with the rear wheel hubs.

Another feature of this car is in the arrangement of the controller handle which turns the current on and off from the motor. As shown in the small illustration this controller handle is mounted on the steering post. The convenience of this novel arrangement is evident at a glance. The left hand rests naturally upon the controller, while the right hand



COMBINED STEERING POST AND CONTROLLER.

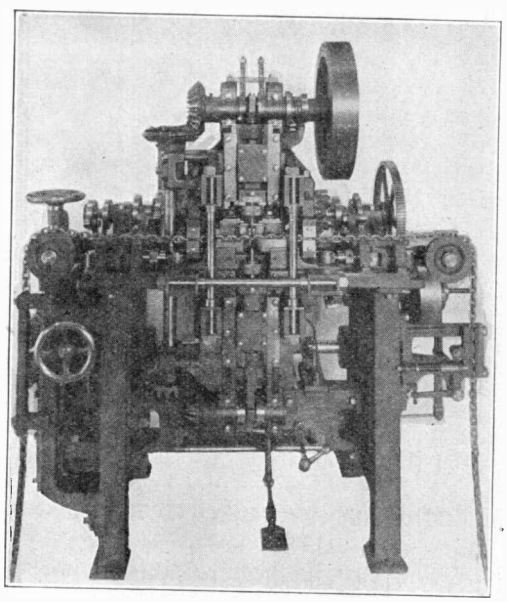
does the steering, and there is consequently no need of a lever at the side of the cushion to take up seat space and to catch the garments of the driver.

ELECTRICAL PHENOMENA OF THE GRAND PLATEAU.

Owing to the peculiar topographical formation of Bolivia, electric and other phenomena are of constant occurrence, the principal zone where such disturbances take place being the Grand Plateau. As the atmosphere is heavily charged with electricity, both in summer and winter, dry or electric storms are of frequent occurrence, both on the plateau and in the valleys. Before the rainy season sets in electrical accumulation becomes considerable on the plateau region, its most violent manifestations taking place toward the eastern section of the tablelands. An electrical storm in these regions is always a most imposing spectacle, as the tremendous force of the wind, almost equal to a hurricane, and the heavy electrical accumulation in the clouds produce terrible atmospheric explosions and violent detonations, while the surface of the ground sparkles and crackles.

THE ART OF ELECTRIC WELDING.

One of the first characteristics of the electric arc to be observed was the great localization of heat. Metals like platinum which could not before be melted were readily fused when inserted in the path of the arc. C. William Siemens, one of the pioneers in electric lighting in Europe, was the first to make application of the arc as an electric furnace, and he used a conducting crucible for one terminal of his circuit and a piece of circular carbon for the other. When the two were brought together and then drawn apart an arc was formed between them, and pieces of metal or ore thrown in the crucible were easily melted.

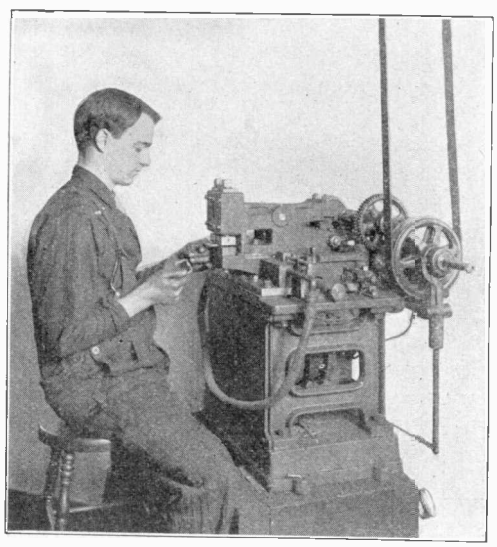


AUTOMATIC CHAIN WELDER.

The links of the chain are first nearly closed by mechanical means and then the chain is run through the machine as shown, electricity completing the process.

De Meritens, a Frenchman, substituted for the crucible the metal object itself, from which an arc was drawn, resulting in the melting of the object. The arc has also been used in somewhat the same manner as a blow pipe, the arc being blown onto the object to be melted, either by an air blast or by the repulsion effect of an electromagnet. The process, however, is limited in its application, being used principally for filling up blow-holes in castings.

The man to first see these limitations and develop a really practical method of electric welding was Prof. Elihu Thomson, and under his patents and others owned by the Thomson Electric Welding Company of Lynn, Massachusetts, the art has been exclusively developed. The principle which Thomson adopted, and which is today the only practicable system of electric welding was to force directly through the metal to be heated such large volumes of electric current that every molecule of the mass traversed by the current would be brought to the desired temperature, the same as the filament of an incandescent lamp is brought to white heat. The heat is not imparted by conduction, working inwardly as in the arc, furnace or the blacksmith's forge, but is generated directly in the interior of the mass itself, working outwardly and expelling impurities in the metal.

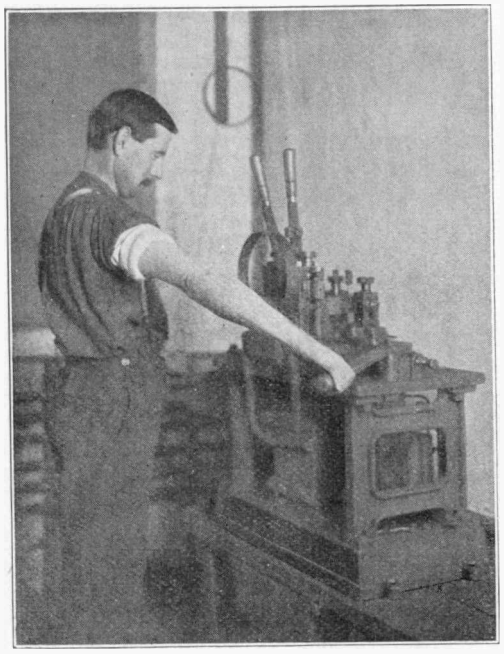


WELDING BUCKLES WITH THE AUTOMATIC ELECTRIC WELDER.

The boy has only to put in the buckle, which drops out after being welded. To weld a buckle requires 3,000 watts for one second.

In some of the earlier apparatus, known as direct welders and used only for small work, the alternating currents for welding were generated in the dynamo and carried to the clamps directly, without transformation, and the clamps and mechanical devices were all incor-

porated in the dynamo. This form of apparatus, while useful where current could not readily be obtained, had many complications and was abandoned for what are known as indirect welders, the welder being no part of the dynamo but connected by wires to it or to any suitable electric circuit, the apparatus employed consisting of a transformer provided with suitable clamps and pressure devices, called the welder, to hold and upset the pieces to be welded, and apparatus to regulate the flow of current for varying sizes of stock. The shape and size of the pieces, also quality of the metal, determine very largely the kind of clamps and pressure devices to be used.



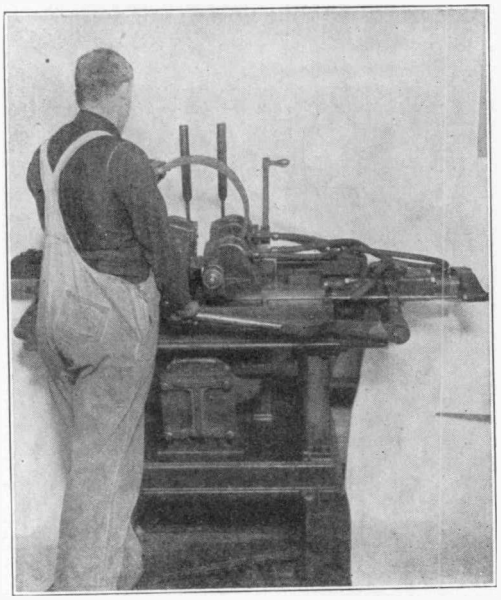
WELDING A STEEL RING 1½ by ⅛ INCH.

Left hand opens the circuit which is closed automatically when the weld is completed by operation of the right hand lever. 10,000 watts or about 13 horse-power are used for 1½ seconds.

In welding small wire end-to-end, for continuous lengths or for hoops, a spring is usually employed, the tension of which draws the clamps together following up the softening of the metal at the joint, the machine being provided with mechanical or electric devices to cut off the flow of current at the proper instant. This might be called more or less automatic, although the pieces are clamped by hand. There are, however, machines for welding wire hoops where all the movements are automatic, the boy simply inserting the ends of one hoop after another.

As the pieces to be welded increase in size, spring pressure is abandoned and recourse had to hand pressure, generally through a lever or wheel; and, finally, where the mass of metal to be welded and pushed up is too great for hand pressure, recourse is had to hydraulic or pneumatic pressure, either through jacks or cylinders.

Sometimes the mass of metal in the pieces to be welded is so great, it is difficult to clamp it securely by hand means, and hydraulic or pneumatic devices are employed. In such cases the apparatus is necessarily massive, somtimes quite complicated, and, consisting largely as it must of masses of copper and gun metal, quite expensive.



WELDING A HEAVY RING 3 by ⅝ INCHES.

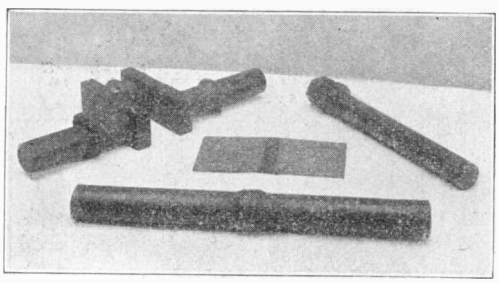
A five ton jack is operated by the lever to force the ends of the metal together when they reach welding heat. Water circulates in the clamps to keep them cool. The circuit is opened and closed by the operator's foot. 70,000 watts or about 94 horse-power are used for 50 seconds.

The welders are generally built, each machine adapted to one kind of work; no machine can be used for all shapes and sizes of work or for all qualities of

metal. In many cases machines are entirely special, fitted to do no other work than that for which they have been built.

The Thomson system of electric welding, beginning with the simple welding of wires end-to-end, to form continuous lengths, has worked itself up to welding pipe and all kinds of carriage hardware. An interesting fact, not generally known, is that most of the retaining wires in solid rubber tires are electric-welded; and the number of electric-welded wires found on wooden tubs, pails, etc., is quite noticeable.

Not only is one piece welded to the end of another, but against the side; this is illustrated by dash frames, most of which are electrically welded. It used to be said that the welding of copper is a lost art, but the Thomson process has been used for many years in welding copper wire. Farm wire fencing and wire mesh for reinforcing concrete work are made by an automatic



SOME EXAMPLES OF ELECTRIC WELDS.

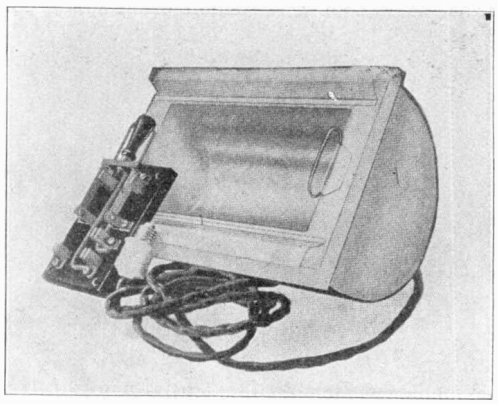
electric welding machine, through which the wires are fed. Tubing and cylinders are also made from sheet steel cut into strips, rolled into the form of a tube or cylinder and electric-welded along the seam. This requires a special machine, suitable for no other purpose. Chain, formed and threaded by automatic means, is also automatically electric-welded. A comparatively recent application of the Thomson process is that of welding attachments on sheet metal ware, dispensing with the riveted joint.

While much has been accomplished which at first seemed impossible, the art is still in its infancy and it is difficult to set a limit to its possibilities.

CHOCOLATE WARMER.

Electric heat is particularly well adapted to the demands of the confectioner, supplying a clean, flameless heat which does not increase the amount of moisture in the atmosphere, which can be closely regulated to the requirements of the work and which is economical. The Hadaway electrically heated dipping pan is designed to meet the demand for a device by which chocolate can be kept in a fluid state at the proper consistency for continuous working or dipping, especially when the work is done in refrigerated rooms.

The use of this dipping pan gives each dipper a pan of melted chocolate which is maintained at an absolutely uniform temperature. This insures uniform goods and permits uninterrupted work by the dipper. The pan consumes about the same amount of current as a 16 candle power lamp. There is no water bath or



ELECTRIC CHOCOLATE WARMER.

piping to rust and leak; no gas flame to vitiate the air.

The warmers are usually made with a high and a low heat, the change from one to the other being made by a small switch. The low heat is sufficient to maintain the chocolate at the proper working consistency, while the high heat is designed to bring the chocolate to the working temperature in a short time.

They are made in two standard sizes. The large size is 14¼ inches long, 7⅝ inches wide, and six inches deep. The small size is 12 inches long, 6¼ inches wide and five inches deep. The dimen-

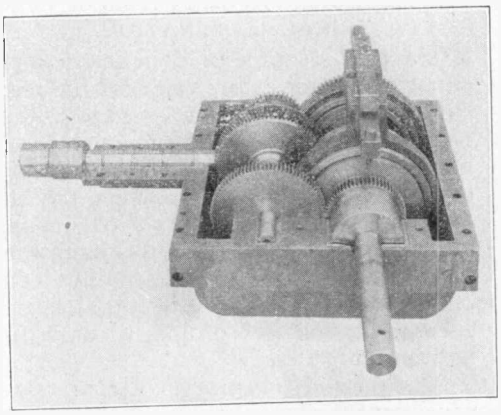
sions refer to the pan in which the chocolate is placed. The heating element is upon the outside of a receptacle in which the chocolate pan is placed and is hermetically sealed in by an outer jacket. The heater and wires are shielded so that accidental contact with them cannot be made, and the operators are absolutely protected from all danger of an electric shock.

REVERSER FOR MOTOR DRIVEN PLANERS.

An easy reversing mechanism for planing machines is something which has been needed ever since planing machines were invented. But in the machine shops of the present time practically the same device for reversing the motion of the bed plate is used that was employed in the primitive shops of a century ago. In the last few years electric power has been adopted to a great extent for driving machine tools; in fact, it is now considered the only economical method, and with the advent of motor drive the need of a reverser for planers which would do away with belt shifting became even more necessary.

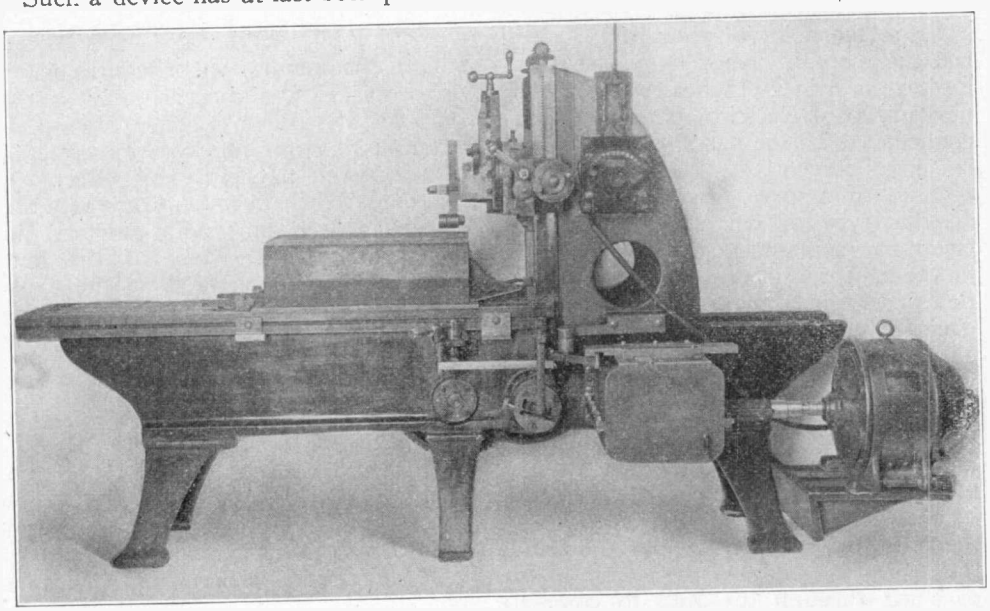
Such a device has at last been perfected which appears to have solved the problem. It is known as the Conklin reversing clutch. A view of the clutch mechanism is shown herewith, also a view of a planing machine direct driven by a motor through the agency of this clutch.

The clutch mechanism consists of a double, reverse, bevel gear driven by the motor shaft, one part having a lower speed than the other. These gears drive



CLUTCH MECHANISM FOR MOTOR DRIVEN PLANER.

the machine through two oppositely driven friction clutches. These are thrown in and out automatically by a pair of yokes carried on revolving drums. These yokes travel back and forth parallel to the driving shaft of the



MOTOR DRIVING PLANER.

machine, bringing first one friction clutch and then the other into play, reversing the operation of the machine.

By the use of this device the sudden strain of reversal is not thrown on the motor, which would otherwise burn out unless a heavy flywheel were added.

THE MERCURY VAPOR SYSTEM OF ELECTRICAL ILLUMINATION.

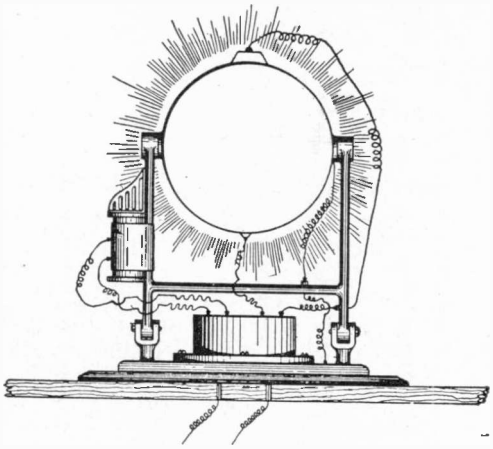
The actual source of light in the mercury vapor lamp is the vapor of the mercury at very low tension confined within a hermetically sealed and completely exhausted tube and excited by the passage of an electric current. Except for the fact that means are required for starting and steadying the current, this lamp consists merely of the exhausted tube containing mercury traversed by the electric current at voltages ordinarily used for lighting purposes.

Much rapid advance in the practical development of this type of electric lighting has been made during the past three years, so that the light has made a place for itself on account of certain unusual qualities which it possesses. The qualities are unique, so much so as to give it a wide field of usefulness.

From the point of view of the physicist the mercury vapor lamp is of great interest as it in a practical way utilizes a new group of electrical phenomena, that connected with the passage of a relatively large current (to the volume of a number of amperes) within a vacuum. In this type of current conductor the electrons, sometimes called corpuscles, in other words, those very minute particles carrying a charge and constituting electricity, pass from out the negative electrode (sometimes called cathode) whither they come through the lead of this electrode, pass through the vacuum space like small balloons, and find their way from the cathode to the positive element electrode (sometimes called anode) through the much larger gas atoms. At the anode they enter the body of the electrode and pass off through the lead to complete their circuit. In their passage through the mercury vapor at very low tension, which always fills every space where mercury is in the neighborhood, these electrons moving at enormous velocities violently agitate the mercury atoms causing them to emit the peculiar light characteristic of mercury.

The flow of the electrons from one electrode to the other, when once established, is accomplished and maintained with but the loss of a few volts, yet before any such flow has been established a very high voltage is required to start the electrons, which means the flow of current.

The original discovery of the phenomena of the mercury vapor lamp is claimed by Louis E. Walkins, as early as 1878. but to Mr. Peter Cooper Hewitt full credit is due for much of its up-to-date development, as before his advent into the field, a little over ten years ago, there had been no commercially practical lamp of this character. Most of the lamps then known were merely in the experimental condition in several laboratories. None of these, however, showed a workable lamp.



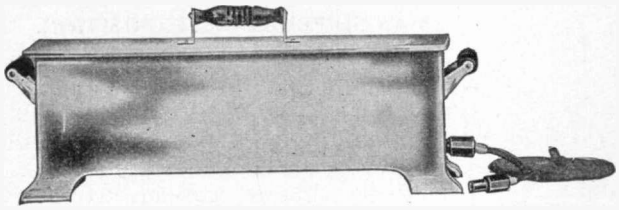
NEW TYPE MERCURY VAPOR LAMP.

The usual form of mercury vapor lamp is now fairly well known to the majority of the readers of Popular Electricity and consists of a tube of glass two or three feet long which emits powerful light of a bluish color entirely devoid of red rays.

A new type of lamp recently developed by Mr. Walkins is shown in the accompanying cut, and in this type the tube is eliminated, its place being taken by a glass globe. The color of the light emitted by this new lamp has also been modified and is said to be much more mellow.

ELECTRIC INSTRUMENT STERILIZER.

The key note of success in the last few years in all surgical operations has been absolute asepsis. Great strides have been made looking to the best means of steril-



ELECTRIC INSTRUMENT STERILIZER.

ization, one of the most recent devices being an instrument sterilizer which can be put upon a glass top instrument table, and used within a few inches of the operator without any danger whatsoever to the patient. It is a well known fact that sterilizers heated by alcohol, gas, kerosene, gasoline, etc., give so much heat from the bottom that they would crack a glass top table. It is also well known that the ether or chloroform fumes used in operations, is inflammable, consequently in the old methods, instruments were sterilized at a distance from the operating room and brought in wrapped in a sterilized sheet. If the operator dropped an instrument it had to be taken out of the room to be sterilized before it could be used.

The new "American" sterilizer is made of one solid casting of aluminum. The heating elements are made up without wire or any cement, porcelain, or quartz whatever. These heating elements are attached to the bottom of the piece, thereby insuring quick heating and efficient results.

The sterilizers of the past, heated by gas and other methods, have been made entirely of plated metal, with soldered seams. In this new sterilizer there are no seams, consequently there is no danger of leaking or of the pieces falling apart.

The sterilizer is fitted with an aluminum tray and cover, and is made for three distinct heats. The maximum, taking 900 watts, is used only to bring the water to the boiling temperature. The minimum, one-quarter of the maximum, is used to maintain this temperature.

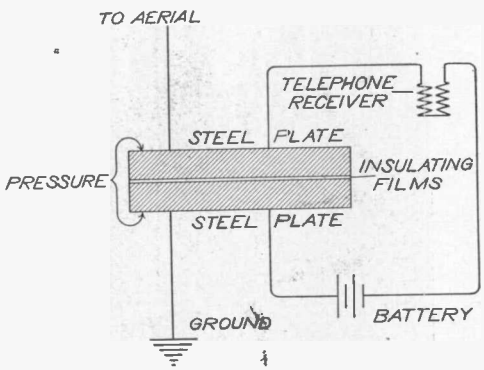
Physicians have found this piece a most welcome accessory to their laboratory or office equipment. It is possible to take the sterilizer with a supply of instruments needed for any major operation to the home, and by simply attaching to the light socket, the physician may himself see that the instruments are put in a perfectly aseptic condition.

The sterilizers are made for any voltage up to 250.

DETECTOR FOR WIRELEESS TELEGRAPHY.

An entirely new type of detector for wireless telegraph systems has lately been developed and operates on the principle that certain dielectrics (insulators) when under high pressure lose their quality as such and become conductors. This discovery led to the construction of the detector shown herewith.

Two steel plates are given a thin coat of insulating matter such as shellac, etc. When dry they are put under high pres-



NEW DETECTOR FOR WIRELESS TELEGRAPHY.

sure. In this condition it is found that a milliampere meter definitely shows the passage of the battery current.

The electric wireless waves having a very high tension, easily break down the thin coat of insulation and as long as the waves pass through the apparatus a telephone receiver, in place of the milliampere meter will indicate with a clear and audible sound the passage of the waves.

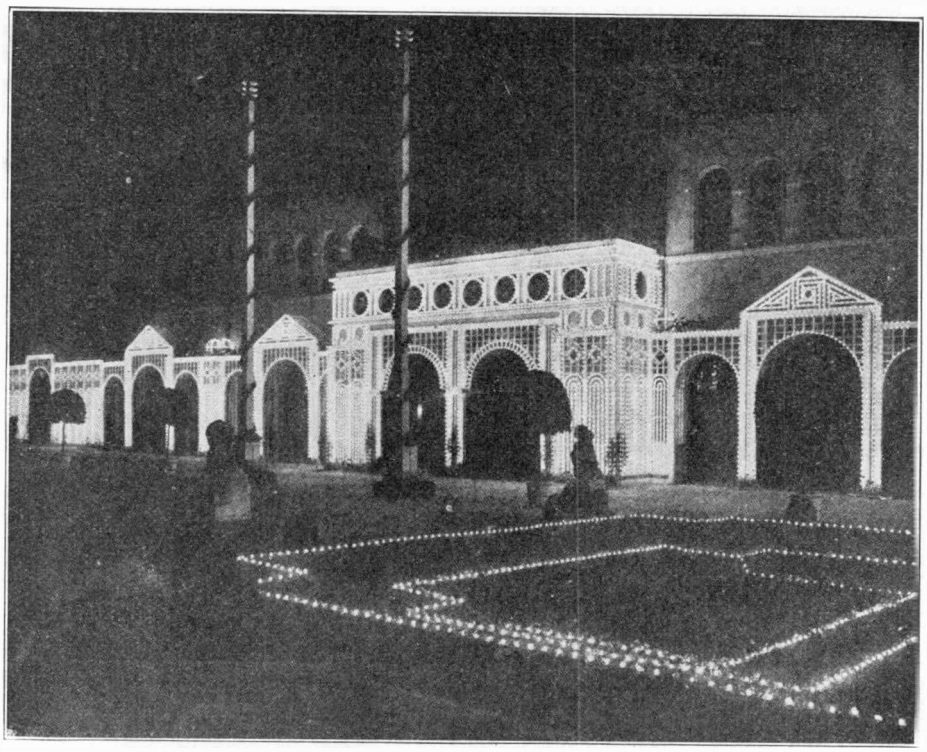
TUNGSTEN PRODUCTION.

Now that the new tungsten lamp is becoming widely known the questions are often asked: What is tungsten? Where does it come from?

Tungsten is a metal which does not exist in nature in the metallic form, but combined with other elements in the form of ore, and it must be reduced from these ores. Tungsten production in the United States for 1907 amounted to 1,640 short tons, the value being $890,048. The principal tungsten minerals are wolframite, a tungstate of iron and manganese, and scheelite, a tungstate of calcium. Both minerals, like tin ores, occur as a rule in quartz veins cutting rocks containing much silica, such as granite and rhyolite, but some apparent exceptions are found, as for instance, in New Mexico, where hubnerite and a small amount of scheelite occur with pyrite and lead minerals in a vein cutting limestone; and at Nome, Alaska, where scheelite is found in the gold placers in a region of schists several miles from the nearest granite outcrops. The greater part of the American tungsten product comes from the mines in Boulder county, Colorado. California is the second state in order of production.

ELECTRICAL FEATURES OF THE GERMAN SHIPBUILDING EXPOSITION.

The applications of electricity now play an important part in the construction and operation of water craft. As a consequence considerable space at the German Shipbuilding Exposition, held during the summer, was devoted to the applications of electricity on shipboard. Very elaborate electrical decorations were also a feature of this exposition, particular attention being paid to the exterior of the buildings and to the grounds. Trellised walks and garden decorations were created where electric fountains invited the sight-seers to rest and recreation, while 35,000 incandescent lamps united in a splendid light effect discernible for miles around.

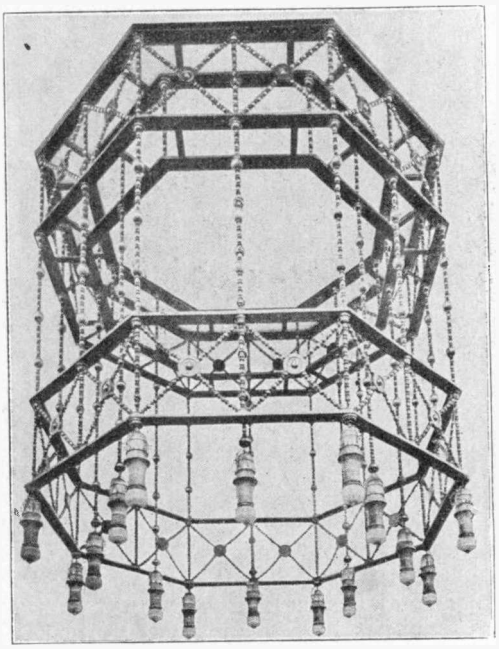


ILLUMINATIONS AT THE GERMAN SHIP BUILDING EXPOSITION.

The night scene in one of the illustra-

tions shows one of the entrances to the exposition and also a portion of the grounds, the lawn, even, being decorated with lamps. The other illustration shows an unique electrolier suspended in one of the buildings and containing 16 flaming arc lamps. These views are reproduced through the courtesy of Mitteilungen der Berliner Elektricitäts-Werke.

In one of the exhibition rooms a captain's bridge was erected, an exact counterpart of a bridge on a man of war. From here were controlled searchlights of various sizes. One of these, with a 35-inch mirror was arranged on the roof



UNIQUE ELECTROLIER AT GERMAN SHIP BUILDING EXPOSITION.

of the chart house. It was electrically switched and regulated from a distance. Smaller reflectors, so-called broadside searchlights, were among the side lights of the bridge. They were also operated from a distance, but by mechanical means.

The compartment topped by the bridge contained a collection of electric cooking and heating utensils, ozone ventilators, also shown in operation. New slow running ceiling ventilators with four-winged wooden fans noiselessly kept the air in sufficient motion.

RUNNING A RANCH BY ELECTRICITY.

Colonel, now known as "Commodore" Thomas W. Lee, formerly the general passenger agent of the Delaware, Lackawanna & Western Railroad, growing weary of railroad duties, went west a few years ago, bought a farm near Idaho Falls, Idaho, which he has equipped throughout with electricity. This does not mean that Commodore Lee has simply put in electric lights, telephones and a few conveniences like that, but that his farm, "The Bungalow" is an out-and-out electrically operated ranch.

Everything about the Bungalow requiring power of any kind is hitched to live wires. Leaving Rigby, Idaho, the railway station of the farm, the driver follows a private pole line carrying three power wires and two telephone wires leading direct to the Bungalow proper.

The term "Bungalow" in general implies 2,000 acres or more, for it requires a drive of 16 miles to make a circuit around the broad fields. The power wires turn at the ranch station and go directly east on the section line. Way out across the fields can be seen another line running north and south. These lines cross the fields for convenience and to them are attached the feed wires that run the motors. The various motors on the farm run the machinery—and all that is required to change the ordinary quiet of the ranch life into a scene of activity is to press the button, figuratively speaking.

At the Bungalow is a small terminal house. Here the power is controlled. In the terminal house there is a motor for the operation of all machinery required at farm headquarters such as turning grindstones, pumping air into an underground tank for furnishing water pressure in case of fire, and in fact anything else that is necessary in carrying out the general work of the ranch, for the Bungalow is the home of system. Electric lights are all over the place and the yard lights can be seen at night for miles. Wires are everywhere.

The Bungalow is a ranch wonder of two years' standing. There is a boulevard four miles long running out from Rigby, and here and there are neat sign boards informing the stranger just where he is. The boulevard was built at

the Commodore's private expense and is a level hand-raked road. On the ranch there is to be found all the modern machinery in existence, from the intricate weather gauge to the best automatic hay lifter on the market.

The power that operates the Bungalow farm is generated at Idaho Falls and transmitted fourteen miles to the ranch, the regular line of the power company running comparatively near the ranch. Then, as above stated, the Commodore has tapped the wires with a private line about four miles in length, including the

ELECTRIC THRESHING OUTFIT.

side lines that traverse the ranch in various directions.

After the power was secured, Commodore Lee, having the idea long in mind, proceeded to invest the sum of $7.50 in an old wagon with stout wheels. He reversed the wheels, putting the rear ones in front. In the front end of the wagon he placed a 15 horsepower motor. Attached to the framework on one side of the wagon, behind the motor, is a starter. On the rear end of the wagon are a couple of transformers. The wagon is covered with a common canvas stretched over a simple frame. To the rear end of the wagon is attached a pole bearing a cross arm. This pole carries the wires out of reach of the head of anyone on the wagon. The wires are strung out to the nearby power line and connected with a single twist and that end of the apparatus is now ready to work by simply turning on the switch on the wagon. This wagon stands 20 or 30 feet away from a grain separator, and a belt transmits the power to the pulley on the separator.

The motor was attached to a small separator this season and threshed at the rate of 1,500 bushels of wheat a day and reached a much higher figure on oats, in a day of 10 hours. The electric power, to state it mildly, has been found much more satisfactory than steam, in so far as efficiency or economy is concerned.

The outfit was rigged up in a hurry to do the work this season and after the Commodore got the idea into his head and directed his electrician, who is regularly employed on the place, there was much skepticism on the ranch, and the neighbors, who were using horse and steam power, as most of the farmers in this country are doing, were inclined to laugh at the project.

But with the motor and other equipment in place and being satisfied that all gearings were right and everything substantial, the Commodore turned on the "juice" and—the motor ran backward! He didn't understand at first what the trouble was, but soon a rearrangement of

the wires brought everything around in shape and the machinery started off without a hitch and was permitted to run several hours before it was stopped.

As to the ranch itself, there is nothing requiring power or the use of electricity, that is not there ready for use. The Bungalow is a great example of applying modern methods to agriculture. There is nothing of old farming about it, nothing of the old drudgery, inconvenience or dissatisfaction. The men on the Bungalow are paid for being wise enough to look so. The field hands do no walking and very little work with their hands. Machinery is electrically operated everywhere possible.

At the house the blades from the mowing machines, often as many as three at a time, are placed on a grindstone, operated by electricity. There are electric lights in the bunkhouse and in the stables, with an electric heater in the bath room.

The expense of all of this has been found to be no greater than the expense of any other improvement. Anything can be made economical or expensive—all depending upon the business capacity of the individual.

The adaptation of electricity to the farm means great things for the future. It means, among other things, the extension of electric lines to every part of the country and with this will come, without a doubt, greater improvement and advancement along all other lines. It means the lightening of the burden of the farmer and a general era of progress.

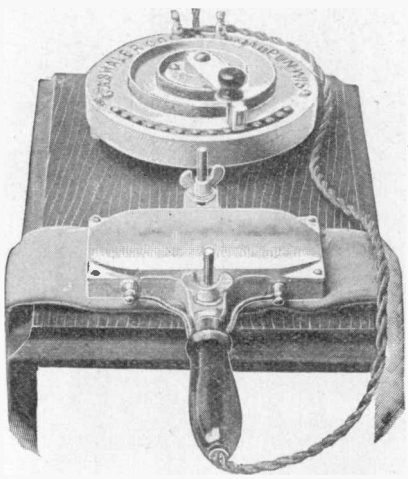
CONSTRUCTION OF SELENIUM CELLS.

Selenium cells, which vary their resistance with the intensity of illumination to which they are subjected, may be constructed in a variety of ways. A common form, easily made, is to wrap two wires upon an insulating core, keeping them separated by a uniform short distance, and then coat the wires over with a thin film of molten selenium. Another plan is to cover the surface of some solid, usually glass, with a thin coating of selenium. A difficulty met with in doing this, especially with glass, is the liability of the selenium to form into drops, instead of adhering uniformly. A new method recently devised in Germany by W. S. Grippenberg, causes selenium vapor to condense on the cold surface of the glass. In this way very thin and uniform coatings which adhere well to the glass are obtainable. Two grooves are cut in the glass close together and of as great a length as possible, and these are coated inside with platinum to act as electrodes.—Electrical Review and Western Electrician.

ELECTRIC TIRE VULCANIZER.

As acknowledged by motorists, one of the heaviest expenses encountered in owning a car is the cost of tire repair. With a proper vulcanizer, cuts in the casings can be repaired so as to put a stop to rotting of the fabric. Likewise the inner tube can be vulcanized, which makes a better job than patching.

The new Shaler vulcanizer makes use



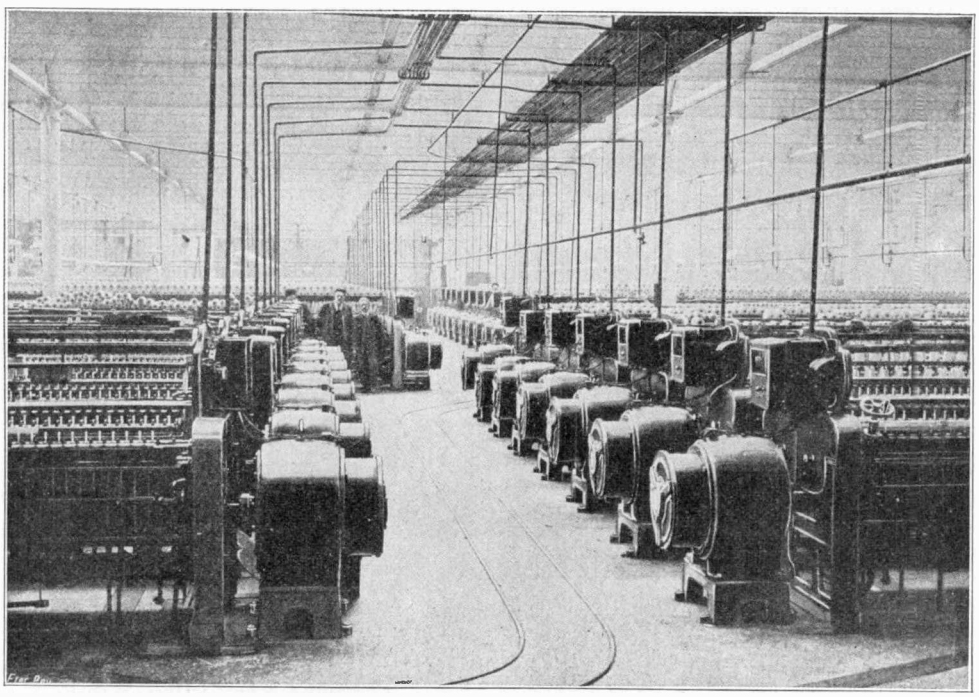
ELECTRIC TIRE VULCANIZER.

of electric current, and work on the casings may be done without removing the tire from the rim. The vulcanizer is simply connected by means of a cord and plug to any electric light socket, and as there is provision made for absolute heat regulation there is no danger of overheating the tire. The heat is regulated either by a rheostat or a thermostat. The accompanying cut shows the vulcanizer fitted with a rheostat for current control and being applied to an inner tube. With this device anyone can do a job of vulcanizing equal to the best vulcanizing plant.

MOTORS IN A TEXTILE PLANT.

Textile manufacturers, both in this country and in England, have awakened to the advantages of motor drive in their mills, and in this country especially electric driven machinery is the rule rather than the exception among the more modern plants.

The economy is greater and the control is more accurate with motor drive than with belts and shafting and the great sheds are far lighter and more cleanly than before. The view in a large English cotton mill, reproduced through the courtesy of the London Electrical Review, is an excellent illustration of the latter fact.



ELECTRIC MOTORS DRIVING DOUBLING FRAMES.

The unusual feature in connection with this installation is the individual drive for each one of the 50 doubling frames. Speed variation is of especial importance in this class of work, and the speed of any frame may be carried to the highest limit according to the particular work being dealt with at the time. Moreover, the plant is much cleaner, as there is no oil to drip from overhead shafts.

ELECTRIFICATION OF THE ST. CLAIR TUNNEL.

The St. Clair Tunnel between Sarnia, Ont., and Port Huron, Mich., is now operated by electricity. This tunnel, which is 6032 feet long from portal to portal, forms a connecting link in the 10,000 miles of track of the Grand Trunk system.

The bore was completed in 1890, and since that time, up to November 12, was operated by steam locomotives of a special type. It was decided to electrify the tunnel, however, to do away with the smoke and gases and to increase the train capacity.

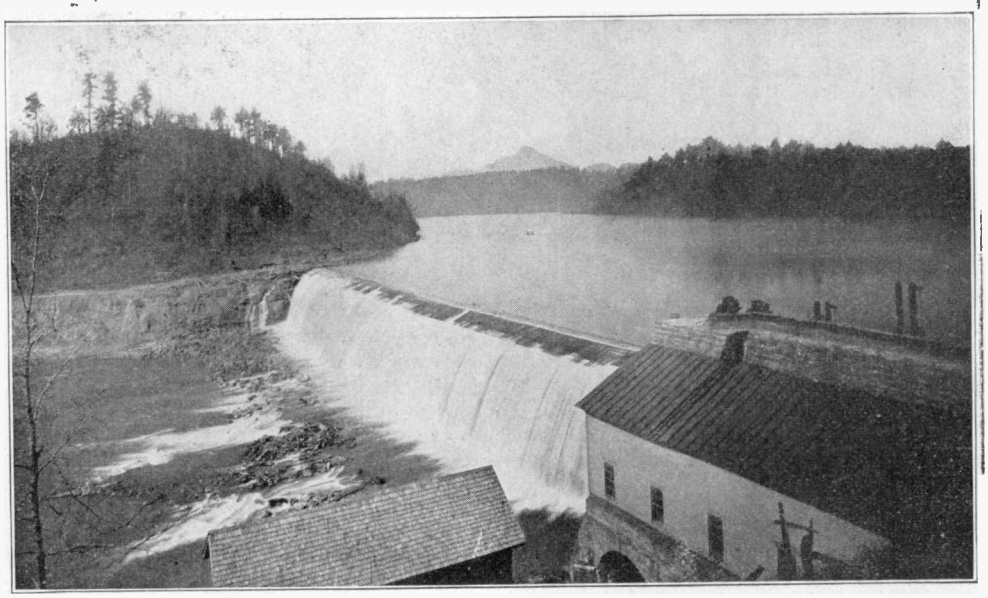
With steam locomotives, the maximum weight of trains was limited to 760 tons, and the ascent was very slow. With the new electric locomotives, trains of 1,000 tons may be hauled at higher speeds. Under old conditions the steam locomotives were unable to cope with the traffic of the road as it is now, while the capacity of the electric locomotives is three times the requirements of present traffic conditions.

HOW ELECTRIC POWER FOR ATLANTA IS DEVELOPED.

BY S. MAYS BALL.

Atlanta, sometimes called the Gate City of the South, on account of the great number of railways which enter and depart from it, is a hustling, bustling, progressive city of some 150,000 inhabitants. In Atlanta there are possibly more "sky-scrapers" and more beautiful residence streets than one can find in any other city of the same size in America.

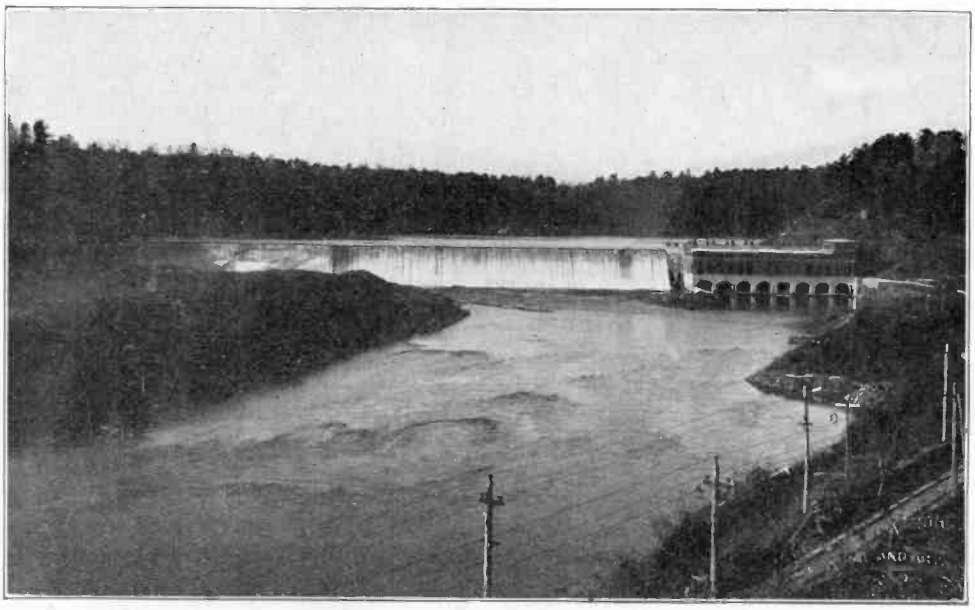
At Bull Sluice, four miles below Roswell, about 12 miles from Atlanta, the Atlanta Water Power & Electric Company has its plant. The dam is a massive concrete structure 48 feet high, which, with two-foot flashboards, gives a head of 50 feet. This plant is fully equipped with the most modern type of water wheels and electric generators. The combined capacity of the water wheels is greatly in excess of the normal low water flow of Chattahoochee River, thus providing for a large increase of power from stored water and at times when the flow of the river is increased. This power is transmitted electrically to Atlanta where it operates the street cars and lights Atlanta's streets, being contracted for and sold by the Georgia Railway and Electric Company. Backwater from this dam when flashboards are used reaches a point under the wagon bridge over the river at Roswell four miles away.



NORTH GEORGIA ELECTRIC COMPANY'S PLANT.

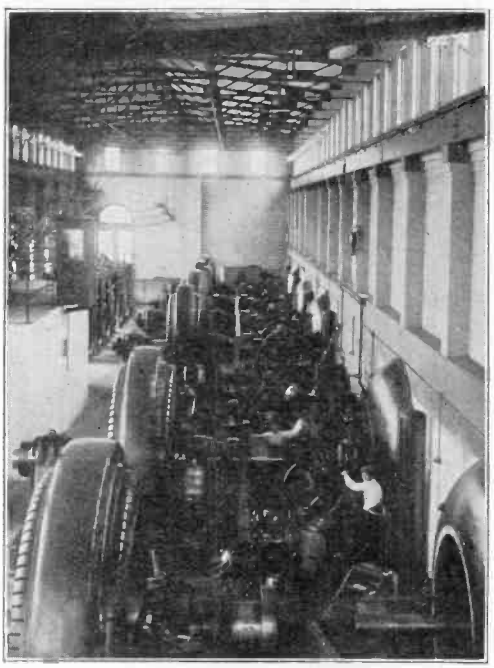
For a number of years the 160 odd miles of street railways in and around Atlanta were operated electrically from a steam power house located in the railroad district of the city. Near Atlanta is the Chattahoochee River containing, as everybody for a long time knew, but nobody took the initiative to bridle, quite a lot of valuable water power. Eastern capitalists, however, finally came down and tied up a lot of this available power near Atlanta, some 12 miles away, and now the street cars and all of Atlanta's street lights are operated from this Chattahoochee River power at Bull Sluice. Power is also brought to the city from another development on the river, near Gainesville, to be used in manufacturing plants and so on.

From the mouth of the Chestatee River on the Chattahoochee, up to the mouth of Little River, there are a number of small shoals aggregating 28 feet of fall.



PLANT OF ATLANTA WATER AND ELECTRIC POWER COMPANY.

Beginning a short distance above Little River is a series of shoals which have recently been developed by the North Georgia Electric Company. The dam of this plant is located a quarter of a mile above the foot of the shoals leaving about seven feet of the fall undeveloped. The dam is a log-crib structure entirely filled with rock and it is 36 feet high. Power is transmitted electrically from this plant, also. Backwater from this dam extends eight miles to Clark's Bridge.



INTERIOR OF ATLANTA WATER AND ELECTRIC POWER CO.'S PLANT.

With these two developments on Chattahoochee River, with say 10,000 to 15,000 horsepower available for commercial use, there is yet a great demand in Atlanta for electrically transmitted power. On the Chattahoochee River near Atlanta there are a number of shoals from which a great amount of power can be obtained—simply awaiting development.

The accompanying views show these various power developments and are reproduced through the courtesy of S. W. McCallie, Geologist of the state of Georgia.

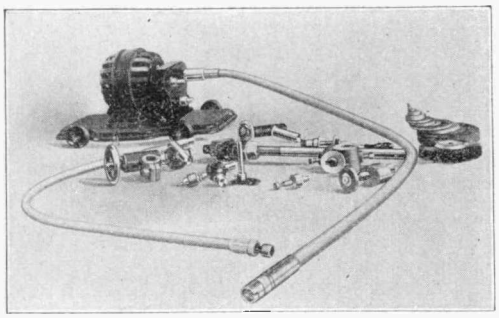
TELEPHONE TO DETECT THE PRESENCE OF FISH.

The movement of water made by fish in swimming is sufficient to operate a telephone, and so communicate their approach to fishermen. A Norwegian inventor has devised a microphone, inclosed in a water-tight box, which may be immersed in the sea, and is connected by wires with the fishing boat. By this device the approach of a shoal of fish can

be detected with certainty. Experienced fishermen can in the ordinary way detect the presence of herring and mackerel long before they reach the fishing vessels by the disturbance which they create in the water. But where the more subtle movements of the flat fish are concerned it is possible that the microphone may prove a useful indicator of their whereabouts.

MOTOR DRIVEN GRINDING, BUFFING AND DRILLING OUTFIT.

There isn't much in the line of grinding, buffing and light drilling that cannot be accomplished by the portable motor driven outfit shown in the accompanying picture. The one-horsepower motor is of the alternating current type mounted on a small truck. It is fitted with a flexible shaft to which the various emery wheels, buffers and drills are



MOTOR DRIVEN GRINDING, BUFFING AND DRILLING OUTFIT.

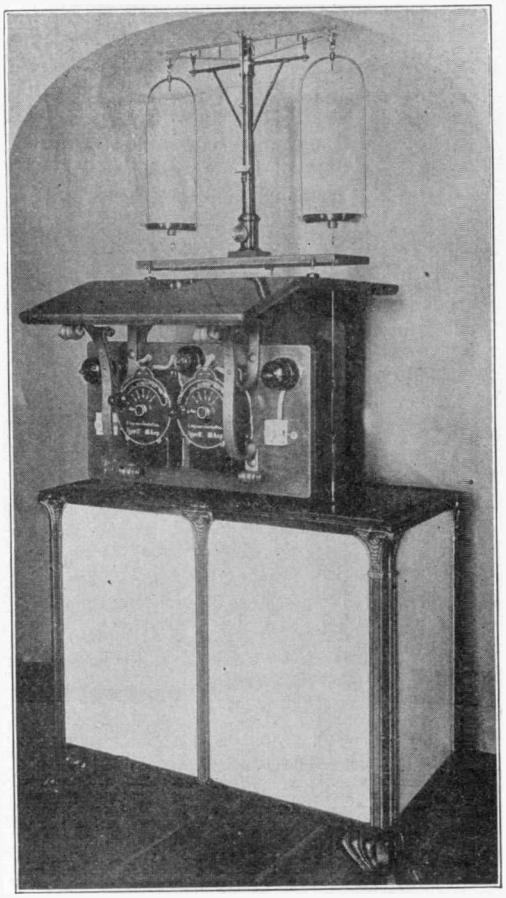
readily attached. The portable feature makes the appliance convenient for large work, and the flexible shaft permits the operator to work with ease on otherwise inaccessible parts.

In order to obtain the correct speeds for emery wheels of different diameters, multipliers of the proper ratios are used, being mounted in the gear case in front of the motor. The ends of the shafts, which revolve at different speeds, may be seen protruding from the case, and the flexible shaft may be coupled to any one of them. There are two of the flexible shafts of different weights furnished with each set, to be used according to the requirements of the work.

TESTING RAW MATERIALS BY ELECTRICITY.

An important operation in many industries is to ascertain the percentage of moisture in raw material as well as in half finished and finished goods. This applies primarily to the hygroscopic materials used by the textile industry which have to comply with certain regulations in regard to the admissible limits of moisture.

Through a process which has been



ELECTRICAL APPARATUS FOR TESTING RAW MATERIALS.

used for many years, the effective weight of the raw material is ascertained by drying it until its weight becomes constant, after which a given percentage of moisture is added, thus obtaining what is called the commercial weight.

Practically all the drying apparatus so far used makes use of an air current

heated by steam, gas, alcohol or by means of electrical resistances. According to tests recently made at Berlin the drying of tissues and raw material of any kind (yarn, raw silk, hair, feathers, etc.) is obtained far more rapidly if heat conduction be replaced by heat radiation, in conjunction with a simultaneous light effect, both the heat and light being produced by electric current. Conduction heat acts only from the surface, whereas radiating energy is able to permeate the whole of the material down to its innermost layers without any risk of the surface portion being super-heated or damaged.

By the use of electricity all the drawbacks inherent in other heating methods are avoided, while provision is made for actually obtaining and permanently maintaining the required temperature. The operator is not troubled in any way, and as the apparatus is safe against fire and explosion and free from any smell, it can be installed wherever desired.

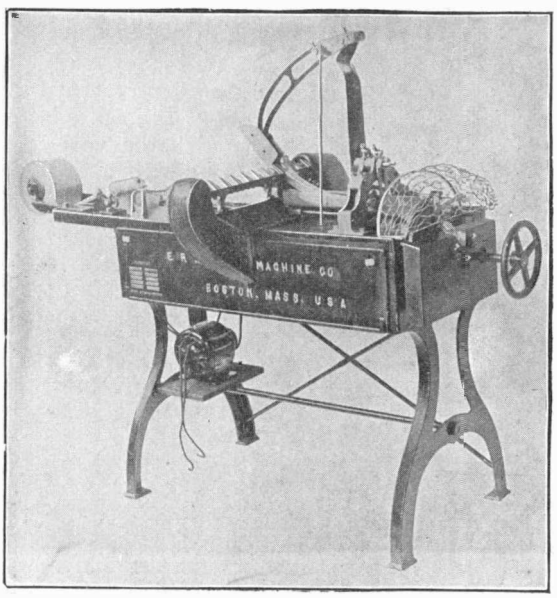
The very handy apparatus represented in the accompanying illustration is readily adapted to the various kinds of material to be tested. It comprises two actually identical drying compartments in the lower cabinet, in which the material is exposed on supports until the scales, arranged symmetrically above the apparatus, indicate a constant weight. Either compartment may conveniently be used as a drying or weighing compartment.

The transverse walls of both compartments are provided with special electric tube lamps, and the supports can be adjusted in accordance with the actual amount of material. The temperature inside the compartments is maintained constant by the aid of convenient switches and regulators, and is checked by a thermometer fitted to a socket.

The bottom and lid are provided with a number of holes allowing the air to pass, which are closed during operation by a slide, avoiding any draught liable to cause errors in calculation. A desk conveniently arranged in front of the scales affords ample room for installing the weights and recording books. G.

ELECTRICALLY OPERATED CANDY WRAPPER.

In consequence of the steadily increasing demand for cleanliness in the handling of all kinds of food products, the candy wrapping machine is coming into favor. The machine shown herewith wraps with a twist-end wrapper, and has a capacity of about 60 pieces per minute, one operator being required to feed the machine. The paper is taken from a roll put on one end of the machine, passes along the top, and is folded by a simple device into a tube. The pieces to be wrapped are fed into a chain



ELECTRICALLY OPERATED CANDY WRAPPER.

of buckets and automatically pushed into the tube of paper one at a time, where they are seized and twisted. The wrapped product is then moved along over the end of the machine, cut off, and deposited on a table, ready for packing.

The motors for operating these machines are placed underneath with flexible cord for attaching to the ordinary electric light sockets, as the current required is quite small. The motors are of about 1-12 horsepower and the entire machine can be moved about readily, as the weight complete is said to be only about 250 pounds.

WIRELESS PICTURE TELEGRAPHY.

BY DR. ALFRED GRADENWITZ.

Many schemes have been suggested, especially during the last few years, for the telegraphic transmission of pictures, diagrams and handwriting. The latest achievement in this connection is of special interest, because of its dispensing with any conducting wire between the sending and receiving stations, the transmission being effected by means of electric waves on the principle of wireless telegraphy.

Those who, without any knowledge of the existence of such waves, happen to see this wonderful apparatus devoid of any material link with the outside world,

WIRELESS PICTURE TRANSMISSION APPARATUS.

at work, producing as if by magic, numberless dots and strokes making up some diagram or picture, might be prone to ascribe the phenomenon to some supernatural cause.

As the transmitting and receiving apparatus designed by Mr. Knudsen, the inventor of this wonderful system, are of remarkable simplicity, relative cheapness and practically identical with one another, they are likely soon to be introduced into the general practice of newspaper men and the identification service of the criminal police.

The apparatus located at the sending station comprises a traveling carriage or revolving band actuated by a motor. This carries a light style or "shade finder," which is destined to travel with lightning rapidity over the surface of the picture to be transmitted, so that every portion of it is traversed once during the complete operation. As distinguished from most other systems of telephotography, which are based upon the use of selenium cells sensitive to light, this new system dispenses with any delicate or

A WIRELESS PORTRAIT.

capricious organ of this kind, relying exclusively upon electrical and mechanical effects.

The style is situated normally at such a height as to leave a discontinuity in the circuit of the relay controlling the primary current of the coil. On being raised, the style, however, closes a contact, completing the circuit and sending out an electric wave.

Any photograph or drawing destined for transmission by this wireless appara-

tus should accordingly undergo some preliminary treatment, calculated to bring out any dark portions in relief. This is effected by dusting a photographic plate with metal powder (iron powder for instance), which while adhering to any opaque portions of the image, will fall off from the transparent portions of the plate. The sensitive plate used in this connection is coated with a much thicker film or gelatine than usual. Immediately after development, in fact before the plate becomes quite dry, the metal powder is applied and by adhering to those parts which are dampest (that is, the opaque parts) produces a relief corresponding to the light gradations of the image.

The receiving apparatus used with the system is practically identical in construction, except that its style is raised under normal conditions and is pressed down by the action of the wireless coherer and relay circuit, on the arrival of electric waves.

The plate used for reproduction is a glass plate the surface of which is coated with dissolved celluloid incorporated with a non-transparent substance such as lamp black. The negative plate produced by the style can be used for the printing of any number of positive copies. A 10 by 12-inch picture can be transmitted in from 15 to 20 minutes.

This scheme is readily adapted to any system of wireless telegraphy.

AN ELECTRICALLY DRIVEN TELESCPOE

BY GRACE AGNES THOMPSON.

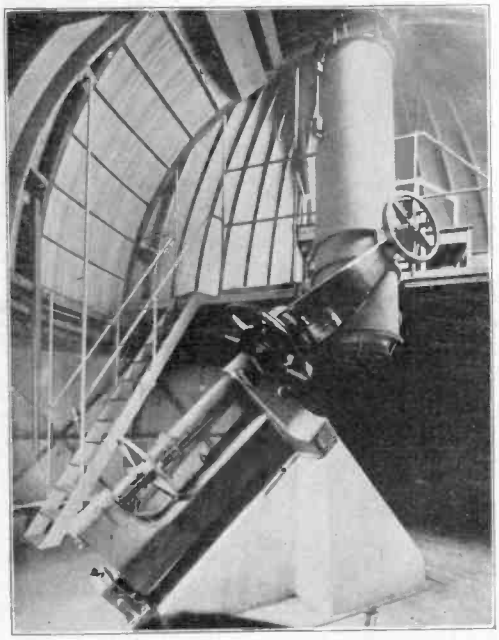
Electricity has won another triumph, the telescope. The application of electricity to this work is not exactly a new idea, electrical power having been used for winding up the huge weights of the driving clock of the great 40-inch refractor at the Yerkes Observatory; also for the swinging and slow motions at this and other observatories. At the Harvard College Observatory telegraphic circuits have been employed over 20 years for controlling the driving clocks of large telescopes at both its stations—in Cambridge, Massachusetts, and near Arequipa, Peru. But only within a very short time has electric power been utilized for actually driving a telescope.

The ordinary method of driving is by a complicated system of weights, levers, springs, and wheels, that is usually known as the driving clock. It is the method that, with various progressive changes towards modern improvement, has been in use for more than a century. But, as just stated, it is a complicated system requiring many parts and no small cost in construction. Moreover, unless this "clockwork" is accurate to an exceeding nicety, it is of no use in a telescope. Being of so delicate a construction, it is easily put out of order and is therefore an object of great concern and care to the astronomer.

With an electrically driven telescope, on the other hand, there is all the advantage of moderate cost, comparative simplicity in the construction of the driving mechanism, and automatic action. All this has been thoroughly demonstrated at Harvard Observatory, where the famous Common telescope, the largest telescope in the world today—a reflecting instrument five feet in diameter, recently mounted at Cambridge—is operated entirely by electricity. Another large reflecting telescope, 24 inches in diameter, mounted at Cambridge about a year ago, was the first to be driven in this manner. The twin of this instrument is now in process of mounting, and when finished, like the Common telescope will be unapproachable for observations except through the electric switchboard. The mirrors for these two telescopes were ground and polished by Alvan Clark and Sons, who have made nearly all of the large reflecting telescopes now famous, each in its turn the largest in the world.

The Common telescope is mounted in the open, without shelter or dome to cover it from the inclemencies of weather—also an experiment which is proving very satisfactory. The observer sits in the "observing-room" in a comfortably heated building. Before him is the eye-

piece of the telescope to which the image of the star is brought by a series of mirrors in the tube of the telescope, and close at his side is the recorder and his electric switchboard, where the mere touch of a button, the turning of a tiny



NEW TWENTY-FOUR-INCH REFLECTOR TELESCOPE ELECTRICALLY OPERATED.

switch, turns the great instrument here or there to reach any part of the starry sphere from horizon to horizon. All this is done as easily as though its many tons were but a feather weight. The switches located at this desk control motors and clutches, by means of which the telescope can be swung at various speeds; while dials and indicators not only show at a glance the exact position of the telescope and the motion that is being imparted to it, but also register the measures made by photometric apparatus used by the observer at the eye-piece. For following the apparent motion of the star, there is a small motor synchronized by an accurate clock which gives a perfectly uniform movement to the telescope, and one which can be prolonged as many hours as desired without any watching and "re-winding" as in the old crude hand way.

For this purpose a specially made governor operated by an intermittent current is employed. The principle of using such a current to control the speed of a motor is not new. Everyone has seen the motorman on the trolley car avail himself of it to run his car at a speed lower than that given by the lowest notch in his controller. This principle was first used in a governor invented by Professor Edward C. Pickering, Director of Harvard Observatory, and Mr. Williard P. Gerrish in 1900. The present form of governor, invented by Mr. Gerrish, is materially different from the original and is the first to be actually used for operating a large telescope.

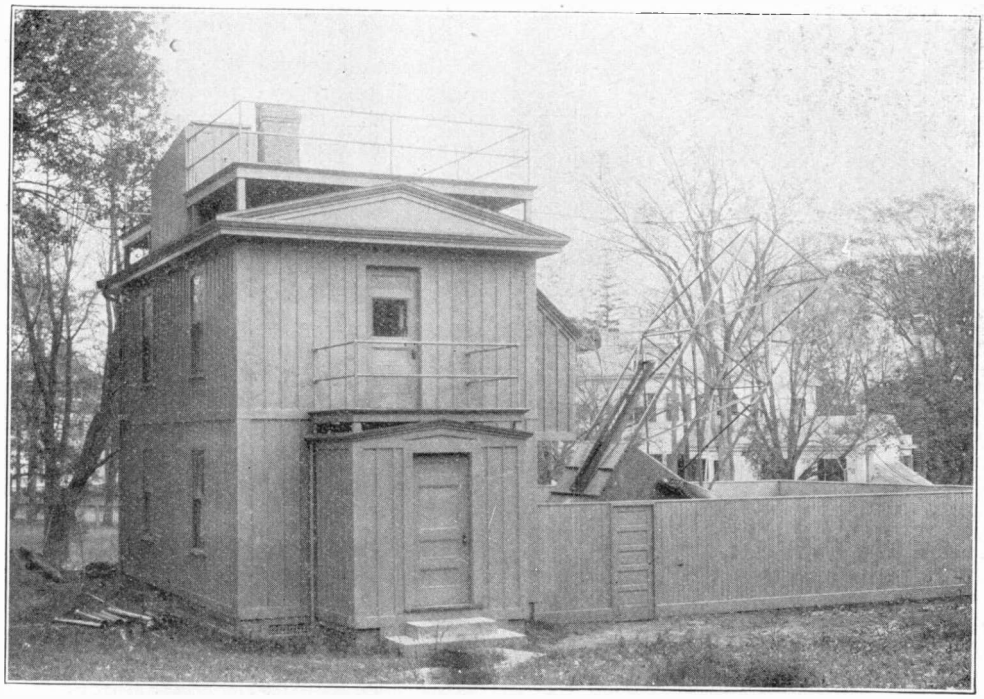
The fundamental object of such a governor is to produce a steady uniform motion, which shall be exactly timed to a prescribed rate as indicated by a clock pendulum or other standard timepiece. As the telescope to be moved is frequently of great weight—perhaps of many tons like the Common—a governor must have at its command a considerable amount of surplus power, more or less of which can be drawn upon to meet the requirements of varying friction and other resistances to the motion of the telescope.

OBSERVING APPARATUS OF A 60-INCH REFLECTOR TELESCOPE.

In a telescope as in a steam engine governor, or in fact any other form of self-governing machinery, the error of rate must exist before it can be corrected. This is axiomatic. The effi-

ciency of a governor is therefore determined by the promptness with which the error is detected and remedied, the latter depending on the amount of the power at the disposal of the governor.

There are two general methods of controlling a continuous rotary motion in machinery: first, by varying the pressure or intensity of the driving force which is applied continuously; and second, by interrupting the driving force at intervals which vary according to the power required, the power while applied being maintained at a uniform intensity.



THE GREAT COMMON TELESCOPE SHOWING ANGLE IRON FRAME.

The new telescope governor is of the latter variety.

The apparatus consists of an electric motor connected to the driving machinery of the telescope. Current to the motor is supplied from an ordinary power circuit. The switch controlling the current to the motor is operated by an electromagnet in an auxiliary circuit of low potential supplied by a battery. This auxiliary circuit also includes a contact device operated by the pendulum of the controlling clock, and a releasing contact which is momentarily opened at each revolution by a wheel in the telescope mechanism which should, when driven at the proper rate, evolve in a period corresponding to that of the controlling pendulum. The armature of the magnet is provided with a locking device so arranged that when the circuit is once closed by the clock contact, it cannot be opened except by the opening of the releasing contact operated by the telescope.

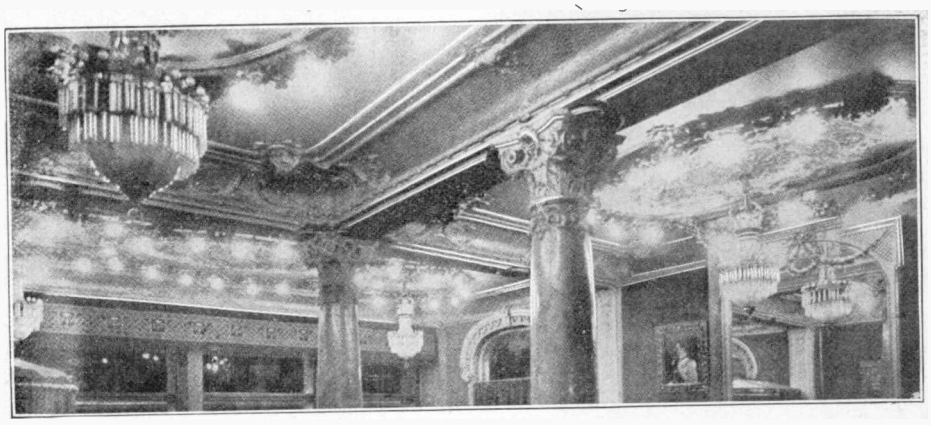
The method of operation is as follows: The clock pendulum closes the auxiliary circuit through the magnet, the armature of which closes the power circuit through the motor. The motor starts at constantly increasing speed until the telescope is moved far enough to operate the releasing contact, when the power is shut off and the machine continues its motion by virtue of its intertia, to which is added that of a heavy fly wheel; but the motion is now, of course, constantly decreasing. The clock again closes the circuit and the same thing happens as before, the machine revolving at an approximately uniform rate during the short interval between clock beats—usually one second.

If the machine runs too fast, the in-

terval between the closing of the circuit by the clock and its opening by the telescope decreases, and a correspondingly shorter interval of power results, causing an immediate reduction of speed. If the speed is too low during any given second, the interval of power is correspondingly increased and the speed increases. The governor with the aid of its fly wheel soon establishes a mean speed, which corresponds exactly to the beats of the pendulum. The small variations which occur within one second are entirely inappreciable, and are minimized by using a heavy fly wheel, the inertia of which further decreases the variations.

EFFECTIVE INTERIOR ILLUMINATION.

Effective illumination of interiors is a matter which now receives the careful attention of the architect. In days gone by it was customary to place the lights in a more or less haphazard manner, with no view to increasing their efficiency or adding to the artistic effect of the interior. Now, however, this feature is given most careful consideration, and there are even professional engineers, called illuminating engineers, who devote their time to this work.



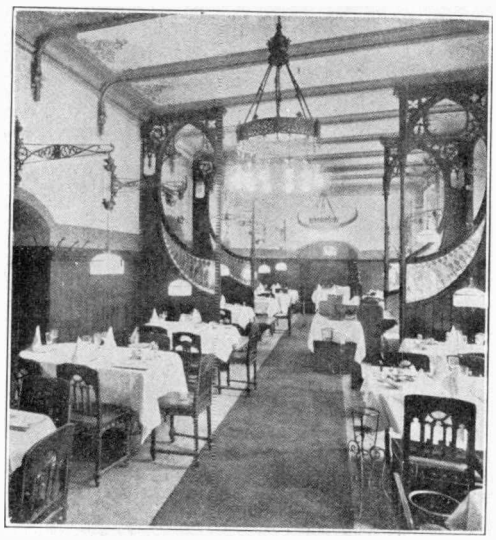
CEILING LIGHTS IN THE MAIN DINING ROOM OF THE TRAUBE RESTAURANT.

In Germany, illuminating engineering has advanced to as great a degree in the last few years as it has in this country, and to illustrate German ideas as to what constitutes effective and artistic lighting, several views are here shown of the Traube wine restaurant in Berlin. These views are reproduced through the courtesy of Mitteilungen, a publication issued by the Berlin Elektricitäts-Werke.

In the "Danzig" room, a quiet nook which seems to be just the place for a few good friends who wish to meet privately, the impression of restfulness is not disturbed by loud, gaudy chandeliers, but for the lighting, simple electric ceiling lights were selected, these giving off a very mild radiance.

"DANZIG" ROOM IN THE TRAUBE RESTAURANT.

The "Gothic" room can be regarded to a certain extent, as a counterpart of the above. There the solemn aspect of the room is somewhat lessened by incan-



"GOTHIC" ROOM IN THE TRAUBE RESTAURANT.

descent hanging lights above the tables.

In the main dining-room incandescent lamps radiating out of bronze wreaths are used very effectively, tantalum lamps having been chiefly employed.

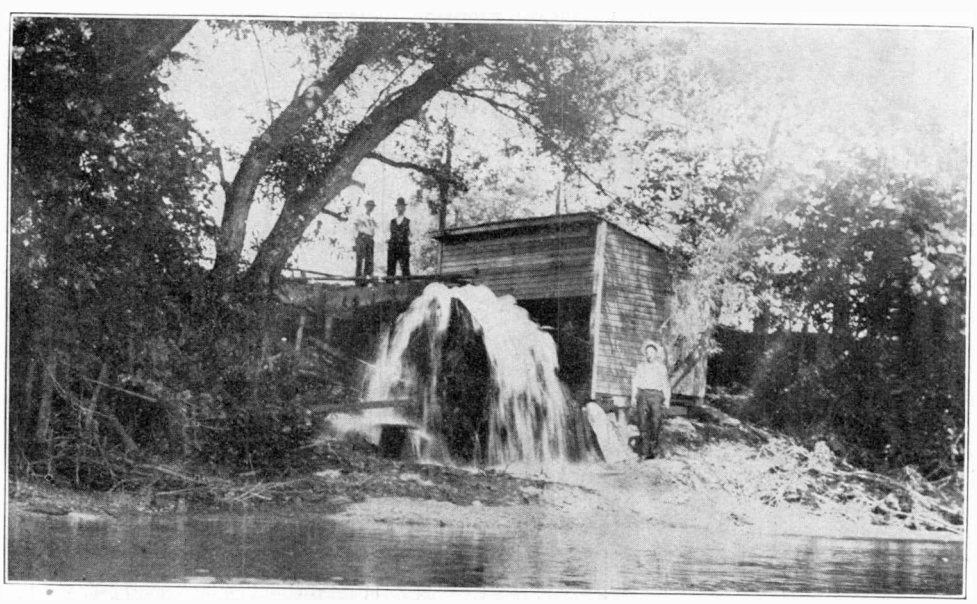
UNIQUE WATERPOWER PLANT.

It is surprising what an amount of energy this seemingly rustic water plant can develop. It lights up one house of 25 rooms and four cottages besides, making a total of 43 rooms. The promenades and byways to and from the main building to the various cottages are likewise lighted. In the main building and dining room electric fans add to the comfort of the summer guests.

A small pond at the rear in the picture is the reservoir, and is about 10 feet higher than the level of the river. When this reservoir is quite full it may be emptied over a water wheel for five hours consecutively, thereby producing sufficient energy to light from 90 to 100 lights. Two hundred and twenty-five tons of water are rushing over the water wheel per hour. The wheel alone weighs 1,000 pounds.

The wheel was made by the engineer right on the spot, with such tools as were then available. The power house used to be a lemonade stand and its equipment shows ingenuity, considering the limited means at hand.

This plant has been operated successfully for a number of seasons by one who did not know the A B C of electricity, and this again adequately demonstrates how simple it is for an inexperienced person to operate a small plant of this sort.



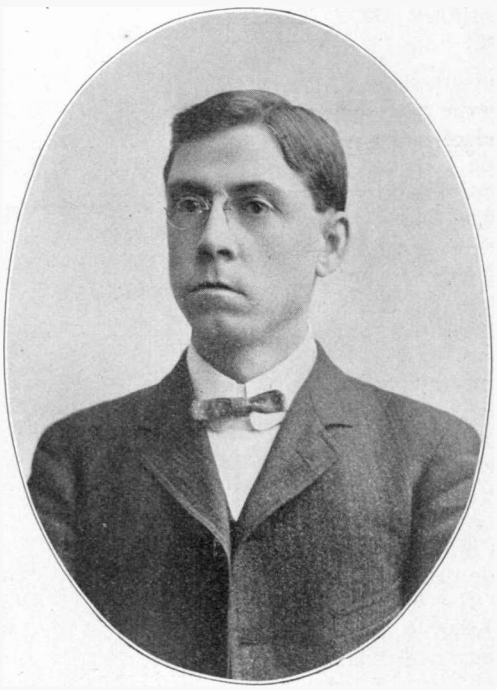
UNIQUE WATER POWER ELECTRIC PLANT.

ELECTRICAL MEN OF THE TIMES.

ARTHUR BESSEY SMITH.

We admire the aggressive man who works himself to a position in the front rank in spite of difficulties. Such a type is Arthur Bessey Smith, assistant professor in telephone engineering of Purdue University, Lafayette, Ind., and one of the recognized authorities of the country on telephone matters.

He was born August 10, 1875, at Altoona, Ia. His father, Cyrus Smith, was a Methodist minister of German-French ancestry from Alsace. He received his preparatory education in the common schools of Iowa and at Woodbine Normal School and later took the electrical engineering course at the University of Nebraska, completing the course in June, 1901. When young Smith arrived at the University of Nebraska one September day in 1896 he had less than $20 in his pocket, and with this meager sum he set out to secure a college education. To a man with less energy and optimism this would have seemed an impossible task. But with perseverance and hard work it was accomplished, and during his entire five years' course he relied wholly on his own resources. He graduated in 1901 with the degree of B. S. in E. E., and was also elected to the honorary society of the Sigma Xi.



After graduation Mr. Smith became a lineman and troubleman for the local telephone company at Missouri Valley, Ia. The next year he went with the Nebraska Telephone Company at Omaha, Neb., and was first general troubleman and then district inspector in the city. He was also made local manager of the company's plant at Tecumseh, Neb. He left Omaha in January, 1903, to take the position of assistant manager of the Woodbine Telephone Company, Woodbine, Ia., and in the spring of 1905 left there to become wire chief of the Amsterdam Automatic Telephone Company, Amsterdam, N. Y., then operating a manual common battery board. In September, 1905, he accepted a position at Purdue University, and took charge of the telephone laboratory and telephone engineering course, which position he holds at present.

Mr. Smith is not only well known by his ability as an educator, but also from his writings on telephony, being looked upon as an authority on the subject. His articles have been widely printed in the most prominent technical journals. He has also conducted valuable research work, both mathematical and experimental, in the action of currents in the primary circuit of local battery telephones. In recognition of his work he received the degree of Electrical Engineer, Purdue, 1907. He is also associate member of the American Institute of Electrical Engineers.

One thing which Arthur Bessey Smith has given to the telephone world, and which stands out prominently as one of the most fruitful of his achievements, is a complete history of the automatic telephone. This able work appeared in one of the prominent telephone journals and is thorough and authentic.

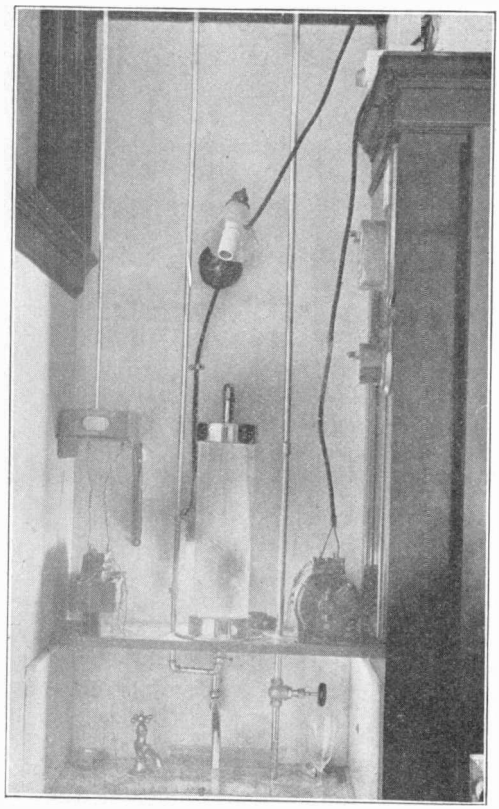
ELECTRICITY IN THE HOUSEHOLD

OZONE WATER PURIFIER FOR THE HOME.

A method of purifying water by means of ozone, to be used in the home with the same facility as the electric light is the latest enemy to bacteria. In the apparatus shown in the accompanying illustration, alternating current (usually of 110 volts) is taken from the ordinary electric light circuit and transformed and stepped up to about 8,000 volts, alternating current. This high voltage produces in the ozonizer (a box containing alternate plates of aluminum and micanite) a silent electric discharge, converting the ordinary atmospheric air drawn through the ozonizer into ozone.

The water to be treated flows, under its own pressure, from the city mains through the pipe to its highest point, and in descending draws the ozone, by means of an aspirator, from the ozonizer, the water and ozone thoroughly commingling. This action is continued during the progress of the water in its steady descent into the glass sterilizer where the ozone ascends in millions of minute bubbles, again coming into intimate contact with every particle of the water and completely destroying all the disease producing bacteria contained therein. The ozonized water then finds an outlet at the top of the sterilizer and may be conducted into any suitable storage receptacle for use.

The reason for the destruction of the bacteria by the ozone is this: Chemical analysis of the bodies of bacteria shows that they are made up of about 84 per cent of water and 16 of solids. Of these solids more than half is made up of carbon. The strong affinity of oxygen for carbon is well known. Ozone, being a concentrated form of oxygen, has an even greater affinity for carbon, and the moment a bacillus comes in contact with a bubble of ozonized air the carbon of its body combines with oxygen and the bacillus is consumed as completely as if it had touched flame. The apparatus shown in the illustration, it is claimed, will purify 4,000 gallons of water per day.



OZONE WATER PURIFIER.

THE ELECTRIC BOOTH.

It is surprising how many convenient and useful electrical appliances can now be used in the household. A great many people still have the idea that all these articles are very expensive and cost a great deal to operate, but this impression is rapidly disappearing as the facts become known and people become conversant with the many smaller and less pretentious devices.

In order to show these articles to every one interested, the Commonwealth Edison Company of Chicago has designed the Electric Booth shown in the illustration and is installing it in some of the best groceries and markets throughout the city. Invitations are sent out to all who live near to call and examine the appliances and see just how they work.

The booth is necessarily small so that it will not take up much space in the store, being only five feet wide by four and a half feet deep. And yet in this small space are shown all of the following articles, each one of which can be attached to any electric lamp socket in the home.

Sewing-room Flat Iron
Shaving Mug
Couch Bracket
Nursery Milk Warmer
Portable Candle Lamp
Cereal Cooker
Egg Boiler
Chafing Dish
Coffee Percolator
Glue Pot
Toaster
Fan
Heating Pad.
Tea Pot
Household Flat Iron
Curling Iron Heater
Pint Water Heater
Soldering Iron
Six Inch Stove
Oil Lamp Changer
Turn Down Lamp
Portable Reading Lamp
Piano Lamp
Dimalite
Corn Popper
Tungsten Lamp

THE ELECTRIC BOOTH.

The demonstrator in charge of the Booth explains all about the operation and cost of the articles, the rates charged by the Company for electricity, and any other matters of interest to users or prospective users of electricity.

Some of the information given is as follows:

To make a cup of coffee by electricity costs only 1-5 of a cent.

The electric flatiron will get hot enough for ordinary use in six minutes.

No need to use beeswax or paraffine on the bottom of an electric flatiron, as there is no flame to blacken it.

You can solder your own pans in a few minutes with an electric soldering iron, also useful for melting sealing wax, etc.

A little article about the size of a napkin ring is called a Dimalite and screws into any lamp socket and will make the lamp turn up or down as desired.

Any one can change an oil lamp to an electric in five minutes by using a Dazzelite Oil Lamp Changer. This saves discarding an expensive or highly prized oil lamp.

Physicians and nurses are now recommending the use of the electric heating pad instead of the old-fashioned hot water bottle. They come with removable washable covers.

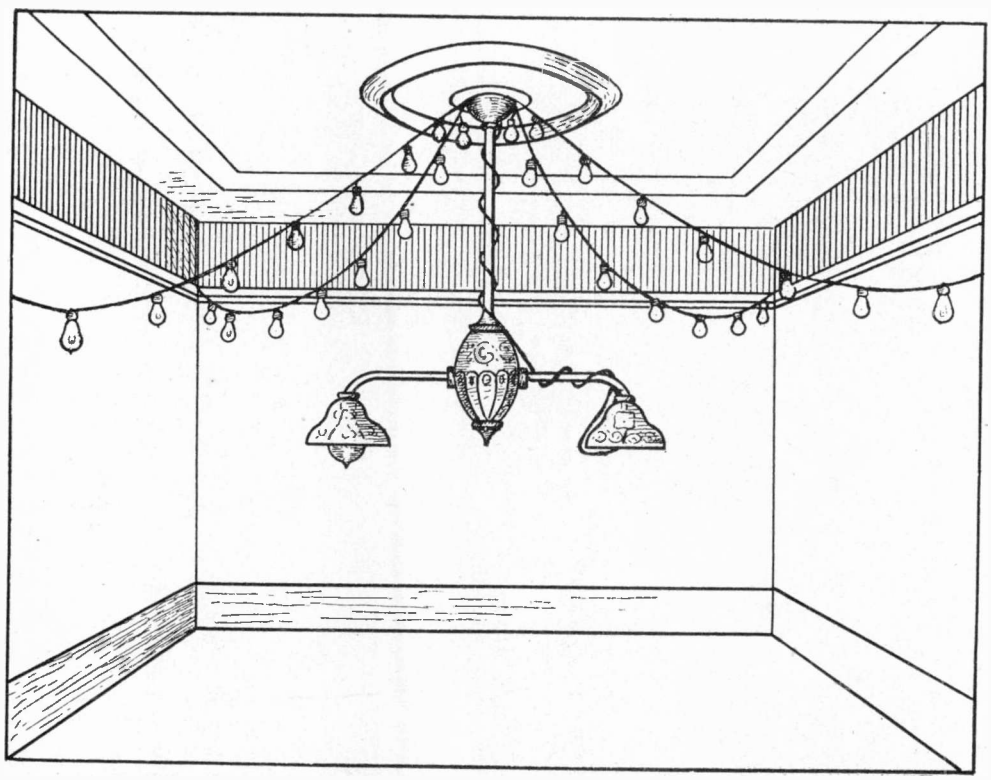
Did you ever taste wafers or bread browned on the electric toaster? Try it, and you will know what delicious toast is, for the electric way is the best way.

ELECTRICAL HOME DECORATIONS.

Throughout the Holidays and during the mid-winter season every mistress of a household is saying: "How can I make this year's entertainments the most memorable and pleasing to my guests?"

Most of our readers are probably familiar with the miniature lamps for use on the Christmas trees instead of the old-fashioned candles. These electric Christmas tree lamps are the most satisfactory means of illumination with the inflammable materials used on the tree, on account of their perfect safety from fire as well as their beautiful effect. But many are still unfamiliar with their adaptability for home decoration whereby most original and pleasing decorative effects may be obtained without the services of an expert electrician, when they are to be used temporarily as for a party, reception or dinner.

Secure from your electric light company, or dealer in electrical supplies, a Christmas tree outfit, 32-lamp size. These are also called "miniature lamp festoons." The 32-lamp size will have one main cord or wire with a plug to go into a lamp socket and four branch cords, each branch having eight sockets in which to screw the little lamps. The lamps come in assorted colors—clear glass, white, red, amber, blue and green. The outfit is sold complete packed in a box lamps and all.



MINIATURE LAMP DECORATIONS.

Unpack the outfit and screw each miniature lamp into a socket of the festoon and screw the plug into one of the sockets on any electric bracket or chandelier in the house and see if all the min-

iature lamps light up. If some do not they are probably not screwed tight enough into their sockets. If one of the eight lamps on the cord is broken or not connected tightly none of the eight lamps on that branch of the cord will light up, so you must make sure that all the lamps are in properly. You have now tested the outfit and are sure that it is in operative condition and that all the lamps will burn properly.

There are several ways to use the outfit, but the prettiest and most effective for holiday occasions is the festoon method. In arranging this, the services of a man are required, but this does not mean an expert electrician. Just an ordinary handy man will do, for if the simple rules given here are carefully followed, there will be no difficulty whatever in connecting the lights.

Take the outfit out of its box and spread the four branches to the corners of the room. Place a step ladder near the center of the room. Have the man grasp the festoon at the place where the four branches come together, and carry it up to the canopy of the chandelier at the ceiling. He now uses a screwdriver, and unscrewing the set-screw which holds the canopy up against the ceiling, lets the canopy down for a couple of inches. Pushing the festoon between the canopy and the ceiling he raises the canopy up again and fastens the set-screw, thus holding the festoon up close to the ceiling.

Now have the man take the ladder to one corner of the room and drive a small nail just above the picture moulding. Then fasten up the extreme end of one of the four branches, using a piece of string tied around the end of the festoon. Never drive a nail into any electric cord or fasten such a cord directly around a nail or any metal. This is why you use string. Fasten up the end of the other branches to the corners of the room in the same way, looping the branches in graceful festoons by manipulating them at the chandelier or the corners of the room.

Now twine the central cord of the festoons around the stem of the chandelier and screw its plug into one of the lamp sockets on the chandelier, after making sure that the lamp which belongs in that socket on the chandelier will light up and is still burning when you unscrew it. Next screw the miniature lamps into the sockets along the cords, selecting lamps with different colors successively on each branch and as the last one on each branch is screwed in, completing the circuit, all eight lamps on that branch will light up. If the festoons are looped gracefully the effect will be very good provided too much light does not enter the room from the windows or from other sources of artificial light in the room.

If it is desired to make a still more festive appearance the electric festoons can be entwined with strings of greenery. If this is done the stem and arms of the chandelier should also be encircled with the greenery in such a way as to completely conceal the cords of the festoons.

Other ways of using these miniature lamp outfits will occur to the hostess who loves to plan original effects, such as weaving them into the decorations of the dining table, running them about the draperies of a double doorway or alcove, and turning the conservatory into a veritable fairyland by stringing the dainty lamps all through the vines and foliage.

WASH DAY LOSES ITS TERRORS.

At a cost of less than two cents for power the Thor electric washer and wringer will do an ordinary family

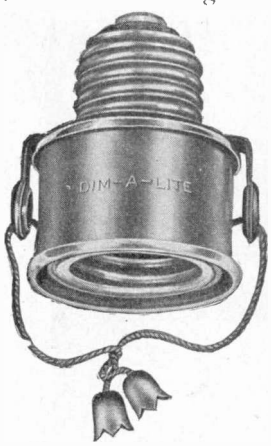
ELECTRIC WASHING MACHINE.

washing in an hour. It does almost everything but hang out the clothes. The washer is operated by a small motor mounted on the framework of the machine. It revolves several times in one direction, reverses and makes the same number of revolutions in the opposite direction. Each revolution of the cylinder carries part of the clothes to the top, spreads them out, then drops them back into the water, exposing every part of them to the torrents of hot suds being continuously forced through the perforations in the cylinder.

The same motor also operates the wringer which is of the three-roll type. The clothes are wrung through the lower pair of rolls into the tub and after they are rinsed or blued are run back through the upper pair of rolls. This obviates the necessity of an extra wringer.

ELECTRIC LIGHT TURNED UP OR DOWN.

This little electrical device, about the size of a small napkin ring, is called a "Dimalite" and will turn up or down any electric lamp which is screwed into it. It fastens into any regular Edison electric light socket. By pulling one of the strings the light is turned on, first very low, then a little brighter and then



THE DIM-A-LITE.

full candle power. By pulling the other string the process is reversed.

This article, besides being very convenient for use in the home, effects a saving in the cost of electricity, for when the light is turned down only a fraction of the normal full-light current is being used.

TALKS ON "CURRENT" TOPICS.

W. S. P.—(1) There are several good electric vibratory massage machines on the market, but we cannot give the names of manufacturers in this department. (2) The amount of electricity used by a vibrator is only about as much as that consumed by an ordinary 16-candlepower electric lamp—that is about 50 watts.

M. L. F.—Some electric light companies furnish lamps free, others do not. It is a matter for you to take up with your own electric service company.

Mrs. B.—It is impossible to give here even an approximate estimate of cost of wiring a nine-room house for electric service, as the cost depends upon the number of outlets (or openings) in the walls required, the number of lamps to be used at each outlet, the number of switches, whether the house is frame or brick, and the price of labor. We suggest you take up the matter with a reputable contractor

H. W. P.—You can use an electric stove to heat your chafing dish instead of with an alcohol lamp, provided the bottom of the chafing dish is flat and the legs of the chafing dish are wide enough apart to allow for a space 4½ inches in diameter for the bottom of the chafing dish to rest upon the stove. Best results are, however, obtained by using the regular electric chafing dish which is equipped with an electric heater designed to properly heat the utensil with which it is sold.

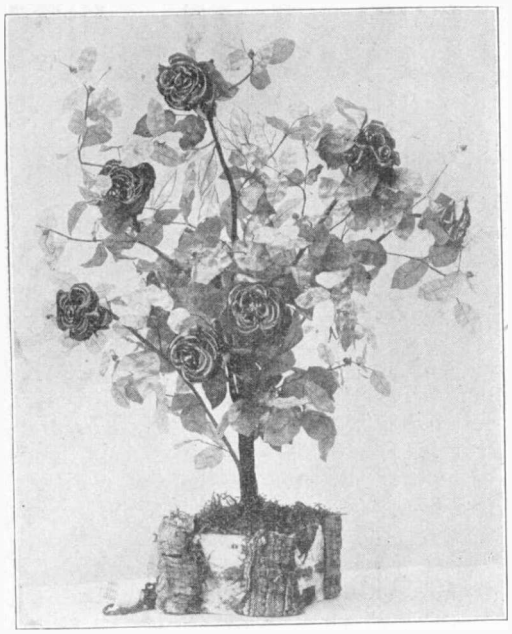
A. L. D.—Cooking by electricity is entirely practical to-day. It is only a question of the cost. The writer was present on Thanksgiving Day at a dinner where no other means whatever was used for preparing the entire repast.

Alice B.—Electric light is not injurious to the eyes when properly installed and used. All brilliant lights, whether gas or electric, should be equipped with shades to keep the direct rays from striking the eyes. In reading, the light should fall on the paper at such an angle that there is no glare. The best position is to sit with the back to the light and let the light come from over the shoulder.

Appleton.—The Tungsten lamp is so called from the fact that its filament (or fine wire which becomes white hot) is made of the metal tungsten.

ELECTRIC TABLE DECORATIONS.

Artistic electric decorations are now very largely employed in the leading restaurants, hotels and clubs, as well as in residences. Very handsome floral pieces and set designs, with vines for draping are available, all electrically lighted. They are furnished with beautiful, soft-colored, miniature lamps interwoven with the foliage and partly concealed in the flowers.



ELECTRICAL ROSE BUSH.

An illuminated rose bush is particularly effective for banquet tables arranged with incandescent lamps in the roses, the bush being 2½ feet high and combining harmoniously with the various colors in the decoration.

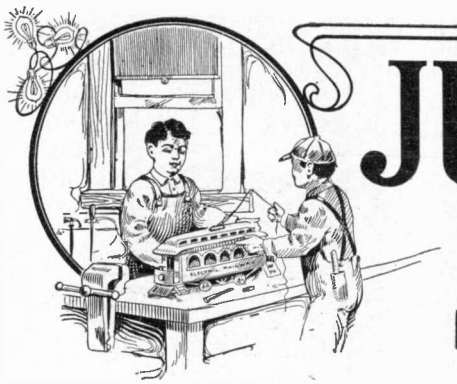
The electric fruit tree is a beautiful creation. The peach tree illustrated is 2½ feet high and may be made higher if required. An orange tree four feet in height with electrically lighted fruit is also particularly effective. Besides these miniature trees, there are electrically illuminated fruit baskets and strawberry beds, all novel and unique for the dining room table or sideboard.

The electric lighted strawberry bed is designed to perfectly immitate a natural bed of berries, the fruit lamps being partly concealed in the foliage. The electric decorated hanging bell is covered with foliage and blossoms containing concealed colored lamps producing a soft-shaded light effect. The tongue or clapper is a miniature fruit lamp, and the whole design measures 24 inches in diameter.

The electrically lighted canoe of birch bark is the most artistic, being arranged to be suspended from an ordinary electric lamp socket. The canoe is covered with sea moss, partly revealing a delicate glow from the colored lamps. Hundreds of other designs might be mentioned.

ELECTRICAL PEACH TREE.

These novelties are coming more extensively into use as the number of homes served with electric light increases, although at one time decorations of this sort were only to be found in public places.



JUNIOR SECTION

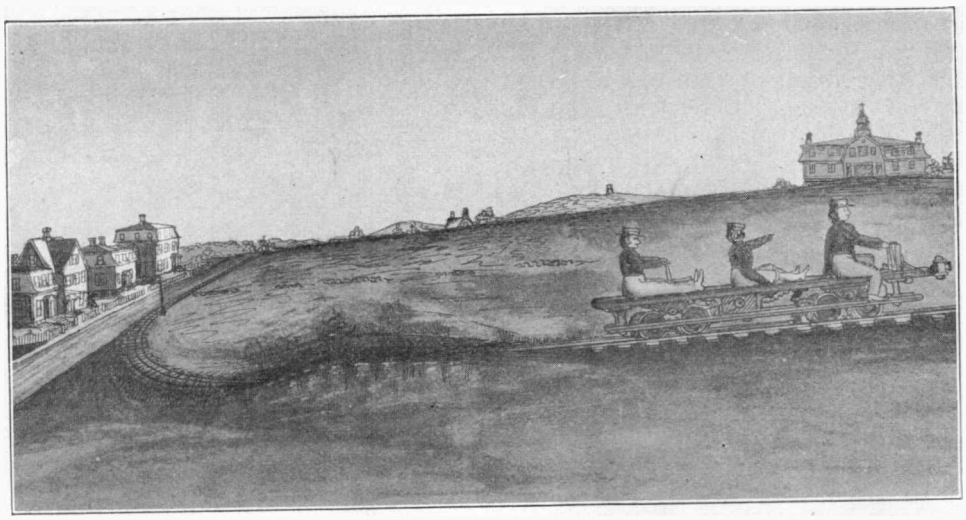
HOW A BOY BUILT ONE OF THE FIRST ELECTRIC RAILWAYS.

One of the early attempts to build an electric railway was made by Mr. Louis E. Walkins in the year 1878. The accompanying picture from the original water color sketch made by the inventor is of considerable historical interest. In the spring of that year Mr. Walkins, then a young boy, purchased of a Mr. Mansfield, then a resident of Hyde Park, Mass., the track and switches of his experimental one foot gauge railroad. Mr. Mansfield, by the way, was the father of the narrow gauge railroad in this country, having built the Belerica & Bedford Narrow Gauge Railroad near the city of Boston, and later the narrow gauge railway at Rangely Lakes, Farmington Maine.

During the summer of 1878 Mr. Walkins put down the track on Summit street, Clarendon Hills District, Roslindale, in the city of Boston. The street was a short one, less than 1,000 feet in length, the line of track curved from the street and run thence in a straight line to a point very near the summit of the hill and was 1,800 feet in length. The rails were of spruce, sawed one inch square and fastened to the ties by screws. The ties were ⅞ inch thick, 2½ inches wide and 18 inches long. Strap iron was fastened to the top of the rails by screws, and on this strap iron the wheels of the car ran. The third rail was situated between the track rails. The rail used was of the same dimensions as the track rail, but consisted of two strips of thin copper instead of iron. One line of the track rail was bonded at the joints by small strips of copper, so as to form a continuous return conductor. The copper third rail was soldered at the joints so as to form a continuous feed conductor. At a point opposite the residence of the inventor was located a pole to which was secured the wires conducting the current from the battery located in the cellar of the house to the third rail and the return conductor.

The battery consisted of 100 cells of the Bunsen type. The car was made of a double runner sled, two trucks being constructed to take the place of the runners. The rear truck was so arranged that an electric motor made by the inventor was secured to the frame of the truck whose pulley was connected by a belt with a large pulley secured to one of the axles of a pair of wheels.

At first a steel spring shoe was used on the power truck to connect with the third rail. Then a brush was used made of copper wire. From the latter the best results were obtained. The grade of the track was nearly level over the whole distance. The car when given a push ran very well and covered nearly the whole length of the track without assistance. More batteries were added and complete round trips were easily made on special occasions. The road was in operation at intervals during three months of the fall of 1878, but it was so expensive to operate that it was finally abandoned about the first of December, 1878. Old residents of Clarendon Hills, Mount Hope



ELECTRIC RAILWAY BUILT IN 1878.

and Roslindale, West Roxbury District, Boston, Mass., can well remember this railroad, as it was a great curiosity to see a car go along as they said by electricity.

The youthful inventor formed a regular little company, which of course was not incorporated, among his young companions. Walkins was president; a young man, Augustus Blaze, in recent years a well-known contractor and builder of New York City, was superintendent, and the treasurer and conductor was Charles Houghton of Roslindale, in later years a successful jewelry salesman of Boston. Regular fares of five cents per trip were collected, the car would carry four or five children and three youths of 18 to 20 years old.

STATIC ELECTRICITY AND ITS APPLICATION TO A SIMPLE WIRELESS TELEGRAPH SYSTEM.

BY WILLIAM STRAHL.

"Static electricity," is the name given to electric charges originating from friction between two bodies, consequently sometimes called "frictional electricity." It is, electrically speaking, of a very high voltage, with a very small amperage, and unlike "current electricity," does not require a complete circuit before being capable of doing work. It is sometimes spoken of as electricity at rest, "bound electricity," showing its existence by its attracting and repelling power over light bodies.

Rubber, sealing wax, sulphur, glass, shellac and rosin briskly rubbed with a piece of cloth or silk, are producers of static electricity. When a very large amount is required frictional machines, like the Wimshurst and Holtz are necessary.

If a charged rod of rubber or sealing wax is brought near a pith ball suspended by a silk thread as shown in Fig. 1, known as electric pendulum, the pith ball is immediately attracted, but soon repelled. If the hand is brought near, the ball will be attracted to the hand. The body then receives the charge and allows it to escape to the earth.

Suspend three pith balls in the same manner and touch them with an electrified or charged rod. The rod repels the balls and the balls repel each other, holding their own respective distances from their neighbors; like repelling and unlike attracting.

The high voltage or pressure, sometimes called electromotive force (E. M. F.) of static electricity makes it very hard to insulate from the earth. Insula-

tors for ordinary current electricity utterly fail for this purpose.

Testing insulators of extra high resistance is usually done with induction coils of various spark lengths. The results are not figured in ohms (which is an electrical unit of resistance) but rated at their safe voltage carrying capacity.

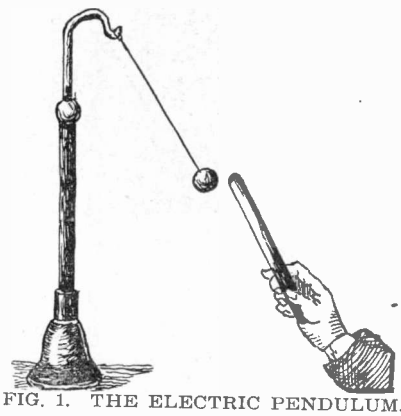


FIG. 1. THE ELECTRIC PENDULUM.

To do away with expensive induction coils, however, any one can test an insulator, quicker and cheaper by using an electric influence, or "induction" instrument as shown in Fig. 2.

A cylinder (a) holds the electric charge. (a′) shows how the static charge distributes itself on the surface. (B) is the insulator, (D) and (D′) are pith balls in normal position. (C) and (C′) are pith balls repelled from the cylinder under static influence.

The instrument is electrified and made ready for testing by passing a charged rod along its surface backward and forward several times, turning right and left. This is necessary, as the electricity does not pass off all at once but remains on in small charges. The pith balls are first attracted to the cylinder, then repelled. After they have reached a distance of about one-half inch or more, the insulator is ready to be tested.

Hold the insulator or material to be tested in the hand as shown in Fig. 2 and slightly touch the cylinder in the center (a), keeping a sharp lookout on the

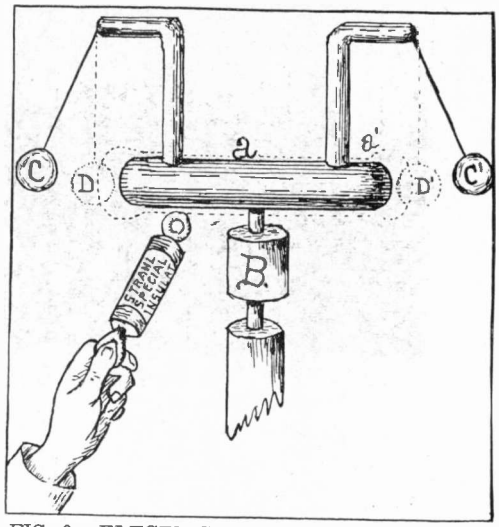


FIG. 2. ELECTRICAL INFLUENCE INSTRUMENT.

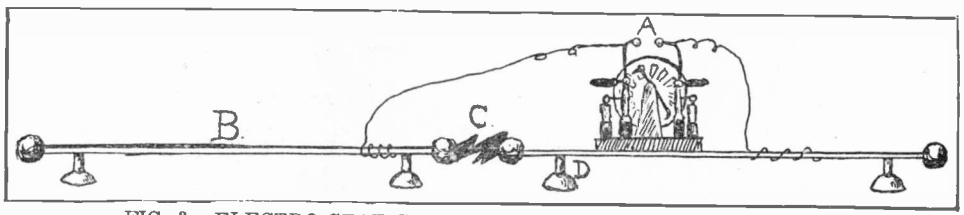


FIG. 3. ELECTRO-STATIC WIRELESS TRANSMITTING STATION.

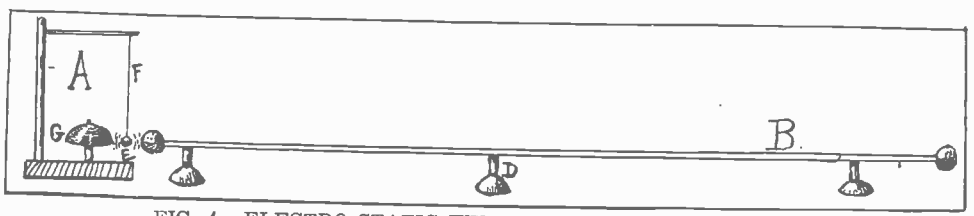


FIG. 4. ELECTRO-STATIC WIRELESS RECEIVING STATION.

pith balls. If the insulator fails, the pith balls will immediately or gradually collapse, depending upon the nature of the material as regards its insulating qualities. The reason the balls collapse is because the charge leaks through the insulator being tested, to the hand, and thence to earth.

If the pith balls continue holding their position the insulator is all right and can be used successfully for insulating purposes of any kind. Sealing wax, which is a good insulator, and wire which is a bad insulator, should be first used as trial insulators to get the extreme action of the pith balls. From these observations it is possible to determine approximately the relative insulating values of various substances.

Now as we have covered the nature of static electricity, and how to insulate it from the earth successfully, we are in a position to apply the principle to a wireless telegraph outfit.

Fig. 3 shows the sending or transmitting station. (A) is a static machine connected to wires or rods (B), the ends of which are soldered to lead balls (wire with ends free from points will answer the purpose). (C) is the spark which produces wireless waves. (D) are insulators, made of sealing wax, supporting and insulating the wires (B) from the earth.

The receiving station, Fig. 4, has one wire or rod (B) instead of two. Insulators and supports (D) are the same as in Fig. 3. The electric chimes act as a receiving detector or coherer, and consist of a metal ball (E) suspended and insulated by a silk thread marked (F), and adjusted so as to have free play between the gong and receiving wire or antenna.

The wires should be as long as possible and parallel to each other, with the receiving antenna the same length as the two sending ones.

At the start, the distance between the receiving and sending stations should be about one foot.

The electric waves generated at the spark (C), Fig. 3, travel along the wires or antenna (B), where they are increased in length. Then they spread in all directions, just as if you dropped a pebble in a smooth sheet of water causing waves to emerge from the center of disturbance.

The antenna (B), Fig. 4, catches these waves, but it being insulated from the earth the waves can only escape by attracting the metal ball (E) which acts as a "proof plane." The ball is first attracted to the antenna (B), receives a

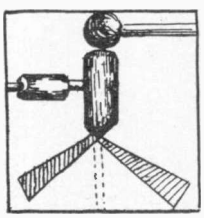


FIG. 5. FOIL ELECTROSCOPE.

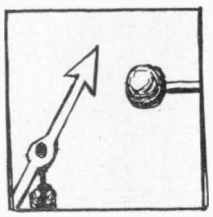


FIG. 6. ARROW ELECTROSCOPE.

charge of like current, is repelled from (B) and at the same time attracted to gong (G), which is electrically connected to the ground or earth. Upon losing its charge, the ball is again attracted to (B) and the same movement continues until all energy is consumed.

The distance should be gradually increased until the sound of the bell becomes faint or its action irregular.

Another detector which may be used is the "foil electroscope" as shown in Fig. 5. This consists of two delicate pieces of tin foil or gold leaf hung from an insulator. Place the wire or antenna over the top of the instrument. The presence of the waves is indicated by the expansion of the leaves. Collapse the leaves by touching the top of the instrument lightly with hand, and continue to increase the distance.

Next use the "arrow electroscope" and place in the same manner as shown in Fig. 6. This arrow is very sensitive and will indicate the presence of charges too feeble to be seen by other instruments.

The chimes, foil and arrow electroscope, all take the place of what are known in wireless telegraphy as coherers, which are nothing more than detectors of electric waves. There are far more sensitive coherers than these, involving delicate apparatus, but the above devices are both instructive and amusing for purposes of experiment.

CONSTRUCTION OF A SIMPLE MICROPHONE.

A very simple piece of electrical apparatus is the microphone. It can be put to a number of uses, and when well constructed offers quite a lot of amusement. Two common worn out dry cells, a standard size cigar box, a telephone receiver and two binding posts are needed.

The dry cells are split open with a

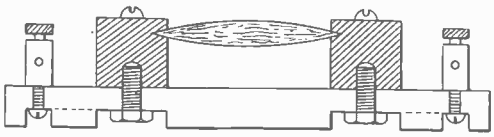


FIG. 1. SIMPLE MICROPHONE.

hatchet and the carbon rod taken out. Two carbon blocks are filed out of the rods with a rasp file. The size of the blocks should be 1 by 1 by ¼ inch. In some makes of cells the rods are already square and in this case the filing will not be necessary as the exact size given here need not be followed. Lengthwise of each block is drilled a ⅛-inch hole and ¼-inch from the ends a small V-shaped nick is made with the file. The blocks are now mounted on the cigar box three inches apart, with the V-shaped nicks facing each other. A binding post is run through the block and the base of the cigar box and screwed down as shown in Fig. 1.

The remaining carbon is filed to the shape as shown at (B) Fig. 2, and is ¼-inch thick in the center and ½-inch wide, terminating in the points which rest in the nicks of the mounted blocks. This piece should fit loosely in the nicks.

Connecting wires are now run from the bottom of the screws which hold down the carbon blocks to the binding posts.

One cell of the battery is connected in series with a telephone receiver and microphone as shown in the plan, Fig. 2. On placing the telephone receiver to the ear a continuous buzzing will be heard. If not, continue adjusting the middle carbon until the sound is heard plainly in the receiver. When the adjustment has been properly made the ticking of a watch or even the walking of a fly can

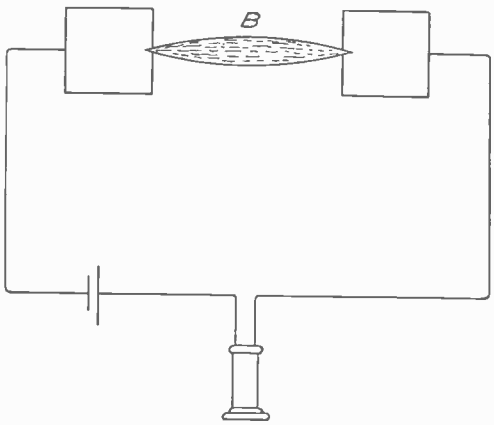


FIG. 2. DIAGRAM FOR CONNECTING UP THE MICROPHONE.

be heard. Talking in the same room and outside noises can also be plainly distinguished.

A GOOD GROUND CONNECTION.

The amateur often experiences trouble in connecting and soldering heavy wires to gas or water pipes. A good ground connection for wireless work can be made by cutting two pieces from a sheet of copper or brass, the shape shown in the illustration, the size of which depends on the diameter of the pipe. Two holes are drilled in each piece large

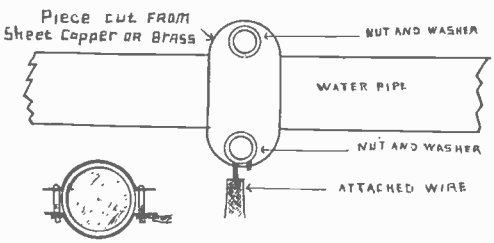


DIAGRAM OF GROUND CONNECTION.

enough to receive two binding posts of an old dry battery.

The pipe is first cleaned with emery cloth and a layer of tin foil is wrapped around the cleaned surface. The connector is then put on and the nuts screwed down tight with the wire attached at one end. This method does away with soldering and poor connection.

QUESTIONS AND ANSWERS.

Readers of Popular Electricity are invited to make free use of this department. Knowledge on any subject is gained by asking questions, and nearly every one has some question he would like to ask concerning electricity. These questions and answers will be of interest and benefit to many besides the one directly concerned. No consideration will be given to communications that do not contain the full name and address of the writer.

CONNECTION OF MAGNETO TELEPHONES.

Question.—Please publish in your Question and Answer department how to connect two telephones using magnetos for ringing the bells, using three wires. Please give diagrams. —F. H., San Francisco, Cal.

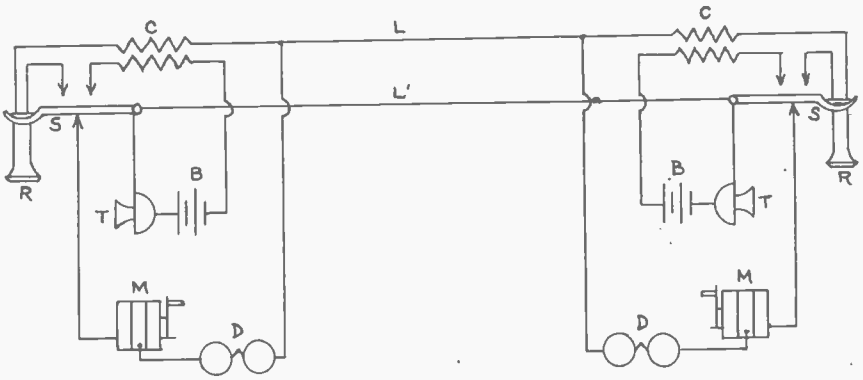


FIG. 1. CONNECTION OF "SERIES" TELEPHONES.

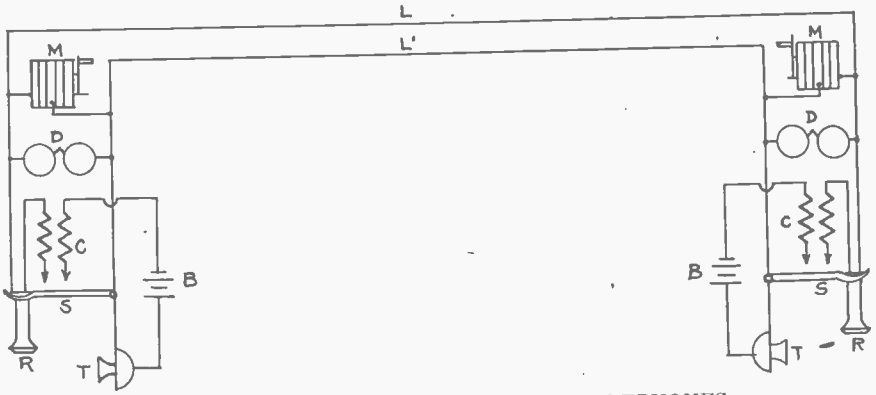


FIG. 2. CONNECTION OF "BRIDGING" TELEPHONES.

Answer.—Your reference to three wires is not quite clear. For the ordinary purposes of telephonic communication two wires are sufficient for both ringing and talking. Fig. 1 shows the connections of two "series" telephones, and Fig. 2 gives the arrangement for "bridging" telephones. In both illustrations (T) is the transmitter, (R) the receiver, (M) the magneto generator, (S) the switchhook, (C) the induction coil, (B) the battery, (D) the ringer, or bell, and (L, L') the line wires.

CONNECTION OF BRIDGING TELEPHONES.

Question.—Please tell me how I could connect three bridging telephones of the magneto type, using three wires.—M. F. H., San Francisco, Cal.

Answer.—The answer to F. H. in this number of Popular Electricity shows how to connect two such telephones; a

third would simply be bridged across the line at any intermediate point.

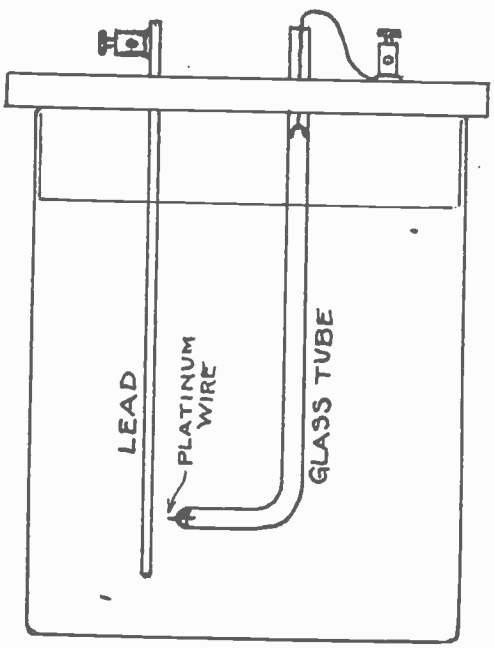
TRANSFORMER DESIGN; INDUCTION COIL; ELECTROLYTIC INTERRUPTER.

Question.—(A) Kindly give measurements for a transformer to operate on a 127 volt, 60 cycle circuit, 10 amperes. I want to use it to step up to 100 times the primary potential.

(B) Why is it that an induction coil cannot be used on an alternating circuit?

(C) Can you give directions for an electrolytic interrupter for a four inch spark coil?—A Reader.

Answer.—(A) For a core type transformer, two coils each six inches long wound on a form three inches square. Primary, 500 turns of No. 11 wire, 250 turns to each coil. Secondary, 50,000 turns of No. 31 wire, 25,000 turns to each coil. Core of sheet iron, three inches square. Each layer of the secondary winding must be separately insulated. It is perhaps unnecessary to point out that the secondary current from such a transformer would be fatal, and its use for experimental purposes is not recommended.



ELECTROLYTIC INTERRUPTER.

(B) The induction coil is quite inefficient as a transformer, owing to the open magnetic circuit. It owes its value as a direct current machine to the self induction of the primary winding, the discharge of the condenser, and the quick break of the interrupter. None of these conditions can be met with alternating current.

(C) Into a glass jar or wide mouth bottle rather less than quart size put a strip of thin sheet lead the length of the jar. A length of 1/8-inch glass tube has an inch of one end bent at right angles, and into this bent end is fused a half inch of fine platinum wire, so that just the tip of the wire protrudes beyond the glass (see cut). The tube is then filled with mercury, and lowered into the jar in such a position that the platinum tip is near the lead plate. Both the plate and the tube are fastened to the cover of the jar, and the space between the lead and platinum may be roughly adjusted by turning the tube. Of course connections are made by clamping a wire to the lead, and dipping another wire into the mercury. The jar is then three-quarters filled with dilute sulphuric acid, in the proportion of four parts of water to one of acid. At least 40 volts should be used for satisfactory working of the interrupter. A coil operated with a Wehnelt interrupter needs no condenser.

OPERATION OF 20 OHM SOUNDERS.

Question.—Would two 300 ohm relays be of any service to a line 1000 feet long using two 20 ohm sounders with No. 14 gauge wire for one line and the water pipes for the other line?—C. V. V. T., Helena, Ark.

Answer.—No. The total number of battery cells required for the relays and the local circuits would not effect any saving over the number used on the straight line; and the line is so short that your transmission should be satisfactory without relays.

REWINDING FAN MOTOR.

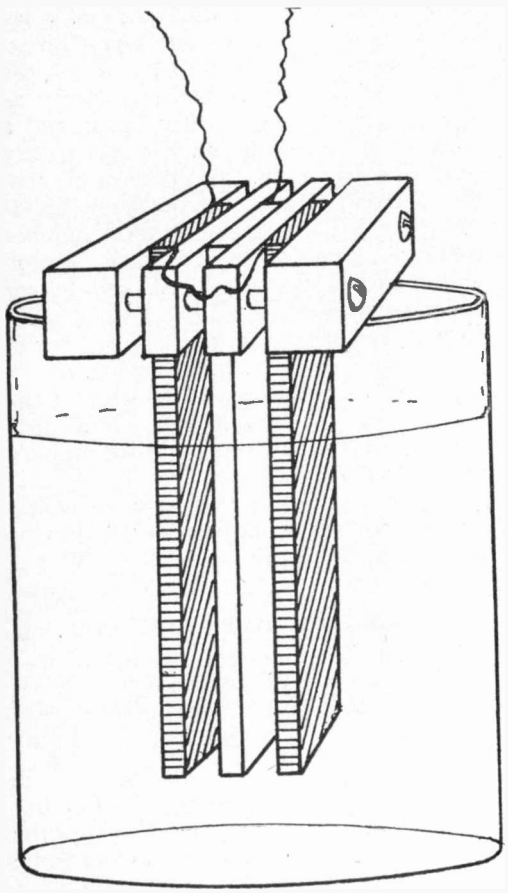
Question.—I have a General Electric 100 volt, 133 cycle fan motor; it has 10 poles wound with No. 23 gauge wire and measures 11 ohms. What change will I have to make, so it will work on a 60 cycle current?—C. R., Logansport, Ind.

Answer—The answer to J. E. D. in the December number of Popular Electricity covers this question.

A HOME MADE BATTERY.

Question.—I have been taking Popular Electricity for four months and find it very instructive, particularly the Questions and Answers pages. I would be very much obliged if you would tell me how to make a good cell for experimenting. I would like it to be of good strength and capacity.—J. D. M., San Francisco, Cal.

Answer—Procure one zinc and two carbon plates, all eight inches long, four inches wide and ¼ inch thick. Make a clamp of wood which has been soaked in paraffine, and fasten one end of the plates in it as shown in the illustration



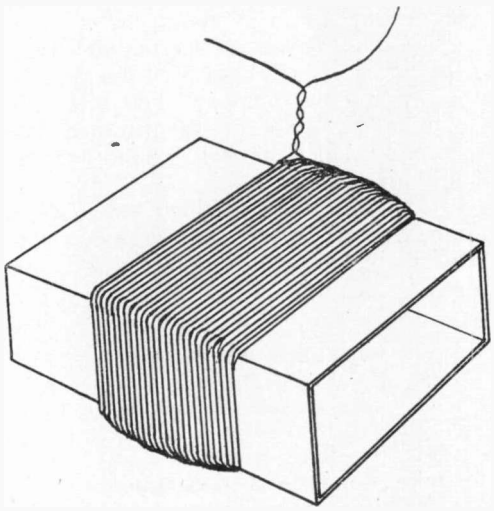
HOME-MADE BATTERY.

—the zinc plate between the two carbons. The wood strips of the clamp are each seven inches long; the outer strips are one inch square, the inner two are one by ⅜ inch. Four inch bolts at the ends of the clamp hold it together. Before screwing together, lay a piece of heavy copper wire under the clamp and across the top of the plate. The two carbon plates are connected together to one wire; the zinc is connected to the other wire. The plates are now hung in a glass jar six by eight inches, the wood clamp resting across the top. The solution for this cell is made by dissolving a pound of sodium bichromate in a gallon of water, and adding slowly a pound of strong sulphuric acid. This cell gives two volts and a large current. When it begins to show signs of exhaustion add a little more acid. Some arrangement should be made for drawing the plates out of the solution when not in use, and hanging them just above the jar.

WATCH DEMAGNETIZER.

Question.—I have a watch that is magnetized and would like to know of a way to demagnetize it. I have taken it to a jeweler and he said it was very bad and he could not do much with it. I have a magneto but want to know how to wind a coil for it.—J. S., Chicago, Ill.

Answer.—We suppose your magneto is an ordinary telephone generator, delivering alternating current. Make a cardboard frame a few inches long, and large enough to enclose the watch. Probably the sliding cover of a match box will do nicely. Around the center of this wind about two ounces of No. 28 cotton covered copper wire. Connect the ends of the winding to the magneto,



WATCH DEMAGNETIZER.

insert the watch in the box, and turn the generator crank vigorously for a few minutes. Only alternating current should be used with this device and such current is generated by your magneto.

HORSE-SHOE MAGNETS.

Question.—(A) What mode is best for thoroughly magnetizing horse-shoe magnets permanently?

(B) What pull should twelve horse-shoe magnets ¼ by 1½ by 7 inches laminated exert on a piece of soft steel ¼ by 3 inches, 1¼ inches away from the poles?

(C) What steel, temper and form give best results?—C. F. S., Cleveland, Ohio.

Answer.—(A) The best method of magnetizing steel magnets of any form is to stroke the end which is desired as the north pole with the south pole of a powerful electromagnet, stroking the opposite end of the steel with the north pole of the electromagnet. Each stroke should begin near the center of the steel and be carried to the extreme end. Another way is to wind the steel bar with a coil of insulated wire and pass direct current through the wire. When the current is turned off, the steel retains its magnetism.

(B) The power of permanent magnets varies in each case with the steel, its temper and magnetism. The attraction varies as the cube of the distance; and the pull at 1¼ inches would be very slight, indeed.

(C) Thin bars, either straight or "horse-shoe," of a fine grained steel, uniformly tempered a straw color, give the best results.

WIRELESS TELEPHONY.

Question.—Will you explain how to make a simple wireless telephone transmitting outfit?—A. M., Natchez, Miss.

Answer.—This question is too broad to take up in this department at the present time. The numerous investigators along this line are carrying on work secretly and have given out very little matter for publication. The DeForest system which employs the arc lamp for an oscillator was described in the July issue of this magazine. By referring to this number you can get some information which may be of value. V. H. Laughter, of Byhalia, Miss., author of "Wireless Telegraphy Made Simple," which appeared in the first five issues of Popular Electricity, is authority on this subject. We would recommend that you correspond with him.

SECONDARY OF SPARK COIL.

Questions.—(A) Why is the secondary of the spark coil divided up in sections? (B) What would the diameter of the sections be? (C) What style of interrupter would you recommend?—R. H. F., Batavia, Ill.

Answers.—(A) The winding of the coil in sections is necessary, as otherwise the current induced in the secondary which runs up in the thousands of volts, would seek the path of the lowest resistance which would be directly across the winding. What is technically known as a "breakdown" would then occur and a complete rewinding of the secondary would be necessary. In order to prevent this "breakdown" the secondary is divided up in sections and the total number connected continuously. Each section will carry it's individual load and deliver to the secondary terminals. For more information concerning this point refer to the answer to D. H. in this issue.

(B) The approximate diameter of the sections will be 3⅞ inches. This distance will vary, however, with the amount of insulation used.

(C) For a coil of this type we would recommend a good adjustable vibrator of the "make and break" type.

FOUR INCH JUMP SPARK COIL.

Question.—What amount and size of wire should be used in the construction of a four inch jump spark coil, and give illustration of how it should be wound?—R. R. A., Alhambra, Cal.

Answer.—See answer (B) to G. S. in the November number of Popular Electricity. A diagram showing the method of winding is given in the same issue, in the article "Construction of a Two-Mile Wireless Outfit."

WIRELESS TELEPHONE.

Question.—What apparatus would be necessary to work up to one mile. The length of aerial, coils, etc. The above questions applying to a wireless telephone outfit?—H. M., Rochester, N. Y.

Answer.—We refer you to the answer to A. M. in this issue.

SPARK COIL.

Questions.—(A) In using a ¾-inch spark coil for sending wireless messages I get a good spark without the aerial and ground, but as soon as the switch connecting the aerial and ground is thrown in I can hardly get an ⅛-inch spark. My aerial is well insulated to prevent undue leakage. Will you explain where the trouble lies? (B) How many dry cells should be used for the above coil? (C) Are dry cells practical for this use?—D. H., New Brighton, N. Y.

Answers.—(A) The reduction of the spark in the case you mention is a very common occurrence when the small size coil is used. With the aerial and ground connected to the opposite sides of the gap, the greater portion of the energy is dissipated at these two extremities, and in consequence the spark across the gap is reduced. To remedy the trouble reduce the spark gap to at least ⅛ inch and bridge two small Leyden jars across the circuit. This will make the spark fat and heavy.

(B) Four to six cells should operate the coil.

(C) Yes.

SPARK COIL DIMENSIONS.

Questions.—(A) Please give the dimensions of a two-inch induction coil for wireless telegraphy and explain how to wind it, also what is meant by the secondary sections and how to go about winding them; also the sizes of wire necessary to use. (B) Please advise if this coil will send up two miles, employing at the receiving end a 150 ohm standard relay in connection with the coherer. (C) Would the transformer take the place of the two inch spark coil, if so, would it be cheaper and could it be home-made and about what is the price of one?—H. O. W., Scott, Kan.

Answers.—(A) By referring to the November, '08, issue you will find the exact dimensions and all constructional details given for a two inch wireless coil in the article "A Two Mile Wireless Outfit." It would be impossible here, to give a complete description of the method for winding the sections and of the section former. However, the secondary is simply one portion of the total secondary winding. For instance, the secondary which is described in the above mentioned article contains 16 sections, the 16 sections holding the three pounds of wire, or three ounces to the section. To wind the sections a spool is first made with movable brass plates for sides and a central wood disk of the exact diameter of the insulating tube. This central disk is of the desired width of the sections. The sections should be wound opposite to one another, that is, the first section can be wound with the end of the magnet wire leading out to the right hand side, and by turning the section former or spool around, the second termination of the winding will be at the left hand side. This plan is followed throughout the total number, and is necessary in order to make the ends of the sections coincide when connecting up the total number.

(B) The coil will send up to the distance you name.

(C) The transformer will take the place of the two inch induction coil and is recommended wherever possible. There is very little difference in the price as you can get a 250 watt transformer for about $30.00 and the finished induction coil would cost fully this much. We would not recommend a homemade transformer.

DESIGN OF A SMALL WIRELESS SET.

Questions.—(A) What size induction coil will be necessary to send up to four or five miles? (B) What power dynamo will be needed to operate the coil? (C) Would the power obtained from a water motor on a faucet in a city house be powerful enough to run the dynamo? (D) A relay of how many ohms will be necessary? (E) What size wire would be best for wiring the outfit?—M. K. R., Philadelphia, Pa.

Answers.—(A) As an estimate we would say that a three-inch induction coil would cover the distance named.

(B) The dynamo is not a necessary piece of apparatus. Dry cells can be used to operate the coil and are recommended as being cheaper and easier to handle.

(C) Water motors and dynamos are built to work in conjunction with one another by a number of manufacturers, and we would advise you to write them direct as they can give you a much better answer.

(D) For a distance of five miles the 150 ohm relay will answer. For better results, however, we would recommend the polarized relay as described on page 188 of the July issue.

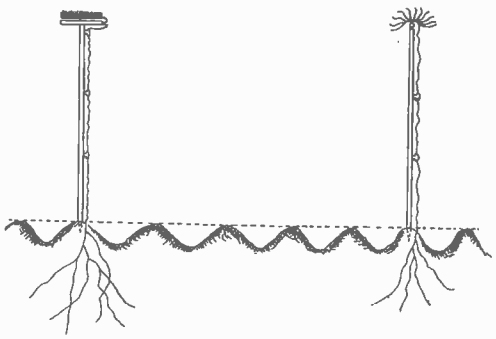
(E) Almost any size you have on hand will answer for wiring the instruments. No. 16 or 18 annunciator is usually employed.

NEW ELECTRICAL INVENTIONS

SOIL TREATMENT BY WIRELESS WAVES.

Probably the most unique system yet devised for increasing plant growth by electricity has just been patented in this country by Porfirio Diaz of Mexico, Mex. The utilization of high voltage, high frequency current is known to effect the assimilation by plants of atmospheric nitrogen. To effect this result Mr. Diaz uses Hertzian waves (the ether waves by which wireless telegraphy is accomplished) in a novel way.

In the middle of the field he sets up a



SOIL TREATMENT BY WIRELESS.

wireless transmitter somewhat similar to a wireless telegraph transmitter. This instrument projects the high frequency waves out in all directions. He also provides a parabolic reflector for the purpose of concentrating these waves at any point. This reflector is also a product of experiments by other inventors in wireless telegraphy and it serves to concentrate the ether waves into a "beam" the same as a searchlight reflector converges light waves.

At different points about the field aerial grounded wires are erected as in wireless telegraphy and the operator directs his "beam" of high frequency wireless waves on first one and then another of these aerials. The waves are thus directed to the earth at numerous points about the field causing, it is said, the nitrogen component in the air to combine with the potash, soda and lime in the soil to form nitrates, which are very necessary to plant growth.

ELECTROPLATING ON GLASS.

In the manufacture of various articles that are silvered, it is advisable to deposit a protective coating of copper over the film of silver to protect the latter. One example is in the manufacture of certain

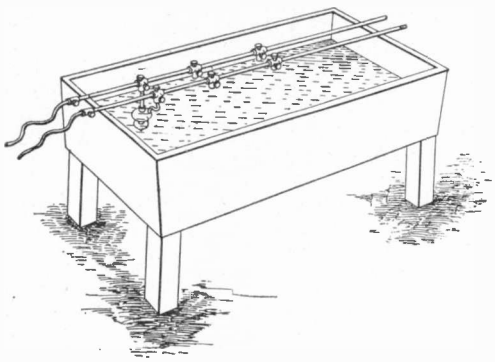


FIG. 1. ELECTROPLATING ON GLASS.

kinds of incandescent electric light globes in which the upper half of the globe forms a silvered reflector. John A. Yunck of South Orange, N. J., has patented such a system as shown in the diagrams.

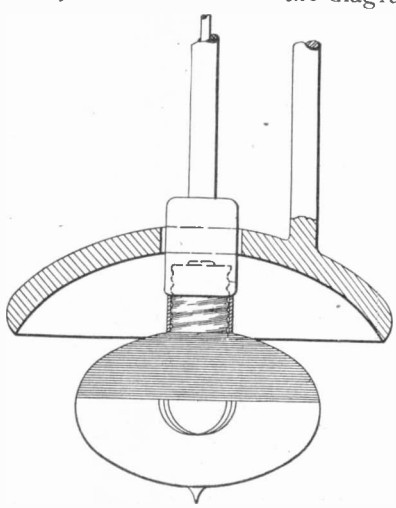


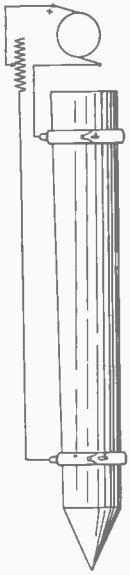
FIG. 2. ARRANGEMENT FOR ELECTROPLATING LAMP BULB.

He makes the lamp (Fig. 1) with its silvered top one electrode in the plating bath, it being supported in the bath from the cathode wire as shown in Fig. 2.

Over this is a canopy of solid copper which is connected to the anode wire, but which of course does not touch the cathode. A plating solution of copper sulphate is used and when the current is turned on the copper deposits from the canopy shaped anode, evenly over the top of the globe on the silvered portion.

ELECTRIC PROTECTION AGAINST THE TEREDO.

In certain localities where piles and other woodwork are submerged in sea water the teredo worm and other forms of animal life attack the wood and destroy it in a very short time. The object of an invention recently patented by William Howe of Seattle, Wash., is to prevent this destruction by electric means. His method is to connect the two terminals of a source of current to the two extremities of the pile as shown in the cut. The wood impregnated with salt water forms a conductor and the current flows through.

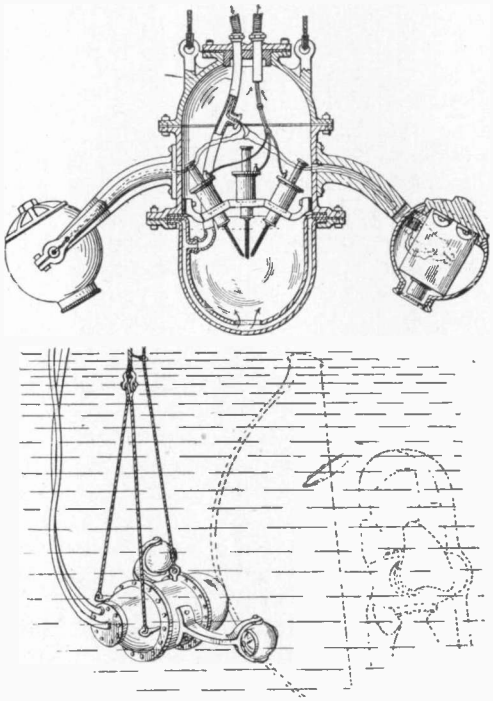


ELECTRIC PROTECTIVE DEVICE.

It has been proved by experiment that teredos which have infected the pile will die when subjected to a high amperage and voltage in the manner shown, either by the heat or by the electric current. The water around the pile is heated and the saturated wood which may be perforated or eaten by the teredo probably attains a greater heat than the surrounding water, thus killing the teredo.

ELECTRICALLY OPERATED CAMERA FOR SUBMARINE PHOTOGRAPHY.

An interesting apparatus for taking photographs at great depths of water, the invention of Louis E. Walkins, Brockton, Mass., is shown in the diagram. As seen in the upper half of the cut there is a casing of steel and glass containing the electrodes of an arc lamp. The conductors feeding the arc lamp pass down from the boat on the surface through two tubes which also bring air into and out of the casing.



SUB-MARINE CAMERA.

The spherical end of the casing is of glass and is held up against the hull of a ship or other submerged object as shown in the lower half of the illustration.

Two arms extend out from the casing as shown and carry small water tight camera cases, the exposure of the plates being made through glass lenses. The operation of the shutter and of the plate magazine is accomplished by a simple electromagnetic device controlled by wires from above.

It is not essential that an arc lamp be used, as any other powerful electrical illuminant will serve, for example a new type of mercury vapor lamp recently perfected by this same inventor.

BOOK REVIEWS.

HARPER'S ELECTRICITY BOOK FOR BOYS. PART I. By Joseph H. Adams. New York: Harper & Brothers. 1907. 407 pages, with 274 illustrations. Price, $1.75.

What active and intelligent boy does not have a new world opened to him the moment he begins to experiment with electricity? There is just enough of the mysterious to arouse his desire for discovery, and ample opportunity is presented to satisfy his desire for constructive work. The "Electricity Book" is one that he will devour eagerly, for it shows him what he can do with his own hands, and how he can accomplish results with inexpensive materials. The book also contains a chapter explaining briefly and in simple language the working of electricity in its daily applications and an appendix of electrical terms and phrases.

How to make simple batteries, induction coils, burglar alarms, telephones, wireless telegraph apparatus, dynamos and motors, how to do electroplating and electrotyping, how to make electrical insect and animal traps; these are but a few of the hundreds of interesting and instructive things that a boy may learn to do by studying this book. It is safe to say that if a work of this nature had fallen into the hands of Thomas A. Edison when he was a newsboy on the Grand Trunk Railway he would have performed every experiment described in its pages.

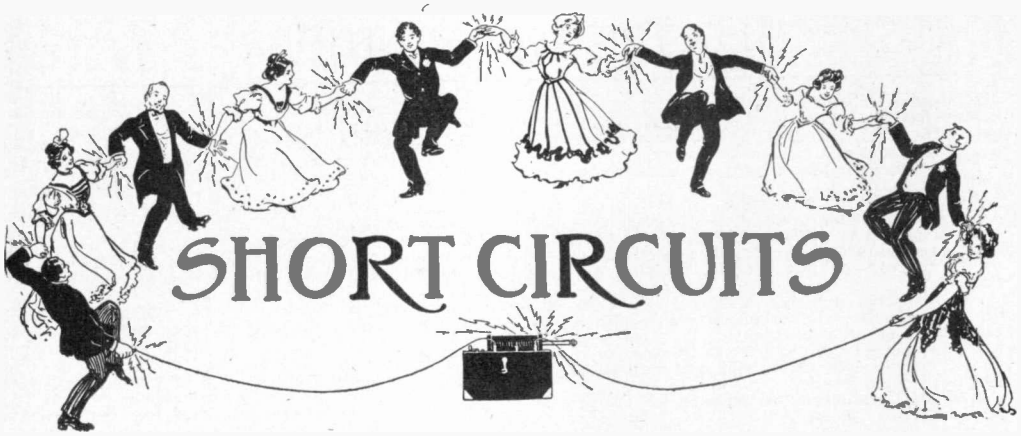
THE WONDER BOOK OF MAGNETISM. By Edwin J. Houston, Ph. D. New York: Frederick A. Stokes Co. 1908. 325 pages, with 77 illustrations. Price $1.50.

The "Wonder Book" is rightly named, for it presents a more or less difficult subject in a way that is not only instructive but at the same time interesting. Fairy tales are even introduced where they will throw light on difficult portions. The author of this work is well known to the readers of Popular Electricity through his series of articles on "Elementary Electricity." He is the favorite writer and a personal friend of thousands of boys, and though 64 years of age is known as the most "popular" boy in Philadelphia. Who else would have thought to introduce the subject of "Magnetic Flux" by connecting it with the story of the invisible attendants in the palace of "The White Cat," or to illustrate the flow of magnetic lines of force in a magnet by the story of the "Blowing Servant of Fortunio." This is the secret of the popularity of his works for young people—the faculty of presenting his subject in an easy style that instantly places him in sympathy with his readers.

The "Wonder Book" describes lode stones, magnets "that remember," how magnets produce magnets, the ways of magnetism, the cause of the earth's magnetism, magnetism and magic, auroral light—in short it describes as vividly as pen can describe the invisible wonders of the mysterious world of magnetism that lies all about us. One need not be a boy to find this book intensely interesting.

SELF-PROPELLED VEHICLES. By James E. Homans, A. M. New York: Theo. Audel & Co. 1908. 598 pages, with 500 illustrations. Price, $2.00.

This is a practical treatise on the theory, construction, operation, care and management of all forms of automobiles. The motor vehicle is a complex machine and the study of its operation constitutes in itself a good education in mechanical art. Although a library of books would be required to answer every question that could arise to the practical automobilist the work under consideration, as a convenient guide book to the intricacies that are almost inevitably puzzling to the owner of a car, fills an important place in automobile literature, and its practical value is unquestionable. The subject readily permits of classification, as, for instance the motor carriage, transmission of power, steering gears, tires, engines, carburetters, etc. A considerable portion of the book is devoted to the general principles of electricity as applied to electrical vehicle construction, dynamos and motors, meters, batteries and battery charging, etc., and the steam engine, as applied to automobiles is also discussed in a separate section.



A little girl who had listened to a discussion of nature fakers in literature, when asked to define the human and animal families replied:

"A brute is an imperfect beast; man is a perfect beast."

* * *

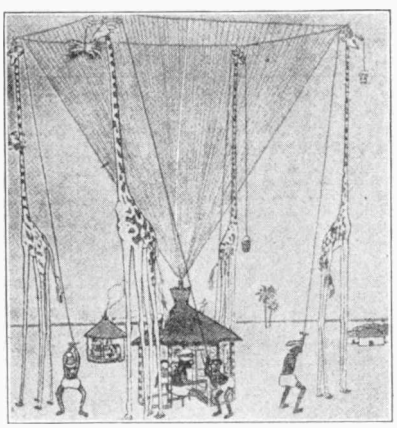
Husband—"Where in thunder did you get that coat? It fits you like a potato sack."

Wife (delighted)—"Does it really, dear? I was so afraid it wouldn't be quite up to the style."

* * *

"If you didn't take so much interest in horses you would be better off!" snapped Mrs. Growler. "You have had horses on your brain all your life."

"I guess that is how I happened to marry a nag!" retorted Mr. Growler, his face ambuscaded behind his sporting paper.



WIRELESS IN AFRICA.

A medical student who prided himself on being a humorist was running down the steps of the hospital which he was "walking" when he met a fellow student. "Hello, Brown!" cried the latter, noticing that his friend looked pleased. "You're in a hurry. What's the matter—any good cases?"

"I should think so!" cried Brown. "We've got a woman in the ward upstairs who is so cross-eyed that the tears run down her back!"

"Bless me!" said the friend. "You can't do anything for her, can you?"

"I should think we can—in fact, we have," cried Brown; "we've treated her for bacteria!"

Doctor—"Are you still smoking?"

Patient—"Yes."

Doctor—"How am I going to do anything for you while you persist in that?"

Patient—"That's what I'm paying you to find out."

* * *

"Mamma, is the old black hen going to be sent away for the summer?"

"No, Tommy; but why do you ask?"

"Well, I heard papa tell the new governess that he would take her out riding when he sent the old hen away for the summer."

* * *

The rich old man with a young wife was having a hard time trying to make her coincide with his idea of what her duties were with reference to himself.

"Madam," he exclaimed, after a heated argument, "I tell you I shall mold you to my will."

"That's easy enough," she retorted. "Only make it in my favor, and I'll attend to the balance."

* * *

Agitated Young Bridegroom (immediately after the ceremony)—"Serena, shall—shall—shall I—shall we—shall we kiss?"

Self-possessed Bride (her third experience)—"It is my usual custom, William."

* * *

"Maria," remarked Mr. Slugwater, the prominent cloak manufacturer, "I have brought you home a garment from our stock for you to wear. It is out in the hall."

"It may interest you to know, Jonathan," replied his better half, handing over a bill for $294.92 for a new tailor made walking outfit. "that I married you for your money and not to increase your trade." And Jonathan went out by the banister and kicked himself till the ambulance arrived.

* * *

Doctor—"Well, my fine little fellow, you have got quite well again. I was sure that the pills I left you would cure you. How did you take them, in water or in cake?"

Tommy—"Oh, I used them in my blow gun."

* * *

Aunt Maria—"I think you and Mr. Mann ought to get along nicely together. You know you both like the same people."

Matilda—"Yes, and, what is better, we hate the same people. Just think what nice long talks we shall have together."

* * *

Jackey—"When you were in Ireland, did you kiss the blarney stone?"

Miss de Mure—"No."

Jackey—"Why not?"

Miss de Mure—"I was too modest."

Jackey—"Too modest to kiss a stone?"

Miss de Mure—"No. Too modest to be hung over the castle walls by the heels."

* * *

Sister Ann—"Did you get any marks at school terday, Bill?"

Billy—"Yus; but they're where they don't show."

ELECTRICAL DEFINITIONS.

Accumulator.—Storage 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.

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.

Branch Conductor.—A parallel or shunt conductor.

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 out-going 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.

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 for changing the direction of electric currents.

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.

Diamagnetic.—Having a magnetic permeability inferior to that of air.

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.

Electroscope.—Instrument for detecting the presence of an electric charge.

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 or system.

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.

Galvanometer.—Instrument for measuring current strength.

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.

Multiple Circuits.—See parallel circuits.

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.—Space between the two electrodes of an electric 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.

Voltage.—Potential difference or electromotive force.

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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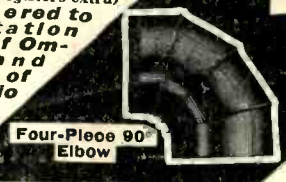

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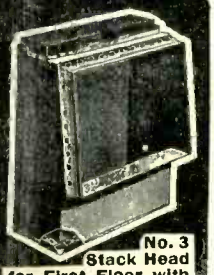

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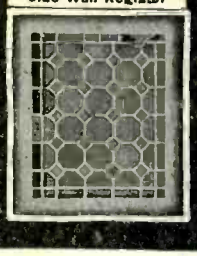

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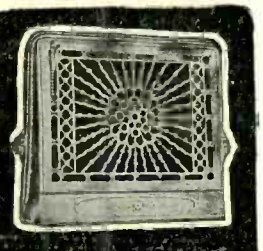

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