Practical Electrics

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January 1923

EDITED BY H. GERNSBACK

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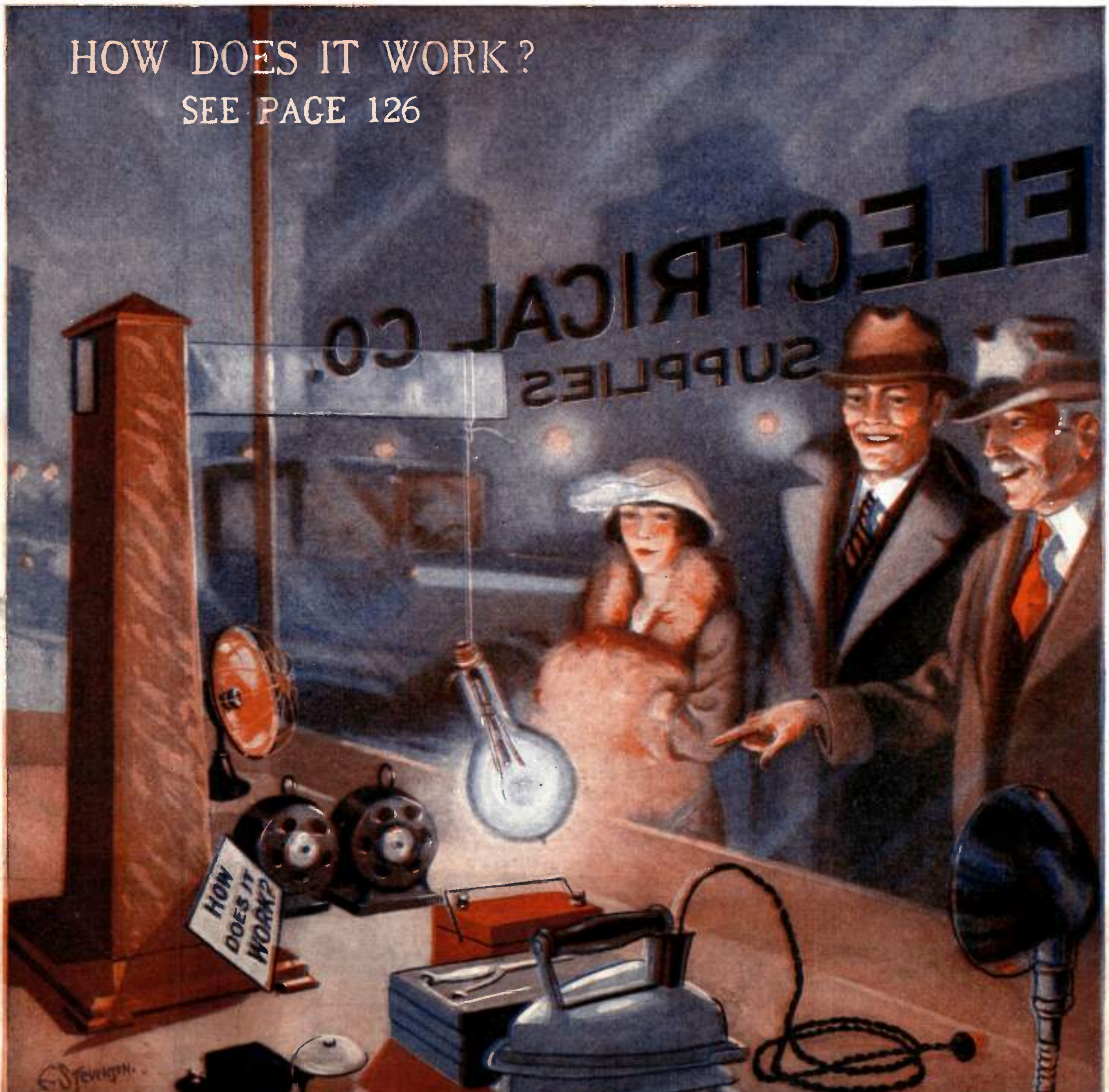

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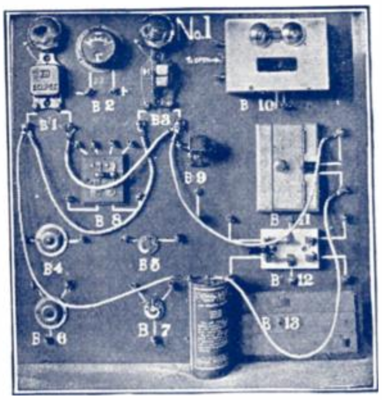

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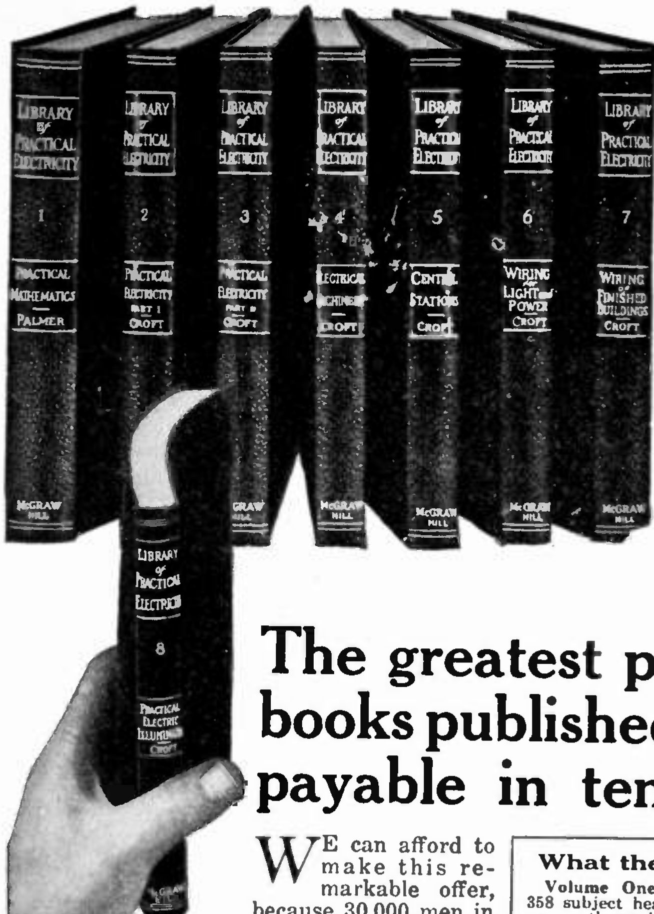

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Practical Electrics

VOL. 2 CONTENTS NO. 3

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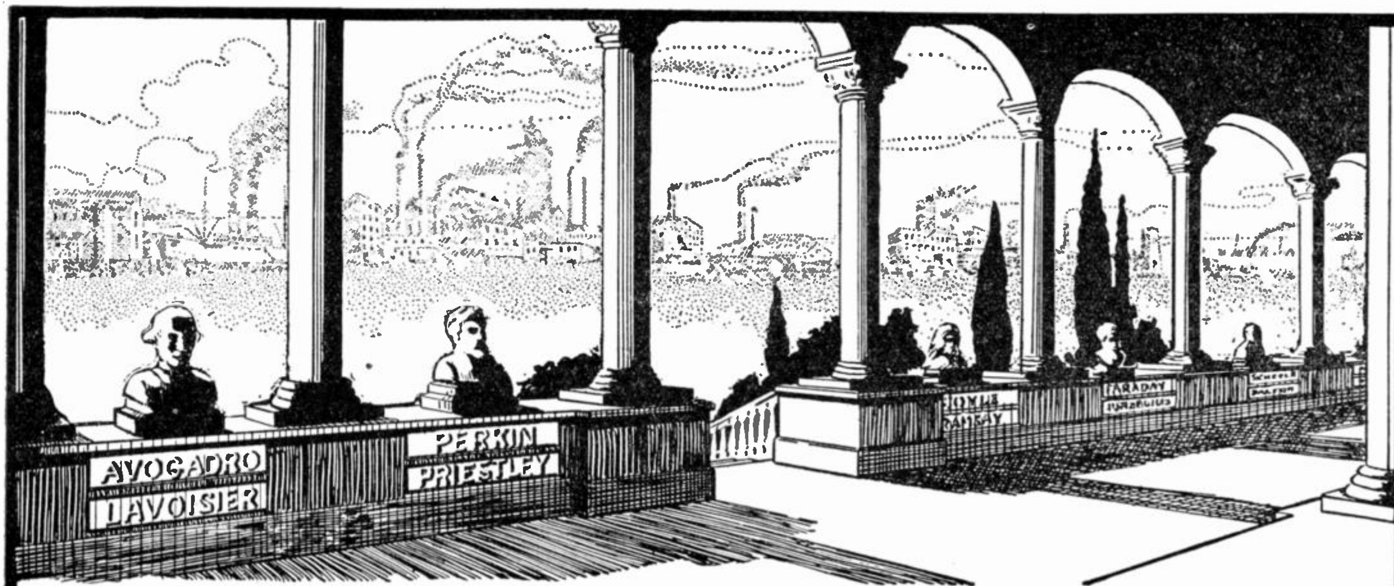

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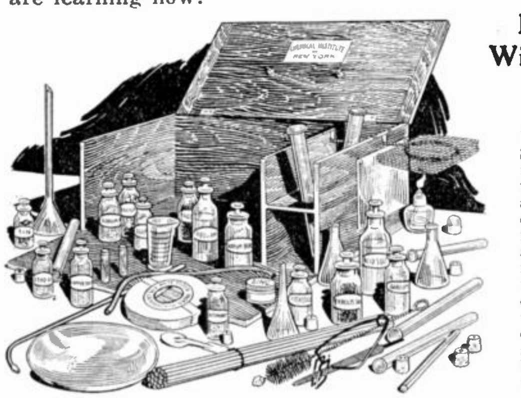

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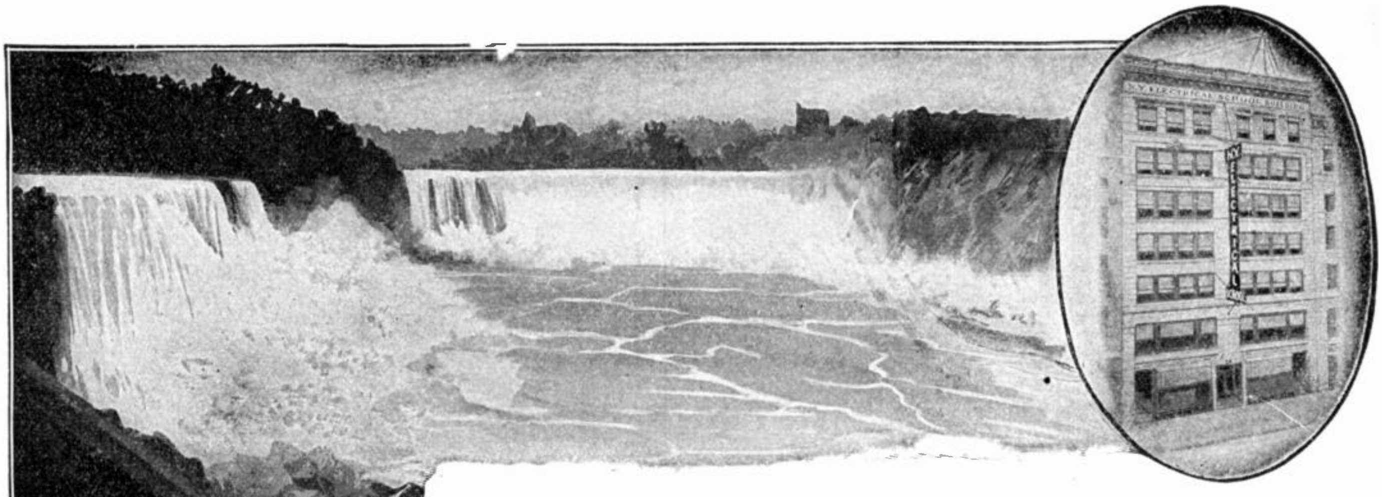

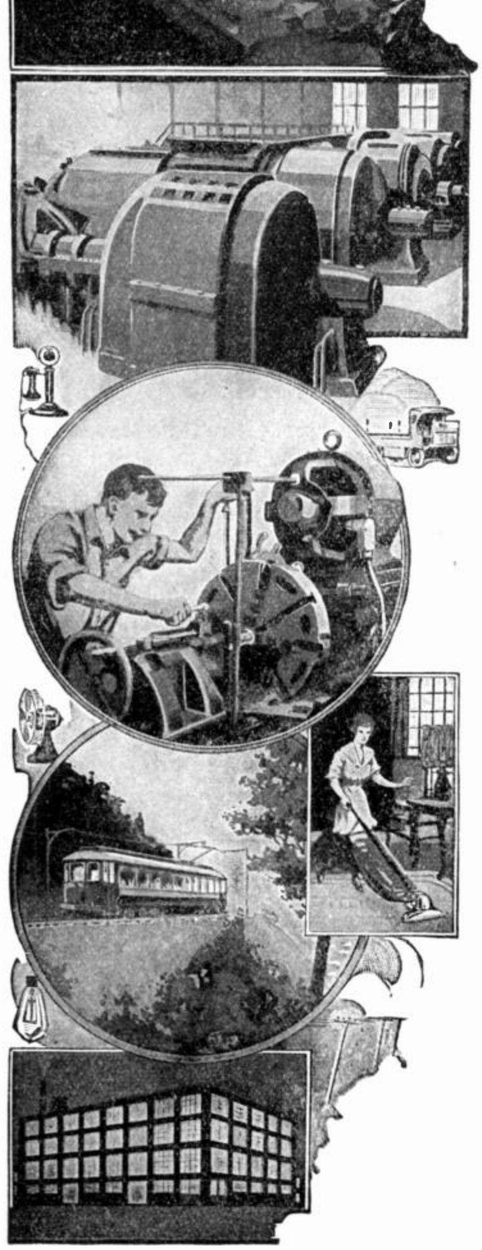

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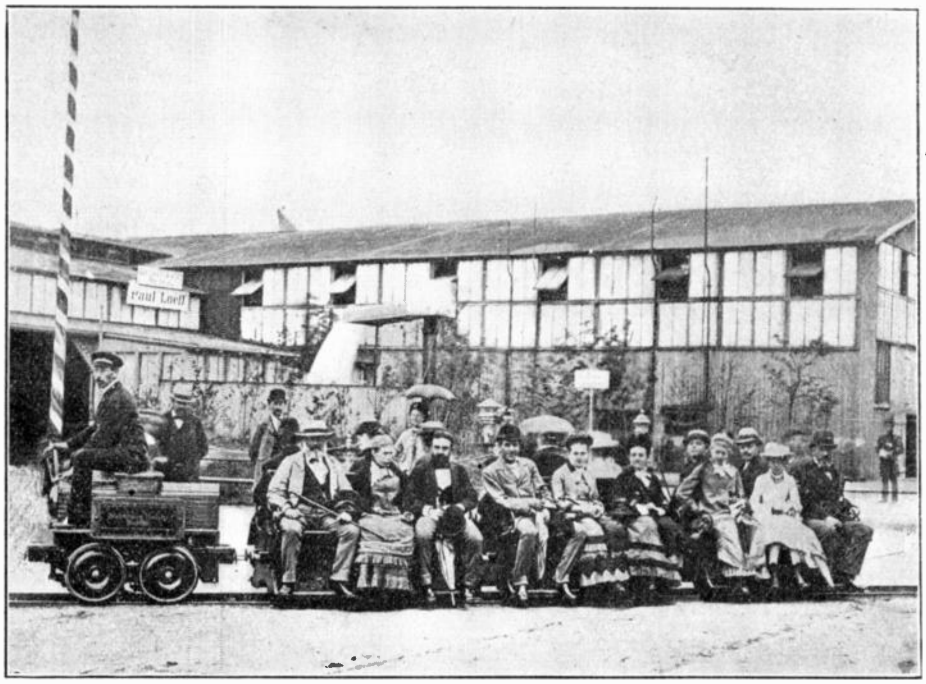
Volume 2
No. 3

Practical Electrics

January
1923

H. Gernsback, Editor and Publisher T. O'Conor Sloane, Ph.D., Associate Editor

Old and New Electric Railroad



The old Siemens & Halske electric railroad of 1879, an interesting reproduction of a contemporaneous photograph. The costumes of the occupants of the primitive char-a-banc or dos-a-dos car, testify to the authenticity of the photograph.

ONE of the greatest names in Germany in the field of electricity and metallurgy is Siemens. The regenerative furnace revolutionized the operation of the open-hearth type of furnace, and led directly to the production of open-hearth steel. The furnace was that of Siemens, and the logical outcome of it was the Siemens-Martin process for producing that kind of steel. It was the only rival of the Bessemer process.

The Siemens two-pole or spindle armature antedates the Gramme ring. We have already illustrated some old electrical railroads of this country, and in this issue our readers will see a reproduction of the Edison electric locomotive of 1879.

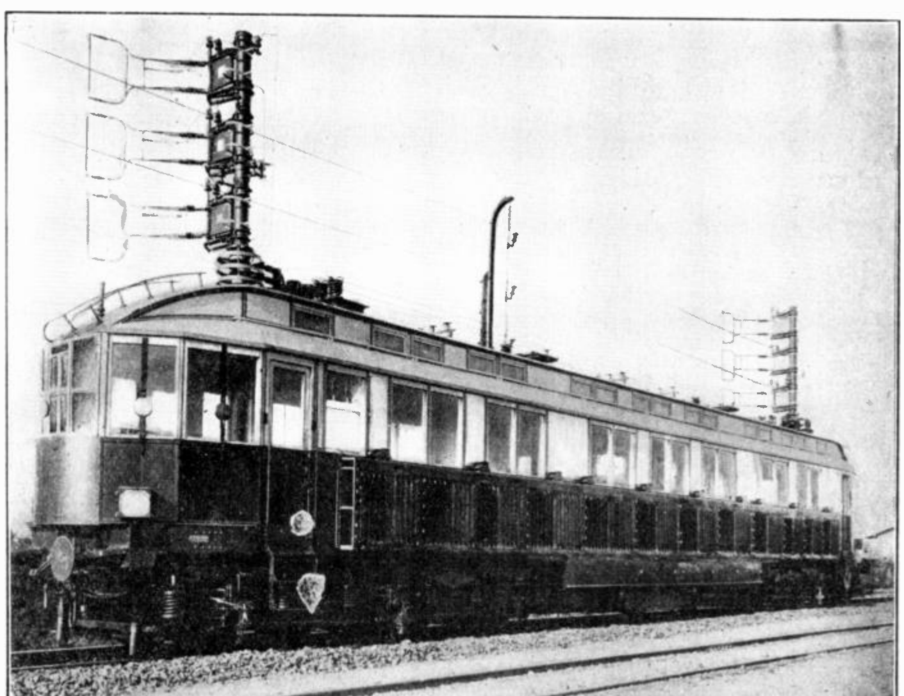
One of our illustrations shows an electric railroad, practically a contemporary of the Edison locomotive; it was due to the firm of Siemens & Halske, and dates back to 1879. In it we see the miniature tractor engine, exactly like the Edison engine, pulling a load of nearly twenty passengers. Undoubtedly the model's speed was very moderate.

Then coming down to recent times, our other illustration shows one of the most recent developments in high-speed railroads. It is an overhead trolley car, which is said to be capable of making over 130 miles per hour. Like the miniature train of 1879, this is the product of the firm of Siemens & Halske. The triple-wire power line with the three horizontal trolley bows give it a very distinct character. Much attention has been given to high speed electric transit in Germany, and this is one of the last products of German electrical engineering.

Both these illustrations show what is being done in Germany, and what was done there in the early days of electric progress. Elsewhere we illustrate some of the achievements of Thomas Alva Edison, who possessed the wonderful faculty of being an initiator of great things in the world of great inventive achievement. At Menlo Park in 1879 he had a model electric railway in operation, with an engine similar to the little German one illustrated in the first of these reproductions, which carried passengers over the New Jersey fields.

We illustrate elsewhere the original Menlo Park Edison engine, exhibited in the Electrical Exposition in the Grand Central Palace, New York. Fortunately, the old engine has been preserved as a monument of early achievement.

Coming to the present day, America is leading the world in the development of electric traction. The great engines on the St. Paul route draw the Pullman trains over the grades of the Rocky Mountains, and the electrification of the suburban roads about New York has already reached great development, and more is impending. Soon central power stations developing a horsepower for every pound or two of coal consumed per hour will take the place of the extravagant locomotive, burning five to ten times the amount per unit.



A modern high speed trolley car of German construction. The lateral connection with the three power lines is especially to be noted as an interesting feature. It is said to attain a speed of 130 miles an hour.

Electric Motor-Driven Camera

THE usual moving picture camera is operated by hand, the photographer not only keeping it pointed in the right direction, but turning the crank at as even a speed as possible, so as to keep the film in motion. As the crank turns, the film is moved intermittently and receives exposures, 16 to the foot. The film gives the negative from which the positive films for projection are made.

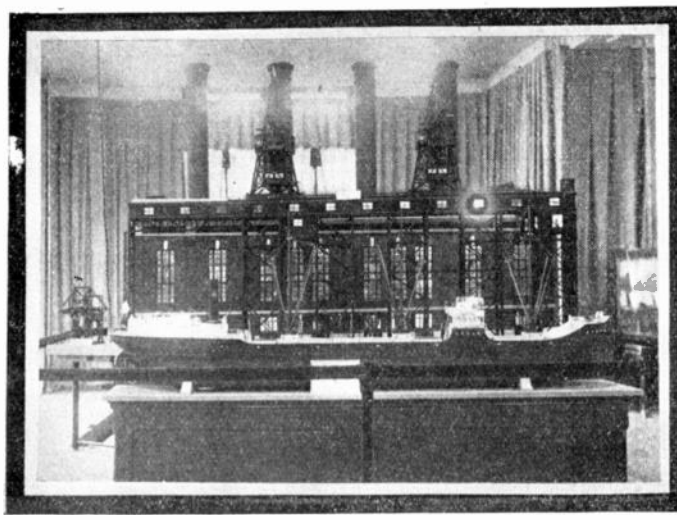
In former times the moving picture camera was also operated by hand, and the operator would have to turn his crank perhaps for an hour or more without intermission as he ground out the pictures.

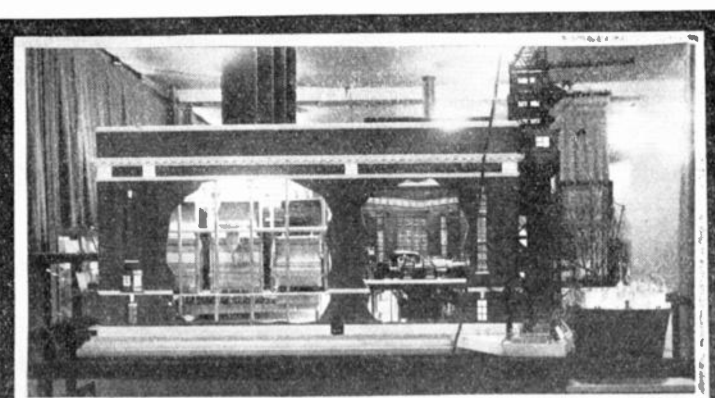
In all advanced establishments this is done away with and the projection machine is driven by electricity. This not only makes the operation of the machine more even and better, but relieves the operator from quite exhausting labor.

The illustration shows a moving picture camera for use on an aeroplane. There is a special difficulty in operating a hand-operated moving picture camera from an aeroplane, on account of the vibration. Regularity of feed of the long film is an essential to good work. The one we illustrate is driven by electricity, so that all the photographer in the aeroplane has to do is to point it in the right direction and let electricity do the feeding of the film.

A motor-driven camera, shown as in use by the well-known aeronaut, Frank Harris, for photography from a moving aeroplane. It conduces to regularity of speed of the film, a very important point.

Model of New Hell Gate Power Station





Left—Front view of a model electric power station, with a ship lying in front of it for discharging a load of coal.

Above—View of the rear of the model where the wall is cut away in order to show the interior.

A VERY perfect model of the last addition to the great power stations of the city of New York has been recently constructed and placed on exhibition in this city. This station embodies all the latest refinements in electrical power production and in the mechanical engineering details as regards transportation of coal, distribution and feeding to the boilers, disposal of ashes and the like.

The model shows the outside and interior of the station, the walls being cut away in places to give a view of the latter. It is said to be the last word in construction and equipment, and has been operated for about a year, supplying light and power for a great part of the city.

It is situated on the water front, where the depth is sufficient to float a 10,000-ton ship, and in the model an ocean freighter is represented as lying in front of the station, ready to deliver its load of coal.

Of course, much of the coal will be delivered in barges, but sea-going barges are now so large that they need the same accommodation as the average tramp steamer.

A very striking feature of the up-to-date electric light station, and one which would be unanticipated by most people, is that its appliances and even the entire plant all seem very simple. This is far from true, for the appearance is quite deceptive. Everything in it is of the best possible construction and numerous refinements are carried out in every department. But these refinements are to a great extent hidden away. The general idea, of course, is to case-in everything as far as possible, to protect bearings and all parts from dust. The effect of this is that a modern dynamo is apt to have the most complicated portions of its mechanism hidden from the observer. Another feature is that units are repeated over and over again, there not being a succession of various ones to anything like the same extent that was seen in the old-fashioned gas works. The writer well remembers the impression of almost emptiness produced on him upon going into a modern electric power station many years ago. This was in the early days of modern electric development.

Another striking feature is the small number of men to be seen. Electrical machinery and steam turbines in a certain sense have the faculty of taking care of themselves, and the modern electric station, with all its automatic machinery, including mechanical stokers, machinery for the disposal of ashes and the like, in a certain sense impresses the observer as a sort of solitude.

This is said in view of the fact that this very model impresses the observer strongly with the small quantity of machinery needed to deliver its enormous horsepower. The absence of the figures of workmen, notable in the model, really carries out the actual state of affairs, that few men do so much by the use of advanced electric machinery.

Basement Door Switch

A door switch operated by a plunger, lighting and extinguishing a basement lamp as the door is opened and shut.

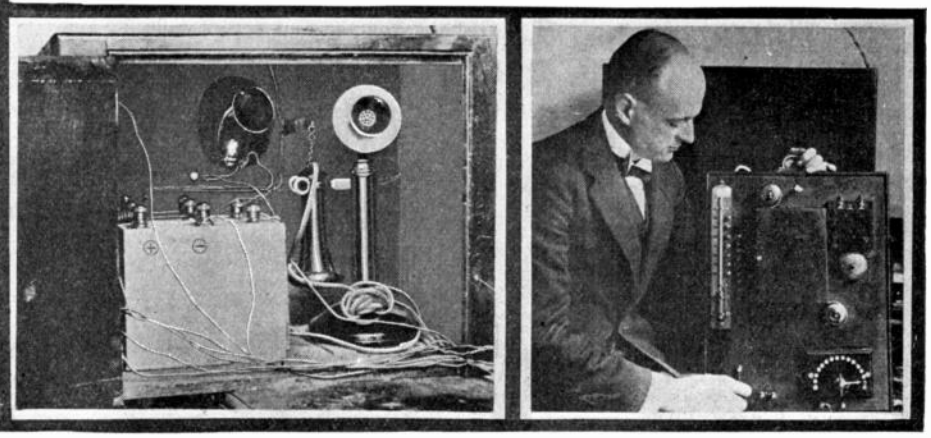
IT seems that people are addicted to leaving cellar lights burning, closing the door and forgetting all about it. In this way considerable kilowatt-hours may be lost which have to be paid for.

The object of the switch, which is illustrated in the accompanying illustration is to prevent such an occurrence. The switch is fastened to the jamb of the door and from it projects to the left, as shown in the illustration, a plunger. When the door closes the plunger is pressed in; this pressing in of the plunger opens the circuit, so that as long as the door is closed the light will be out, thus saving an effort of the memory, and incidentally operating to cut down the waste of power.

When the door is opened, the plunger springs out, closing the circuit and lighting the lamp.

It may be that the occupant of the house may not wish the lamp to be lighted when the door is opened, so a switch handle is provided by which the light can be definitely turned off so that the lamp will not be lighted when the door is opened.

Telelarm System



An alarm system for protecting houses electrically, actuated by a thermometer affected by fire, the switchboard and appurtenances and apparatus back of the switchboard are seen in the left.

IN England, what is known as the Telelarm system, a hybrid word meaning distant alarm, is being introduced, it is said, with considerable success, and with the approval of the insurance companies.

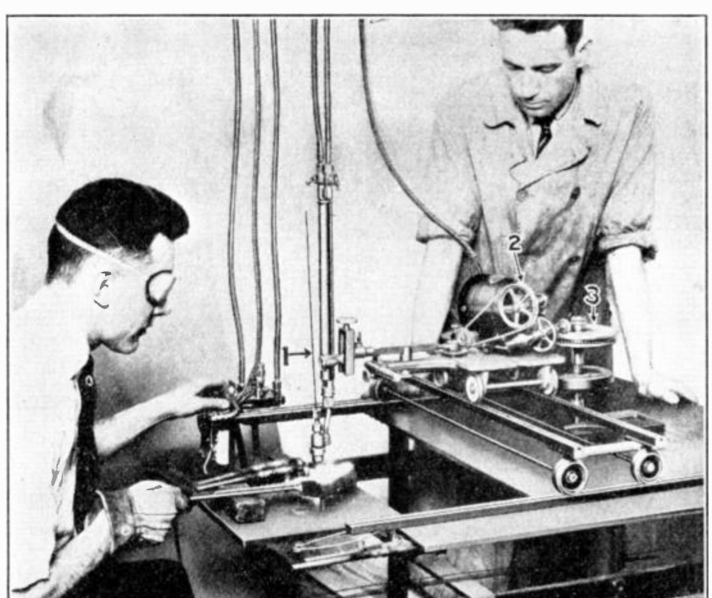
It is two-fold in action; a thermometer, in case of fire, acts upon the circuit and transmits an alarm to a fire department station, while another section of the system is connected with the police headquarters and arranged to act as a burglar alarm. The burglar alarm circuit is a closed one, so that if the burglar attempts to secure a safe entrance by cutting the wire, the alarm sounds.

We are told that this alarm system is being installed in many of the larger buildings, such as schools and the like, in England, although little is heard of it here in this country.

The alarm circuits may be run all over the building, leading to the central apparatus shown in the two illustrations, one presenting the switchboard and the appurtenances, and the other giving a view of the interior of the apparatus.

It certainly is a step in the direction of perfection, and is applied in a country where it is to be hoped they have fewer burglaries and fires than we have on this side of the ocean.

Automatic Welding Machine



An automatic welding machine moving the welding arc over the cut. 1, the wire fed to the arc. 2, the electric motor. 3, the regulating wheels.

THE electric arc, the oxy-acetylene flame and localized incandescence, all give the opportunity of applying intense heat to a very small area. This has made modern electric welding, as it is somewhat incorrectly called, a possibility.

In many cases the operation consists in melting a bar of the identical material over the joint to be welded, so that a true case of fusion results. When a bar of the same material as the pieces to be welded is used, it is called autogenous soldering, or when the material proper is made to give the base for operation, it is called autogenous welding.

All sorts of effects can be produced by different motions given to the welding flame. It may be carried strictly along the line so as to heat only a narrow strip of the metal. Its action may be laterally extended during a slow traverse, by moving the hot flame or arc in circles also; thus a path of an inch in diameter may be covered.

It is obvious that many effects can be produced, also that for high art in welding, as it may be called, the path must be very accurately controlled and regulated.

The illustration shows an electric apparatus which imparts any desired movement to the welding flame or arc. There will be seen a rod of welding material, indicated by a small arrow (1), pointing at it, which is let down to the flame. The appliance shown at (2) is the electric motor. It will be noted that all sorts of motions can be given by the motor to the welding point, the two railroads at right angles to each other, and the miter gear raising it almost to the dignity of the surface lathe.

The illustration shows the use of the electric arc as a soldering instrumentality, and it is shown joining a steel drop forging of varying thickness to a thick tubing. In this instance a wide weld is desired, and the arc was kept rotating in circles. The welding wire feeds by gravity.

We give elsewhere a most interesting article on arc welding such as is in use with this machine. The application of automatic feed makes the process peculiarly applicable to construction as distinguished from mending fractures. It is the electric successor to the well-known oxy-acetylene blowpipe still in use.

Edisonia

TODAY a marvelous development in the transmission of intelligence has taken place, and progress in it is so rapid that the imagination can hardly keep pace with it. What are supposed to be ether waves are radiated through space. They rapidly lose in energy per given radius of progress, yet after traveling three or four thousand miles diminishing in amplitude for every mile are virtually magnified by the marvelous vacuum tube, so that they can be received by a telephone and appreciated by the human ear.

The fundamental action of the vacuum tube is based on what is known as the Edison effect—which is the name for the conduction of a current of electricity by electrons in the vacuum tube with its ignited filament. This discovery of the electronic conductivity of the residual atmosphere in an exhausted bulb, with an incandescent filament, is the basis of modern wireless transmission and reception.

The modern electric light is, it is fair to say, based upon the ignition by a current of electricity of a metallic filament. When the mechanical generation of electric power became a reality, the application of electricity to illumination was seen to be a possibility. There was great agitation among the gas engineers and capitalists, for fear that electricity would ruin their business. One of the great points made against the electric light was that it was said to be indivisible.

The production of a lamp of moderate illuminating power, if such could be produced and if a number could be lighted from one generator, implied the desired achievement of the subdivision of the electric light. In other words, a substitute for the too powerful arc light was needed. The first attempt which attained any degree of success was a metallic filament bulb lamp using platinum as the material for the filament, and when platinum did not stand the work, a filament of carbon was substituted. These were some of the earliest steps in the history of the art, and Edison was identified with them all.

The small unit lamps placed across heavy copper conductors, the lamps all in parallel with each other, and each lamp getting within a few volts potential of that received by its neighbor, marked the sub-division of the electric light and enabled each lamp to be turned on individually without disturbing the others.

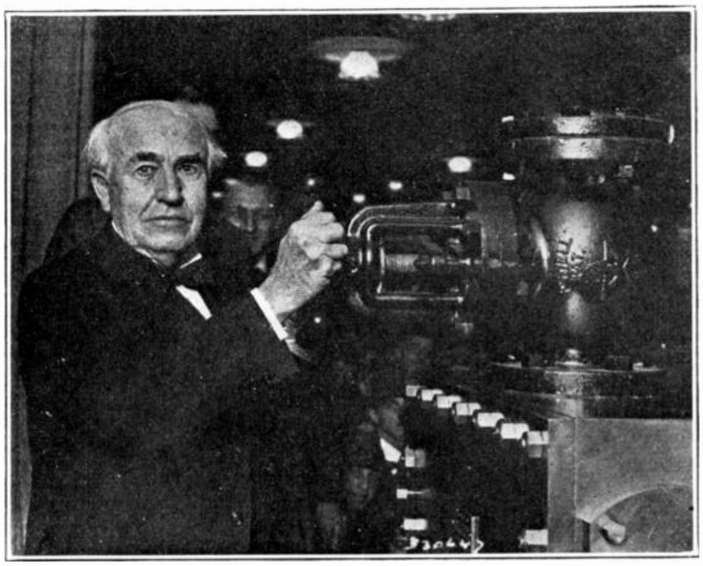
The essential feature of the system on which the whole circuit was based was a combination of low resistance conductors or mains, with high resistance lamps, placed in parallel across the mains.

The famous Pearl Street Station was identified with the Edison inventions, which after a lapse of over forty years, are still in use, tributes to his far-seeing inventiveness.

By using three conductors, with a maximum potential of 220 volts, divided in two for 110 volt lamps by the use of a central or neutral conductor, an economy in copper used for the system was effected. This was the famous Edison three-wire system.

We illustrate elsewhere a train of cars pulled by a miniature electric locomotive, representing the experiments with an electric train of 1879. At this time the Wizard of Menlo Park had such a railroad in operation there, and the original locomotive was exhibited at the electric exposition in this city recently.

There is a movement at the present day which it is fair to say is not fully realized, which is in the direction of substituting incandescent lamps for arc lights. The tungsten filament incandescent lamp at a moderate estimate is now of four times the efficiency of the old carbon lamp; and the little bulb but a few inches in height and diameter at the largest, has become a rival of the clumsy arc lamp with its mechanism and with the necessity for constantly replacing the carbons, and as a minor feature, the waste of carbon ends. It is interesting to note that Edison in the electric light field early identified himself with the incandescent light, showing comparatively little interest in the arc lamp. The arc lamp is soon to be a thing of the past excepting for very special uses. It is even being displaced in the moving picture projection apparatus by the high power, incandescent lamps.



THOMAS ALVA EDISON

There seems almost to have been a prescience in the inventor's mind in those early days of the advantage of the incandescent lamp over the arc lamp, and his preference was perhaps partly based on the fact that without a wasteful resistance in its circuit, the arc lamp cannot be used in parallel on a constant potential system.

Today we hear a great deal about the loud talker. The loud-speaking telephone with its horn is familiar to all. In the very earliest days of the telephone, Edison evolved his famous loud-speaking telephone, whose action was based on variations in frictional resistance between a strip of metal and a chalk cylinder saturated with caustic alkali solution. This receiver spoke in a very loud voice, the variation in the talking current affected the frictional resistance by the decomposition of the electrolyte, and the strips of metal were attached to the telephone diaphragm and caused it to vibrate. It was a loud speaker of the last century.

In the field of telephony, the great inventor was identified with the carbon transmitter or microphone, and his many inventions affecting the construction of this carbon microphone, did much to develop the art. In telegraphy the art of multiplex transmission over single wires, and the production of the so-called phantom wires, obtained for him a most distinguished place as one of the very originators of this phase of the art.

A generation has attained middle life since all these things were done. The great inventor is still working in his laboratory, still engrossed in the highest phases of invention, but the exhibit at the electrical exposition, some features of which we illustrate here, in spite of its age, seems like a romance.

During the war, Edison's services as chairman of the Naval Consulting Board led to very remarkable results. Against the traditions and hard and fast rules of the Navy, inherent apparently in the graduates at Annapolis, the great inventor applied the same trains of thought, which had evolved the electric lighting system now in universal use, the almost miraculous phonograph, and the innumerable inventions of which only a part have ever reached the Patent Office, and which fractional part exceeds the record of any other human being.

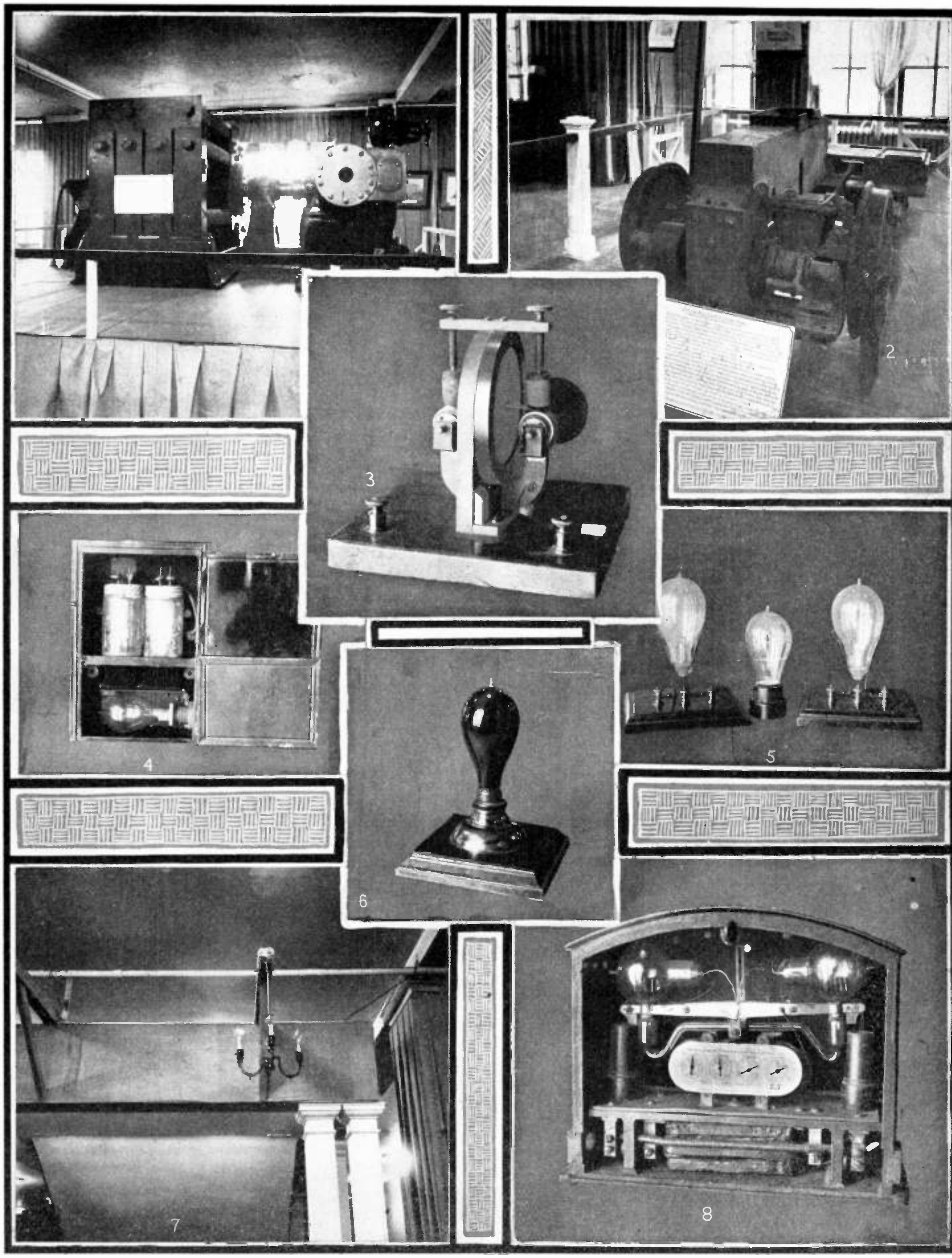
Our ships were being convoyed as they crossed the ocean; the great inventor camouflaged one of the ships, removing the smoke-stacks and smoothing the contour with a canvas screen, and the ship was invisible at a distance of six miles. She made trip after trip in safety, all alone, perfectly protected by the great inventor's method. She was then put into a convoy and escorted across the ocean by war vessels and on this first protected trip was sent to the bottom by a torpedo.

The smoke screen which interposed a dense mass of smoke between the vessels to be hidden and the enemy, reduced the protected ships to inactivity, for they could see nothing. Edison found that by painting the ships black and developing a smoke screen behind them they were completely hidden and yet had a perfectly clear field of vision for attacking the other fleet. He applied the sea anchor to suddenly turn a ship at a sharp angle so that it could escape a torpedo. Everything he did was marked with the inherent originality of his nature. Today he is working away early and late in his laboratory, as he did more than half a century ago.

The great inventor, as everyone knows, is afflicted with deafness. One story is that he considers this an advantage as it leaves him alone with his ever busy mind. He has seen the electric light system grow from his little Pearl Street Station in New York until the whole world is illuminated by the incandescent wire heated by the passing electric current. He has seen his tinfoil phonograph become the cornerstone of the enormous phonograph industry, and the great inventor was in the beginning of things in the moving picture industry. His work has been at the basis of much of the progress of the world in electrical and other ways, but his great mind does not know how to rest.

It must not be forgotten that he has done wonderful work outside of electricity, but it is the electrician who has to claim him as his own, for the Edison inventions in electricity have revolutionized the world.

The first carbon filament incandescent lamp burned through the night of October 21st, 1879, and the subdivision of the electric light was solved. The Pearl Street Station established 110 volts as the house voltage and this is standard today. Everywhere, Edison appeared as the originator.



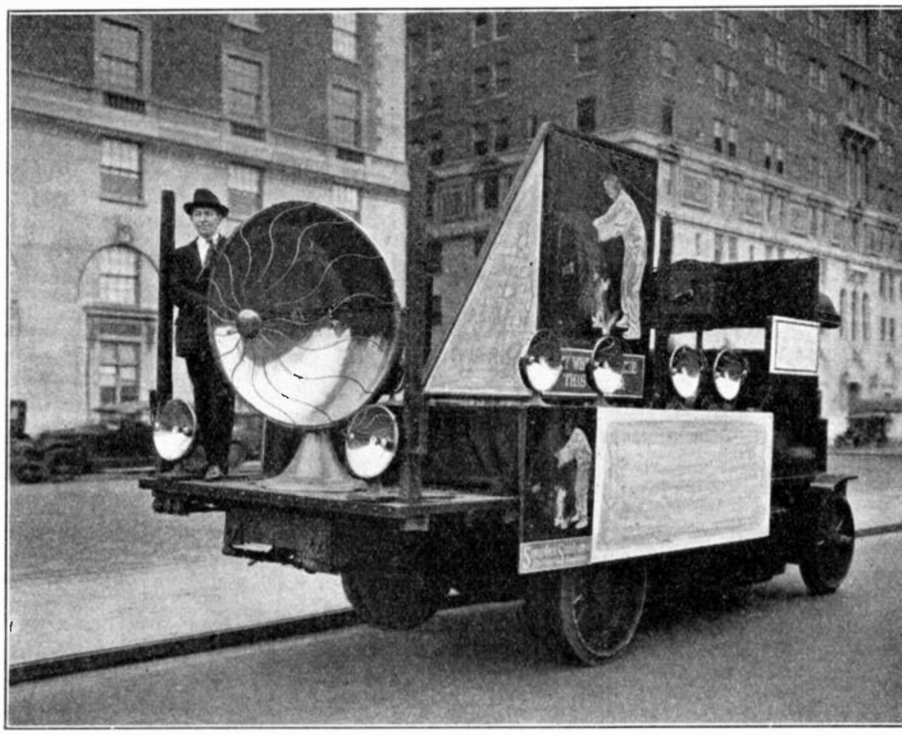
(1) End view of the Jumbo dynamo, one of those installed in the famous Pearl Street Station of 1882; a true relic, not a replica. (2) The original Menlo Park electric locomotive of 1879; this was operated by power conducted through the rails, and excited great interest. (3) The loud speaking telephone operated by electrolytic decomposition varying the coefficients of friction; the diaphragm was caused to vibrate by the pull of the horizontal strips, which were pressed against the electrolytic rollers. (4) Electrolytic meter; the change in weight by deposition or solution of zinc giving an accurate measure of the current consumed. The voltage being kept constant, this gave the watts. (5) The actual incandescent lamps, whose action led to the discovery of the Edison effect, now used in the vacuum tubes and amplifiers of radio communication; it is the basis of all modern radio work. (6) A famous incandescent ruby lamp which burnt continuously for 28 years. (7) A primitive gas light chandelier fitted with electric lamps, one of the very earliest examples of the electrolier, going well back into the last century. (8) An oscillating electrolytic meter indicating on dials the current passed. In this and Fig. 4 the reader will notice the incandescent lamps, used simply to maintain the temperature in cold weather, the current being automatically turned on and off in order to maintain the temperature.

Giant Electric Radiator

MANY have had occasion to notice an electric truck traversing the streets of New York, carrying on its rear end a gigantic electric radiator. It was intended to bring to the attention of the public the efficiency of a properly constructed apparatus of this type, which, as the reader knows, comprises two elements, one a heating coil which is brought to full incandescence by the current, and a polished reflector to reflect into the room the heat received from the coil.

The radiator on the truck, the size of whose reflector can be estimated by the reader from the illustration, is the largest ever made. The reflector has a diameter of four and one-half feet, and the coil takes 50 amperes of current, having a potential difference between terminals of 220 volts, so that it absorbs about 11 kilowatts, nearly 15 horsepower.

In all respects this monster radiator is a duplicate of the 6-ampere coil made for use in buildings. Numbers of radiators of this general type have been made, and the characteristic feature of the one thus demonstrated lies in the mounting of the heating coil. This is carried on a hollow porcelain core which as far as the heating portion is concerned is a truncated cone, with the base to the front. In this way a more complete reflection from the parabolic reflector is obtained, for when the coils are cylindrical it will be seen that the coils in the rear to a considerable degree cut off the rays from the front wires, while the conical disposition of the coil causes the rays from the front wires to reach the reflector much more fully than in the other case. The standard size is 12½ inches in diameter of reflector, the coil takes six amperes of current at 110 volts. From personal experience we find that it sends out a powerful shaft of radiant heat.


A novelty in advertising. A giant electric radiator was transported through the streets on an electric truck, whose batteries supplied it with power to keep its coils ignited.

The heat projected from the great radiator on the truck was perceptible in its intensity at a considerable distance, and certainly was a remarkable exhibition of what electricity can do. The power was derived from a storage battery.

Safety Switch

AS a general rule, when a switch on a heavy line is open the rule of "safety first" is supposed to be carried out. In other words, the accidental closing of a switch is one of the things to be guarded against. In regular practice this precaution is accomplished by placing the switch so that the handle has to be lifted to close it. In order to close it under this condition it has to be raised against the attraction of gravitation, and this is the general rule which is followed by engineers in placing switches on switchboards.

If a switch is pushed up so as to barely make contact, an arc may be started, so that for safety there are two things to be attained. One condition of safety is that when a switch is opened it shall stay so, and the other is that when it is closed it will be pushed well into the clips or other contact, so as to avoid anything approaching an arc; the latter may be caused by imperfect contact.

In the switch shown in the illustration, there is a special provision to bring about these results. Midway of the base a pair of brass strips are secured, and as the switch approaches its closed position these leaves come in contact with a wedge-shaped piece on the handle, which prevents the switch from closing or from touching the true contacts until it is somewhat vigorously pushed toward its base. By being pushed strongly toward its base the brass strips open as they strike the wedge, it is received between them, and as considerable force is required to do this, the switch is almost inevitably jammed back to its proper position. The electric contacts cannot touch each other until the wedge enters between these strips, so the strips and wedge protect it from accidental arcing contact, and if anybody attempts to close it the resistance offered by the wedge and clips is such that they are reasonably sure to use enough force to put it into its proper closed position. Simple as this idea appears, it is a mechanical protection of great efficiency.


A safety switch; before the switch closes it is caught by an elastic detent, so that some force is required to close it. In this way accidental closing, which is an ever-present danger about switchboards, is eliminated.

In the operation of the arc lamp, where the light is due to the ignition of the carbons by the heat produced by the arc proper, to start the lamp the arc has to be "struck," as the technical term is. This means that the carbons are to be touched together so as to start the current, and almost immediately drawn slightly apart so as to form a gap across which the arc will extend, and which space the arc will bridge. If a switch such as the one shown is lightly touched only to the contacts, it is obvious that there is danger of starting an arc, which may burn out the metal and do considerable injury if not immediately stopped. In the case of such a switch as this, it is the uncertain touch and light contact which will do harm.

Electric Whipper

WE have had occasion to illustrate in our columns a number of egg beaters, as they are usually termed, which, however, can be used for many other purposes—such as mixing mayonnaise, whipping cream, and the like. Most of these have been of rather small size, adapted for treating small amounts of material.

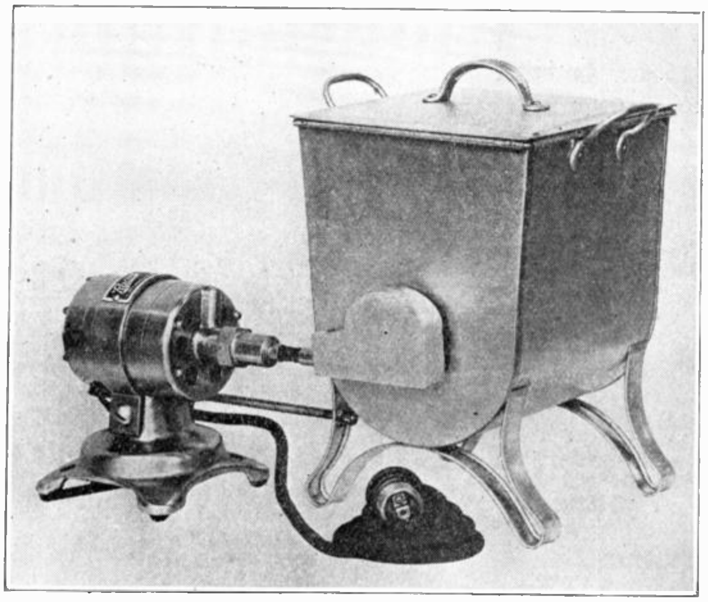
Our present illustration shows a large-sized one, a motor with axis at right angles to the axis of the beater drives it through beveled or helical gearing. By a flexible cord the motor is attached to a socket, and the mixing process goes on until the preparation has acquired the proper consistency.

If it were a question of beating eggs, it would be of interest to know how many could be got into the very large container shown.

Through the lower part of the receptacle a horizontal shaft extends which can be pulled in and out by hand and which, when withdrawn, remains attached to the gear and gear-case seen on the outside of the machine, all coming away together.

A rotary wire beater is contained within the machine, through whose center this shaft passes, so that it is the driving shaft thereof, and when withdrawn releases the beater so that it can be taken out and washed.

The motor is connected to the gear-case and removed therefrom by hand, simply introducing the end of its spindle into the gear-case. The smallest of the machines has a capacity of three pints, and the largest a capacity of eighteen pints. It never does to use an electric motor for one purpose only, so this motor is arranged to operate an emery wheel. It is built for a potential circuit of 110 to 130 volts direct or alternating current.



An apparatus for whipping cream, beating eggs and doing other things of like nature required in the kitchen.

Immersed Hot Plate

THERE is little of a striking nature which can be said about an electric hot plate, as most of them are constructed, and have to be constructed, on similar general lines.

The one illustrated is 7 inches in diameter and stands 3¾ inches high. The heating element consists of 36 inches of coiled wire, which is easily renewable. Its uses are obvious, as it represents a small stove.

What is illustrated is a demonstration of a somewhat striking nature, in carrying out which the whole apparatus is immersed in a glass vessel of water, and the heat is turned on—whereupon the water is heated and presently starts to boiling furiously. The demonstration is of an order which would fit rather well into our Elec-Tricks Department, as a store window demonstration and exhibit.

One of the peculiarities of an electric heater of the hot plate type is that it may be in full activity and yet show no evidences of it. The first striking proof of it will be when the current is strong enough to heat it to redness, but here we have an exhibition of the work done while at quite a low temperature, certainly much lower than that which obtains in the atmosphere. But the boiling water and the bubbles evolved from the heating coil are an excellent proof of what the apparently inert coil is doing. There is one heater made in which the heating element is brought to full redness and is enclosed in a transparent tube, to that it has the peculiarity that when immersed in water and heating the same, it still shows its incandescence, which no heating coil in direct contact with water will do.

An electric hot plate, whose action is demonstrated by immersion in water. The liquid is brought to a boil and steam is evolved copiously.

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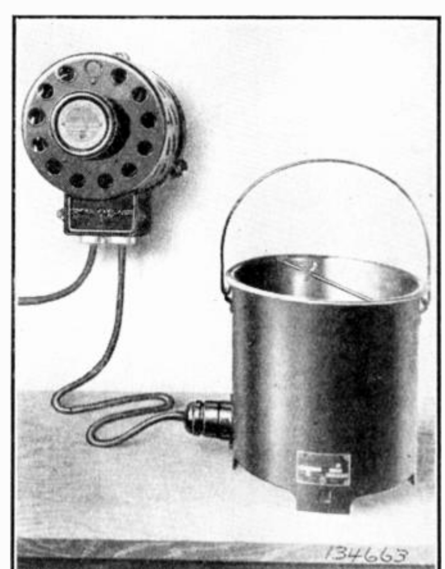
Electric Glue Pot with Rheostat

THOSE of us who have made glue over a gas flame in the familiar double pot, the glue receptacle being surrounded with water, have undoubtedly been troubled by too sudden boiling, if we neglected, as often happens, to turn down the gas flame a little. Boiling over can happen just as well with a double-electrical glue pot, but so perfect is the control over an electric heating coil that what is virtually a single glue pot, or one containing no envelope of water, can be used.

It is claimed that the dry type of glue pot has been demonstrated by practical workers to be superior to the old-fashioned wet one, with its liability to boil over, and with the additional complication that it upsets occasionally, spilling hot water on table and floor.

The glue pot illustrated is a double one, but contains no water, except that which is mixed with the glue in the interior compartment. The current for the heating coil goes through a rheostat of good range and many divisions, so that the heat can be controlled within very close limits. The rheostat can be disposed of in various ways; in the illustration it is shown screwed to the wall, but it can lie on the bench just as well. The user will find where to set his rheostat hand for different quantities of glue in the interior part. The distribution of heat applied by a heating coil is what makes the dry heating practical, there being no localization of intense heat, as is the case with a gas flame. The glue pot itself is of spun copper; the casing is of steel.

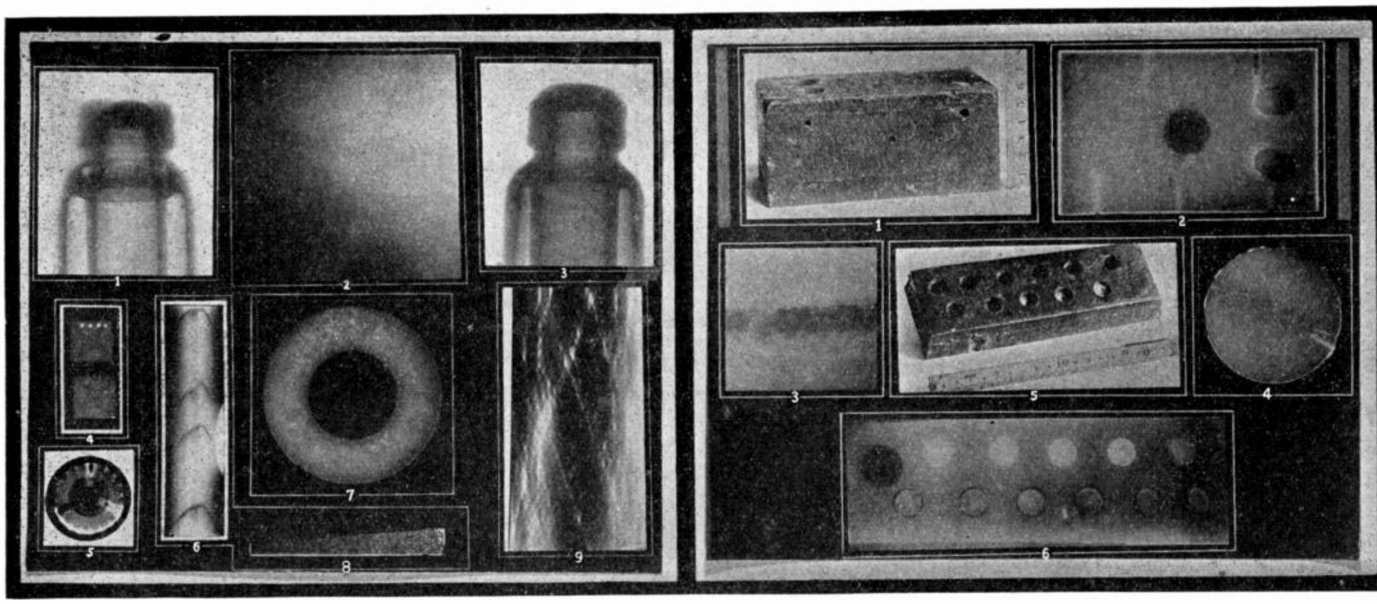


A glue pot which applies the heat to glue without the use of water, which is supposed to be a superior method, and which is rendered practical by the use of electricity.

X-Ray Diagnosis of Metals

By Dr. Alfred Gradenwitz

Berlin Correspondent, PRACTICAL ELECTRICS



Various examples of the application of X-rays for the detection of flaws in metals, notably those which are concealed within the mass of the material. It is possible to detect flaws in a bar of iron several inches thick, the pieces shown being from half an inch upward in thickness.

WHILE medical applications of the Roentgen ray at present constitute a science of their own, experimentation with regard to X-ray tests of metals may still be considered in its infancy. Although no one, of course, would question the suitability of X-ray methods for the detection of flaws, blisters and other defects, in fact, for the diagnosis of metals, there is still much divergence of opinion as to the scope and future possibilities of these methods.

At the London Congress of the Roentgen and Faraday Societies, in 1919, the general consensus of opinion, however, was that iron samples up to 55 millimeters (2¼ inches) and steel samples up to 40 mms. (1.6 inch) in thickness can be satisfactorily examined by means of the Roentgen ray. When taking into account the best work so far done in this connection, the following data will be seen to limit the present scope of X-ray metallography, at least in the case of iron and steel:

Iron samples up to 50 mms. (2 inches) thick can be successfully tested with an exposure of about 13 minutes, a current intensity of about 2 milli-amperes in the X-ray bulb and a pressure between the terminals of the bulb corresponding to a parallel spark gap of about 25 centimeters (10 inches). In the case of steel of the same thickness under otherwise equal conditions, 1 hour 20 minutes; with a thickness of 55 mms. (2¼ inches), 1 hour 45 minutes is required. Flaws of 0.1 mm. (.004 inch) can be detected in steel samples up to 45 mms. (1.8 inch) thick. However, all these results are possible only in the event of the sensitive plate below the objective being blackened distinctly. It is obvious that beams containing hard rays mainly should be used in this connection.

It would, of course, be preferable to be able to reduce the times of exposure, which, it might be argued, could be achieved by running the X-ray bulb at higher pressures and thus increasing the hardness of the rays. However, so far from obtaining this result, negatives would thus only be made flat and show less contrast. Moreover, though a more powerful radiation could be obtained by other means, it is doubtful whether photographic plates, which of course are extremely pervious to hard X-rays, could be acted upon at all by any large percentage of such rays.

Some typical cases of X-ray metallography, referring to several branches of both mechanical and chemical engineering, are illustrated herewith by courtesy of Messrs. Reiniger, Gebbert and Schall, of Erlangen, in whose laboratory these investigations were made:

On the right are shown iron and copper samples, Fig. 1 being the photograph of an iron block 60 millimeters (2.4 inches) thick, drilled at different points; Fig. 2 an X-ray diagram of the same iron block; Fig. 3 an X-ray diagram of an iron fragment 10 mms. (.4 inch) thick, repaired by autogenous welding; Fig. 4 an X-ray diagram of an iron fragment 15 mms. (.6 inch) thick, repaired by autogenous welding (the welding seam appears as a white line and accordingly is shown to contain air bubbles); Fig. 5 a photograph of a copper block 30 mms. (1.2 inch) thick with holes drilled to various depths (2 to 26 mms.); and Fig. 6 an X-ray diagram of the same copper block.

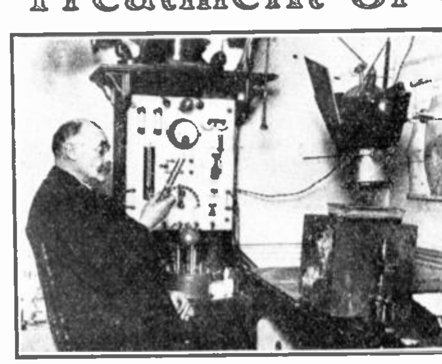
On the left are several X-ray diagrams of divers materials, Fig. 1 showing a defective porcelain insulator; Fig. 2 a steel plate 20 mms. (.8 inch) thick with flaws outwardly invisible; Fig. 3 a flawless porcelain insulator; Fig. 4 a square tool forged from round steel (the star represents a pressure diagram); Fig. 5 a bevel gear wheel with several boxes driven in hot; Fig. 6 a copper tube with cracks invisible outwardly; Fig. 7 a bronze ring with a structure characteristic of irregular alloying; Fig. 8 a section through a bronze bush 5 mms. (.2 inch) thick with a similar structure, and Fig. 9 a steel wire cable 65 mms. (2.6 inches) in diameter.

X-Ray Treatment of Cancer

THE rôle played by radium in its effects upon the human system has not been injurious, simply because of the great scarcity of the metal, which minimizes its action and keeps it within non-injurious limits.

A tangible amount of true radium would be a most disagreeable neighbor and would affect the system very seriously. One theory about the beneficial effect attributed to some of the famous mineral waters of the world is that it is due to the presence in the water of radium or radio-active substances.

A somewhat similar state of affairs obtains for X-rays. In full strength they are terribly injurious. A number of deaths are accredited to them, and physicians administering them use the greatest precautions to protect themselves from X-ray burns. A minimized action of X-rays might be beneficial.

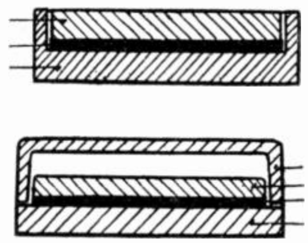


Charging liquids by the X-ray so as to impart radio-activity to them; a beneficial application of the hitherto injurious X-rays is thus supposed to be developed.

From Manchester, England, comes a device for using X-rays to impart radio-activity to drinking water, sea water, milk, oil and other substances. It is as if the liquids in question were charged with radium emanations. The oil may give a sort of an external application for rheumatism and the like, to be applied with friction as a liniment is used; milk and fresh water would enable one to drink the emanations, as we may somewhat inaccurately yet descriptively term them. A bath in the sea water thus treated might be compared to a bath in radio-active waters at any of the great baths of England or the Continent.

New German Flatiron

THERE are quantities of electric flatirons of different types on the market. The real and the claimed advantages of each construction have often been written up in the technícal papers. It is astonishing how little fundamental improvements in these appliances have taken place in recent years.



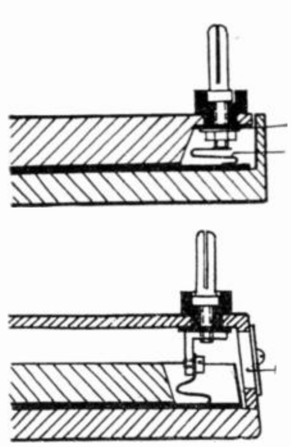
Two typical constructions of the body of flatirons illustrated, one with cover and the other without.

While people often looked upon electric flatirons apparently from the standpoint of luxury, and estimated their value from the brightness of their nickel plating, without troubling themselves about the electric qualities, on the other hand some people looked upon efficiency and the guaranteed period of their life as very important factors.

Efficiency plays a very minor rôle on account of the exceedingly short period of use and a guaranteed life of one to two years expresses, at the very highest, only a period of use of a few hundred hours, not enough to give a definite judgment upon the value of the construction.

The wild industrial period following the war was responsible for the lack of advance in the construction of the electric flatiron, when manufacturers, with no knowledge of the subject, simply copied what they saw—so that the same troubles occurred over and over again. These troubles are due to the often complicated construction, to the bad design of the connections, to the employment of poor material, to wrong distribution of the heating element, and even to the awkward form of the iron.

If the construction hitherto used is considered, two types may be distinguished: the two-part iron, consisting of the ironing surface or sole and the weight-plate, between which the heating element is placed, and the three-part iron, in which the weight-plate is covered with a hood. In reality, the number of the constituent parts of a flatiron are considerably more than this—and all of them figure as sources of trouble.

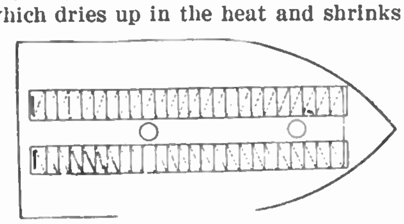


A bad and a good connection to the heating element of a flatiron, one depending merely on pressure, the other on absolute attachment.

In the two-part iron the electrical connections between the contacts on the upper part of the iron and the ends of the heating coils are, as a rule, neglected, and the contacts are poorly maintained by simple pressure. If this is not done effectually, the contact surfaces tend to separate and to develop the dreaded unsafe contact, or else the insulation gives way, so that again imperfect contact results. A fixed rule of construction should be, that, between the heating coils and the contact plug, only fixed metallic connections are to be allowed.

In the iron with a hood or case, there is generally an opening provided through which the interior connection has to be made. Much patience is required to carry out this operation, and it is hard to manage. No practical way of avoiding this difficulty can be spoken of in the present case. The capacity of the plugs is fixed by the Underwriters' laws, but not the construction of the insulating bushing.

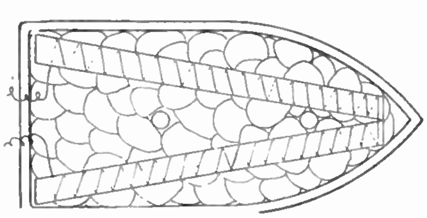
Sometimes mica insulation is used, which dries up in the heat and shrinks or



Bad arrangement of the heating coils of a flatiron, leaving the point without heat.

becomes weak by subdivision; sometimes the bushings are so small that they break easily, which is favored by the drag upon the flexible cord when the iron is in use.

The heating elements in many instances seem to have exacted the deepest thought. It is incredible what is to be found in some flatirons. As an ideal heating element, we may accept sheets of infusible mica be-

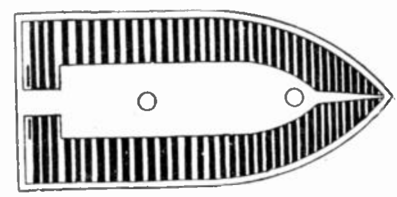


A good arrangement of the coils, heating the point to a considerable extent. These coils are imbedded in rough insulation.

tween which a liberally proportioned coil of heating wire is placed. This arrangement one often finds in the products of high grade factories. But it costs a great deal. The makers of various countries have employed for a number of years with very good results as a satisfactory substitute, micanit. Lately some manufacturers think they can work more economically when they use mica scales, that are the waste product from sheet mica and fall from their loose attachment to the sheet. On this are placed the heating coils made of cheap resistance wire, which is covered again with a second layer of the mica scales. On this the upper section of the flatiron rests.

Sometimes such heating elements are contained in a sheet-iron case. They may be quite uneven, giving a poor heating capacity and are comparatively worthless from the electrical standpoint. The same applies to wire bedded in soft asbestos, for asbestos is very hygroscopic. On the other hand, the heating elements may consist of thin asbestos cement with the sinuous heating wire imbedded therein.

Recently, flatirons are being made in which the heating coils and cement are both pressed together into the bottom of the iron. The heating contact is exceedingly good in these cases, but the insulating quality of the cement is often far less than can be desired. There is hardly any cement that is not hygroscopic and has not some chemically combined water, which is always set free upon cooling. Such irons when they are first connected to the circuit show a low insulation resistance,

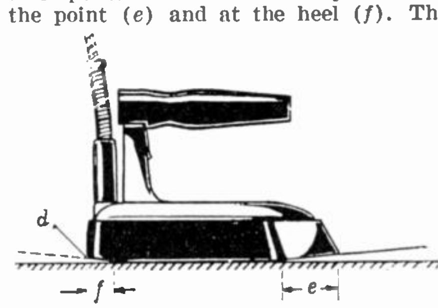


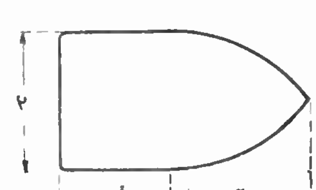
Healing coils of an advanced type flatiron, which coils it will be observed go to the very point of the iron, so as to apply the heat where it is most needed.

which increases as they get hot. The heating elements of such irons cannot be replaced, and this is a distinct disadvantage, no matter how long a life is guaranteed. There is often a wrong lay-out of the heating parts. Two of the illustrations show this, while another shows the correct arrangement. The heating of the point of the iron is especially important; it should cool at the same rate as the front of the iron when in use.

The power expended per unit of area of the working surface (watts divided by square inches) is of comparatively little importance. American irons generally show 50 per cent higher heat than do the German.

Even the form of the iron is of importance, although this is not generally realized. Many practical tests have shown that the wide surface is the best, and that a high built body gives its heat better to the material than a thin sole with a hood. An analogous fact has long been observed with gas stoves. The contour at (*a*) in the elevation and section shown in the illustration must be only slightly rounded, the contour (*b*) should be more rounded, so as to accord with the heel (*f*) and the corner (*d*). This avoids doing injury when drawing the iron backwards over the goods. The front must represent the bow of a boat. A mirror-like surface of the sole makes the work easy and brings about quick and intensive application of heat. The operation is made easier by the lift at the point (*e*) and at the heel (*f*). This





An advanced type flatiron shown, to illustrate principally its dimensions and the rise of the point, as well as the rounding of the heel.

shape operates like the runners of a sled, obviates the resistance due to wrinkling

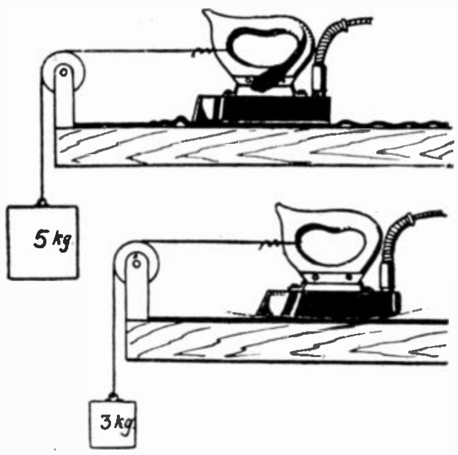
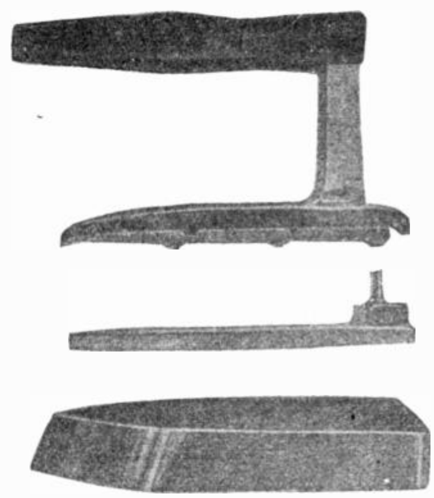


Diagram showing the difference of traction of an improperly and properly shaped flatiron.

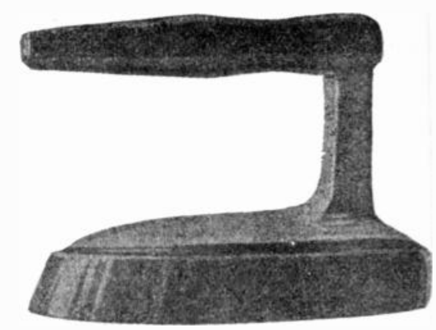
of the goods, and prevents the early fatiguing of the operator. The difference in resistance to motion is very impressive, and is shown in one of the illustrations.

The particular iron we are describing



German flatiron of advanced type taken to pieces.

consists of three principal constituents—the sole, the heating element with connecting plug, and the upper part with heat insulation and handle. Unreliable joints between the heating body and the plug are avoided; hygroscopic cement is not used. The iron can be supplied with special heating material or with micanit.



Advanced type of German flatiron put together and ready for use.

Breaking down of the insulation and burning out of contacts are quite excluded by the construction. The form of the iron reduces the traction and it is well rounded up at the front and at the heel. All parts are polished and nickeled, and the heating element can be readily replaced.

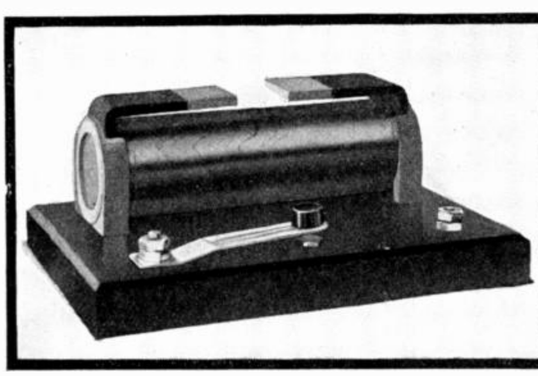
A Simple Magnetizer

THE electro-magnet shown in the illustration is designed for magnetizing new magnets, or remagnetizing old ones which have become depolarized or weakened.

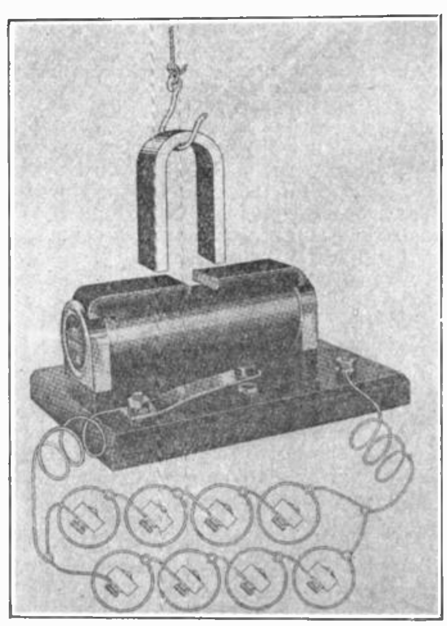
It is a powerful electro-magnet, mounted on a base with a switch as shown; its two pole-pieces are carried parallel with its axis above the top and brought rather close together. Eight or ten dry cells are sufficient to operate the apparatus and the polarity is determined readily by a compass held above it, or by suspending a magnet of known polarity above the pole-pieces as shown in the diagram.

For magnetizing a U-magnet the poles are placed upon the poles of the magnetizer before the current is turned on. The switch is then closed and left closed for a few seconds; the magnet, which, of course, is firmly gripped by the attractive power of the pole-pieces, is rocked back and forth by hand. This gives a better contact and a more thorough magnetization.

The apparatus is exceedingly compact and convenient, and is applicable to the remagnetizing of polarized apparatus, such as polarized relays and the like, and for magnetizing the magnets of magnetos.



A magnetizer which can be used for magnetizing the field magnets of magnetoes if they get depolarized and available for similar work.



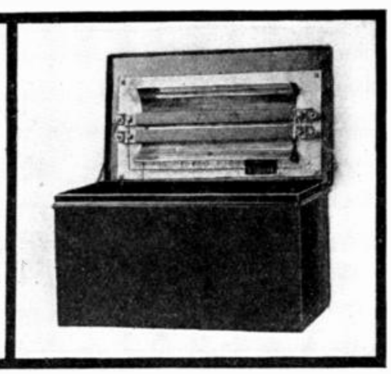
Determining the polarity of the magnetizer, so that when used for magnetizing it will not operate against the residual magnetism or pole markings of the field magnets under treatment.

Electric Battery Opener

STORAGE batteries, such as are used on automobiles especially, are sealed with a pitch-like composition known as sealing compound or sealing composition, and to open them this has to be melted or softened.

We have already illustrated a knife constructed for this purpose, which is heated by the electric current, by which cells can be opened one by one.

We illustrate here a larger apparatus, one which takes in an entire battery, of automobile size at least, which when closed is heated by electricity so as to melt the composition on the battery tops. The heating is done by the heating elements which are seen fixed along the inside of the top of the open box in the illustration. The resistance wire in the heaters is encased in sheet mica and the wire and mica together are placed and compressed in a steel jacket. The heating elements are backed by a cylindrical reflector.



A heating box, whose object is to heat storage batteries so as to soften the compound in order that they may be taken apart. It can also be used to dry out the boxes and for other such services in the storage battery service station.

The action is perfectly simple; the battery is put in the box and the cover is lowered so as to close the box. This automatically turns on the current of the heaters by a switch. Five or six minutes will soften the sealing composition so that the battery can be opened.

But this is not all that this appliance accomplishes. A battery box often has to be dried. Possibly it has to be washed to free it from acid which the wood has absorbed into its pores. In such case it also must be made perfectly dry before being put into use. The apparatus we describe does precisely this thing—dries out the case so that the wood is in good condition for painting, and is made ready for the reception of cells and the resealing operation. It can also be used for drying out and baking armatures, fields and coils.

It will be recollected that the melting of the cement on top of storage batteries is not unaccompanied by a certain amount of danger from the combustion of the hydrogen or exhaustion of air or hydrogen mixture which may take place. Such appliances as the one we illustrate effectually do away with all such danger and indicate an important advance in the line of work, which often seems to be conducted on rather primitive lines.

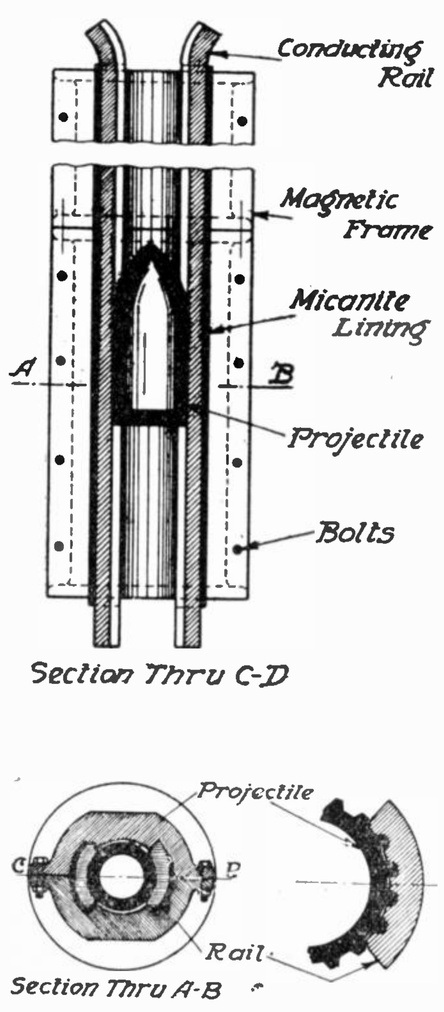
There is no question that the heated knife or the opener described and illustrated here will conduct greatly not only to the safety of operations, but to their convenience and cleanliness.

Electric Gun

THE idea of discharging a projectile from a gun by electricity is not by any means a new one. The usual way that has been adopted for doing it has been to surround the barrel with windings of insulated wire, which receive the current and constitute a single solenoid or a series of solenoids if progressively excited. By giving the current all at once or progressively to different portions of the windings the projectile is drawn forward and discharged. A similar principle has been applied to the traction of trains.

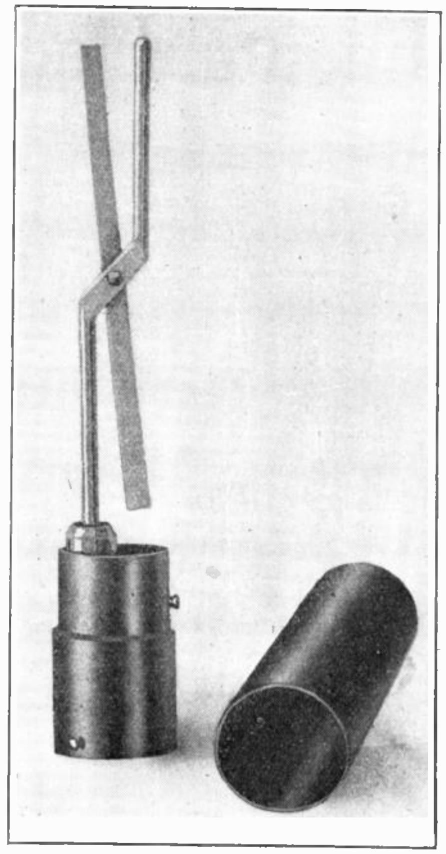
But the present gun which we illustrate is exceedingly interesting, as presenting a departure from this method. The bore of the gun is provided with two rails insulated on back and sides but with the interior rail surface, which corresponds very closely to the shape and size of the shell, without any cover. A strong current is connected as regards one pole to one rail and the other pole to the other rail. It will be seen that this leaves the circuit open, but if a shell is introduced into the breech of the gun the circuit will be closed, and the current will go through the long conducting rails and through the shell. The inventors' theory is that the shell will be drawn forward by the field established with accelerated velocity, shortening the path of the current, and the discharge from the mouth of the piece at good velocity will be secured.

The rail may be grooved with lands and the projectile may be shaped to correspond, as shown in one of the drawings, so as to be given a rotary motion on discharge.



Longitudinal and cross-section of an electric gun operating by the action of a powerful field and not using the solenoid principle. The action depends on the tendency of lines of force to shorten themselves.

Balanced Vane Electroscope



An electroscope with an aluminum vane for the purpose of working on high voltage power cables.

CONSIDERABLE attention has been given of late to the production of instruments for use on high-voltage lines, to detect live conductors. The one we illustrate is of extreme simplicity of construction, and it really returns to the oldest kind of static experimentation. The idea is that the modern potential used on power lines is so high that special instruments are needed to detect their excitation, for their voltage is so great that it would be risky to use conductive instruments on them.

The appliance we illustrate is an aluminum vane electroscope. An aluminum vane 1/4 inch wide and 5 1/2 inches long is delicately mounted on an axle a little above its center of gravity, causing the vane normally to hold a vertical position. The bearings are of the finest description, so that the apparatus moves with great ease on the slightest impulse. It is carried on a frame which is mounted on a base of vulcanite 3/8 inch in diameter, 2 1/2 inches long. The instrument is contained in a cylindrical brass case; the upper part is lifted off when the instrument is to be used. Its use is simplicity itself. If a lead-coated cable is in question, about a four-inch length of the sheathing is removed, and the instrument is held close to the cable. If the cable carries a voltage of more than 1,000 the vane is strongly attracted. In damp weather it works quite satisfactorily, whereas the old-fashioned gold leaf electroscope, with its fragile indicator, will not operate in unfavorable weather conditions.

The instrument is an insurance against personal injury, as it enables an electrician to ascertain whether the wire is alive or dead before he touches it, thus avoiding what may be a fatal shock.

The instrument is of the static class, it passes no current, but is charged by the high potential circuit. However, from the standpoint of the usual electrostatic charge, the potential may be considered low.

Two Uses of Old Incandescent Lamp Holder

(A Chinese Contribution)

WHILE the filament of an incandescent lamp is burned out or sometimes the globe is broken, we always throw it away as a thing of no use. But it is still useful to us if we have any devices to use it for other purposes.

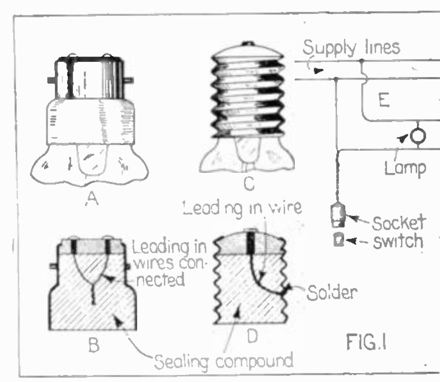
Recently, I found that the globe holder may be used as a socket switch or a safety fuse plug, and it is more economical if the switch-socket or fuse box were not at hand, and is easily to make up at home that even women or little boys can do it well.

1. Used as a socket switch as shown in Fig. 1 (A) is the globe holder and (B) is the sectional view of it. By soldering or winding the two leading wires, and then sealed with melted asphate (from an old dry cell) or sealing wax will be used in its stead if the former were not at hand. If you wish to close the circuit then put or screw in the holders just like we put on the lamp, while open, or break the circuit by taking away or loosening the holder. (C) and (D) are another form of holder and their makeshift are same to (A) and (B).

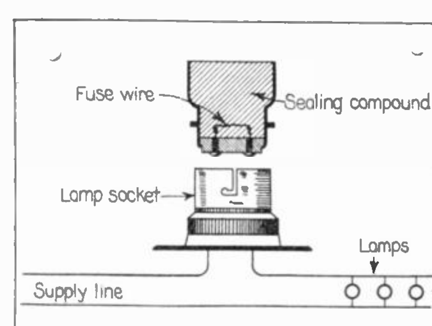
2. Used as a safety fuse plug. Fasten a fuse wire to the two leading wires and sealed with asphalte as the switch and mounted on a flat socket while in use. You may make several such like plugs as for changing will they are burned out. It is easily to put on or take away just as we put on the lamp without danger.

Contributed by HENRY T. S. SU,
Kiangsu Provincial Technical School,
Nanking City, China.

The above communication from "Far Cathay" is of much interest to us. It shows that PRACTICAL ELECTRICS has reached the Orient and, we shall hope for further contributions from our correspondent. His suggestions are of considerable interest for our readers.



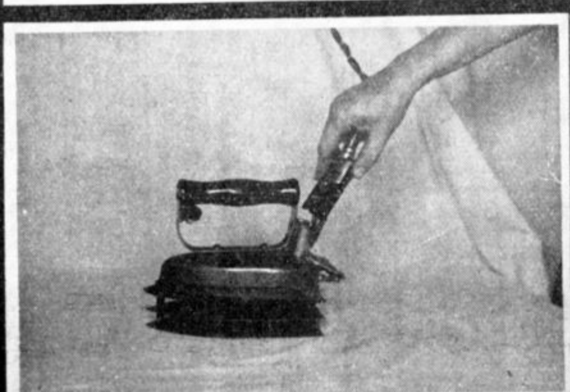
How a broken down lamp base may be used as an effective switch. Two different varieties of lamp base are shown.

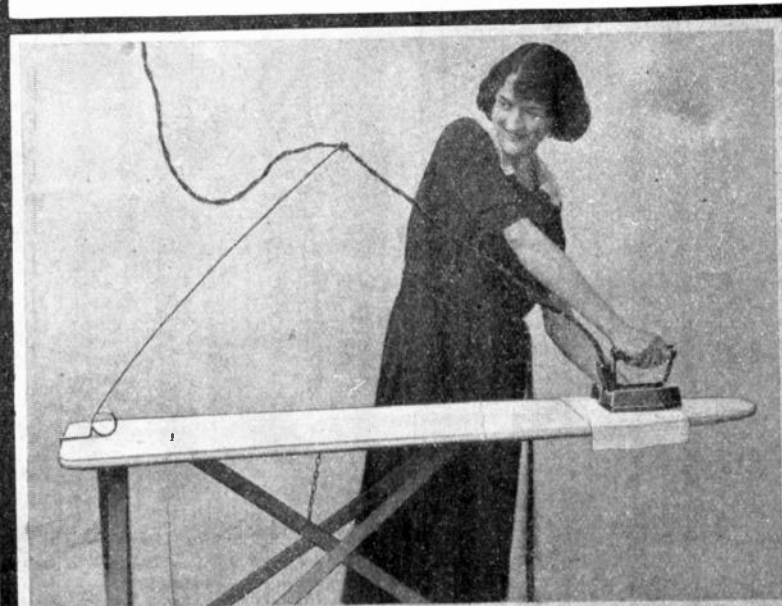


A lamp base whose bulb is broken is made to act as a fuse plug; both these contributions come to us from China.

Longer Life for Electrical Devices

By M. M. Hunting





Left—above—The destruction of a flexible cord; the minute wires within it are apt to break, bringing about all sorts of troubles.

Left—below—An attachment for a flatiron, avoiding the deterioration of the wire at the point of connection to the iron, where repeated bending is apt to destroy it sooner or later.

Below—A simple spring for keeping flexible cord off the ironing board, saving it from wear and destruction incident to repeated bending.

ELECTRICITY is elusive, and in the use of electrical devices there are certain things we must not do if we wish to have them operate perfectly. These devices will last longer than otherwise if we pay attention to these ounces of prevention, each worth many pounds of cure.

The average electrical cord does not improve in quality if water is spilled upon it. For this reason Chicago has to replace on its telephone service line an average of 310 instrument cords every day out of the 365. Wet umbrellas placed against these cords are the usual cause of the trouble, so the rainy day is a busy day for telephone repair men. This truth applies to electrical cords for connecting flat-irons, dishwashers, clothes-washers, and vacuum cleaners, devices that are far more liable to have water spilled upon them than fans, and toasters. Clothes-washers frequently are protected against this occurrence happening. It is well on general principles to avoid getting these household friends into or near wet territory.

Out of every one thousand families in the United States more than 700 use electric irons. This household device is in more general use than any other one device that depends upon electric current for its operation. The average electrical cord in the home or father's office is seldom kept kinkless. These cords are twisted, tied in knots to shorten them, and maltreated in dozens of other ways until the tiny wires inside the insulation break through their covering and cause "shorts" or burn the insulation completely off. Inside the connecting cords there are many small copper wires, pliable to be sure, but they were never intended to be bent in the same place repeatedly or continuously. That is why your electric iron near the cord connection is protected with a steel coil that keeps the cord free from kinks. The use of a simple device to hold the iron cord free from kinks is a valuable investment for the kitchen. This device is shown in one of our illustrations.

In the use of your electric iron be sure that you do not let it fall. This may injure the heating element or loosen the inner connections, which sooner or later will cause trouble. This is also good practice in the use of any electric appliance, for few devices of this kind are guaranteed against falls.

And speaking of electric cords, do not hang a wire over a nail or drive a nail through it. You are likely to cause a short circuit by the former procedure, and it will be a certainty in the latter. A small piece of cardboard folded and used to protect staple or tack from touching the wire is an obvious prevention of short circuits. Better still, use a protected staple.

We become so accustomed to the use of electricity that we forget that all is not gold that glitters. A little insulation out of place can be the means of causing considerable trouble. Such spots should be attended to at once, especially on flexible cords. Avoid touching them. Under certain conditions your body becomes a conductor of electrical current, and these conditions are hard for many of us to determine. Better be safe than sorry. An exposed spot on an electrical connecting cord is sure to cause trouble sooner or later.

In the electric home of today there are many other devices besides the handy flat-iron. The electric percolator, the electric tea kettle, the grill, the electric curling iron, milk warmer, and others make a very long line. In the care of these devices, especially those in which liquids are used, do not permit them to burn dry. It is bad business.

Every well regulated electric family at some time "blows a fuse." This should not be done and you should know how much current you can safely carry in the use of electrical devices. Appliances that produce heat require much more current than do electric fans or sewing machine motors. The cluster plug does not provide for more than 1,000 watts. Lamps in the home consume from 25 to 60 watts on the average. It is the wise user of electricity that connects but one heating appliance and one light on the same socket. If in doubt add together the number of watts on the appliances and see if the sum exceeds the 1,000 watts. Always read the manufacturer's instructions, that usually come from all reputable houses. If you know something about the secrets of electricity a fuse can be easily replaced, but if you have not this knowledge let some competent person repair the damage.

If you are a user of an electrical motor for your sewing machine, do not forget that it needs lubricating for better work. Sewing machine motors, if oiled three times a week, should be capable of running constantly during this time. For intermittent use, one drop will make it happy. Three drops of oil will keep your vacuum cleaner running contentedly unless given tremendous use. A half thimble full of pure, clean vaseline in the oil cup of an electric fan will make it purr contentedly throughout a season.

Nothing has brought to the housekeeper as much labor-saving power as the electric clothes-washer. Its motor can now be used to freeze the ice cream, while it washes the clothes in the tub. This electric maid must have good care, or it will become an expense in the family budget that was not anticipated. Oil regularly where needed. The instruction book will tell you when, how and where. Tighten all bolts and keep the belts at their proper tension. Never overload. Wash the proper

The vacuum cleaner is not to be neglected, and is certainly entitled to a due meed of oiling by the housekeeper.

weight of clothes for the machine you are using. Note the water level and fill accordingly. Wringer rolls you can clean by the use of a little kerosene. Do not leave this on, but wash it off immediately. There is a reason. To remove grease and oil stains, use a good soap and water. Scouring powders should be used with care on metals. They sometimes do harm, and start corrosion and staining.

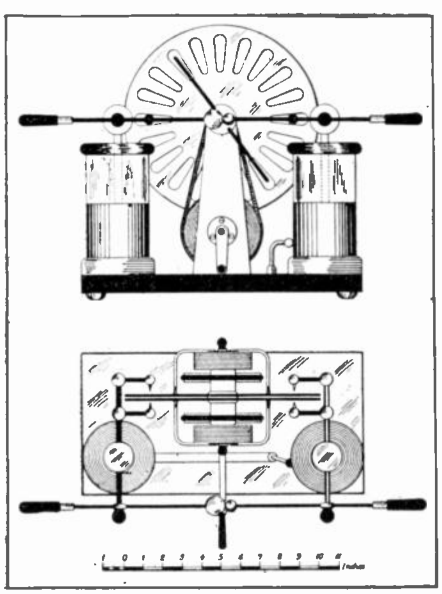
It is supposed with considerable probability that many housekeepers treat electric apparatus as they do their sewing machines, neglecting the lubrication and satisfied as long as the motor turns. But the writer very properly emphasizes the fact that a little lubrication will not only lead to better results but will greatly increase the durability of the machine. There is nothing worse in mechanics than wearing out bearings by running them dry, and while every effort may be made to simplify lubrication to the last degree, the very ease of doing it should lead to its receiving proper attention.

Grease cups, while they are supposed to lubricate for comparatively long periods, should be looked after and the openings should be cleared with a piece of wire, not with a piece of wood such as a match, which is liable to break off and obstruct the passage.

Ten-Inch Wimshurst Machine

WE reproduce from an English contemporary some illustrations of a Wimshurst machine.

The plates are made of ordinary window glass weighing 15 ounces to the square foot, and each plate has 20 of the tin-foil sectors shown, attached to it with shellac. The center hole in the plates is drilled of a diameter of three-eighths inch; a brass tube of that external diameter, rotated and fed with carborundum powder and turpentine, was the drilling tool. This tube formed a bushing and was threaded with 26 threads to the inch for its entire length. On one end there was a circular flange, which was trued up in a lathe. The plate was pushed over the tube against this flange, and a wooden cylinder, which was the boss of the driving pulley, was screwed on so as to jam the plate between its end and the flange.



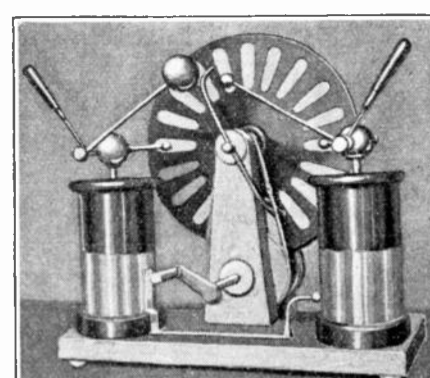
A home made Wimshurst machine shown in diagram with scale of dimensions. It has ten-inch plates and gives a four and one-half inch spark.

Flannel washers soaked in shellac were used on each side of the plate. Thus, each plate had its own tube to which it was firmly secured. Driving pulleys were attached to each boss, and when the plates were threaded on a brass bar running across between the standards, their mounting was complete. The Leyden jars were made of fruit jars. It is better to use balekite or specially good glass for them.

The collecting combs originally were made with three teeth on each one, but it was found that one tooth was sufficient.

To cut the sectors, a template was filed up of reasonably thick metal. The tin-foil was laid up ten pieces thick and was cut with a safety sazor blade. The plates were varnished with shellac solution, and were baked in an oven. They were then laid upon a full-sized drawing showing the sectors in good heavy lines, readily discernible through the glass in spite of the shellac. The sectors were put in place one by one, each over its place in the drawing, and the shellac was made to secure each sector in place by the heated template being placed upon the tin-foil. If properly done, the surface of the plate can be sandpapered without destroying the tin-foil.

The other features of construction are clearly shown; the driving pulleys have



A perspective view of the Wimshurst machine, which in connection with the diagram will make its construction clear to all.

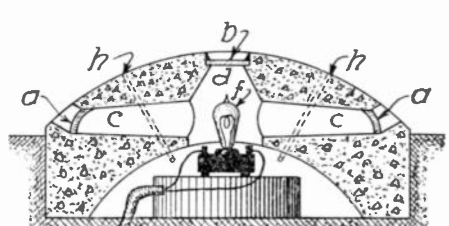
perhaps three times the diameter of the driven ones, and one of the belts crosses, making one of the plates turn in one direction and the other in the reverse.

Traffic Light

SOME time ago we illustrated a new traffic light, a lamp contained in a substantial structure rising a little above the street level, and clearly visible to all automobilists.

The structure in which the light is safely embedded rose a few inches from the street like a very low dome, and if a car for any reason diverged from the proper course, it could run right over the signal without any injury to itself or the signal.

The section of one of these low level



A traffic light at the street level, which can be run over by an automobile, without injury to the car or to itself—yet which is an effectual guide.

traffic signals is given here. At (b) there is a transparent plate or lens through which the light is seen, and as many radial channels (c c) as desired, run to the periphery about the street level, and are also closed at their level by lens' or plates of glass, colored or otherwise. The light of the central and only bulb shines out through these in any desired direction, colored or uncolored as desired. The body is made of reinforced concrete, so the lamp is absolutely protected from all chances of injury.

Experimental Photoelectricity

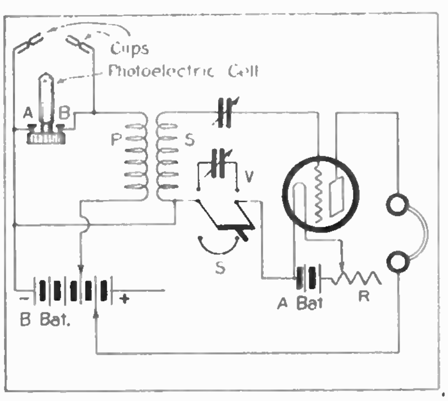
By Raymond B. Wailes

THE subject of photoelectricity, or the action of light upon certain substances with a consequent production or alteration of an electric current, has fascinated all who have delved even beneath the surface of the subject. Although photoelectric effects are not at the present time commercialized to a large extent, the future may have much in store for us, for man's wasteful ways will be turned in the direction of the harnessing of free motion and many of the forces of nature.

Various substances, particularly selenium, an element obtained as a by-product in the manufacture of sulphuric acid from pyrites, are almost perfect insulators of electricity in the dark, but under the influence of light become conductive, allowing a current to pass through them and actuate any desired apparatus. Several substances produce a current of electricity directly upon being illuminated. It is to these substances man may yet turn when our present sources of supply will have dwindled to a nothingness.

Photoelectricity is applied in light telephony, wire photography or phototelegraphy, smoke prevention, talking motion pictures (light telephony), the grading of coffee and other beans, and several other conveniences, which are increasing in importance.

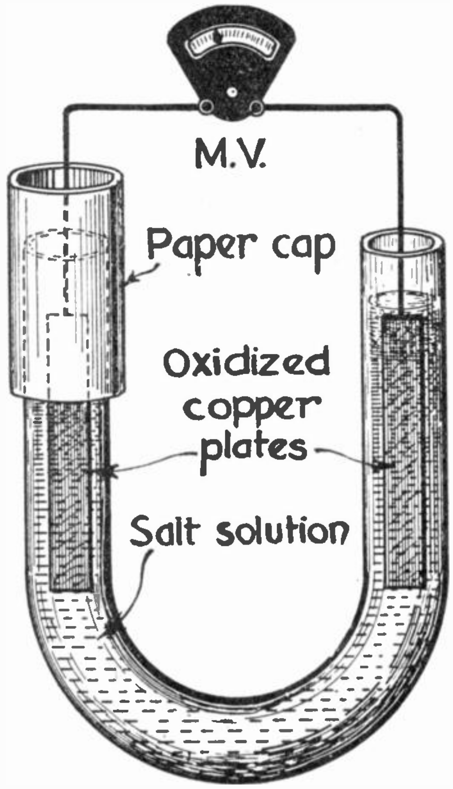
Many experimenters are familiar with the selenium cell. This particular cell will



2. An experiment in photo-electricity utilizing the vacuum bulb and a special photo-electric cell.

be described under photoelectric substances. A host of other substances which exhibit photoelectric properties are at the command of the experimenter of today. Some very simple cells can be made of materials at hand which actually produce a current of electricity when strongly illuminated, a battery not being in any way connected with the cell.

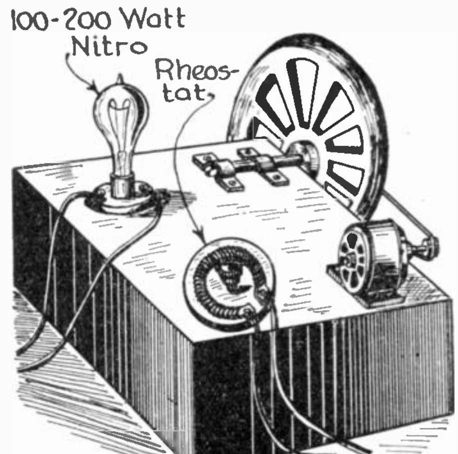
Perhaps the simplest actino-electrical cell is shown in Figure 1. Here a U-tube is filled with a one per cent solution of common salt, each limb of the tube containing a copper electrode. The electrodes should be thoroughly oxidized by holding them in the tip of the Bunsen burner flame. Each limb of the U-tube should be covered with a black paper cap. On exposing the cell to the light from a high wattage lamp or from the sun with both black paper caps down over the limbs, thereby protecting the electrodes from the light, no current of electricity will be produced. When one of the caps is raised, a current is produced. The electrode exposed to the light is always the negative pole. Lowering the cap and raising the other one produces an opposite current. The current is produced directly by the action of the light.



1. An actino-electric cell, one which when affected by light may be made to develop chemical reaction and produce a potential difference.

Light may alter the resistance of many artificial and natural substances, thereby producing a desired effect in the circuit, such as operating a loud speaker, flashing a light, etc.

One of the simplest and most efficient circuits to be used in experimenting with photoelectric substances is shown in Figure 2. Here the audion or vacuum tube is made use of. An amplifying transformer, connected as shown, is required. In this circuit the high voltage from the B battery is impressed across the terminals of the photoelectric cell, or substance to be tested for photoelectricity, as well as being used as the plate potential of the vacuum tube. Two taps are led off the B battery in order to produce this effect. A pair of spring jaw clips are connected to (A) and (B). By means of these clips substances under test can readily be



4. An electrically driven apparatus for giving intermittent beams of light as used in photo-electric experiments.

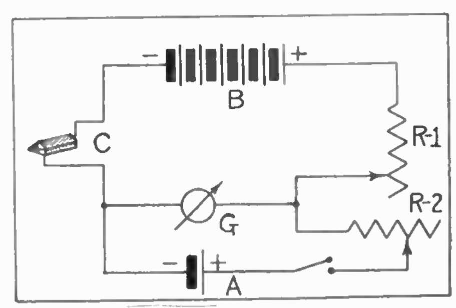
held while exposing them to the light source—a 100 or 200 watt nitrogen lamp.

Many metallic minerals can be used as photoelectric substances, the wires from (A) and (B) being connected directly to the ends of the minerals, if crystalline, or to sharp corners if massive.

Some substances under test will be found to conduct the B battery current when they are in the dark and not exposed to the source of light. This current is called the *dark current*, and can be neutralized by employing the hook-up shown in Figure 3. Here a small cell (A) is connected as shown. The substance under test is connected in at (C), preferably by soldering, and the galvanometer needle is adjusted by means of the resistance R-2 until it is at zero. Then the B battery or high potential may be cut in, and the substance under test exposed to any desired light.

The B battery current can be obtained from an ordinary radio B battery usually producing about 22.5 volts. It acts as a carrier current; the increase in current which is produced when the substance is illuminated and consequently, if photoelectric, has its resistance lowered, readily actuates the galvanometer needle. A relay can be substituted for the galvanometer so that external circuits can be operated and controlled.

The audion circuit is particularly adapted to photoelectrical experiments. With a sensitive pair of phones very small

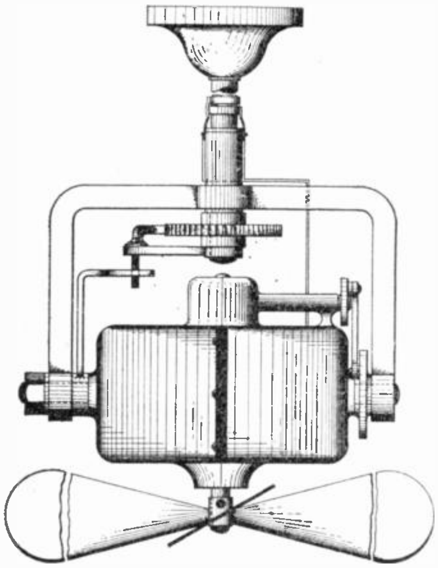


3. Connections for testing the effect of light upon a mineral. Various minerals are cited in the article as having their resistance affected by light rays.

changes in the resistance of the substance under test can be detected. If the source of illumination be varied by means of a rotating sector as shown in Figure 4, the rotor being placed between the source of light and the substance under test so that the light intermittently falls upon it, a hum or intermittent sound can be detected in the receivers. This method is not always applicable, for some substances have a great photoelectric fatigue, or slow or very slight light-recovery properties. The light first impinging upon the specimen will, say, vary its resistance and thereby cause a deflection of the indicating instrument, or phone. This effect will soon die out, for on darkening and exposing again, many substances will be found to be dead to the light rays. The substance has been fatigued, or seemingly, poisoned. The recuperation is sometimes very rapid, usually a fraction of or a whole second, sometimes many.

Some substances will be found to produce a current when not exposed or insolated to the light but subjected to a source of heat. This is a thermoelectric action, the specimen under test acting as a miniature thermocouple. Heat rays can be removed from the source of light by passing the rays through suitable filters.

Oscillating Electric Fan



Elevation showing the general mechanism of an electric fan which throws its blast seriatim in all directions.

THE ordinary electric fan may be mounted on a stationary base which, of course, can be shifted about by hand, and sometimes the inclination of the fan can also be changed by hand so as to direct the blast of air wherever desired.

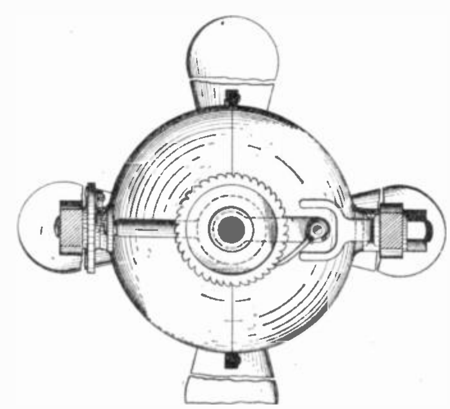
A modification of this, which indicates an advance in construction, keeps the fan in oscillation about the axis passing upward through the stand. The fan blades rotate around one axis, while the entire fan rotates about a second one. This, of course, gives rather a limited range of

The oscillating fan in its carriage, mounted on a ceiling and supported some distance therefrom.

action, and the fan which we illustrate goes a step beyond this and introduces a third axis of rotation.

The fan motor is contained in a drum-like structure immediately above the fan. By means of the horizontal shaft extending from the head of the machine to the right, which carries a crank on its end working a connecting rod attached to a fixed abutment below, the fan is kept in oscillation in a plane passing through its axis of rotation. This much establishes the two axes of rotation.

An arm will be seen extending upward from the left side of the motor casing, and this arm oscillating back and forth with the motor-case, rotates the fan



Looking down on the mechanism of the oscillating fan, showing how the double motion is communicated to it by rachet and reciprocating fork.

around the vertical axis of the motor, thus establishing a third axis of rotation, so that the draft from the fan will reach every part of the room.

Another arm attached to the motor-case will be seen extending vertically upward from its left side. The upper end of this terminates in a fork, and the motor-case, as just described, oscillates back and forth, moving the fork to and fro, which, acting on the pawl, gives a slow, intermittent motion of rotation to the fan. The various illustrations show clearly the relation of parts.

Coal Scale Indicator

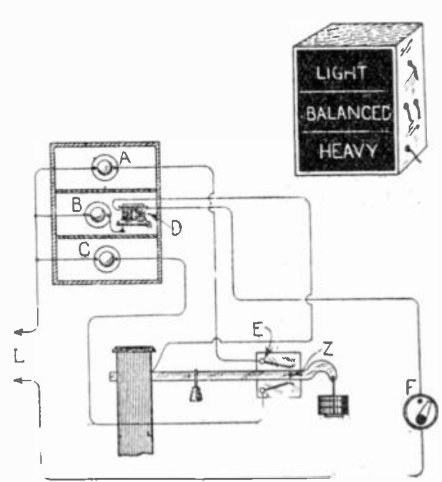
THE object of this indicator is by the lighting of one of three lamps to indicate to the driver of a coal truck whether his load is too heavy, too light, or correct.

Most coal dealers have the scale beam inside of the building, where the weighing is done, and there is a certain amount of difficulty in letting the drivers know how they stand as regards the weight of their load.

The illustrations give the principle of the construction of an electric indicator, which does not affect the balancing of the scale in any way, and which can be made with material generally found lying around in most shops.

Referring to the illustration (A) (B) and (C) represent three lamps. If the system is to be worked off the lighting circuit, lamps must be selected which will be of proper size. They need not be of high candle power. They are contained in a box which has a glass pane facing the outside, so that this glass can be seen by the driver. In front of the lamp (B) the word "Balanced" is painted; in front of (A) the word "Light"; and in front of (C) the word "Heavy." As the circuit now stands, an armature (D) which appertains to a magnet is not attracted and falls down, as it is evident that the magnet can receive no current. But when so depressed, it strikes a contact to the left of the letter, and completes the circuit for the lamp (B), so that the lamp (B) is lighted. This assumes of course that a switch shown at (F) is closed.

Attached to a block (E), which is alongside the scale (B), there are two



A simple apparatus for telling whether a load of coal is too light, too heavy or correct. We must hope that it will generally be a little too heavy.

contacts, which may be made of brass or copper strips or even wire. (Z) is a copper or brass bolt or nail fastened to the scale beam, rising and falling with it. If the beam rises, it means that the coal is too heavy, because when the beam rises it indicates an excessive weight on any platform scale. This makes contact with the upper strip attached to (E), and also with the leads going to the electro-magnet (D). The effect is twofold; the armature is drawn upward, opening the circuit of lamp (B) so that it is extinguished, while the lamp (A) is thrown into the circuit and is lighted, and illuminates the inscription "Heavy," which is in front of it. If, however, the load is too light, the end of the scale beam descends, makes contact with the lower brush attached to (E), and connects the coils of the magnet (D) into the circuit, so that the armature is again attracted, extinguishing the lamp (A), because the contact at (Z) is broken, while the lower contact illuminates the lamp (C), in front of which is the inscription "Light."

There is one detail to be remembered—the armature must not be permitted to touch the magnet core, but must be held back by an adjusting screw or otherwise, so that it will not stick by residual magnetism. The switch (F) is opened when the apparatus is not in use; as long as the switch (F) is closed, one of the three lamps will be lighted.

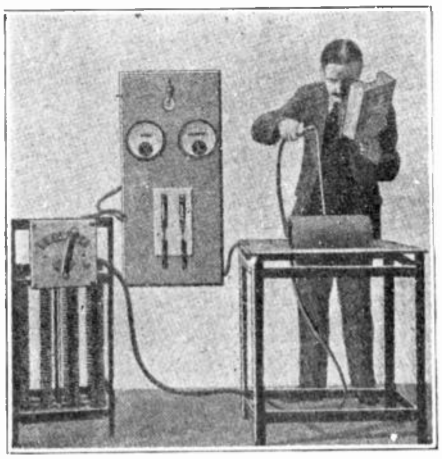
The wiring diagram is shown in the simplest and most direct way of connection. But by crossing the wires and slightly complicating the system a change which may appear to be for the better, can be made. This is to have the lowest lamp connected for "heavy," and the top one for "light." This seems more logical as weight is supposed to descend and lightness to rise. This arrangement, which can easily be carried out, is shown in the illustration on the face of the signal box.

Care must be taken that the connection to the scale beam shall not introduce any friction. The wire can be connected to the bearing and the current can pass to the beam through the knife-edges.

Contributed by GEORGE W. SALSMAN, JR.

Electric Arc Soldering

SOLDERING with the electric arc is no new thing. Although this fact is hardly known, it really goes back to 1860, when the English electrician, Wilde, who was one of the founders



Modern electric arc welding. The article welded is directly below the hand of the operator so as to give the best possible conditions for the flow of slag and feed of the rod.

of modern electric power engineering, attempted it, but without practical success.

Some forty years ago the Russian engineer, Bernardos, originated a process in which the piece to be welded forms one of the electrodes, the other being a carbon pencil. This process is still in use to some extent, one trouble being that it oxidizes the metal, and if iron, the carbon combines with it, and makes it very hard and brittle.

In the Zarener apparatus two carbon electrodes set at an angle of about 60 degrees are used. In the Slavanioff process one electrode is of metal, and as it melts supplies the metal for the welding. It is now claimed that after twenty-five years the inventor Kjellberg has solved the problem and can produce autogenous soldering by the arc, comparable in quality to oxyacetylene work. In his apparatus there is a metallic electrode which is surrounded with a layer of non-conducting material, and which fuses only at a very high temperature. This forces the arc to take the direction of the axis of the compound electrode, as if it were enclosed in a pipe; the melted metal is fed down upon the joint through the same pipe, and this coating for the electrode is selected of such material as will make a flux, when it melts. As the process goes on, it is found advantageous to hammer the joints, so as to make the juncture more compact and bring about a true welding, for autogenous soldering is not soldering at all, but is really welding.

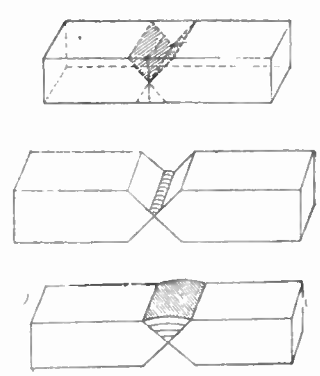
Strohmenger and Le Chatelier have modified the Kjellberg process and developed what is called the quasi-arc process (which means an "arc as it were"). By using asbestos for the coating, its porosity makes it available for impregnating with any solution, which will conduce to the perfection of the joint, and a thread of aluminum led alongside the rod of metal and in contact therewith for its whole length, melting with it, acts as a deoxidizer.

In this process a voluminous slag is obtained. This spreads over the joints and protects the metal from oxidation. If the surface is a horizontal one, facing upward, the end of the electrode is thrust right into the slag. In such case the slag is highly advantageous. If one has to solder a surface above the electrode the slag is annoying rather than useful.

Le Chatelier did a good deal of work on the composition of the tubular coating of the electrode, varying the fusibility from 1,800 to 2,700 degrees F., the material being a silicate. For applying the arc to an overhanging surface, an especially infusible coating was used by this inventor.

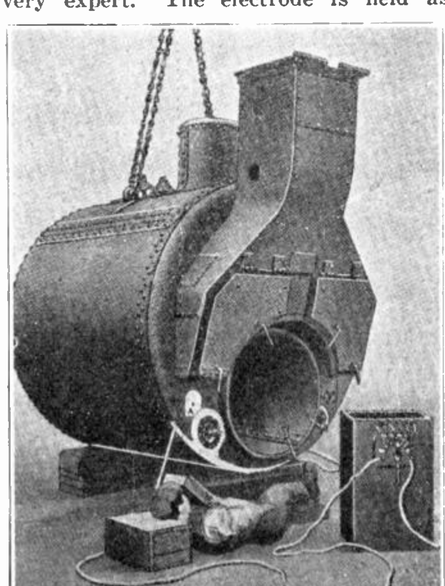
The manipulation is very similar to that employed in oxyacetylene welding, so that an operative accustomed to the blow-pipe soon learns how to handle the arc. It is interesting to note that both processes are often combined in the same place; in some instances it is necessary to cut a groove all along the fracture or joint, as shown in the illustration. If the metal is iron or steel, this is done most readily and effectively with the oxyacetylene blowpipe.

To apply the process the electrode connected to an active circuit is touched for an instant to the material, which in its turn has been connected to the other lead of wire. It is immediately withdrawn slightly and an arc is struck, as the expression goes. The metal in the electrode begins to melt and the distance between the surface of the piece and the electrode is maintained at one-eighth to one-quarter of an inch. It is rather important to keep the distance the same so as to avoid an



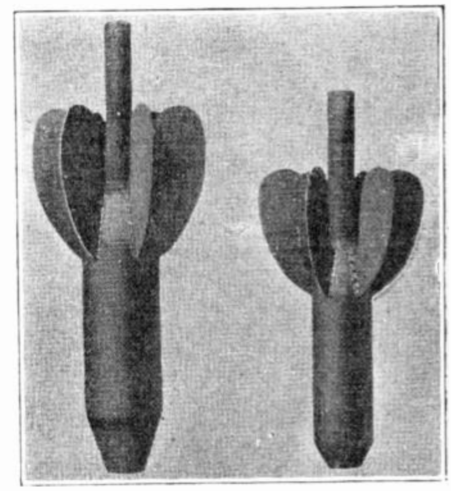
Three steps in the process of welding the bar. The clean cut at the top; next a small amount of metal has to be deposited in the cut and which is to be further cleaned, and below and at the bottom the cut is fully welded by a slight excess of the material.

irregular draught upon the dynamo. As the electrode melts away, the operator instinctively advances it, and soon becomes very expert. The electrode is held as



Working on a boiler. An example of a most disadvantageous and troublesome way of working, as the slag tends to flow away from the cut and the rod cannot feed by gravity.

nearly perpendicular as possible, to secure a good feed. Red glass is used to protect the eyes. As soon as sufficient metal has accumulated, the arc is withdrawn and



Winged projectiles made by means of electric arc welding. An example of how the process is applied to production as distinguished from repairs.

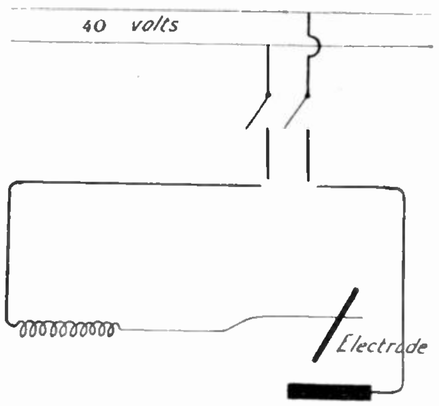
the joint is vigorously hammered. The hammering is stopped as soon as the metal reaches a dull red, 1,300 degrees F., or the joint may be impaired by the jarring.

The sectional views show the successive steps of welding. A small layer of metal is first deposited in the bottom of the cut, to a thickness of about one-quarter of an inch, and the operation stopped, while the surface of the metal above the layer is scraped so as to brighten it. Other layers of metal are successively melted in, until the place is completely filled and the metal even rises a little above the surface.

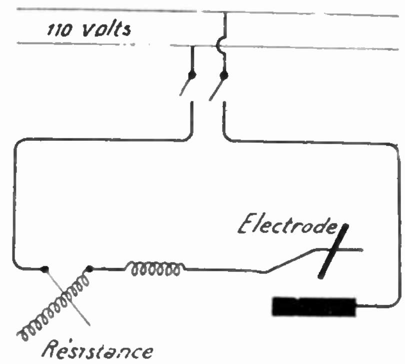
It is always advisable, or even necessary, to give a preliminary heating to 300 or 400 degrees F. of the part to be welded, which is very readily done by placing a block of red hot iron from the forge upon the cut. Although in many cases alternating current can be employed, the direct current enables the temperature to be more easily regulated. Using direct current, the electrode is usually connected to the negative pole, which has the effect of giving a higher temperature to the metal being treated. In this way heat is concentrated where it is needed, and the sum total of the heat is less than if alternating current is employed. But there is one case in which the poles are connected in the opposite sense, when a large mass of metal is to be deposited upon another piece. In this case heat is needed at the electrode to melt a quantity of metal quickly.

So far we have dealt with the repairs of steel and iron. Defective pieces can be restored as they come from the rolls by effectively filling in any surface holes, although, of course, holes in the interior are hopeless. But when it comes to copper and brass, the problem is more difficult on its face. Here the oxyacetylene process encounters great difficulty on account of the high conductivity of the metal, but with the arc the high temperature instantly melts the metal and does the work. The electrode is almost always pure copper, surrounded by a copper fluxing material, and in this case the copper electrode is connected to the positive pole, if, as is desirable, the direct current is used. Frequent hammering and intermittent scraping of the metal is necessary.

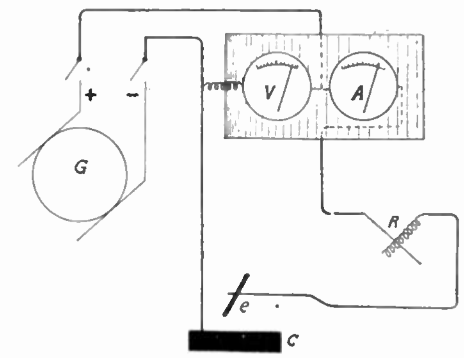
When using the direct current special attention must be given to the resistance, which should be of ferro-nickel or of some



The simplest connection of an electric welding circuit, the lower heavy black line representing the material to be worked on.



A circuit the same as the preceding, except that there is a variable resistance introduced so as to control the amount of current passing through the welding arc.



A full connection, (D) representing a generator, and (V) and (A) volt- and ammeters, (C) the material operated on, (e) the carbon; and (R) the variable resistance.

metal whose resistance is very slightly affected by temperature. For alternating current a choke coil would seem the obvious thing, but a coil giving self-induction, one without any iron core, is recommended as the better.

When the circuit is of more than 220 volts potential it is strongly advised to use a transformer to reduce the voltage.

The arc process is not always available; for thin metal spot welding is recommended. Metal a quarter inch or less in thickness is not adapted to the process described.

Boilers are mended with it, corroded propeller shafts on ships have all pittings closed up by it, and it is used in true productive work, as in the making of projectiles—it being remembered that in many of these cases the oxyacetylene flame is used as an adjunct.

Appliance for Tapping Electric Wire

By Maurice E. Pelgrims

Antwerp Correspondent of PRACTICAL ELECTRICS

THIS device, of French manufacture, consists mainly of a rectangular piece of insulating material (Fig. 2) provided with two steel needles fitted to brass plugs (A and A').

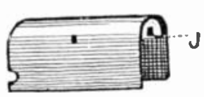


FIG. 1

A cover for the clip; the latter, when mounted on a double wire, will make contact with both leads to enable a lamp to be lighted from it.

To obtain a connection with the current flowing through a lamp cord or the like, all that is required is to insert the needles in each wire respectively, in such a manner that each needle pierces through its wire's insulation and the inner metal threads. A cover (Fig. 1) is then placed over the wires by sliding it along the grooves provided at (C and C') of the insulating material. The points of the needles, which may protrude about one-sixteenth of an inch, will then rest in the groove (J), which is also made of insulating material.

From the two tapping needles two wires run out to be connected where required; they are held in place by means of screws (B and B'). This type is used to branch a secondary circuit on an existing circuit, (D) representing an opening through which a nail or screw may be driven to fasten it to the wall or board, etc., as the case may be. Hole (D) may also be used as bearing for a supporting shaft (E), (Fig. 3), to which is attached a socket as shown, the result being then as in Fig. 5, which shows how an additional lamp may thus be connected anywhere on an existing line. An additional support (Fig. 4) permits the entire branching socket to be screwed to the wall as in Fig. 5.

The use of this new electrical accessory will render it possible to greatly simplify emergency wirings on existing circuits; countless applications are available for it. The illustration below shows different combinations: 1.—As used to tap the current on the existing line. 2.—As arranged to connect additional lamps to the existing line, supported by the original line. 3.—As fitted to the wires for screwing on walls, etc.

It will prove useful for temporary extra indoor decoration, as at balls, meetings, etc., where additional lamps or garlands enhance the decorative effects.

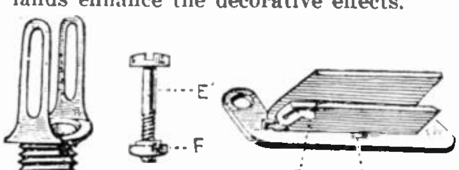
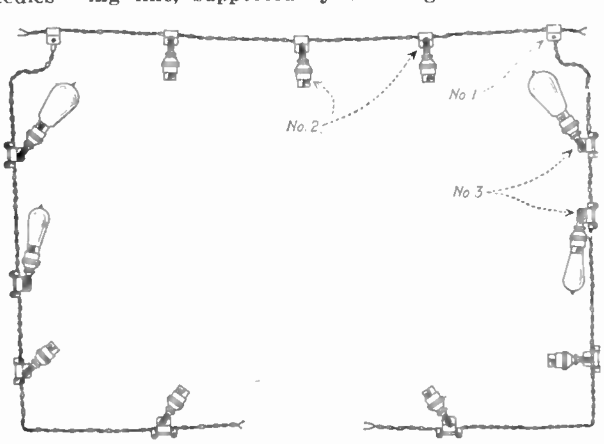


FIG. 3 FIG 4

Details of the lamp connections shown in the preceding illustration for permanent connection to a wall.

It is obvious that this system is capable of considerable development. In the large illustration, different phases are shown. In the upper portion three lamp sockets hang directly from the original lighting circuit. This same circuit is tapped, however, to the right and to the left as shown, establishing a short length of wire in parallel with it. On this short length of wire, lamps are shown connected to the wall sockets just described. Plugs below are ready to receive additional lamp sockets.



How a line can be tapped, No. 1 being one of the general taps, No. 3 showing individual lamps on the branch circuit, and No. 2 lamp sockets on the main circuit.

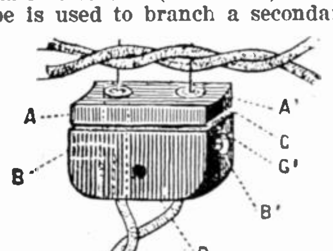
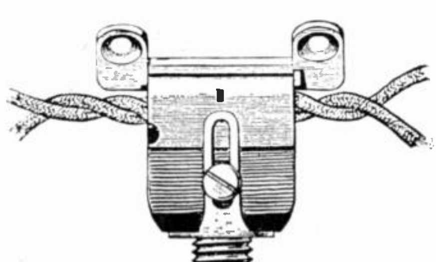


FIG. 2

A further illustration of the clip, full description of which is given in the article, each point projecting next to its one wire, so as to give almost perfect connection for a lamp.



A wall clip arranged secure to the wall with a forked connection screwed to it to receive the lamp socket.

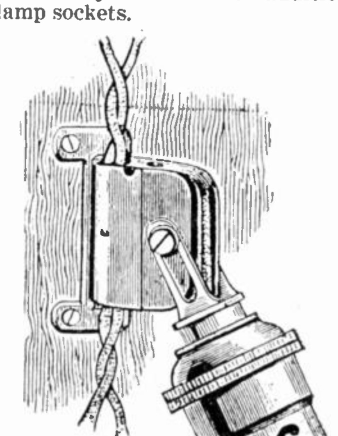


FIG 5

The lamp socket in position with the clip, the whole screwed to a wall to make a permanent connection thereto.

Awards in the $50 Special Prize Contest

For Junior Electricians and Electrical Experimenters

First Prize, $25	Second Prize, $15	Third Prize, $10
Mr. Edward L. Friedman	Mr. Leslie White	Mr. P. A. Simpson
621 W. 23rd St.	735 Rood Ave.	10703 Parkhurst Drive
Pueblo, Colo.	Grand Junction, Colo.	Cleveland, Ohio

First Prize

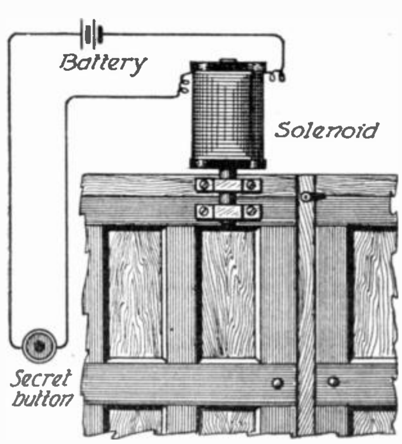
Electric Pantry Lock

By Edward L. Friedman

CHILDREN are often inclined to "raid" pantries and other storehouses of sweets. I employed the following method of keeping the pantry and other places locked, so that no key would be needed to open them, and so that they could always be opened by a turn of the magic button.

In order to make such a lock for a door a solenoid is fastened directly above the door on the inside. Clamped to the door, and immediately underneath the solenoid, is a bracket with a hole in it. This is arranged so that the end of an iron rod can drop into the bracket and a stop under the bracket will prevent it from slipping through. Half of the rod is in the bracket, the other half is in the solenoid. When the current is turned on the rod is pulled up by the solenoid and the door can be opened. When the door is closed, the current is turned off and the rod falls back in place, preventing the opening of the door. The switch or button should be concealed so as to be out of sight.

In making this lock, care should be taken in the construction of a solid, strong solenoid in order that all attempts to wrench open the door will be futile. If the door opens inward no bracket will be needed; the projecting bar will hold it.



A lock whose bolt is controlled by a solenoid and operated by a concealed button; a keyless lock.

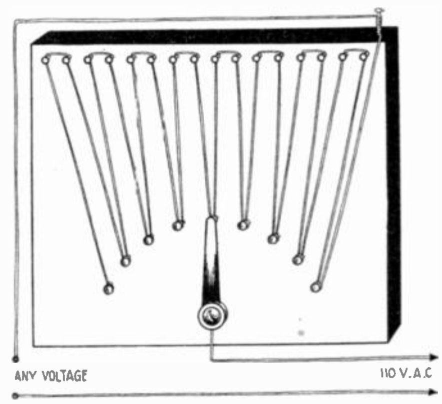
Second Prize

Drum Snare Rheostat

By Leslie White

A VERY good rheostat can be made from an old set of snares taken from a snare drum. The close wound silver-plated wire snare makes the best as the resistance is much greater per foot than the open wound ones. A set consists of twelve snares; six double lengths of wire. Solder the snares together so as to make one long length.

Obtain an inch board, 18 inches long by 12 inches wide; two binding posts; 25 ¾-inch No. 7 screws; the set of snares and a piece of asbestos paper that will cover the board. Tack the asbestos paper to the board with small tacks at each corner.



The snares from a drum are found to give an ideal resistance for a delicate rheostat, whose construction is shown in the illustration.

About an inch from the edge of the board at one end set a line of screws one inch apart, the last one to be a binding post. On the other end of the board place a screw in the center, 6 inches from the edge, and make a half circle on both sides with 9 screws, 4 on each side of the central screw. These will act as switch points. A piece of No. 6 or No. 8 bare copper wire flattened out with a hole drilled in each end will make a very good lever for the switch. On one end of the lever fasten a wooden handle such as come on coffee or tea pot lids. The other end is set under the binding post, in center at edge of board.

The screws in the half circle must be set in the wood at the same level so the lever will pass over them freely yet make good contact with each screw-head.

Now string the wire. Attach one end to the top binding post by soldering. On the upper row of screws pass around two screws, on the half circle of screws pass around but one. Solder the end of the wire to the last screw in the half circle.

This rheostat if properly made will step 110 volts A. C. current down to almost zero voltage and is just the thing for small motors, toy trains, doorbells, and may be used in connection with radio bulbs and small battery lamps using direct current from storage batteries.

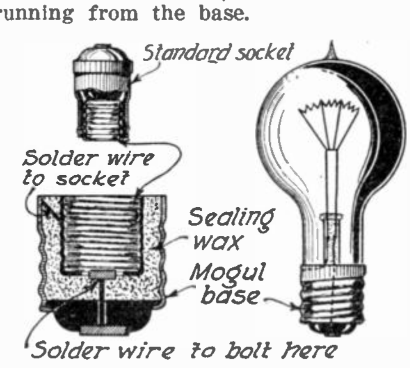
The wire snares may be bought from any musical instrument dealer for a dollar.

Third Prize

Reducing Lamp Socket

By P. A. Simpson

TO make a reducing socket out of a mogul lamp base and an old standard lamp socket, take an old lamp with a mogul base, break the bulb and take all glass out of the base; save the two wires running from the base.



Making a Mogul lamp base adapted for receiving a standard lamp base, so that the Mogul socket can be used for the standard lamp.

Next take a standard lamp socket, remove the brass socket part, and put it inside of and concentric with the Mogul base. Solder one wire from the Mogul base to the side of the standard brass socket, bending it as shown; solder a brass bolt to the wire running from the center of the Mogul base; fill space between the bases with sealing wax or plaster of Paris.

This reducing socket is very useful in an electrical workshop or chemical laboratory, also in a repair shop or factory. The construction is simple, and dispenses with any reason for throwin mogul bases away, which is a frequent practice.

$50 in Prizes!

A special prize contest for Junior Electricians and Electrical Experimenters will be held each month. There will be three monthly prizes as follows:

First Prize	$25.00 in gold
Second Prize	$15.00 in gold
Third Prize	$10.00 in gold
Total	$50.00 in gold

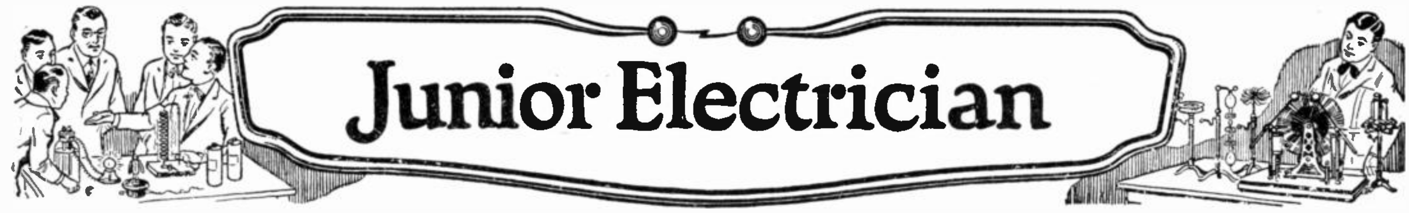
This department desires particularly to publish new and original ideas on how to make things electrical, new electrical wrinkles and ideas that are of benefit to the user of electricity, be he a householder, business man, or in a factory.

There are dozens of valuable little stunts and ideas that we young men run across every month, and we mean to publish these for the benefit of all electrical experimenters.

If in any way possible, a clear photograph should be sent with the idea; but if that is not possible, a good sketch will do.

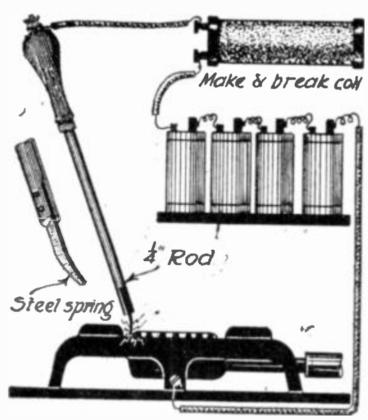
This prize contest is open to everyone. All prizes will be paid upon publication. If two contestants submit the same idea, both will receive the same prize.

Address all manuscripts, photos, models, etc., to *Editor, Electrical Wrinkle Contest*, in care of this publication.



Junior Electrician

Contact Spark Lighter for Gas Stove



A stove lighter, operated by hand. A touch of the implement to the metal of the stove produces the lighting spark, with great economy of battery.

THE illustration shows a simple device used for lighting a gas stove or other fixture by means of a contact spark. A wooden handle is attached to a quarter-inch brass or steel rod, the end of which is split, and a steel spring, such as a short length of clock spring, soldered or riveted in.

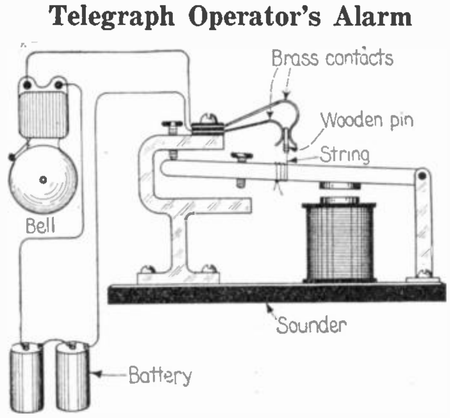
A flexible lead is connected to the end of the handle and carried to a make-and-break spark coil. Five or six dry cells or a 6-volt storage battery are included in the circuit, as a heavy spark is required to light a gas stove. Another lead makes contact with the base of the stove.

To use the device, turn on the gas and snap the spring point across some part of the burner near the issuing gas, which will be lighted. No switch will be required as long as care is taken not to leave the lighter in contact with the stove base. A saving in matches will result from the use of such a lighter.

If there is an A. C. lighting circuit in the house, a small step-down transformer can take the place of the battery and spark coil.

Contributed by H. H. PARKER.

Telegraph Operator's Alarm



A telegraph operator's alarm—the first motion of the armature of the relay starts a bell ringing, whose sound does not cease until the operator wakes to his task.

WE have again received a contribution from the Philippine Islands. It seems that a telegraph operator there has assigned to him sometimes the midnight hours when there is nothing to do except wait for his release signal of "G. N.," or good night. Of course, during those hours it is but seldom that a message will come in or go out.

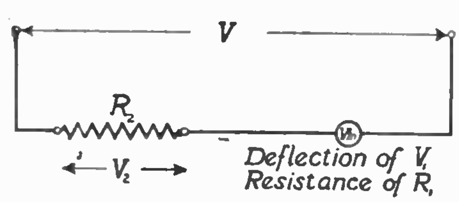
It seems he sometimes falls asleep, and the noise of the sounder is not sufficiently loud to awaken him. The illustration explains very nicely a special alarm circuit which will start a bell to ringing, and keep on ringing it if the armature of the sounder is depressed even for a single tap.

There is a spring contact which when closed completes a circuit including a battery and a bell. To keep the circuit open a wedge of wood is to be inserted between the leaves. The wedge is tied to the armature bar by a bit of string or thread. When the message comes in the armature is attracted, the bar is pulled down, withdrawing the wedge, and the spring contact closes. When this happens, the bell starts to ringing vigorously and the operator is awakened.

Contributed by C. C. CAMPOS.

Resistance Measurement

IT frequently becomes necessary to know the resistance of a coil of wire, or of some instrument, or perhaps of a condenser or an antenna. The connection



A diagram illustrating a very simple system of resistance measurement, utilizing a volt-meter and a resistance coil.

shown gives this figure and is also useful for measuring insulation resistance.

The apparatus required is a voltmeter and a source of E. M. F.

The potential difference of the source and also the range of the voltmeter should be of such values that a readable deflection is obtained wherever possible.

(a) Measure the potential difference of the source V.

Then connect R_2 in series and measure again as shown in the sketch, and this time obtain V_1 from which

$$\frac{V}{R_1 + R_2} = \frac{V_1}{R_1}$$

$$\text{Then } R_2 = \frac{R_1 V - R_1 V_1}{V_1} \text{ or } R_1 \frac{V - V_1}{V_1}$$

(b) $V - V_1 = V_2$

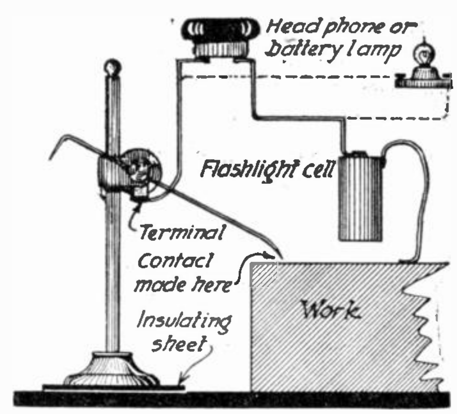
$$\text{From which } R_2 = R_1 \frac{V_2}{V_1}$$

A curve may be plotted between R_2, the resistance desired, and V_1, the deflection of the voltmeter when the resister R_2 is connected in series, from which the resistance may be read off.

Contributed by A. H. WOLFERZ.

Electric Contact on Surface Gauge

THE sensitiveness of a surface gauge is greatly increased by having the point complete an electric circuit when it touches the work. This may be indicated by the touch of metal to metal closing a



A surface gauge giving an electric alarm when the scriber touches the metallic surface, whose contour it is testing.

circuit and ringing a bell, or, better still, lighting a low-voltage lamp or making a click in a head-phone, the latter being the most sensitive method.

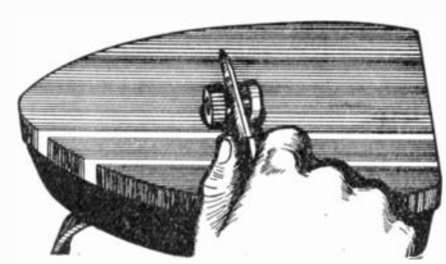
In a dark shop, especially, it is hard to determine by sight just when the point is brought down to the work. The electric contact method greatly facilitates the work and yet is not complicated. A sheet of rubber, fiber or even shellacked paper, is glued or cemented to the bottom of the surface gauge base to insulate it from the work, machine table or surface plate.

Then a terminal plate cut from sheet brass has a light, flexible, insulated wire soldered to it and is clamped under the tightening screw of the surface gauge or to any other convenient part of the apparatus. This wire goes to the bell, lamp or phone, as the case may be. Another lead goes from this to the battery; if a phone is used an old, nearly exhausted flashlight cell will do. The other battery lead makes contact electrically with the work, or machine table.

Contributed by H. H. PARKER.

Easily Made Lock Nuts

BRASS lock-nuts with an 8/32 thread may be easily, quickly and cheaply



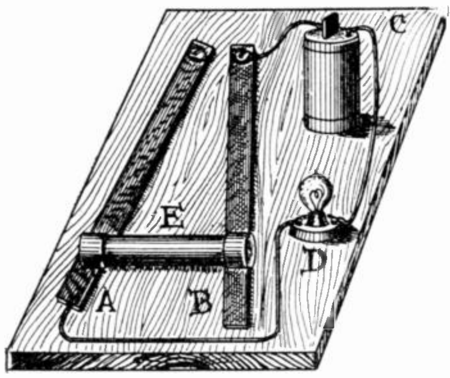
Making lock nuts of the brass nuts taken from dry batteries.

made from remains of discarded dry cells.

First get a flat piece of iron and a butcher knife (or other large knife). Then collect all the spare nuts from old dry batteries that you have. Now lay one of the nuts, from the battery binding posts, on its side upon the iron, take the knife, place the cutting edge in the little hollow that encircles the nut. Pressing on the knife, roll rapidly back and forth until nut comes in two pieces. Take either part (preferably the top), file both sides and your lock-nut is finished. Throw away the other part.

Contributed by John L. Stiles.

Fuse Tester



A fuse tester adapted for fuses of different lengths, the contacts being divergent to accommodate various sizes.

THIS is a very simple fuse tester, and the illustration is practically self-explanatory.

(A), (B) are metal strips, (D) is a flashlight lamp in a miniature socket, (C) is a dry cell. They are connected as shown. The fuse to be tested, either cartridge or plug, (E), is placed so that the two contacts of the fuse each touch one of the strips.

The strips are made spreading in order to accommodate any length of fuse. The current from the cell passes through the fuse if it is good and completes the circuit through the lamp. If the lamp does not light, the fuse is expended.

Contributed by Wm. C. Capune.

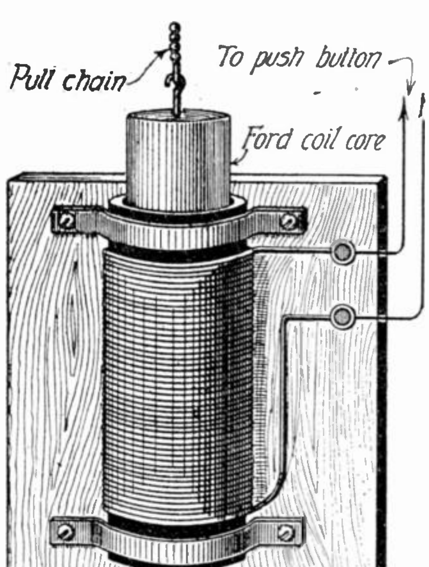
Solenoid Switch

I HAD occasion to use some kind of a switch for pulling the chain on a chain socket lamp, so as to light or extinguish it, and this had to be done at the distance of 100 feet from the lamp. The same arrangement would apply in the case of a lamp at an inaccessible height, and is so simple that many others may find a use for it.

In my case it worked perfectly. A solenoid is to be constructed by winding five layers of No. 22 wire around a mailing tube, which may be from three-quarters to one inch inside diameter, and 5 inches of its length are to be covered with the wire. It may have a total length of 6 inches. This is then mounted vertically on a wooden base as shown in the illustration.

For a core of the solenoid I used the core of a Ford coil, but, of course, a round bundle of iron wire or other cylinder of iron would answer perfectly. A hook is soldered to the center of the core, as shown. The solenoid is mounted below the pull chain of the socket, which is fastened to the core by the hook. The wire connections are exactly the same as those of a doorbell, with a push-button to actuate it. The solenoid core should have a play of sufficient extent to operate the switch. This the constructor will have to look out for. For a very long circuit a relay and local battery may be used.

Contributed by Charles Finical.

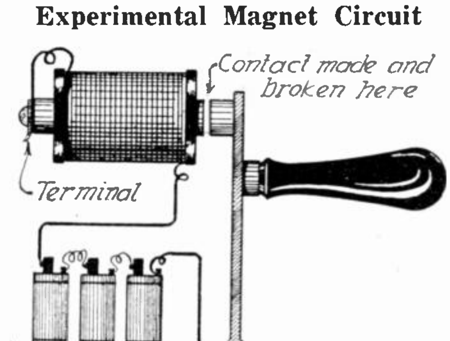


A solenoid switch for turning an inaccessible light on and off electrically.

Electrical Articles Scheduled for January, 1923, "Science and Invention"

- Electricity and X-rays to Kill Cotton Weevil.
- Submerged Searchlights to Light Niagara Falls.
- Motion Pictures That Talk—Big feature article describing and illustrating four of the latest and best systems, including that effected by Dr. Lee de Forest.
- Electric Bath de Luxe. By H. Gernsback.
- Electric Tight Rope Walking.
- New Electro-Medical Ideas.
- Loud-Talker Contest Prize Winners and Descriptions of Instruments.
- Experimental Electro-Chemistry. By Raymond B. Wailes.
- Electrical Motor Hints—$50,00 in Prizes Monthly.
- Radio Department—Fifteen articles including up-to-date list of broadcasting stations.
- Latest Patents.
- Question and Answer Box.
- Patent Advice.

Experimental Magnet Circuit



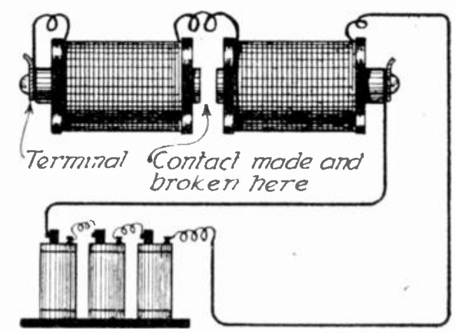
An electro magnet circuit whose peculiarity is that the circuit is completed through the core of the magnet, so that it is only closed when the armature is against the magnet pole.

AN interesting experiment with a pair of electromagnets or with a magnet and armature is to include the magnet cores in the circuit as shown in the sketch.

This might suggest something to an inventive genius, such as a quick-acting trigger cut-out or similar device, as it can be seen that the magnets are not energized until the cores, or core and armature, actually touch.

The cores can be brought right up to each other without any pull interfering, but as soon as they touch they are locked together. Similarly, while a strong pull is required to part them, once they are pulled apart the circuit is broken and there is no attraction between the cores.

Contributed by H. H. Parker.

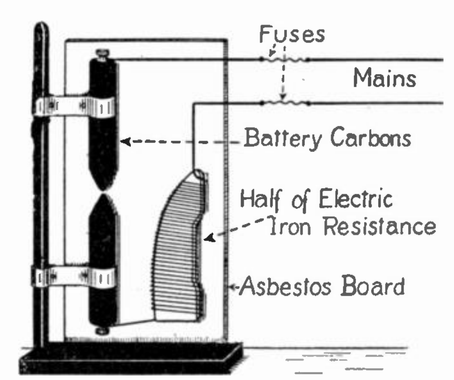


An identical system to the one just described, except that two magnets are used and the contact of their cores completes the circuit.

Arc Lights on 110-Volt A. C.

THE illustration shows a connection operating an arc light from a lighting circuit. The two carbons are from dry cells. A resistance is necessary or the fuses will blow. The reason for this is: An electric arc decreases in resistance as it becomes hotter, or as it gives more light. If connected directly on a power line, it will constantly diminish in resistance and burn out some of the connections and bulb fuses. To counteract this trouble a resistance has to be placed in series with it, and the material of the resistance should be such that as it gets hot it will increase in resistance. This works exactly counter to the arc, and holds it reasonably steady. I used half the heating unit of an electric iron to keep it constant and found it to be very satisfactory. To test the arc out I placed the whole on an asbestos base, as in the diagram, and placed the carbons just touching each other. When the current is turned on a brilliant light will come from the tips of the carbon; with an ordinary porcelain insulator tap one carbon rod so as to increase the distance between the two to about an eighth of an inch.

A resistance used in circuit with an arc increases in ohmic value as the current increases, due to the accompanying heat increase. The greater the current, the greater is the resistance. Exactly the opposite takes place in an arc, so that if there is no counteracting appliance, the resistance from an arc gets less and less, and it passes more and more current until something burns out.

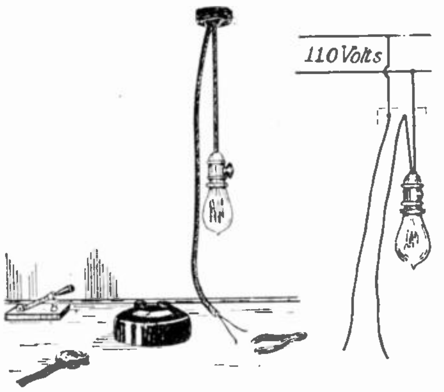


An arc light using a resistance taken out of an electric flatiron as ballast for the arc.

Different electrical apparatus can be made using the electric arc, as an electric furnace, searchlight, spotlight, etc.

Contributed by Samuel Litchinsky.

Test Terminals from Lighting Circuit



A system of taking test terminals from a lighting circuit for use on the electrician's work-bench.

A CONNECTION which will prove a convenience for a workshop or laboratory is illustrated herewith.

A piece of lamp cord long enough to reach from the work bench to one of the electric fixtures is secured. One end of the lamp cord is then tapped into the lighting circuit so as to be in series with the light, while the other end is arranged to hang over the bench.

The two terminals thus provided are always within easy reach and are useful for testing electrical apparatus. There is no danger of blowing a fuse because the light is in series. When not in use, the terminals may be twisted together. It is well to have the "hot wire" connected to the lamp.

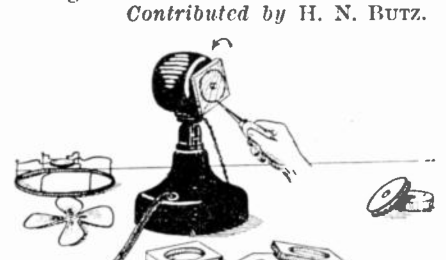
Contributed by H. N. BUTZ.

Making Small Wood Pulleys

HERE is a very satisfactory method of turning small wood pulleys without a lathe: The fan and fan guard were removed from an ordinary 8-inch 110-volt electric fan. On the end of the motor shaft thus exposed I mounted a small block of wood, 2 by 2 by 1/4 inches. The block was mounted by drilling a hole in its center and then forcing the block on the motor shaft. When the motor is then started the block is rotated at high speed.

By holding a sharp awl or other instrument against the spinning block the wood may be turned down to a flat or grooved face pulley which is suitable for experimental apparatus. I found it necessary to have the tool sharp always, and also that an awl-shaped edge gave better results than a straight edge or a sharp-pointed tool. Old files which have been sharpened on an emery wheel do good work. A small emery wheel which will fit the motor shaft is very handy for sharpening the same tools used for the turning.

Contributed by H. N. BUTZ.



Using a fan motor for turning out light wooden pulleys, a new application of this useful motor.

Home-Made Telegraph Line

THIS simple telegraph has been in use for weeks, giving efficient service. Directions for constructing it follow:

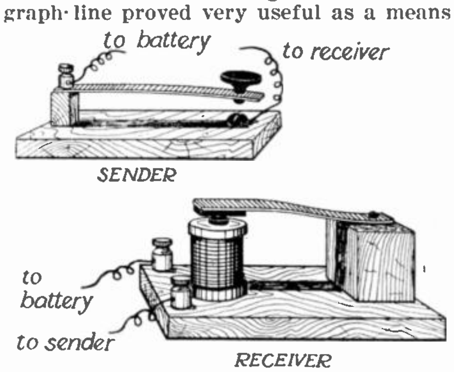
I found in my electrical laboratory a fire-alarm bell with three iron magnets. These magnets I unscrewed from their base.

Next, proceeding from laboratory to workshop, in a 3 x 4-inch wooden base I bored a small hole about as large in diameter as a 5-penny nail, and in this the magnet was inserted.

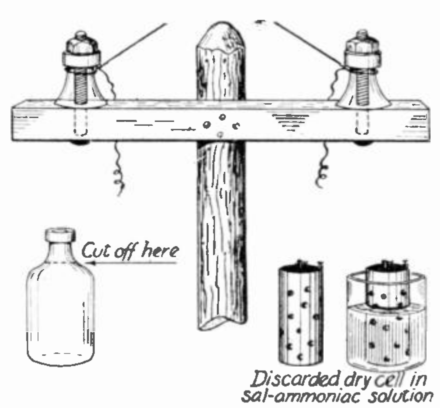
I then worked out a small block of wood and fixed the telegraph set in position, as shown in the illustration. I procured two old dry batteries which I drilled with holes, and two fruit jars from which I cut the tops off, to permit the dry batteries to enter. About 20 cents' worth of sal ammoniac was divided equally and placed in each jar, lukewarm water being then added to fill the jar.

From four large medicine bottles I cut off the necks and bolted the necks to a piece of wood shaped to represent the cross arms of a telegraph line. I ran wires from our house to the residence of a friend, ten doors away.

This home-made arrangement of a telegraph line proved very useful as a means of learning the code, and also practical for sending messages.



Sending key and sounder of a home made telegraph plant, requiring practically nothing but material found in the workshop.



Use of bottle necks for insulators and of discarded dry cells for the working battery of the home made telegraph.

Contributed by DOMINIC BRONCO.

Spark Coil Experiments

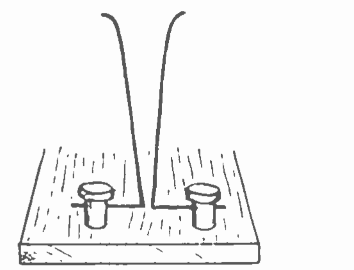
EXPERIMENTERS will welcome a small spark coil outfit which may be carried from place to place, and is so constructed that many experiments may be carried out. The one described here will be found to answer all purposes:

A neat base, 12 inches by 8 inches by 1 inch is prepared. Two binding posts are inserted 1 inch from the end, each post being 2½ inches from each side. Two and one-half inches from the other end, two more posts are inserted, each being 1½ inches from the side.

Two Ford spark coils are mounted on the base. The primaries are connected in series and the secondaries in parallel. One of the vibrators is blocked. The two binding posts, 1 inch from end of base, are used for primary connections while the other two are for secondary.

Two pieces of No. 14 hand-drawn copper wire, 16 inches long, are bent at an angle of 90 degrees, four inches from end. Two more pieces, 6 inches long, are bent 2¼ inches from the end.

By placing one of the longest bent wires in each secondary binding post, the wires being one-quarter inch apart at the bottom and receding until they are 1½ inches apart at the top, as shown, and connecting one of the primary posts to the hot wire of the 110-volt alternating current mains, the other post to a water-pipe or other suitable ground, long sparks will start at the bottom of the wires and climb to the top. As soon as the top is reached another series of sparks will start at the bottom and go up, etc. This is called "Jacob's Ladder."



Electrical Jacob's Ladder which is produced by the simplest method, and is of special interest as the same is used on high voltage power lines.

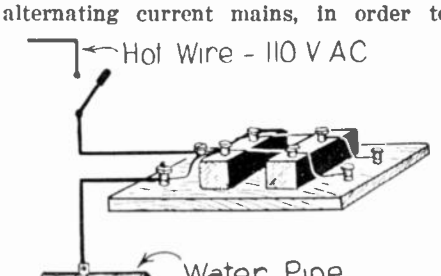
Another experiment is to connect one secondary wire to an ordinary lamp. When the "juice" is turned on, if viewed at night, the lamp will be filled with a very pretty and mysterious glow. Different sized lamps glow differently.

A small drinking glass, three-quarters full of water, is placed upon a brass or copper plate; another plate of the same metal is placed on top of the glass. The bottom plate is connected to one secondary and the top plate to the other. After the current has been turned on, long streamers of bluish flame should appear around the glass, and the water will give off a bluish glow. This is a very pretty experiment and the effect is more pronounced at night.

In order to operate Oudin coils and Tesla transformers, put the two small bent wires in the secondary posts so as to make a spark gap. A wire is connected to the primary of the Oudin coil or Tesla transformer and one post to the spark gap, with a high voltage condenser in series. The other post is connected to the other end of the primary.

Still another experiment can be performed at night. When the coil is set in operation, the secondary posts and wires connecting them to the secondaries of the coils, will be covered with a corona discharge, and sometimes, if the vibrator is adjusted properly, long blue straggling sparks will jump off the secondary binding posts in different directions.

To find the hot-wire of the 110-volt alternating current mains, in order to operate the coils, connect a wire to a water pipe and touch the alternating current wires. The wire that sparks is the hot-wire.



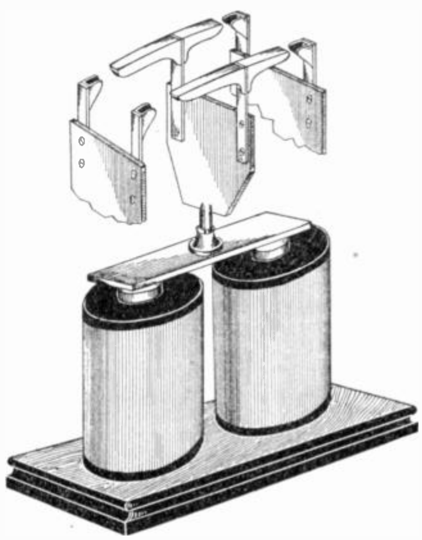
How two spark-coils are arranged for the experiments, the primaries in series and secondaries in parallel.

Contributed by JAMES EDWARDS.

Automatic Current Reverse Relay

PARTICULARLY when charging storage batteries, is a reversal of the charging line a serious occurrence. It may not only discharge the battery if preventive precautions are not taken, but will probably destroy the battery. If a reverse-current-release circuit breaker is employed, the circuit will open upon reversal of current, but the charging stops right there until such a time as discovered by attendants.

The illustrations shows a type of relay which will automatically preserve the correct polarity in the charging line, regardless of the reversal of the line one or a dozen times. The construction is simple.



A polarized relay operating to reverse the current, with specially good connections.

The cores of a polarized relay are rewound with coarse wire and mounted upon a good insulating base. A proper resistance will have to be inserted between the line and the relay windings, the correct value for which will depend upon the individual circuit being employed in charging.

Two well insulated contactors are mounted upon a perpendicular extension of the oscillating arm and leads are run to the battery bank or other apparatus. Stationary contacts are placed on either side in two pairs, so that the oscillating arm will bring its two contacts in conjunction with the stationary contacts, on either side, depending upon the direction in which the armature arm is inclined.

Leads are run to the first stationary pair direct from the line and then crossed over to the second stationary pair in such a manner that the polarity of the correspondingly opposite stationary contacts are opposite. If the polarity of the line is of one stationary status, the relay will keep the contacts on its extension inclined

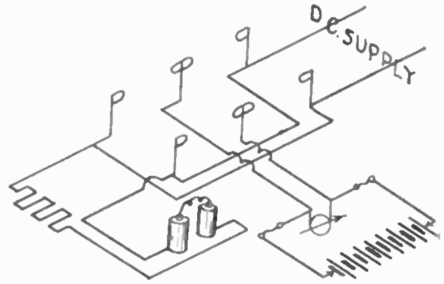
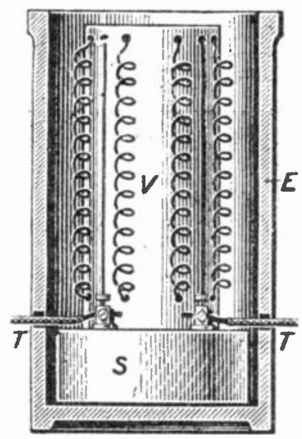


Diagram of the wiring of the polarized relay, showing how the reverse effect is obtained.

to one side, but if the line polarity reverses, the reversal of the current through its windings will cause the oscillator arm to incline to the other side, effecting a reversal of the charging line, by dint of the wiring employed; and the charging line will therefore again be of the original polarity. A wiring diagram is given.

Home Made Water Heater

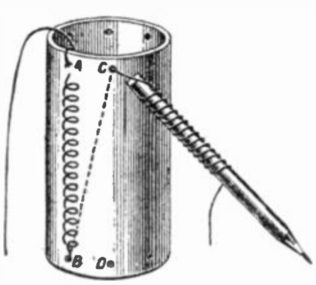


Interior view of a simple and easily constructed water heater using a porous cup to carry the coils.

FROM our French contemporary *La Science et la Vie*, we take the following:

A cylindrical battery jar four inches high and two inches in diameter is pierced with eight equidistant holes, a little over 1/16-inch in diameter; around the upper edge and near the bottom there are eight other holes corresponding to these. A porcelain jar is to be used which can be easily drilled by hand. About five yards of ferro-nickel wire, 12 mils in diameter, form the heating element of the apparatus.

Referring to the illustration, the wire is fastened at the point (A), keeping over an inch free and projecting outwards, whose use will be seen later. The long section of the wire is then wound around a pencil, forming a spiral of fifteen turns. The spiral lies along the outside of the jar, and the end is passed through (B) and the straight wire is led to (C), passed through the hole, and another spiral is formed as before. To the eight spirals thus arranged and spaced equidistant around the outside of the vessel (B) two similar ones are connected in the interior.



Details of manipulation in constructing the heating element of the heater, winding and placing the coils.

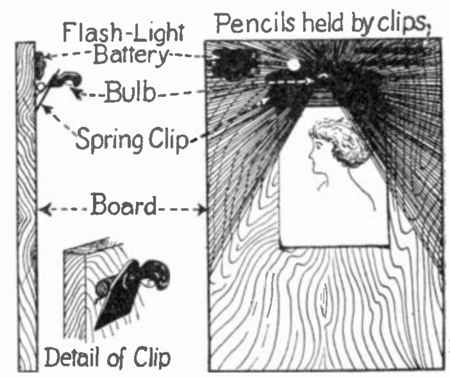
The vessel is then fastened to a block of wood (S) which projects on all sides about half an inch and which carries two binding posts to which the free ends of the wire are connected. An earthenware vessel (E) receives this apparatus. If a can is used, special care must be taken that the wire does not touch it.

> *EXPERIMENTERS and amateurs, we want your ideas. Tell us about that new electrical stunt you have meant to write up right along, but never got to. Perhaps you have a new idea, perhaps you have seen some new electrically arranged "do-funny"—we want these ideas, all of them. For all such contributed articles that are accepted, we will pay one cent a word upon publication. The shorter the article, and the better the illustration—whether it is a sketch or photograph—the better we like it. Why not get busy at once?*
>
> *EDITOR.*

Illuminated Writing Board

MANY people, especially students and newspaper men, find themselves required to take notes in the dark or on a cloudy day.

The portable writing board shown in the accompanying illustration is of about



A writing or drawing board illuminated by a flashlight, available for reporters and artists who may have to work in obscure places.

one-quarter inch wood and 12 by 18 inches in size. On the upper edge there is a heavy spring clasp to hold the paper, and upon this there is fastened a small dashlight fitted with a pocket flashlight battery.

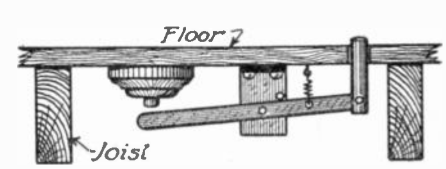
On the upper left-hand corner the flashlight battery is secured, and a switch opens or closes the circuit. The whole is enclosed in a neat, waterproof box. On the upper right-hand corner are two pencil clips to hold the pencils when not in use.

Contributed by FRANCIS J. LORENZ.

Floor Push Button

AN electric push button in the floor to be operated by the foot may be a convenience in shops, factories, etc. The one shown in the picture is very satisfactory and easy to make. Bore a ¾-inch hole in the floor at any desired spot for the pedal; 12 inches from this hole, on the under side of the floor, fasten the push button in place.

The mechanism is clearly shown in the sketch. An arm made of strap iron about 14 inches long, held in position by an angle bracket, presses the button when the pedal is depressed. The pedal is made of a piece of an old broom handle,



A floor push-button; the every-doy bell push used for the dining-room to be operated by the foot.

five inches long. A small spring supports the weight of the pedal when not in use.

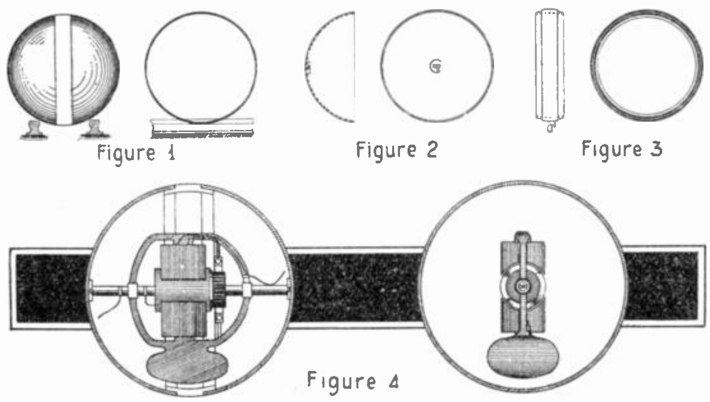
There is nothing fixed about these specifications; the idea can be carried out with the simplest appliances and is applicable to many purposes.

Contributed by HAROLD JACKSON.

IN this department are published various tricks that can be performed by means of the electrical current. Such tricks may be used for entertaining, for window displays, or for any other purpose. This department will pay monthly a first prize of $3.00 for the best electrical trick, and the Editor invites manuscripts from contributors.

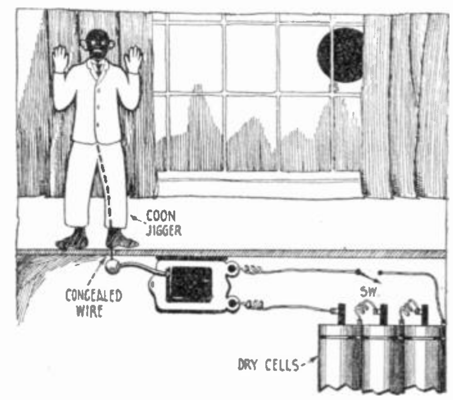
To win the first prize, the trick must necessarily be new and original. All other Elec-Tricks published are paid for at regular space rates.

Awards in the Elec-Tricks Competition



Left. A ball on track, which operates by means of a motor and pendulum concealed within it.

Right. A dancing figure operated by a concealed electric motor, designed especially as a window attraction.



First Prize

Traveling Ball

By L. J. Ballard

THIS ball is made in sections as shown, the two main sections being of metal and the center one of insulating material. It runs upon a pair of rails, which are connected to a source of electric current. Thus each of the metal halves is connected with its own rail.

Within the ball there is a motor whose terminals are connected to the right and left metal half of the ball, and there is a heavy counterpoise pendulum. As the motor rotates it tends to swing the counterweight forward, and in this way the ball mysteriously progresses along the rails.

Special care must be taken, of course, to conceal the fact that the ball is in sections. Ball bearings are recommended for the main bearings of the motor-shaft. The track is straight and has to have current turned on and off by a flasher, and can be laid a little higher at one end than at the other, so that after the ball has traveled up, under the influence of the current, gravity will bring it back again. The illustration is so clear that the entire construction will be readily understood.

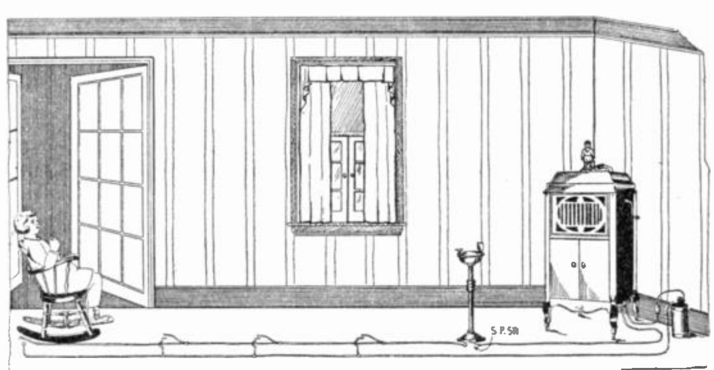
Second Prize

Dancing Doll

By Frank G. Du Roy

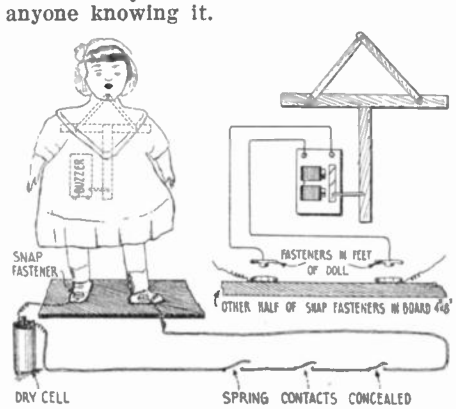
THE outfit for this dancing doll consists essentially of a doll with removable head, a small buzzer, a dry cell and some fine insulated wire. The buzzer is fastened on the inside of the doll and is connected with a stiff piece of wire to the arms, which latter are connected together by a small piece of wood.

The wooden strip is pivoted in the center of the body by a nail or screw. When the circuit is closed the doll will shake its arms and shoulders in a natural manner and will amuse the spectators. By using a number of secret contacts under our rug and placing the doll on the Victrola, I have very often succeeded in keeping friends spellbound.



A dancing figure operated by electricity which can be cut off from the current by a number of secret switches as shown.

To make the affair even more mysterious, I ran my concealed wiring to a contact, which is held closed by an ash tray stand, and if friends try to repeat my performance I simply remove the ash tray and thereby break the circuit without anyone knowing it.



An enlarged view of the dancing doll, which is supposed to operate on top of the phonograph in the illustration above.

Third Prize

Another Dancer

By D. Byrd

TO make a unique window attraction for a store, and at the same time one which is mystifying to the public, take an electric door bell, remove the gong so that the hammer is free to move to and fro, and fasten the mechanism of the bell under the floor in the store window.

Bore a small auger hole through the floor immediately above the end of the bell hammer. Fasten a small stiff wire to this end. Fasten the other end of the wire to an ordinary toy "Coon Jigger."

Connect in series, three dry cells and dead wires from them to the terminals of the bell. The hammer will vibrate back and forth at a rapid rate, thus causing the "Coon Jigger" to dance violently. The wire which connects the gong and "Jigger" should be so arranged that it cannot be seen.

Fourth Prize

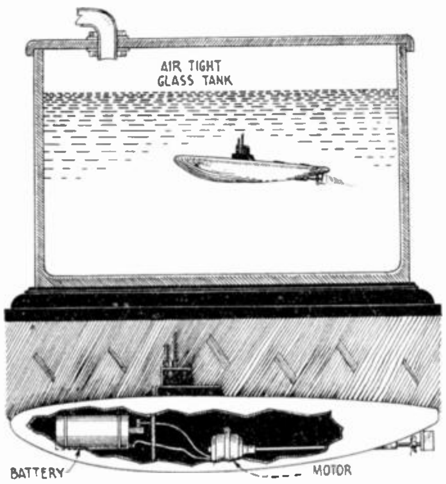
Cartesian Submarine

By G. Clear

A WATER-TIGHT glass tank is built like an aquarium and is made airtight as well. A hole is cut in the top for the water supply, and two rubber gaskets cut a little larger, and also two iron plates which fit one inside and one out, with a bolt through them, so they can be screwed up tight and keep all air out.

The tank is filled two-thirds with water; a small submarine is made in three parts, a battery is put in the front, ballast in the center, and a small battery motor in the back to drive it. Just enough ballast is provided to keep the submarine very low in the water; the rudder can be set so the boat will travel in a circle. There must be a hole in the bottom of the boat.

A small hole is drilled in the iron frame at the back (where it cannot be seen), above the water, and a small tube—gas pipe will do—is screwed in. The other



A little submarine actuated by an electric motor and made to descend or rise to the surface by air pressure controlled by an electric air pump.

end is taken to an adjoining room and a motor-operated air pump attached to it. When air is pumped into the tank the submarine will submerge to the bottom and stay there as long as the pressure is maintained. The pump is driven with a motor and flasher; it can be timed to put a little more air in when it is turning, and a leak can be arranged to let air slowly escape when the motor is in active operation so that the submarine will rise again. Little fish can be made to act in the same way; varying the pressure will make them rise and descend.

PRIZE WINNERS

First Prize, $50.00
L. J. Ballard
250 Beacon Street
Somerville, Mass.

Second Prize, $20.00
Frank G. Du Roy
37 Vermilye Avenue
New York City

Third Prize, $15.00
D. Byrd

Fourth Prize, $10.00
G. Clear
Polwarth, Saskatchewan
Canada

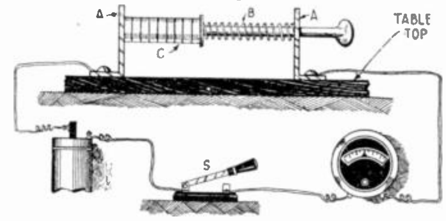
Fifth Prize, $5.00
Amedeo Giolitto
836 Illinois Avenue
Rockford, Ill.

Fifth Prize
The Magic Clamp
By A. Giolitto

AN experimenter possessing a good voltmeter or galvanometer can perform the following trick, which will keep anyone guessing as to how he can tell the correct number of carbon buttons clamped between two metal pieces.

To make the trick appear more mysterious the clamp can be covered with a handkerchief, after a person has clamped some carbon buttons in it. Then the performer steps from the adjoining room and tells the person how many pieces of carbon he has placed between the two metal pieces (A).

The numbers are inscribed on the voltmeter scale in the following manner, before the trick is performed: A carbon button is clamped between the metal pieces (A) which are screwed to the table top and connected to a switch, voltmeter, and battery as shown in the diagram. Closing the switch will cause the needle of the voltmeter to swing over the scale and



A compression rheostat used as the basis for a very good mystification; a purely scientific piece of magic.

then the number 1 is placed over the point where the needle stops. Adding another carbon button in the clamp will increase the resistance of the circuit and therefore the voltmeter will give a lower reading, the number 2 being placed on the scale so as to correspond with this reading. If three carbon buttons are in the clamp the voltmeter will give a still lower reading as the resistance of the circuit has been still further increased, the number 3 being placed at the point where the needle comes to rest, etc.

The buttons (C) should all be of the same size and can be made by sawing up a carbon taken from a dry cell.

How Does It Light?

IT seems that an incandescent lamp suspended in a store window at the end of a shoestring, and constantly giving light, has attracted considerable interest from passers-by in a city of the Northwest. The lamp in question is hung in mid-air at the end of a common shoe-

"Big Business" is sometimes carried on a shoestring. Here an electric lamp depends on the same fragile tenure.

string from a gallows-frame, as shown in one of the illustrations. Note particularly that there is no outside connection that touches either the brass thread of the lamp, or the brass tip.

Our front cover, and the adjoining illustrations, show the new mystery. It was originally conceived by Matthew Aparton, of Portland, Oregon.

The reader will observe in the same illustration that a horseshoe magnet is shown. The magnet, however, was simply a deception, as it had nothing to do with the lamp.

A small hole is bored on the under side of each rear pedestal of the scaffold, through which two very fine cotton or silk covered copper wires are drawn from under the flooring and led into a fine slit cut into the lower surface of the platform, thence running into the upright post and on through the projecting bar. The center threads are drawn out of the shoestring and the two fine copper wires are led through in their place. In order to make a double contact on the base of the lamp without touching the top of it, a fine hole is bored through the brass side of the base, one of the wires is pushed through this hole, and it is then fastened to one of the filament contact wires. The other fine wire is then slipped through the shoestring for about half an inch and tied around the outer brass base. The empty shoestring covers everything from view.

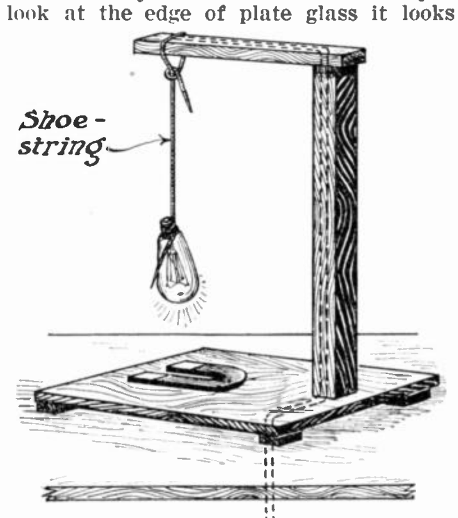
On connecting the wires to a lighting circuit, the filament of the lamp glows brightly.

A variation more mystifying than this is shown on our front cover.

Here we have a scaffold, the cross piece of which is made of plate glass. Everyone can readily see through the plate glass, and at first sight it seems out of the question that one can light an electric lamp through a piece of glass. Nevertheless it can be done, and has been done by the Editor of this magazine. Furthermore, it is quite simple of accomplishment.

Instead of running the wires through the piece of wood, we take two No. 36 or No. 38 copper wires, which are sufficient to carry the current for a 40-watt lamp. These two copper wires are run along the two narrow edges of the piece of plate glass until they come to the shoe string, where they enter the latter following the method described above.

Now everyone knows that when you look at the edge of plate glass it looks



The mysterious frame from which the brightly lighted lamp is suspended by an actual shoestring.

green. For that reason, the edges upon which the wires run are painted with a somewhat thick green paint, which covers the thin wire entirely, giving the onlooker the impression that the green paint is the natural green color of the glass.

Of course, some juggling with the color has to be done in order to get it of the right green. For instance, too light a green or too dark a green would be detected readily.

Short-Circuits

THE idea of this department is to present to the layman the dangers of the electrical current in a manner that can be understood by everyone, and that will be instructive too. There is a monthly prize of $3.00 for the best idea on "short-circuits." Look at the illustrations and then send us your own particular "Short-Circuit." It is understood that the idea must be possible or probable. If it shows something that occurs as a regular thing, such an idea will have a good chance to win the prize. It is not necessary to make an elaborate sketch, or to write the verses. We will attend to that. Now, let's see what you can do!

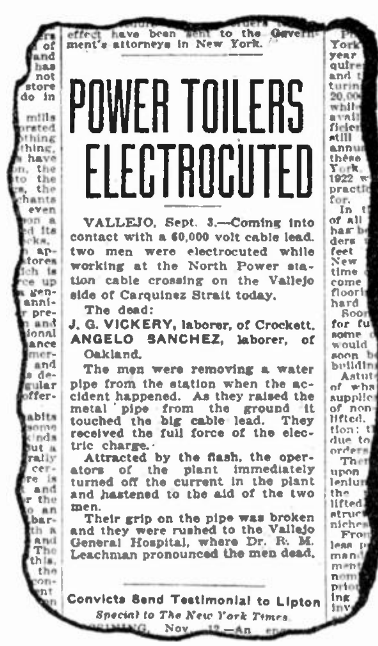
Here, friend, are the bones
  Of good Michael O'Dwyer;
Who would rescue one felled
  By a live trolley wire.
—SAULUS RICHMAN.

Prize Winner $3.00

Friend Mary, here planted,
  Is lost to the Nation;
Wet wash on a wire
  With a poor insulation.
—JOHN CALDER SCOBEY.

Under this myrtle
  Is Abraham Kohn;
He shorted the juice
  'Twixt the light and the phone.
—F. W. MCKENNEY.

Here's the grave
  Of Maggie dear;
A leaky iron,
  A stove quite near.
—O. E. BUSSELL.



effect have been sent to the Government's attorneys in New York.

POWER TOILERS ELECTROCUTED

VALLEJO, Sept. 3.—Coming into contact with a 60,000 volt cable lead, two men were electrocuted while working at the North Power station cable crossing on the Vallejo side of Carquinez Strait today.

The dead:

J. G. VICKERY, laborer, of Crockett.
ANGELO SANCHEZ, laborer, of Oakland.

The men were removing a water pipe from the station when the accident happened. As they raised the metal pipe from the ground it touched the big cable lead. They received the full force of the electric charge.

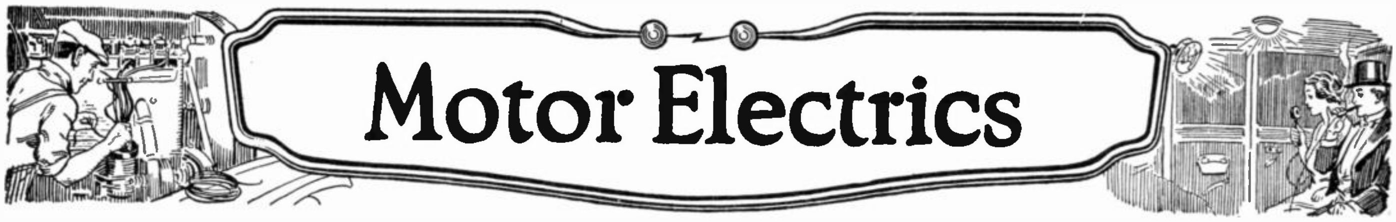
Attracted by the flash, the operators of the plant immediately turned off the current in the plant and hastened to the aid of the two men.

Their grip on the pipe was broken and they were rushed to the Vallejo General Hospital, where Dr. R. M. Leachman pronounced the men dead.

Convicts Send Testimonial to Lipton

Special to The New York Times

In this grave
  Lies poor old Jim;
The juice of a trouble lamp
  Leaked through him.
—JOHN MATTINGLY.



Measuring Distances by the Automobile

IN the last century the writer was a member of an exploring party in the Yellowstone country, where the Yellowstone Park now is. Everything was wild then; there were no roads and we slept either in tents or in the open. A rough attempt at topographical work was carried out, using the prismatic compass for bearings, while distance was measured by an odometer. All along the route of the party a two-wheeled cart traveled, on one of whose wheels a revolution counting instrument was affixed, so that the diameter of the wheel being known, mileages could be calculated from the readings of the counter.

In modern times the automobile, furnished with what is a revolution counter attached to the front wheel, does the same service for the traveler, while an electric appliance operated simultaneously gives the miles per hour at which the cars travel. The apparatus used on the automobile is not very finely graduated, and distances of less than one-tenth of a mile cannot well be read, at least with any degree of accuracy. It has been found also, what one would hardly suppose, that lost motion occasions considerable inaccuracy, when a measurement of distance is concerned.

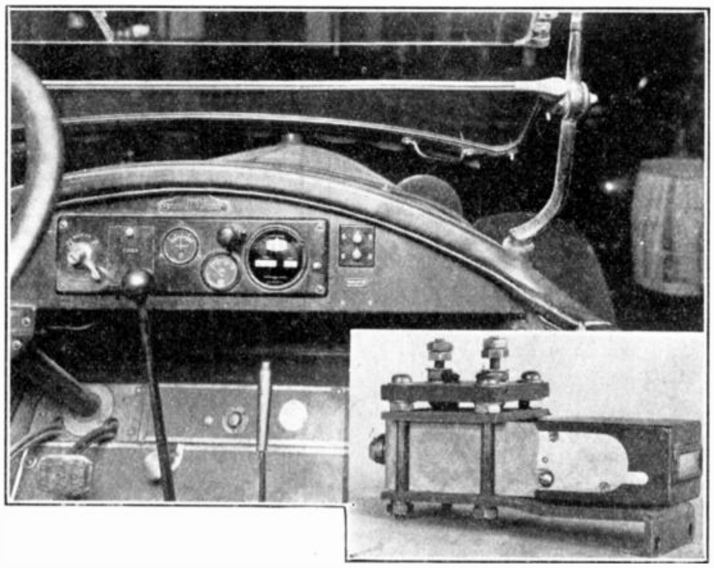
In such operations as the laying out of telegraph lines, where consecutive measurement is to be made from one pole location to the location of its neighbor, in the surveys for underground street lighting and for many such purposes, the distance needs to be read in feet.

One standard distance for telegraph poles is 176 feet, which gives 30 poles to the mile. Sometimes they are placed closer; 150-foot spans represent almost exactly 35 poles to the mile. It will be seen that as the tenth of a mile is 528 feet, the everyday speedometer on the automobile instrument board would be quite futile for any such purpose as placing such poles. An electrical apparatus does this with a close approach to accuracy.

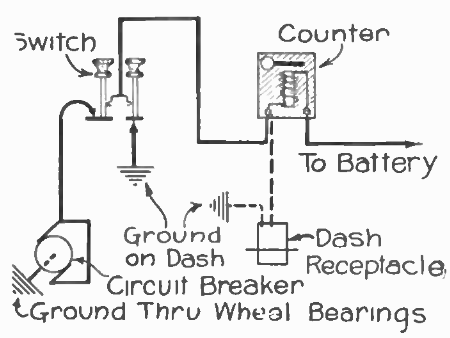
An automobile wheel carrying a 32 by 4-inch non-skid tire, properly inflated, passes over a distance of 8.38 feet in each turn. A counter is mounted on the instrument board of the car, which is operated by a current from the storage battery, and on the front wheel of the car there is an interrupting device acting on two stationary brushes like the commutator on the brushes of the two-pole motor. There are two interruptors on the wheel, so that each revolution gives two counts on the dial, each count representing a distance of a little over four feet. If we take the circumference of the wheel exactly as stated, then each count will represent a distance of 4.19 feet. A four-foot approximation is quite accurate enough for the laying out of pole lines, 42 counts on the instrument gives the distance from pole to pole where there are 30 poles to the mile. As it is found that a count of forty gives the approximate number of feet for the above standard with sufficient accuracy for practical purposes, 36 counts give 150-foot spans, or 35 poles to the mile in round numbers.

It was found that variations in the air pressure in the tire do not introduce errors large enough to be of any importance. The wearing down of the tire also introduces an error which is of little importance and which increases with time, but the coefficient of error can be found by running the car over a known distance, a half mile for ordinary purposes, while several miles can be covered for more accurate work. A speed of 25 miles an hour should not be exceeded.

Where distances are to be measured with still greater accuracy, the interrupter has been arranged for four contacts per revolution, in which case each count represents approximately two feet. It will be seen how greatly the reasonably good accuracy of the speedometer is surpassed by this electrical attachment, and it certainly is an interesting move in the direction of accuracy.



The instrument board of an automobile with indicator to give the readings of special apparatus for measuring distances with great exactness. The insert shows the indicating instrument.



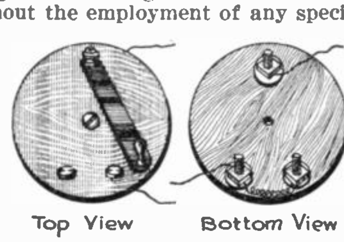
The circuit of the above measuring apparatus showing its switches, wiring and grounds.

Automobile Light-Dimming Switch

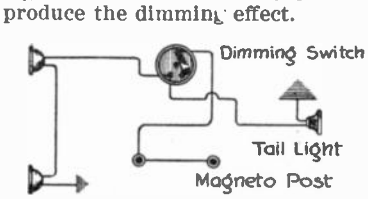
THE switch shown in the illustration is a very simple arrangement for dimming the headlights of an automobile without the employment of any special resistance. The idea of dimming the headlights of an automobile is to prevent the glare from impeding the vision of the driver of a car approaching in the opposite direction.

The general idea is for full illumination to have the two headlights receive the full voltage of the battery, and for the tail-lights also to receive it; in other words, they are connected independently, in a general sense in parallel with each other.

To reduce the light the tail-light is thrown into series with the headlights. This cuts down the voltage and reduces the illumination to one-half or less of the normal intensity. In one position the current of the battery divides at the switch, part going to the tail-lights and part to the headlights, so that each receives the full voltage. In the other position of the switch the headlights are brought into series with the tail-lights to produce the dimming effect.



Front and rear view of a switch by which the headlights of a car may be dimmed or made to operate at full brightness.

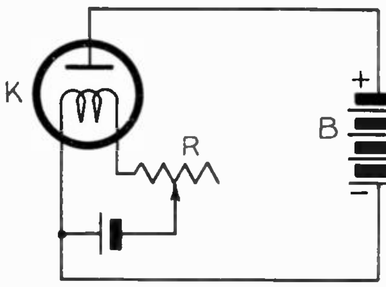


Connections for using the dimming switch of the other illustration, putting the headlights in series with the tail light or independent thereof.

Measuring Maximum Values of Voltage

By L. R. Felder

In measurements of voltage in alternating current work it is the effective value which is measured and used. However there is at least one particular class of measurements in which it is the maximum value of the voltage wave which is important, and that is in measurements of dielectric strength and insulation tests. What is usually measured in these tests is the voltage at which the insulation is pierced or otherwise breaks



1. Another interesting application of the kenetron to determine the peak of an alternating current, as fully explained in the article.

down, and in alternating current work this piercing or break-down voltage is the maximum amplitude of the voltage wave.

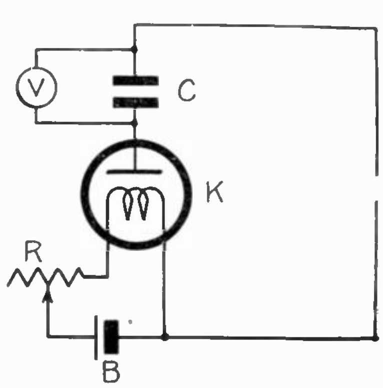
The problem of measuring this peak value of voltage is entirely different from that of measuring the effective value, for effective values can be measured directly on the usual types of meters, but maximum voltage must be measured indirectly by other means. It is possible, for example, to measure the effective piercing voltage by a meter, and then calculate the maximum voltage from the usual relationship between effective value and maximum value, namely,

Max. Voltage = 1.4 + Effective Voltage.

However since this relationship applies only to an alternating voltage having a pure sine wave, it will be evident that its use is very limited since the voltage wave may be very different from a pure sine wave. Again, spark gaps have been used to measure maximum voltages, but this method involves errors and inaccuracies. Thus when the spark gap discharges, the arc over the gap may produce stresses in the insulator under test besides the stresses produced by the high voltage, which is being measured, thus making the test unfair and the results inaccurate. Then again the voltage at which the gap arcs over depends upon such conditions as air circulation around the gap, nature and condition of the sparking surfaces, etc., all of which make any measurement unreliable. Similarly when the other usual methods are employed there are other disadvantages and errors involved which ruin the accuracy of the measurement.

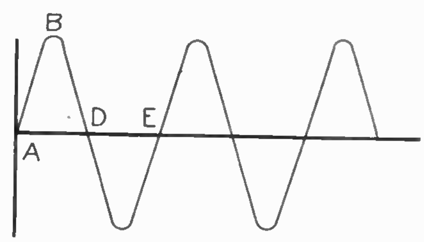
With the development of Electron Tubes there have taken place improvements and changes in the methods of electrical science, and one of these has been the development of an outfit for the accurate measurement of the maximum amplitude of an alternating voltage wave, regardless of the shape of the wave. This apparatus has been developed by the General Electric Company and utilizes a member of the Vacuum Tube family, namely, the Kenetron, thus adding another useful function to the large number of uses to which these tubes can be put.

The Kenetron is a highly evacuated glass tube containing two electrodes, one a tungsten filament, the other a cold tungsten or molybdenum plate. The tungsten filament may be heated to incandescence by current through it, supplied by a source of low voltage. This incandescent filament emits negative electrons, whose flow is controlled by the voltage on the plate. Let us consider for a moment Fig. 1 which shows a Kenetron K whose filament is lit by means of a battery (B). (R) is a rheostat to control the value of the lighting current. If a positive potential is applied to the plate the negative electron emitted by the filament will be attracted to the plate. If a negative potential is applied to the plate of the Kenetron the negative electrons emitted by the filament are repelled by the plate, and thus there is no current flow, and the circuit is open. In other words, *the Kenetron permits current to flow through it only in one direction when the plate is positive, but not in the other.* This is the principle on which the direct measurement of maximum values of A. C. voltage waves depends.



2. A kenetron condenser used to show the peak of the voltage of a non-sine alternating current.

This apparatus for the measurement of peak values consists of the elements shown in Fig. 2. (K) is the Kenetron, (B) the filament battery, (R) the filament resistance, (C) the high voltage condenser made of glass, and (V) is an electrostatic voltmeter. The operation of this outfit, based on the above mentioned principle, is as follows: The alternating voltage whose maximum value is to be measured is applied at the terminals



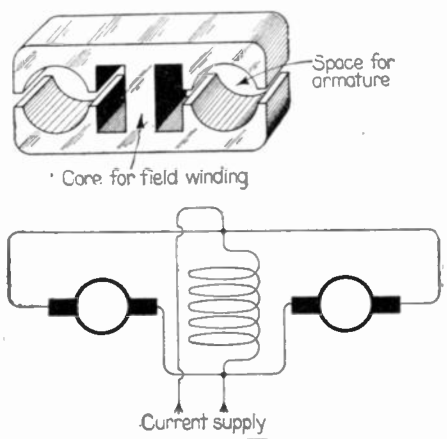
3. An alternating current curve, but not a sine curve, to which the factor 1.4 does not apply.

(TT) of the apparatus. Let us consider the first cycle of the alternating voltage as in Fig. 3. During the first quarter of a cycle (AB) of Fig. 3 there is a gradually increasing flow of current into the condenser, for the electron flow from filament into the plate increases as the voltage rises from (A) to (B). This current flows into the condenser (C) in the direction shown by the wave, and charges the condenser to the voltage of the applied source at every instant up to (B). When point (B) is reached, the voltage is at its maximum, hence the current through the condenser is also at its maximum, and the condenser is therefore charged to the maximum value of the voltage wave. This maximum value is registered by the electrostatic voltmeter across the condenser (C). Now when a condenser is charged by a direct current to a maximum voltage it retains this charge *unless the condenser charge leaks off somewhere*, depending on the insulation of the condenser.

Now the condenser (C) was charged by a direct current, since the direction of current flow between points (A) and (B) is the same at all times. Also the condenser has no means of discharging after point (B) is reached. For between points (B) and (D) there is still direct current flowing into the condenser in the same direction as before, and between points (D) and (E) of the voltage wave there can be no flow of current at all, for as we saw above the Kenetron will not permit any current to flow through it when the plate is at a negative potential, as it is between (D) and (E). Thus when the condenser (C) is charged to its maximum value by the positive half of the voltage wave it retains this charge, since it cannot discharge through the Kenetron. Thus the maximum value of voltage is constantly registered on the electrostatic voltmeter (V). Should there, for any reason, be a rise in voltage above (B) in Fig. 3 (due to a surge, for example), there will be a corresponding increase in the electron flow, the current into the condenser (C) will rise, and the increased charge will be registered on the voltmeter (V) as an increase in voltage. Thus we see that this device affords a ready means of measuring accurately and directly the maximum values of A. C. voltages.

THIS department is conducted for the benefit of everyone interested in electricity in all its phases. We are glad to answer questions for the benefit of all, but necessarily can only publish such matter as interests the majority of readers.
1. Not more than three questions can be answered for each correspondent.
2. Write on only one side of the paper; all matter should be typewritten, or else written in ink. No attention can be paid to penciled letters.
3. Sketches, diagrams, etc., must always be on separate sheets.
4. This department does not answer questions by mail free of charge. The editor will, however, be glad to answer special questions at the rate of 25 cents for each. On questions entailing research work, intricate calculations, patent research work, etc., a special charge will be made. Correspondents will be informed as to such charge.
Kindly oblige us by making your letter as short as possible.

Motor Design



An interesting construction of a motor with two armatures and a single field coil, suggested by one of our readers.

(215)—Sam Elder, of Alto Lomo, Calif., asks:

Q. 1.—Will the motor as shown in diagram work and will it give a great amount of power?

A. 1.—A motor such as you describe would work, but the arrangement will not have more power than a motor with a single armature and field equal in size to the one designed here but arranged according to the regular styles. We believe that there will be a depreciation of the power value in your arrangement.

Q. 2.—How would such a motor be connected up?

A. 2.—The motor could be so arranged that both armatures are in shunt with the center field.

Electro-Dynamics

(216)—Albert A. Rall, Independence, Missouri, asks:

Q. 1.—Kindly check diagram No. 1 and see if this arrangement will close an external circuit by means of ultra-violet rays so that I will be able to get a reading on a galvanometer. I do not wish to use an electrometer in place of galvanometer. Give me as much information on an arrangement of this as possible.

A. 1.—Your diagram will work if slight changes are made; no ultra-violet beam need be employed. Instead of the galvanometer, however, you could employ a very sensitive milliameter. In circuit 1, a high voltage battery is not absolutely necessary.

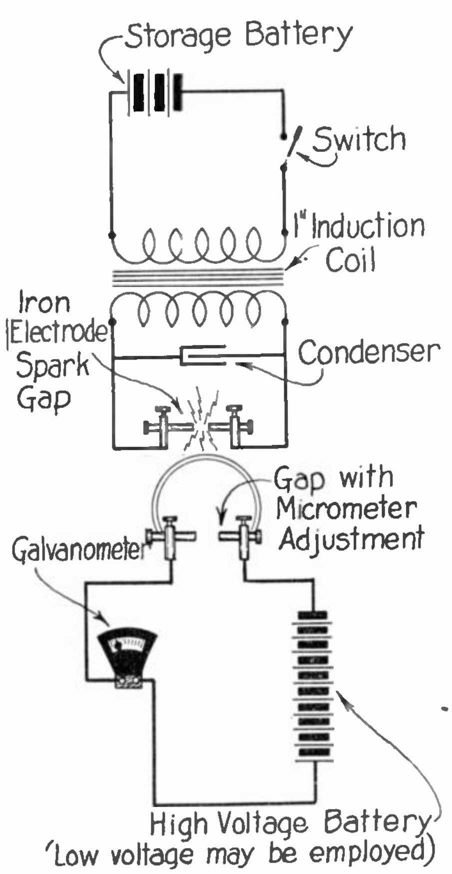
Q. 2.—Kindly give me information on the construction of a photo-electric cell so that I will be able to receive a reading on galvanometer as shown in diagram No. 2. I want to indicate that it is in proportion to the amount of light illuminating it, and in no way producing a current due to the heating effect of the rays. This cell also when placed in darkness is to show no current if possible.

A. 2.—You will find many interesting articles on photo-electric cells in recent issues of PRACTICAL ELECTRICS. Ordinary photo-electric cells do not produce current, and it will be necessary to connect batteries into the circuit. Special types made of copper plates placed in dilute sulphuric acid generate current, however.

At no time is the current absolutely nil when the photo-electric cell is placed in a dark area. Nevertheless, in most photo-electric cells, the current passed through them is proportional to the amount of light falling upon the cells. This proportion does not vary directly, but has a different characteristic for each individual cell. At a certain point, the photo-electric cell refuses to operate at any higher conductivity. Consequently, an extra amount of light imposed upon the cell will have no further effect on sensitive galvanometer readings.

In your first circuit, it will be merely necessary to tune the wave length of the transmitting station, so that it corresponds with that of the receiving station. A micrometer gap placed in the receiving circuit, will, when the transmitting station is operated, permit the passage of a spark across this gap, which spark will conduct the current of the battery.

In rhubidium photo-electric cells, the voltage employed is from 350 to 600 volts.



A curious problem in electro-dynamics, using ultra-violet rays produced between iron electrodes. The above are diagrams 1 and 2 of the query.

Railway Crossing Signal

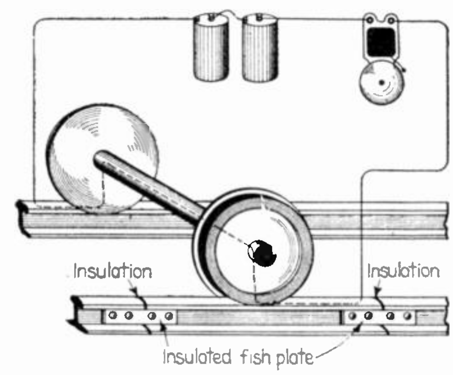


Illustration showing the principle of the operation of a railway crossing signal, using an insulated section of rail to operate it.

(217)—William Campbell, of New Kensington, Pa., wants to know:

Q. 1.—What causes an electric bell to ring when the train passes across a certain section of the track? I have been looking for all kinds of contacts, but have been unable to find any.

A. 1.—The contact for ringing a bell at a switch, etc., is made directly through the rails through the intermediary of the axle of a car. The rails are insulated from each other by fibre fish plates as per our diagram, and current applied to one side of this insulated rail section is carried across to the other by means of the axle of the car, as stated above. Sometimes the relay is inserted into the circuit.

Magnetic Effects

(218)—Lee C. Loque, Vicksburg, Miss., wants to know:

Q. 1.—What is the effect of passing a magnetic flux at right angles through an iron bar already magnetized?

A. 1.—If a bar of iron that completes the magnetic path of a magnet is saturated, any attempt to pass magnetism through it at right angles to the same would simply distort the magnetic lines of force of the field; there would be no cutting its effect in separate sets of lines.

Q. 2.—Would the strength of an electro-magnet be increased if a permanent bar magnet were inserted in the core?

A. 2.—No, an electro-magnet would not increase its strength, if a permanent steel magnet were put in the path of this magnetic circuit, provided that the electro-magnet is properly designed, so as to bring the core to its saturation point.

Q. 3.—Can an iron bar be absolutely and completely magnetically saturated?

A. 3.—No iron bar can be completely saturated, the effect of the current getting constantly less until an almost complete saturation is reached. By greatly increasing the number of turns around a coil the flux of the magnet will be slightly increased, but so small is this increase at the end that the increased effect would be scarcely noticeable.

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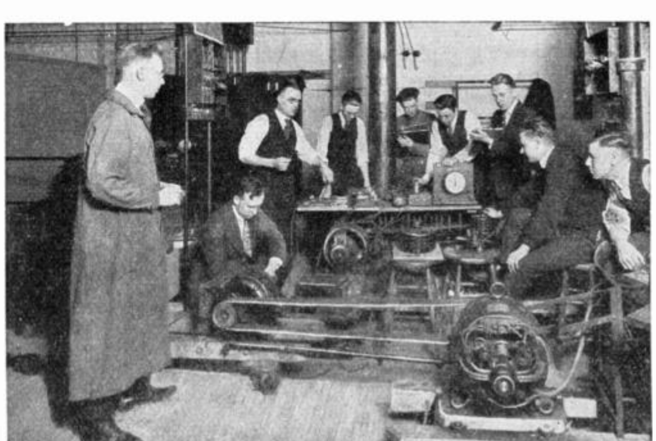

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Age ....

Education ....

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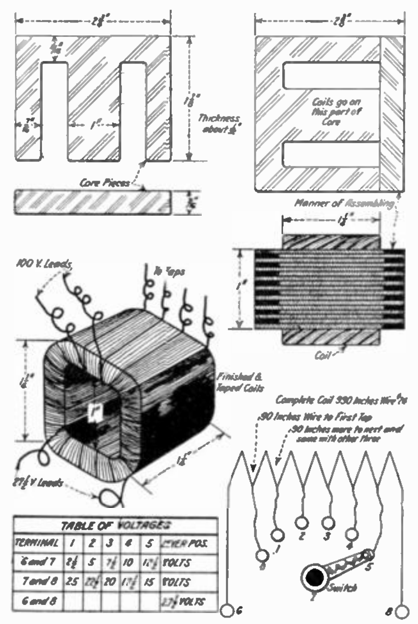
Closed Core Transformer

(219)—Marvin Leacroft, Hurleyville, Ky., writes:

Q. 1.—I would like the general outline of a transformer in which the coils pass through openings in the laminated core, so that only the top and bottom of the windings is exposed.

A. 1.—In a recent issue we described the construction of a very nice transformer on the lines you indicate, and we reproduce here on a diminished scale its layout. You will see that by using a sectional structure the laminations surround the coil, each lamination representing a three-pronged fork or comb-like structure, which pushes into place within the already wound coil. Rectangular cross-pieces close the end and if the whole is properly made, a very neat piece of work can be produced. Various taps can be taken from intermediate portions of the coil to give different results in the way of stepping up or stepping down the voltage, all of which you will find shown in the diagram. We also refer you to the original article.



Layout and dimensions of a transformer with closed core.

Step-Down Transformer

(220)—S. C. O'Dell, Cincinnati, Ohio, asks:

Q. 1.—Please give data on a step-down transformer to develop 18 volts, 9 amperes, at the secondary.

A. 1.—Here is the data which you have requested. This is for a transformer whose imput is 170 watts, and will deliver 18 volts, 9 amperes from the secondary. The iron core is 10¼ inches by 6¼ inches, made in the form of a rectangle, whose sides are 1 inch square in cross section. This is wound with 680 turns of No. 15 double cotton-covered wire, about 5 pounds of this wire being used for the primary. The secondary is wound with 111 turns of No. 10 double cotton-covered wire.

Lightning vs. Light

(221)—D. T. Root, of Farmdale, Ohio, questions a certain article on electricity, stating that lightning is not electricity.

Q. 1.—Please notify whether I am correct or not.

A. 1.—Evidently you have mistaken the meaning of the word lightning, and the flash of light due to the same. When the article stated that lightning was electricity, the statement was absolutely correct. Lightning is electricity and electronic disturbances in the atmosphere are particularly prevalent when a disruptive charge occurs between two points. What you probably intended to say is that the flash of light and the sound as a result of lightning, are not electricity.

Electric Window Display Novelties

(222)—Joseph F. Albion, Placenta, Col., inquires in reference to the above subject which has been interestingly treated in our Elec-Tricks Department, as follows:

Q. 1.—Can you mention several window display novelties?

A. 1.—There are several very good electric window display novelties. One is the magnetic ball. This ball is steel and is placed upon a platter mounted upon four legs, each leg being wound in to form a magnet. A commutator turns on the current in each leg intermittently and successively causes the ball to roll around.

In the second device there is a track in which are rolling various colored balls. They are seemingly in a race with each other, and a fan on either end causes them to travel around the track at some speed. In the third device, a stream of water is shot up toward a pail which is inverted, and it seems as though water is merely flowing from the pail and the pail is suspended in mid-air by radio or any other system you may care to advertise. In a fourth device, the lamp is lit up ostensibly by radio but in reality in the regular way, the wires being cleverly concealed. Each of these and many others have been described in ElecTricks Department of PRACTICAL ELECTRICS.

Noisy Mine Telephone

(223)—Ross A. Dano, of Herrin, Ill., states:

Q. 1.—I have installed a 1-wire telephone system in the mine where I am employed, using a single wire with a ground wire at each instrument, connected the same as in party lines, the ringing of one instrument rings them all. There is no central instrument and no one in charge of any one of them. The system is a success with one exception. When the electric locomotives which are used to haul coal are on the same entry as the phone line that one wishes to use, we find the line becomes very noisy. Could you advise me as to how this could be overcome without much expense. The circuit used for the above mentioned locomotives, pumps, lights, etc., is 250 volts, building up to 275. Locomotives are supplied with power from overhead trolley wire, using the rails for return.

A. 1.—There are several reasons why your phones are noisy. One is a probable ground; second, the fact that you are setting up cross currents in the wires. This is an artificial electrical atmospheric disturbance which even cripples telephone service in the cities and on special lines. It is overcome by enclosing the entire telephone cables in a lead sheath, which sheath is normally grounded along its entire length. Third, the vibration set up by the locomotive may affect the transmitter to such an extent that the carbon granules are shaken around inside. This could hardly be rectified unless an entire change were made in the phone transmitter. It is necessary that you suspen the transmitter from rubber bands and inclose this completely in fine mesh gauze in order to cut out extraneous noises and undue vibrations.

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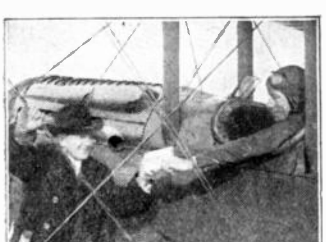

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View in an Airplane Factory

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The Bolometer

(224)—A. L. Heidemann, Milwaukee, Wis., writes:

The following question arises with reference to the bolometer described in October PRACTICAL ELECTRICS as to why the Wheatstone bridge connection is used:

Q. 1.—Would it not be better to connect the bolometer grating in direct circuit with the galvanometer, so as to get the full benefit of the current? In the Wheatstone bridge only a small part of the current affects the galvanometer.

A. 1.—We must recollect that the galvanometer must show only the changes of resistance of the infinitesimally thin platinum, and thereby the changes in its temperature. But a galvanometer will also show changes due to variations in the electromotive force of the battery, if everything were connected in direct circuit as you suggest.

But as every source of current inevitably varies more or less, some arrangement must be made to overcome a separate source of error, which would make the instrument inaccurate as a measurer of heat, and this source of error would be the changes in the battery if direct connected. The Wheatstone bridge connection supplies precisely the means of overcoming this error, as it is a proportional affair in the case of the bridge, and the changes in the source of current, in the way of increase or decrease of voltage or resistance in the battery, do not affect it. What is said really is of special interest as it shows how effectual the Wheatstone bridge is for measurement on account of this very proportional relation of currents in its arms, and its independence of fluctuations in the actuating current.

Step-Down Transformer

(225)—Vernon J. Wyse, Archbold, Ohio, asks:

Q. 1.—Please give data for a step-down transformer with 2-volt steps for voltages varying from 2 to 28 volts.

A. 1.—You do not tell us what your primary current is to be. We would advise that upon an iron core 10¼ inches long, 6¼ inches wide, with sides one inch square in cross section and assembled so as to resemble a hollow rectangle, you wind 660 turns of No. 15 B. & S. gauge single cotton-covered wire on one of the long sides. This is about five pounds of wire, and will act as the primary of your transformer. On the secondary wind three turns of No. 11 B. & S. gauge double cotton-covered wire for each two volts desired; thus, 3 turns equal 2 volts; 6 turns equal 4 volts; 9 turns equal 6 volts, etc. The secondary when completed will have 42 turns of wire upon it.

Another Transformer

(226)—V. O. York, Millington, Mich., says:

I desire to construct a transformer to cut down 220 volts to 110, to operate an electric iron.

Q. 1.—Can you give me data?

A. 1.—We advise that you construct a transformer in the following manner:

Upon an iron open rectangular core 11 inches long, 6½ inches wide, with sides one inch square in cross section, wind 660 turns of No. 15 cotton-covered wire for the primary. This core is made out of laminated iron and the wire is wound in six layers. The weight of the iron is about 11½ pounds, and 5 pounds of double cotton-covered wire are needed. For the secondary wind 330 turns of No. 12 double cotton-covered wire.

Rectifying Troubles

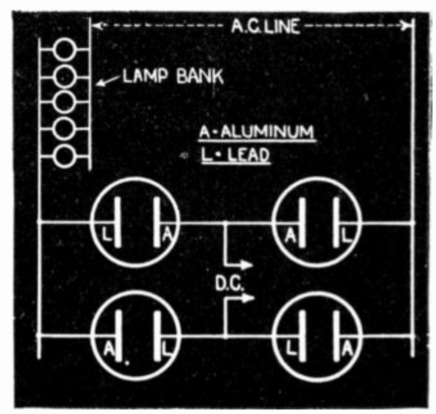
(227)—R. Badgerow, Holland, Mich., writes:

I have built a rectifier as described in PRACTICAL ELECTRICS from which I can draw 30 amperes, but the fuses blow and the liquid boils over. The device does not seem to rectify.

Q. 1.—Will you tell me what is wrong.

A. 1.—We see no reason why the rectifiers will not operate. We have never had any difficulty with the same. There is no reason whatever why the fuses should blow. We would suggest that you secure four aluminum and four lead plates, size 4½ inches by 6 inches; place these in jars and connect them as shown in the accompanying diagram. The lamp-bank in the circuit is made of five lamps. These rectifiers heat up, of course, and little can be done to diminish their heating. For the electrolyte we would suggest a saturated solution of baking soda or ammonium phosphate. The space between the lead and the aluminum plate is from ½ inch to 1 inch, and if relatively large jars are used to house these plates, the heat is diminished to a great extent. Large jars are not very cheap, and consequently are seldom used.

We fail to see how it is possible to obtain 30 amperes from a rectifier when



A chemical rectifier, its distribution and connections.

a bank of only five lamps is in series with the same. The maximum current which can be drawn from a rectifier when properly hooked up is the amount flowing through the lamps, and if you use five 1-ampere lamps in the circuit you cannot possibly draw any more than four and one-half to five amperes from the rectifier.

Mechanical Rectifiers

(228)—J. F. Campbell, Roslindale, Mass., asks:

Q. 1.—Please tell me how to build a mechanical rectifier.

A. 1.—By mechanical rectifier, we presume that you mean a vibrating rectifier. A very good one was described on page 228 of the March-April issue of PRACTICAL ELECTRICS.

Transformer Ratios

(229)—J. E. Cornier, New Bedford, Mass., asks:

Q. 1.—Is the voltage exactly inversely proportional to the amperage in step-down transformers?

A. 1.—Theoretically the transformer transforms the voltage in inverse proportion to the amperage, and vice versa. Consequently, a 550-volt transformer with 40 amperes on the primary side, should deliver 200 amperes at 110 volts at the secondary side. The losses in ordinary transformers are about 6 per cent, so in reality the transformer will develop about 188 amperes on the secondary side.

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Panel Knobs
Key Knobs
Binding Posts
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Radio Frequency Transformers
Instrument Posts
Hexagon Nuts
Spring Binding Posts
Switch Studs
Cap Nuts
Brass Lugs
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Dials
Lubricated Switches
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Mica
Vario-Coupler Rotor
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Time Saved by Household Electricity

By Mary Gwynne Howell

THE value of electrical household appliances as *time-savers* as well as labor-savers should not be underestimated, since "spare time" is to the overworked housewife a rare and precious thing.

Where it can be proved to her that mechanical helps will not only do better work, but that they will do it in less time than she could do it by hand, the housewife is likely to be much impressed.

That electrical appliances accomplish the work quickly as well as efficiently can be proved from the following time studies made on consecutive days under identical conditions:

Time Study I.—*Washing Up*
By hand—Thirty crocks and table silver

	Min.
Collecting and scraping	6
Washing and drying the silver	5
Washing and rinsing crockery	8
Drying	6
Total time	25

By means of an electric washing-up machine, properly connected with the plumbing

	Min.
Collecting and scraping	6
Washing and rinsing crockery and silver	7
Total time	13

The crocks drain in the machine baskets and do not need hand-work.

Time saved per operation, 12 min.
Time saved per day, 36 min.
Time saved per week, 4 hrs. 12 min.

Time Study II.—*Cleaning Carpets*
By hand—Two carpets and two rugs

	Min.
Sprinkling floor surfaces with damp tea leaves	2½
Sweeping carpets with a stiff broom	17
Gathering up dust with brush and pan	4½
Sweeping rugs with short stiff brush	6
Total time	30

With Electric Suction Cleaner

	Min.
Cleaning carpets	15
Cleaning rugs	6
Total time	21

Time saved per operation, 9 min.
Time saved per week (3 times) 27 min.

N.B.—The more carpets and rugs there are to be cleaned in a house, the greater the proportion of time which can be saved by using a suction cleaner.

Time Study III.—*Washing Clothes*
By hand—Bed and body linen for family of five

	Min.
Preparing tubs, etc.	6
Washing white clothes	1 hr. 8
Rinsing same	22
Washing woolens	20
Rinsing same	17
Washing "colored" items	33
Rinsing same	15
Rinsing and bluing "whites" after boiling	30
Wringing or mangling	15
Total time	3 hrs. 46

With an Electric Washing Machine

	Min.
Preparing machine	5
Washing "whites"	15
Wringing by machine	5
Washing flannels	15
Wringing	5
Washing "colors," etc.	15
Wringing	5
Rinsing "whites" in machine	5
Bluing "whites" in tub	10
Rinsing "colors" in machine	5
Rinsing flannels	5
Wringing	11
Total time	1 hr. 41

Time saved per wash day, 2 hours 5 min.
Time saved per year, 108 hours 20 min.

With the smaller devices, such as a toaster, utility motor, etc., the whole of the time that would be expended on handwork in making toast, beating eggs, whipping cream, polishing silver, etc., is saved, since the worker is able to proceed with other work while the machine is operating. This applies to some extent to the use of an electric washing machine, which does not need attention during a 15-minute wash.—*London Electrician.*

Sun's Electrified Dust

PROFESSOR S. A. FLEMING gave the fifth Henry Trueman Wood lecture before the Royal Society of Arts in London recently. "The Coming of Age of Long-distance Wireless and Some of Its Scientific Problems."

It has been proved, said Dr. Fleming, during the last 20 years that the received signals at distances of 6000 to 12,000 miles were many thousands, or even millions, of times stronger than could be accounted for by pure diffraction or bending of the waves around the earth. It was generally agreed that long-distance wireless telegraphy only took place in consequence of the existence of an electrical conducting layer in the earth's atmosphere. This was present at a height probably, of 100 to 200 kilometers, and was thought to be due to electrified dust which came from the sun. The outstanding problem of long distance wireless telegraphy and telephony was the neutralization of the effect of vagrant waves on the receiving apparatus.

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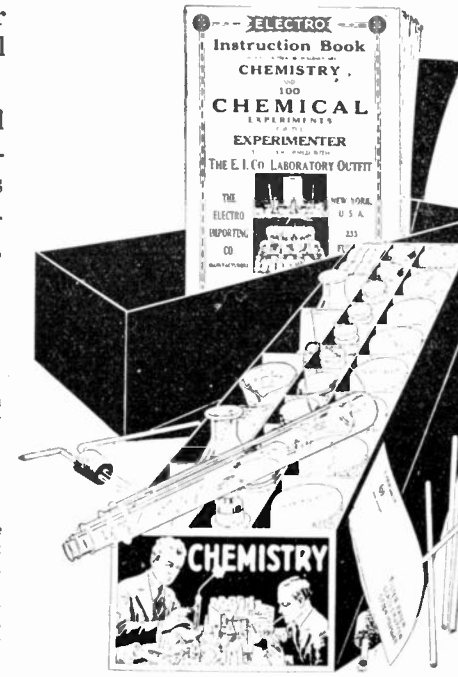
This outfit is not a toy, put up merely to amuse, but a practical laboratory set, with all the chemicals, apparata and reagents necessary to perform real work and to teach the beginner all the secrets of inorganic chemistry. With this outfit we give free a book containing a Treatise in Elementary Chemistry, useful data and recipes, and 100 instructive amusing experiments.



DESCRIPTION OF THE OUTFIT

The outfit consists of forty-four (44) chemicals all C. P. (chemical pure) put up in appropriate wooden boxes, glass bottles and hermetically closed jars. The acids are put up in glass bottles, with ground-in glass stoppers, and there is a sufficient quantity of chemicals supplied (mostly one to two ounces) enough to make dozens of experiments with each.

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The instruction book is a real Chemistry Course for the Beginner. Some of the Contents are: Division of Matter: This is a Treatise on Elementary Chemistry, and deals with the theory of the Elements, Molecules and Atoms, etc.

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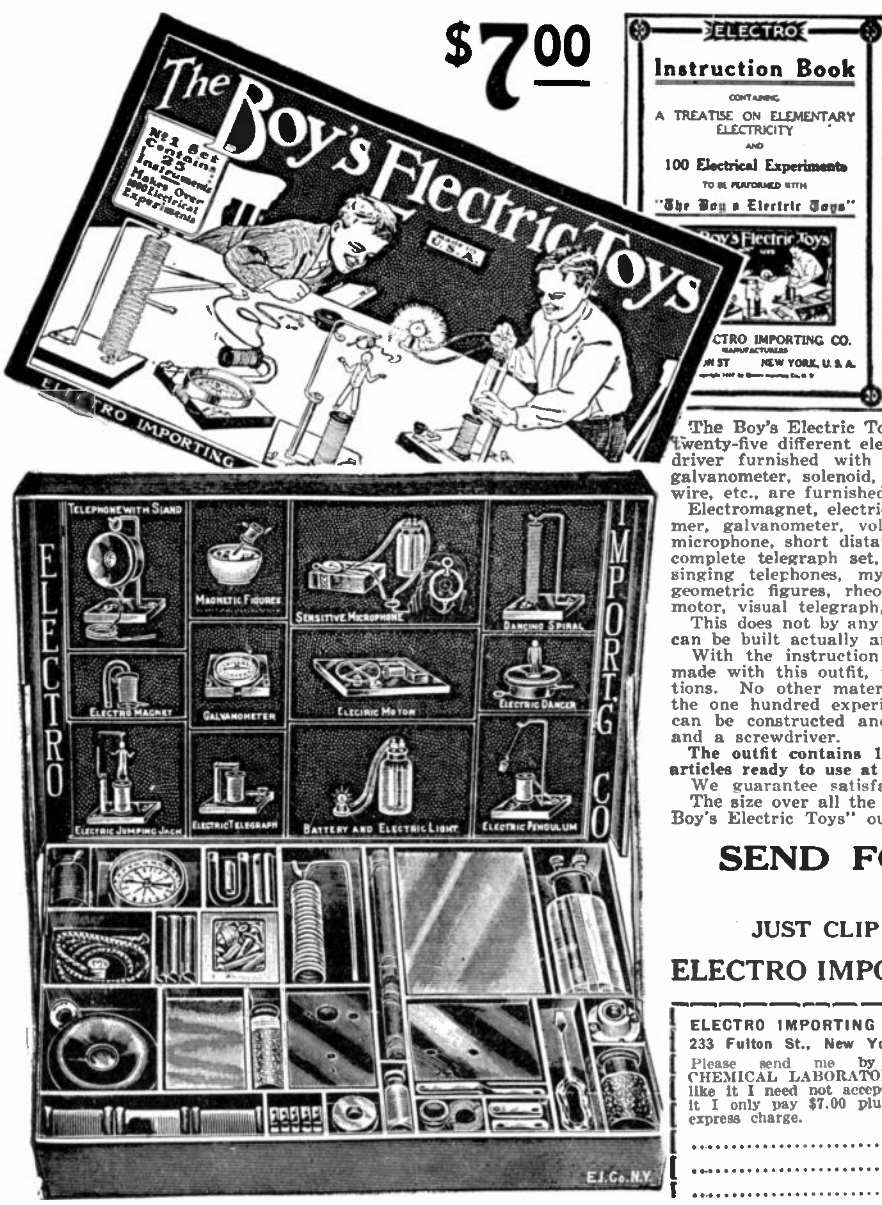

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This does not by any means exhaust the list, but a great many more apparatus can be built actually and effectually.

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P. E. 1-23

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P. E. 1-23

Ideal Electric Kitchen

THERE is no doubt that the all-electric kitchen will be the highest mark of efficiency in the labor-saving house of the future.

Although conditions are not favorable at the moment, yet there is always the hope that "somehow" and "sometime" electricity will be sufficiently cheap and plentiful to be adopted as the universal household servants for heating, cooking, and driving appliances, as well as lighting. With such future popularity in view, it may be as well to consider particulars which are likely to find favor with the housewife.

Looking at it from the point of view of electricity taking the place of servants, there are several things to be remembered:

1. The ideal electrical equipment consists not of a multiplicity of electrical utensils, but of appliances capable of a multiplicity of tasks.

The busy housewife is not much better off for electrical appliances so numerous and intricate in design that they take more trouble to keep clean than the old-fashioned pots and pans. Electric toasters and grillers, coffee pots, immersion heaters, and hot plates, are perfectly delightful regarded singly, but a thorough collection of them will entail quite a lot of cleaning and polishing, and this "aftermath" is a point of considerable importance to the servantless housewife. On the other hand, what a treasure beyond price to such a woman is a general utility motor, with its "magic" attachments capable of cleaning the silver and brass, shredding the vegetables, chopping the meat, beating the cakes and batters, and such like tasks. These are time-taking and energy-expending jobs, and an appliance that will accomplish them swiftly and efficiently will find high favor in the eyes of the home worker.

2. Of all hated tasks possibly washing up will take first place. Why? Because it is "messy"; it takes up at least half an hour of precious time three or four times a day; it involves much muscle and step motion; and—the biggest grievance—it has no lasting results. It is not a "worth-while" job and yet there is no escape from it. There is, then, a real need for electrical dish washers, and, provided they are safe, efficient and reasonable in price, such appliances will be hailed with delight in the servantless kitchen.

3. Practically all the major household machines should be considered as fixtures. Washing machines, clothes driers, ironers, ironing boards with their accessory electric irons, dish washers, etc., all require convenient and adequate connections to gas, electricity, water supply and drainage.

At the moment, perhaps, this need is not very apparent, since such appliances are in the experimental stage as far as the housewife is concerned, but once the all-electric kitchen becomes an everyday affair instead of a novelty, it will be essential to arrange the appliances logically, install them permanently and utilize them intelligently. By such means household management will be placed on a business basis.

Apart from actual labor-saving appliances there are still matters in which the practical utilization of electricity in the kitchen is possible. Of these the most important are ventilation and illumination.

In no place is efficient ventilation more necessary than in the kitchen, yet there is seldom any provision made beyond the door and windows.

Not only is it difficult to keep the kitchen at an equable temperature, but any attempt to keep it cool while cooking is progressing often means a draught, and a draught means a cold for the cook, and a cold for the cook means danger to the whole household.

The simplest method of overcoming this difficulty is by the installation of a motor-propelled fan in a panel in the upper sash of a window. The fan in motion will draw out all cooking odors as well as the hot air, and, moreover, will keep the air in motion, which is a desirable factor in all ventilation.

Since cooking odors in the house are closely connected with inefficient ventilation a hood over the cooking stove is a great asset, and when a blower operated by electricity is connected with the hood, it is possible to draw off all cooking odors directly, without giving them a chance of pervading the hall atmosphere.

And not only in the kitchen, but throughout the house is added ventilation by means of electrical appliances a point to be considered.

Electric lighting has reached a stage of efficiency beyond criticism, and it is probably the housewife's fault rather than the electrician's that her kitchen is not as a rule adequately lighted. At the same time the installation of lamp sockets in such positions as to ensure a good light at the sink and the stove will make her realize how important are such details.

In conclusion, domestic difficulties invite mechanical help, and nothing but the cost of electricity deters its general adoption. Everything but the price is in its favor, and could this difficulty be eliminated electricity and electric appliances should reign supreme in every house in the land. What can be done about it?

Chemistry of the Storage Battery

IN lead storage batteries, in the charged state, a positive plate of lead peroxid (PbO_2) and a negative plate of finely divided lead, are introduced into sulfuric acid. When discharged, the surface of both plates has been changed to lead sulfate ($PbSO$). The plates may be brought back to their original condition by sending a current through the battery in the reverse direction. Storage battery plates are usually made by two general methods, which are only modifications of the original Planté or Faure process.

The Planté process includes all methods in which the active material is made from the plate itself, which should be pure soft lead. There are numerous methods of accelerating the formation. Usually the surface is worked up mechanically by cutting grooves, provided it has not been cut in this form. The next operation is to produce the necessary amount of active material. The plates are frequently permitted to stand in some corroding solution of acids that produce a thick layer of lead sulfate ($PbSO_4$), for a certain time. The lead sulfate may then be reduced electrolytically to lead, or oxidized to lead peroxid (PbO_2). When acids other than sulfuric are used, these must be thoroughly washed out before the battery is ready for use. For instance, a mixture of nitric and sulfuric acids would have the effect of producing a layer of sulfate.

The theory of the lead storage battery which is generally accepted is known as the "sulfate theory," and is due to Gladstone and Tribe. Sulfuric acid combines with the plates on discharge, and is set free on charge, according to this theory. On discharge, hydrogen is deposited on the lead peroxid which reduces it to lead oxid (PbO), which is changed to lead sulfate ($PbSO_4$), as represented by the equation:

PbO_2	+	H_2	+	H_2SO_4	=	$PbSO_4$	+	$2H_2O$
Lead Peroxid		Hydrogen		Sulfuric Acid		Lead Sulfate		Water

At the same time the sulfate radical (SO_4) is deposited on the lead plate and combines to form lead sulfate:

Pb	+	SO_4	=	$PbSO_4$
Lead		Sulfate Radical		Lead Sulfate

The sum of these two equations is the total change in the storage battery on *discharge*:

PbO_2	+	Pb	+	$2H_2SO_4$	=	$2PbSO_4$	+	$2H_2O$
Lead Peroxid		Lead		Sulfuric Acid		Lead Sulfate		Water

When in the *discharged* state both plates are covered with sulfate. Upon *charging*, the reaction on the positive plate is:

$PbSO_4$	+	SO_4	+	$2H_2O$	=	PbO_2	+	$2H_2SO_4$
Lead Sulfate		Sulfate Radical		Water		Lead Peroxid		Sulfuric Acid

while on the negative plate:

$PbSO_4$	+	H_2	=	Pb	+	H_2SO_4
Lead Sulfate		Hydrogen		Lead		Sulfuric Acid

The sum of the last two equations represents what takes place in the whole battery on *charging*:

$2PbSO_4$	+	$2H_2O$	=	PbO_2	+	Pb	+	$2H_2SO_4$
Lead Sulfate		Water		Lead Peroxid		Lead		Sulfuric Acid

This equation is just the reverse of the one given as the sum of the first two equations, and the changes taking place both on *charge* and *discharge* may be represented by the reversible equation:

PbO_2	+	Pb	+	$2H_2SO_4$	$\rightleftarrows$	$2PbSO_4$	+	$2H_2O$
Lead Peroxid		Lead		Sulfuric Acid		Lead Sulfate		Water

From right to left this represents the charge, and from left to right the discharge.

The exact action of the storage battery has been much discussed. The reactions given above present the most obvious interpretation of what takes place. There is however room for some difference of views and there still seems to be something unaccounted for in the action of the lead-plate couple.

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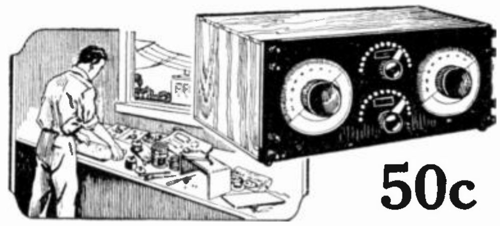

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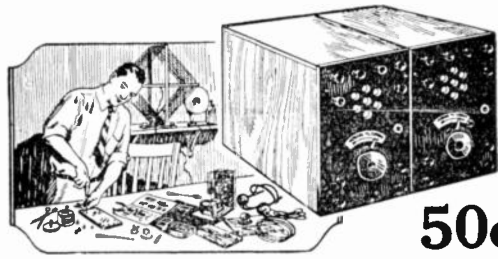

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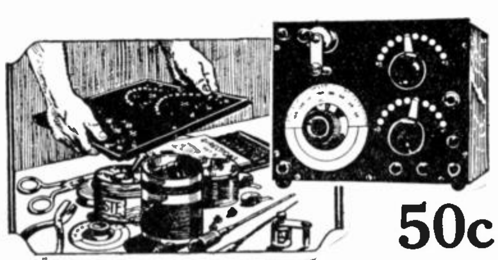

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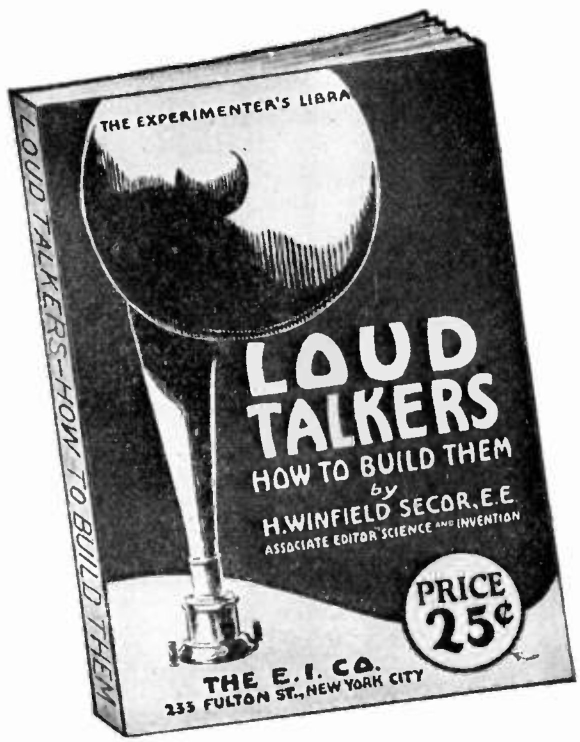

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by H. WINFIELD SECOR

Associate Editor of Science & Invention

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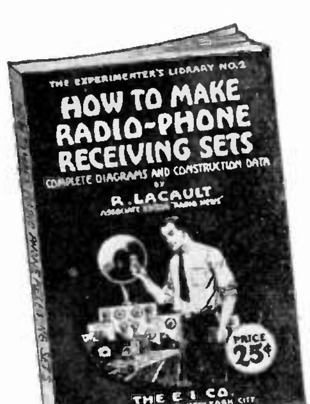

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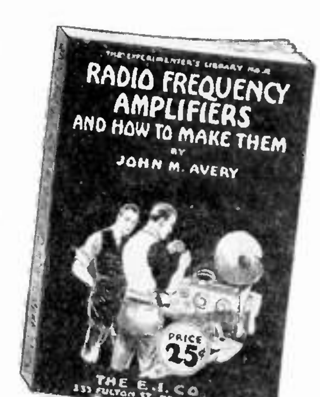

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