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The ELECTRIC GHOST

See Page 257

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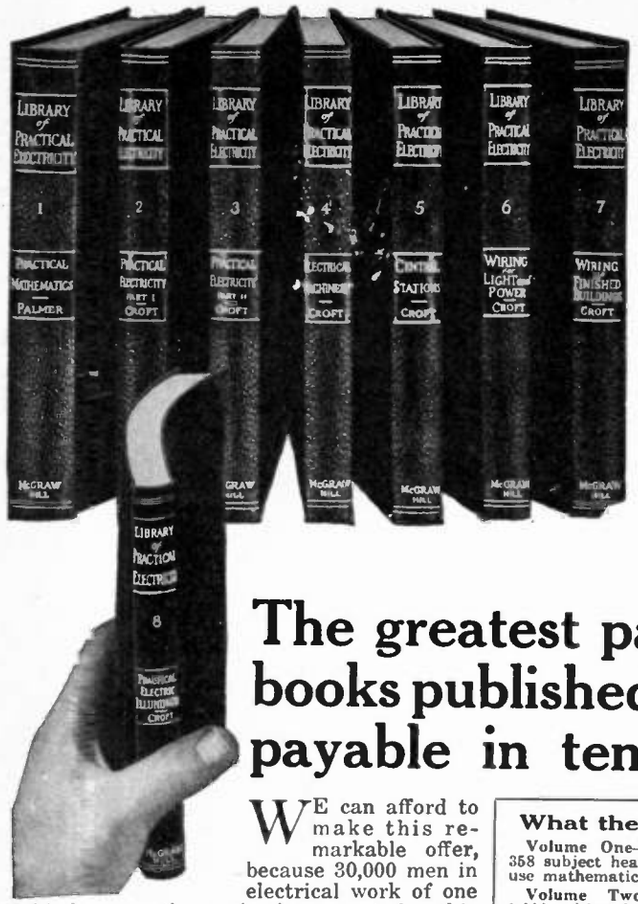

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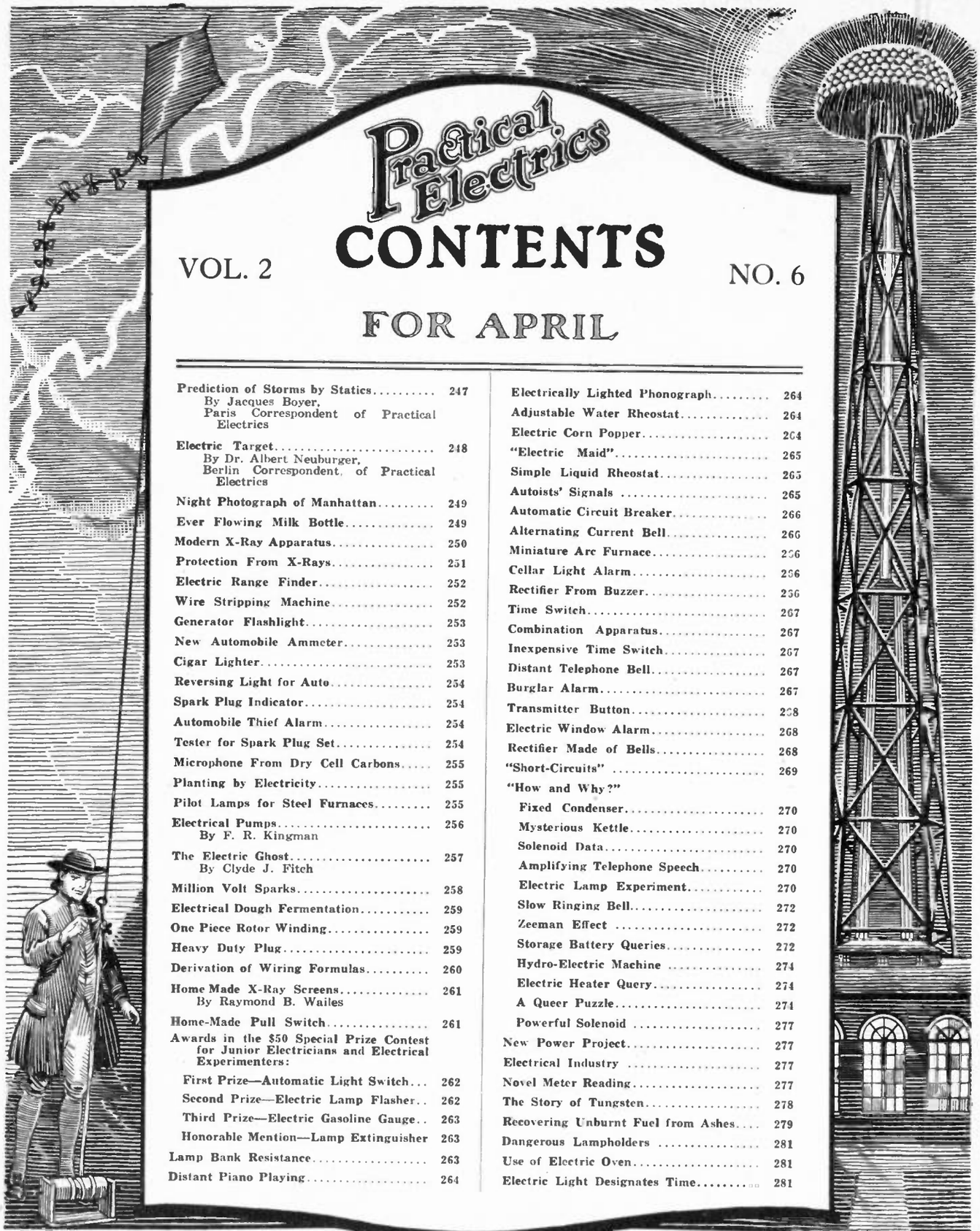

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VOL. 2 NO. 6

FOR APRIL

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Courtesy Metro Pictures Corp.
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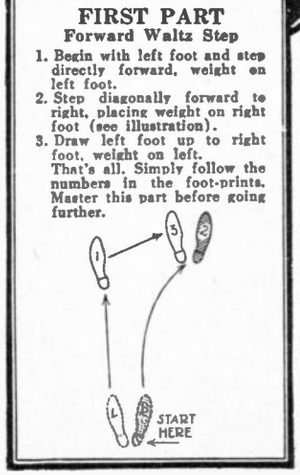

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Volume 2
No. 6

Practical Electrics

April
1923

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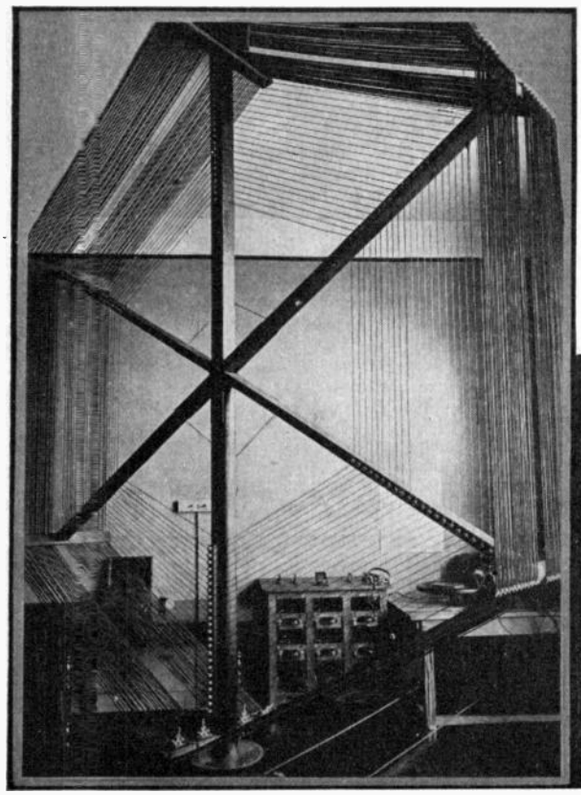
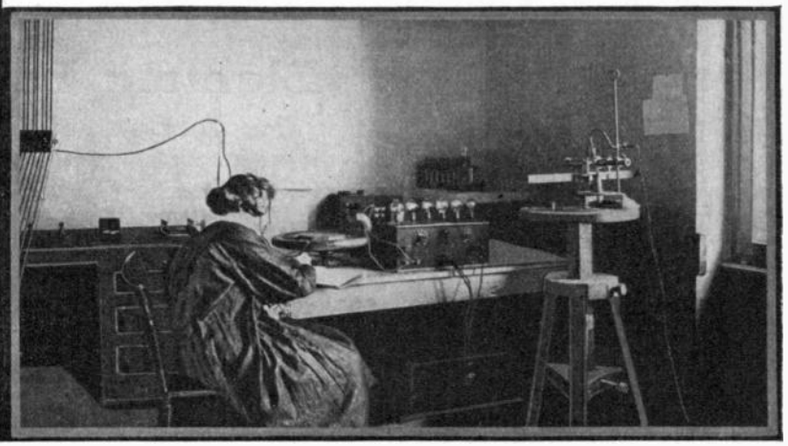
Prediction of Storms by Static

By Jacques Boyer
Paris Correspondent of PRACTICAL ELECTRICS



Left — Directive frame antenna designed for reception of the obnoxious statics supposed to be the enemy of wireless, but which are here utilized for the detection of approaching storms and the determination of the point of the compass from which such storms are approaching.



Below—The electric weather predicter; the operator at her switchboard tracing the course of distant storms, utilizing ether waves in the form of static for determining with some degree of accuracy their movements.

PROFESSOR ALBERT TURPAIN of the Faculty of Sciences at Poitiers, France, was one of the first to conceive the idea of using an antenna and radio-telegraphic apparatus for predicting storms.

In a circuit containing a battery and a sounder he connected a Branly coherer, one of whose terminals was connected to a long wire acting as an antenna, and whose other terminal was grounded. When electric waves affected the antenna, diminishing the resistance of the coherer, an operative current from the battery passed through the electromagnet. A pen attached to the armature registered the discharges on an ordinary cylindrical register operated by clockwork, while a tapping lever decohered the filings of the Branly tube.

Next, taking into consideration the unreliability of the coherer, various physicists and meteorologists substituted for it an electrolytic detector and then crystal detectors. They registered in this way storm phenomena, either by a relay acting on a chronograph, or by a galvanometer whose deviations were registered photographically.

A little later Professor Turpain adopted in place of these appliances a registering microammeter. The current to be detected passed through a coil suspended in the magnetic field of a strong electromagnet. Prof. M. S. Rothé, then of the Faculty of Sciences of Nancy, used a Duddell chronogalvanometer for the same purpose, but if the observations made by these different methods gave useful indications for predicting storms in the vicinity of the station, they could only give very vague information on the direction and path of distant storms.

Since 1911 Professor Rothé, thanks to the progress of radio-telegraphy, has attacked the problem on other bases. Studying in a general way the propagation of Hertzian waves, he had the idea of utilizing static for these predictions. Wireless operators are familiar with various kinds of atmospheric or telluric discharges, affecting wireless transmissions. Snow and hail, for example, produce a distinctive sound in telephone receivers, and this special sound called "sizzling" or "humming" by the English, is quite distinct from the instantaneous sounds due to storm discharges. English meteorologists call these last-named static "clicks," if they are sharp-sounding, and "grinders," if they keep up a prolonged noise.

During the war, Professor Rothé at the request of M. Rouch, head of the Metereologic Survey of the Army, started experiments on this subject, first in the Aerotechnical Institute of Saint-Cyr (1917-1918), and then in the Cosmo-Physical Institute of Strassburg, employing radiogoniometry. At Saint-Cyr he set up a large frame wound with numerous coils of thin wire, so as to be in tune for very long waves. Following the classic system, he connected the extremities of his winding to the terminals of a variable condenser and put in parallel a detecting apparatus. The first bulb acted as a detector and the others as amplifiers.

In spite of the rudimentary nature of this original installation, Professor Rothé and his assistant, M. Etienne, determined for static the existence of special directions or azimuths varying with the day, and the hours of the day. When circumstances were favorable, they could follow the progress of a storm. In 1919-1921, with several assistants, the same savant developed his final method which he brought to completion during the summer of 1922. The hexagonal frame shown in one of the illustrations, photographed at the Strassburg Institute, turns upon a vertical axis. It has five coils which placed in circuit can be tuned for waves of 1,000 to 30,000 meters in length. Below is a graduated disk and contact slip ring, and commutators are carried upon the horizontal supports.

For waves varying from 1,000 meters to 4,200 meters, one section of the winding of the frame antenna is used, and two, three, four and five sections for waves of greater length up to 30,000 meters.

Using the terminals of the switch, the observer connects the circuit to a telephone circuit in the next room. Back of the switchboard there are storage batteries and apparatus for orientating the frame. The telephonic computator seen in the other photographs seated before the table, can turn the frame by means of the wheel directly in front of her. To

the right are seen the five bulb amplifier, storage batteries, and oscillograph, carried on a tripod. A heterodyne rests on the floor below the table.

To determine the position of the radio telegraphic station, the first thing to do after tuning is to turn the frame until a maximum sound is received, for then the transmitting station lies in the direction of the vertical plane of the frame. Greater precision is obtained by turning the frame through 90 degrees so as to produce extinction of the sound.

Radiogoniometric observations once obtained, give a certain number of interesting data. We give big abstracts of a memoir of Professor Rothé, now in charge of the Physical Institute of Strassburg, and from various observations of Professor Lacoste of the College of Mende (Lozère) who also carried out a set of experiments with the same apparatus in the vacation periods of 1921-1922.

At first static was observed in definite direction when storm clouds appeared on the distant horizon, and from all points of the compass when a storm occurred in the vicinity of the station; a steady rain stopped it, but violent rain-falls failed to suppress it or did so only in part. In winter, static which in hoar frost or conditions favoring dew or during an aurora were null, grew stronger as the sun rose, and fog due to the evaporation of moisture filled the air. Noises corresponding to those due to snowfall were then perceptible. Besides these, "sizzlings," Professor Rothé noted during the course of the day varying static to which he gave different names, and which he defines as below. He calls clicking (craquements) those whose lowest note sounded like the snapping of a piece of wood; and continuous clickings characterized by louder, shorter and sharper sounds than the preceding he called snappings (claquements). He gives the name of discharges to less frequent manifestations due to storm clouds at greater or less distances; this static gives loud metallic sounds, and during their entire duration varies neither in intensity nor in pitch.

Professor Lacoste counted the static produced per minute on azimuths for each 20 degrees. In the most favorable conditions he made several observations completely around the horizon, changing the amplification so as to get rid of the lesser statics. To distinguish better the different kinds of static, he employed Professor Rothé's method of registration, using an oscillograph.

In this way Professor Lacoste obtained for storms at Strassburg long series of characteristic peaks in the tracings of the registration apparatus, which peaks were due to violent discharges; he obtained several records corresponding to lightning and hailstorms. For more distant storms he found definite indications on the curves, sometimes exceeding a minute in duration. He also located isolated peaks due to clickings and snappings. He found that storms give static of different lengths, but what is more important, he found that a radiogoniometric frame enabled the time of a storm to be predicted. He has defined among others the three following laws, applying to barometric depressions:

1. A distant barometric depression with sharply concentric close, isobaric lines, accompanied the maximum snappings observed in the region south and southeast from such depression.

2. When the center of a depression is far away, and the isobaric curves are of large diameter, the same maximum will be in the direction of the periphery of such depression.

3. Secondary depressions, barometric pockets, and local barometric elevations, define the front of the storm, but the maximum cannot be easily found. There is hope that in the future the time of a storm will be predicted with accuracy.

4. When a wireless observer finds static to be isolated, few, and weak, growing no stronger in the course of the day, he can announce an atmospheric calm in the immediate neighborhood of his station. On the contrary, if the static becomes more frequent in the course of the day, and one or more maxima are found, these are due to distant storms in the direction of such maxima. Besides, when very strong clickings definitely orientated are heard, the existence of a barometric depression is proved. Then when the frame shows practically the same violent discharges at all points of the compass, the storm has reached the locality of the station.

Although the results described above do not give absolute certainty, this method of radiogoniometry will certainly facilitate weather predictions when stations distant from each other make simultaneous observations of static.

Electric Target

By Dr. Albert Neuburger

Berlin Correspondent PRACTICAL ELECTRICS

Left—The shooting benches of a German target range. Center—A view of the targets of the electric rifle-range. Right—The target observers who give the results of the shooting.

THE manner in which hits are indicated on targets is usually a very primitive one. In most cases there is little difference between the fashion of today and that of past centuries. A man usually stands below the target in a protective trench, having a stick in his hand. With this stick, at the end of which is a small disk, he points out where the bullet struck. If the target was missed, he gives a special sign with his staff. Sometimes there is a painted board standing beside the target. The circles on the target have numbers, and on the board are corresponding numbers and the man in the trench points out the corresponding number on the board.

There are other ways of announcing, but all are very primitive and sometimes very dangerous for the man at the target.

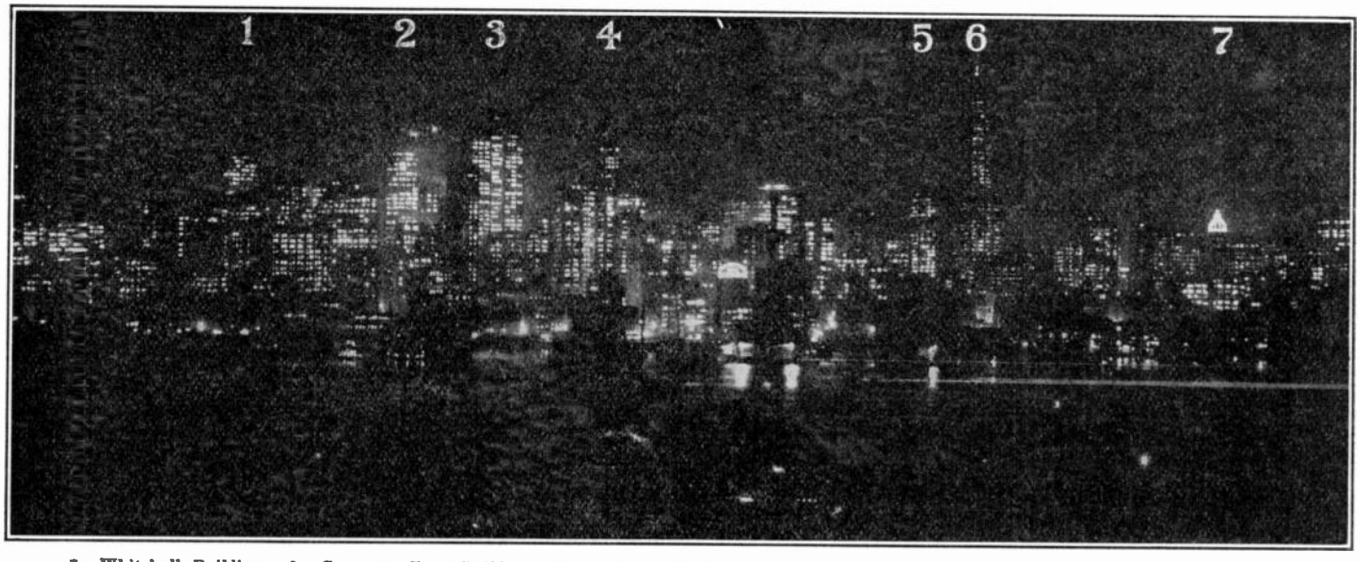
An electric self-indicating target has been introduced in a German shooting gallery. The installation consists of transmitters and receivers. The transmitters area in the trench before the target. The receiver is placed on the shooting stand. Transmitter and receiver are of the same kind. Each of them shows a scale with 23 fields, which contain the numbers from 0 to 20 and the inscriptions "Telephon" and "Stop." On each a needle is turning. The needle of the transmitter bears a handle by which it can be turned on each number of the scale. In order to exclude every doubt on which range it stands, it is connected with a special wheel. This wheel operates to stop it always in the middle of a number. Transmitter and receiver are connected together, so that they must make uniform motions.

An electric installation causes the needle on the shooting stand always to have the same position as the needle of the transmitter near the target. Every time the operator turns the needle on the transmitter at the target, an acoustic signal is produced on the shooting stand, which announces the changing position of the needle to the rifle-man and to the man who is registering the results. In order to protect the needle from being turned by the rifle-man, so as to give a false reading, the whole scale is covered with a glass plate which cannot be opened.

As the shooting galleries usually contain a number of shooting stands side by side, each of the acoustic signals has its distinctive sound, thus eliminating any possible doubt as to which stand is signaled to. In the same manner, the signal at each transmitter has its own sound. These signals are produced when a button on the shooting stand is pushed.

There is also provided a telephone for direct conversation between the rifle-man and the recorder at the target. The signal "stop" directs cessation of firing, and is especially for signaling from target to shooting stand.

Night Photograph of Manhattan



1.—Whitehall Building. 2.—Guaranty Trust Building. 3.—Equitable Building. 4.—Singer Building. 5.—Park Row Building. 6.—Woolworth Tower. 7.—World Dome.

WE take pleasure in reproducing a photograph giving a panoramic view of the lower part of Manhattan Island, the business district of New York, seen from the Brooklyn side.

In the dark of the late evenings, the city of New York, seen from the East River or the Hudson River, is a most wonderful sight. It is a true galaxy of electric lights. Window after window of the great buildings shines brightly through the darkness, the gold dome of the World Building reflects its quota of light, and the high-power lamps in the Woolworth Building make a most effective display.

The tall buildings of New York give a most peculiar effect when the city is seen by daylight from the bay. It looks like a city built upon a rising hill. The high buildings rising up suggest structures of less altitude, situated like an Italian mountain town on the summit of a hill. But of course it is the height of the buildings that give this effect, for lower Manhattan is practically level.

The glory of the business district of New York has an exponent in the wonderful buildings, whose lights are seen in this photograph. The World Building, with its gilded dome, is dwarfed among its neighbors. Yet not many years ago its height seemed almost fabulous, and after the measurement of the main building was given, it seemed astonishing to think of the dome surmounting the building. Now there looms over the lower city the great Woolworth Tower, rising to about double the height of the World Building. Poor Richard said that a penny saved is a penny gained. Had Benjamin Franklin lived in Woolworth days, it is hard to think what he would have said of the nickel and the dime, out of which the Woolworth Tower was capitalized.

In the writer's early days the street car service of New York was given by cars, some of them drawn by two horses, some by one, while sometimes a team of mules might be seen, evolving the rapid transit of those days. There were numerous stage lines, the rattling stages with iron tires banging over the stone paved streets of those days, many of them paved with round cobblestones. Stages and street cars were unheated; the stages made not much over four miles an hour; the street cars did a little better. There was a skating pond on Fifth Avenue and 46th Street, another on Fifth Avenue and 59th Street; the main post office was housed in a decrepit church building at the corner of Nassau and Liberty Street. For a bird's-eye view of the city one would climb up to the top of a wooden bell tower, perhaps 100 feet high, which stood in Jefferson Market. Now we go up nearly a seventh of a mile from the street below.

Some of the leading buildings are indicated by numerals.

Ever Flowing Milk Bottle

A PERPETUAL fountain of milk pouring into a glass tumbler which does not overflow, is a contrivance adopted by dairy organizations for stimulating the consumption of milk. The unseen source of the milk and the reason for the tumbler never overflowing, notwithstanding the continuous flow of the liquid into it, tend to mystify the onlooker.

The device is actuated by a small electric motor. The supply of milk is concealed in a tank contained in a cabinet, which apparently is only a stand on which the electrically-operated contrivance is mounted. The fluid is pumped into the bottle through a tube entering at its mouth, the liquid completely enveloping the tube and concealing it. Consequently, as the milk flows out, the tube is not revealed.

Examination will prove that the liquid is not milk, but a fluid prepared to represent the product of the cow. In reality it may be of any color, so as to represent grape juice or other beverages. A shoe-manufacturing enterprise has applied the idea as a means of pouring shoe polish into a shoe. The device therefore constitutes a miniature pumping plant.

Dairy organizations in Baltimore, Philadelphia, Chicago and Pittsburgh have made use of the contrivance in a national campaign for increasing the use of milk. The self-contained, electrically operated milk bottle is supplemented with suitable text inscribed on the front of the cabinet, for example: "For Better Health Use More Milk."

An everflowing milk bottle. Everyone knows how it is done; the opacity of milk or of its imitation makes the deception perfect.

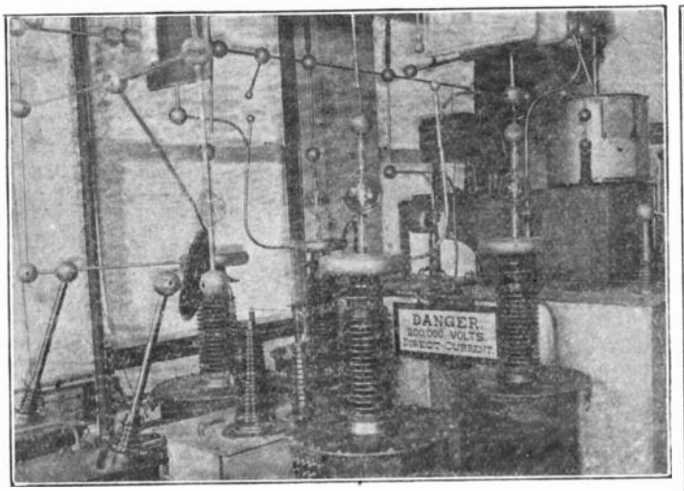
The same perpetual flow of fluid has been used in this city by a leading wine dealer of former days. The glass tube through which an electric motor pumps up the fluid into the bottle is curved in parabolic contour, so as to be enveloped by the fluid. The dark wine (it would be grape juice now) covered and hid the transparent tube perfectly.

The same principle has been applied to very elaborate displays, with numerous bottles or other sources supplying streams of fluid all at once, without cessation. Some of these were quite striking and involved a complication of conduits and comparatively powerful electric pumps to keep the many conduits supplied.

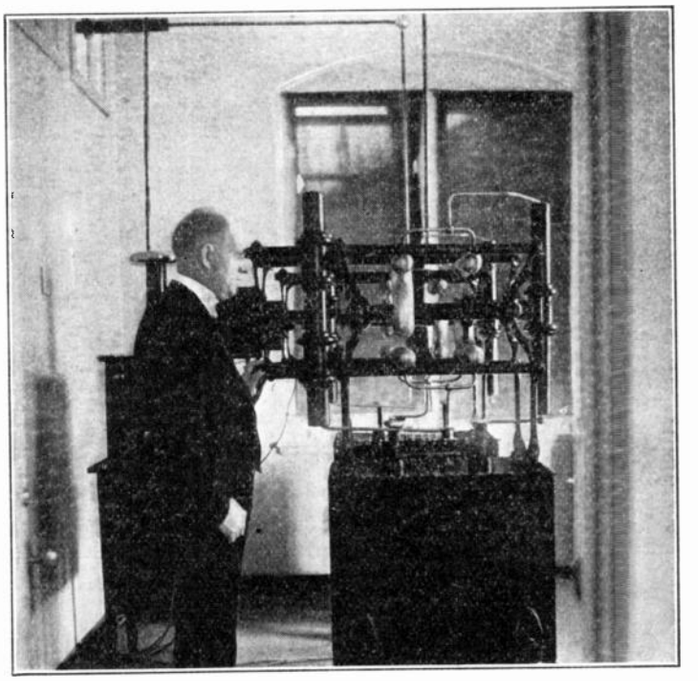
It will be observed that the capacity of the stream of alleged milk enveloping the tube through which the supply enters the bottle, makes the deception particularly easy in this case. Grape juice by its dark color also gives a good screening effect.

Contributed by S. R. WINTERS.

Modern X-Ray Apparatus



A portion of an X-ray apparatus for producing a continuous uni-directional current, belonging to the X-ray plant of Columbia University, New York.



Electrical transformers delivering 200,000 volts potential; this operates the great Garfield Hospital X-ray apparatus, the largest in the world, in Washington, D. C.

THE apparatus illustrated here is used for the production of continuous unidirectional current at pressures up to 200 kilovolts. It is part of the X-ray plant at the Crocker Institute for Cancer Research, Columbia University, New York City, where the most modern methods of treatment for cancer are being developed under the supervision of Dr. Francis Carter Wood, Director of the Institute. The set consists of an alternating current generator, a high-tension transformer, four kenotron vacuum tubes to rectify the alternating current, and condensers to smooth out the pulsations.

The generator is of the induction alternator type, and when running at full power delivers alternating current at 220 volts and 500 cycles.

This flows into the primary of the transformer and there is stepped up to 100 kilovolts. This high-tension circuit carries current to the kenotrons, which act as valves, permitting the current to flow in one direction only.

The kenotrons stand on large insulators above cylindrical iron tanks. The tanks contain small but highly insulated transformers, which supply a few amperes of current to keep the kenotron filaments at a white heat. Behind the kenetrons will be noted two large rectangular tanks. These contain the condensers which are oil immersed.

The condensers act as equalizers for the rectified current which comes from the kenotrons in pulsations, 500 a second. They store up electricity during the pulsations, and give it out again between the pulsations, keeping the pressure on the X-ray tube nearly uniform.

It will be observed that all the high-tension conductors are of large diameter brass tubes—in order to prevent the corona or brush discharge that takes place at high voltages from sharp corners and small wires.

The usual commercial forms of high-voltage X-ray machines rectify the alternating current by some form of commutator, supplying the tube with unidirectional but pulsating current. Since the voltage varies during a pulsation, only the mean or average value can be determined, and even this changes with the wave-form and the load.

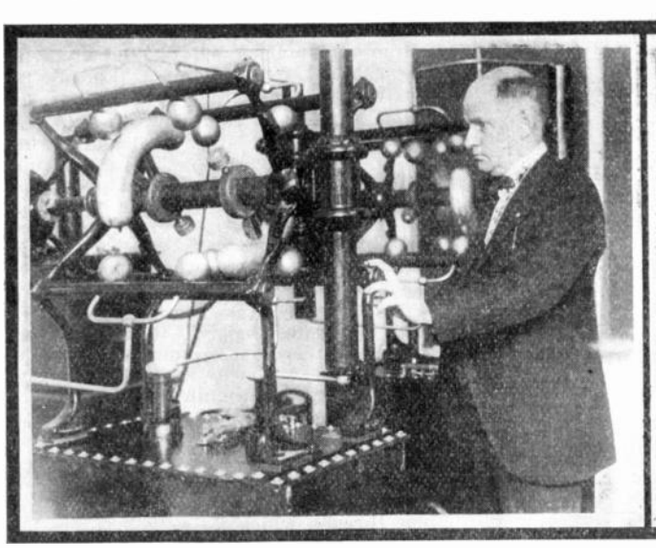
With the present machine the voltage is almost constant, and may be accurately determined and consistently reproduced.

The purpose for which the apparatus was constructed was to determine the exact amount of X-ray required to kill a cancer cell. This is the basis of all treatment, but is as yet an unknown quantity. In addition, the apparatus is being used in studying many problems in biology and physics.

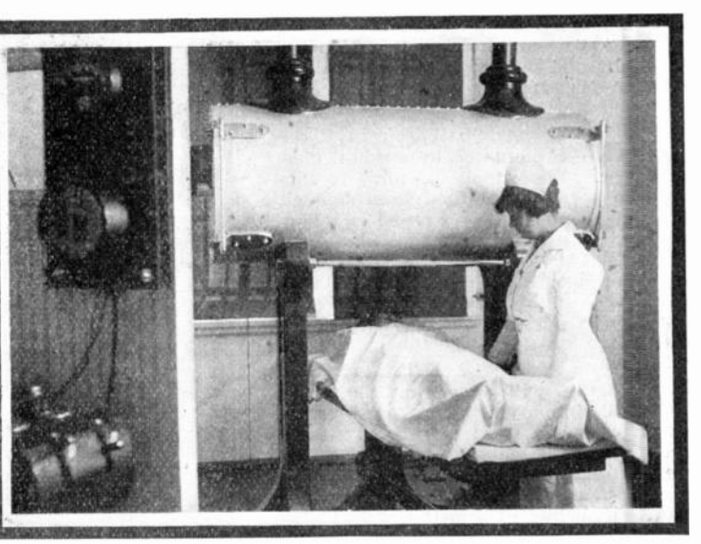
Describing the new X-ray Laboratory and apparatus at Garfield Memorial Hospital, Dr. E. A. Merritt, the Roentgenologist, said recently:

"The new X-ray apparatus installed in Garfield Hospital, which is now ready for operation, was designed and built under the personal supervision of one of America's foremost electrical engineers. He has devoted twelve years of his time to developing what he considers the last word in the construction of X-ray apparatus.

"The equipment will deliver 200,000



Another view of the Garfield X-ray plant, showing further details, with Dr. E. A. Merritt, Roentgenologist, operating it.



Treatment of a patient on the operating table in the Garfield Hospital. It will be observed that the nurse is unprotected, as the entire apparatus is perfectly shielded.

volts, which is 100 per cent greater than has been produced in America by any other apparatus until this particular type was put into use.

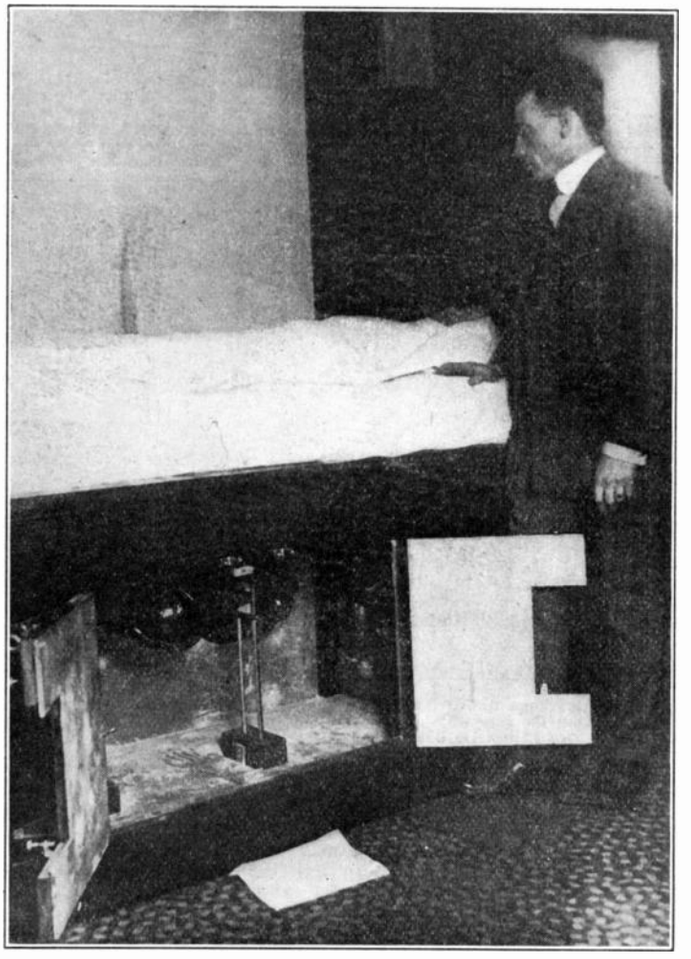
"The benefits derived from the X-ray treatment, particularly in application, particularly in rect proportion to the amount of X ray energy expressed in terms of short wave lengths that can be delivered, and the output of this machine is now as great as can be utilized by the most perfect X-ray tube yet devised and installed, specially made for this and the similar types of apparatus.

"The transformers are located in a separate room under lock and key, and the electrical energy is transmitted from them to the X-ray tube in another room through large brass pipes which are located ten feet from the floor and connect with the large lead-lined cylinder enclosing the X-ray tube.

"A jacket of lead one-half inch in thickness lines this cylinder, in order to prevent the escape of the X-rays. There is in the bottom of the cylinder an aperture six inches in diameter, in which filters made of metals are placed, and it is through the metal filters filling this opening that the X-ray plays upon the parts of the body to be treated.

A vast amount of thought has been devoted to protection of the patient from possible contact with any part of the apparatus which may produce dangerous shocks, and this protection has been perfectly achieved. All of the usual lead impervious screens and devices are unnecessary as the apparatus itself furnishes the necessary screening. Therefore it is possible for the attending physician to stand by the patient and talk to him without any danger.

"The apparatus consists of two very large high-tension transformers, to which power is supplied from the city circuit, and is stepped up to 200,000 volts and rectified by revolving spheres, known as toroids. The control stand, which governs the starting and stopping of the motors, and regulates this voltage, is in the same room with the patient, but sufficiently removed in distance from the transformer room so that there is not the slightest noise. An operating table which can be lifted to the proper height by a worm-gear device is placed beneath the X-ray tube in its lead casing. This casing is two feet in diameter and six feet long and is carried by movable wooden pedestals at either end. The table supporting the patient is run in between these wooden supports until that portion of the body to be treated is directly beneath the screened aperture in the side of the cylinder. No other adjustment or additional protection are necessary.



We show above a new type of X-ray machine. This comes from Milwaukee. A striking characteristic of it is that the X-ray cabinet is placed beneath the bed; it is shown here with the doors open. The patient above it is being X-rayed, with absolutely no disturbance whatever.

"The entire machine is controlled, after the patient is in position, by the operator, who occupies a place at the control stand. The only duty of this operator is to make a record of the time of treatment and watch the operation of the machine. There is no emergency whereby the patient could receive any injury.

"Heretofore, even with X-ray installations of only one-half of this capacity, it has been necessary to line the walls of the treatment room with lead and place the patient in this room with an unshielded tube. The method above described, of protecting the tube and the high-tension terminals, obviates all such necessity, and the X-ray treatment room is no longer a place in which the patient has to be segregated while being treated.

"The X-ray Laboratory of Garfield Hospital is under the immediate supervision of Dr. Thomas A. Groover, Dr. C. A. Christie and Dr. E. A. Merritt, Dr. Merritt being the Roentgenologist of the hospital. This apparatus was installed in the Garfield Hospital for the reason that it was essential to connect with alternating current, and because this is an institution with adequate space for such an installation."

Protection from X-Rays

THE following are some recommendations which have been made by an English body, The X-Ray and Radium Protection Committee of Great Britain:

The danger of over-exposure to X-rays and radium can be avoided by the provision of efficient protection and suitable working conditions. The known effects on the operator to be guarded against are:

1. Visible injuries to the superficial tissues, which may result in permanent damage.

2. Derangements of internal organs and changes in the blood.

These are especially important, as their earlier manifestation is often unrecognized, and the following precautions are recommended:

1. Not more than seven working hours a day.

2. Sundays and two half-days off duty each week, to be spent as much as possible out of doors.

3. Annual holiday of one month or of two separate fortnights.

Sisters and nurses, employed as whole-time workers in X-ray and radium departments, should not be called upon for any other hospital service.

The protective measures recommended are dealt with under seven sections, but it must be clearly understood that the protective measures recommended for these various purposes are not necessarily interchangeable; for instance, to use for deep therapy the measures intended for superficial therapy would probably subject the worker to serious injury.

I. *Diagnostic Purposes.*—In the case of screen examinations—

(a) The X-ray bulb to be enclosed as completely as possible with protective material equivalent to not less than 2 mm. of lead; the material of the diaphragm to be equivalent to not less than 2 mm. of lead.

(b) The fluorescent screen to be fitted with lead glass equivalent to not less than 1 mm. of lead, and to be large enough to cover the area irradiated when the diaphragm is opened to its widest. (Practical difficulties militate at present against the recommendation of a greater degree of protection.)

(c) A travelling protective screen, of material equivalent to not less than 2 mm. of lead, should be employed between the operator and the X-ray box.

(d) Protective gloves to be of lead, rubber (or the like) equivalent to not less than ½ mm. of lead, and to be lined with leather or other suitable material. (As practical difficulties militate at present against the recommendation of a greater degree of protection, all manipulations during screen examination should be reduced to a minimum.)

(e) A minimum output of radiation should be used with the bulb as far from the screen as is consistent with the efficiency of the work in hand; screen work to be as expeditious as possible.

In the case of radiographic examinations ("overhead" equipment)—

(a) The X-ray bulb to be enclosed as completely as possible with protective material equivalent to not less than 2 mm. of lead.

(b) The operator to stand behind a protective screen of material equivalent to not less than 2 mm. of lead.

Electric Range Finder

MODERN artillery practice differs widely from that of former days. In old times the guns on a ship were carried on a regular deck, and opposite each gun there was a port to be opened when the gun was fired. In a popular version or description of the battle between the "Bonhomme Richard," the rather inadequate ship which the French Government gave Paul Jones for his exploits, and the English ship, "Serapis" off Scarborough on the Yorkshire coast, the story is told that the ships were lashed side by side so that the ports could not be opened on Paul Jones' vessel, and the guns were fired against their own ports, blowing them off, so that they could fire on the enemy's vessel.

Electric range finder for use in artillery practice, one of the ways of carrying out the astonishingly accurate long distance artillery practice which received such impressive illustration in the World War.

In those days the ships were made of wood, and claims were made that some wood would swell up and partly close a hole made by a cannon ball. As all ships were made of wood in those days, it was an object for the enemy to set them on fire; so one feature of artillery practice was the shooting of red hot cannon balls. These were heated to redness in a furnace, a lot of wet hay or straw was rammed into the gun in front of the powder, for everything was a muzzle loader in those days, and the piece was discharged in the hopes of imbedding the ball in the enemy's sides and setting him on fire.

One great point was to hit the enemy's ship at the water line, between wind and water, as it was called. There was not much chance of getting a ball through the side of a ship beneath the water; while if a hole were made well above the water it would not constitute a leak in any sense. The gunners pointed the guns as well as they could and watched their chance to discharge them; the rolling of the little vessels then used complicated the problem greatly, as it affected the elevation of the guns. Pictures of the gun deck on those days show the men stripped to the waist, and this is supposed to have been done with a special purpose; many of the wounds received were due to splinters of wood which were scattered in all directions by balls entering the ship, and the feeling was that if the cloth of a garment were carried into the wound by a splinter it made it all the worse and less amenable to healing treatment.

All this was short range work, point blank firing or nearly so, and the projectiles were solid spheres of iron. This was the regular line of fighting between ships at sea. Where ships were attacked from a fort or where a fort was attacked from the water, bomb practice at high trajectory with plunging shells, was adopted.

In modern artillery practice against vessels at sea, the enemy will be fired at when quite invisible from the gunner's platform. The extreme range is certainly less than that of the German siege gun which was used against Paris during the war, but firing may begin at a range of 20 miles, the enemy being sighted from the fighting mast tops of the vessel.

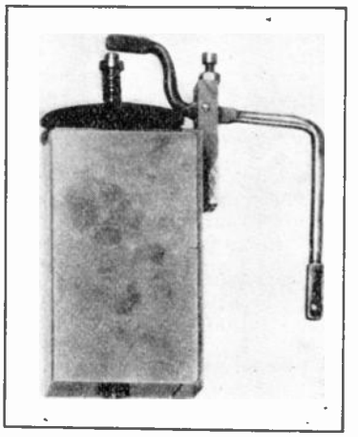
The most elaborate calculations have been made to determine the course of the projectile, the ships are built to give as steady a platform as possible, and elaborate apparatus is used to direct the pointing of the guns by what may be termed "calculating machinery."

The illustration shows an apparatus designed for use in forts, to direct firing against the enemy's ships. It comprises a system of ranging and following a moving vessel and has been under trial by the Department of War of the United States. The data of observation are telephoned to the officer at the apparatus and by manipulating the machine the pointing of the gun is determined. A ship at 20 or even 10 miles distance is a very small target, and the utmost refinement of practice is required to hit it. Some of the original formulas used in gun practice took into account every conceivable element. So much so was this the case that one or more of them have been dropped from modern practice. The fight between Paul Jones and his English adversary was a wonderful contrast to the long range battle between the English and German ships off the Falkland Islands.

Wire Stripping Machine

ALL experimenters at some time or another have encountered the difficulty incident to stripping the ends of insulated wire with a pen-knife or other tool. The operation done in this way by hand is not only slow but is imperfect, is very apt to nick the wires, and if there are a number of wires bunched together it leaves them spread about in the most awkward way. The ends of the wires have to be twisted together before use.

The apparatus illustrated is designed for use where a quantity of wires which may be single, or twisted wire, or flexible cord, has to have the ends stripped. The appliance is very small, 3 inches square by 9 inches long, and contains a set of knives. These knives are rotated at high speed by an electric motor, and their operation is two-fold. They cut the insulation away from the wire without injury to the metal; and having stripped the end to the desired length, the copper strands are tightly twisted together, by the action of the machine, so that when the wires are withdrawn the end is in perfect shape for insertion in the binding posts or for making permanent connections.



Simple apparatus for removing the insulation from the ends of conductors, dispensing with the usual application of the knife or screwdriver to this purpose. It may be placed horizontally.

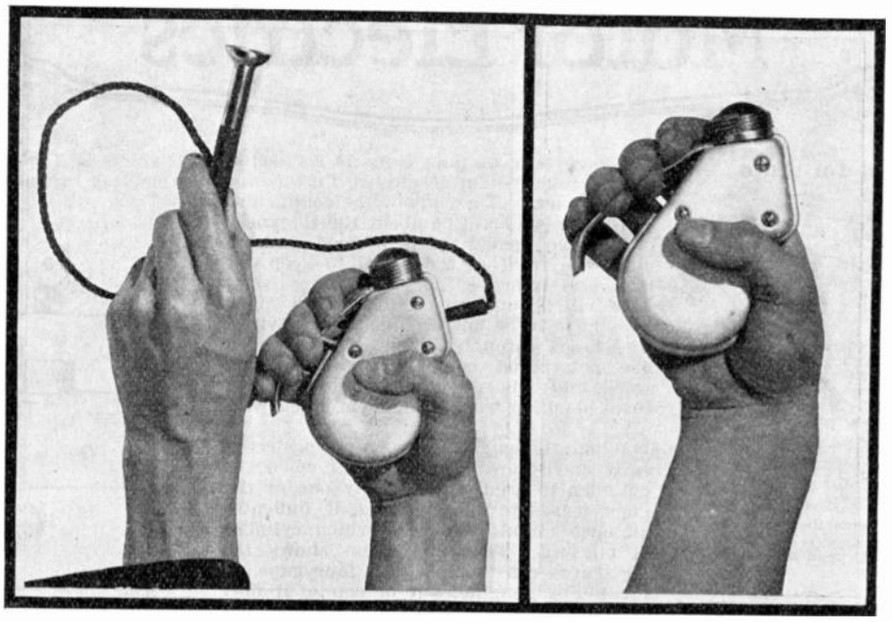
The main drive shaft is carried on bearings and a screw on the outside adjusts the knives for different sized wire, even while the machine is running. The knives are self-centering; there is a pedal which when pushed down causes the machine to operate. This pedal presses on the end of the shaft seen on the left of the illustration, and on the right there is discernible the little opening through which the wire is inserted.

By using different collets, the machine is adapted for different sizes of wire. The moving parts are all enclosed in an aluminum hood, which is easily removed, for oiling or inspection. When open, the knives are easily changed or removed for sharpening. The speed of operation depends entirely on the operative's speed in inserting the wire end, and of course varies somewhat with the style of wire worked on.

Generator Flashlight

THE writer believes that many people coincide with his view that the omnipresent flashlight operated by its minute dry battery, is at once a wonder and an annoyance. This apparatus is so small that its usefulness about a house and the amount of work which it does is really surprising. The unsatisfactory feature is the giving out of the battery.

In purchasing batteries, the age of the battery must always be looked out for, as a dry battery gradually deteriorates by merely standing idle, and an old battery is frequently exhausted before being inserted in the hollow case of the flashlight.



A flashlight operated by a generator contained in a case held in the hand. The fingers operate the generator and the case is of a shape to fit the palm.

The flashlight which we illustrate, while naturally somewhat higher in first cost, dispenses absolutely with the battery trouble, and flashlights of this type have acquired extensive use in Europe.

Within the case, which is given a sort of pistol-grip shape, there is contained a magneto. By pressing the handle the magneto is caused to rotate, and by releasing it, repeating the pressure again, and keeping up the process, the generator is kept in operation and the lamp is lighted as long as the fingers are kept in motion.

An interesting development is the operation of a pencil type lamp attachment for the use of physicians for diagnostic purposes.

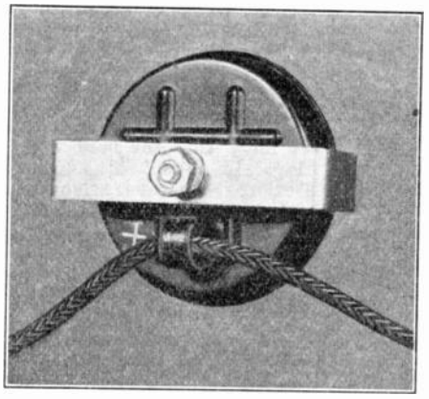
The generator flashlight is supposed to be of French origin and is certainly a very interesting development of the flashlight.

The illustrations show the physician's appliance and the regular lamp.

New Automobile Ammeter

AN automobile ammeter that has no electrical coils or convolutions and is very simple in construction involves a radical departure from the principles used in most previous ammeters, as no coils are used. The case of the instrument has a magnetic yoke or loop projecting to the rear, through which is passed the cable or wire carrying the current, which actuates the index. The yoke has pole pieces extending into the inside of the ammeter. These poles vary in magnetic polarity and strength, according to the direction and strength of the current passing through the wire and, being made of a special alloy steel, act without any residual magnetism error which would change the zero of the instrument.

There is also a fixed permanent magnet inside the instrument with poles located at right angles to the poles of the yoke. Pivoted on a shaft in the center of this group of poles is a soft iron vane which takes up a position corresponding to the relative strength of the permanent and the electro-magnetic poles. The shaft carries the usual index which indicates the value of the current on a dial. The movement is so balanced that shocks or swaying will not cause the pointer to swing.



The last simplification of the ammeter; this instrument contains no windings and no internal leads, operating by the field of the main external conductor.

This peculiar construction, which was made possible by the development in the Westinghouse laboratories of the new non-residual steel alloy, reduces by more than 50 per cent the number of necessary parts and greatly increases the reliability and strength of the instrument.

Instead of wiring the meter to the car system by means of two leads of wire or cable with connections and clips, the only operation necessary is to pass the main cable through the opening of the yoke in the back of the instrument. All possibility of ground is eliminated; there can be no short circuits or burn-outs; no amount of overload will injure the meter; and there can be no loosening of connections.

Cigar Lighter

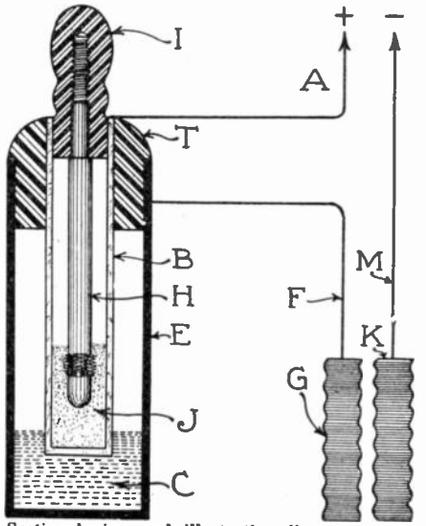
THE illustrations show a very ingenious cigar lighter of French invention.

A metal vessel (E) contains a little water (C) at the bottom to keep it cool.

An electric cigar lighter; the upright portion holds gasoline and a sparking rack is seen at its base; the lighter proper is lying alongside of it; it operates by connection to the lighting circuit.

Concentrically placed within it is a second vessel (B) which contains some gasoline (J). A metal rod with some asbestos near its bottom, with a wooden plug (I) at the top, enters this vessel and remains there when not in use as shown. (T) is an insulating collar of wood or fibre. One of the leads (A) from the lighting circuit is connected to the metal case (E). From the metal case a second lead (F) goes to a corrugated plate (G); the other lead from the circuit (M) connects with a second corrugated plate (K). (K) and (G) are about one-eighth of an inch away from each other.

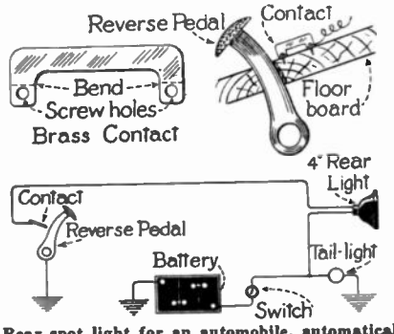
To light the taper, as it may be called, it is rubbed down the space between the two corrugated plates, which operation completes the circuit intermittently; sparks fly out and light the gasoline soaking the asbestos, and a flame which stays lighted long enough to take care of the cigar or cigarette, ensues. The photograph shows the complete apparatus with the lighter lying at its side.



Sectional view and illustrative diagram of the connections of the cigar lighter, and of the reservoir containing the gasoline.

Motor Electrics

Reversing Light for Auto



Rear spot light for an automobile, automatically turned on when the reverse gear is thrown in by the chauffeur, lighting up the road behind him so that he can watch his path.

HAVING once experienced an accident when a car backed down into a deep gulley while being turned about in darkness, an owner installed the foot-operating reversing light as illustrated herewith.

A 6-inch reflector type lamp, such as used at the front of the car, was mounted at the rear, adjacent to the tail light, in position to direct its rays rearward. This was connected to the same wire leading to the tail light, but the ground lead was taken back to a simple switch which made contact when the reversing pedal was pushed forward, thus lighting up only when the owner is about to reverse. This switch was made as a brass wiping blade to touch the side of the pedal, allowing of a considerable movement for contact.

Such an installation is a simple matter for any owner to make, and will be found helpful as obviating the uncertainty of backing in darkness.

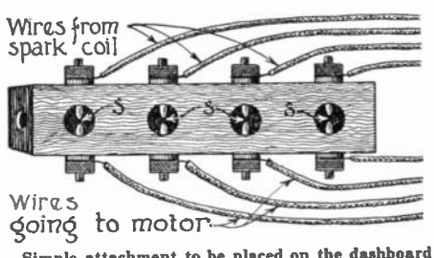
Contributed by GEORGE A. LUERS.

Spark Plug Indicator

THIS appliance is at once an indicator and intensifier for spark plugs on an automobile engine.

Eight old spark plug cores are the first requisite, in whose place, however, reasonably heavy copper wire can be used. But the spark plug cores are preferable as supplying good insulation and having binding posts or connecting studs on their ends.

A block of wood about three-quarters of an inch by two inches is required, and four holes are bored into it in the center line of the wide side, if for a four-cylinder



Simple attachment to be placed on the dashboard of an automobile, so that the chauffeur can watch the action of the spark plugs indirectly, each one having its own spark gap exposed to view.

motor. Other holes at right angles to these receive the spark plug cores tightly, so that they will stay placed. The strip of wood is screwed to the dashboard of the car so that it is seen from the seat, and each pair of plug cores is connected in the high potential circuit for one of the cylinders. The ends of the conductors of the cores should be about the thickness of a dime apart. It is a good plan to glaze the front of the board to keep out dust and improve the appearance.

It will be understood that these spark gaps have to be on the high circuit wires. The holes through which they are seen are not bored completely through the wood, and it is well to paint the inside of them black, or even stain them black with ink.

When the engine is running perfectly, each spark gap passes a spark when the cylinder is fired. But if any one of the gaps ceases to show sparks, it indicates an open circuit and tells which cylinder is missing. The illustration shows the apparatus constructed with four gaps, as for a Ford engine, but of course it may have six, eight or twelve gaps for different types of motors.

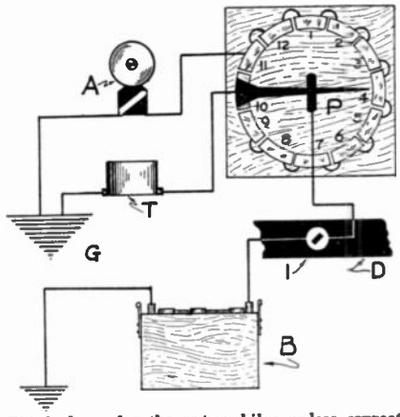
Contributed by CHARLES FORD.

Automobile Thief Alarm

THE accompanying illustration shows a "Thief Alarm" for automobiles. Fig. 1 shows a steel box 4 inches by 7 inches by 5 inches, which can be placed on the dash or at one side. Opening the door reveals a face similar to that of a clock, with a hand operated by the handle (R).

The numbered dial is shown on the right. It contains a circle of segments numbered from 1 to 12, over which slides a hand (P). When the car is running the connections are as shown above From the battery (B) the current flows through the dash switch (D) to the arm (P). Then to segment No. 10 and to the timer.

When the driver leaves the car he turns the dash switch and moves the arm to point to any of the numbers except No. 4, which is the right number. A thief attempting to make off with the car would



Thief alarm for the automobile; unless correctly connected, it will be quite impossible for the car to be driven any distance.

turn the dash switch, and unless he chanced to turn the arm to No. 4, the bell in the box would ring, as all the other segments are connected together inside.

The current would flow from the arm (P) through the segments out from No. 11 to the bell, and if a system similar to this is in use, a bell ringing in a car would attract the attention of everyone in the vicinity.

Contributed by O. C. WATKINS.

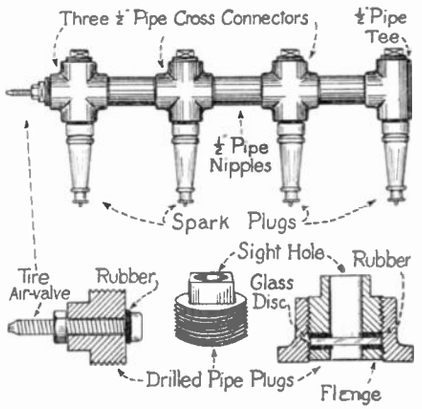
Tester for Spark Plug Set

THE illustration shows a tester for determining the condition or action of spark plugs under pressure.

This appliance consists of three cross pipe connectors, one "T" connector, three pipe nipples and five plugs. Four circular glass discs are set into rubber inserts in the connectors and the spark plugs are screwed into the opposite ends. An air hose connector is used for attaching a tire pump, and the pressure is carried up to 70 pounds.

Under these conditions the plugs are tested with a spark coil, and the spark can be observed through the sight glass. In addition to the electrical test, the compressed air gives an opportunity to detect leaks in the gaskets or around the electrode of the porcelain.

Contributed by GEORGE A. LUERS.



This apparatus tests spark plugs under pressure equal to the compression of the engine, a valuable feature.

Experimental Electrics

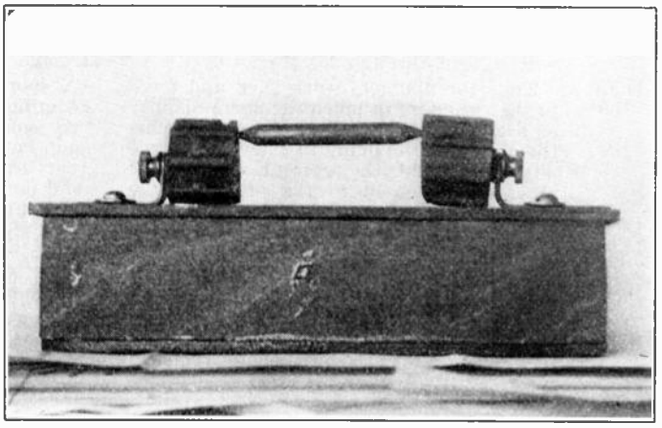
Microphone from Dry Cell Carbons

THE microphone shown in the accompanying illustration is very sensitive and costs practically nothing to construct. It consists of a small pencil of carbon supported loosely between two blocks of the same substance mounted on a sounding board and box of thin wood.

For the carbon blocks I sawed off the tops of dry cell carbons, which have a binding post attached. A small indentation is made in each of these on the end opposite the binding post. The carbon pencil is obtained from an old flashlight and the same is filed to a point at both ends. This is mounted between the two blocks.

The sounding board and box for the base must be of thin wood, preferably pine, and fastened together with glue, as brads or nails decrease the sensitiveness. The blocks are connected, by means of a piece of fine wire or telephone cord, to a dry cell and a 75-ohm receiver. Any sound in the range of the microphone will cause the sounding board to vibrate, which increases, or decreases the pressure between the pencil and the two blocks. This changes the resistance, and the flow of current is increased or decreased, thereby producing sounds in the receiver. The sounds emitted from the receiver are usually much greater than the original sounds, so the microphone may be used to amplify weak sounds such as the ticking of a watch.

Contributed by VINCENT DALEY.



A sensitive microphone made from dry cell carbons and mounted on a sounding box to increase its sensitiveness and responsiveness.

Planting by Electricity

A CALIFORNIA grape grower located in the San Joaquin Valley has devised a novel method for planting 200 additional acres to vines in record time. He has utilized electricity to do the heavy work.

A power line ran close to his vineyard and he arranged with the power company to connect the line with an insulated cable long enough to reach to all parts of the planting area. Four ⅝-horsepower electric drills, each fitted with a 3-inch auger, were then connected with the power line. One man was detailed to look after the cable and another to operate the drill. A third placed the cuttings in the holes and tamped the earth around the roots.

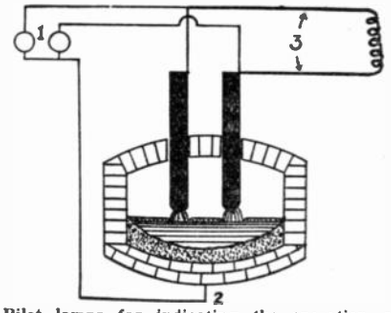
With such a crew the work of drilling holes and placing the vine roots proceeded at a fast pace, for it was but the work of an instant to drill a hole 14 inches deep, leaving the earth soft and ready for the plant. An average of 2½ acres of planted vineyard was covered daily by each drill crew, and not only was valuable time saved, but the cost of planting was less than under old methods.

Contributed by ARTHUR L. DAHL.

Using electricity to bore holes in the ground for the planting of grape vines—a California achievement which economized time and money.

Pilot Lamps for Steel Furnaces

THERE are several cases in which pilot incandescent lamps are used to regulate or rather to direct electrolytic, metallurgical and similar processes. Thus in the manufacture of aluminum in the electric furnace, a mixture of cryolite and bauxite is melted up so as to represent a sort of an electrolyte, and a current passing through it decomposes the bauxite only, precipitating aluminum, which is drawn off from time to time. The cryolite acts as a solvent and is but slightly decomposed. As aluminum is separated from the bauxite in the mixture, the resistance of the bath increases. An incandescent lamp accordingly is connected with the bath from electrode to electrode in parallel with the electrolyte, and this burns brighter and brighter as the bauxite is decomposed, so that when its brilliancy increases noticeably the operative simply has to add more bauxite to the melt, reducing the resistance, so that the lamp burns less brightly or goes black.



Pilot lamps for indicating the operation and guiding the feed of carbon electrodes in a metallurgical furnace.

This is simplicity itself. Now, coming to metallurgy, the United States Bureau of Mines has described a pilot lamp control for arc furnaces of the Heroult type. In these furnaces the heavy carbon electrodes enter through the roof and in correct operation an arc is maintained between the charge in the bottom of the furnace and the lower ends of the electrodes, which are supposed to be supported at a very short distance above the surface of the charge. There may be two or more electrodes.

The ordinary reading instruments may show the correct total of power received, yet one electrode may be buried in the melt and do but little work, while the other may be maintaining an arc of twice the normal and proper intensity. It is even possible for one electrode to be frozen fast in the furnace charge while the other electrode has an arc of such great length that it localizes the heat dangerously and is very hard to regulate.

To secure even working of the several electrodes, 40-watt tungsten filament lamps are used as pilots. Each lamp is connected to its own electrode as regards one terminal, and the other terminal is connected to the shell of the furnace or to an iron bar buried in the melt. If no arc has been drawn from the electrodes to the melt, both lamps will burn brightly and with equal brilliancy. When an arc is struck the light appertaining to the carbon in question goes down a little, so that by using the lights as a guide the arcs can be struck one by one, the lamp in parallel with the arc burning with diminished brilliancy. If by mismanagement, one of the electrodes comes in contact with the melt, the lamp appertaining to it is short-circuited and goes out. The lights show the exact position of the electrodes at every moment.

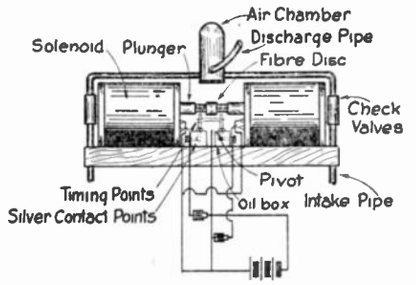
By drawing a distinction between electrolytic processes, such as those operating by decomposition or compounds by the passage of the electric currents, and metallurgical furnaces in which the current is primarily a source of heat, a useful classification is attained. The electrolytic processes do not usually involve the application of the furnace.

Electrical Pumps

By F. R. Kingman

MANY varieties of pumps have been invented in the last few years. The word invented, however, may be considered misleading, as in reality they are only improvements on former pumps. The newer pumps are based upon old fundamental principles. In a final analysis there are four principal kinds of pumps, as described below:

1. The reciprocating pump, which has a cylinder and a piston or a plunger that works up and down in the cylinder.



An electrical reciprocating pump operating by solenoids which actuate two pistons.

2. The rotary pump, one type of which works upon the centrifugal force principle and another type operates upon the impeller system. It has for its rotating element, impellers or lobes. Air chambers are needed for satisfactory operation. The centrifugal pump also has impellers but works upon the centrifugal principle.

3. The pistonless pump, such as the pulsometer, jet pump and hydraulic ram.

4. The diaphragm pump. It is also pistonless, but works somewhat on the reciprocating pump principle.

Most electrically operated pumps fall under one of the above types, driven by an electric motor. Some are direct-driven, some direct-coupled and others belt,- chain,- or gear-driven.

The writer has carried on some experiments in electric pumps, of construction differing from that of the ordinary electric pumps.

The first one built by the writer was a small ironclad solenoid pump, was about ten inches long and six inches high. In the drawing above the reader will get a clear idea of how it was constructed and how it operated.

The pump was built out of two ironclad solenoids, having soft iron copper-plated plungers. The winding of the solenoids was on brass cylinders bored out to fit the plungers. At the outer end of the two brass cylinders was a magnetic stop. A small hole was drilled lengthwise through the center of these magnetic stops just large enough to allow a small pipe to be inserted or screwed into the outer end as shown in the drawing.

The pipe leading from each end of the solenoid was connected to two check valves. The lower valve permitted the water from the intake pipe to be drawn into the cylinder by the magnetic action of solenoid No. 2 pulling the plunger out of solenoid No. 1. A vacuum was created which caused the water to be sucked up in the cylinder No. 1.

The solenoids were mounted on a base in line with each other and the plungers were direct connected, as shown in the drawing, by a strip of brass. At the end of the stroke of the plungers the current is cut off from solenoid No. 2 by the action of the plungers, which operate as a timer. The current is sent through solenoid No. 1.

Now the water which is in the cylinder of No. 1 is forced out through the outlet check valve and up into the air chamber. While this action is taking place the plunger of the solenoid is sucking in water and at the end of the stroke the current will be sent through No. 2 again.

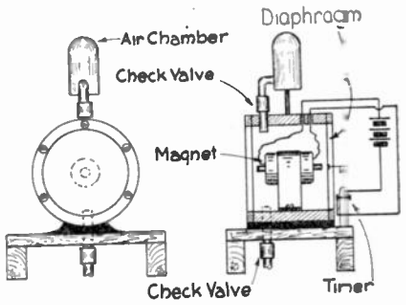
Thus the plungers work back and forth in the cylinders in much the same manner as a steam reciprocating pump. To define the action of the pump in a few words we might say that the current is switched from one solenoid to the other by the timer as the plungers reach the end of their strokes, thus forcing a stream of water up into the air chamber.

The working model which the writer built operated very efficiently and pumped quite a stream of water under about fifteen feet pressure head. A six volt battery was used. Each solenoid required about eight amperes at six volts pressure or about fifty watts to operate each.

It will be understood that the full load current from the battery was an intermittent current, as the timer was so adjusted as to cut the current off just a short time before the plungers of each solenoid reached the end of their stroke. The writer learned, however, that the greatest effect was being produced per watt when the plungers were moving towards the magnetic stop, within a distance of one-eighth to one-sixteenth of an inch.

The main reason this type of pump was never a commercial success was because a really efficient one was never constructed.

A short time after building this pump the author constructed another one. As before, solenoids were employed, but this pump had a diaphragm. Its action was a great deal the same as the ironclad solenoid pump, but instead of using cylinders and a plunger, a flexible diaphragm was used. This type of pump was found to be more efficient than the other pump.



A diaphragm pump utilizing an electro-magnet, indicating a departure from the solenoid drive.

The diaphragm was made out of sheet spring brass and was connected to the plungers by a small brass rod, as shown in drawing below. The electric timer and valves worked just as the one shown in the first drawing.

In the diaphragm pump it will be readily seen that in a very much shorter stroke of the plunger, a greater amount of water will be forced out and taken in, and the plunger will also be in closer range of the magnetic stop, thus giving it a greater attractive force and consequently rendering the apparatus more efficient.

This pump delivered about three times the quantity per second as did the first, though the same amount of power was used in each one. Now there is a great possibility of constructing a much larger pump similar to this one that would prove as efficient as other electric pumps in use today.

Another diaphragm pump built by the writer is illustrated. It gave good results. The action was much the same as that of the first diaphragm pump mentioned.

This pump is operated by a single magnet instead of a solenoid. It resembles a large single pole watch case telephone receiver, except that it has a diaphragm at each end of the pole. The magnet was well planted and covered so that it was perfectly water-proof. The diaphragms were constructed of soft iron and the case was of soft iron.

The magnet was operated from a six volt storage battery. The pump was pulsating in its action, the center of both diaphragms being drawn toward the poles of the magnets at the same time. When the current was cut off by the timer, the diaphragms were released again and water was drawn up by suction into the pump.

There is a possibility of developing a pump of this type that would prove successful. There is always a demand for a good commercial pump that is economical in operation and requires very little care.

Interesting Articles to Appear in Our May Issue

Chicago-New York Engineers' Symposium. By Clyde J. Fitch.

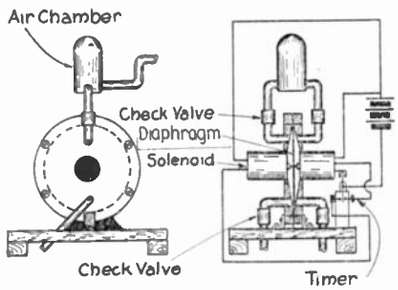
Influenza and the Telephone. By Dr. Albert Neuburger, Berlin Correspondent, PRACTICAL ELECTRICS.

Electricity and Crime.

Original Speaking Kinematograph. By Lucien Fournier, Paris Correspondent, PRACTICAL ELECTRICS.

High Frequency Induction Furnaces. By T. O'Conor Sloane, Ph.D.

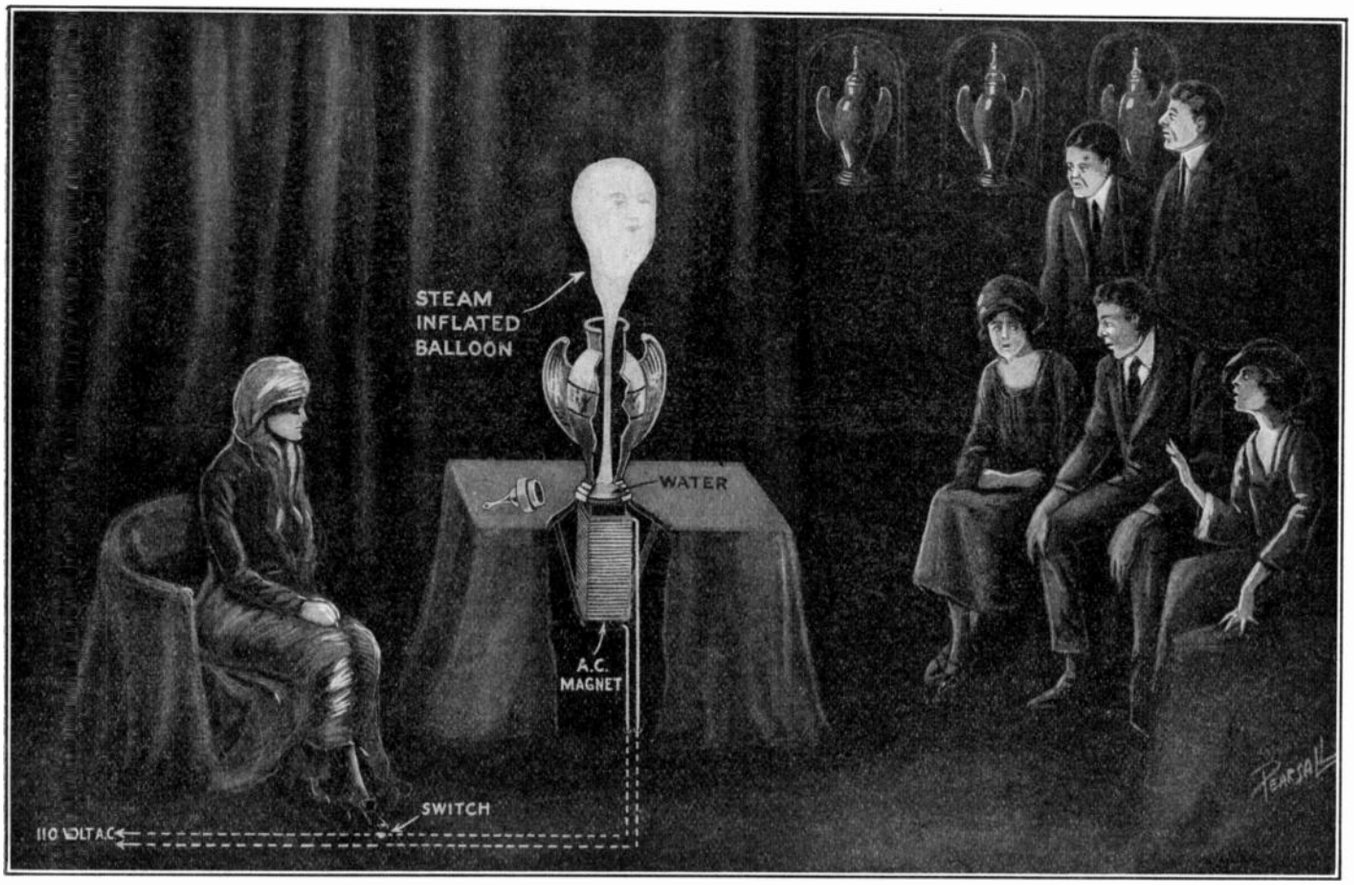
New Theory of Magnetism. By T. J. J. See, Ph.D., Professor of Mathematics, U. S. Navy.



A variation on the pump just described, in which the diaphragm feature is introduced, thus obviating the friction of the cylinders.

The Electric Ghost

By Clyde J. Fitch



An alleged spiritualistic seance, in which the apparition of a ghastly face rising out of a funeral urn supplies the awe-inspiring feature for the credulously disposed.

PERHAPS the most spectacular séance I ever attended promised to be one grand success, but an accident upset the whole affair.

Entering a large, darkened room, the audience seated themselves around a small table in its center. A black cloth covered the table, hanging nearly to the floor. On the walls were a few niches, which contained funeral urns. Black velvet draperies covered the doorways and windows.

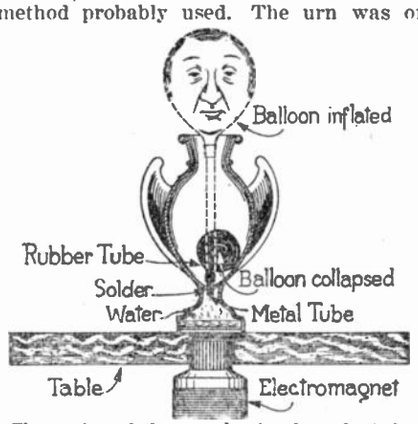
The medium entered. She appeared very energetic. She proceeded to remove one of the urns from a niche, in the wall, unscrewed the cover, and then placed the urn on the table. I peered into the urn, but could see nothing in its dark depths. I glanced at the medium, who had already seated herself in a chair. She appeared motionless and as rigid as a statue. I felt uneasy in the silence, with the pale faces of the medium and the sitters shining in the dark.

I glanced back at the urn, and behold, from the mouth of the urn a misty white form slowly arose. I watched this apparition as it gradually grew into the form of a man's head, with plainly distinguishable features. The face appeared as pale as death itself, and seemed to emit a mysterious phosphorescent glow. Suddenly the death-like silence was interrupted with a BANG! The ghost disappeared in a white cloud. We sprang from our chairs and rushed for the door, and in my haste I bumped the table and tipped over the urn, out of which ran a stream of steaming water. I realized then that the ghost was a fake and produced by scientific means, and all my fear and creepy sensations departed

The medium picked up the urn and rushed out of the room. Turning on the light and raising the black cloth which covered the table, one glance underneath was sufficient to reveal the secret of the haunted urn. The illustrations show what I observed.

A large magnet, about 18 inches long, was securely bolted to the under side of the table. The core of the magnet was about 3 inches square in cross-section and was made up of transformer steel laminations tightly clamped together. The wire on the core appeared very large, about number 6, and was wound in three layers. Evidently the magnet was designed for use on a 110-volt circuit.

Just what was in the urn I never discovered, but the illustrations show the method probably used. The urn was of bronze, its interior divided by a diaphragm across it just above the base; the bottom compartment was soldered and held water. A tube connected the two compartments, in the upper one of which was fixed a thin rubber tube terminating in a rubber balloon. Normally the balloon and tube are rolled up, but when the urn is placed over the magnet through which an alternating current is passing, the heavy currents induced into the bottom of the metal urn generate enough heat to boil the water and inflate the rubber tube and balloon with steam, which unroll and expand and are forced out of the urn. The medium probably used a special balloon, as the features of the face, such as the nose, appeared to extend out like reality and were not painted on the rubber. However, a plain balloon with a painted face, tinted with radium luminous paint, might have been used.

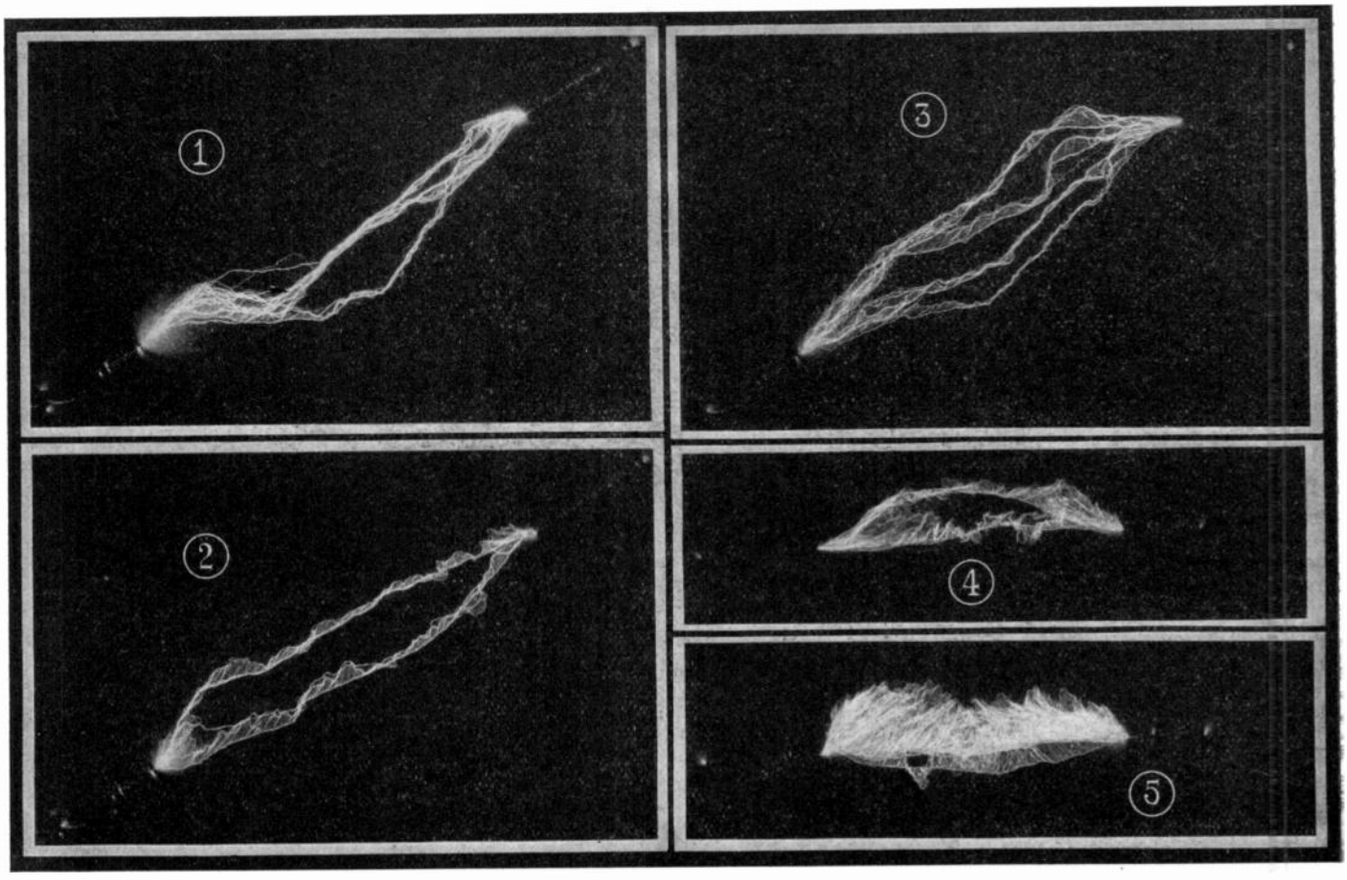


The section of the urn showing how the induction from an alternating current coil is made to produce the inflation of a painted balloon.

Unfortunately for the medium, she either forgot to open the switch in time, or the balloon was old and worn with use, for the pressure of the steam was too great for it, and the balloon burst. If the switch had been opened in time, the steam would have condensed and the balloon would have collapsed, allowing the "ghost" to go back to his haunts.

But the effect of the séance, had it not been interrupted, would have been marvelous. With nerves already unstrung by the mysterious and ghost-like actions of the medium, the onlookers would have been ready to believe in almost everything that was supposed to happen. Plaster casts of the "spirits" could have been made, as some psychical investigators like to do.

Million Volt Sparks



Five examples of electric discharges produced at the Pittsfield, Mass., G. E. laboratory, (1) 1500 volts, 60 cycles, 14 feet between sharp points. (2) and (3) Other discharges under the same conditions as in Fig. 1. (4) 1,200,000 volts, 60 cycles, with grounded neutral, and 11 feet between sharp points. (5) The same conditions as those of Fig. 4, except that this is 20 volts less potential difference. Observe the beautiful and delicate tracery of the discharges.

IN early days electricity as a science was divided into two classifications, static electricity and current electricity, the latter often being called dynamic electricity.

To the first were attributed the so-called frictional excitations, such as those produced by the old-time electric machines with their leather cushions coated with a paste, termed amalgam, while current or dynamic electricity was taken to represent the quiet and efficient type of electricity, such as delivered by a primary battery.

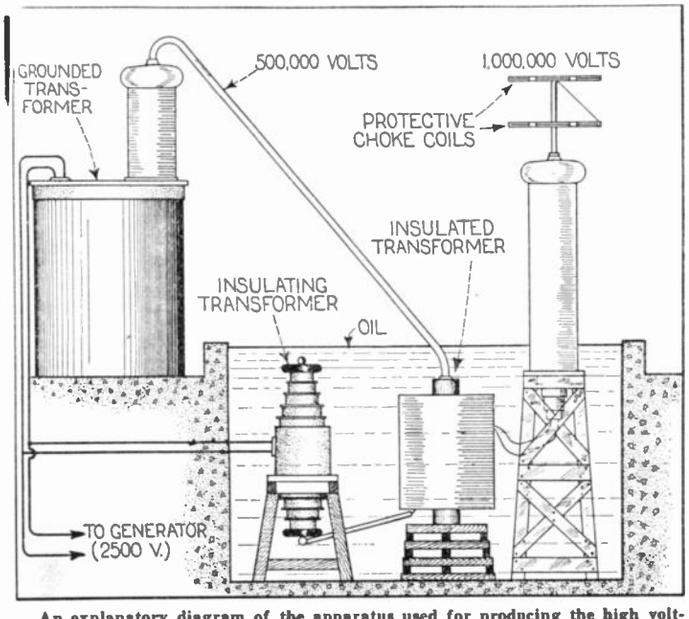
Of late years, although there are a good many of such late years, the battery, except for special purposes, has been displaced by the mechanical generator or dynamo, and recognition has gradually come about that static and dynamic electricity are one and the same, except that recurring to the more familiar phenomena, the potential evolved by static excitation is enormously higher than that due to the battery or direct current dynamo. Yet it is perfectly fair to say that when a switch on a battery circuit is opened, the two members of the switch represent the coat sleeve and stick of sealing wax of the old time experiment. They may be taken as the two plates of a condenser, with the air for a dielectric.

By the use of step-up and step-down transformers, any desired change of voltage can be produced if an alternating current is used. This power of modifying voltage by the apparently inert transformer, in which no part has any effective motion, and in which any motion whatever is a defect, has had a profound effect on electrical engineering, and has made possible the development of hydro-electric power distribution.

One of the great puzzles connected with the sparking distance of static electricity was the assigning of a definite voltage to a gap of a given length; and there is little doubt that the crude estimates of such voltages generally erred on the side of assigning too high a voltage to the inch. These estimates were little better than estimated guesses in many cases.

But the alternating current and the transformer has changed all this. A circuit excited by a voltage producing a current can easily be made to tell what voltage exists between its extreme terminals. If the voltage is changed by use of a transformer, the perfectly simple ratio of turns of wire in the primary and secondary gives the data for calculating the voltage of the secondary. The measurement of high voltages can be made a very simple matter to execute, and quite high voltages are produced without difficulty, although when the 200,000-volt mark is passed, the difficulty of dealing with the excitation of the circuit increases in a very rapid ratio as a bit of practical engineering.

Yet for testing experimental and research work in ordinary commercial routine, 700,000 volts potential has to be dealt with, as in the testing of insulators and the like, with a tendency constantly ranging upward. Instances of the utility of these high voltages, outside the testing requirements, are supplied by X-ray work: an X-ray tube is operated at over 100,000



An explanatory diagram of the apparatus used for producing the high voltage in effecting the discharges; part of the apparatus is immersed in an oil tank; observe the protective choke coils.

volts, which gives a frequency of what seems the enormous quantity expressed by 24 followed by 16 ciphers. This does admirably for radiographs, photographs of the bones and other parts of the human system, now so extensively used by physicians in diagnosis. But for the treatment of cancer a higher frequency is considered essential, which is provided by radium, and to make an X-ray tube give the radium frequency, it is calculated that a potential of something like 2,000,000 volts would be required.

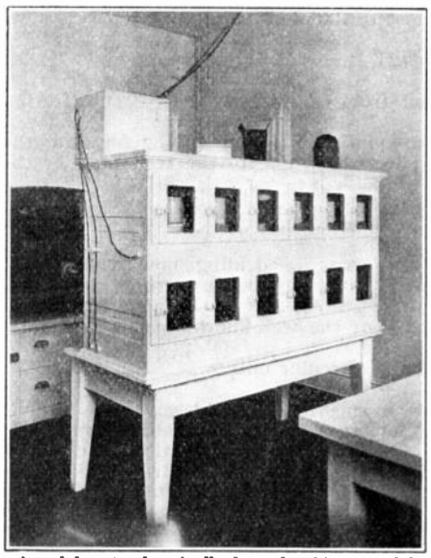
We reproduce in this issue some wonderfully beautiful photographs of electric discharges, produced by an apparatus installed at the Pittsfield Experimental Station of the General Electric Company. These discharges are typical of those produced by potential differences in the neighborhood of 1,000,000 volts between the grounded terminal and a terminal of high excitation; 1,000,000 volts potential difference gave nine-foot sparks. It is to be understood that each photograph represents a large number of discharges following each other at high frequency and producing the really beautiful patterns shown. In the experiments, naturally the greatest precautions had to be exercised to avoid accident, and the sparks took certain liberties. Thus, in one test at 1,000,000 volts potential difference, a discharge took place from one of the choke coils, shown in the diagram above the million volt terminal to an iron pipe on the wall, a distance of 18 feet; accepting the direct ratio of voltage to length, this indicated something like 2,750,000 volts.

Electrical Dough Fermentation

THE fermentation of dough through the action of yeast was formerly experimented with in food laboratories by the use of heat radiating from electric light bulbs burning in proximity to the rising dough. Now, thanks to the electrical ingenuity of the Bureau of Agricultural Economics of the United States Department of Agriculture, a fermentation cabinet has been designed and built wherein the heat is controlled automatically and uniformly by a miniature electric system.

The cabinet was made of cypress wood. It contains several compartments, and doors are provided on both sides of the cabinet, leading either to the compartment containing the baking ovens, or to the working table. The apparatus has the capacity for working twenty loaves a day. The sample doughs are started into fermentation before they are placed in the ovens. Heat is maintained by electricity, automatically controlled by a thermo-regulator.

The heating system resolves itself into two units, one for normal working temperature and the other at a higher intensity of electric current. One section of the heating coil is situated in the middle of the cabinet, while the other unit is in the lower portion of the cabinet. A series of shallow pans of water are kept in the cabinet to insure proper humidity, which should be at least 85 per cent. An electric resistance box is seen mounted on top of the cabinet, in the left-hand corner.



An elaborate electrically heated cabinet used by the United States Department of Agriculture for testing the rising of dough; the temperature is accurately regulated in any desired way.

Other than serving as a fermentation cabinet, this cypress container of inviting appearance may be used as a storage cabinet where water and baking pans can be maintained at proper temperatures. The device was primarily designed for service in the milling and baking investigations incident to the Grain Standardization Act, which is being administered by the Bureau of Markets and Crop Estimates of the United States Department of Agriculture.

Old time chemists and physicists will recollect the hot air baths of the older days. In these the heat was supplied by gas, and some kind of a thermostat turned the gas higher or lower as needed to maintain a constant temperature. In some cases the regulation was done by hand and a common turn cock was operated in accordance with the readings of a thermometer projecting from the heated chamber.

Contributed by S. R. WINTERS.

One-Piece Rotor Winding

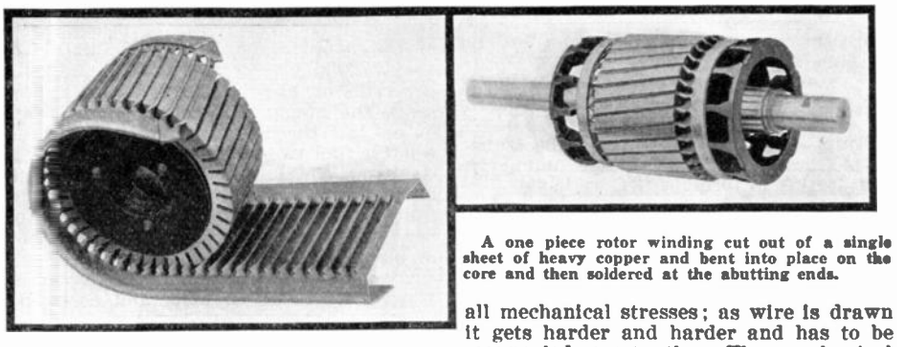
THE illustration shows a very interesting way of constructing a rotor for an induction motor.

The usual method of building these rotors is to employ copper bars which lie in the armature core-slots and whose ends are then connected by silver-soldering or other means. Whatever is done, this is certainly a multi-piece construction, and there is always a suggestion at least of the bars shaking loose or moving in the slots. There is a good deal of detail, too, involved in putting the bars in place and effecting the end connections.

In the rotor construction we illustrate, one single piece of sheet copper winds the whole rotor. A sheet of copper is punched out in the form shown in one of the drawings by a special process. It is then wrapped around the rotor core, the cross members filling the slots tightly. After the winding is in place, the individual bars are expanded into the slots still further by swaging, so that the rotor may almost be regarded as a single integral piece of construction.

But this is not all. There is, of course, a joint at each end of the winding, where the two ends come together to complete the circles of the end rings. These two joints are silver-soldered. This softens the copper, so it is re-hardened by a contracting operation.

We know that copper is hardened by all mechanical stresses; as wire is drawn it gets harder and harder and has to be reannealed constantly. The mechanical treatment of the end rings hardens the copper at the joint, by the same effect of mechanical stress.



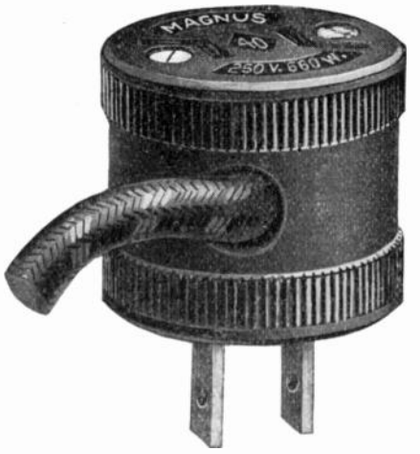
A one piece rotor winding cut out of a single sheet of heavy copper and bent into place on the core and then soldered at the abutting ends.

Heavy Duty Plug

THE illustration shows a heavy duty plug which has received a rather appropriate name, Magnus, indicating large or great, and which is designed to give double service.

When inserted into a base socket, the flexible cord extending from its side is connected to any circuit, as for running table apparatus or other purposes. In the flat top there will be observed two rectangular openings, which are spaced and connected so as to receive the regular plug used about the household. This gives a second connection to the base socket, so that another lead is available for running other apparatus. Thus on a table, percolator, toaster or other two pieces may be run simultaneously.

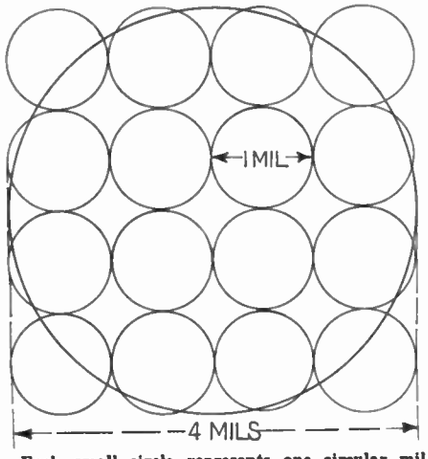
The plug we illustrate will stand 660 watts at 250 volts, or more than 2 amperes, and certainly makes the base socket doubly useful. It is recommended also for stage use in theaters, the double connection being a great convenience here.



A heavy duty plug containing openings on the top for the reception of a second plug as may be required, to surmount the one shown and give another connection.

Derivation of Wiring Formulas

By Samual Spagnola



Each small circle represents one circular mil, and the large circle, 4 mils in diameter, represents the resistance of sixteen circular mils.

FORTUNATELY, a number of well-known formulas used in connection with interior wiring do not require an extensive knowledge of mathematics, and it is to the derivation of these formulas that this article will be devoted, employing the simplest possible language. This method will not only add materially to a more comprehensive understanding of a subject employing formulas, but may also eliminate to a great extent the usual mechanical and unthinking application of same.

The object of this article is to show in a simple way how the wiring formula, namely:

$$\text{Circular mils} = \frac{10.8 \times 2D \times I}{e}$$

is derived. Also why it takes only five-sixteenths or three-eighths the amount of copper for a three-wire Edison system of that required by a two-wire system at one-half the voltage.

Fundamental principles of circuits tell us that the resistance of a wire increases with its length. Water flowing through pipes behaves almost identically with an electric current flowing through a wire; the resistance offered to the flow of water increases as the length of the pipe increases. By carrying the water analogy farther it will be found that the resistance of the pipe will decrease if we increase the diameter. It will be found that this applies also with a wire, or to put it in technical language, the resistance of a wire varies inversely with the cross-sectional area.

By placing the above assertions in the form of an equation we have

$$(1)\quad R = \frac{l}{a}$$

l = length in feet.
a = cross-sectional area in circular mils.

or the resistance of a wire is proportional to its length, and inversely proportional to its cross-sectional area expressed in circular mils.

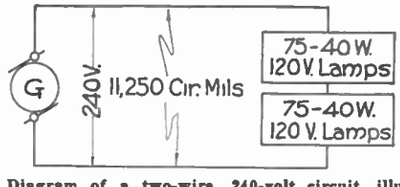


Diagram of a two-wire, 240-volt circuit, illustrating calculation of circular mils.

If a standard is now chosen, say a wire one mil in diameter and one foot long, tests will prove that all wires made of metals or their alloys, when kept at a constant temperature, have different resistances; silver has the lowest resistance or the highest conductivity. This is known to all electricians. Therefore to make equation (1) general, it will be necessary to introduce a constant which will be designated by "K." The value of "K" for silver will be 9.78 ohms per mil foot at a temperature of 75 degrees Fahrenheit; copper is next, having 10.8 ohms per mil foot at 75 degrees Fahrenheit, and so on down the metal group to alloys having close to 700 ohms to a mil foot.

$$(2)\quad R = \frac{Kl}{a}$$

but from Ohm's law $R = \frac{e}{I}$; substituting in equation (2) and solving for e, or the voltage drop due to the resistance of the conductor is:

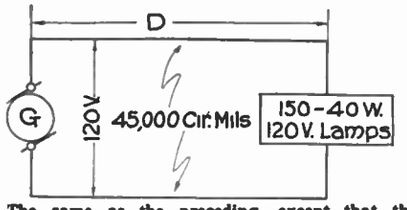
$$(3)\quad e = \frac{K\,l\,I}{a}.$$

Since we are dealing now with copper wire, 10.8 may be substituted for K, as above stated, 2 D for l, and a in circular mils, or the well-known wiring formula

$$(4)\quad \text{Circular mils} = \frac{10.8 \times 2D \times I}{e}.$$

2D is substituted for l because the formula refers to a complete metallic circuit.

We are now in a position to calculate the relative amount of wire or copper required for a two-wire and a three-wire



The same as the preceding, except that the voltage is supposed to be 120 volts, requiring a heavier wire.

system delivering the same amount of power. To demonstrate this point clearly a concrete example will be chosen, as follows: Let,

E = 120 volts or the line voltage.
I = 50 amperes (150 40-watt lamps).
D = 100 feet or the distance one way.
e = 2 per cent of the line voltage or 2.4-volt drop.

Substituting these numerical values in formula (4):

$$\text{Cir. mils} = \frac{10.8 \times 2 \times 100 \times 50}{2.4} = 45{,}000.$$

Let the same amount of power be transmitted, but at twice the voltage, and again substituting in formula (3), we have:

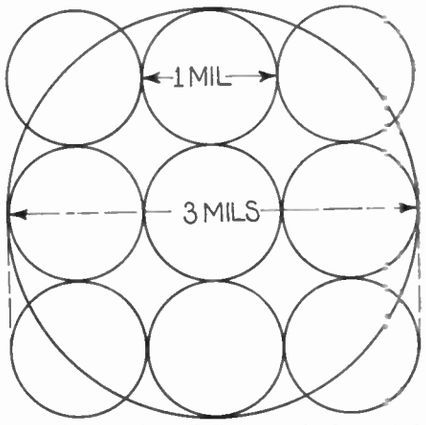
$$\text{Cir. mils} = \frac{10.8 \times 2 \times 100 \times 25}{4.8} = 11{,}250.$$

As twice the voltage is used, we must use one-half the amperages. The current is one-half, since we are delivering the same amount of power at twice the voltage. Also the drop is 2 per cent, or 4.8 volts.

By comparing these two results it is obvious that the amount of copper necessary to transmit the same amount of power at 240 volts is one-quarter that required for 120 volts.

By applying these principles to a three-wire system, the general procedure for calculating the size of wire for a three-wire Edison system would be to base our assumptions on a load or current whose potential is equal to the pressure of the outside legs, which is in this case 240 volts.

The value of the current so found is



Another circular mil diagram; the large circle, 3 mils in diameter, has the resistance of nine of the small ones, representing, therefore, nine circular mils in one wire.

then substituted in formula (4), thereby determining the size of wire in circular mils. The neutral wire may be according to modern practice as follows:

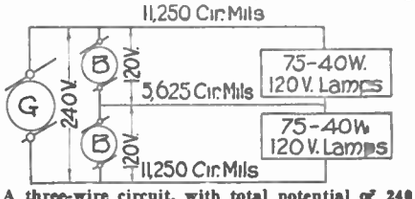
(a) One-half the cross-sectional area of the outer wires.
(b) Equal to the size of the outer wires.
(c) Or twice greater than the cross-sectional area of the outer wires.

Case (a) is the one most commonly used in practice, although case (c) has the advantage where it may be desired to change from three-wire to a two-wire system. To do this the two outside wires are connected in parallel to form one polarity, and the neutral having twice the area of either outside wire, operates in circuit with them. Since the weight of a wire is proportional to the circular mil of cross-sectional area, the relative amounts of copper required to transmit the same amount of power for a two-wire system and a three-wire system (case *a*) are as follows:

	Three-wire Cir. mils	Two-wire Cir. mils
Positive leg	11,250	45,000
Neutral leg	5,625	None
Negative leg	11,250	45,000
Total.....	28,125	90,000

The proportion of the three-wire to that of the two-wire or $X = \frac{28125}{90000} = 0.3125$ per cent, or five-sixteenths, which represents the amount of copper that is required in a three-wire system—case (a)—relative to a two-wire system transmitting the same power. Or, following the same outline with case (b), it will be found that only three-eighths the amount of copper is required to deliver the same amount of power.

Of course, if it is possible to maintain a perfectly balanced load, and assuming

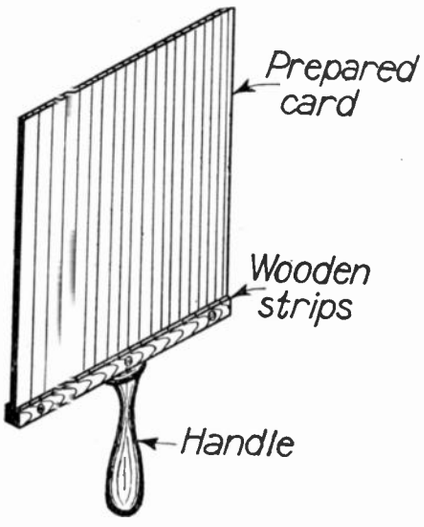


A three-wire circuit, with total potential of 240 volts, giving size of side and of neutral lines.

that two 120-volt lamps used in series are connected across the mains, or 240 volts, then the load is balanced for each set or pair of lamps, and no neutral would be required.

Home Made X-Ray Screens

By Raymond B. Wailes



An X-ray screen of simple construction, whose preparation is elaborately described in the text.

A SPECIAL X-ray screen, in the majority of cases a large one being desirable, has often been needed in the laboratory. The high cost of the most generally used substance, barium platino-cyanide, prohibits the construction of the screen or fluoroscope with it. Quite a few substances, however, can be used with complete success in lieu of the expensive platinum double salt.

Calcium tungstate has long been known to have the properties adapting it for use on an X-ray screen or fluoroscope. Calcium tungstate can be obtained as a precipitate, but this cannot be dried and dusted over a card gummed with gum Arabic and water as is usually the practice in making the screen, for it is the crystalline structure that gives the calcium tungstate its properties, and this crystalline form is not present in the precipitated variety.

The precipitated calcium tungstate, prepared by mixing calcium chloride and sodium tungstate solutions, filtering and washing the precipitate, can be converted into the crystalline and fluorescing form artificially by heating it in a tube and passing a current of hydrochloric acid gas over it.

Some experimenters have had success by using approximately 300 parts by weight of sodium tungstate, 100 parts of calcium chloride and 50 parts of sodium chloride, heating the powdered mixture to a high temperature. In this way crystalline calcium tungstate forms. The melt is dissolved out, with warm water, when cold, leaving the crystals of calcium tungstate in the bottom of the beaker. They should be filtered off and dried.

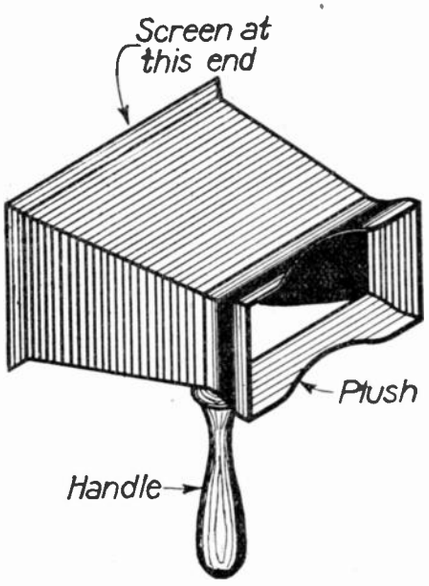
Scheelite is calcium tungstate as found in nature. This mineral is white in color and composed of many small crystals. It makes a splendid X-ray screen when powdered and sifted by means of a sift-top can, over a card moistened with gum Arabic solution.

A simple fluoroscope is shown in the illustration. The first is merely a card gummed with a solution of gum Arabic in warm water and then coated with one of the preparations given here. This simple fluoroscope should be used in a darkened room, as outside light would dim the shadow effect produced by the tube. The stereoscope type of fluoroscope is readily made from thin wood, lined with plush at the nose bridge.

Uranium salts, particularly the fluoride, are more or less adaptable to the use of the fluoroscope. Uranium fluoride gives a particularly sharp image when used with a small tube.

Uranium fluoride is prepared by mixing solutions of ammonium fluoride and uranium nitrate. The uranium fluoride precipitates as a yellow powder. There must be an excess of the ammonium fluoride, more than enough to precipitate the uranium nitrate from its solution, for the precipitated uranium fluoride is soluble in water but not in a solution of ammonium fluoride, and the presence of this latter salt keeps the precipitate from dissolving. The precipitate should be filtered off and washed free from the ammonium nitrate formed and the ammonium fluoride present with wood alcohol, or other alcohol. This alcohol-washing dissolves away the ammonium salts but leaves the yellow uranium fluoride on the filter. After drying it can be sifted on a gummed card, and when the surface has hardened can be used directly.

Calcium sulphide, luminous, is somewhat adapted for use as an X-ray screen. The cheaper luminous paints are composed of this substance. It can be prepared by heating powdered oyster shells and sulphur in a tightly closed crucible for about 20 minutes. The Bunsen burner will not produce sufficient heat for the interaction between the two.



A fluoroscope of approved construction, to get X-ray silhouettes.

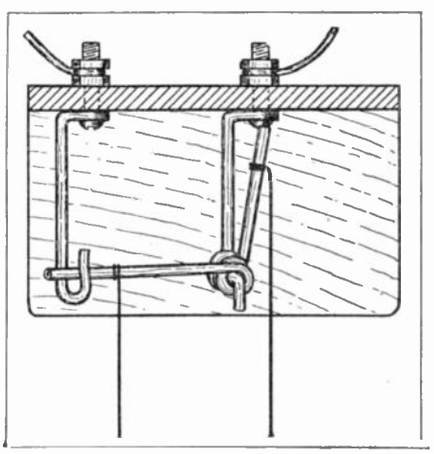
If platinum black is obtainable, then barium platino-cyanide can be prepared quite readily. The platinum black should be mixed with twice its weight of powdered potassium ferrocyanide and heated to dull redness. This forms potassium platino-cyanide, which dissolves out when the whole is lixiviated with water. The solution is fluorescent. To this solution add mercurous nitrate, which precipitates cobalt-blue mercurous platino-cyanide. The solution should now be heated, producing a white precipitate. Pass hydrogen sulphide gas into it and filter off the precipitate. Discard it. The filtrate, which is platino-cyanic acid, is neutralized with barium hydroxide solution, freshly prepared, and filtered. When the solution is allowed to crystallize, yellow crystals of barium platino-cyanide forms. They can be sifted on a moistened card as described above.

Home Made Pull Switch

A CEILING switch to be operated by a cord, which is constructed entirely of wire for its essential part, is shown in the illustration.

One piece of wire is bent into a sort of bell crank, with its arms nearly at right angles to each other, and two or three turns around a mandrel at the bend, so as to give a good bearing. A piece of wire with an eye at the end is attached by a bolt to one of the terminals of the electric circuit. As shown in the illustration, two nuts are used, one to secure the screw in place, the other to hold the wire of the circuit. This is on the right hand of the drawing. The lower end of this wire is bent at right angles. The opening in the bell-crank wire receives the bent portion, whose extreme end is then bent down to secure the crank in place.

On the left is another wire, this time bent over, and secured to the other lead of the circuit, as shown in the illustration. This piece has a hook in its lower end. When the left weight is down, the end of one arm of the bell crank is held firmly in the hook and the circuit is closed. If the weight is pushed up, the right weight pulls the bell crank out of the hook, because the angle of the bell crank is a little more than a right angle, which brings the weight back of the dead point. This construction must be such that the contact arm will be removed a good distance from contact with any part of the left hand connection. A pull upon the left cord pulls the bell crank over and closes the circuit.



A simple construction of a ceiling switch, operated by two pendants, which hold it open or closed as desired. Weights not shown are attached to the cords.

Contributed by R. J. SHEYOCK.

Awards in the $50 Special Prize Contest
For Junior Electricians and Electrical Experimenters

First Prize, $25	Second Prize, $15	Third Prize, $10	Honorable Mention
Mr. George G. McVicker	Mr. Leroy Cox	Mr. I. L. Fruit	Mr. K. F. Pontius
North Bend	Placentia	421½ Sixth Street	Akron
Nebraska	California	Portland, Oregon	Ohio

First Prize

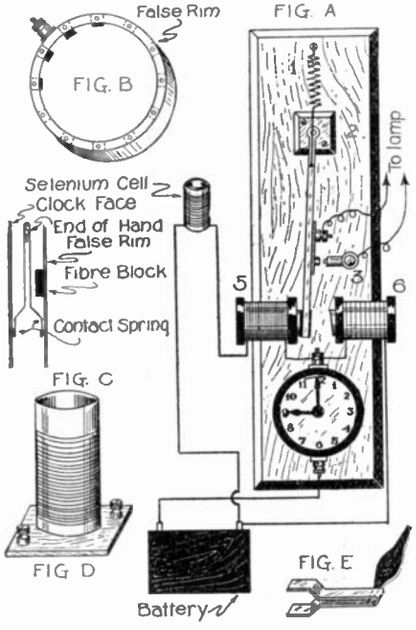
Automatic Light Switch

By George G. McVicker

THIS apparatus turns on the light when dark arrives and turns it off when sunlight dispels night. There are many places where an automatic switching device for turning on or off the lights as the sunlight increases or diminishes will be found of great service.

The accompanying drawings and description show how such a switch mechanism may be constructed, with but little expert work and but a few simple tools.

A panel board (1) 6 by 12 inches is used for the base. At one-third the distance from the bottom end two electromagnet coils are mounted with about three-quarters of an inch space between their inner facing ends.



A very ingenious light switch, which with the expenditure of a minimum wattage, and by the use of a selenium coil, turns lamps on and off according to the light.

A pendulum four inches long is pivoted on a block (2) so that the lower end hangs in line with the axes of the coils. On each side of the lower end of the pendulum are attached soft iron disks as armatures. Near the upper end is attached a coil spring with its upper fastening directly in line with the pivot point of the pendulum and a point midway between the ends of the coils. Its lower end is attached an inch or so below the suspension point of the pendulum. This spring is for the purpose of holding the pendulum to whichever side it is drawn by the respective helices.

A contact point is attached to the panel board at (3) to which one of the wires of the lighting circuit is attached. The other circuit wire is attached to a post on the pendulum, which is connected to a stud making the contact with (3).

An ordinary four or five-inch, round, metal case clock is secured and the glass crystal is taken off; the minute hand is removed, and to its outer end a piece of spring brass is soldered to each side as shown at Fig. (E) so that the spread ends of the springs will follow around the outer diameter of the clock face behind the hand.

A false rim as shown in Fig. (B), which will fit over the clock case, is procured, and on the inner side of the top flange of this rim 12 fiber blocks, each a ¼-inch cube, are riveted and cemented with the rivet heads countersunk on the bottom side. The false rim, Fig. (B), is then placed on the clock, but insulated from the clock case and in such a position that when the springs on the hand pass around they will be depressed by the fiber blocks; but the springs must not press on the metal of the false run as the hand passes around.

A selenium coil is then prepared as follows: A wood core one inch in diameter is placed in the lathe and a double-thread, 32 to the inch, is cut for a distance of three inches on the surface. Two separate lengths of No. 28 B. & S. bare copper wire is then wound in the threads and each end of each wire is secured to the wooden core. This will leave a space of about 1/64 inch between the two wires. Selenium paint is then used to cover the surface between the wires. Each of the two wires is attached to its own binding post at the base and the cell is then placed at some point where the outside light will fall on it. A glass jar may be placed upside down over the cell to protect it.

A storage battery is connected in the circuit with the coils and the selenium cell as shown, and the device is ready for operation. This operation is as follows: The properties of selenium are such as to allow a current to pass through it in proportion to the amount of light falling on the surface. Thus when sunlight falls on the selenium between the wires a current from the battery passes through the helix connected with the selenium cell, whenever a contact is made by the clock. The same current passes through both coils, but coil (6) has three times the windings that coil (5) has, and thus has nearly three times the pull.

When sufficient light falls on the selenium cell the pendulum is pulled to the helix (5) and the current circuit is broken at the points at (3). But when no current is allowed to pass through the selenium cell because of darkness, then the helix (6) pulls the pendulum over, making the contact at points (3) and lighting the lamps.

Instead of leaving on the current from the battery so as to pass continuously, which would be of detriment to the selenium cell as well as to the battery, the clock makes a contact every five minutes by means of the springs soldered on the end of the minute hand. The false cover is insulated from the case of the clock by means of shellac paper or thin fiber. As the springs are pulled beneath the small fiber block, they are depressed, and just as the ends of them leave it they fly apart and the top one strikes the surface of the false rim. This makes the contact through the battery and helix, the only requirement being the winding of the clock.

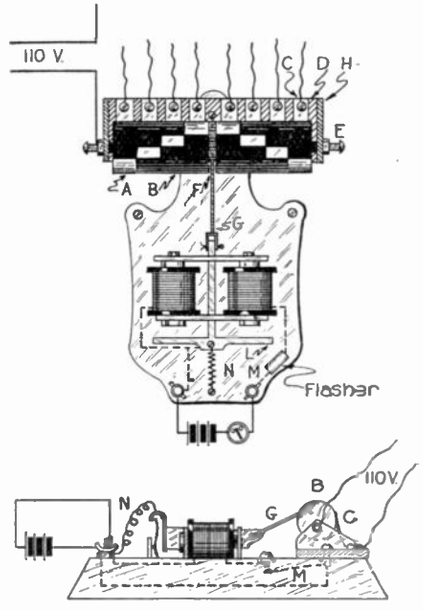
Second Prize

Electric Lamp Flasher

By Leroy Cox

THIS flasher was made to flash several lights, each at a given time. It was constructed from a direct stroke door bell in the following manner:

The gong was removed and in its place was mounted a shaft carrying two drums (B B), with a ratchet wheel between them. The ends of the shaft are countersunk and the drum is mounted as shown. The spaces (A) represent the contact pieces which are arranged as shown, or in any suitable way.



Direct stroke bell is utilized for the construction of an electric light flasher, employing a thermostat bar to regulate its operation.

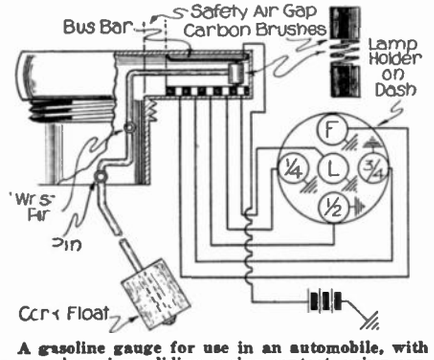
Next brushes (C) are mounted as shown. A connecting rod (G) is then pivoted to the upper end of the armature stem. There are as many teeth on the ratchet wheel (F), as there are contacts (A), in the one full circle of the drum. A flasher (M) for two or three dry cells is made of a compound strip wrapped with resistance wire, and mounted under the base in the main circuit. Care must be taken in insulating this from the bell base. It is then connected in series with the buzzer coil. The buzzer make-and-break contacts are bent so as to make a closed circuit constantly. A spring (N) draws the armature away from the electromagnet poles.

When the current is turned on, the electromagnet draws the armature up. The end of the connecting rod (G) catches in the ratchet, turning the drum far enough around, so that another brush is in contact with another contact point. This lights one or more lamps; the wire on the small flasher immediately heats up, and soon breaks the contact. The spring (N) draws the armature back in place. When the wire on the flasher cools down, the bar closes the circuit, the action is repeated and another lamp or lamps are lit by the action of the flasher drum.

Third Prize

Electric Gasoline Gauge

THE purpose of this automobile gasoline gauge is to indicate to the driver



A gasoline gauge for use in an automobile, with a very ingenious sliding spring contact, using carbon brushes for telling the contents of the tank.

at all times just how much gasoline is in the tank by lighting differently numbered lamps in a little lamp panel on the dash.

The live wire or battery wire may be fastened to the ignition wire. This turns off the current from the lamps when the ignition is turned off, and is a safe way to wire it if the driver has any fear of not turning the switch off, if fastened direct to the battery.

The lamps are ordinary automobile lamps such as used on the dash or tail lights, preferably of small current consumption so that they will not use up much of the battery output.

Two carbon brushes slide in a guide frame or tube (A); fairly stiff springs press them apart for the purpose of securing good electrical contact, and so that the swish or wash of gas in the tank when the car is in motion will not cause the brushes to respond to the action of the cork float too readily.

As the brushes slide through the tube they successively throw one lamp after another into action, and each lamp corresponds to a known level of the gasoline in the tank.

Honorable Mention

Lamp Extinguisher

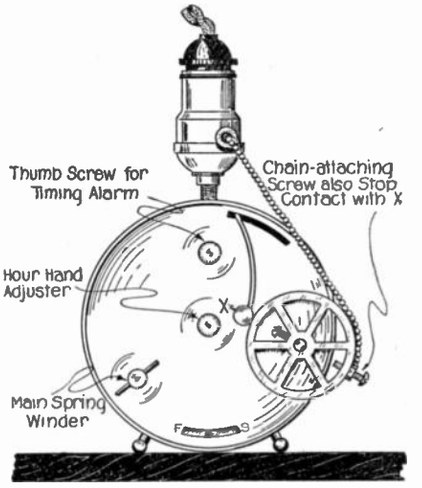
By K. F. Pontius

THE system consists of a pull-chain light socket with a drop cord attachment plug, a grooved pulley one and one-half inches in diameter, two bolts or set screws and an alarm clock with the alarm bell assembled as a cover for the back.

To complete this equipment, first remove the alarm and time winders and adjusters from the back of the clock by unscrewing them and then remove the bell. This now gives you a projecting shaft on the alarm side, to which is attached a pulley by means of a set screw.

In order to install the socket switch, enlarge the handle hole on top of the clock by reaming it out to 21/64 inch and threading with a ⅛-inch pipe tap. By means of a short nipple the electric socket can be screwed on, being careful to have the chain opening in the rear of the clock in line with and over the pulley. Pass the chain over the groove of the pulley and attach it by a bolt at a point located as in sketch. Bend the alarm hammer over to the left of the pulley and close up. This will act as a stop for the pulley when the alarm unwinds. Assemble the thumb screw for setting the hour, the alarm indicating hands and also main spring winding handle. The switch is now ready to operate.

Set the alarm for any time you wish and when the alarm trips, as the spring unwinds, it will turn the pulley, which will pull the chain down. This will trip

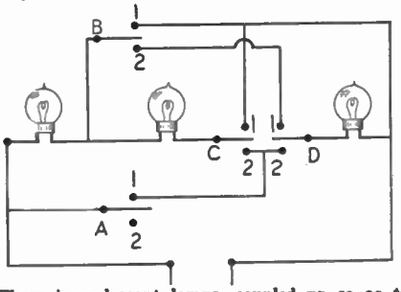


An alarm clock arranged to extinguish a lamp with a chain pull socket, so that it will put out electric lamps at any desired hour.

the socket and put out the lamps and as the bolt on the edge of the pulley strikes the old hammer, the alarm will stop unwinding. To rewind it, give only half a turn and reset. This equipment should not cost over $4.

Lamp Bank Resistance

OUR contemporary, *La Nature*, has published several connections of lamp banks. The first shows three lamps of 110 ohms resistance.

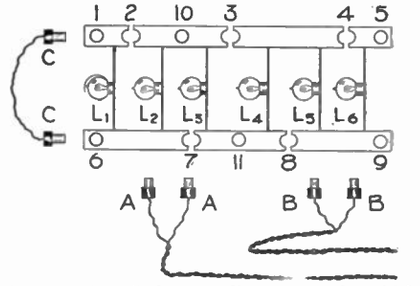


Three incandescent lamps, coupled up so as to give seven distinct resistances, according to the placing of three switches.

At A, B, C and D there are switches, and by closing these different switches respectively on points 1 or 2 the following seven resistances are obtained:

Connections	Resistance	Switches A	B	C	D
1	110 o	2	1	2	1
2	55	1	1	1	2
3	220	2	2	1	2
4	36.66	1	1	2	2
5	330	2	2	2	2
6	73.33	1	2	1	2
7	165	2	2	1	1

Another arrangement is published by *La Nature*, in which six lamps are employed, the illustration giving the layout. These six lamps give 36 resistances, ranging all the way from 18.3 up to 660 ohms. In the table the letters indicate the plugs and the figures following each letter indicate the hole into which the respective plug is thrust. It is suggested that this arrangement may be applied to condensers, so as to vary the capacity of a group.



An extension of the preceding system, by which six lamps give eighteen separate and distinct resistances.

Resistance	Plugs	Resistance	Plugs
18.3	$A_2A_4B_7B_8$	92	$A_1B_6A_9$
22	$A_2A_6B_7B_8$	110	A_1B_6
24.4	$A_2A_4B_8B_1$	132.5	$A_1B_{10}A_9$
27.5	$A_2A_4B_8$	146.6	$A_1B_{10}A_6$
30	$A_2B_7C_6A_9$	165	$A_1C_7B_{10}$
31.5	$A_2B_7A_9$	194	$A_1B_{10}C_6C_9$
33.5	$A_2B_7A_6$	220	A_1B_8
36.6	A_2B_7	247.5	$A_1C_5C_4B_8$
41.2	$A_4B_6C_7B_{10}$	275	$A_{10}C_7B_9$
44.4	$A_2B_6B_4$	301	$A_1C_5C_{10}B_{12}$
48.5	$A_2B_6B_8$	330	A_1B_8
55	A_2B_6	366.6	$A_1C_7B_8$
60.5	$A_8B_6A_{10}B_1$	385	$A_6C_7B_8$
66	$A_1C_7B_{10}A_6B_9$	403	$A_{10}C_7C_{11}B_8$
73.5	$A_1B_6A_8$	440	A_1B_4
77	$A_1B_6C_9A_4$	495	$A_6C_7B_8$
81	$A_1B_9A_4$	550	A_1B_9
88	$A_2B_6A_9$	660	A_1B_8

$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.

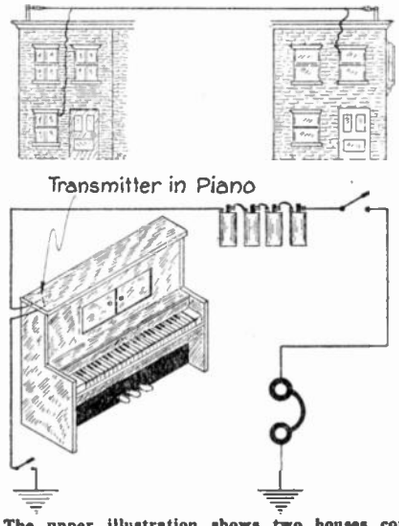
If in any way possible, a clear photograph should be sent with the idea; but if that is not possible, a good sketch will do.

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

Distant Piano Playing



The upper illustration shows two houses connected by a wire, so that the music of a piano in one building can be transmitted to an invalid in the upper story of another one. Below is shown the general layout, battery, telephone and ear-set for the invalid to use.

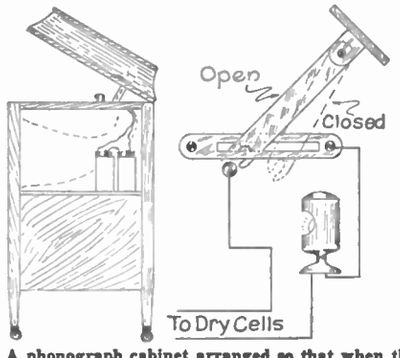
THE following description relates how electricity was utilized for the purpose of bringing cheer to a recuperating invalid:

"My home is on the corner of the street, and a friend's home is at the other end of the block. He has just come home from a hospital, but is still in bed. I had an inspiration recently, which, carried out, made it possible for him to hear our piano being played while he was in bed.

An insulated wire was run from his house to mine, being carried about one foot above the roofs on insulators. Another wire was run from his bedroom to the water pipe in the bathroom to give a ground. A 100-ohm telephone receiver was connected to the ground wire and the line wire at his bedside.

The lead into my house was connected to one terminal of a telephone transmitter; the other terminal of the transmitter was connected to four dry cells. A ground wire was connected to the other terminal of the battery. The transmitter was placed inside of the piano. A switch was also connected in the line of the ground wire." *Contributed by* KENARD ESER.

Electrically Lighted Phonograph



A phonograph cabinet arranged so that when the lid is opened, a light is automatically switched on, which light may be put in any desired position, either for getting the records out of the lower part of the cabinet, or for putting in the needle.

WHEN the lid of a phonograph is raised, if in a dark place, a light is required for putting on the record, inserting the needle and starting the music. Our illustration shows a simple arrangement for effecting this result.

The brass supports of the lid, if the diagram of the circuit is followed, will complete a circuit when the lid is open for supplying an automobile dashboard lamp. The current goes from the dry cells to the pin on which the cover support rests when the lid is raised, and this cover support, in contact with the horizontal guide plate, connects it to the wire from the dry cell.

To the other end of the guide plate one lead from a flash lamp or automobile lamp is attached. The other lead from the lamp goes to the battery. It will be seen that in this way raising the lid lights the lamp and putting the lid down extinguishes it.

Contributed by CHARLES HOERST.

SUPPOSE an invisible hand suddenly descended upon you, grabbed you, and placed you upon a dissecting table, just as the modern investigators do when observing and dissecting a bug.

Have you any reason to believe that some greater intelligence from the "outside" will not do this to you some day?

This exceedingly interesting possibility is discussed by George Allan England in his extraordinary tale, "THE THING FROM —OUTSIDE," appearing

In April Issue of "Science and Invention."

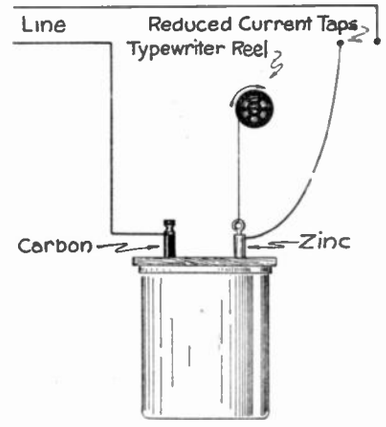
The Belin System of Radio-Television. Not a visionary article but photographs and full description of the famous French inventor's new and amazing machine that actually works.
My Visit to a Modern Battleship. By H. Winfield Secor.
New Tidal Power Scheme to Develop Electricity.
Talking Over a 7,000 Volt Transmission Line.
Helium Gas From the Carbon Arc.
Telegraphing Pictures by Code. By D. W. Isakson.
Making Rain With Electrified Sand.

Adjustable Water Rheostat

THE illustration shows a very simple water rheostat which is adjustable by raising and lowering one of the electrodes. The illustration is so simple that it speaks for itself. The jar, of a gallon capacity and three-quarters full of salt water, as shown here, contains one carbon and one zinc electrode, which pass through holes in a wooden cover. A string is attached to the zinc rod with which to raise and lower this rod.

To wind the cord on, a typewriter tape reel is used. This must be mounted with a rather tight bearing, or what is better, a washer of leather or fiber may be placed between the reel and the board, so that the friction will be derived therefrom.

It also will be simple enough to arrange for a ratchet and pawl to hold the reel. The writer says he has reduced current



A simple water rheostat in which the zinc is suspended by a cord wound upon an empty typewriter tape reel.

with this rheostat so as to light a 6-volt 2-candlepower lamp upon an ordinary lighting circuit, and has obtained 90 to 95 volts through the rheostat. In practice he uses a scant tablespoonful of salt with three-quarters of a gallon of water, three-quarters of a gallon being the contents of his jar.

Contributed by C. E. SCHANZLIN.

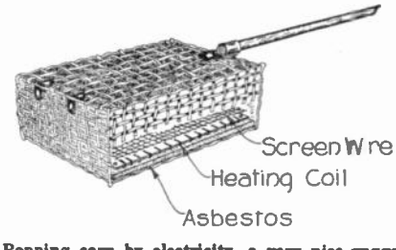
Electric Corn Popper

THE corn popper herein described can be constructed by anyone at practically no expense. The material required to build it can be found around almost any experimental shop. It possesses the advantage of taking but a short time for heating.

The device is made from an ordinary corn popper intended for use over a stove. A piece of heavy asbestos 4½ inches by 7¼ inches is placed inside of the network on its bottom. A piece of heavy mica is cut a little larger than the asbestos; this is for the heating coil to be affixed to. Small holes are cut in the mica close to each other. A small piece of copper wire is clipped over a wire in the heating coil; it is then run through these holes and twisted to hold the heating coil in place.

A piece of screen wire 5¼ inches by 8 inches is cut and the wires around the margin or edge are unraveled. The screen wire is placed just above the heating coil and the wires around the edges are twisted around the wires of the basket to hold all in place. The heating coil is connected to the light circuit and the corn popper is ready for use.

Contributed by ROY C. HUNTER.

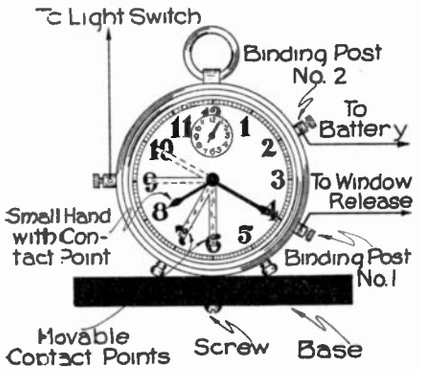


Popping corn by electricity, a very nice suggestion for those who enjoy the exploded corn kernel.

"Electric Maid"

THIS apparatus was constructed to do the following things in the morning for me:

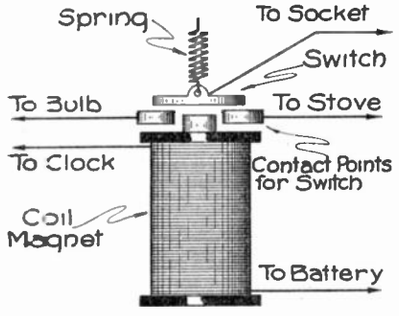
First. One hour or so before I want to get up, the clock, or rather the small



The alarm clock for an electric maid, who does everything for the early riser in the way of heating coffee, turning on the radiator, closing the window and the like.

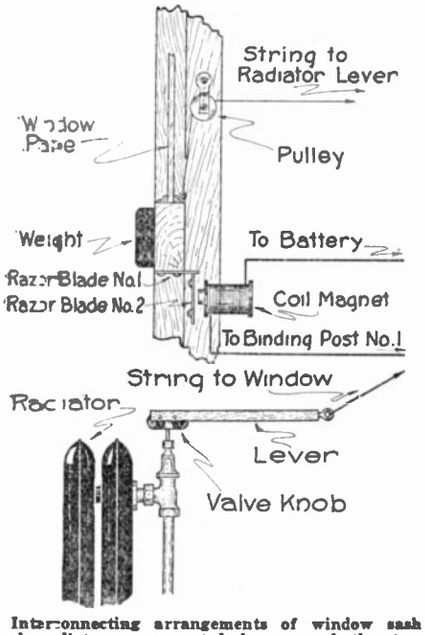
hand of the clock, will close a circuit from some dry cell batteries. This will release the cord that holds the window up. The window now will be pulled downward by a weight, at the same time opening the radiator valve, to turn on the heat.

Second. When the time comes to arise, which can be at any hour, the alarm clock will ring as usual, but at the same time the small hand will close another



Ingenious arrangement of the magnet for carrying out some of the various operations described in the article.

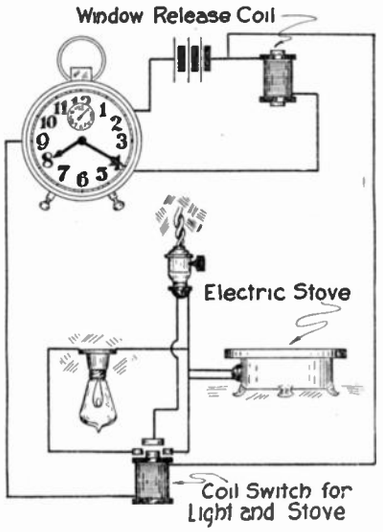
circuit. This will switch on the light, and the electric toaster or stove.



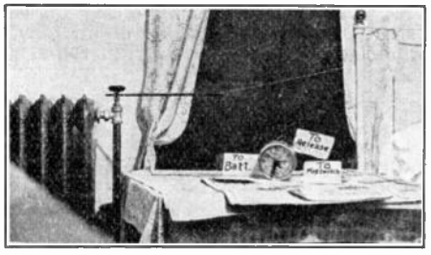
Interconnecting arrangements of window sash and radiator as operated by one of the two magnets.

It would also be possible to give the sleeper a strong enough electric shock, when this switch is closed, to wake him up thoroughly. I never used this however.

Contributed by HEINRICH POLSFUT.



General layout of the electric maid, showing the two magnets employed to carry out its varied functions.



Photograph of everything in readiness on the table and elsewhere for operation of the obliging servant—the electric maid.

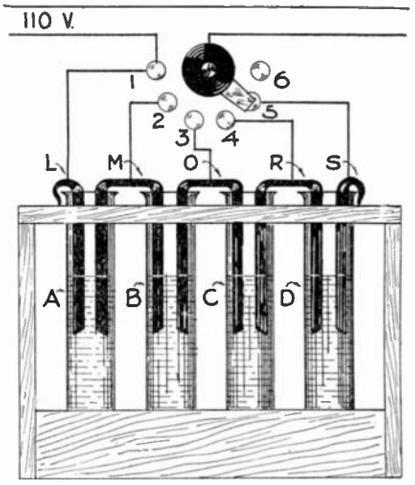
Simple Liquid Rheostat

A RHEOSTAT of preeminently simple construction, employing only a few test tubes and some strips of copper, is illustrated here.

The author states that he finds this the best rheostat for 110-volts that he has ever used. Suppose, as in the drawing, that there are four test tubes in the group. Three U-shaped strips of copper, connect across, from test tube to test tube, their ends dipping a third or half way down to the bottom of the test tubes. Two terminal or end plates, bent over so as to form little clips, are needed for each of the two test tubes at the ends.

In the center of the bend of each of the three intermediate strips short wires are secured by soldering, and to the end clips two other wires are soldered. The five wires are then brought to five studs arranged in the arc of a circle, over which a switch bar moves. Upon studying the diagram it will be seen that when the switch is on the left stud (No. 1) there will be no resistance introduced. On switch No. 2 there will be resistance, due to a single test tube. With switch No. 3 the resistance will be due to two test tubes; on point 4 the resistance of three, and on point 5 the four test tubes in series give the maximum resistance of the rheostat as shown. Of course the level of the liquid in the tubes can be varied so as thereby to increase or diminish the resistance, or it will be easy to have an arrangement for drawing the plates up from and partly out of the solution, all being a matter of detail.

Contributed by ERWIN HANIFL.



A multiple point liquid rheostat, giving various resistances according to the stud on which the switch-point is placed.

Autoists' Signals

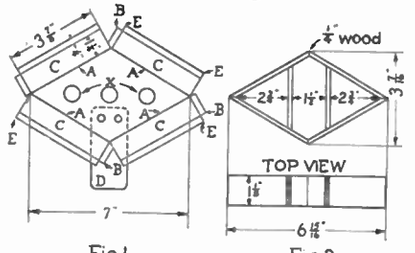


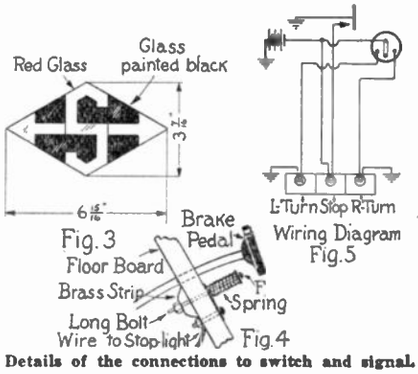
Fig. 1 Fig. 2

How to cut the tin and arrange the three compartments.

A PIECE of tin, 6½ inches by 10 inches is laid off in the dimensions given in Fig. 1. Next comes a wooden frame divided into three compartments, as in Fig. 2. On a piece of red glass block off with black paint the parts appearing shaded in Fig. 3. Next bend up the sides (C) of the sheet of tin on the lines (A), and, after bending them, solder flaps (B) to the sections (C). The three holes (X) should be fitted with sockets and small candlepower bulbs. Next bolt a piece of heavy sheet iron (D) on the back of the signal. Then place the wooden frame inside of the tin box, the glass on top.

Now carefully bend over the margins (E) of the parts (C), placing a strip of felt under them so as not to break the glass. The signal is placed on a rear fender, using strip (D) as a bracket. A switch should be made as in Fig. 4. This should be placed near the foot brake, so that when the brake is applied the pedal strikes the head of bolt (F) and completes the circuit for the stop signal by grounding its lead. The turn signals are operated by a two-point switch mounted operated by a two-point switch.

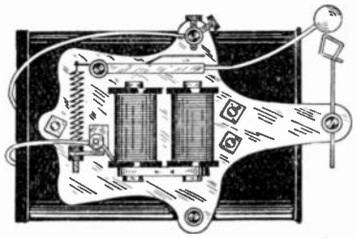
Contributed by FRANK HARRIS.



Details of the connections to switch and signal.

Automatic Circuit Breaker

A BELL having the tension spring and the contacts fully adjustable is the basis of this circuit breaker.



An automatic circuit breaker, one of whose characteristics is the introduction of a condenser to be contained within a tobacco box which forms the base of the apparatus.

A catch made of a safety-pin catches and holds the clapper, being attached to the bell support by a binding post. An old tobacco can serves as a base. I put a spark coil condenser in the base and shunted it across the contacts, which reduced the arcing when the line was short-circuited or accidentally overloaded.

Such a circuit breaker will operate on all loads between 25 and 250 watts. It has been in use for some time in my electrical shop and gives good service.

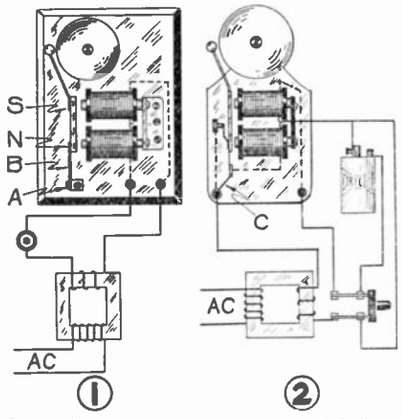
Contributed by EDWARD AYERS.

Alternating Current Bell

AN alternating current bell is much easier to make than a direct current one, as it requires no contacts in its construction. Therefore it has an advantage over the direct current bell, as it has no make-and-break to give trouble. Fig. 1 shows how such a bell can be made.

A pair of electro-magnets which can be taken from a telegraph instrument are mounted on a wooden base. They act upon the armature which is screwed to a wooden block (A). The armature is simply a small permanent bar magnet (NS) with a bell hammer soldered to one end and a spring (B) soldered to the other end.

The operation of the bell depends upon the fact that like poles repel while unlike poles attract. Upon referring to the diagram it will be seen that when the core of the upper magnet becomes a north pole the lower core will become a south pole, and since unlike poles attract, the armature will be attracted. But as the current in the A. C. circuit reverses, the polarity of the cores will also reverse, and as like poles repel, the magnets will allow the armature to return to its former position. It is also obvious that the armature



Connections for an alternating circuit bell; one bell has a polarized armature, and the other dispenses therewith.

will vibrate just as fast as the current in the A. C. circuit reverses; thus if the frequency in cycles per second of the A. C. circuit were 60, then the armature would strike the gong 60 times a second. The above bell is what is known as a polarized bell and will only ring on alternating current.

Fig. 2 shows how an ordinary door bell can be connected so that it will ring as a polarized bell. As the regular contacts are not required, they are short-circuited by the small piece of wire (C). A dry cell or perhaps several connected as shown will keep the upper magnet magnetized with one polarity, while the other magnet will be alternately magnetized in different directions just as fast as the polarity of the A. C. circuit to which it is connected reverses. Hence, when the current flowing through the coils tends to make the ends of the cores south or north poles, the magnetism of one magnet will neutralize the magnetism of the other. Consequently, the armature will not be attracted, but when the magnetism of the magnets agree in direction, then they will attract the armature, and since the direction in which the lower magnet is magnetized is constantly changing, the armature will vibrate.

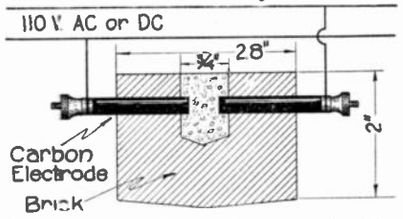
The switch connected as shown in the diagram will open or close both alternating current and battery circuit.

Contributed by AMEDEO GIOLITTO.

Miniature Arc Furnace

THE Bunsen burner used in most laboratories does not furnish sufficient heat to melt many reagents and chemical fluxes and fusions.

An old brick made of good clay is to be cut down to a cube two inches on each side; a hole three-fourths of an inch in diameter is drilled exactly in the center



A miniature arc furnace for use in the laboratory, doing the work of the Bunsen burner and blast lamp for heating small sized crucibles.

on one side, to a depth of one inch. Below this hole, five-eighths of an inch from the top, two holes are drilled from the outside to the center, commencing at two opposite corners, one-fourth of an inch in diameter.

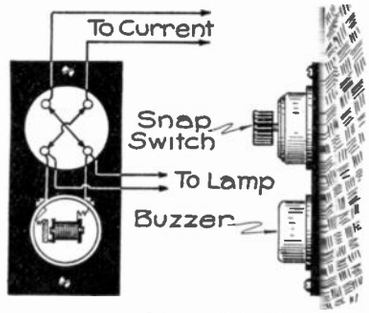
Two carbons from two wornout cells of a flashlight battery are sand-papered or ground down to fit the one-fourth inch hole snugly; two binding posts procured from an old dry cell are soldered to the caps of the carbons.

The furnace is now ready for operation; place the carbons in the one-fourth inch holes on both sides, so that each will project one-eighth of an inch into the interior cavity formed by the three-fourths inch hole. The 110 volt line is connected to the two binding posts of the carbons. To start the furnace, push one carbon against the other and then instantly draw it away about half an inch. This strikes an arc across the gap between the ends of the two electrodes, giving a heat of about 2,000 to 3,000 degrees Centigrade. A small porcelain crucible will just fit the top of the three-fourth inch hole and almost any chemical reagent can be melted in this way.

This apparatus should always be placed on a ring stand or tripod, as the outside of the furnace becomes quite hot when in operation for some time. Care should be taken to avoid touching both of the carbons while the current is turned on, whether the carbons are arcing or not. A switch placed on a cord would be found convenient as a permanent addition to this furnace.

Contributed by CLARENCE MOORE.

Cellar Light Alarm



A buzzer connected in parallel with a lamp gives its alarm as long as the lamp is lighted, thus constituting a cellar lamp alarm.

THE construction of a rather unique current saver is illustrated here. Very often one forgets to turn off the cellar lights, thus wastefully increasing the amount of the light bill.

A low pitch buzzer placed in the circuit of the cellar light serves as an efficacious reminder. The snap switch and buzzer can be mounted on a formica, bakelite or hard rubber base and screwed to the wall.

Contributed by IRVIN E. PEPPIN.

Rectifier From Buzzer

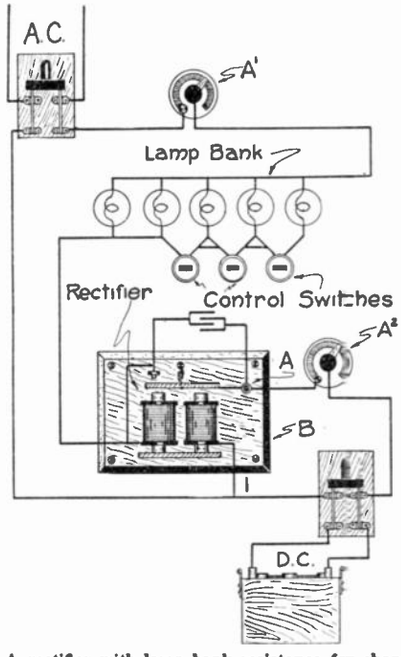
THE illustration shows a rectifier for charging storage batteries.

A lamp bank of five 16-candlepower carbon lamps is arranged as shown in the diagram. The first two lamps are in constant use as soon as the main switch is thrown on, and the remaining three can be thrown into service by the single pole snap switch in the lamp bank control.

The current is rectified by the converted buzzer. This is made to rectify the current by connecting the electromagnet to the line, and the contacts (both armature and stationary contact) are connected to make and break the current, so as to eliminate the reverse current. Across the contact points a condenser is shunted to prevent excessive sparking at the points. The current is measured by the ammeter (A_1) for the alternating current, and (A_2) for the direct current.

When properly constructed this arrangement should have a capacity, at full load of 8 volts, 10 amperes.

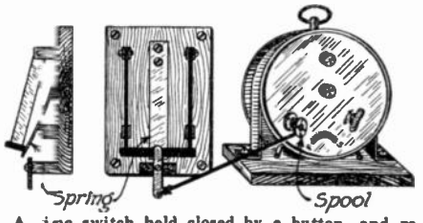
Contributed by CARROLL MOESCHLER.



A rectifier with lamp bank resistance for charging a storage battery, giving a good current and 8 volts potential.

Time Switch

THIS switch, whose construction is so simple that it can be understood from the illustration, is operated by an alarm clock.



A time switch held closed by a button, and released by an alarm clock, upon which it springs back and instantly opens the circuit.

When an alarm clock sounds its warning note the key with which the alarm spring is wound, turns around a number of times not very rapidly. Upon the spindle, or clamped upon the key, an ordinary spool is secured, and to this spool a string is attached, so that when it turns the string will be wound up. It is well to give the string one or two idle turns to give it a grip.

As shown in the drawing, a knife switch is to be opened, and, of course, it is an object to open such a switch very rapidly. Accordingly, a strong spring is placed beneath it, whose action will cause it to fly out of the clamp when free to do so. A piece of fiber or hard wood is arranged as a trigger, with a screw going through its center, and when set its ends extend over the cross-bar of the switch as shown, and holds it to its closed position with the knife edges between the leaves of the clamps. If this so-called trigger is turned, the switch will fly open under the stress of the spring, and will do so instantly. The string which goes around the spool on the clock is attached to the lower end of the trigger after the clock is wound.

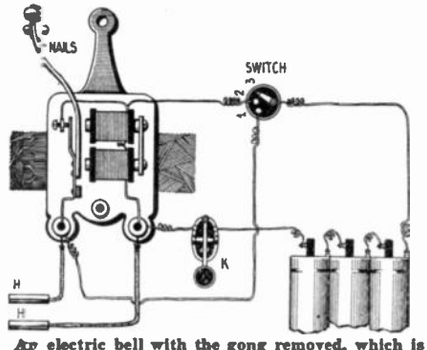
When the clock reaches the time for which it is set, the alarm goes off, the spool is rotated, winding up the spring, pulling the trigger and releasing the switch, which at once flies open.

It is to be observed that the sudden opening of the switch is quite beneficial to avoid arcing. It is also obvious that many modifications can be introduced, so as to make the appliance serve for other types of switches.

Contributed by J. S. MITTAG, JR.

Combination Apparatus

IN the illustration is shown a combination of three useful articles: a Morse telegraph set, a wireless buzzer practice set, and a shocking machine.



An electric bell with the gong removed, which is so connected as to represent (a) a Morse telegraph set, (b) a wireless buzzer for practicing the code, and (c) a shocking machine for those who use electrical treatment.

By moving the switch (S) to contact No. 1, the key (K) upon being depressed, works the wireless buzzer set.

Moving the switch to contact No. 2 establishes a circuit so that the key operates a Morse system.

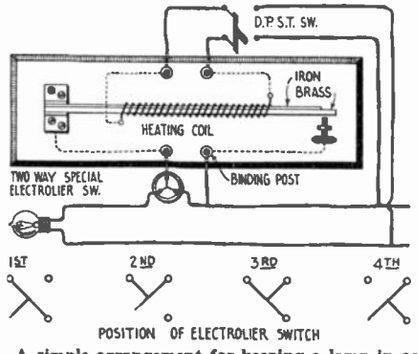
When the switch lever is placed on contact No. 1 and the key (K) is held constantly depressed, a fairly good shocking machine is obtained by having two metal or carbon handles (H) connected to the binding posts of the bell.

Moving the switch lever to contact No. 3 opens all circuits.

Contributed by FRED D. VERCELLINO.

Inexpensive Time Switch

THE time switch here described for keeping a lamp in action two or three minutes after turning the switch is very simple, practical and easily made. This time switch is an apparatus that closes or opens a circuit after the lapse of any time up to three minutes after the regular switch is opened or closed. The wooden base is 7½ inches by 3 inches. A thermostat bar is made by riveting with six rivets equally spaced a strip of 1-16-inch brass ½ inch wide and 6 inches long, to a strip of iron of the same width and thickness, but only 6½ inches long. Two strips of brass ½ inch wide by 1½ inches long are bent at right angles 1 inch high and are bolted to the base; between the upstanding ends of these the end of the iron and brass compound thermostat bar is firmly riveted. A set-screw is fixed to the base to the right in the illustration, so that it can be adjusted until it almost touches the brass of the compound bar at the free end where it projects beyond the iron bar.



A simple arrangement for keeping a lamp in action three or four minutes after the circuit has been opened, by means of a thermostat bar. A special switch enables it to be used without reference to this feature.

A heating coil 3 inches in diameter and about 3 inches long is slipped over the thermostat bar and the ends are fixed to binding posts on one edge of the base as shown; these hold the coil in place, so that it will not touch the bar. Two other binding posts are fixed on the opposite edge of the base and a short wire is run from one of them to the set-screw, and another from the other binding post to the end of the thermostat bar, that is riveted or bolted between the brass clips.

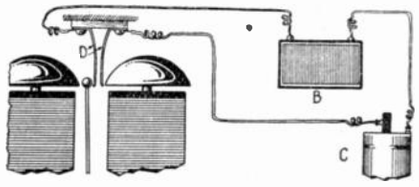
The switch is now finished and is connected up as shown in the drawing. A two-circuit electrolier switch will be required, although two single-pole, single-throw switches can be used.

There is also a special switch, four positions of which are shown. When the switch is in the fourth position the time switch is not connected in the circuit. When the time switch is to be connected up, the electrolier switch is placed in the third position, which connects the time switch in the circuit and leaves the light in action. This should be done about three minutes before the time the switch is to be used. When the time switch is to be used, the electrolier switch is turned to position one, and switch number one is opened. This opens the circuit and puts out the light in two or three minutes. Position two is to be used when it is desired to turn the lights off at once.

Contributed by ROY C. HUNTER.

Distant Telephone Bell

AN ordinary bell and battery on their own local circuit are placed in series, in any desired place where it is requisite that a telephone bell be heard, as in some



The motion of the clapper of a telephone bell is made to operate a relay circuit, ringing a bell in some distant room.

distant room. Immediately over the telephone the circuit is connected at two binding posts, and to these are connected two copper or brass springs, see (D).

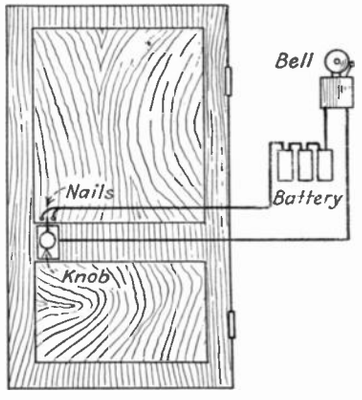
If one adjustment is correctly made, the clapper of the telephone bell will lie between these two strips, touching neither or only one when the bell is not sounded. When the central office rings the telephone bell, the clapper will vibrate, and there will be spring enough in the strips, so that for each vibration of the clapper it will close the circuit, the current coming in from the local circuit, going through one of the springs, through the clapper, and then through the other spring, and out on the local line, thus ringing the distant bell.

Another method of adjusting it, if there is difficulty in doing the above, is to place both strips to one side of the bell clapper, and then when it goes in that direction, it will press them together and thereby close the circuit. In this case the resistance bell will ring with one-half the frequency of the telephone bell.

Contributed by BEN LADNER.

Burglar Alarm

THIS is an extremely simple yet absolutely efficacious alarm which operates by the least movement of the knob of a door. To the stem of the knob a straight projecting spring is attached and two nails are driven into the door, one on each side of this projecting piece, so as to act as stops or contacts therefor. An alarm bell and battery are connected in circuit with the two nails as one twin or branched terminal, and the metal work of the lock as the other. It is necessary to have the projecting piece a spring, so that the motion of the knob will not be interfered with by the nails.

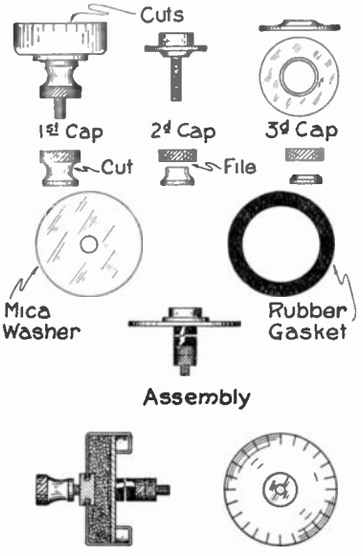


The simplest of all burglar alarms, which rings a bell when the knob of the door is turned, without waiting for the door to be pushed open.

If anyone attempts to enter the door, as they turn the knob either way, the projecting piece will touch one of the nails, complete the circuit, and the bell will ring.

Contributed by J. FALCONER.

Transmitter Button



The details of a transmitter button, to do the work of the well-known Skinderviken and other typical telephone carbon elements.

A SIMPLE transmitter button can be constructed by anyone in accordance with the following instructions:

Three brass caps are removed from the carbons of old dry cells; one small piece of mica and one piece of rubber from an old inner tube, the thicker the better, are also required. On one of the caps the binding post is retained, except that light cuts are made with tinner's snips all around the open, or bottom edge, about one-eighth inch deep and the same distance apart.

Next, two rubber washers are cut from the piece of inner tube to fit the inside of the brass cap; the cap is placed on the rubber, edge down, and twisted slightly. This will make a mark for the outside of the washer. The inside circle should be one-eighth to three-sixteenths inch smaller. The washers are cut out with a shears.

From the binding post of another cap cut away all except about one-sixteenth inch. Cut a diaphragm from a piece of thin mica to fit the inside of the first cap. Make a hole in the center to fit over the screw of the second binding post; saw two of the knurled nuts in two and ream out two pieces to make two brass washers. The others will serve as two knurled clamping nuts. Assemble thus: Place the mica on the screw of the second cap, next come two brass washers, then the two knurled clamping nuts.

Now take another brass cap. Knock the screw out of the center, then drill or file away the center until the middle of the crease; then trim away all of the vertical part of the sides with tin shears, leaving a brass washer the size of the inside of cap.

Pound up a piece of the hard central carbon rod quite fine; sift through a fine mesh screen to remove the dust, and then through a coarser one to remove the large pieces, making certain to save the fine grains that are about one-sixty-fourth to one-thirty-second inch in diameter.

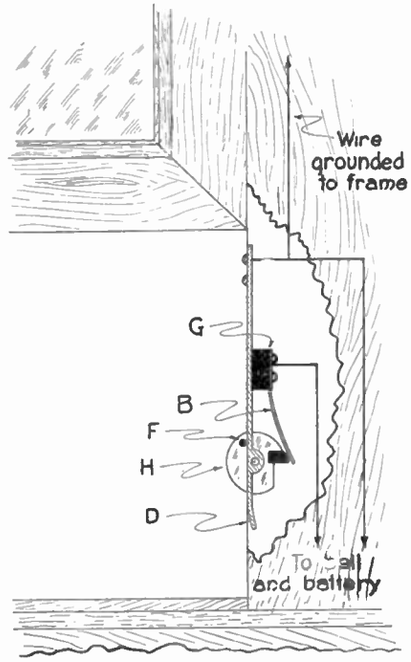
To complete the assembling, place one rubber washer in the first cap at its bottom; fill the cavity in the center three-quarters full of the carbon grains; place a mica disk with parts described, on top of the rubber ring; put in another rubber ring on top of the mica; now place the large brass washer on top of this with the half of the crease left down. Clamp with pliers the small portions of cap over the edge of the brass washer, and the button is complete.

Contributed by O. W. WYRICK.

Electric Window Alarm

A CAM support is cut out of sheet metal, and provided with two ears drilled out as bearings for a cam shaft. These ears are bent up as shown in the illustration. The cam has a flat surface and adjacent thereto is a slot in which a block of fiber is secured; a stop-pin limits the amount of rotation of the cam.

Referring now to the second illustration, we see there the cam support carrying a contact spring screwed to a fiber block, the two latter being shown singly in the first illustration. In the position shown, the cam is prevented from rotating clockwise by the stop-pin, and in this position the fiber block is pressed upon by the contact spring so as to keep the circuit open.

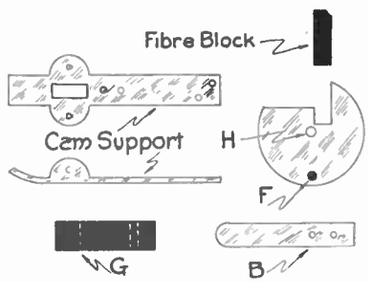


A side section of a window jamb, showing the burglar alarm device operated by the turning of a roller by the sash when pushed up or down.

If the sash is already up and is pushed down, the motion, it will be seen, is without effect on the cam because of the stop-pin. But if the sash is down and is pushed up the cam will be rotated through about 60 degrees, the insulating block will be drawn from beneath the contact spring, which then will strike the metal of the cam, complete the circuit, ring a bell, or turn on lights, so as to give an alarm.

The connections are clearly illustrated in the diagram showing the window sash raised and the alarm switch in position to ring.

Contributed by BELGRAVE F. GOSTIN.

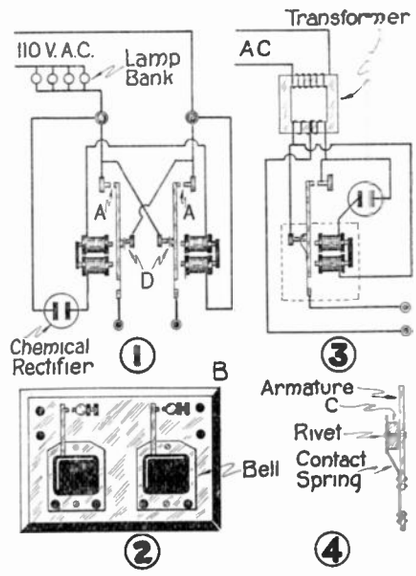


Details of some of the working parts of the window sash alarm, showing roller cam.

Rectifier Made of Bells

A GOOD rectifier which will rectify both sides of the cycle can be constructed from two electric bells as illustrated.

The hammer is cut off the stem and the gong and its brackets are removed. Each armature is fitted with a contact (A),



Two bells in combined operation, forming a rectifier. Figure 3 shows how, by utilizing a rectifier, the work can be done with a single bell.

which operates against the adjustable contact. The magnet and accessories are mounted on a base as shown and the connections of bells are shown in Fig. 1. It will be noted that the armature of one of the bells is shown on the right hand side of the magnets; this was done in order to simplify the wiring diagram, but when the bells are mounted on a base as shown in Fig. 2 they may be connected up facing in the same direction.

In the diagrams the light lines show the magnet circuit, while the heavy lines show the path taken by the rectified current. In series with the electro-magnets a small chemical rectifier is connected, which is nothing more than a lead and an aluminum plate immersed in a solution of sodium phosphate and water, the solution being contained in a glass. This one-jar chemical rectifier may be very small, as it only needs to pass enough current to operate the magnets.

By referring to the diagram (Fig. 1) it will be evident that when the polarity of the A. C. line coincides with that of the small chemical rectifier the magnets will become magnetized and will attract their armatures, thus reversing the current. Since the polarity of the A. C. line has already reversed, the current at the D. C. terminals will always flow in the same direction. But when the polarity of the A. C. line again reverses, the chemical rectifier will prevent the magnets from becoming magnetized; hence they release their armatures, which again reverses the polarity of the A. C. line, and thus the polarity of the D. C. terminals will be the same as before.

Two electric bells will not be necessary if the experimenter has in his possession a small transformer, as the transformer and a bell can be connected as shown in Fig. 3 so that they will rectify both sides of the cycle.

An important point in the operation of these rectifiers is that a small piece of iron (C) must be placed between the contact spring and armature as shown in Fig. 4. The idea of doing this is to prevent the contact spring from remaining in contact with (D) when the armature is being attracted by the magnets.

To prevent sparking at the contacts, condensers such as used in telephone work are connected directly across the contacts.

Contributed by AMEDEO GIOLITTO.

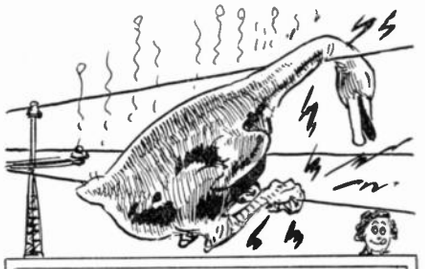
Short-Circuits

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!

In state here lies
Maud McAllister.
Her body "shorted"
Comb and register.
—E. HILL.

PRIZE WINNER $3.00

Here lies the body
Of simple Mark McNutt.
He tried a knife switch
To see if it would cut.
—REAGAN DENNIS.



Goose on Electric Wire Cuts Off Lights of City

RICHMOND, Ky., Feb. 6.—Searchers today located and removed from a high tension electric wire a goose which had escaped from a produce yard here Sunday night and alighting on the wire caused a short circuit that plunged the city in darkness. The goose was well cooked.

These are the remains
Of an eager old goose.
Her love for "currents"
From life pried her loose.
—MRS. G. W. GUPTON.

Lies buried here,
Harry O'Tuck,
While fixing the socket,
The lightning struck.
—FRANK L. CULLEY.

TWO PAINTERS ARE KILLED BY LIGHT CURRENT

William Castleberry, 16 years old, 1233 West Fifth, died a hero Monday evening when he tried to save his 28-year-old brother George, who was electrocuted by an ordinary 110-volt electric light wire, while attempting to unscrew an electric light bulb.

Both were working on a touring car at Mack's Auto and Paint Trimming company, 2310 South Robinson. George had reached up to unscrew an electric light bulb, to attach a drop light. In some manner he came in contact with the current, which passed through his body, killing him instantly.

Hand Is Seared.

William, seeing the flash, as the current seared his brother's hand, grasped the hand in an effort to jerk it away from the socket, and in turn also was electrocuted.

George died at once, and William before an ambulance arrived.

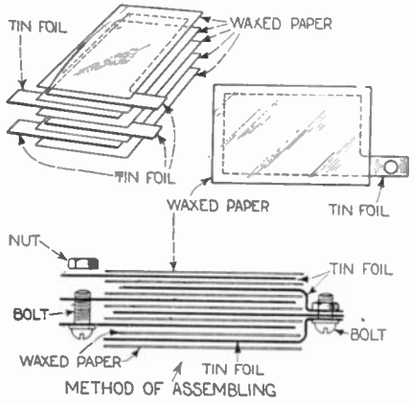
This coffin holds
Hedwig Wiener.
Because she shorted
The iron and cleaner.
—CARL FLEMING.

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.

Fixed Condenser



How to make a fixed condenser with tinfoil and pasteboard, or other conductor and dielectric.

(258)—Walter Purchase, Richmond, Va., asks:

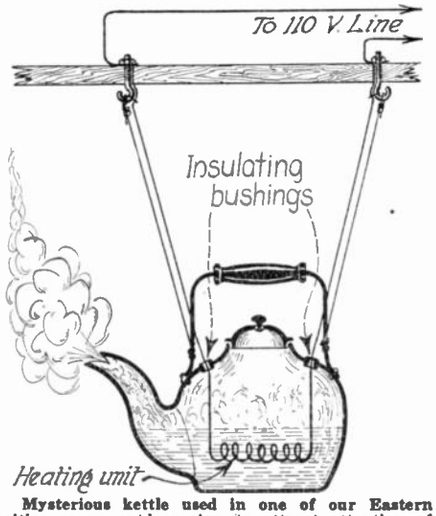
Q. 1.—Please show me the construction of a simple fixed condenser.

A. 1.—A simple fixed condenser is shown in the illustration. This condenser is made up of sheets of tinfoil and waxed paper. The condenser may be clamped with two pieces of stiff cardboard and a few rubber bands.

Mysterious Kettle

(259)—Herbert Mead, Newton, Mass., asks:

Q. 1.—In a display window in Boston there is a kettle hanging in midair which

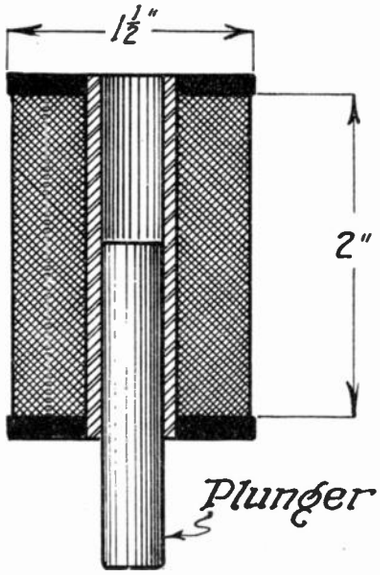


Mysterious kettle used in one of our Eastern cities as an outdoor sign to attract attention of passersby. One of the ostensible supports must be a small pipe carrying water to supply the loss due to evaporation.

has a continuous cloud of steam issuing from its spout. How is this kettle arranged to hold boiling water without cooling?

A. 1.—The kettle probably has an electric heater within it. This heater is connected to the service line by means of copper wires concealed in the cords by which the kettle is suspended. In order to keep a large kettle of water boiling, the heater will consume about 200 watts of electrical power. A simple heater for a 110-volt circuit can be made of about three feet of No. 26 B. & S. nichrome wire wound in a coil and immersed in the water in the kettle. As water has a very high resistance, it will not appreciably short-circuit or otherwise interfere with the action of the heater. The illustration shows the kettle with the heating unit connected with the circuit by means of insulated wires running through holes drilled in the kettle near the hinge of the handle.

Solenoid Data



Section of a solenoid with dimensions for about an inch travel of the core.

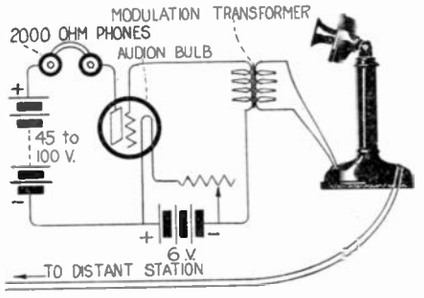
(260)—A. Starcoe, Ontario, Canada, writes:

Q. 1.—Will you kindly tell me how much and what size wire I will need to make a solenoid that will lift two or three ounces?

A. 1.—The drawing shows a solenoid that will meet your requirements. The plunger is ⅜ inch in diameter by 2 inches long. The pull of this solenoid varies from approximately zero, when the plunger is at the lower end of the coil, to about 8 ounces when the plunger is ¾ inch in the coil. Then the pull is constant for ¾ inch and drops down to zero for the next ½ inch. You will require 800 ampere turns on the coil, and if you intend to energize it from a 6-volt storage battery you will need about ½ pound of No. 24 B. & S. insulated magnet wire. This will give about 1,600 turns and will pass about ½ ampere.

Amplifying Telephone Speech

(261)—E. Montero, Mexico, D. F., inquires:

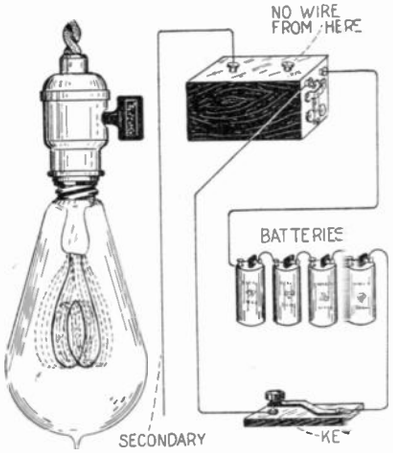


Use of an audion bulb for amplifying the sound of an ordinary telephone receiver. The connections are shown in full detail.

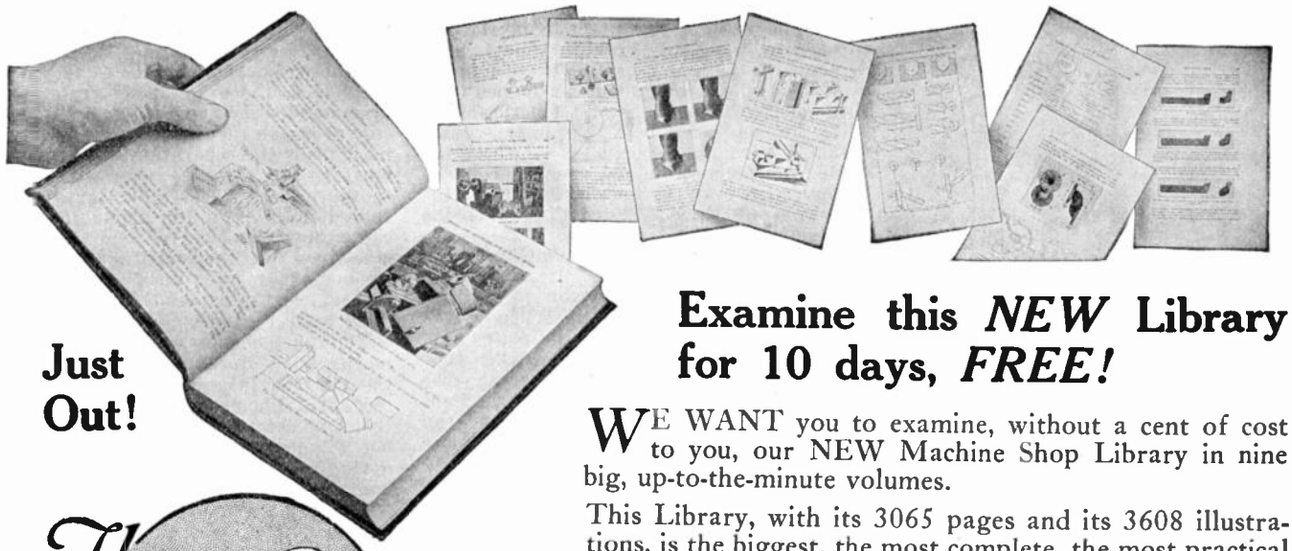
Q. 1.—Will you please show me a hook-up for amplifying the voice of an ordinary wire telephone by means of an audion bulb. It is to be used at each end of the line, about 100 miles apart, and must work through the company's service.

A. 1.—You may amplify the sounds received over your telephone, by connecting instruments in the manner shown in the diagram. Disconnect the telephone receiver from the instrument, and connect the primary of the modulation transformer in its place. The rest of the instruments are connected up as shown, and the receiver is placed in the plate circuit of the tube. It will probably be found to advantage to use a pair of 1,000 to 2,000 ohm receivers in place of the telephone receiver in the plate circuits. Installation such as this can be made at both ends of the line and the voice will be found to be much louder after the tube is once properly adjusted.

Electric Lamp Experiment



Vibration of a filament of a carbon incandescent lamp, due to alternating current, explained.



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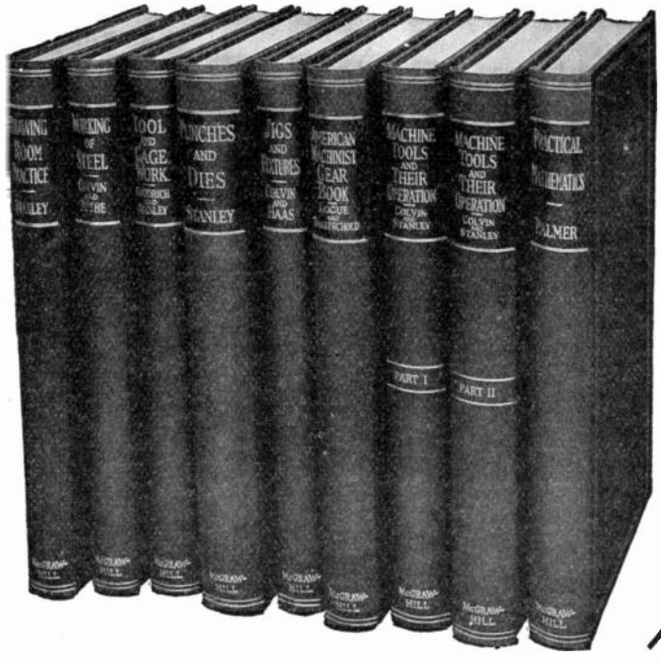

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(262)—Herbert Martin, McPherson, Kan., writes:

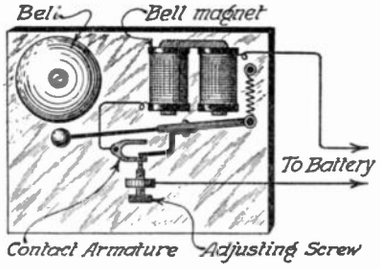
While working one night in my laboratory, my hand accidentally came in contact with the high tension wire of a spark coil. My head was about six inches from the electric light globe and I noticed that the filament trembled vigorously. After that I tried the experiment shown in the diagram placing the end of one secondary connection near the bulb, and obtained the same result when I closed the key on the primary circuit.

Q. 1.—Will you please explain the cause of this phenomenon?

A. 1.—The phenomenon you speak of is due to a condenser effect. When a condenser is charged, the metallic plates tend to pull toward each other, and when they are discharged the pull is gone. The same thing happens in the electric light bulb. In the particular experiment you mention, your head comprised one plate of the condenser, the glass globe the dielectric, and the filament the other plate. As this condenser, for such it is, is charged, the filament is drawn toward the side of the bulb nearest your head, and when the condenser is discharged, as when the current reverses, it is released, thereby causing it to vibrate.

Slow Ringing Bell

(263)—Roy Miller, Chicago, Ill., writes: Please publish a drawing in your "How and Why?" department showing the construction of a slow-ringing doorbell.



An ingenious arrangement for making a bell ring with very slow frequency, by the use of a peculiar type of fork make-and-break connection.

A. 1.—The illustration shows a slow-ringing bell which can be made from the parts of an ordinary doorbell. A pivoted armature is arranged to make contact with the adjusting screw when the hammer is down. The current then passes through the electro-magnet, which attracts the hammer and pulls it up against the gong. At this position the arm carried on the hammer strikes the upper part of the pivoted contact piece, moves it up, and opens the circuit. The hammer then falls down by the force of gravity and the arm hits the lower arm of the pivoted contact piece, which moves it down and closes the circuit. The cycle is then repeated, the frequency of vibration depending upon the distance between the upper and lower part of the contact armature.

Zeeman Effect

(264)—Mr. Wm. F. Kelly, Greenwood, Miss., writes: Having learned of Zeeman's discovery, viz.: That when an incandescent gas is placed in a magnetic field the spectral lines become split up, and that the frequency of the light emissions depends upon the radius of the orbit of the electrons, I would appreciate very much indeed your furnishing me with some more information on this phenomenon.

Q. 1.—What incandescent gas did Zeeman use?

A. 1.—Zeeman used a sodium flame as a source of illumination for his experiments. This flame was placed between the poles of a powerful electromagnet and the light emitted was analyzed by a powerful interference spectrometer. He observed that the spectral lines were split up into two or more components. When the flame was observed at right angles to the magnetic field, the original spectral line was accompanied by two other lines at each side of it. In the case of very strong magnetic fields the separation was as great as one-fifth the distance separating the two sodium lines. When the flame was observed parallel to the magnetic field the center lines disappeared and the two outside lines remained. Later investigations showed that the lines are sometimes trebled, sextupled, and sometimes multiplied even a greater number of times.

This phenomenon was explained mathematically by Lorentz and is a proof that the electron is a constituent of all matter. J. J. Thomson showed that the negative ions set free by an incandescent carbon filament, and electrons set free from a zinc plate exposed to ultra-violet light, had the same values as the electrons produced in a vacuum tube. The oscillatory motion of the charged ions which before ionization constituted the atoms, sends out electromagnetic waves of various frequencies, depending upon the radius of the orbit of the ion, and is responsible for the radiations from a luminous body. The Zeeman effect has furnished mathematical and experimental proof that these charged ions are identical with the electrons set free in a vacuum tube.

Q. 2.—Where can incandescent gases be produced and how produced?

A. 2.—In Geissler tubes one phase of incandescence is seen and by heating volatile salts of metals, such as the chlorides, to a high heat, incandescent gas is produced.

Storage Battery Queries

(265)—Frank Rollins, Hartford, Conn., asks:

Q. 1.—What is the lowest voltage to which a lead battery should be discharged?

A. 1.—A lead battery should never be discharged to a voltage less than 1.75 volts per cell, and this voltage should be measured while the battery is discharging current. The open circuit voltage of a cell means nothing, because no matter how long it may have been discharged it will register 2.1 volts after standing on open circuit a short while.

Q. 2.—What is the efficiency of a lead plate storage battery?

A. 2.—The ampere-hour efficiency of a battery is the ratio of current in ampere-hours drawn from the battery, to current in ampere-hours put into the battery. The watt-hour efficiency, which is the real efficiency, includes the voltage as well as the ampere-hours. The ampere-hour efficiency is sometimes used to convey a false idea as it is about 15 per cent higher than the real efficiency. In general practice the watt-hour efficiency varies from 75 to 80 per cent.

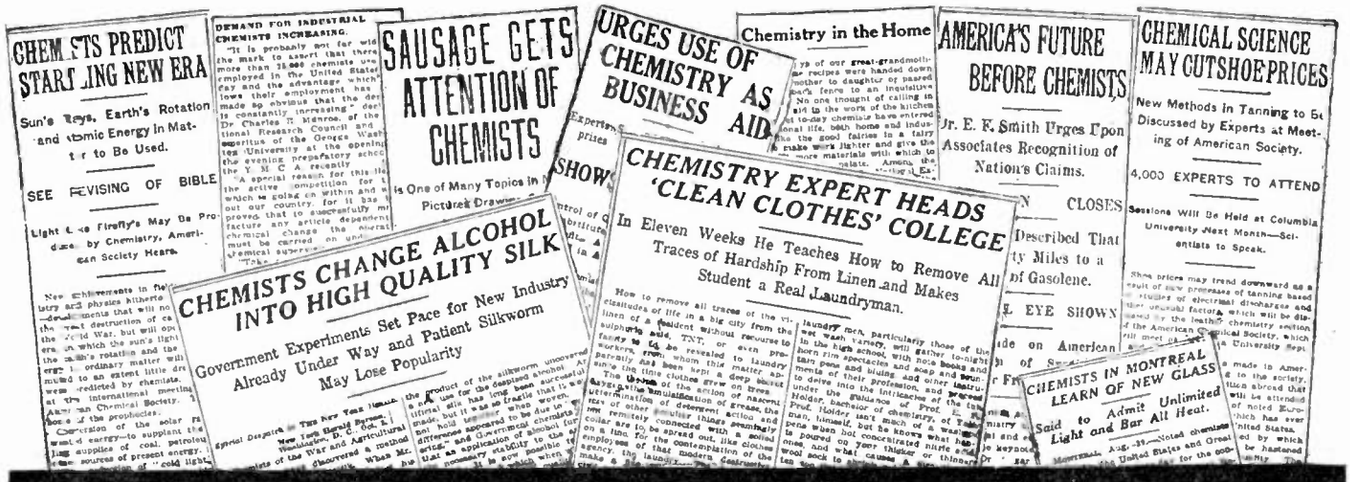
Q. 3.—What is meant by sulphating?

A. 3.—Sulphating is a chemical action which takes place in a storage battery and is supposed to produce lead sulphate on both plates when overdischarged or left long in that condition. It forms a whitish scale on the plates. This scale is a non-conductor and the battery is incapable of being charged.

(266)—M. A. Feeney, Brooklyn, N. Y., asks:

Q. 1.—What is the average life of a storage battery?

A. 1.—The average life of a storage battery varies with the conditions of service. Stationary batteries last from 5 to 10 years. During the first few years the depreciation is about 5 to 7 per cent. but



The United States Needs Chemists

What did America get out of the War? You often hear that question asked, yet few people realize just what material advantage the United States did gain. She gained industrial supremacy. Hundreds of manufactures formerly almost unknown here, have come to this country to stay. With hardly an exception they belong to the so-called Chemical Industries, for which the services of trained chemists are essential. The dyestuff industry alone gives employment to thousands of chemists, for whom there was little demand prior to 1914. Outside of the laboratory there are innumerable executive positions which can be filled only by men who understand chemistry.

The salaries of chemists are good, and the work is fascinating. Opportunities are plentiful for independent work in agriculture, medicine, food purification, water supply, the development of patents, and countless other fields.

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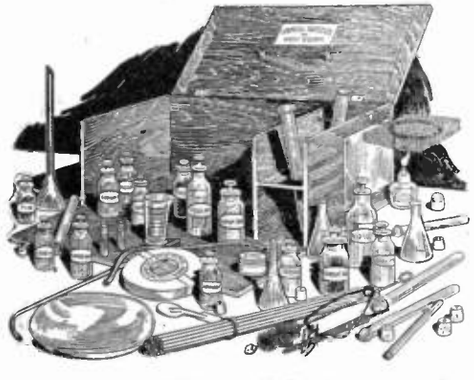

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Did you know that aluminum formerly cost over $100 a pound? In 1886 an American chemist, C. M. Hall, discovered a cheap method for extracting it from its ores, which brought the price down to 25 cents a pound!

Did you know that **carborundum**, the universal abrasive, was unknown until E. A. Acheson, another American chemist, discovered it in 1891?

Did you know that **silicon**, an important ingredient of special steels, fell from $100 an ounce to 10 cents a pound, due to a cheap method of production evolved by American chemists?

Did you know that the dye, **indigo**, dropped from $4.00 a pound to 15 cents a pound when the chemists learned how to prepare it in the laboratory?

Did you know that between 1914 and 1917 the **American dye exports** jumped from 2 million to 57 million pounds?

Did you know that **vanillin**, the flavoring principle of vanilla, was reduced in price from $800 a pound to $10 a pound when chemists perfected a method for its synthesis?

Did you know that John Hyatt, an American chemist, invented the useful commodity **celluloid**?

Did you know that **Thorium Nitrate**, used in gas mantles, sold for $200 a pound in 1895? In 1916 it was priced at $2.60 a pound, due to improved chemical methods of refinement.

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after this the depreciation may be considerable. For traction or automobile service, which is much more severe, the life of a battery may not exceed six months. The life of the positive plates of the battery is only half as long as that of the negatives.

Q. 2.—How may a sulphated battery be restored?

A. 2.—The plates should be removed and scraped, after which the battery should be charged a long period of time at about half rate and then partially discharged. This should be done a number of times until the sulphating is eliminated. When the cells are only slightly sulphated the charging and discharging treatment is sufficient without scraping. If the cells are badly sulphated the charge should be about one-quarter the normal rate for three days.

Adding a small quantity of sodium sulphate to the electrolyte will help to cure the cell by decomposing or dissolving the sulphate. After the plates are restored to their proper condition the cell should be emptied and thoroughly washed and fresh electrolyte added.

Q. 3.—Is there any harm in using a thin layer of oil on the electrolyte to prevent the acid spray?

A. 3.—A thin layer of oil will do no harm, but has the objection of interfering with the hydrometer and also sticks to the plates when removing them and interferes with their conductivity on replacing them. A layer of finely granulated cork is sometimes used on the electrolyte, but it makes the cell look dirty. The best practice is to depend entirely upon ventilation to remove the spray.

Hydro-Electric Machine

(267)—George Herman, Virginia City, Nevada, asks:

Q. 1.—Is there any system of generating electricity direct from steam?

A. 1.—Electricity may be generated direct from steam by allowing it to escape through proper nozzles at high pressure, but the system is very inefficient. The steam boiler must be mounted on glass legs or other suitable insulators to insulate it from the ground. The escaping steam passes through a pipe leading to a series of outlets so shaped as to impede the passage of steam by forcing it out of the direct course. These jets are lined with wood and are led through a box of cold water. This is to partly condense the steam which is found essential to its action. Dry steam produces no excitation. A collecting comb held against the jet becomes charged. The boiler becomes negatively charged and the collecting comb positively charged. By changing the material of the lining of the jets, or by adding turpentine, the sign of the electricity is reversed. If the water contains acids or salts no electricity is produced.

Electric Heater Query

(268)—Harold Pitcher, Lyleton, Man., Canada, writes:

The heating element of an electric heater is placed in a container into which is forced oxygen. At high temperatures the heating element in contact with the oxygen will deteriorate rapidly, thus making it necessary to reduce the current flowing through the heating element.

Q. 1.—Will the heat generated in the heating element in oxygen be the same, with a lower current, as the heat generated in the heating element in air with the higher current?

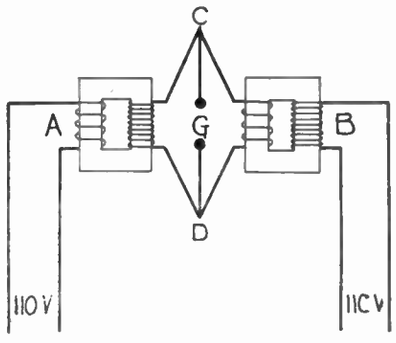
A. 1.—It will be less. There will be no advantage in forcing oxygen into a case which contains a resistance coil which is to be heated electrically, because the heat of a resistance coil is caused by the resistance offered to the passage of an electric current, and not by oxidation. Therefore, all that would happen if you were to introduce oxygen into the heating chamber, would be that the wire would possibly oxidize, but practically no additional heat would be produced.

A Queer Puzzle

(269)—Fred Higby, Boise, Idaho, asks:

Q. 1.—In the diagram (A) is a "step-up" transformer giving a secondary voltage of 10,000 volts, while (B) is a "step-down" transformer giving a secondary amperage of 75. Both are operated from the same circuit of 110 volts A. C. The secondary circuits of the two transformers are so connected that the currents through each of them are forced to pass through a single wire (CD) for some distance at the same time and in the same direction. This wire is thoroughly insulated and is quite large, so as to offer no appreciable resistance to the current from either transformer. The secondary winding of transformer (A) has many turns of fine wire which allows the high-tension current from (A) to pass, but not the low-tension current from (B).

Now, is it not obvious that when both the transformers are operating in unison, the secondary currents of both transformers will pass through the single wire (CD) at the same instant and in the same direction, making it the same as a single current with a voltage of 10,000 and an amperage of 75; in other words, with a wattage of 750,000? Then, if an electrical machine operating at this voltage and amperage were placed in the circuit it should operate as well as it would on a dynamo giving the same current. If this scheme is impractical I would like to know the reason why.



A rather puzzling connection, whose peculiarities are illustrated in the answer to the query concerning it.

A. 1.—Your device will not work for the simple reason that the secondary winding of transformer (B) must consist of a few turns of heavy wire in order to deliver 75 amperes with a low voltage, therefore this winding will have such a low resistance that it will practically short-circuit transformer (A) and completely ruin it.

This same question which you have evolved has been thoroughly discussed among scientific and electrical men quite some time ago, and at first the answer that such a device would be a perpetual motion machine caused great stir.

Nevertheless, experiments proved that it is exactly a converse of this scheme in that either one or the other transformer is destroyed.

Under ordinary circumstances you will find that transformers feeding the same wires in electrical circuits have always the same secondary potential, and great care must be exercised to keep them that way.

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Highest grade made. Brilliant black composition. Figures inlaid in white enamel. For ¼" or 3/16" shaft.

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Made of best black composition, provided with 8/32" bushing. Height 1", Diameter 1¼".

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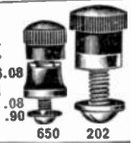
"RASCO" POSTS



R-650, Post made entirely of best black composition—8/32" screw—each .....$.08

R-202, Post has nickel-plated bottom part, each..... .08
Dozen, each style ..... .90

RASCO SWITCH POINTS

Nickel-plated and polished. The following have been found the most popular.

1, ⅝"x⅛", 6/32" thread, doz.....$.35
2, 3/16" high, ¼" dia., 6/32" thread, doz. ..... .35
3, 5/16"x3/16", 4-36 thread, doz... .35
4, ¼" dia., ⅛" thick; shank 6/32" doz ..... .40
5, ¼" dia., 3/16" thick; shank 4-36, doz. .40
6, 3/16" dia., 3/16" thick; shank 4-36, doz. .40
7, 3/16" dia., ⅛" thick; shank 4-36, doz. .40
75, Switch Stop ⅞" long, 4-36 thread, complete with nut, each ..... .04
76, New style Switch Point, to be pressed into bakelite panels with forced fit. Wire is soldered to pin end. Head ¼" dia., 1/16" thick, doz. ..... .40
77, same as above, but head is ¼" dia. x 3/16" thick, doz. ..... .40

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Substitute for Vacuum Tube Socket. Four of these take one Vacuum Tube. Grasp tube firmly. Best contact possible. Take less room. Are better.

R-1550 Sockettes, nickeled, set of 4 .....$.25

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Note: Set of 4 sufficient to hold 1 Tube.

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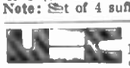

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THE bearing to hold variometer and variocoupler rotors. Total length of bearing 2¼". Outside shaft, 1¼". Length of thread 1". Length of threaded sleeve, ⅝".

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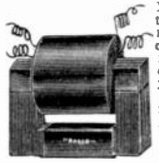

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No.	Turns	Range	Price
R-5000	25	120- 250	$ .40
R-5001	35	175- 450	.45
R-5002	50	240- 720	.50
R-5003	75	390- 910	.55
R-5004	100	500- 1450	.60
R-5005	150	600- 2000	.65
R-5006	200	900- 2500	.75
R-5007	250	1200- 3500	.80
R-5008	300	1500- 4500	.85
R-5009	400	2000- 5000	1.00
R-5010	500	2800- 6100	1.15
R-5011	600	4000-10000	1.30
R-5012	750	5000-12000	1.45
R-5013	1000	7900-15000	1.70
R-5014	1250	9750-19500	1.95
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Take the place of binding posts on instruments or panel. Cord tip firmly gripped by jack. Made of brass, highly nickel-plated and polished. Screw to attach lead wire. No soldering necessary.

R-1500, Cord Tip Jack, each.....$.15

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Only seamless tubing made in United States. Perfectly seasoned. Heavy wall. (I.D.—Inside Diameter. O.D.—Outside Diameter. L.—Length).

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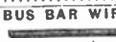
BUS BAR WIRE



This wire is square, measuring 1/16" by 1/16". Easy to solder as it is already tinned. Used on all up-to-date instruments. Sold in 2-foot lengths only.

R-6400 Bus Bar Wire, per 2-foot length..$.05

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Made of special graphite copper-plated at the ends. Round rods 1¾" long, ¼" diameter. Resistance accurate within 20 per cent.

R-5300 Resistance 12,000 ohms.....$.65
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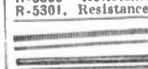

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R-8032, Brass Rod, 8/32" thread, per length .....$.08
R-6032, Brass Rod, 6/32" thread, per length ..... .06
R-1425, Brass Rod, plain ¼" round, per length ..... .10
R-3616 Brass Rod, plain 3/16" round, per length ..... .06

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Base is solid black composition; mounted on same is nickel holder and binding post, which holds the fluted hard rubber knob with its sliding rod member. Patent nickel detector cup and binding post. Patent cup holds crystal.

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Same denominations as above also these: SERIES 1st STEP, 2nd STEP, 3rd STEP, SECONDARY CONDENSER, TELEPHONE, SECONDARY, DETECTOR, TRANSMIT, GRID VARIOMETER, PARALLEL, COUPLING, PRIMARY, LOADING COIL, RECEIVE, ANTENNA, PLATE VARIOMETER, "BLANK", AUDION, ON, OFF.

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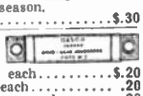

R-5050, Phone Condensers, each.....$.20
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Thinnest copper foil made, .001" thick. Comes 4" wide.

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Weather resisting. Used particularly for cementing covered wires. Coils covered with this cement require no form. Wires hold together solely with this cement.

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Made of special India mica in two sizes, 2⅛" diameter and 1-13/16" diameter. Excellent for experimentation in telephone work.

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R-2551, Diaphragm, 1-13/16" ..... .15

RHEOSTAT WINDINGS

These windings, with the switch arm shown below, constitute a complete rheostat for the experimenter. Resistance wound on flexible black fibre. Carries 1½ amperes, resistance 6 ohms.

R-4300, Rheostat Resistance each .....$.20
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Fits above.

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We list only best qualities.

"DCC" means Double Cotton Covered. "GS" means Green Silk. "E" stands for Enameled. The following come on 8-ounce spools:

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R-2501, DCC No. 20..... .60
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R-2503, DCC No. 24..... .85
R-2504, DCC No. 26..... .95
R-2505, DCC No. 28..... 1.15
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The following come on 4-ounce spools:

R-2507, GS No. 20.....$ .50
R-2508, GS No. 22..... .55
R-2509, GS No. 24..... .60
R-2510, GS No. 26..... .65
R-2511, GS No. 30..... 1.05
R-2512, GS No. 32..... 1.30
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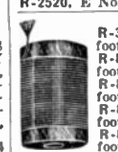
The following come on 8-ounce spools:

R-2514, E No. 20.....$ .45
R-2515, E No. 22..... .55
R-2516, E No. 24..... .60
R-2517, E No. 26..... .65
R-2518, E No. 30..... .70
R-2519, E No. 32..... .80
R-2520, E No. 36..... 1.00

LITZ WIRE



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Electro-Chemical Telegraph

(270)—Mr. L. Matthews, Pittsburgh, Pa., asks:

Q. 1.—What is an electro-chemical telegraph?

A. 1.—The electro-chemical telegraph depends upon some chemical reaction at the remote station for producing a visible and permanent effect.

A paper ribbon is charged with a solution of some salt, which when acted on by the passage of the electric current through it gives a colored product. The paper may be saturated with potassium ferro-cyanide. If a current passes through this paper, an iron stylus bearing upon the paper being used to conduct it thereto, Prussian blue will be produced, giving a blue stain, and the dot and dash code of the Morse or Continental system may be imprinted thus. The paper may be saturated with potassium iodide solution, in which case the current will set iodine free, giving brown dots and dashes. Or a weak solution of starch containing a little potassium iodide may be used for treating the paper, in which case the current will produce blue marks upon it. Those who are at all familiar with chemistry can evolve other preparations for treatment of the ribbon.

The ribbon is fed over a metal cylinder which rotates by clockwork, which acts as one pole of the circuit, of which the stylus is the other one. Except for the fact that chemical decomposition or reaction is used, the action is identical with that of the old-time Morse telegraph.

110-Volt Motor Rewound for 6 Volts

(271)—Paul Murphy, Butler, Pa., asks:

Q. 1.—Is it possible to rewind a 110-volt series wound motor for either 6, 12, or 18 volts D.C., so as to obtain a speed of from 7,000 to 8,000 r.p.m.? I wish to run this motor on storage batteries for operating a small four-inch blower, similar to those on vacuum cleaners. The armature of the motor is 1½ inches in diameter and is mounted on a ¼-inch shaft 5⅜ inches long. There are 22 segments in the commutator.

A. 1.—We do not advise you to rewind your motor for the lower voltage. To obtain the same speed on say 18 volts as you now obtain on 110 volts, would mean that the motor would draw over six times the amount of current, and the brushes and commutator, which are not designed for this heavy current, would heat up and soon be destroyed. The motor would run, of course, but not at a speed of 7,000 r.p.m.

Atmospheric Magnetism

(272)—Mr. William Colbron, Albany, N. Y., asks:

Q. 1.—What is atmospheric magnetism?

A. 1.—Faraday discovered that oxygen gas, which is two-ninths by weight of the atmosphere, is of a highly paramagnetic character; and nitrogen, the other chief constituent of the atmosphere, is of a neutral character. Thus we have an atmosphere of eminent magnetic capacity subject to great physical changes of density, temperature, etc., and entirely independent of the solid earth. This daily heating and cooling of the atmosphere by the sun's rays greatly affects its power of transmitting the earth's magnetism, which may account for those diurnal changes in the terrestrial magnetic lines of force.

Q. 2.—Will sunlight affect magnetism?

A. 2.—The sun's violet rays possess the power of inducing permanent magnetism

when concentrated by a lens on steel needles. This fact, however, is doubted by some experimenters.

Powerful Solenoid

(273 —M. O. Bayless, Shale, Ga., asks:

Q. 1—What is the current consumption of a solenoid developing 30 horsepower, with a 5-foot stroke, and is such a machine on the market?

A. 1.—We do not know that any such machine as you describe has ever been built, but it is entirely possible that one could be built. It would consume 42 kilowatts or more.

New Power Project

ANNOUNCEMENT was made recently by the Byllesby Engineering and Management Corporation of a new electric, water and steam power construction and development program for the twin cities of Minneapolis and St. Paul at an estimated expenditure of $80,000,000. Construction work will occupy a ten-year period and will increase by 306,000 horsepower the electric generating capacity of Northern States Power, which serves 350 cities and towns in Minnesota, the Dakotas, Wisconsin, Illinois and Iowa. The latter company is one of the operated properties of the Standard Gas & Electric Company.

Electrical Industry

ELECTRIFICATION of railroads, resulting in the conservation of the coal supply and increased speed in travel, is seen as the great electrical development of the future by the Illinois committee on public utility information, in a bulletin covering the history of electricity prepared for distribution in the public schools of the state.

The only obstacle preventing this on a large scale for the present is the great cost, the bureau points out, although the practicability of electricity as railway motive power has been proved already in the mountain divisions of one road.

Three thousand uses of electricity today have made America a machine-land, banished darkness, lightened the housewife's duties and operate machinery that would require the services of 3,000,000,000 slaves to duplicate, according to the bureau. The electrical industry today represents an investment of practically $5,000,000,000, with nearly $750,000,000 spent annually on improvements and extensions, the bulletin said.

Novel Meter Reading

AN innovation in meter reading, by means of which a photograph of each meter face is taken, has been recently adopted on the Toronto Hydro-Electric System. So far, this system has only been used on demand wattmeters, but it is quite applicable to any meter on the company's lines. The great point of the system is that the meter is read with photographic fidelity, and an indisputable record is brought to the office files. There have been no disputes in this case, but if such should occur, the records are at hand being the means of transporting monthly to the office shelves all the meters on the company's mains.

The photographs are taken with a special camera, equipped with an anastigmat lens of short focus, a simple automatic shutter controlled by the operator, making exposures with varying speeds as fast as one-fifth second, and with lamps for furnishing light for the exposure. The actual photograph is obtained with the front of the camera against the meter dial by pressing downward an exposure lever. This action automatically turns on the light, opens and closes the shutter,

then locks the shutter until the film for the next exposure is wound into place. This prevents the possibility of a double exposure; that is, the superimposing of one exposure upon another. Identification of the meter is obtained by stamping on the outside of the glass dial the meter number. The light is furnished by two four-cell dry batteries stored in either side of the camera, supplying current to four 3.8-volt Mazda miniature lamps.—*Electrical News.*

The Story of Tungsten

THE efficiency of the modern electric light is due to tungsten filaments, which have widely extended its field of usefulness, and which, it is estimated, reduce the American lighting bill by one billion dollars a year because of the high illumination obtained from a small use of electricity. Behind this unadorned statement lies the story of a struggle to conquer the seemingly unconquerable, and an eventual triumph of science over a metal that acts contrary to the laws of metallurgy.

Tungsten was discovered in 1781 by two Swedish mineralogists, who gave it its name from the word tung, meaning heavy, and sten, meaning stone, because of the great weight of its ore. A cubic foot of lead weighs 708 pounds, and a cubic foot of tungsten 1,193 pounds.

For more than a century experiments were made to determine the value of the new metal, whose brittleness precluded its use except as an alloy. With the development of the incandescent electric lamp the carbon filament was found too perishable to withstand the vibration and shock of many uses to which the light was otherwise suited, and a search was begun for a filament material that would be more enduring. Tungsten, because of its great strength and heat resistance, seemed to be the most desirable metal. Accordingly, the expert research men of the electric lamp industry sought for a way to use it. For years tungsten resisted their efforts, because it was too brittle to be workable, or to stand any shock.

Eventually a method was found whereby powdered tungsten, mixed with a binder, to hold the particles together, could be squirted through fine dies, and it was in this form that the tungsten filament was first used. Experiments with the strange metal continued, for the electric light manufacturers were unwilling to forego what promised to be the ideal filament. The treatments, by heat and pressure, that rendered other brittle metals ductile, had no effect upon tungsten. Finally, experiments were begun in defiance of the known laws of metallurgy, and a treatment that made other ductile metals brittle was attempted.

The metal is pressed into rods a quarter-inch square and sixteen inches long, in which form it is put through a series of dies, each one smaller than the one before, until it becomes wire no thicker than fine thread. The filament of the smallest electric lights is made of tungsten so fine that it is drawn through a tiny "eye" cut in a diamond, and 250 miles of this filament are made from one 16-inch rod of the stubborn metal.

Effect of Alternating Currents Superimposed on Direct Current

THE effect of the above disposition on electrolytic decomposition has been recently investigated in England.

It is clear that one ammeter (A_1) measures the total current and (A_2) the direct current only. The battery employed had a capacity of about 30 ampere-hours. The direct current was varied by adjusting, and the alternating current by alternating the distance between the coils of the transformer.

In most of the experiments the electrolytic cell consisted of platinum electrodes in dilute sulphuric acid, and in all the cases mentioned above (defined by the relative magnitude of the direct and alternating currents) it was found that the superimposed A. C. increased the magnitude of the D. C. Since this occurs even when the resultant current wave is in the form of a uni-directional ripple, the earlier explanation of the phenomenon, as due to the wiping out of polarization effects, is clearly untenable.

The magnitude of this curious effect, of course, varies with the relative values of the two currents. It will be found that the increase in the D. C. reaches a maximum as the A. C. increases.

It is evident that electrolytic action applies in this case.

The effect only passes off some minutes after the A. C. is switched off, and the greatest sensitiveness is obtained when the voltage applied to the cell is below that of decomposition. The effect was obtained, with some differences in its magnitude, when one electrode was a wire and the other had a much larger surface.

In order to throw light on the cause of this curious phenomenon, Mr. Cooper made microscopical observations of the electrodes during electrolysis, and it was noticed that the whole of the hydrogen

was at times absorbed by the cathode, while oxygen was freely given off at the anode. For example, in one case a current of over 1½ milliamperes passed before hydrogen was noticeable, although the application of high frequency A. C. at once caused evolution of hydrogen. This observation, however, does not seem to bring us nearer to an explanation of the effect.

The experiments were repeated with high frequency currents with much the same results, excepting that when the applied D. C. voltage was below the decomposition voltage the effect of the high frequency current was much less than that of low frequency.

The phenomenon here discussed is utilized in the electrolytic detector for wireless telegraphy, but in this case one fine wire is used, just dipping into the electrolyte. Mr. Cooper reproduced these conditions, using a large piece of platinum foil as the second electrode. If, under these conditions, the applied voltage is sufficient to cause a ready evolution of bubbles the application of a small high frequency current scatters the bubbles, repelling them from one another as if they were electrified, and the direct current at the same time rises. Possibly the same effect takes place with the larger electrodes.

Another curious phenomenon was observed which does not appear to have been noticed before. If the applied D. C. voltage be reduced until only one or two minute bubbles form on the wire electrode and then a small high frequency current is passed momentarily, a large hemispherical bubble forms over the electrode, and this whether it be anode or cathode. This bubble starts its formation from the body of the electrolyte, appearing to start some 3 mm. below the electrode, and traveling very fast and taking up its position with unerring accuracy. The bubble is very large compared with those formed by electrolysis and its appearance suggests something in the nature of an electric discharge.

Recovering Unburnt Fuel from Ashes

THE German firm of Fried Krupp have devised a magnetic separator for the purpose of recovering coke and unburnt coal from ashes. Practically all coals contain iron in the form of pyrites, which may have slight magnetic properties. The burning of the coal, however, converts the pyrites into an oxide, which is magnetic; and as the whole of the iron passes away with the slag, the metal exists there in a very much more concentrated form than in the original coal. These facts are taken advantage of to effect the separation.

The machine employed consists essentially of a magnetic drum over which the furnace refuse is passed. The drum rotates slowly about a horizontal axis, just as in the case of an ordinary magnetic separator. The ashes to be treated are delivered by a bucket-elevator to a vibrating screen which separates them into various sizes. Each size is passed separately to the circumference of the drum. The slags containing iron are held magnetically to the surface for a portion of the revolution, and then drop off into small wagons or other receptacles as the current exciting the portion of the drum which held them is automatically broken. The coal and coke which may be present do not adhere to the drum but leave its surface directly after contact with it and fall into their own receptacles. It is said that lumps of slag up to 3-inch mesh will adhere to the drum and thus be eliminated from the fuel.

The magnetic separators are built in sizes capable of dealing with quantities of

ashes ranging from one-half ton to two tons per hour. The fuel recovery by these machines can either be burnt under boilers by means of forced draft or it can be briquetted, both methods being in use. Among the users of magnetic separators may be mentioned the Hungarian State Railways, who treat locomotive ashes by the method described.

Dangerous Lampholders

In a recent issue of the *London Electrician*, a correspondent refers to the dangers of incandescent lamp sockets. He writes that undoubtedly such fittings are dangerous. Lampholder and lamp cap are "English" for socket and base. Undoubtedly the fitting you name is dangerous. It would appear, however, that it is not the lampholder which is at fault but rather the lamp cap. For the regulations to call for a holder that will entirely screen the skirted cap means that various sizes of holders would be needed for the several sizes of caps.

For your information, I refer you to the practice in Canada. We have one standard medium screw socket, but for all extended metal caps the skirting is insulated from the base of the cap by the glass filling as per sketch. This makes a perfectly safe lamp cap and obviates the necessity for screens, etc.—I am, etc.,

J. T. Scott, Engineer,
Canadian General Electric Co.

Use of Electric Oven

An electric range consists of two departments—the oven and the plates; the latter being equivalent to burners on a gas or oil stove. These are so devised as to give three degrees of heat—high, medium and low.

The capacity of the electric range oven is rated at from 1,500 to 2,000 watts. The plates have lower average consumption. Superficially judged. It would appear that it is cheaper to cook on the plates than in the oven. This, however, under further consideration proves to be wrong.

The oven of an electric range is, in effect, a skillfully constructed "fireless cooker. The heat introduced is held within the walls of the oven, and is there retained for a surprisingly long time. Thus, taking an oven operation that would consume 40 minutes of actual cooking time, possibly it would be necessary to use full current only about 15 minutes; while with the plate it might be necessary to continue full current consumption during the entire act of cooking. This is not always true, because it is possible when utensils fit properly to cook on plates also at very low consumption point. But all things considered, oven cooking is more economical than plate cooking. It should therefore be used as much as possible, especially for the longer processes; employing the plates for such special cooking as cannot be done in the oven.

It naturally follows that several items of food will be placed in the oven at the same time; a dinner in which the menus are carefully planned, so that the dishes making it up will cook in about the same time, is ideal for electric ranges.

Electric Light Designates Time

In the middle ages the timeball as a means of marking the passing hours was popular. For the convenience of men and women of the various courts of Europe a great ball was dropped from the ceiling of the palace throne room at certain intervals, says the *London Opinion*. Today many cities have timeballs in prominent places which drop at noon to warn the citizens of the time. Many harbors, Montreal and Quebec, for instance,

still use the timeball to mark noon and other hours.

But it remained for a little country in South America, Uruguay, to inaugurate a really modern and efficient system for sending broadcast over the capital city, Montevideo, the time at exactly 8 o'clock at night.

At that hour every electric light in the city grows dim for a few seconds and the residents set their clocks and watches.

Lighting Halls and Rooms

BULBS in all rooms should be frosted or shaded. Hall—Electricity or lamp hung from center in form of lantern or cast iron bracket to hold at least one bulb or one lamp. If side lights are desired, fixtures of brass, cast iron, or enameled iron are effective.

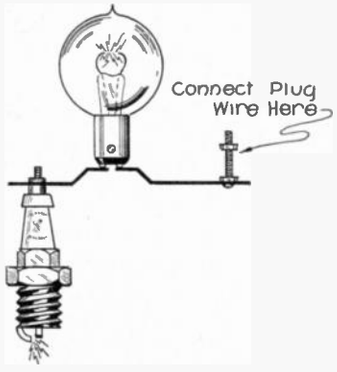
Living-room—If possible, at least one baseboard plug, one center ceiling light or side brackets if desired. If room is large a center floor plug is desirable. Plugs permit lamps to be used without unnecessary cords showing. If wire must pass through rug, do not cut rug but push threads apart.

Dining-room—If a center light in shape of dome is used, hang low enough to avoid shining in eyes of those dining. A soft effect is gained by side brackets representing sconces. Wired metal or glass candlesticks on mantel and sideboard, give pleasing effect. Floor plug near dining table for electrical table appliances.

The Electric Cord

DO you often have to take to the repair shop your electric pad, percolator, iron, or vacuum cleaner? Perhaps it is because you think of the electric cord as a rope, forgetting that it is made up of several strands of fine copper wire. The number of times you can bend these without their breaking is limited. When you would detach the machine from the cord, do not take hold of the cord and jerk it but grasp the edge of the plug to pull it out. Take care to keep the cord from kinking, being jammed in doors or stepped on. Breaking the wires of the cord breaks the circuit, and the "juice" cannot slip along and do your work. There is also danger of an arc.

Spark Gaps from Lamps



THE illustration explains a method of using old head-light bulbs as spark plug intensifiers. When the filament burns out, a short gap is formed inside the bulb. By soldering two short strips of copper or brass about an inch long on each of the bulb terminals, a complete intensifier is provided.

The gap in the bulb prevents the spark from passing across the plug electrodes until the charge is great enough to jump the gap. At this time the spark is hottest. Foul and broken plugs can be made serviceable by employing intensifiers. For oil pumping cylinders, also, intensifiers will be found useful.

Contributed by CARL D. MASON.

Steam by Electricity

THE natural order is being reversed in a large plant at Grande Mere, where electricity is being used for generating steam needed for paper manufacturing, instead of the usual process of making electricity from steam.

This is possible because locally the price of coal happens to be higher at this plant than the equivalent quantity of electricity.

The work is being done in the plant of the Belgo-Canadian Pulp and Paper Company, which is making steam in a 20,000 kilowatt electric steam generator. The efficiency of the installation is 98 per cent. of the theoretical. Thus 60,000 pounds of water are evaporated into steam per hour with apparatus that costs only about $25,000 to install

This installation cost is much less than would have been the cost of a coal-burning plant of the same steam capacity, and it is believed that $4,000 a month is being saved by the new system which replaces one which would require seventy-five tons of coal per day to operate.

The amount of steam generated and the pressure maintained in the boilers is governed accurately according to the quantity of steam required in the paper-making. This is done simply, increasing or decreasing the depth to which the electrodes are immersed in the tanks accomplishes the regulation quickly and accurately.

Such installations are being considered for numerous other plants but they will probably be possible only where cheap electric power is available from water-power plants. If the saving in initial cost, small space occupied by the boilers and saving of fuel become important, the chances for this scheme will be good. It is probable, however, that in 999 cases out of 1000 engineers will still continue to make electricity from steam, instead of using this new process of making steam from electricity.

America Equips Japanese Ship With Electric Drive

BUILT in America rather than in her own country, so that she might be electrically equipped in the most complete manner, Kamoi, the Japanese fuel ship, was launched off the Delaware capes during October, 1922, and sailed home to join the Japanese navy. Her commander is T. Murase. Her electric drive was most successfully demonstrated in preliminary trials, and representatives from both the American and Japanese navies and from the electric company which equipped her were delighted with her conduct. The Kamoi is the first foreign ship of any navy to have been equipped here with an electric drive.

Household Use of Electric Power

SEVENTY per cent more of the average family budget goes for telephoning than goes for electricity for household lighting and appliances, according to figures published by the Ohio State University.

Electric Lighting

THE greatest improvement that marked lighting in centuries was when Aimé Argande invented the flue chimney in 1782. The next improvement was gas, and the third was electric lighting.

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Get Posted—Good prices paid for butterflies, insects. See Sinclair display advertisement, page 283.

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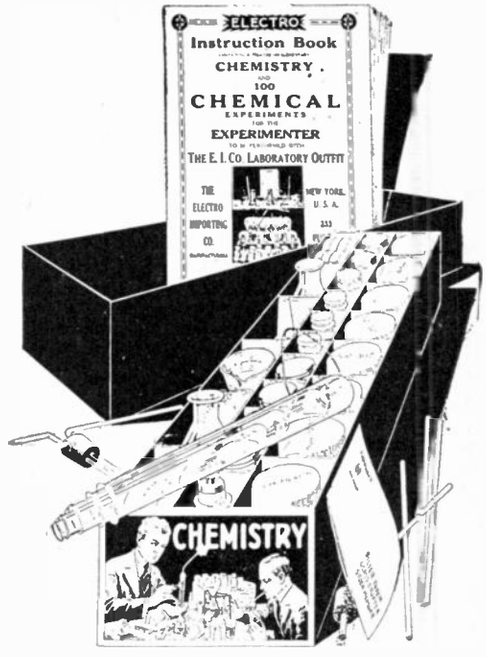

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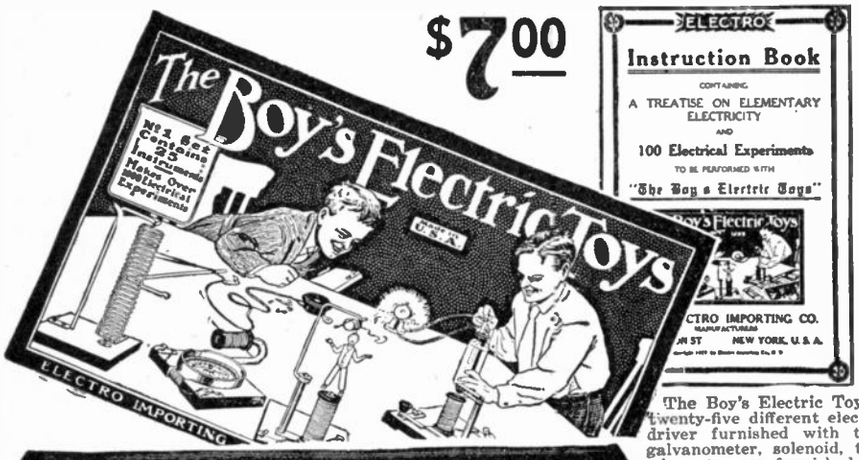

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