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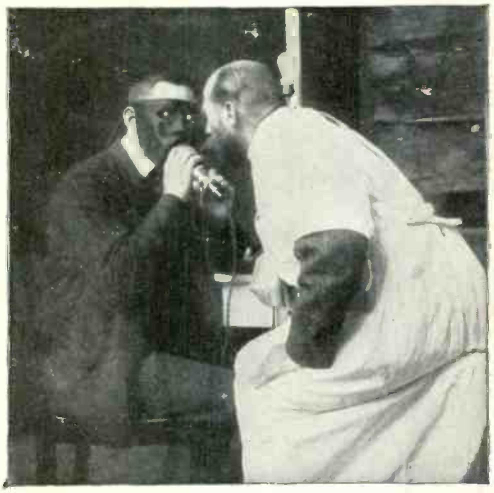

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Vol. II. FEBRUARY 1910 No. 10

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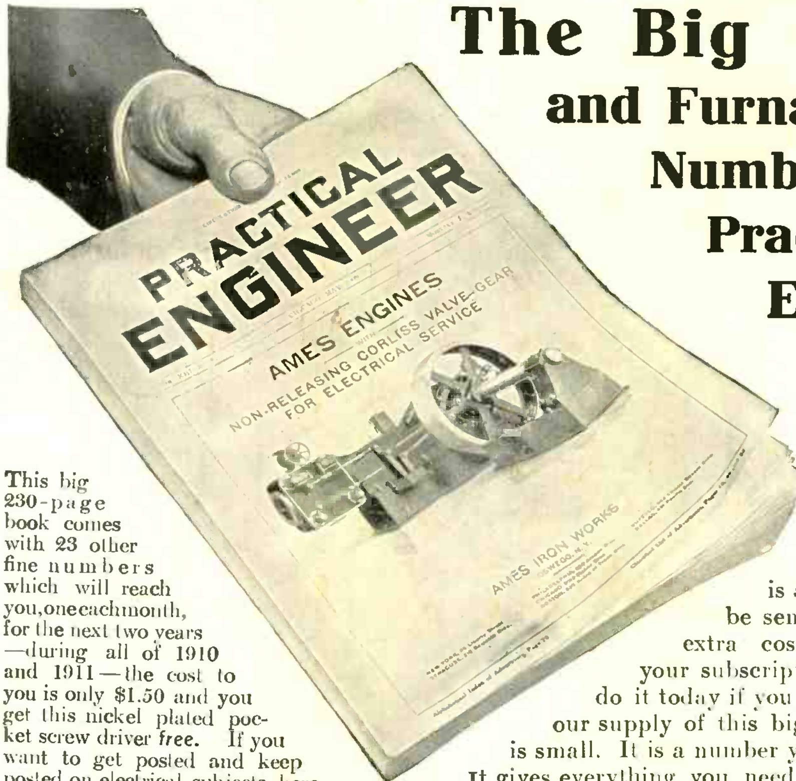

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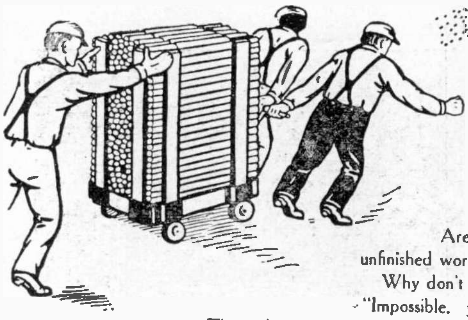

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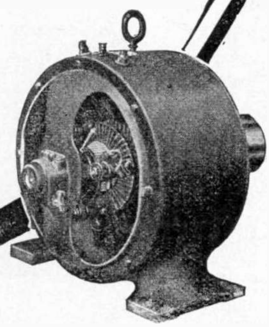

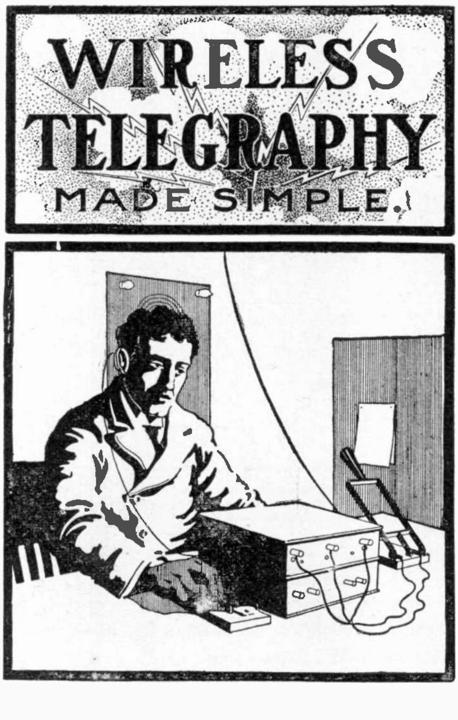

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IN PLAIN ENGLISH

HENRY WALTER YOUNG, Editor

Vol. II FEBRUARY, 1910 No. 10

CONTENTS

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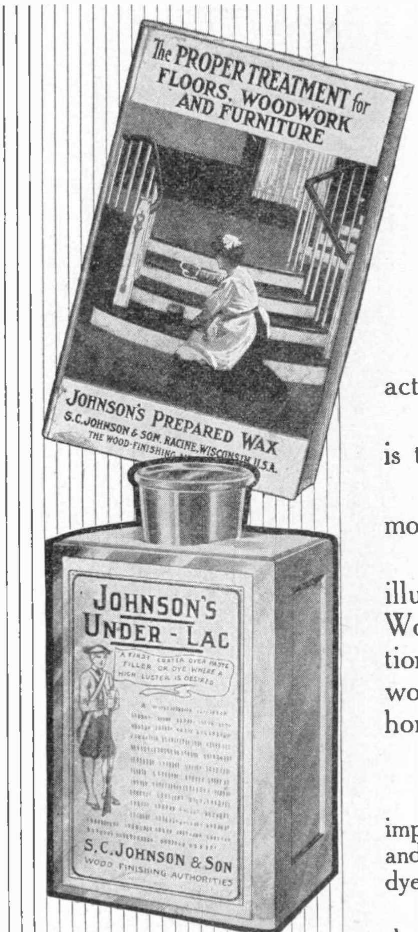

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Now as to what you can do: This matter is up before a committee in Congress. It must not be *pushed through* without public protest, for it is fundamentally wrong. To help prevent this unjust tax write (1) a postal today to Hon. J. W. Weeks, Chairman, House Postal Committee, Washington, D. C. Just say: "I wish respectfully to protest against any increase in the postage on periodicals." (2) Address a similar postal to your Congressman, Washington, D. C. (3) Get up a simple petition addressed to "The Honorable Senate and House of Representatives of the United States in Congress assembled," and send it to Washington with as many names attached as possible.

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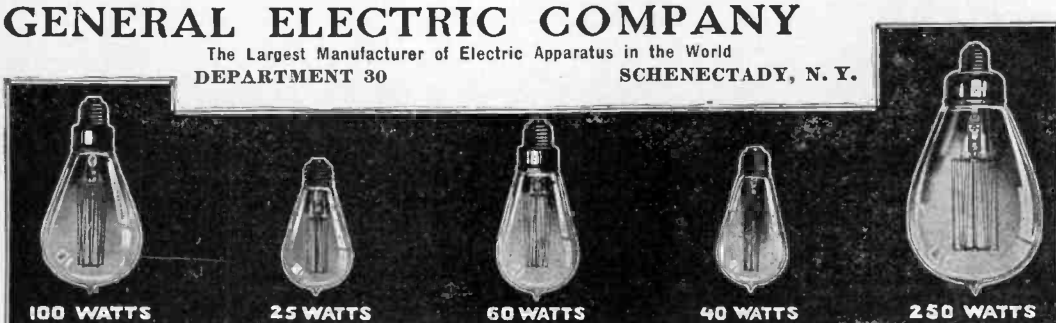

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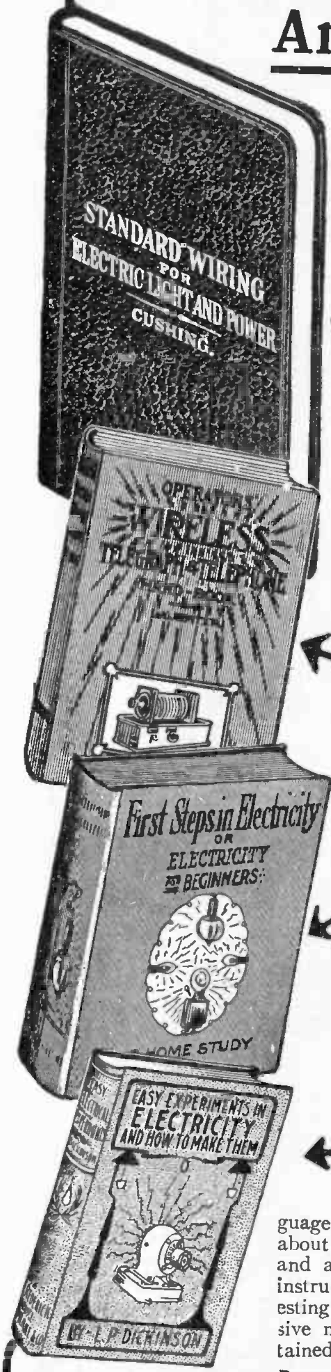

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By

SAM DAVIS

Many persons who have heard about the old Western mining-camp dance-hall sign; "Do not shoot the piano player; he is doing the best he can," do not know that this world-traveled joke is the product of Sam Davis, a Nevada humorist. Curiously enough, many who know him as a humorist are not aware of the fact that he can thrill with majestic English as easily as he can amuse with lighter words or move to grief with darker tones. Yet such is the fact, proof of which is afforded in the following speech which Mr. Davis delivered in Virginia City, Nevada, a few years ago, at a banquet held to celebrate the introduction of electric power in the Comstock mines.

BORN from nothing, it leaps into existence with the full-fledged strength of a giant, dies, is born again; lives a thousand lives and dies a thousand deaths in a single pulsating second of time.

It soars to every height, plunges to every depth, and stretches its vast arms throughout illimitable space.

It plants the first blush upon the cheek of dawn; with brush of gold upon the glowing canvas of the West, it tells the story of the dying day.

At its mere whim and caprice, a thousand pillars of light leap from the dark and sullen seas which surge about the poles, while from its shivering loom it weaves the opalescent tapestry of the Aurora to hang against the black background of the Arctic night.

It rouses Nature from her winter sleep, breaks the icy fetters of the frost that binds the streams, lifts the shroud of snow from off the landscape, woos the tender mold and bids the birth of bud and blossom; dowers the flower with perfume and clothes the earth with verdure of the spring.

It rides the swift courses of the storms that circle round the bald crest of old Mount Davidson; cleaves the black curtain of the night with simitar of flame; rouses the lightnings from their couch of clouds and wakes the earthquake.

Beneath its touch, the beetling crag, which took Omnipotence a thousand years to rear, crumbles into dust, the mere plaything of the idle wind; and yesterday, where stood the glittering spire, the shining tower, the frowning battlement, today the cold gray ocean rolls in undisputed might.

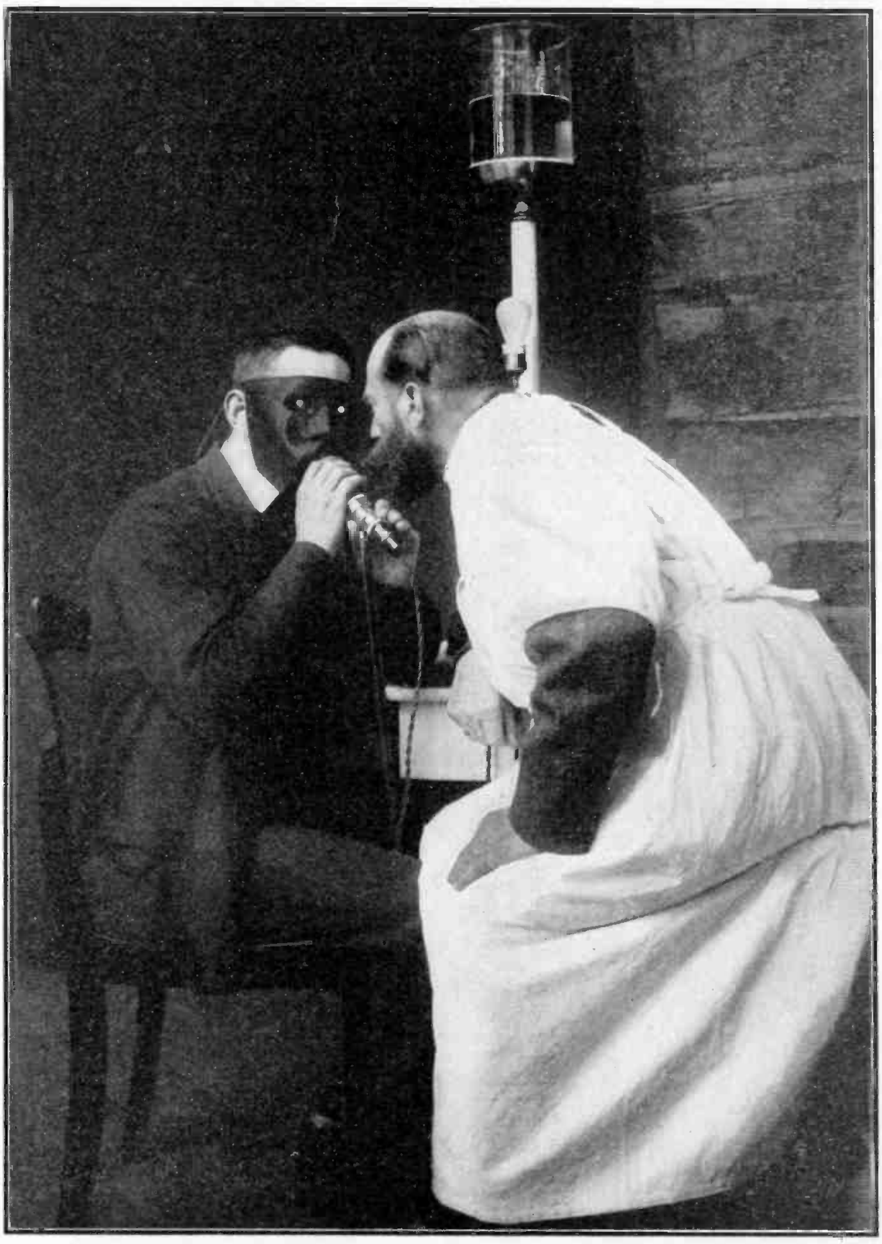
It gathers the doings of the day from the four corners of the world, the tales of love and death, of fire and flood, of strife and pestilence, and under 8,000 miles of shivering sea, whispers the babble of two hemispheres.

It turns the wheels of peace where poor men toil, and helps the husbandman to plow and plant and reap his whispering grain.

It rides the wings of war where brave men die; and when it stalks between contending hosts, exalts the kingly crest and helps an empire plant its flag of conquest.

It glows in lonely attics where weary workers toil to earn their crust. It shines o'er scenes where feet of feasters tread the halls of revelry. It lights the mourners on their pathway to the tomb. It glares in haunts where jeweled fingers lift the cup of pleasure to the mouth of sin, 'mid the sobbing of sensuous music and flow of forbidden wine; and speeding on its way, illumes the dim cathedral aisle, where surpliced priest proclaims the teachings of the Master, and golden-throated choirs lift their Hosannas to the King of Kings.

It was the Maker's ally at the dawn of Time, and when God from the depths of infinite space, said "Let there be light," it sent the pulse of life along Creation's veins, baptized Earth's cold brow with floods of fire, and stood the sponsor of a cradled world.—*From the Live Wire.*



ILLUMINATING THE INTERIOR OF THE SKULL

(See Page 634)

POPULAR ELECTRICITY
IN PLAIN ENGLISH

VOL. II FEBRUARY 1910 No. 10

The Navigating Compass

By BROTHER POTAMIAN, D. SC., London, Professor of Physics in Manhattan College, New York

The compass came into use for navigating purposes towards the middle of the Thirteenth Century mainly through the fine magnetic work accomplished by a Frenchman, one Pierre de Maricourt, better known as Petrus Peregrinus, or Peter the Pilgrim. He derived his title of Pilgrim from the fact that he made a pilgrimage to the Holy Land, doubtless as member of one of the crusading expeditions of the time. He was a man of uncommon ability and brilliant originality who made discovery after discovery in the domain of magnetism, describing its phenomena, laying down its laws and placing it for all time on the solid basis of observation and experiment.

Having outlined on paper what he deemed a perpetual-motion machine consisting of a wheel with magnets to supply the driving-power, he wrote to a friend of his in Picardy to inform him of the invention giving at the same time certain details necessary for its construction. Peregrinus was prevented from testing his views on the magnetic motor by being away from home while serving as military engineer with the French forces then (1269) encamped before the revolted city of Lucera in southern Italy. It is unfortunate that he had neither the time nor the tools necessary to construct his machine, as he would have certainly recognized and proclaimed to the world the delusive character of perpetual motion and thereby saved both labor and money of other pursuers of this will-o-the-wisp for better investment.

That his friend might the better understand the mechanism of the wheel, Peregrinus described in a systematic manner the various properties of the lodestone, all of which he had investigated and many of which he had discovered. This letter of his, written in the camp before Lucera and entitled Epistola de Magnete (Letter on the Magnet) is, therefore, the earliest regular treatise in any language on the magnet. It stands out prominently as the first great landmark in magnetic philosophy, the second being Gilbert's "De Magnete" (On the Magnet) published in the year 1600. Both these works have been translated into English within the last few years.

In one of the thirteen chapters into which the "Letter" is divided, the author describes the compass which he devised and in which the needle is supported on a double pivot as shown in Fig. 1. It will be observed that the magnet is thrust through a wooden upright, while at right angles to it is added a pointer of non-magnetic material, brass or silver. Fig. 2 shows the pivoted compass as well as a light movable bar with a pair of terminal pins for the purpose of sighting an object in the horizon and recording its position by means of a circle divided into 360 degrees. This is the earliest pivoted compass known, the prototype of all others; and as such, is of special interest. Figs. 1 and 2 do not appear in the "Letter" of Peregrinus but are drawn according to the description therein given.

It is evident that the compass of Peregrinus would have been more sensitive if the needle had been supported on one point only rather than on two. It is likely that Flavio Gioja, the Italian pilot, simplified the compass in the year 1302 by using only one pivot and by attaching the needle to the card with its thirty-two divisions.

To be sensitive and respond promptly to changing magnetic conditions, it is necessary that the needle and card should be as light as is consistent with the practical conditions of construction. Lord Kelvin in our own day gave this matter much consideration with the result that we have in the Kelvin compass an instrument which is the joy of every navigating officer.

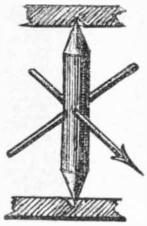


FIG. 1. THE FIRST PIVOTED NEEDLE (1269)

In this compass as usually constructed, there are four strongly magnetized needles arranged in two sets placed respectively to the right and the left of the north-and-south-line and enclosed and sealed in very light brass tubes shown in Fig. 3. To diminish the pressure on the pivot and thereby augment the sensitiveness of the instrument, the light, brass "card" with its magnetic outfit is immersed in a liquid consisting of 45 per cent of alcohol and 55 per cent of water. The liquid serves not only the purpose of buoyancy but also that of steadiness, which is an important matter when a ship is rolling or tossing in the trough of the sea; it also renders all motions of the "card" smooth and easy; and, at the same time, saves the pivot and sapphire cap from injury by concussion which might frequently occur.

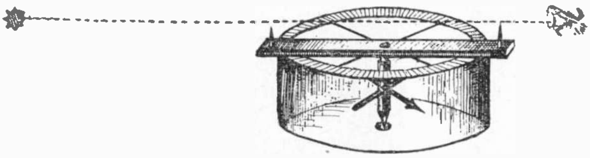


FIG. 2. THE FIRST PIVOTED COMPASS (1269)

As to the direction in which the needle points, there was considerable diversity of opinion in the Thirteenth and subsequent centuries. Some said that it pointed to the pole star, while others held that it was controlled by magnetic mountains located near the poles of the earth.

When the pilots of Columbus came to notice that the needles of the "Santa Maria" veered away to the West instead of standing true to the pole, they grew alarmed believing that the laws of nature were changing as they advanced over the trackless ocean into the unknown. The moment was a trying and dangerous one for the great Admiral; but his ingenuity and tactfulness rose to the occasion. He told his seamen that the needle did not point to the "Cynosure" (Polaris) or last star in the tail of the Little Bear as commonly supposed, but to a point in the heavens at which there was no star and around which the "Cynosure" itself and all other stars regularly revolved. The esteem in which Columbus was held by his men on account of his knowledge of astronomy and cosmography led them to accept the proffered explanation; their fear was allayed and the westering of the compass needles of the caravels bothered them no more.

When Columbus returned to Spain, he did not fail to report the strange behavior of his compass, when to his surprise, he met with nothing but incredulity, the learned ones of the day declaring that *he* was in error and not the compass, because the latter was everywhere true to the pole.

Even Gilbert, the philosopher of Colchester, (England) who published his great

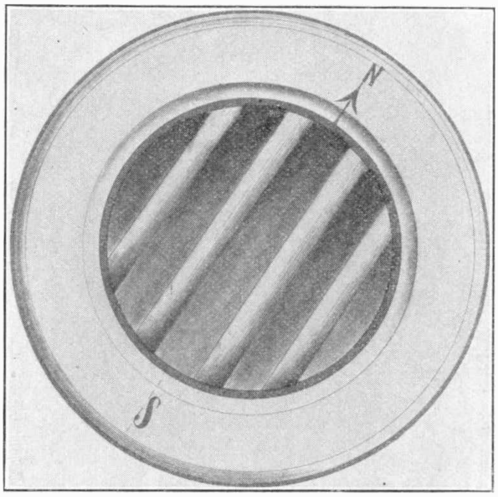


FIG. 3. THE PRESENT KELVIN COMPASS

work on the magnet in the century year 1600 believed in this fidelity of the needle to the pole because he allowed himself to acquire the conviction that the magnetic pole of the earth coincides with the geographical pole, the pole of rotation.

It was this Gilbert (1544-1603) who showed that the controlling influence on the compass needle is not in the pole-star or in any of the constellations, that it is not in the heavens above but in the earth itself. He attributed the magnetic condition of the earth to the masses of lodestone contained in its crust to which may be added that this condition also arises from currents of electricity flowing in the earth from east to west arising from the heating action of the sun.

As the vertical circle passing through the geographical poles and the place of an observer is called the geographical meridian, so the vertical circle passing through the poles of a compass-needle determines the magnetic meridian of the place. In few, very few places do these two meridians coincide; whence it follows that in very few places does the needle stand true to the pole, the couplet of the poet to the contrary notwithstanding—

So turns the faithful needle to the pole
Though mountains rise between and oceans roll.

In New York, the needle points nine degrees west of true north; while in San Francisco, it points 16 degrees east. This departure from true orientation is technically called "magnetic declination." Popularly it is known as the "variation of the compass." It is clear that a surveyor who wants to register the true bearing of an object or a navigating officer who wants to set his course must know the amplitude of this variation. Its value has been determined for a great many places in the United States by the Coast and Geodetic Survey; for the purposes of navigation, charts have also been prepared for a number of places on the Atlantic, Pacific and other oceans, copies of which are to be found in the chart-room of every ship.

As this variation of the compass changes with time, its value has to be determined at intervals and new charts prepared. Just now, we have a non-magnetic yacht, the "Carnegie," out on the work with an able body of expert observers under the general direction of Dr. Louis A. Bauer, Director of the Department of Terrestrial Magnetism, Carnegie Institution, Washington. Numerous determinations have already been made and reported along the route in the North Atlantic followed by our fast liners to Europe showing that the corrections required do not, in general, exceed one degree. A result has just been announced which is of great importance to the navigators of vessels on this part of the ocean highway, viz., that in steaming from Europe to the neighborhood of Sable Island with the compass as sole guide, a ship would be about 30 miles too far north of her regular course, so that if the oceanic currents encountered happened to set in in the same direction, the vessel would be exposed to shipwreck. From Sable Island to New York, the chart errors are reversed in sign in which case the vessel would be put out of her true course in a southerly direction.

As already said, the "Carnegie" is built of non-magnetic materials, the gas-engine used when the sails are inefficient being made of manganese-bronze.

A similarly built and equipped yacht the "Galilee" was used in recent years for the magnetic survey of the Pacific Ocean.

It has been noticed by all Arctic explorers that the compass becomes more and more sluggish in its action the nearer it is to the magnetic pole. This is accounted for by saying that the part of the earth's directive force which controls the needle, the horizontal component as it is called, becomes less and less as we approach the magnetic pole, at which place it vanishes altogether. This may be made clear by the following analogy: Suppose you drive a peg in the earth to represent the magnetic pole. Attach a long rope to the peg and pull on the end. The force which you exert is nearly horizontal and is the same as the force which would turn the needle. Then draw up hand over hand on the rope. The horizontal pull becomes less and less, and when you are immediately over the peg the horizontal force has all disappeared and the pull is all vertical. Vertical pull will not turn a magnet needle, but only makes it press more heavily on its bearing.

In his account of magnetic work carried on in the vicinity of the magnetic pole a few years ago, Captain Roald Amundsen, the Norwegian explorer and discoverer of the North West Passage, wrote: "At Prescott Island, the compass which for some time had been somewhat sluggish, refused entirely to act, and we could as well have used a stick to steer with."

Since the directive force on a compass-needle vanishes entirely at the magnetic pole, it follows that the needle will remian indifferently in any position in which it is placed; you may turn it to the East or the West and it will point accordingly.

If you are east of the magnetic pole, the needle will point west; if at a station west of the pole, the needle will point east. If, on the other hand, you go up to a latitude higher than that of the pole (70° N.), the needle will point south, from which it follows that the compass is of little use in the Arctic Highlands or in circumpolar exploration generally.

In aerial navigation, however, the compass is serviceable if kept away from masses of iron; the same is true in mines of coal, salt or silver as well as in submarine boats. On shipboard, the standard compass by which the steering compasses are corrected, is always placed aloft and away from smokestacks, iron masts, machinery, dynamos and motors.

Frost and Fans in Show Windows

During the last month the writer, who is an electrical inspector, has had occasion to inspect something like 400 show windows in various stores and shops. In cold weather these windows, especially if open into the store, are often coated upon the inside with frost. Just as a pitcher containing ice water will in summer condense moisture from the air and "sweat," as we call it, so warm air from the store will come in contact with the glass which is chilled by the outside air, and give up its moisture, which forms frost. To avoid this an electric fan is indispensable. By its use the air is kept in motion and the interior of the window is warm and dry. If the window is enclosed, frost will gather only during the coldest weather, because the temperature within the window is nearly the same as that of the outside air. At times, even in this class of window, the electric fan is effective in clearing the frost from the glass. Portable fans for this purpose should be equipped with reinforced cord rather than with the ordinary drop cord very frequently used.

Illuminating the Interior of the Skull

A German scientist, Dr. Carl Hertzell of Berlin, has recently devised an electrically operated Ophthalmo-diaphanoscope, as he calls it, for illuminating the retina of the eye from the back so that a surgeon may examine the eye from the front, the lighting being accomplished by the patient holding a high candle power electric lamp in his mouth.

The frontispiece illustrates a special form of electric lamp used and shows the inventor in the act of examining a patient's eye with the apparatus. The examination must be made in a dark room.

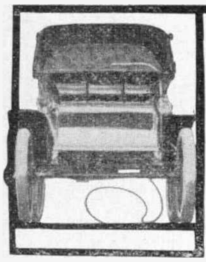
The back of the human eye is examined by this equipment to far greater advantage than is possible by means of an eye mirror and reflected light, as the retina of the eye may be illuminated from the back by an electric lamp of as high as 80 candle power without discomfort to the patient, who wears a black mask over his face.

A system of water cooling is employed for the electric lamp, this being necessary on account of the large amount of heat generated in producing this intense light. A water jacket is provided over the lamp and the circulating cooling water is stored in a glass tank mounted on the top of a column from which the cooling liquid is conducted by an auxiliary flexible tube into the lamp cooling chamber, a waste tube carrying away the heated water.

An electrically operated signal is provided which shows when the cooling water has been exhausted from the upper tank, an electric lamp being lighted when the cooling stream ceases to flow, lighting the chamber which is darkened while the observations are being made by the surgeons.

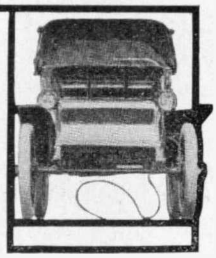
When Incandescent Lighting Reached Russia

By 1883 Edison's incandescent lighting system had spread to far points of the world. At the coronation in Moscow the illuminations were as follows: the Tower of Ivan the Terrible and its side galleries were lighted with 3,500 small Edison lamps supplied by dynamos and portable engines located on the opposite shore of the Moskwa. This portable plant was connected with the tower by 70 overhead lines.

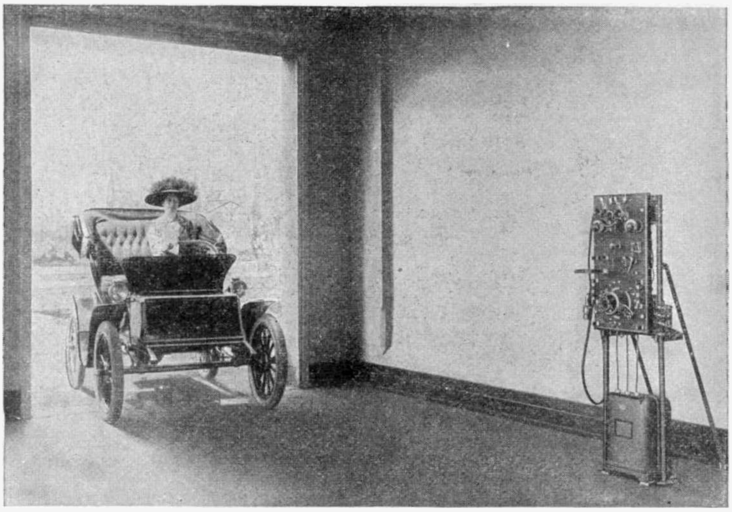


Charging "Electrics"

Showing the simplicity of the process of charging vehicle batteries



Without question the electric automobile possesses advantages which are paramount in a particular field—that is, a field where simplicity, cleanliness and ease of operation are most to be desired. The question however arises in the minds of many who are contemplating the purchase of an electric: "How shall I charge my automobile batteries?" They are under the impression that this is an operation which requires a considerable knowledge of electricity and is not to be attempted by other than an electrician. On the contrary, however, any one may learn to do it after one demonstration, and right in the home garage at that.



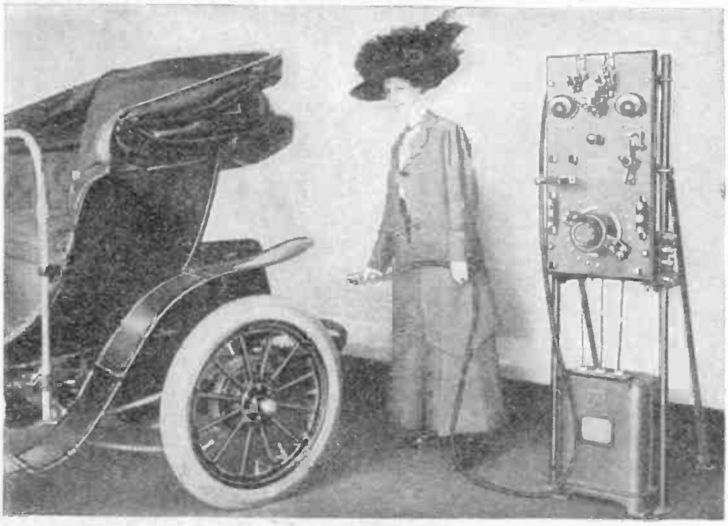
YOU ENTER THE GARAGE WITH YOUR MACHINE

The mercury arc rectifier system of battery charging is simplicity itself and is used wherever alternating current is available. As alternating current is used almost entirely in the residence portions of any city it is the only kind with which we need concern ourselves.

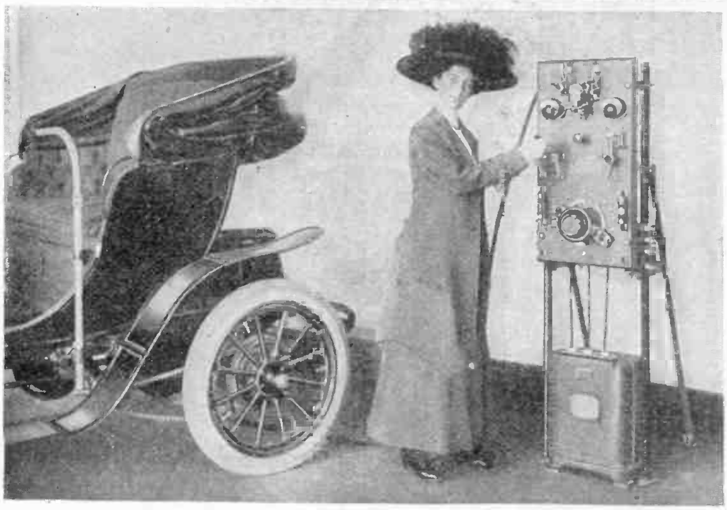
It is not the object of this article to describe minutely the working of the mercury arc rectifier, but to show by the series of illustrations, procured through the courtesy of the General Electric Company, what a simple matter it is, for a woman even, who is not supposed to know a great deal about volts and amperes, to recharge the batteries of her electric vehicle. Suffice it to say that the mercury arc rectifier consists essentially of a mercury vapor tube something like the tube of a Cooper Hewitt mercury vapor lamp which gives that peculiar ghastly greenish light. The rectifier tube has special terminals for attachment of the current carrying wires. Send alternating current from the lighting circuit into one set of terminals and you can take out direct current, which is the only kind that will charge a battery, from the other set. Connections are already made on the board to do this. You only need to concern yourself with plugging the cable into your battery terminals (you can't get it wrong), the closing of simple switches and the manipulation of a rheostat handle.

In the first picture you are entering the garage with your machine. At the right stands the mercury arc rectifier, its tube be-

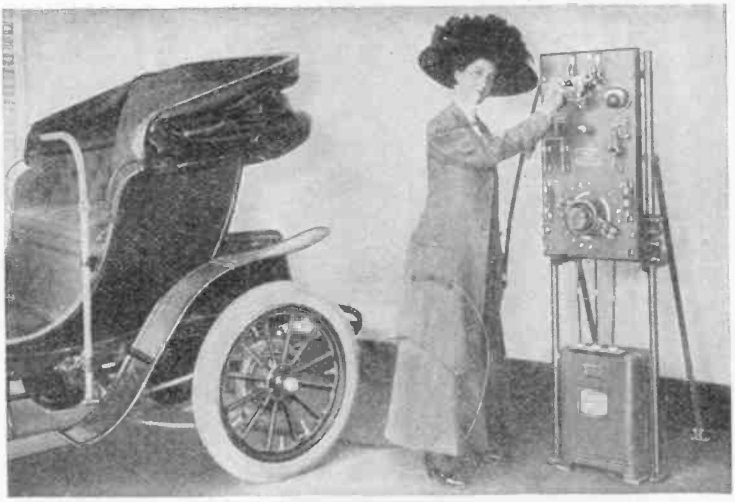
AND GRACEFULLY ALIGHT



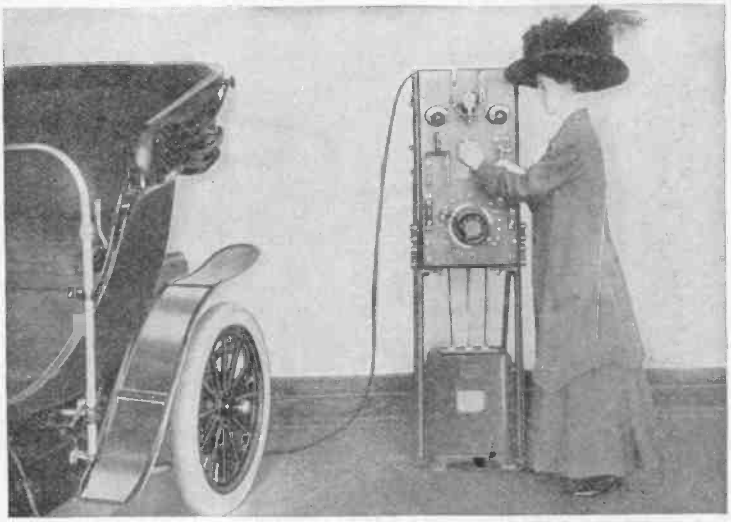
THEN YOU CONNECT THE CABLE



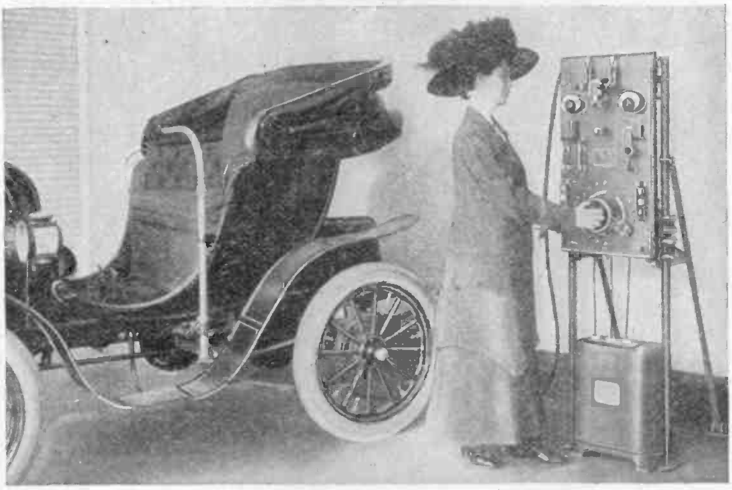
CLOSE THE LINE SWITCH



AND THEN THE CIRCUIT-BREAKER



HOLD THE STARTING SWITCH DOWN AND GENTLY ROCK THE HANDLE

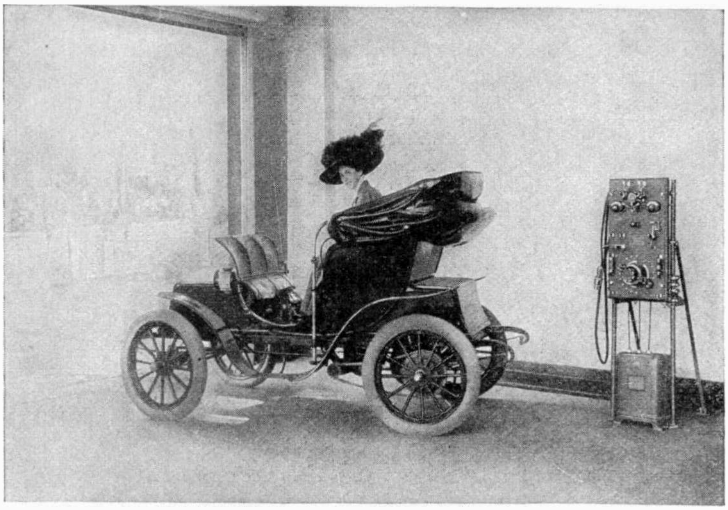


RAISE AND LOWER THE VOLTAGE BY THE RHEOSTAT HANDLE ing hidden from view behind the switch board.

You back up close to the rectifier and alight from the machine gracefully. Be sure to alight gracefully otherwise the charging process will be seriously hampered.

Then you take the connecting cable, which is already properly attached at the switchboard, and plug it into your battery terminals as shown in the third picture. The plug and terminals are so shaped that you can't make a mistake.

Now close the alternating current line switch as in picture four, which lets current from the lighting circuit into the tube; then the circuit-breaker as in picture five. This latter is what might be termed an electric safety valve. Next hold the starting switch down (you will find it at the right side of the panel) and start the tube in operation by gently rocking the handle which you will find in the center of the panel, as in picture six.



GAILY RIDE AWAY

The battery is now being charged and you can release the starting switch.

Batteries must, however, be charged at a certain voltage or electrical pressure, and a certain number of amperes per minute or per hour must be sent into them; the same as if you were charging a watertank at a rate of so many gallons of water per minute from a hose stream under a pressure of a given number of pounds per square inch. This charging rate depends upon the number of cells and other conditions. Knowing what this charging rate should be for your battery you regulate to the right amount by turning the rheostat handle as in picture seven. There are an ammeter and a voltmeter on the board which show at a glance how many amperes are flowing and at what voltage.

That is all there is to it. When the battery is charged you open the switch, disconnect the cable and gaily ride away.

An Electrical Valentine

Professor Clerk Maxwell who died over a quarter of a century ago used to be in the habit of penning amusing physio-comic parodies on well known poems, as a mode of relaxation from his scientific work. One of these which appeared in the Scientific American in 1880 is entitled "An Electric Valentine," and runs as follows:

TELEGRAPH CLERK A TO TELEGRAPH CLERK B

"The tendrils of my soul are twined
With thine, though many a mile apart;
And thine in close-coiled circuits wind
Around the magnet of my heart.

"Constant as Daniell, strong as Grove;
Seething through all the depths like Smee;
My heart pours forth its tide of love,
And all its circuits close in thee.

"O tell me, when along the line
From my full heart the message flows,
What currents are induced in thine?
One click from thee will end my woes.

"Through many an Ohm the Weber flew
And clicked this answer back to me:
I am thy Farad, staunch and true
Charged to a volt with love for thee."

Elementary Electricity

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

CHAPTER XXII.—THE DYNAMO-ELECTRIC MACHINE

A dynamo-electric machine is a device for filling and emptying conducting loops with magnetic flux and employing the electro-motive forces so induced in such loops for producing currents for employment in external circuits.

The great value of dynamo-electric machines can be seen from the fact that nearly all the electricity employed today for commercial purposes, such as arc and incandescent lighting, electric power, trolley systems, electric furnaces, and other purposes in electro-chemistry, for electric heating, welding, and forging, etc., is produced by various types of dynamo-electric machines.

The operation of the dynamo-electric machine is dependent on a principle discovered by Faraday in 1831, and generally known as dynamo-electric induction. This principle is substantially as follows: If a coil of insulated wire, the ends of which are connected to a galvanometer, be moved across the poles of a magnet, so as to pass through its magnetic flux, an electro-motive force will be produced in the coil as shown by the movement of the galvanometer needle in a certain direction. If the coil be moved in the opposite direction a current will also be produced but now in the opposite direction as indicated by a change in the direction of the galvanometer needle.

The value of the electro-motive force and therefore of the current produced depends on the rate at which the flux produced by the magnet enters or leaves the loop and not on the amount of the flux itself; for, while the coil is stationary although flux is passing into and out of it, yet no electro-motive forces, and consequently no current is produced.

A comparatively small flux entering or leaving the loops rapidly may produce in them a higher electro-motive force than a much larger flux entering or leaving slowly.

The dynamo-electric machine consists practically of means whereby conducting loops are rapidly revolved through a magnetic field so as to be successively filled and emptied with flux. As the loops are revolved in the magnetic field, the flux passes through them in alternately opposite directions during each complete rotation between two opposite magnet poles.

Generally speaking, that part of a dynamo-electric machine which is provided with conducting loops and is so moved as to pass through magnetic flux is called the armature, while the means for producing the flux, generally consisting of electro-magnets, is known as the field magnets.

The direction of the electro-motive forces induced in the moving loops and therefore of the current produced in them, depends on the direction in which the flux passes or threads through them; that is, on the position of the magnet poles as well as on the direction of the motion.

If, for example, a conducting loop (A), Fig. 147, be moved downward between the poles (N) and (S) of a permanent horse-shoe magnet, then since the flux comes out at the north pole of the magnet and enters at the south pole its direction will be as indicated by the small arrows, while the direction of the electro-motive forces produced will be such as to establish a current flowing in the direction of the longer arrows. When, however, the coil is moved upwards the direction of the current produced is changed.

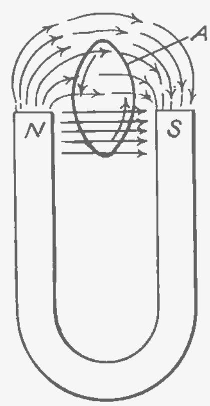


FIG. 147. HOW ELECTRO-MOTIVE FORCES ARE PRODUCED IN A MOVING COIL

The direction of the electro-motive force produced can be determined as follows:

Regard the face of the loop as the face of a watch. Then if the flux passes through the watch face towards the observer's eyes in the same direction as the light by which he sees the face, the electro-motive force and current produced will have the same direction as the motion of the hands of the watch. If, however, the flux is poured into the loop against the direction of the light rays the electro-motive force and currents induced will be against the motion of the hands.

It is evident that during each complete rotation of an armature between field magnets consisting of two magnet poles such as (N) and (S), the direction of current induced in any of its loops will be reversed. In other words, the electric current produced will not be direct but alternating.

Field magnets consisting of two poles only are said to be bi-polar; those consisting of four poles are said to be quadri-polar, and those containing a greater number of poles, multi-polar. It is evident that the number of changes in the direction of the currents produced in a quadri-polar machine will be twice as great as in a bi-polar, and that the number of reversals will increase with the number of poles.

Since the number of reversals depends on the number of turns the coils pass the magnetic pole, the number of reversals per second will increase with the number of revolutions per second.

In many cases the currents are taken directly from the armature by means of copper or other conducting brushes, resting on metallic rings suitably supported on the armature axis. When, however, it is desired to obtain direct currents, or those flowing continually in one and the same direction, a device called a commutator is employed consisting of insulated conducting segments suitably supported on the armature axis and provided with conducting collecting brushes.

In some forms of dynamo-electric machines instead of moving the armature coils through the magnetic field the magnetic field is moved past the coils. In other words, the armature coils are stationary and the field magnets movable. Such machines are called revolving-field dynamos or generators. The currents, however, in such machines are produced in accordance with the principles above described.

While the strength of the electro-motive forces produced in the armature does not depend on the total amount of flux in the field yet it does depend on the total rate-of-change in the amount of flux that passes through the armature loops. Other things being equal, this will be greater, the greater the amount of flux that is passing through the field. The value of the electro-motive force generated will also depend on the speed with which the armature is rotated; that is, the speed with which the loops are successively filled and emptied with flux.

Since electro-motive forces are produced in each of the loops the total value of the electro-motive force produced will depend on the number of the loops in which the electro-motive forces are induced, as well as on their connection and grouping. Evidently if all the separate coils are connected in series, the electro-motive force will be greater than if, as is the case in some forms of armature windings, such as the Gramme-ring and others, they are connected in multiple or parallel.

In order to increase the quantity of magnetic flux passing through the field magnets, which in all large dynamos are electro-magnets, it is of course only necessary to increase the number of windings or turns on the electro-magnet as well as the current strength passing through them; or, in other words, to increase the number of ampere-turns.

It is necessary that care be observed in the character of the magnetic circuit or the path provided for the passage of flux through the cores of the electro-magnets and the armature; for, other things being equal, the smaller the magnetic reluctance the greater will be the amount of magnetic flux that passes. For this reason the materials of the cores of field-magnets and the armature should consist of soft iron or soft steel.

The cores of the field magnets are made of solid masses of soft iron or steel. The armature cores must be made of thin sheets or plates of iron or steel. Were the armature cores made like those of the field magnets of solid iron or steel, an increase of temperature would result, shortly after the starting of the machine, sufficient to burn the insulation on the armature coils. The reason is evident. The currents passing through the armature coils are rapidly alternating. These rapid alternations set up electro-motive forces in the mass of iron or the core, producing currents known as foucault, eddy, or parasitic currents. Though the electromotive forces thus generated are not very high, yet if the cores consisted of solid iron or steel their electric resistance would be so small that the currents produced in them would be sufficient to raise the temperature of the core very markedly. If, however, the iron or steel is laminated in a direction at right angles to that in which these currents tend to flow, the resistance of the circuits is greatly increased, so that the strength of the foucault currents generated is comparatively small.

Although it is unnecessary to laminate the cores of the field magnets, yet it is necessary to laminate their pole pieces, the name given to the prolongations of the field magnet poles into shapes that permit them nearly to surround the revolving armature. Marked changes occur in the intensity of the magnetic flux produced in the pole pieces by the rapid rotation of the armature.

Foucault or eddy currents are also set up in the armature wires or conductors constituting the armature coils. Where ordinary wire is employed in the armature coils the strength of the eddy currents is comparatively small. When, however, heavy copper bars or conductors are used it is necessary to form them of a number of separate bars or wires, since, otherwise, strong currents would be induced in the wires.

The electric energy produced by the dynamo is a result of a transformation into electric energy of the mechanical energy required to drive the armature. Were this transformation complete any given amount of mechanical energy put into the machine would produce an equal amount of electric energy and the efficiency of the machine would be 100 per cent; that is, the ratio between the amount of electrical energy produced in the armature and the mechanical energy required to be expended in order to drive the armature would be unity.

The cause of the difference between the output and the intake is to be found in losses that occur whereby energy uselessly expended in the machine fails to appear as electricity in the external circuit, but appears in the machine as heat. It is easy, therefore, to determine roughly whether a dynamo is working efficiently or not. If it remains cold while running and doing satisfactory work, it has a high efficiency. If, however, it heats, this heat indicates a loss and therefore a decreased efficiency, and the hotter it becomes after working under a load the greater is the loss of energy and the less the efficiency.

The principal losses in the operation of a dynamo are:

1. Mechanical losses, such as those due to air churning or the setting in motion of air by the rotating armature; losses due to friction of the shaft of the generator; and losses due to the friction of the collecting brushes on the commutator. Mechanical energy so lost appears as heat in the air, in the journal bearings, and in the brushes and commutator segments respectively.

2. Electrical losses. These can be divided into two kinds: i. e., losses in the circuit or circuits of the machine; losses in the iron core of the armature or pole pieces; or in the copper wire or bars forming the armature coils. The energy so lost appears as heat in the machine or especially in its revolving armature.

3. Magnetic losses, or those due to what is called magnetic hysteresis.

By magnetic hysteresis is meant that quality of a magnetic substance, like iron or steel, in virtue of which energy is dissipated on the reversal of the magnetization. A certain amount of energy is dissipated or lost by hysteresis which may be regarded as a variety of molecular friction attending magnetization and demagnetization. As ordinarily constructed in direct-current dynamos, work is done in magnetizing the field magnets, not only to give the iron its initial magnetism, but also to reproduce the magnetism it loses during running. The loss, however, by hysteresis is especially found in the armature core which is subjected to rapid magnetizations and demagnetizations.

In order to decrease the loss due to journal friction the diameter of the armature shaft is made as small as ample strength will permit, and efficient lubrication is provided. The energy lost by brush friction increases with the number of brushes and the pressure on each brush. The amount of this loss, however, is not very appreciable in large dynamos, although in very small dynamos it forms an appreciable part of the losses. When not excessive the loss due to air churning by the rotating armature, is not altogether objectionable from the ventilation and consequent cooling of the armature that is thus ensured.

The commercial circuits on which by far the greater amount of current produced by dynamo-electric machines is employed, are either series circuits or multiple or parallel circuits. Series circuits are employed generally for arc lighting, or for street car trolley systems.

In series or multiple circuits as the number of electro-receptive devices is increased or decreased, some device must be employed whereby either the electro-motive-force or the current produced can be maintained constant.

In the case of a series dynamo, such as that employed for series arc lamps it is the current strength that must be maintained constant, since each additional lamp introduced into the circuit increases its resistance. The regulating device employed must therefore be able to increase the electromotive force to such an extent as shall result in the current strength remaining constant. Suppose, for example, that a single arc lamp requires a pressure of 50 volts at its terminals in order to produce the requisite current. Then, thirty such lamps connected in series would require the machine to produce a pressure of fifty times thirty or 1500 volts, while sixty such lamps would require a pressure of 3000 volts.

In the multiple circuits, however, it is the pressure that must be maintained constant and the current strength that must be varied, since for every additional device added to the circuit an increase of current is necessary.

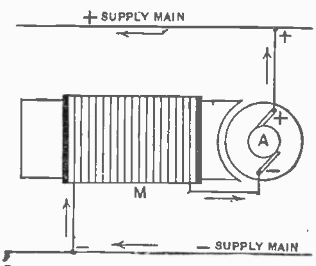


FIG. 148. DYNAMO WITH FIELD IN SERIES

A generator suitable for connection with mains feeding multiple-connected devices; that is, suitable for connection with constant-potential mains, should be able while maintaining the pressure constant to vary the current strength in proportion to the number of separate devices added or removed.

Dynamo-electric machines must therefore be provided with means whereby the pressure can be regulated for series circuits, and the current strength regulated for multiple or parallel circuits.

The E. M. F. produced by a dynamo can be changed by varying the speed of rotation; by varying the number of conductors on the armature; by varying the magnetic flux passing through the armature; or by shifting the position of the brushes on the commutator.

The number of conductors on the armature remains constant in the same machine, and its speed of rotation must for practical purposes also remain unchanged. There

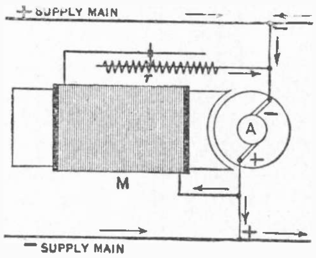


FIG. 149. DYNAMO WITH FIELD IN SHUNT

are, therefore, only two ways in which the E. M. F. produced can be varied. This is by a change in the amount of the magnetic flux, or by a change in the position of the brushes. In the case of series arc-lighting dynamos the variation in the E. M. F. is obtained by shifting the brushes either automatically or by hand. In generators employed on constant-potential mains, the necessary variation in the amount of current, is effected by a change in the amount of magnetic flux.

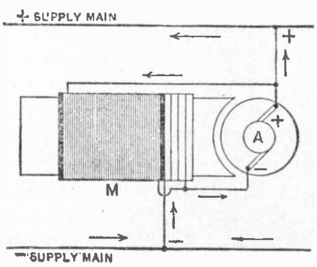


FIG. 150. COMPOUND WOUND DYNAMO

Dynamos suitable for feeding series circuits are known as series-wound dynamos, of the type represented in Fig. 148. Here, the magnet coils (M) are connected in series with the armature (A).

Generators suitable for feeding multiple or parallel circuits are known as shunt-wound dynamos. Here, as shown in Fig. 149 the magnets are not in series with the armature circuit but are connected at the brushes in shunt with the external circuit so that a portion of the armature current is always employed for developing the magneto-motive force in a field magnet.

It will be observed that in the shunt-wound generator the field-magnet circuit is connected with a rheostat or adjustable resistance (R), by means of which the magneto-motive force of the field magnets can be regulated by varying the current strength of the circuit. This regulation is obtained either by hand or by the action of an electro-magnet.

Another method of making a generator self or automatically regulating is by what is known as compound-winding. In a compound-wound generator, as shown in Fig. 150, the magnet coils are partly excited by a shunt-winding taken from the brushes and partly by a series winding connected with the main circuit. Want of space prevents any further explanation as to the manner in which these different forms of machines are capable of regulating either the pressure or the current.

Dynamo-electric machines producing alternating currents, or those in which the direction of the current rapidly changes, are called alternators. Although the details of construction differ somewhat from those of direct-current machines, yet, generally speaking the construction of both machines is the same.

The changes or reversals in the direction of the E. M. F. or current in alternating circuits are called alternations. A generator is said to produce 16,000 alternations per minute when it reverses the direction 16,000 times per minute, or produces 8,000 waves in one direction and 8,000 waves in the opposite direction. Such a machine is said to produce 8,000 cycles per minute, a cycle being a double-reversal or a complete to-and-fro motion. By the frequency of alternations of a machine is meant the number of cycles it produces per minute. A machine producing 16,000 alternations per minute, or 8,000 cycles per minute, would have a frequency of 8,000 alternations.

Alternating electric currents are employed extensively in the operation of alternating motors. For this purpose what are known as multiphase alternating currents are employed. These consist of a number of separate alternating currents differing in phase by a certain amount.

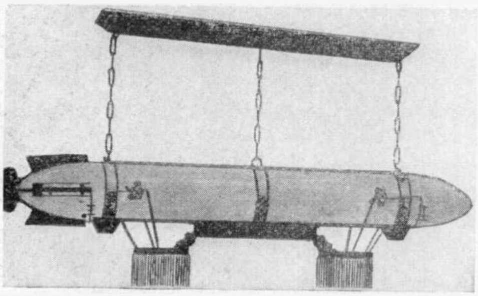
Waves of current or pressure are said to be in phase or step when their crests or tops occur simultaneously, and are said to differ in phase when the crests or tops do not occur simultaneously.

There may be a great number of multiphase alternating current systems. In practice not more than three separate systems are employed. These are single phase, two phase and three phase.

(To Be Continued.)

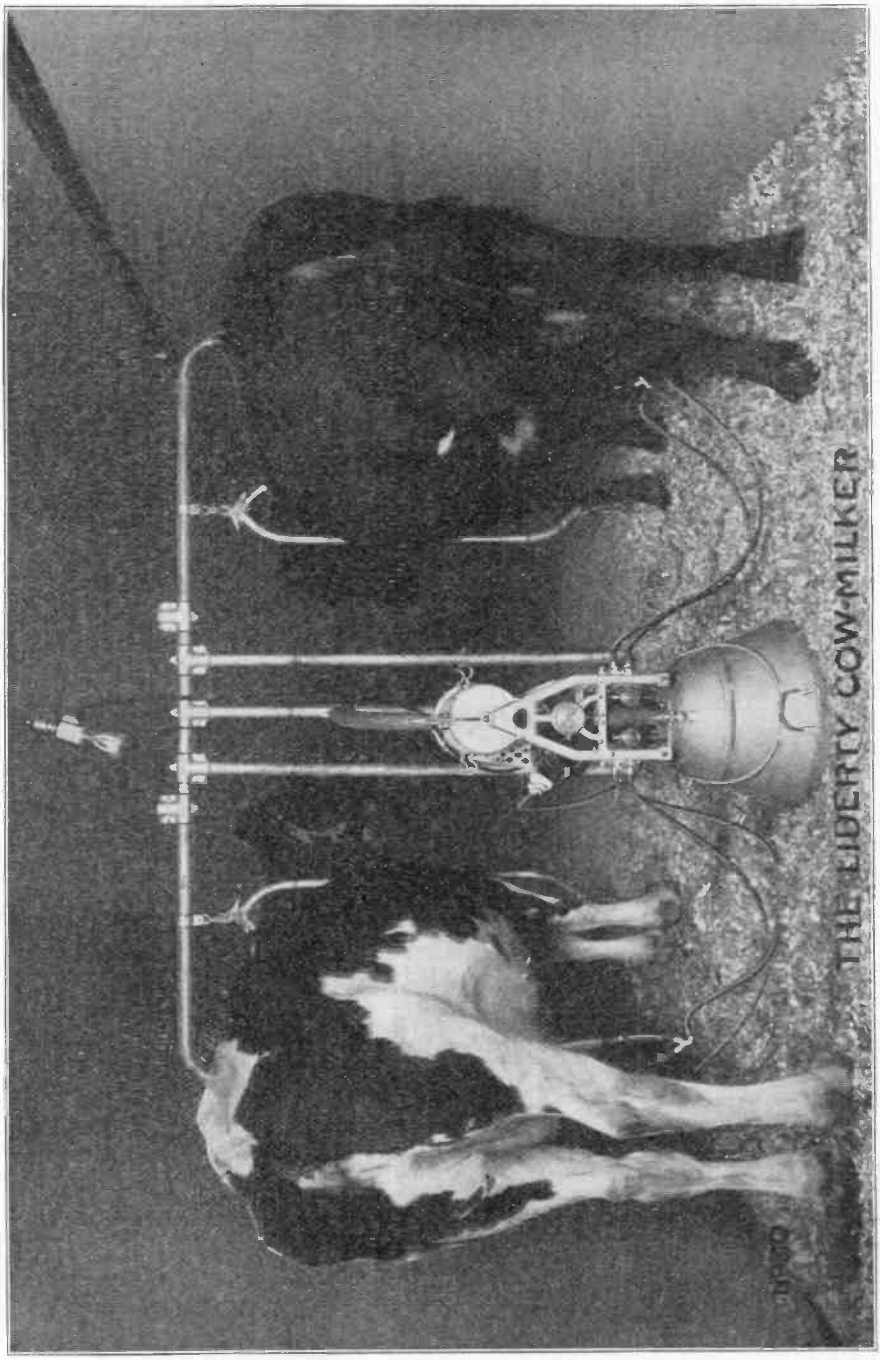
Count Zeppelin's Unique Gift

Count Zeppelin, the famous aeronaut, has accepted the godfathership to the recently born third child of the German crown prince. It is customary to make presents on such an occasion and the ingenious count ordered a miniature airship in the shape of an electric chandelier. He visited recently the factory in Berlin and was cheered by the public who recognized him at once.



ELECTRIC CHANDELIER IN THE FORM OF AN AIRSHIP

As we see from the picture all details are well represented, such as the various apparatus for steering sideways and up and down, the propellers, cars, connecting gangway, etc. The main body consists of glass and has a crystal-like surface. The metal parts are well ground until they assumed a matt surface, and are of silver color. In each car there is one electric bulb lamp, also two more in the long body. When these are lighted it gives a wonderful effect. The whole is suspended on three chains and will for a long time be an attraction in the castle of the German crown prince.



AN ELECTRIC VACUUM COW MILKING MACHINE IN OPERATION

The Latest Way of Milking Cows

In these days when the inventive spirit has managed to solve almost all mysteries of the days of our forefathers, progress has been made in every line and particularly in the dairy business. We call it business as it has to be run as a factory and each minute means money. Where are the days that a machine separating milk to cream and skim milk was looked upon as a mystery or fake? And how near are the days when hand milking will be ridiculed as are at the present day the gravity system "to get the cream," and hand threshing "to get the crop?"

A really practicable cow milking machine is now obtainable and as is usual in new things electricity has made it possible. It is a simple affair. First there is the air tight milk can or receptacle from which lead the long flexible tubes with suction cups attached for extracting the milk in the most natural and sanitary manner possible. Then there is the milking machine proper, consisting of a pulsating vacuum pump driven by an electric motor which creates a partial vacuum in the can.

The vacuum in the can is indicated by the vacuum gauge. By means of an operative connection between the crankshaft and double valves, the latter will be in operation as soon as the crankshaft is in motion. The valve is so constructed that a hollow cylinder connects the vacuum created in the can with the suction cup in one position, thereby drawing milk from the cow, and in the second position it breaks the vacuum and opens to the air, thus destroying the vacuum in the suction cup and exposing it to the normal atmospheric pressure. After this operation is finished suction is again applied and milk drawn and the operation as above described repeated. It is readily seen, therefore, that nature's operation is imitated very closely. The calf, when he gets his mouth full of milk is bound to take a breath and swallow, thus destroying the vacuum for a moment exactly the same as in the milking machine.

After the milking process is finished all that is necessary to clean the machine is to hang the cups in a pail of water and suck the water through the cups and tubing. Then warm water is used, with a 10 per cent solution of common salt.

"From where does the electric current come?" Many of the largest dairy farmers in this country have for a long time recognized the great importance of having electric light in a sanitary cow barn. They have realized all the benefits given to the world by this great discovery. Electric light in a cow barn is the best and safest. The great Chicago fire in 1871, as we all know, was started by a cow kicking over a lamp in the barn of Mrs. O'Leary, DeKoven street, and the history of fire insurance shows that destruction of a large proportion of the dairies starts in this very way. Electricity in dairy establishments is therefore becoming more common than is ordinarily supposed.

The electric current required to operate one of these cow-milkers is very small, and a one-kilowatt dynamo (a little over one horsepower) will create all the current needed to run a number of milking machines and have lights in the barn besides. The dynamo can be operated direct from the fly wheel of a small engine, if the regular lighting current is not available. A couple of wires can easily be run in any barn and an attachment provided at each lamp socket so as to run a cord therefrom to operate the motor of the cow-milking machine.

Great Electrical Growth in the West

According to the 1910 edition of Blanchfield's Western Electrical and Gas Directory, the development of the electrical industry in Arizona, California, Idaho, Nevada, Oregon, Washington, British Columbia and the Hawaiian Islands has indeed been remarkable. The directory contains the names of 940 companies and individuals under the heading of Electric Light and Power and 201 names under Electric Railways.

A condensed history of the development of these industries presents facts that are startling. In one city, alone, it is possible to deliver over 275,000 electrical horsepower, from steam and gas (or distillate) engine driven plants, and over high potential, long distance lines from hydro-electric stations—traveling, in one instance, 351.95 miles. Another city can be supplied with over 135,000 electrical horsepower. The largest installation, under one roof, provides 40,000 kilowatts, normal rating, which is over 50 000 horsepower.

Talks With the Judge

"What is a watt? What is a kilowatt? What is a kilowatt hour?" The Judge almost shouted the questions. "Every month I use and pay for a mysterious something which we call electric current. When I pay my bill, if I make any inquiries, they tell me that the month before my meter read so many kilowatt hours, this month it reads so many, the difference is so many, and at *my* rate per kilowatt hour it amounts to five dollars and seventy-seven cents. That all 'listens' fine, and I am glad it isn't six dollars and I go away. But just the same, I wish I could know what it is I am buying. A watt is a most elusive thing. To buy one is like buying imagination, as it seems to me."

"Judge," I said, in my most impressive manner, "the watt is the unit representing the rate of work of electrical energy. It is the rate of work of one ampere flowing under a potential of one volt."

"Fiddlesticks!" said the Judge, "Why don't you tell me that it is perfectly elastic, incompressible entity, which, traveling at the rate X to the *nth* power miles per hour will amount to five dollars and seventy-seven cents in *n* minus one years. It would mean just the same to me."

"Wait a minute," I said, "seven hundred and forty-six of these watts equal one horsepower, and a horsepower as you know is the energy required to lift 550 pounds one foot in one second."

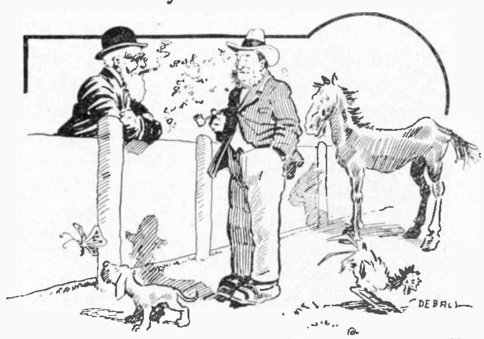
"Now you are talking sense," said the Judge. "A horsepower is something tangible. Keep right down on that physical plane and I can follow you."

"But the watt is rather a small unit for everyday use," I continued, "so they devised the kilowatt, which is one thousand watts. A kilowatt, therefore, is equal to almost exactly one and one-third horsepower.

"However, you don't buy kilowatts of electric current energy from the central station company. You buy kilowatt-hours. If you were to go to your neighbor and say, 'I will pay you five dollars for the use of your horse,' the first question he would ask would be 'For how long?' He would want to know how many horsepower hours of energy you were going to take out of the animal. The chances are he would then ask you a certain price per day, or, in other words, for 10 horsepower hours, if the horse were used 10 hours a day.

"So you see the time element enters into the problem. If you use one kilowatt for 10 hours, from your circuit, your total is 10 kilowatt hours. Or if you take out 10 kilowatts for one hour the total is 10 kilowatt hours just the same.

"Now to make this kilowatt hour even more comprehensible to you, let us take a few concrete examples of what a kilowatt hour of electrical energy will do. A kilowatt hour of electricity will burn 20 ordinary 16 candle power carbon filament lamps for one hour; it will keep four domestic irons in use for one hour; it will cook 15 chops in 15 minutes; it will run a sewing machine for 21 hours; it will carry you three miles in an electric brougham; it will run an electric clock for 100 years."



He Would Want to Know "For How Long"

"Well, I think I understand now what a kilowatt hour is, but I don't understand why all do not pay the same price for a kilowat hour of electricity. As far as I can find out the rate is not uniform. That doesn't seem fair."

"There are different rates, it is true," I replied, "but these rates are uniform to all those requiring a particular class of service. For instance, here is a little shoemaker who has only one lamp which burns an hour or two hours in the evening. He has to have his meter installed, meter men must come and take readings, clerks must make out his little bill, his lamp must be renewed occasionally, etc. You can readily see that his little service requires about as much attention as the good sized manufacturing plant next door which has several hundred horsepower in motors in operation.

"Then again there are certain classes of service which are supplied in the daytime or late at night, when a large part of the great generating equipment is idle. Such service

His Little Service Requires About as Much Attention as the Manufacturing Plant Next Door

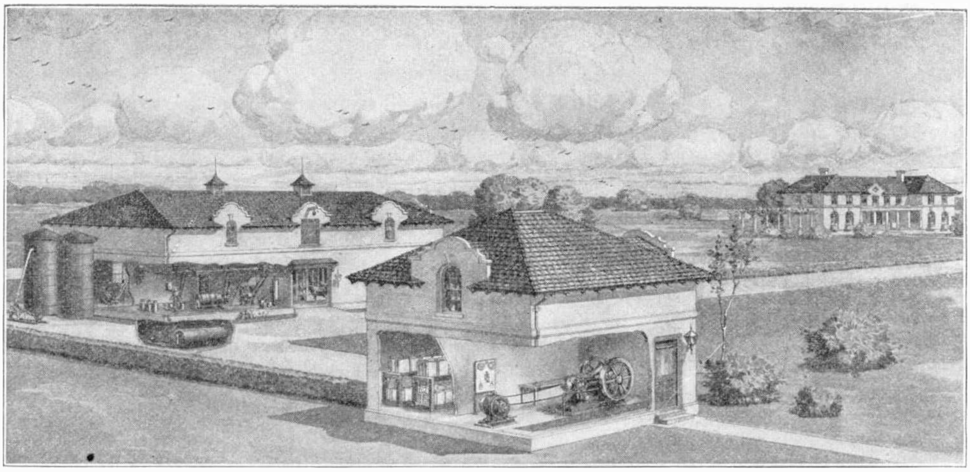
as this is encouraged and an attractive rate made, and might be spoken of as 'velvet' to the central station. Such a customer as this *ought* to have a better rate than the one who comes onto the lines between five and eight o'clock in the evening when lights are burning full blast all over the city and what is known as the 'Peak of the load' is on and the generating equipment is working at full capacity.

"In your own city, Judge, they have a way of equalizing the rates in a way which is as near fair to all as possible by using what they call the maximum demand system. Your lighting rate is 12 cents net, per kilowatt hour for all electricity consumed in each month up to and including an amount that would be equivalent to 30 hours constant use of your maximum demand in such month. For all above that they only charge you six cents. By the maximum demand is meant the greatest number of lamps which you have turned on at any one time during the month—they have meters to register that. This maximum demand indicator on the meter works something on the principle of a physician's thermometer. You know when a physician puts the little thermometer under your tongue the mercury runs up the tube to the point which registers the temperature. Then the mercury will stay up at this point in the tube until the latter is shaken in a particular way. It is the same way in a maximum demand meter. There is a tube something like a thermometer tube and a mercury column is made to rise in the tube to a height proportionate to the number of lamps burned on the circuit. The mercury will not drop back in the tube but always registers the highest number of lamps or in other words the maximum current demand at any time during the month. When the meter reader comes around at the end of the month he releases the mercury column so that it falls back and is in shape to register the next month's maximum demand. This will explain to you why it is that your neighbor who uses more current than you do, may some months pay less per kilowatt hour, the reason being that he uses more than the 30-hour maximum demand equivalent and so gets in on the lower rate for some of his current. That's only fair. He is a customer who burns his lamps a greater number of hours and current to him costs the company proportionately less than it does delivered to you, for the "fixed expense" connected with his installation is no more than yours.

"In your city, also, users of electric current for power get a different rate because they are great big users of current, wholesale users you might say, and also their power is ordinarily taken during the daytime and they shut down as the peak of the load due to lighting comes on. Ten cents a kilowatt hour is their rate, up to 30 hours of the maximum demand, after which it is five cents for 30 hours more; all in excess is then three cents.

"To find out exactly what the various rates are you should send to your lighting company for a complete schedule. Remember, however, that this rate proposition is one of the most complex problems which the big central station companies have to encounter. Years have been spent in studying it out and trying to make it just to all the various classes of customers. The maximum demand system just referred to is one way—perhaps the most satisfactory way—but in other cities different methods of charging may be employed."

A 20-watt tungsten lamp gives one-fourth more light than the carbon filament lamp of 16 candle-power, on one-half the current.



Electric Light and Power for Country Homes

By LOUIS A. PRATT

PART I.

The object of this article is to set forth in plain and simple language some of the facts of interest to any person wishing light and power for a country residence, farm, or small manufacturing plant, where central station current is not available.

The need of the electric lamp in isolated localities not reached by central stations, has long been felt and has been one of the deterring influences in the trend of population from city to country.

The safety, cleanliness and convenience of electric light is so generally recognized that there is every incentive to make it universally available, the principal obstacle being the lack of a sufficiently cheap and dependable source of energy.

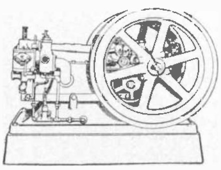
The gas engine, however, now supplies this want and independent plants are not only possible, but they are also comparatively inexpensive to install, and can be operated at extremely low cost, both in the matter of fuel and attendance.

Abundance of light can therefore no longer be classed as a luxury, but must be considered as a necessity to home comfort within the reach of a moderate income. Power is also needed by every farmer in keeping pace with modern methods and the ever increasing scarcity of labor, and is available on a basis which makes it an attractive and profitable investment.

For much of the data which follows, I wish here to acknowledge my indebtedness to the engineers of the Alamo Manufacturing Company, the Westinghouse Storage Battery Company and to Mr. T. H. Amrine of the University of Illinois.

THE GASOLINE ENGINE

As noted in the introduction, the principal obstacle in the way of private electric generating plants has been the difficulty of obtaining a satisfactory source of energy. This obstacle has been removed by the introduction of gas engines, that is, engines operating on natural or manufactured gas, gasoline, distillate, kerosene or alcohol. In this country the fuel most generally used is gasoline. The type of engine in general demand is the horizontal or vertical water-cooled, four-stroke-cycle engine.



FARM GASOLINE ENGINE

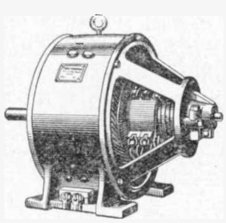
These engines have what is commonly called the hit-and-miss system of control, are very economical of fuel and do not easily get out of order. They are successfully used for operating the electric dynamo or generator where current is wanted for power only, for charging storage batteries, or for lights for places where a slight variation, or flicker, is not objectionable.

When the engine is required for operating the generator for lighting purposes, a closer speed regulation is required than can be obtained with the ordinary gas engine, because the voltage or electrical pressure produced by a dynamo varies with the speed and if the speed is not constant the lights flicker. To meet this requirement there has now been perfected standard throttling governor engines, and by this method of construction it is possible to produce lighting outfits having a regulation producing as steady lights as are obtained by the use of the best makes of steam engines.

THE ELECTRIC GENERATOR

The electric generator has reached such a stage of development that little need be said in explanation. The generator, or dynamo as it is called, is a machine used for generating the electric current.

From the generator the current can be either taken direct over wires for use in lighting or to run electric motors for operating various machinery, or it can be run into storage batteries and taken out for use as needed.



A DIRECT CURRENT GENERATOR

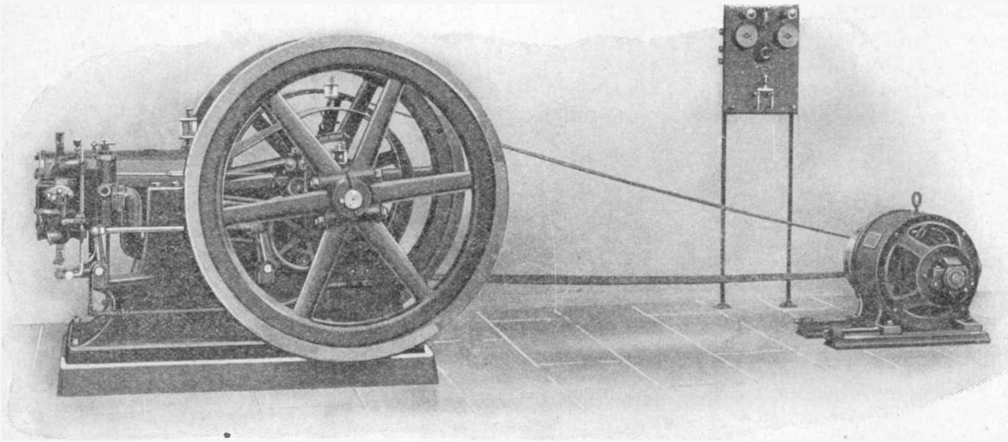
For isolated electric plants two classes of direct current generators are now considered. First—generators of 110 to 125 volts of a variety of speeds, either for belted drive or connected direct to the engine; and, second—generators of 30 to 50 volts for use in charging the storage batteries for low voltage domestic lighting service; 50 volts being high enough voltage to charge a battery of 18 cells, should one wish to use so many cells in a low voltage system.

The distinction between a generator and a motor is that the generator converts the power of the engine into electric energy, while a motor converts this electric energy into mechanical power again.

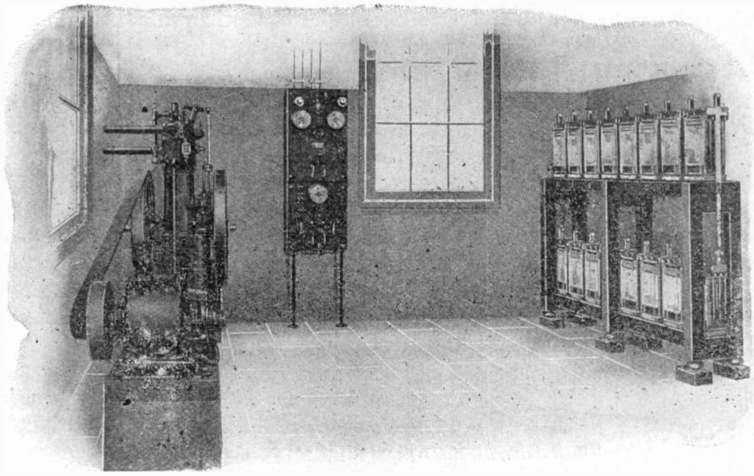
THE STORAGE BATTERY

The storage battery may be considered simply as a reservoir for storing electricity. The use of the storage battery makes it possible to store up electrical energy which can later be used for lighting and power. The convenience of such an equipment will be readily appreciated. The gas engine and generator may be operated during the day, the battery charged and the engine shut down. The battery is then ready to furnish current for lighting the house and premises during the evening and night hours.

A battery is made up of one or more cells. The capacity of a battery cell is designated in ampere-hours, that is, it will deliver a certain number of amperes for a given number of hours. The normal rating or condition of greatest efficiency, is the number of amperes that the cell is capable of supplying on discharge for eight hours. This rating has been accepted as normal for storage batteries in lighting service by all battery manufacturers. As an example



TYPICAL FARM PLANT, INCLUDING ENGINE, GENERATOR AND SWITCHBOARD



LOW VOLTAGE STORAGE BATTERY PLANT

a battery cell which may be called a 10-ampere cell, will deliver 10 amperes for eight hours, and, therefore, has a capacity of 80 ampere-hours.

A cell may, however, be discharged at a rate higher than the eight-hour rate, depending upon the load upon the circuit, that is, the number of lamps that are to be lighted. A cell will supply for five hours one and four-tenths times the normal eight-hour rating, or for three hours twice the normal rating, or for one hour four times the normal rating. To illustrate: The discharge ratings of the 10-ampere cell would be

10 amperes for 8 hours, or
14 amperes for 5 hours, or
20 amperes for 3 hours, or
40 amperes for 1 hour

It will be seen that the capacity in ampere-hours decreases as the rate of discharge increases, the capacity at the one-hour rate, as shown in above table, being 40 ampere-hours while the normal rating is 80 ampere-hours.

To determine the capacity of cells required for lighting service it is necessary to know the number of lamps to be lighted at one time, their candle power and efficiency.

The efficiency of a lamp depends upon the amount of energy, or watts, required per candle power to light the lamp to full brilliancy. There are a number of different types of lamps on the market, showing a great variety in efficiency. It, therefore, becomes necessary in determining the amount required to light a given number of lamps, to know not only the candle power of the lamp but its type, whether of the old style carbon filament, which is called a 3½-watt lamp, or one of the newer type metallized filament lamps, which furnish a candle power on from 2 to 2½ watts, such as tantalum and gem, or the more efficient tungsten lamp which will supply a candle power on 1¼ watts. Compared on the basis of 16 c. p., these lamps will require the following energy:

Carbon Filament	55 watts
Metallized Filament	40 watts
Tungsten	20 watts

To determine the amount of current required to light each of the three types of lamps just mentioned, divide the number of watts by the voltage. Assuming that the voltage of the circuit is 110, it will be seen that each of the lamps will require the following amount of current to burn them to their full candle power:

Carbon Filament, or 55-watt lamp, ½ ampere.
Metallized Filament, or 40-watt lamp, 4-11 ampere.
Tungsten, or 20-watt lamp, 2-11 ampere.

Since batteries are more expensive than lamps, it will be found in most cases, that it will pay to use the high efficiency tungsten lamp, or the metallized filament lamp, and reduce the cost of the battery. If, on the other hand, one figures battery cost on the basis of the carbon filament lamp and has the battery large enough to supply a certain number of this type of lamp, and afterwards finds that more light is required, it will be very convenient to increase the lighting capacity of the battery by substituting the high efficiency lamp for the carbon filament lamp. For this reason it is recommended that batteries be figured on the basis of the carbon filament lamp, and if it is afterwards found that the capacity is too low, the battery need not be overworked, to its detriment, but the load may be decreased by the use of the tungsten lamp, which, as above stated, is equivalent to increasing the capacity of the battery.

Having determined the number of lamps which are to be used for a given number of hours, the number of amperes required may easily be calculated and the result compared with the capacity of standard size storage battery cells at their various discharge ratings, for the different numbers of hours. These ratings and capacities are scheduled in manufacturers' catalogues.

The number of cells to be used in a battery in series (or tandem) will depend upon the voltage required for the circuit. If the system is to be of low voltage, for strictly domestic lighting purposes, where 27½ or 30-volt lamps are to be used, a battery consisting of 15 or 16 cells will be sufficient. Where the system is to be one of 110 volts, at least 56 cells should be used. In figuring the number of cells required, divide the voltage of the circuit by 2.05, which is the voltage of each cell when fully charged. A few extra cells are usually required for overcoming the resistance of the circuit.

In thus determining the capacity of a battery cell, the use of 16 c. p. lamps is assumed.

Another point to be considered when determining the capacity of the battery is the convenience with which it may be charged, that is, whether it is to be charged once a day or whether the charge must last a number of days. In any case, the capacity must be calculated in ampere-hours. Naturally, a battery to supply current to a given number of lamps for three nights must have a greater capacity than one which will supply current to the same number of lamps for one night.

If motors, such as used in domestic service, are to be operated from the battery, they must be considered, when determining the capacity. Usually the number of amperes required for driving the motor are stamped on the name plate, and the motor can be considered as so many amperes, or the equivalent of so many lamps. The number of minutes or hours the motor is to be operated should be considered as so many ampere- or lamp-hours.

As an illustration of how one may determine the capacity of a battery for lighting country homes, we would quote from page 14, Bulletin No. 25, written by Mr. T. H. Amrine and published by the University of Illinois:

"Now that we have decided upon the number of lights in each room the next step in the design of our lighting system is to estimate the hours during the day that the lights in each room will be lighted. This will give us an idea of how large our storage battery will have to be to operate the lamps. Of course, the size of the battery will also depend upon how often it is convenient to charge it. Let us assume that we wish our battery to be of sufficient capacity to operate the lights on one charge the entire day when there is the maximum amount of light used. This will be in the winter when the nights are long and when there is some special occasion that keeps the family up later than usual. We will make out a probable lighting schedule for this day. The schedule is given below. In the column to the right are given the lamp hours per day. The lamp hours per day for each room are the number of lights in that room multiplied by the number of hours during the day that they are lighted.

"Dining Room—two lights on during breakfast and supper, 5:00-6:30 a. m.; 5:30-7:00 p. m.	6 lamp-hours
"Living Room—Three lights on only after supper, 7:00-10:30 p. m.	10½ lamp-hours
"Kitchen—Two lights on while preparing dishes morning and evening, 5:00-7:30 a. m.; 5:00-7:30 p. m.	10 lamp-hours
"Front-Hall—One light, 8:00-10:30 p. m.	2½ lamp-hours
"Front Porch—One light, 7:30-9:00 p. m.	1½ lamp-hours
"Rear Hall—One light, 5:00 6:00 a. m.; 6:00-7:30 p. m.	2½ lamp-hours
"Bedrooms—Two lights, 5:00-5:30 a. m.; 9:00-9:30 p. m.; One light, 10:30-11:00 p. m.	2½ lamp hours
	35½ lamp-hours

"This gives a total of 35½ lamp-hours. Hence, we wish a battery that will operate one lamp approximately 36 hours, with one charge."

A complete copy of this report may be obtained from the Experimental Station, University of Illinois.

(To Be Continued.)

Where Electricity Stands in the Practice of Medicine

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

CHAPTER II.—ELECTRICITY IN TUBERCULOSIS.

Never has there been so much attention given to the treatment of tuberculosis as at the present time and the whole world seems aroused to the necessity of combating this disease. It is equally true that never has there been so much done to combat disease in general; not only in seeking methods of cure but also in that other equally important field, searching for means of prevention. In both, electricity has proved a useful and willing ally of the physician.

In treating tuberculosis, the earlier the disease is recognized, the better the chance of cure, so that electricity has proved doubly important because of its diagnostic as well as its therapeutic properties. Tuberculosis frequently may be shown by the X-ray, long before it is recognized by ordinary methods. This does not mean that the X-ray should be used to the exclusion of other means. On the contrary I am distinctly opposed to this. But it should be used in connection with the customary physical and laboratory methods of diagnosis.

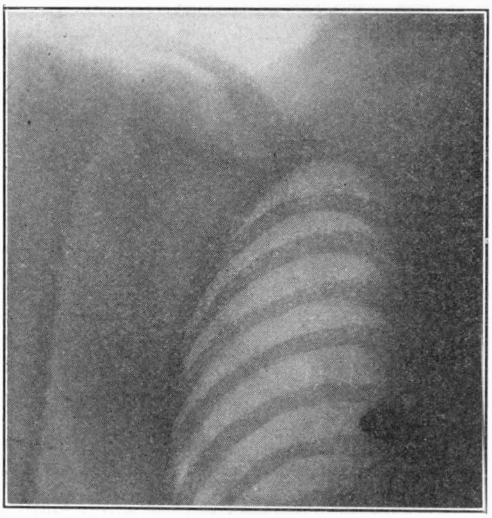


FIG. I. X-RAY SHOWS NORMAL HEALTHY LUNG

You say, What will the X-ray show?

Before answering this question it is necessary for the sake of the lay reader to remember that tuberculosis is not limited to tuberculosis of the lungs or consumption, but that the germs producing this disease attack many other parts of the body, such as glands, kidneys, tendons, bones, peritoneum, skin, etc.

Now, of what use is the X-ray in enabling us to recognize any of these forms?

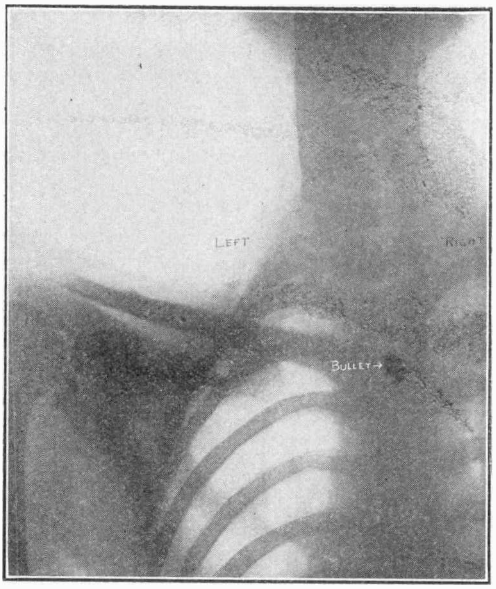


FIG. 2. A HAZINESS IN THE UPPER LUNG CAVITY INDICATES THE FIRST STAGES OF CONSUMPTION

First, let us consider tuberculosis of the lungs and let us remember that the X-ray is a transmitted and not a reflected light and that which we see in the X-ray picture is super-imposed shadows, resulting from the obstruction to the passage of the rays offered by the varying densities of the tissues traversed. Thus it is that we have a marked contrast between bones and the soft parts, but little or none between the structures making up the latter. For this reason some knowledge and experience are necessary in properly interpreting X-ray pictures or plates.

When a fluoroscope is used with the X-ray for the purpose of directly examining any portion of the body, the screen lights up (fluoresces) when the rays strike it, and the shadows which appear on it are the result of the interference with the rays.

When the lung is normal and healthy it offers practically no resistance to the passage of the X-ray, and, therefore, in looking through a person with the fluoroscope it

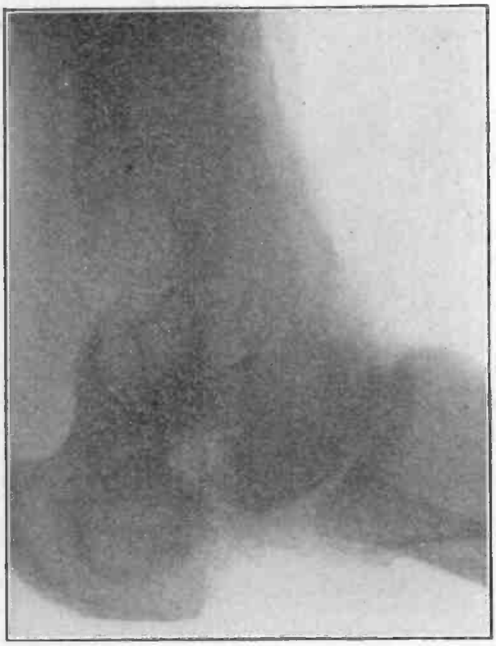


FIG. 3. SHADOWS OF THE BONES INDICATE PRESENCE OF TUBERCULOSIS

appears light and of an even tone between the ribs or shows thus when an X-ray picture is taken. Fig. 1 is an X-ray picture taken for the purpose of locating the bullet shown plainly by the dark spot. This picture shows also a perfectly normal and healthy lung, as indicated by the clearness of the lung cavity.

When the individual takes a full breath the light areas increase and become still lighter.

If a portion of the lung is diseased, it shows a haziness, or a spotted or mottled condition where diseased places offer obstruction to the passage of the rays. Fig. 2, also taken for the location of a bullet, shows on the right side and in the upper part of the left lung cavity a haziness indicating the first stages of consumption.

When the lungs are inflated with air a tuberculous portion will remain the same as before instead of increasing in luminosity as in the healthy lung. Cavities may be shown by the ray, and hardening and calcification of lung tissue. All the findings should be confirmed by physical examination or tuberculin reaction.

In an X-ray picture of a healthy bone the outline is clear, distinct and regular, showing where present, the canal containing the bone marrow and where there are articular cartilages on the ends of the bones they are clearly shown, with well-defined margins. When tuberculosis invades a joint these articular surfaces lose their distinctness and the shadows of the bones tend to fuse with one another as shown in Fig. 3.

Also if the process involves the bone it changes the character of the shadow, and

FIG. 4. X-RAY PICTURE SHOWS THAT THE PERIOSTEUM IS INVOLVED

ordinarily may be recognized. (Fig. 4.) If the covering of the bone (periosteum) is involved the irregularity in the outline is seen plainly.

So much for the use of electricity in recognizing tuberculosis; now of what value is it in treating or preventing this disease?

In tuberculosis of the lungs three forms of electric treatment are of the greatest value, their relative usefulness being in the order named: high frequency currents by auto-condensation, ozone inhalations, and the X-ray.

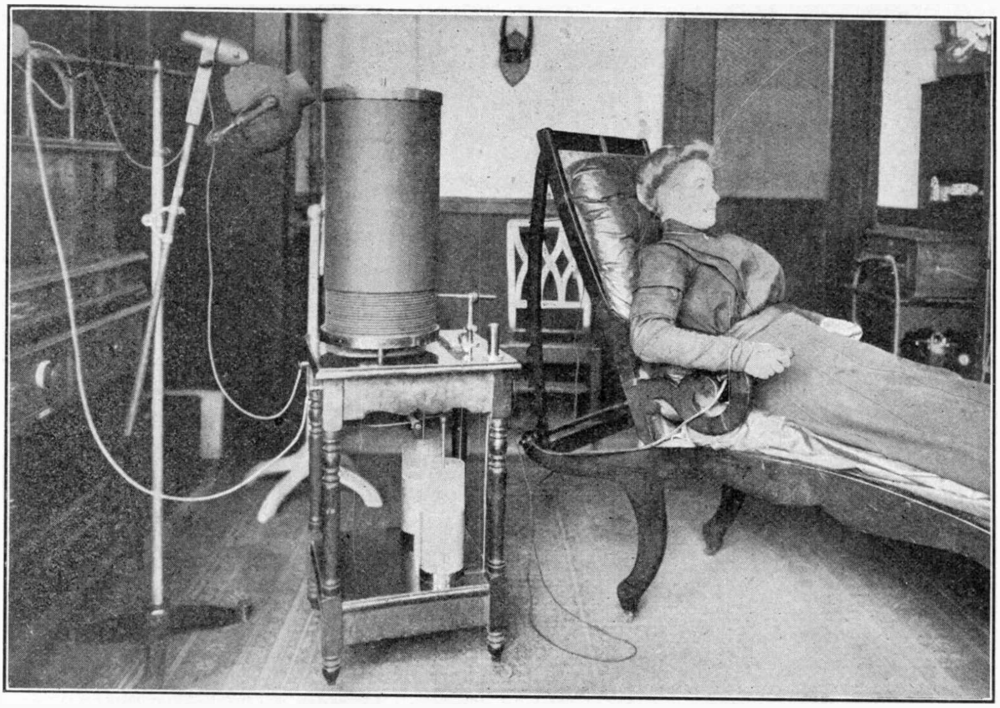


FIG. 5. METHOD OF TREATING BY AUTO-CONDENSATION

Some will not agree with me in this statement, but it is in accordance with my experience, which has been considerable, and there is an old saying that "he knows the water best who has waded through it."

Practically I believe in the suitable combination of all three, and also in the use of all other measures, medicinal, dietetic and hygienic which have been demonstrated of value, and it should be understood that the electro-therapeutic treatment in no wise interferes with other treatments, but gives the sufferer just that much added chance for recovery.

On the other hand the percentage of cures brought about by the three measures named, compares most favorably with that obtained by all other forms of treatment.

By the word "cure" in consumption is meant the arrest of all of the symptoms of the disease and maintenance of this state over a definite period of time. Doctors call this a "symptomatic cure."

In using auto-condensation the patient is placed on the auto-condensation couch or pad, (Fig. 5), holding the handles or electrodes, before the current is turned on, and keeping hold of them until the seance is ended and the current turned off again; thus avoiding all shock.

The average duration of each treatment is ten minutes and ordinarily a daily treatment is indicated, the exception being in cases which are running a high temperature, and the reason is that auto-condensation raises the temperature and in some cases might do so to an alarming extent if care were not exercised. On this account if a patient carries a temperature of 102.5 degrees or over, the first treatment should never be longer than five minutes, and a second treatment should not be given until the reaction from the first has subsided, which often will be about the third day after the preliminary seance.

In this respect (temperature) a similarity will be noted between auto-condensation and tuberculin reactions. After two or three treatments a toleration is established and daily ten-minute treatments may be employed.

Cough, expectoration, and other symptoms are aggravated somewhat during the first three weeks of treatment by auto-condensation, after which noticeable improvement takes place.

In Fig. 5 the method of treating by auto-condensation is illustrated. Beneath the cushions of the couch are plates of zinc, a portion of one showing above the upper cushion in the illustration. The plates are charged with one form of electricity (either positive or negative) while the patient is charged with the opposite kind, through the handles; the cushions preventing the two charges from neutralizing one another.

Thus the patient forms one layer of a condenser and as the charges are rapidly withdrawn and alternated, a nutritional wave or cellular massage takes place, upon which the value of this treatment largely depends.

Ozone may be used by means of the various instruments on the market for use in the physician's office, the inhalations lasting from five to 30 minutes, as tolerated by the patient. One method of office treatment is illustrated in Fig. 6.

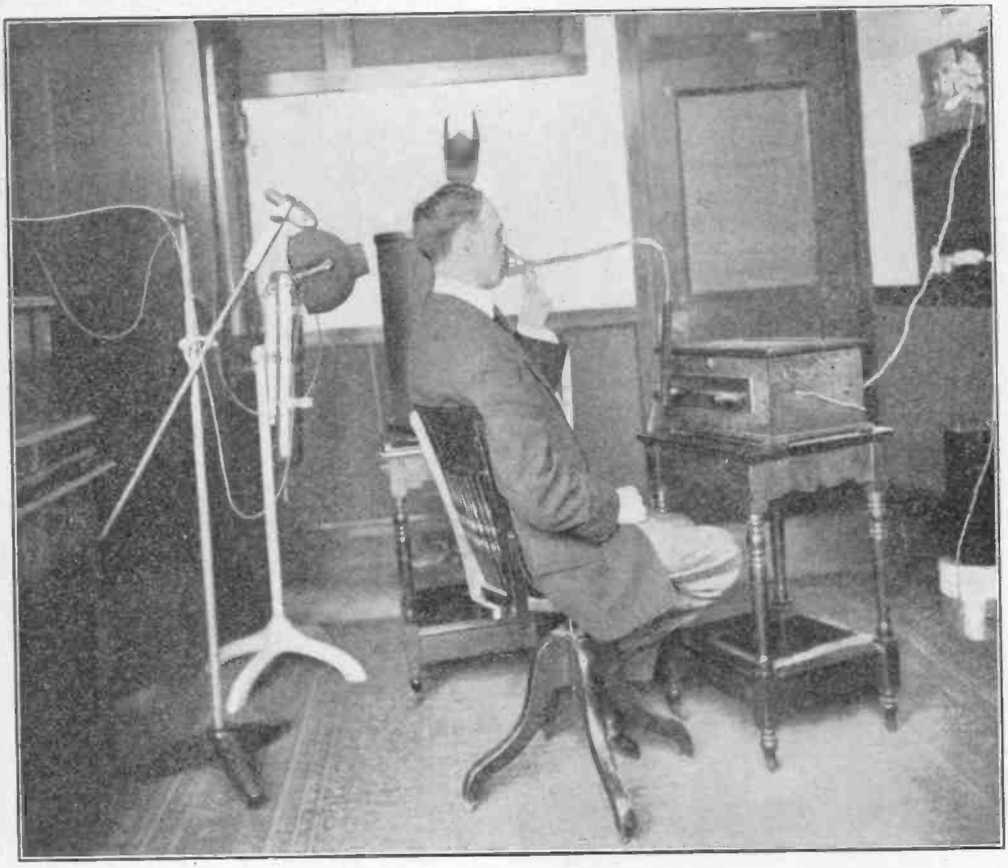


FIG. 6. PATIENT INHALING OZONE

In my opinion a better method is the use of an ozone generator placed in the patient's room and run night and day, thus keeping the air constantly charged with the ozone. A moment's thought will convince anyone that this is much more sensible than crowding in the ozone for a few minutes and then being without it for the remainder of the twenty-four hours, though equally necessary.

Ozone is produced whenever an electric spark passes through the air. At the same time nitric and nitrous oxides are liberated which are entirely unfit for inhalation. With the average machine, air charged with the ozone and the oxides is filtered through essential oils to remove the objectionable gases. I am inclined to believe that the greater part of the ozone is also disposed of by this process.

Theoretically it is possible to get the ozone strong enough to exert some corroding effect upon the red skin (mucous membrane) lining the air passages, but in reality there is no danger with any of the machines that I have investigated.

The ozone also removes offensive odors from the room, being a remarkable disinfectant.

The action of the X-ray upon the tubercle bacillus is first to stimulate its growth but

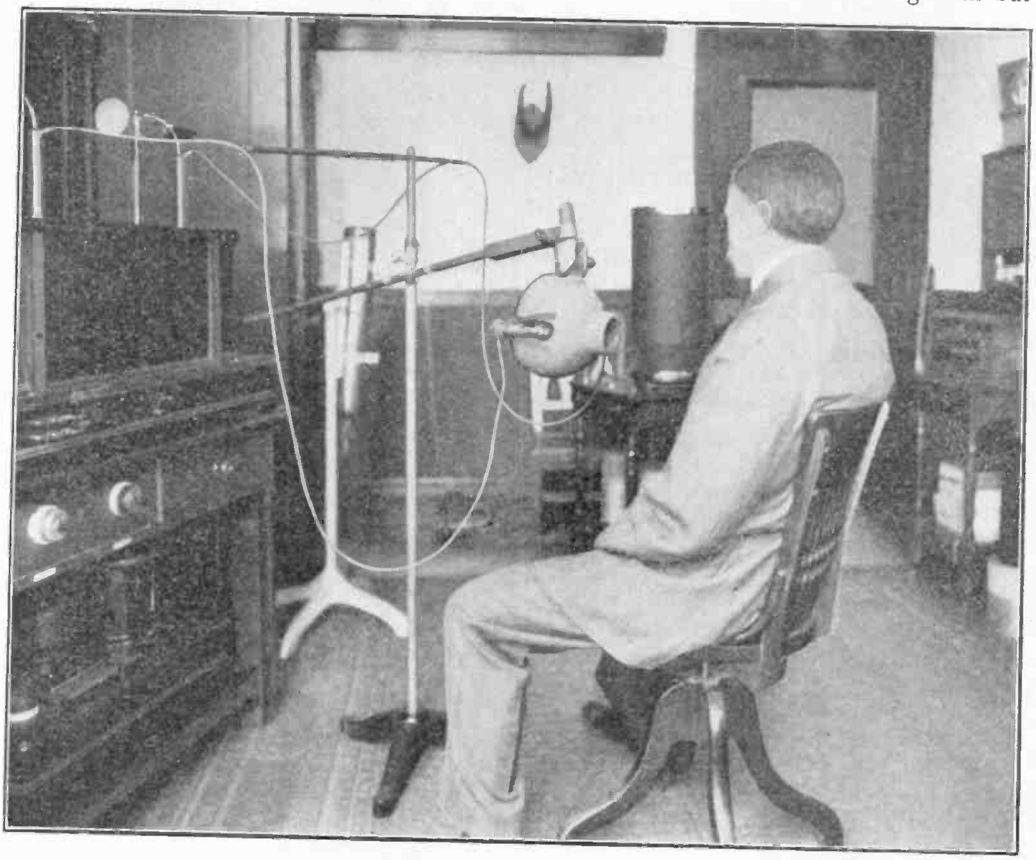


FIG. 7. TREATING A PATIENT WITH X-RAYS

finally to carry this to the point of overstimulation and death as a result of inability on the part of the germs to reproduce themselves. It also calls out from the system its natural anti-toxic or disease-overcoming properties. It is our best electro-therapeutic method for tuberculosis of glands, bones, and all superficial forms, except lupus (tuberculosis of the skin); but in consumption the difficulty of introducing enough of the ray into the lung without first producing a burn on the skin

Where the ozone is made by numerous fine contact points, so little of the nitrous and nitric oxides are produced that no filtration is necessary and this style for ozonizing the air of the room is my choice.

The instrument works directly from the alternating current light plug, and should be placed on a stand near the patient's head, if the latter is confined to the bed. The windows of the room usually should be kept open, top and bottom.

of chest or back has interfered with its more extended use.

In using the X-ray in tuberculosis of the lungs it is customary to expose first the chest and at the next treatment the back of the patient, thus avoiding too frequent exposure of the skin of either chest or back. In the illustration, Fig. 8, the position of the patient sitting in a chair with the X-ray shining on the chest is shown. The tube is enclosed in a protective shield, which only allows the rays to pass out through an opening toward the patient. The rays separate as they emerge, so that they may be considered as possessing the shape of a cone with the base entering the body of the patient. Although the aperture in the shield is small, they diverge sufficiently to include the entire chest at the distance which the tube is placed from the body.

In the illustration the patient is shown with all clothing on and it is my custom only to remove the outer garments, believing that a moderate amount of clothing protects the skin from some of the softer rays, which are those most apt to produce a burn, and at the same time the clothing offers no obstruction to the stronger rays that are required to penetrate to the lung tissues. The average duration of each treatment is from seven to ten minutes and the frequency about three times per week. Where used, as I advise, in connection with auto-condensation and ozone, a five- to eight-minute treatment two or three times a week is ample. The patient may be placed in the recumbent position if preferred, and the clothing removed, protecting the face with lead foil or other shield. Some operators use a thin sheet of aluminum over the chest, or else sole-leather, for the purpose of cutting out the soft or weak rays.

In treating tuberculosis of glands, bone, etc., the tube is brought relatively nearer the area treated than in treating the lungs, and a tube of medium vacuum at about 10 inches is suggested with five- to eight-minute treatments three times a week, protecting neighboring parts with a protective shield, or using a shield on the tube itself. Follow up each X-ray exposure with from three- to five-minute treatments with the spark from the glass vacuum tube attached to the high frequency machine.

In tuberculous peritonitis the high frequency spark is superior to the X-ray, and should be used daily for eight or 10 minutes with two or three five-minute X-ray exposures each week.

Tuberculosis of the skin (lupus) is so extensive a subject that it will be separately considered next month. The result of X-ray treatment in various forms of tuberculosis has been the subject of some investigation, and the following table will give an idea of approximately the percentage of symptomatic cures which may be expected. By using the other measures described in this article in connection with the X-ray, the number of favorable results may be considerably increased.

Tuberculosis of the lungs	25 per cent
Tuberculosis of the glands	60 per cent
Tuberculosis of the joints	40 per cent
Tuberculosis of the long and flat bones	35 per cent
Tuberculosis of the peritoneum	40 per cent
Tuberculosis of the tendon sheaths	70 per cent

In all forms of tuberculosis except where the lungs are involved, a judicious combination of surgery with the X-ray frequently is indicated, and gives better results than either method alone.

GLOSSARY

Articular Cartilages—Cartilages between the articular surfaces of bones.

Bacillus—A rod-shaped germ.

Calcification—The deposit of a lime or chalk in the tissues.

Diagnosis—The art of distinguishing one disease from another.

Diagnostic—Aiding in or pertaining to diagnosis.

Expectoration—Spitting.

Fluoroscope—An instrument used to intercept the X-rays on a screen so that the shadows may be seen by the eye.

Ozone—A form of oxygen liberated by the passage of an electric spark through the air. Its chemical symbol is O_3.

Peritoneum—The sack or membrane lining the abdominal walls.

Peritonitis.—Inflammation of the peritoneum.

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

Tuberculin Reaction—A visible local or general reaction to a product of the germ of tuberculosis.

An Electrical "Violinist"

Musical purists will scoff at the idea that an electro-mechanical device of any description can draw real music from a violin. They will say that the delicacy of touch, the finesse of bowing and above all the feelings of the musician himself can never enter into a production, the interpretation of which is not inspired by the human soul. But comparatively few of us are musical purists, and no one with an ear attuned to musical harmony can listen to a performance of that latest triumph of human ingenuity—the automatic electric violin player—without having aroused in him the feeling that he is hearing and witnessing the supernatural; feelings which might have inspired Poe when he imagined that he heard an orchestra that "played fitfully the music of the spheres." This music which we hear is not produced by human hand but by that subtle force, Electricity, which pervades all the Universe, yet, in spite of the majesty of its power consents to divert an infinitesimal portion of this force to the production of sweetest melody.

The automatic violin and piano or Violano-Virtuosa as it is called is electrical in its operation, the instruments being played separately or in unison as desired. Any full-sized violin of the Stradivarius model may be fitted into the machine and played.

The violin is clamped in a horizontal position as shown in the picture. Directly over the strings are mounted a number of plungers so arranged as to press upon any string on any position, the same as the fingers of a human performer. These plungers are not normally in engagement with the strings but when the right impulse of electric current flows through the little solenoids which operate them they are forced down upon the strings as long as the current flows.

THE VIOLANO-VIRTUOSA

Bowing is done by little disks suspended just above the portion of the strings usually touched by the bow. These disks are constantly revolving, driven by an electric motor. They also are pressed down to engage the strings by electro-magnet devices similar to those which operate the fingers. Lightly or heavily they operate; singly, or in unison for duets, trios and quartettes. This electric instrument will also produce the tremolo, no fingering is too difficult for it and the fast passages can be played faster and more accurately than by a violinist.

At this point you ask "What is the solenoid or electro-magnet like, that moves the fingers and the disks downward?"

A solenoid consists simply of a coil of wire through which current is passed. A strong magnetic field is at once produced within the coil. An iron plunger within the coil will then be sucked up or forced out of the coil, depending upon which way the current is flowing in the latter. By this principle the marvelous effects are produced. Special magnets produce the pizzicato, staccato, legato, bouncing bow, etc. The method of producing the tremelo is novel in that it is brought about by shaking or vibrating the tail-piece of the violin sideways, this as well as all other expression devices being brought about by electro-magnet plungers.

Another question which you will ask is how the current is supplied to the electro-magnets for exactly the right lengths of time. This is accomplished by a perforated paper roll similar to the one in an ordinary pneumatic piano player. The sheet passes constantly over a metallic roll which is always electrically connected to one terminal of all the electro-magnets. The other terminals of these magnets are then connected to as many metallic fingers, which bear upon the upper side of the moving paper strip. This strip, as we have said, is perforated in accordance with the music to be played, and as a consequence the various fingers of the electro-magnet circuits are allowed to come in contact with the metal roller through the perforations and complete the circuits of the individual electro-magnets at the proper time to play a particular note, bow a certain string, vibrate the tail-piece, etc. At the same time other perforations operate similar electro-magnets for the operation of the piano movement.

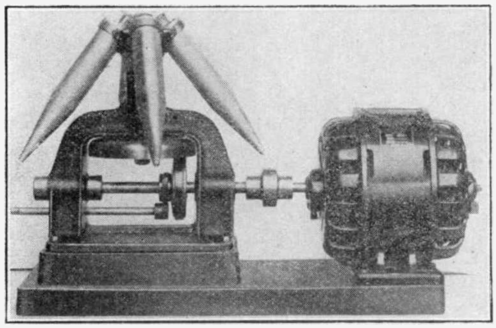
The violin is tuned by pressing a button, this causing the proper note on the piano to be struck; the "A" string on the violin is then tuned to harmonize with this note. The other strings may be tuned by pressing down on the bows and tuning the different keys until the strings exactly harmonize with each other.

A simpler and much easier way of tuning the violin is provided by pushing tuning buttons each arranged to sound two strings in unison and turning the keys until the two strings sound as one note. The violin is never taken out to be tuned, but is tuned in its position while in the machine.

Oil Testing Centrifuge

This odd appearing machine is an electric driven centrifuge for determining the percentage of sediment and water in crude oils. It operates by virtue of the centrifugal force developed by rapidly whirling the torpedo shaped tubes mounted on the machine at the left, and which are rotated by the electric motor shown at the right.

At a velocity of 1,500 revolutions a minute there is an outward pull of 320 pounds,



OIL TESTING CENTRIFUGE

exerted on the contents of each tube; or, in other words, the average apparent difference in specific gravity between the oil and the water it contains is 320 times the actual difference and is about twice this in the point of the tube where most needed. The separation is thus made about 300 times as rapidly as would be the case without rotation, and if the water and sediment were allowed to separate by merely letting the liquid stand.

The glass tubes are arranged so as to be surrounded by water in aluminum shields and this acts as a cushion and reduces the danger of breaking to a miminum. The arrangement provided for transmitting the power permits of gradually increasing the speed from rest to the desired speed, thereby eliminating the slopping of oil out of the tubes, while the power transmission system used permits the motor or shaft to be mounted with the axis in horizontal position.

It may be stated that the weight of tube, shield, water and oil sample, ready for rotation, is one pound and the distance from the axis of rotation to the center of gravity of each tube is five inches. About a one-fourth horsepower motor is required.

The Story of a Newspaper Scoop

At Glasgow, Scotland, in the city hall, Lord Rosebery delivered on a Friday afternoon in September a remarkable speech on matters of supreme importance to the people of Great Britain. He spoke from two to four o'clock continuously. In its own offices in Carmelite House, London—401 miles away—the London *Evening News* reported the speech, printed it verbatim, and had its edition on the street before the speaker had left the Glasgow city hall.

This extraordinary journalistic achievement was accomplished solely by virtue of the powers of the electrophone—a specially constructed and extremely sensitive telephone devised by Giuseppe Angelini, an Italian scientist.

Had the ordinary means of telegraphic transmission been relied upon, it would have been impossible to give more than a summary of Lord Rosebery's eagerly awaited utterances.

But the importance of the promised speech at the existing juncture was such as to lead the *Evening News* to make a special effort to put London in possession of it with the absolute minimum of delay.

The task of organizing and carrying out a scheme such as this was no easy one. In the first place, the work of preparation had to be accomplished at lightning speed. The necessary permission was only obtained at 10:40 p. m. on the previous Wednesday. Two expert electricians went north by the midnight trains, and between 10 a. m. on Thursday and 10 a. m. Friday, the day of the speech, all the arrangements were completed.

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SCENE IN THE "ELECTROPHONE ROOM"

Attached to the rostrum of the Glasgow city hall were the electrophone transmitters, in tiny brass fittings so unobtrusive that it is doubtful whether any of the vast audience noticed them. In the electrophone room at Carmelite House sat twelve shorthand reporters, each with a receiver at his ears.

Connecting these two distant points was a total length of 2,000 miles of telephone wires, weighing 1,600,000 pounds.

Along those thin strands of copper wire came the words of the great statesman. The well-turned phrases dropping from the lips of the speaker were caught up by the little transmitters, and with the incredible speed of electricity flashed into the ears of the waiting stenographers at Carmelite House.

For two minutes the trained pencil sped over the paper. For two minutes only, and then the timekeeper gave the signal and the writer stopped. It was the turn of the second reporter. He, too, accomplished his two-minute task, and so on down the line.

Meanwhile the first experts were transscribing their notes and handing them to sub-editors.

Slip by slip the copy went out to the linotype operators, who rapidly set it up in type, and a few minutes after Lord Rosebery had resumed his seat in the Glasgow City Hall, London was reading the speech; the vast audience 400 miles away had hardly finished applauding.

For the day's unique achievement the telephone trunk lines between Glasgow and London became practically private wires. At the Glasgow postoffice and at St. Martin's-le-Grand the wires were temporarily disconnected from the exchange operating boards, thus connecting Glasgow and Carmelite House direct.

While the speech was being reported, one of the staff of the London *Daily Mail*, the morning edition of the *News*, entered the electrophone room. He was moved to put his impressions into the following form:

"Cardboard labels with the printed word 'Silence' on every door in a certain corridor of the Carmelite House; guards at the top of both stairways leading to the corridor, keeping out all unauthorized persons; office boys and messengers hurrying, but hurrying furtively, treading as though on eggshells; a long row of mats, to deaden sound, leading to a green-curtained doorway.

"What is the meaning of these mysteries; what strange secret is behind that solemn curtain, from the other side of which not even a whisper comes? I—being an authorized and privileged person—am permitted to pass within.

"A dozen or so men are sitting round a long table, down the middle of which runs a baize-covered board. Attached to the board are many wires, which are twisted together above and extend up and out of the room. Each of the men sitting at the table is holding with one hand a telephone receiver of unusual shape, fitted for both ears while with the other hand he writes.

"At one end of the table is a young man with a long bamboo wand. Every now and then he touches, with this wand, the head of one or other of the writers. As far as an outsider can tell, nothing happens when the scribe is tapped with the mystic stick—he keeps on writing, and says not a word. Standing round the table are other men—a few of them holding receivers to their ears, others looking on.

"It is a scene such as would cause a savage to depart hurriedly, howling 'sorcery,' a scene which even a few years ago would have been incomprehensible to any of us; would have savored of unholy magic. But, knowing what it meant, I took one of the receivers and held it to my ears. And then . . .

"I was tempted, myself, to cry that it must be magic, for surely no miracle of Paracelsus, no wonder of Battista della Porta or Cornelius Agrippa, no garden of glamor that Michael Scott created, was ever stranger than this.

"I held the receiver to my ears, and it took me away—took me like the Arabian Night's carpet—from London into a great hall 400 miles distant, where the greatest orator in the United Kingdom was delivering a speech of surpassing importance.

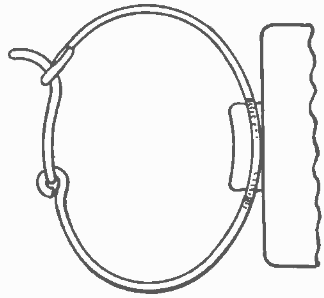
"Every intonation, every inflection, was as plain as if the speaker had been in the same room as myself. I listened, captivated, bewitched. I closed my eyes. Lord Rosebery thumped the table beside which he stood—in Glasgow. I heard him do it. He dropped his voice, raised it—that clear and marvelous voice. He was earnest, scornful, ironic, bitter—in Glasgow. I heard it all. I heard the applause (in Glasgow), the laughter, the 'Hear, hears,' the murmuring. He quoted a number of figures in connection with an assurance company. Every number was heard plainly at this end of the 400-mile-long wires.

"And so, from grave to gay and gay to grave, with its satire and scornful irony, its polished periods, its low-pitched sentences culminating in ringing eloquence, the speech was heard as perfectly here in London as in the Glasgow city hall."

Unusual Applications of Electro-Magnets

For the removal of iron and steel filings, and other magnetic substances from the eyes, the value and method of using the electro-magnet have long been recognized, but the cases under consideration are of rather an extraordinary nature, and show the possibility of adapting the electro-magnet to various other uses.

The first patient had accidentally broken off a sewing needle in the hand, and had failed to remove the broken piece at the time. The wound healed nicely, and no further difficulty was noticed for some months, at the end of which time a sensitiveness and a sharp pricking sensation was frequently felt at about the middle of the fore-arm, which indicated that the needle had traveled up to this point.

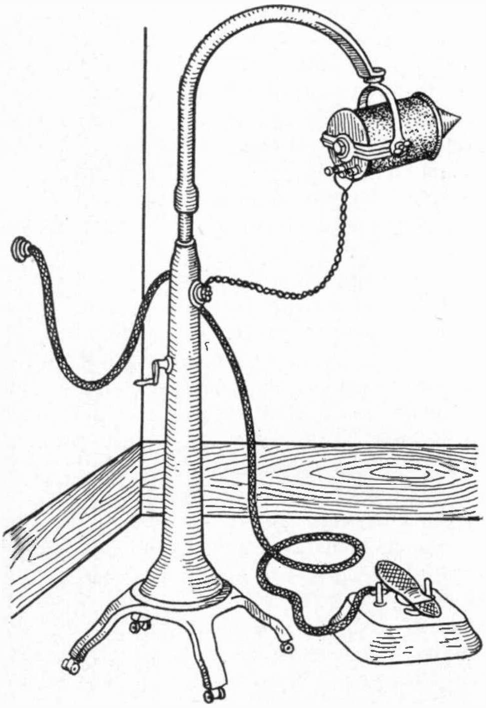


A MAGNET TO BE APPLIED TO THE ARM

It was decided to try the experiment of drawing the needle to the surface by means of a powerful electro-magnet which would save a painful operation and leave no scar. A magnet was constructed of such a shape that it could be applied to the arm by means of straps, and connected to a source of current with a flexible cable. This magnet was applied to the arm and worn continually for several days, with the result that the needle worked itself to the surface, but was unable to perforate the skin. The magnet was removed, and a very slight incision enabled the broken piece to be removed with forceps, and avoided the necessity of a deep incision to extract same.

It was not necessary for the patient to be confined for several days, for this, of course, would have been very monotonous. The magnet was energized by means of a small storage battery, and a flexible cable, connecting the magnet and battery, allowed the patient almost complete freedom of the arm, and the battery was sufficiently light to permit of its being suspended over the shoulder by a small strap.

Another patient had accidentally swallowed a horse-shoe nail, which became lodged in the windpipe, too far down to be reached by external means without great danger of dislodging it and causing it to fall deeper into the passage way. It so happened that a very large medical electro-magnet could be had right away, and use was made of this to withdraw the nail by the following means: The patient was laid in a reclining position with the pole of the magnet close by the mouth, and the current turned on, after which a flexible silver tube



A LARGE MEDICAL MAGNET

was introduced through the patient's mouth and passed down the throat until it came in contact with the nail, which was dislodged by a few careful manipulations of the tube, and as soon as released it immediately jumped up through the tube to the pole of the magnet. This simple operation undoubtedly saved the life of the patient, as it would have been extremely difficult to extract the nail, had it passed down the air-passages below the windpipe.

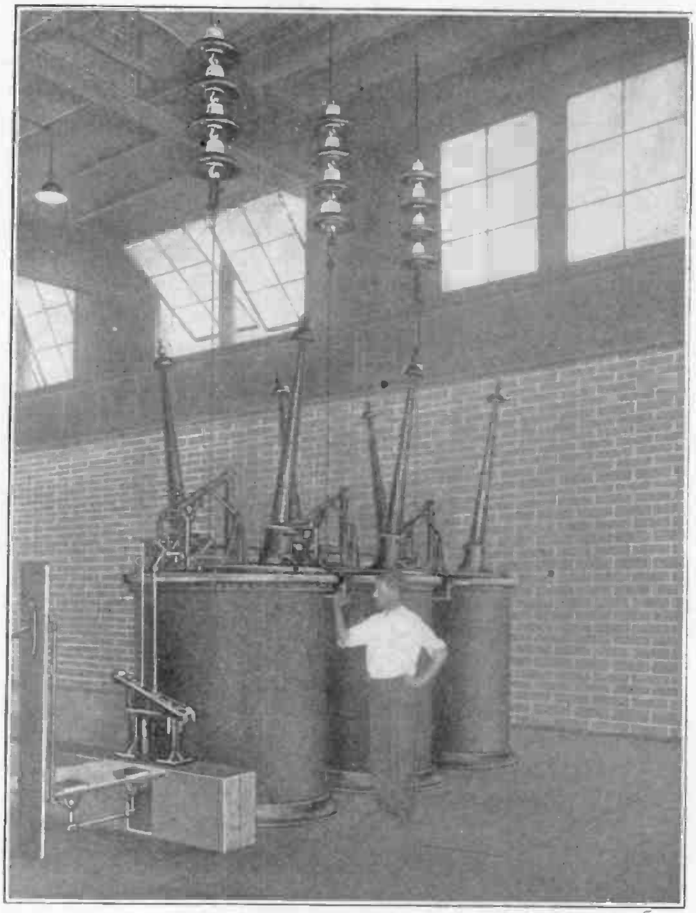
The magnet used in the latter case was of the straight-core type with a conical end, and capable of exerting a pull of 400 pounds on a tip one inch in diameter.

What Happens on a Short-Circuited Line

In any electrical power transmission system there are what you might call three sections or elements: first there are the dynamos which generate the current at a comparatively low voltage or pressure; next to them come the transformers which step this pressure up to enormously high values; finally the transmission wires themselves leading away from the transformers miles and miles across the country. The voltage or pressure which at all times exists between the wires of the line is enormous, although a charge cannot escape from one wire to the next because of the wide air space between them which is almost a perfect insulator.

We say that a charge cannot escape from one wire to the next—by this we mean under normal conditions. But accidents may happen which will allow current to flow from one of the wires to the next of many thousand volts lower potential. For instance, a small boy, or maybe a foolish grown-up person comes along and wants to see some fire-works, so he throws a piece of wire across the transmission wires. Here then is a path of small resistance for the eager current to flow across from one wire to the other, which it does in a flash, forming what we call a short circuit. The wire which caused the trouble does not last for a breath of time. Thousands of horsepower of energy trying to rush across it melt it in an instant, even converting it into metallic vapor. This vapor will also carry current and constitutes what we call an arc—a veritable flaming discharge. Such arcs between the wires have even been known to have been started by owls or hawks trying to fly between the wires and touching the two with their flapping wings.

Now when such an arc or short-circuit is started there is trouble enough in the power station if protective apparatus is not installed. The dynamos, as we have said, supply the line with current in much the same manner that big pumps supply a



CIRCUIT-BREAKERS WHICH ARE THE SAFETY VALVES OF AN ELECTRIC SYSTEM

system of water mains. In a water system if one of the big mains should happen to burst it would correspond to a short circuit in an electrical system, only in the case of the pumps no particular harm would result. The pumps would simply deliver all the water they could into the system and let it go at that.

But a dynamo is constituted differently. If the engine back of it is powerful enough the dynamo will work so hard that it will burn out its own windings in order to pump current through the short-circuit, In fact it would work itself to death, unless, perchance, the transformer should commit suicide first

When a short-circuit occurs, therefore, it is necessary to take the dynamos off the line very quickly so that they cannot do themselves harm—and this is done automatically by what are called circuit-breakers, which are a form of automatic switch to break the connections before harm can result to the generating apparatus.

There are various kinds of circuit-breakers, and of all sizes, from the little ones which occasionally you have seen open with a blinding flash on the front platforms of street cars to the great oil type taller than a man as you may see in the accompanying picture.

These oil circuit-breakers are large oil tanks. One of the line wires enters each tank and is connected to a plunger-like terminal. This terminal normally rests in contact with another terminal near the bottom of the tank. By a gravity operated mechanism these terminals can, however, be separated to a distance of 47 inches. The gravity operated mechanism is released by the tripping of a little catch, the tripping being accomplished automatically by what is called a solenoid and which responds to any undue rise of current in the line such as would be caused by a short circuit.

When a short-circuit occurs somewhere out on the line the circuit-breaker immediately acts and opens the line before harm is done, the opening or breaking being done under oil so that there is no dangerous flash to present a fire hazard.

The circuit-breakers which you see in the picture will open safely a line carrying 110,000 volts pressure. They are used in the service of the Southern Power Company in the vicinity of Charlotte, N. C.

An X-Ray Proof Box

Physicians and others who employ X-rays find at times that their photograph plates have been spoiled without their knowledge, till too late, by the penetrating rays from the apparatus which may reach these plates even though they are stored in another part of the room. Dr. M. H. Farmer sends us the following description of a simple means of protecting the plates when not in use.

"I took a tin can that originally contained Nabisco wafers, which was kindly donated by my grocer. He also gave me a lot of heavy lead foil backed with paper that came around tea cases. The foil in this case was extra heavy and excellent for the purpose.

"I covered the box, lid and all, using a good carpenter's glue. I then made a wooden box large enough to take in the tin box, lining the former also with the lead foil and providing it with a tight fitting foil lined cover.

"With this X-ray proof box I found that plates kept perfectly for six months and they would probably keep much longer if not required for use."

Time Service by Telephone Companies

Selling time service as a by-product is the newest field upon which a telephone company may enter. The furnishing of standard time by the Western Union Telegraph Company for many years has proved such a scheme to be practicable, although the latter company has never extensively pushed the sale of its by-product. That a telephone company might profitably give this kind of service in the homes and business places of its subscribers was the idea of H. C. Todd of Missouri, secretary of the Telephone Association of the "Show-Me" state. Mr. Todd was the manager of a telephone exchange and one of his customers was using an electrical time stamp. The manufacturers of this stamp asked Mr. Todd to return it to them as they wished to replace it with an improved type. But he refused to do this, saying that one of his customers was paying him good money for the service. He said further that, while on the subject, he wished that the manufacturers would send him some time clocks as he thought he could sell time service to some of his business people.

This idea set the manufacturers thinking, with the result that they have originated and developed to a practical stage a complete electrical clock system by means of which any telephone company may furnish standard time over its lines to any of its customers. This system is the product of two years of painstaking research and experiment.

At the subscriber's station is located an imposing clock. In the back of this clock will be found only a ratchet wheel to move the hands and a relay to operate the ratchet. Once every minute the current from the telephone exchange, under the control of a master clock there, moves the hands ahead.

The master clock is controlled and regulated to standard time automatically as in the case of master clocks employed by the Western Union. The master clock does not send the current impulses direct to the subscribers' clocks but to a number of secondary or intermediate clocks. These in their turn operate the subscribers' clocks.

Electrically Heated Oil Tempering Bath

The oil tempering bath is very largely used by manufacturers for the purpose of tempering steel tools or dies. It has been common practice to heat the bath by gas, but as very close regulation of temperature is essential for a uniform quality of product, gas heating has not proved satisfactory. Added to this is the ever present fire hazard due to the excessive heat possible when gas is used.

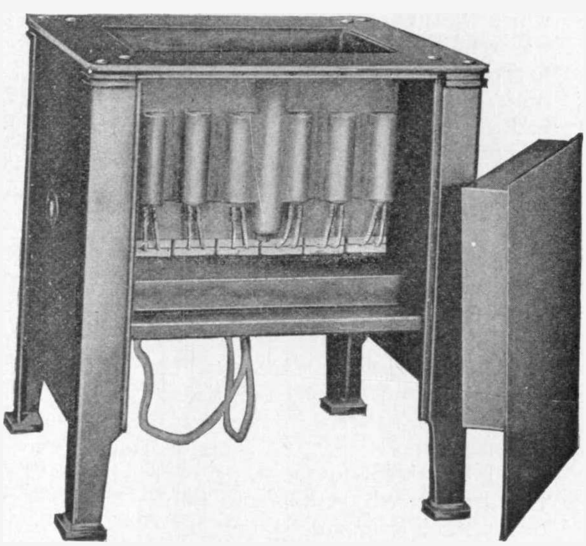
As is often the case, the use of electricity has been advocated as a solution of the problem of proper oil tempering, and there has recently been perfected an electrically heated oil bath which seems to meet all the requirements of such apparatus.

The bath proper consists of a cast iron tank, or pot, having twelve lugs evenly spaced around the sides. These lugs are drilled to receive standard cartridge type electric heating units which embody coils of fine wire which are heated to a high temperature by the passage of electric current through them. Around the pot is placed a heat retaining jacket consisting of an inner and outer wall of sheet metal, the space of three inches between the walls being filled with mineral wool. There is a protected recess in one end of the pot, not shown in the illustration, in which a thermometer can be placed to indicate the temperature of the oil.

There are two methods of using the oil bath. In the first method the temperature of the oil is raised to about 250° F., the work placed in the bath and full heat turned on.

When the oil reaches the desired temperature, the work is removed and the current turned off. This method requires a single heat bath. The second method is to turn on full heat, bring the oil to the desired temperature, then introduce the work, and by means of regulating switches maintain that temperature constant any length of time desired.

Where desired, a cast iron basket or tray is supplied in which the work can be placed. The basket has eye bolts at each end to facilitate handling. The bottom of the basket is perforated with ⅞-inch holes permitting free circulation of the oil. There are also legs provided on the bottom of the basket which keep the work, which is to be tempered, an inch or more above the bottom of the bath.



ELECTRICALLY HEATED TEMPERING BATH

The Search for Submarine Treasures

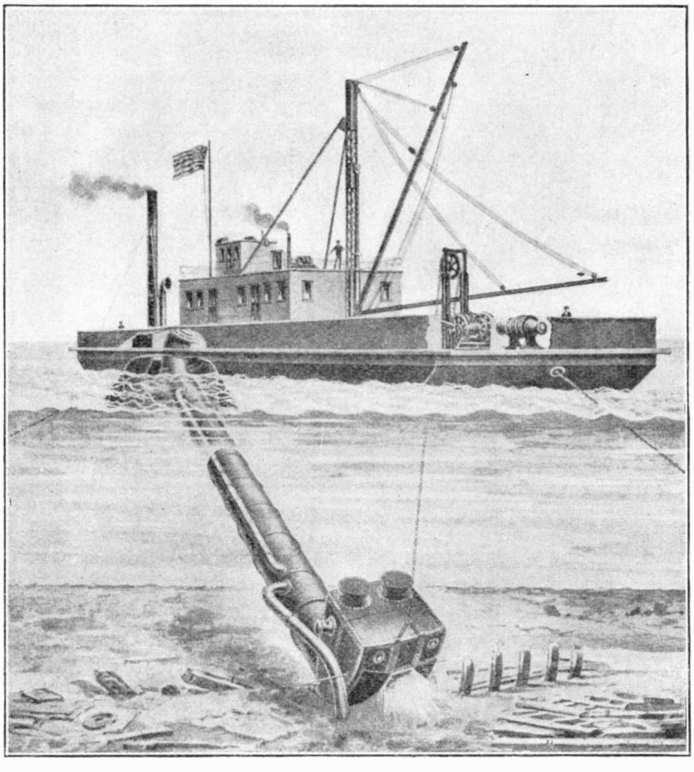
By V. FORBIN

Two years ago, a great deal was said about a submarine engine invented by an Italian engineer, by the aid of which it was going to be easily possible to recover treasures lying at the bottom of the sea in shipwrecked vessels. It appears that the hopes founded on this apparatus have not been realized, inasmuch as Mr. Simon Lake, inventor of the type of submarine that bears his name, has been commissioned to construct an engine intended for the same purpose, for an English salvage company.

We note to begin with, that this company is not engaged in a vain quest, as have been so many other companies which, at various times, have been organized for the exploration at the bottom of the sea, for a Spanish galleon of problematical existence.

On the 9th of October, 1799, the English ship-of-war, Lutine, carrying a treasure of nearly 30 millions of francs in gold and silver bars and in coin, which the London cabinet was sending to Hamburg, to avert a great financial crisis there, and which had been insured for £1,060,000, ran aground in the offing of the entrance to the Zuyder Zee. Under the pressure of France, at that time at war with England, Holland took possession of the precious wreck, and the salvors were set to work. But the encroachment of the sand produced by a tempest, soon forced them to abandon the enterprise.

After the re-establishment of peace in Europe, towards 1820, the King of Holland ceded his rights to the King of England, who transferred them to the Lloyds Company. This company, during the course of the nineteenth century, tried five times to explore the wreck, taking advantage of the calms succeeding violent tempests, during which the sand had been washed away from above the ship. These efforts were not without results, as they permitted the recovery of 198 bars of precious metals and 12,000 pieces of gold and silver, making a total value of more than 2,700,000 francs. Finally, the Lloyds Company entered into a contract with a special maritime salvage company, which company commissioned Mr. Lake to design an engine which would facilitate the thorough and systematic exploration of the wreck. Constructed at Wyvenhoe, England, the machine designed by this eminent engineer, will go at once into service.



SEARCHING FOR SUBMARINE TREASURES

It was, first of all, a question of raising a quantity of sand, estimated at 40,000 tons, accumulated on the wreck and around it, and also to take out the sand from the interior of the hull, after having removed the deck in case it still exists. For this purpose, the inventor has constructed a large pontoon with a flat keel, 41 meters long by 14 meters wide, furnished with powerful electric windlasses and admitting of a kind of well to serve as a protection to the submarine engine that we are about to describe. The engines on board operate two powerful centrifugal pumps, constructed especially to suck up the sand. Two other pumps of less power are connected with the submarine working chamber; these serve more especially for the clearing out of the interior of the wreck, and will be used to good advantage for the protection of the divers against the encroachment of the sand.

These four pumps have a capacity of evacuation, of 40,000 tons per 24 hours of work. Their enormous power will permit of the clearing of the wreck in a few days, and this to take advantage of the summer calms. They will rapidly remove the sands washed up by great storms.

Our illustration shows the method of operation of this submarine apparatus, which is composed of a pipe and of a working chamber. The first, 51 meters long, with a diameter of one meter is made of steel plate; its upper extremity is connected by hinges with the interior of the pontoon. An interior ladder gives the operators access to the working chamber; water-ballasts running the length of the exterior walls, facilitate the plunge.

The working chamber, also constructed of steel plates, is based on the same principle as that of the submarines of the Lake type. Being eight feet in length and width, it allows of two large doors which give passage to the divers, and it can instantly be filled with compressed air. Finally, it is pierced by several light-ports through which the operators can examine the bottom of the sea by powerful electric searchlight reflectors arranged in the interior of the chamber.

This is the way in which the curious engine is managed: If it is a question of working on a wreck the location of which is already known, the surface boat, drawn by a tug, takes its place, and the tube, with its working chamber, is let down by chains in the direction and to the depth desired. On the contrary, if it is necessary to search for the location of a wreck, the submarine chamber, thanks to the action of the water-ballasts, will be kept at the bottom of the sea, in such a way that a wheel, ingeniously fastened below the chamber, comes in contact with the earth. This wheel, provided with great teeth, can bite into the most slippery rocks. It is operated by an electric motor placed in the chamber, and mounted so as to turn in any direction required, like a unicycle, and to pass around rocks and other obstacles. In its action, it carries along, not only the submarine parts of the engine, but also the surface boat. This happy arrangement permits, therefore, of the thorough and methodical exploration of the bed of the sea.

The principle of the mixed submarine of Mr. Lake will be applied later to another use, notably that of the exploitation of pearl-oyster banks. Our illustration shows the engine applied to an operation of this kind. Two dredges, operated mechanically, will be connected with the axis of the chamber by hinge-levers, and the dentated wheel described above will drag the engine (including the surface boat) along the whole length of the bank. The dredges, when filled, will be managed by an interior lever which will make them turn on the axis so as to pour their contents into a car sliding along on rails arranged the length of the tube, and which will bring the oysters to the surface.

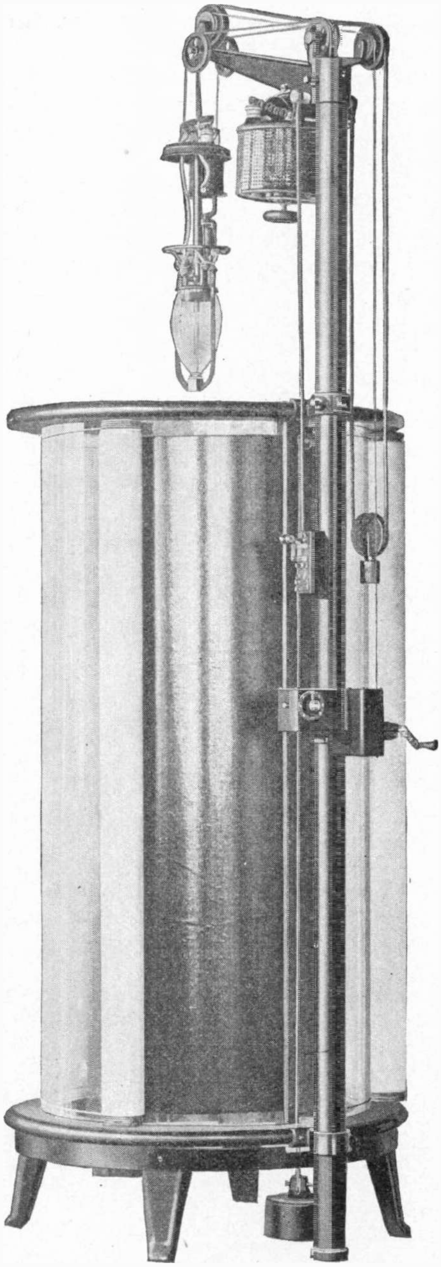
It is expected that this engine will yield excellent returns in the clear waters of Ceylon, and that in one day as many oysters will be harvested as could be brought up by several hundreds of divers; but the recovery of submarine treasures will remain its principal application, and there will be no lack of employment in this direction. The hunters for treasures of this kind have already made out a list of the most famous wrecks.—*Translation for Popular Electricity from La Nature, Paris.*

Making Blue Prints by Arc Lamp

The reproduction of original drawings in the form of blue prints, black, brown and VanDyke prints has become an important subject, and, by the way, quite a problem to the great majority of manufacturing, railroad, construction and engineering companies requiring them. Original drawings, which are usually of considerable value, are now considered a part of the permanent records and as a result are not allowed outside of the drafting room or office of the company owning them, necessitating therefore the production of exact and accurate copies for use in the operating end of the plant, and for mailing, advertising and numberless other purposes. In many cases these copies are required in large quantities and upon a moment's notice, and an efficient apparatus for making them should be provided.

Until quite recently Solar printing, which was accomplished by exposing the tracing and sensitized paper to the sun's rays by means of a frame with a glass top so arranged and located that it could be easily exposed to the sun, was the method in general use. The impracticability of making these frames large enough, the limited capacity of them, unfavorable weather conditions and countless other objections, such as the demand for prints for night working forces, prints in large quantities at reduced cost and uniformly clear and distinct prints at all times, opened a field for he electric blue printing machine which substitutes electric light for sunlight. Such a machine is shown in the picture.

It is composed mainly of a cylinder formed by two half cylinders of bent plate glass held in position by a frame. Each half of this glass cylinder is provided with a curtain, the duty of which is to hold the tracing or drawing and the sensitized paper tight against the glass during the exposure, without slipping and bulging. The arc lamp, which is supported by the crane, travels down centrally through the glass cylinder while making the exposure, its speed at the time being regulated by a suitable governor. The printing process is the same as in photography, the sensitized paper, which afterwards becomes the blue print, taking the place of the photograph printing paper and the tracing from the drawing, made on transparent tracing cloth



ARC LIGHT BLUE PRINTING MACHINE

taking the place of the photograph plate or film.

The arc lamp used for this purpose is especially constructed for blue printing and gives out light rich in actinic or violet rays.

The travel of the lamp through the glass cylinder while an exposure is being made is controlled by an automatic shaft governor.

Resistance, Current and Voltage

There is a popular and deep-rooted notion among some students in electricity that the greater the resistance of a wire, the more current will be required.

This is a fallacy that should be "pulled out by its roots" to prevent further confusion in the minds of the students and also to prevent further dissemination of such a notion.

In order to correct the above fallacy, let us refer to Ohm's Law, which is the most important one in the study of electricity. According to this law, $C=\frac{E}{R}$, that is, the current (measured in amperes), is equal to the electromotive force (measured in volts), divided by the resistance (measured in ohms). If, in this formula, $C=\frac{E}{R}$, we substitute figures in place of letters, and alter the figures in such a way as to still have a correct equation, the fallacy of the above statement will become apparent.

Let us take some figures and form an equation which we know is true, such as $6=\frac{12}{2}$. Here the C is represented by 6, the E by 12 and the R by 2.

Keeping in mind this last equation, $6=\frac{12}{2}$, it will be evident that as soon as we change the denominator (the 2 in this case), we alter the value of the quotient; it will be either increased or decreased. Let us change the 2 to 4, and our fraction now reads, $\frac{12}{4}$. But now the quotient of this number no longer equals 6 but 3. The quotient 3, thus derived, is evidently less than 6. Hence, increasing the denominator of the formula, decreases our quotient. Likewise decreasing our denominator in the formula, $C=\frac{E}{R}$, increases (C), our quotient obtained by dividing E by R. Therefore if the resistance of a wire is increased the less is the quotient or the less the current that will flow through such a wire. This, of course, holds true only when no change is made in the voltage. When the resistance has been increased and it is desired to place the same amount of current in a circuit as it had before, this can be accomplished only by raising the electro-motive force.

To illustrate: Assuming we have a circuit where the electro-motive force is 12 volts and the resistance 2 ohms; the current then would equal, by Ohm's Law, $\frac{12}{2}$ or 6. Now supposing conditions were such that the resistance had been increased to 4; our current then would equal the quotient of $\frac{12}{4}$ or 3, therefore 3 amperes. If the current is to be the same as it was before, i. e., six amperes, the only way this can be accomplished is to raise the voltage; in this case it would have to be a voltage equal to a number, which when divided, by 4 would equal 6; this number evidently is 24, because $\frac{24}{4}=6$.

Therefore, to furnish the same amount of current in a wire, the resistance having been increased, it will be necessary to raise the electro-motive force.

The electro-motive force in such a case must be increased in the same proportion as the resistance is increased. Therefore, the greater the resistance, the greater must be the electro-motive force, if the current (in amperes) is to remain the same as it was before.

S. Nolte, Jr.

Corrections

In the December issue, on page 548, there is a typographical error in the first line of the announcement "In the Beginning," the year 1850 being mentioned, whereas it should have been the year 1880.

On page 487 of the same issue, in Prof. Edwin J. Houston's serial article "Elementary Electricity," the statement is made that the quantity of electricity flowing in a circuit "decreases with a decrease in the resistance." This should have read, "*increases* with a decrease in resistance."

Suggestions Wanted

To the Editor of Popular Electricity:

We are told that the average efficiency of an ordinary steam boiler and engine in output of energy is equivalent to approximately seven per cent of the total heat energy in fuel consumed, and that the maximum result secured under ideal conditions does not exceed 17 per cent. Then a method of generating energy which shall increase the output 100 per cent, or, say, decrease the cost of power by 50 per cent, would mark a revolution in the business of power production all over the world. Granted that such a plan is feasible by the use of more or less well known natural laws, I would like to obtain, through Popular Electricity, the opinion of as many readers as possible, of the best method of setting about to reap the largest financial reward from such a discovery, yet at the same time avoid the disturbance to established industries which might arise from such a proposal.

The argument is, that the means adopted for bringing about such a result may not be patentable and therefore cannot be disclosed prematurely, nor should one nation be placed in a position to take advantage of the discovery ahead of others, but that the method should be on some predetermined date given to the world simultaneously, and controlled by proper interests in each country who would recoup themselves for the cost, and reap a substantial profit besides in the exploitation of the energy throughout the civilized world, thus cheapening production.

I would like your readers to kindly favor me with an expression of opinion on how this should be best attained on the assumption that, that which is referred to is available.

F. P. RONNAN.

[The above may appear like seeking means for disposing of our chickens "before they are hatched." But it will not do any harm to give the subject some thought. Every one laments the fact that under what are ordinarily termed good working conditions 90 per cent or more of the energy in coal is lost and never performs useful work. Bright minds are however constantly at work on the problem and some day a world-startling discovery will be made. How to reap the most substantial profits when the discovery is made is one question.]

Christian Science Healing by Telephone

To the Editor of Popular Electricity:

In an item published in your January issue under the heading, "Christian Science Healing by Telephone," reference is made to what is reported to be the custom of giving "absent treatments" over the telephone between certain points named. Will you permit me to say that no legitimate use of the telephone could be made in such a manner as that described. The telephone is often found to be very convenient for those who feel in need of help and who wish to ask a Christian Science practitioner for treatment. In such instances the patient would merely use the telephone to acquaint the practitioner with his condition, and the practitioner would not be at all likely to do more at the moment than to say a few words of encouragement to the patient and assure him that the treatment would be given immediately or as soon as possible. The mental process known as the treatment would take place entirely within the consciousness of the practitioner and therefore would not be "projected" to the patient over a telephone wire. It is obviously impossible for silent prayer to be conveyed from place to place by wire. So in answer to your question, let me say that it would make no difference whether the telephone connection was "pulled down" or not after the practitioner had received the call for assistance. As you say, the question "is non-electrical," and I have therefore undertaken to answer it briefly from the metaphysical standpoint.

Christ Jesus said, "Ye shall know the truth, and the truth shall make you free." According to Christian Science it is Truth which makes free from bondage to sin and sickness. It need make no difference to the one seeking help from Christian Science whether the liberating truth comes to his thought through conversation, through reading and study, or through what is known as present or absent treatment.

Thanking you for the privilege of making this explanation, I am.

Very truly yours,

GEORGE SHAW COOK.

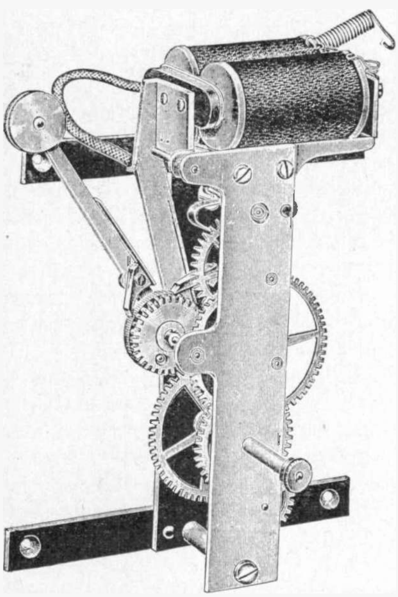
Christian Science Committee on Publication for the State of Illinois.

Boiler Indicating System

An electrical indicating system similar to the hotel and theatre carriage call device is employed in the great power house of the New York Edison Co., for indicating in the boiler room at any moment the number of boilers needed during the next 15 minutes. The system operator stamps the perforating card with the hour and date and places the card in the signaling machine, the corresponding number instantly appears on the board in the boiler room.

Clock That Winds Itself

The cut shows the interior mechanism of a new kind of clock which winds itself by means of two little electromagnets. The clockwork is operated by a weight and this weight is wound up at regular intervals by the electromagnets. The method is exceedingly simple. When it is time to wind, the circuit carrying current from a battery to the coils of the electromagnets is closed by

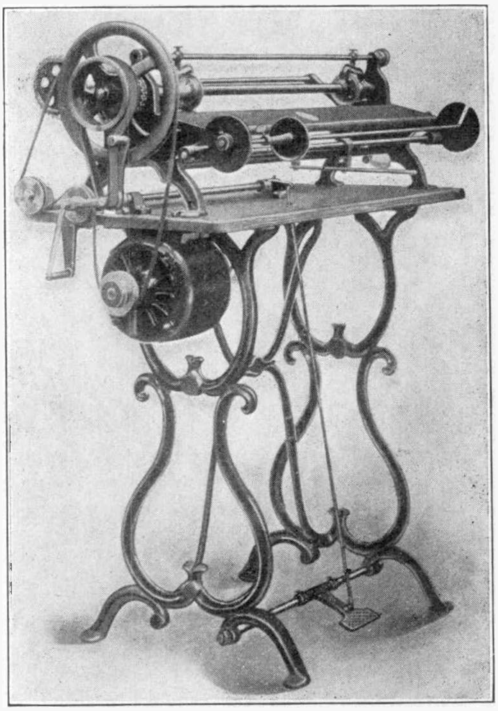


SELF-WINDING CLOCK MOVEMENT

a simple means actuated by the clock work. The electromagnets then begin to operate like the magnets in ordinary induction coils or in a telegraph sounder; drawing down the armature and letting it go again automatically. This movement of the armature to and from the pole pieces of the electromagnets moves a lever which, by a system of pawls and ratchets familiar to mechanics, moves the winding mechanism. The current is automatically shut off by the clock when the proper amount of winding has been done.

Wall Paper Trimmer

Development of a means for further increasing the usefulness of wall paper trimmers has recently been successfully com-



WALL PAPER TRIMMER

pleted by the addition of a small electric motor to drive a modified form of the hand wall paper trimmer. The construction is such that the operator has full control of the machine, being able to start and stop instantly, go slow or fast, and the only effort required being a pressure of the foot.

It will be readily seen that this is a great advantage over the old way of turning the crank, as it gives the operator free use of both hands. While the user can turn out double the work in the same time with the greatest ease, the cost for power is very small, as the motor used is of only $\frac{1}{8}$ horse power.

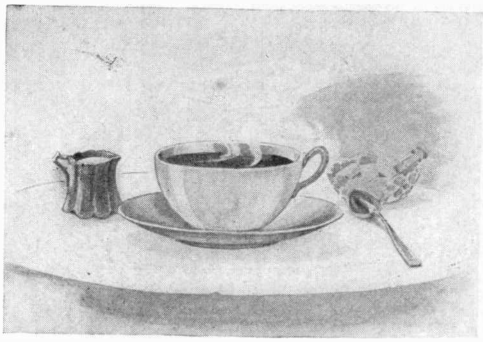
Electricity in the Household

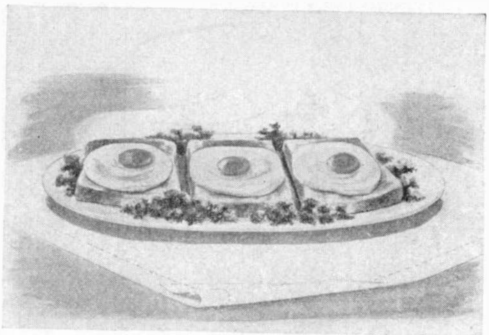
Cooking on the Table

We hear a great deal nowadays about being able to cook a breakfast on the dining room table by the aid of electric cooking utensils. Some few are inclined to think that this is more or less playing at the game of housekeeping. But that it is not is evidenced by the increasing number of electric breakfast table utensils going into the homes.

Is the idea new to you? Have you ever wished for a device to make cooking easier? Your grandmother was satisfied with a fireplace; your mother was delighted with a stove or range; you once thought a gas range to be the acme of perfection. But perfection is never reached and electricity is right now working a change in household methods as radical as did the cook stove and the gas stove in their times.

For instance there is the electric stove and toaster—a table outfit. Think of it! Your optimistic dream is realized. It does any kind of light cooking, toasting and chafing dish work. It will actually boil a full quart of cold water, from the hydrant at this time of year, in 18½ minutes, starting with the stove cold. It will make two slices of toast and fry an egg in 4½ minutes from the time the current is turned on. It may be operated constantly for an hour at a cost of from three to six cents, depending on the heat used and the cost of current.



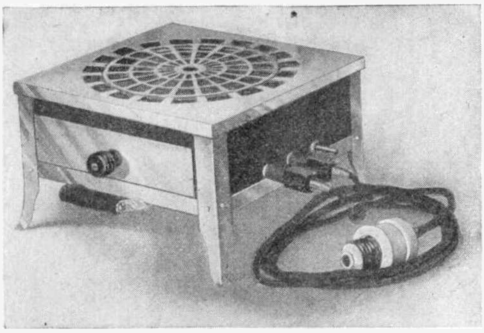


AN APPETIZING BREAKFAST

Toast is made in the little sliding grid. On the top the coffee is made and the eggs fried or any dish whatever kept constantly warm on the table.

Do you enjoy a hot lunch after the theater? Have your friends learned to expect something dainty from the chafing dish when they call upon you? You and they will enjoy these things if the smelly alcohol lamp, which splashes over or goes out at just the critical moment, is discarded and its place taken by the electric stove which can be used in such a variety of ways.

The following dishes are a few of the many which can be prepared on this little table stove without the necessity of starting up the range.

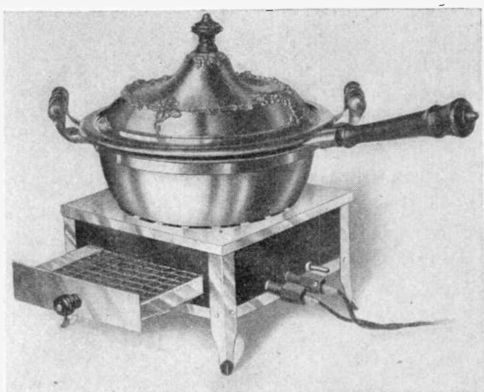


ELECTRIC STOVE AND TOASTER

Lyonnaise Potatoes

One tablespoonful of butter,
One onion chopped fine,
Twelve cold boiled potatoes, cut into dice,
Parsley, salt, pepper.

To the butter and onion add the potatoes and stir quickly for five minutes, using the high heat, taking care they do not stick to the pan; season with salt and pepper, add chopped parsley, drain and serve.



IT IS IDEAL FOR THE CHAFING DISH

Oyster Pan Toast

One dozen large oysters
One tablespoonful of butter
One cup oyster juice
Two slices toast.
Salt, pepper.

Melt the butter and as it creams add oysters and juice. Season with salt and pepper. Cover and cook two minutes. Serve on hot toast, moistened with oyster juice. Use thin slices of stale bread for the toast, toasting it in the stove drawer.

Shrimp Wiggle

One cup shrimps
One cup canned peas
Four tablespoonfuls butter
One and one-half cups milk
Two tablespoonfuls flour
Salt, paprika.

Melt butter and add flour, with salt and paprika, stirring constantly, then pour the milk on gradually as soon as the sauce thickens. Add the shrimps broken in pieces and the peas drained from their liquor.

Golden Buck

Two cups grated cheese.
Salt, paprika.
One cup milk
One-quarter teaspoonful mustard.
Six squares buttered toast
Six poached eggs.

Boil the milk in a granite saucepan; add the cheese, mustard, salt and paprika; stir constantly until the cheese is melted. Have the toast ready (made in the drawer) and pour enough of the cheese over each piece to cover it; place a carefully poached egg on the top of each piece; dust lightly over with pepper and salt and serve immediately.

English Monkey

One cup sotf bread crumbs
One cup milk
One cup grated cheese
One tablespoonful butter
Two eggs
Salt, paprika
Toast or saltines.

Make the toast in the stove drawer while you are preparing the rest. Soak bread crumbs in milk; melt butter and add cheese; when cheese has melted add soaked crumbs. Slightly beat the eggs and add to the cheese mixture. Season, cook three minutes and pour over toast.

OR FOR MAKING THE COFFEE

One Day in the Electric House

Jones was what you might call well-to-do. He wasn't rich by any means, but he owned his home and took pride in it. As a consequence he determined to make it up-to-date by using electric current for household purposes wherever possible, especially as electricity was no longer looked upon as a luxury but a convenience which was at the same time an economy. It is needless to say that Mrs. Jones was heartily in accord with his determination to "modernize." When everything was finally installed and the "push-the-button" regime had begun, a typical day in the Jones' household was something as follows:

A Delightful Breakfast

Jones wanted to get down to the office early that morning so the electric alarm clock "got busy" at the specified time of arising and kept going till Jones turned off the switch. It was one of the first wintry days of late fall, and as he hopped out of bed he snapped the switch of the luminous electric radiator which immediately gave out a comforting heat by which to dress.

The household didn't boast of an early rising janitor and consequently the heating plant in the basement was not up to working pitch so early in the morning and the radiator became almost a necessity to Jones. For the same reason, real good, hot water for shaving was not available at that early hour. But this made no difference for attached to the spigot in the bathroom was an instantaneous electric water heater. After the shave he indulged in an electrical massage, congratulating himself meanwhile that he could indulge in this 25-cent luxury every morning without raising his current bill more than a few cents in a whole month.

Having shaved and dressed he repaired to the dining room, without delay, for since the advent of electricity it was not necessary to rout the whole family out at an early hour for a "regular" breakfast. On the dining room table stood the coffee percolator, an electric frying pan and a bread toaster, the electrical connections already made to the sockets of the electrolier above the table. Snap, snap, snap—the three switches were turned in a jiffy and the water almost immediately began to bubble in the percolator.

The cook had left some slices of bread, a few strips of bacon and a couple of eggs on the table the night before and had also "loaded" the percolator. It was only a few minutes before he had turned these materials into an appetizing breakfast. Did it taste good to him? Of course it did. He made it himself, didn't he?

Glancing up at the electric clock he saw that he had plenty of time to make his train, so he passed leisurely through the hall, not forgetting to light his cigar at the electric lighter which hung conveniently near the door.

Only one incident occurred to mar his "get-away." He inadvertently stepped on the electric burglar alarm matting without first disconnecting the circuit for the day, and set bells ringing in different parts of the house. But as he said to himself, it was time somebody else was up besides himself anyway.

Jones had no more than left the house before Sarah the cook was busy in her electrical domain. Sarah, by the way, had been with the family ever since the electric "fixings" as she called them, had been put in, and in all that time there had been no indications of an uprising. Her kitchen was a model of simplicity, compactness and neatness. There was the electric range with a full complement of utensils from cereal cooker to oven, each responsive to the turn of a switch. In addition there were an egg beater, meat chopper, coffee grinder, potato parer, ice cream freezer, cream whipper and other "tools of the trade," al mounted on a circular table and arranged to be driven by a single motor at a moment's notice. She also had an electric refrigerator which would keep the meat and vegetables cool and at the same time make 10 or 15 pounds of pure ice in a day for the family consumption.

In the meantime, Marie, the maid, who was the only other servant, had been through the downstairs rooms with the electric vacuum cleaner and the rugs and curtains were clean and fresh as the day they were bought.

After she had arisen, Mrs. Jones' first care was the baby's bath, and she called Marie over the house telephone to come and prepare for this delightful function which

This Delightful Function

took place beside the electric radiator in a tub of electrically heated and sterilized water.

Breakfast over and the children off to school, Mrs. Jones did some sewing which to her seemed more of a diversion than real work because the machine was operated by a motor and there was no exhausting pedaling to do.

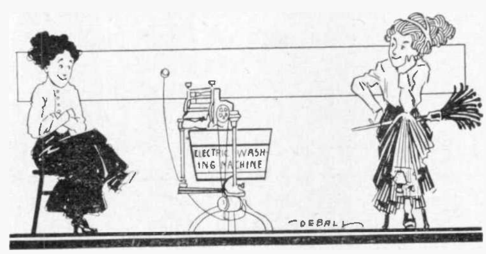
Lunch was a function which the children enjoyed, because mother always cooked it

Marie Dried Her Hair With an Electric Blower

for them herself, "Without fire," as they expressed it.

In the afternoon Mrs. Jones was due to appear at a reception. Marie shampooed her hair and dried it with an electric blower, which sent a blast of either hot or cold air through the golden fluff. Then she perfumed it with an electrical atomizer, curled it with the electric tongs and finally did some expert work with the electric vibrator. An electric hat cleaner renewed the latest millinery creation and a vacuum brush removed the last speck of dust from her gown.

During the afternoon there was little for the two servants to do, as electricity had done away with most of the cumbersome tasks. The day before they had between them done the laundry work, which couldn't be called much of a task because of the electric washing machine and wringer and the mangle which ironed most of the coarse work.



Between Them They Did the Laundry Work

But this afternoon they ironed out the fine work with the electric iron to fill in the time.

Father and Mother were both going to the theatre that evening, but this did not prevent them from spending their usual half hour with the children in the electric nursery at the top of the house, where Willie ran his electric trains and Elsie lighted up her doll house with electricity, to her mother's never failing astonishment and delight.

After the theatre these two had a habit of dining in Jones' den instead of at a restaurant. He produced his electric chafing dish and connected it by a cord and plug to the sockets in the baseboard of the room. Then he produced the elements for his Chef-d'œuvre and chicken a la King on toast, the latter made on his private electric toaster. The coffee was made in his copper percolator.

When it was time to retire Mrs. Jones turned the current into the electric heating pad and slipped it into the baby's bed, first being careful to adjust the thermostat so that the pad would develop a mild, even heat all night long; and Jones set the burglar alarm.

So ended the day in the electric house.

An Electrical Laboratory for Twenty-Five Dollars

By DAVID P. MORRISON

PART II.

There is one other form of cell I shall describe on account of its wide range of use. This is the dry cell. A dry cell can be made almost any size you desire, the voltage remaining the same, however, but the capacity of the cell for producing current increasing with increase of size. The dry cell is really nothing more than a modified form of what is termed a Leclanche, it being a liquid cell. The elements of the Leclanche cell are zinc and carbon while the liquid is sal ammoniac. To construct a dry cell that is equivalent to a one-quart Leclanche you will proceed as follows: Secure a piece of sheet zinc say No. 22 gauge about $6\frac{1}{2}$ by 7 inches and a small piece about $2\frac{1}{2}$ by $2\frac{1}{2}$ inches. Form the large piece into a cylinder seven inches long having first turned the edges about $\frac{1}{8}$ of an inch so that they may be hooked together, forming a lap seam. Pound this seam down by placing the cylinder on a rod of iron or piece of pipe. Next mark out a circle two inches across, by means of a compass on the smaller piece and cut it out, this is to form the bottom. It might be well for you to cut this a little larger and trim it down to the size of the cylinder afterwards. Now solder in the bottom and also the seam which makes a water tight cup. Next solder a piece of copper wire to the upper edge of the cup which will form the negative terminal of the cell. In soldering the zinc you should use hydrochloric acid as a flux, applying it to parts to be soldered after they have been thoroughly cleansed. After soldering, all parts should be thoroughly washed to remove any trace of the acid as it eats away the zinc.

The carbon element may be made from a square or round piece of carbon eight inches long and not more than three-quarters of a square inch in cross section. A bare copper wire may be wrapped around the upper end of the carbon element to serve as the positive terminal of cell. This method of connecting the wire may be improved upon in the following way: File the upper end of the carbon until it has the

FIG. 12. FILE THE END OF THE CARBON THUS

form shown in Fig. 12. Then wrap a thin piece of pasteboard tightly around the body of the carbon several times, allowing it to project about an inch above the end just filed and tie it firmly in place. Now take the end of a piece of No. 16 copper wire and wind it around the end of the carbon rod. Then melt a small quantity of lead and pour it into a mold formed by pasteboard. When lead cools it will contract and grip the carbon very firmly, thus making a good connection. The cell is now ready for the electrolyte which in this case will be in the form of a paste.

Two methods will be described for making the paste, and you can use either or both just as you wish. First mix about one-half pound of manganese dioxide and one halt pound of powdered carbon or graphite; after these dry powders are thoroughly mixed then pour in a saturated solution of sal-ammoniac and thoroughly mix, adding only enough solution to make a paste about like soft putty. The saturated solution is made by dissolving the sal-ammoniac in water until some of the sal-ammoniac remains in the bottom of the vessel. Cut from a heavy piece of cardboard a disk that will just fit into the bottom of the zinc cup. Soak this disk in hot paraffin and push it down against the bottom of the cup. Now secure a piece of pipe or round piece of wood about 1¾ inches outside diameter and 12 inches long; stand it up in the center of the cup, the end resting squarely on the bottom of the cardboard. Make a mixture of about ten ounces of plaster of paris and one ounce of common flour, or in this proportion, and add some of the saturated solution of sal-ammoniac until the mixture can be easily poured. Now hold the pipe or stick firmly against the bottom of the cup with one hand and pour in around it the plaster of paris mixture to within about ½ inch of the top of the cup. This mixture will harden quickly and you can remove the pipe or piece of wood by watching the mixture carefully and removing the core when the mixture will just hold itself together. You must use some care in doing this for if you wait too long the plaster will be so hard you cannot remove the core. If, on the other hand, you try to remove the core too soon the plaster will not remain in place at the side but run down into the bottom of the cup. Let the plaster dry for at least an hour, in order that it may thoroughly harden, before proceeding.

Place your carbon element in the center of the opening in the plaster of Paris and pack tightly around it the first mixture you made, up to the same height as the plaster of paris. You must be careful in packing the putty in place not to force the carbon rod out of the center of the opening or to break it. A short piece of ⅜ inch iron rod will be a great help in tamping the putty down. Tamp the putty slowly and evenly all around the carbon rod and you will in that way prevent breaking or moving it from place. Your battery is now complete with the exception of sealing it, which can be done by melting some sealing wax or pitch and pouring it into the top of the cup, filling the same to its upper edge.

Another method that is sometimes used is as follows: Make a canvas bag of such a size that when filled and placed in the zinc cup there will be a space of something like ¼ inch all around between bag and cup. Place your carbon element inside of this bag and pack in around it sufficient paste to fill it up to a distance of six inches. The neck of the bag should then be tightly tied around the carbon rod. Care must be used in tamping the paste into place to keep the carbon rod always in the center of the bag.

The paste used in filling this bag can be made as follows or in this proportion.

Powdered graphite or carbon	5 parts
Powdered manganese dioxide	5 parts
Sal-ammoniac	1 part
Chloride zinc	1 part
Glycerine	1 part

Dissolve the sal-ammoniac and zinc chloride in a little water and add the glycerine. After having thoroughly mixed the carbon and manganese add the above solution making a paste like soft putty. If there is not sufficient solution add a little water.

Place the filled bag into the zinc cup and fill the surrounding space with the following flour paste or in that proportion. Mix one teaspoonful of flour, ¼ oz. zinc chloride, ½ oz. of glycerine, ½ oz. of sal-ammoniac and 4 oz. of water. It might be well to bring this mixture to a boil and avoid any lumpiness. Pour this paste into the cup, keeping the bag standing in a perfectly upright position in the center until the paste has set, filling it to within ½ inch of the top. Your cell is now complete and may be sealed as in the previous case.

HOW TO USE POWER FROM THE LIGHTING CIRCUIT

The various cells described will be useful in supplying limited amounts of electrical current but where the demand is rather large you must resort to some other source of supply. If you have the good fortune to have at your disposal a power or lighting circuit from which you can obtain electrical current you will no longer be limited in your experiments for want of sufficient supply. This supply may be either alternating or direct current. The difference between the two was explained in first article of this series. If it is direct current the pressure between the wires will usually be 110 or 220 volts. This pressure will be, in the majority of cases, entirely too high for your use and means must be provided for reducing it to the desired value. As an example, suppose you want to operate a 10 volt lamp and it takes a current of ½ ampere when this voltage is impressed. If the voltage of the circuit to which you want to connect your lamp is say 110 volts, then some device must be connected in circuit so as to adjust the voltage upon the lamp to the proper value. Such a device is called a rheostat. Since there is to be only ten volts impressed upon the lamp and there is a total of 110 volts available there must be 100 volts pressure between the terminals of the rheostat, it being in series with lamp. The rheostat will carry the same current as the lamp which in this case is ½ ampere. By applying Ohm's Law to that part of the circuit corresponding to the rheostat you can determine the value of the resistance that must be in the rheostat to meet the above requirements.

$$\text{Resistance} = \frac{\text{Pressure}}{\text{Current}}$$

$$200 = \frac{100}{\frac{1}{2}}$$

Hence there must be a resistance of 200 ohms in the rheostat. In a similar manner the resistance of any rheostat can be determined if the current it is to carry and the difference in pressure that is to exist between its terminals are known. The construction of the rheostat will be taken up shortly.

When the source of supply is alternating current you can still use a rheostat in series with the apparatus that you desire to pass a current through; but in this case you cannot use Ohm's Law to calculate the resistance of the rheostat as it holds for direct current only. You will have to determine the value of the resistance by experiment, as the quantities involved in calculating its value are too numerous and complicated to allow an explanation at the present time.

The majority of your experiments will require a direct current and if you have only alternating current available some means must be provided for changing it to direct current. There are a number of means that may be employed in accomplishing this. An alternating current motor may be driven by the alternating current and either belted or direct connected to a direct current generator or dynamo. Direct current can then be drawn from this generator of any desired value up to the ultimate capacity of the generator or motor. Such an arrangement is called a motor-generator set. When the two machines are combined and constructed as a single machine it is called a rotary converter. Such a machine may be used in changing direct current to alternating current, but it is usually beyond the scope of the amateur to build one. Likewise with the mercury arc rectifier which has been developed within the last few years. It fulfills the above requirement very well and at a high efficiency, but it is out of the question for you to try to construct one. So you must resort to some form of electrolytic rectifier.

ELECTROLYTIC RECTIFIER

The efficiency of the electrolytic rectifier is low at best compared to that of the motor-generator, rotary converter and mercury arc rectifier, but the simplicity of its construction leads to the selection of this particular type to be described in this article.

The action of the rectifier in the electrical circuit is the same as that of a check valve in a water pipe. It will allow the passage of current in one direction without offering very much resistance; but will offer a great resistance where the current tends to flow in the opposite direction. This being the case one-half of the loops shown in Fig. 5 (Part I) will be reduced to practically nothing on account of the resistance of the rectifier. With such a device the current will flow in

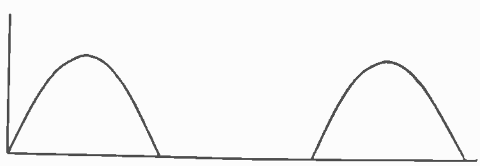


FIG. 13. CURRENT WOULD FLOW ONLY HALF THE TIME

the circuit only half the time and would be represented by curve shown in Fig. 13. This would be an undesirable condition to have; but fortunately it can be overcome by making use of four valves and arranging them as shown in Fig. 14.

The small arrow in each circle indicates the direction in which the current will meet with least resistance in passing through that particular valve or cell. If there is an alternating pressure applied to the terminals marked (A C) it will tend to produce an alternating current through the circuit composed of four cells. Suppose the pressure is acting toward the right in the upper wire of (A C). The greater portion of the current will flow through the circuit of least resistance, which in this case is through cell

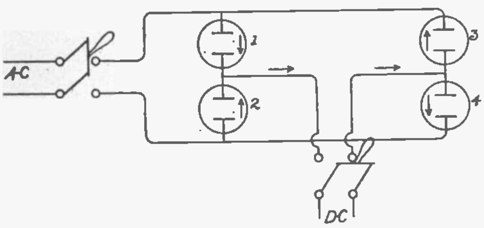


FIG. 14. RECTIFIER ARRANGED WITH FOUR VALVES

(1) to (D C) and through cell (4) back to the lower wire of (A C). Next suppose the pressure is acting towards the right in lower wire of (A C). Then the greater portion of the current will flow through cell (2), to (D C) and through cell (3) back to the upper side of (A C). In both cases the current in flowing through the (D C) leads in the same direction. This current is constant in direction but not constant in value. It is really an alternating current with one-half of the loops reversed in direction giving a pulsating current as shown in Fig. 4, (Part I). It can be used in charging storage batteries and in practically every case where a perfectly steady current is not required.

Each of the cells consists of an aluminium plate and a conducting plate, such as carbon, lead, iron, etc., or any metal that is not acted upon by the solution into which they are immersed. The solution that the plates are immersed in is called the electrolyte. This electrolyte is capable of acting upon the aluminium in a very peculiar manner, when a current is passed through the cell from an external source. When the current flows from the conducting plate to the aluminium there is very little resistance offered to its passage through the cell; the only resistance being that of the electrolyte. If, however, an attempt is made to send the current through the cell in such a direction that it must flow from the aluminium plate to the conducting plate, there will be a great resistance offered by the cell to its passage and practically no current will flow in the circuit. This action is accounted for by the fact that a very thin coating of oxide forms on the surface of the aluminium plate. Cells possessing this property are called asymmetric cells.

The following instructions show how to construct an electrolytic rectifier that will deliver a direct current of three to six amperes at a pressure of 15 to 25 volts. The alternating pressure need never be more than 30 volts, hence means must be provided for reducing line voltage to desired value. In this case you can use either a rheostat or a transformer in regulating the voltage impressed upon the alternating current (A C) terminals of the rectifier. The transformer is much more efficient than the rheostat and its construction and operation will be taken

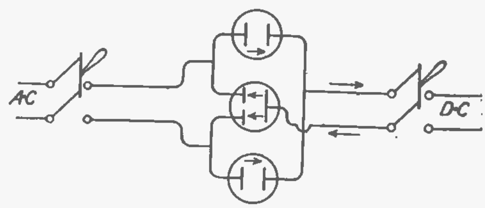


FIG. 15. RECTIFIER ARRANGED WITH THREE VALVES

up shortly. The number of separate cells required to complete the rectifier as shown in Fig. 14 is four. This arrangement would require four containing vessels which can be reduced to three, however, by arrangement shown in Fig. 15. The middle jar in this case contains really two cells. The path of the least resistance to current flow is indicated by the arrows.

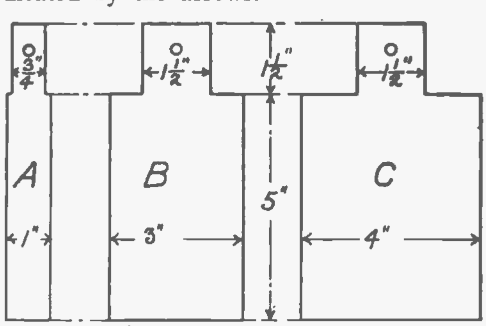


FIG. 16. DIMENSIONS OF CARBON AND ALUMINUM PLATES

You will want three jars of approximately the following dimensions, 6 by 4½ by 3 inches. If you can not secure jars of this kind three ordinary battery jars, such as are used for the "crow foot" battery will serve very well.

Cut out of some $\frac{1}{8}$ inch sheet aluminium four pieces of dimensions given in Fig. 16 (A). The material to be used as the conducting plate in this case will be carbon. The carbon plates should be cut from some $\frac{1}{4}$ inch carbon which can be done by means of a hack saw. There should be two pieces corresponding to dimensions of (B) and one piece corresponding to dimensions (C). The two smaller pieces are to be used in the outside cells while the larger one is for the center cell. Both the aluminium and carbon plates should have holes in their upper ends to be used in fastening binding posts to them by means of screws. After the binding posts are fastened, dip the upper end of all plates in melted paraffin, which will prevent the salts from creeping. It might be well to dip the upper edge of the jars in the paraffin.

The top of each cell can be cut from some $\frac{1}{2}$ inch seasoned wood and should be of such a size as practically to cover the top of the jar as it will prevent impurities falling into the cell and the solution from evaporating. Openings should be cut in each top to allow the upper ends of the aluminium and carbon plates to project through. These openings should be such a distance apart that the two elements when fastened in them will be parallel and $\frac{1}{2}$ an inch apart.

The efficiency of the electrolytic rectifier decreases very rapidly as the temperature rises. Since there will be quite a temperature rise if the rectifier is used for any length of time, means must be provided for keeping its temperature as low as possible. This can be accomplished by passing cold water through some glass tubing placed in the electrolyte. Secure some $\frac{3}{8}$ inch glass tubing and bend it into the form shown in Fig. 17. Place two of these worms in each cell and connect them all in series by means of a short piece of rubber tubing. The rubber tubing must be securely wired to the ends of the glass tubing. Arrange connections so that cold water will first enter the middle cell since this cell will carry double current.

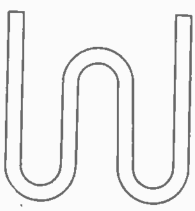


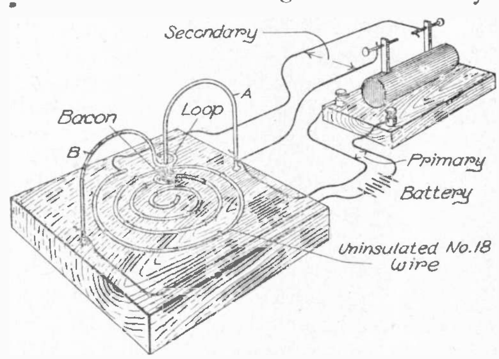
FIG. 17. GLASS TUBE COOLER

The electrolyte to be used is acidulated sodium phosphate. A saturated solution of the phosphate is prepared and the jars filled, with plates and cooling worms in place, to within one inch of the top. The rectifier cannot be started however until some means is provided for adjusting the alternating current voltage, to be impressed upon its terminals. Assuming we have such a device and the (A. C.) voltage can be maintained at a value of 30 volts, add sulphuric acid to each cell until the ammeter in the direct current circuit reads five amperes on full load. (An ammeter will be described later.) Acid should be added to each cell in proportion to the amount of sodium phosphate solution it contains. The rectifier will operate much better if it is allowed to run under full load for two or three hours as the aluminium plates have to be formed.

[NOTE: Part III will take up the construction of an alternating current transformer.]

Electric Mouse Trap

I believe the readers of the Junior Section will be interested to know how I constructed an electrical mouse trap. The store where I worked was over-run with the little pests and I have been able to get rid of them by



ELECTRIC MOUSE TRAP

using the trap described in the following paragraphs.

I took a piece of board about five inches square and one inch thick and upon the upper surface fastened a spiral of uninsulated copper wire, No. 18, making the spiral about four inches in diameter and the turns of wire about $\frac{1}{8}$ inch apart.

I also have a one-half inch spark coil such as is used in wireless telegraphy, and which as you know gives a very high voltage across the secondary. One of the secondary terminals of this coil I connected with the wire spiral. The other I connected to a wire (A) which was bent up and over in a curve so that its point came down in the center of the spiral but not touching the latter and ending about one-half an inch above the board. A similar bend of wire (B) was also mounted on the board and terminated in a little loop surrounding the end of (A) as shown in the cut. On the end of (A) I stuck a piece of bacon.

The wire (B) was connected through the battery to one of the primary terminals of the spark coil. The other primary terminal was connected to (A).

Now the mouse comes along to eat the bacon. To do this he must necessarily stand on some of the wires of the spiral. As he nibbles at the bacon he moves it around till the loop of (B) touches (A). This closes the primary circuit of the spark coil as you will see. Then a high voltage is developed across the secondary terminals. Of these secondary terminals the mouse has one (A), in his mouth and is standing on the other [the spiral]; the result is a dead mouse.

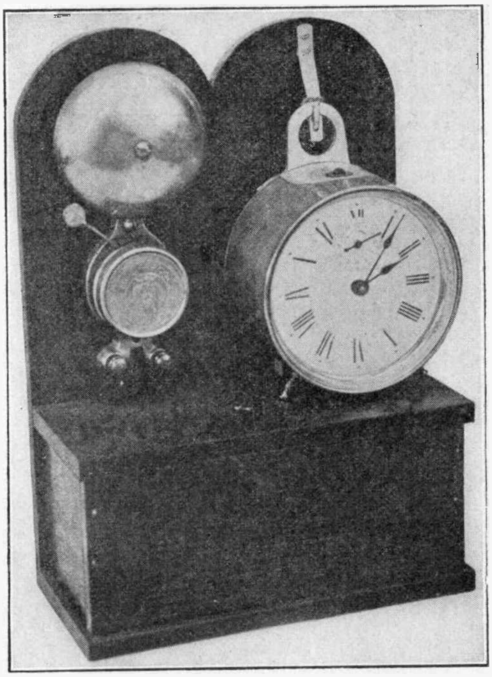
—Elmer Rhynerson.

A "Fool Proof" Alarm Clock

The "quad" chief in one of the large telegraph offices sends in this suggestion for an electric alarm clock, which has solved the "getting-up" problem for him for many years. He says that it has never failed to work and is "fool proof."

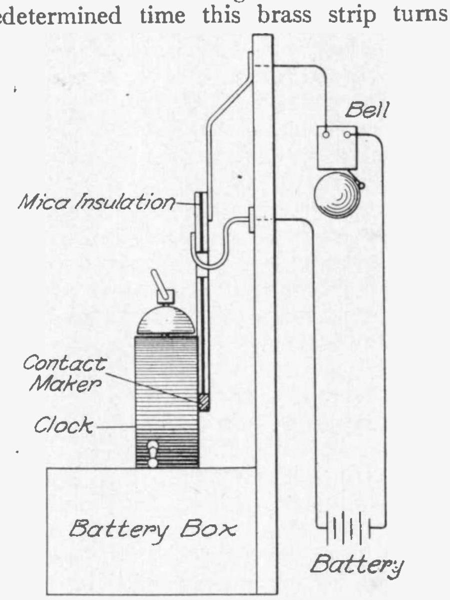
He made a neat box to hold the cell or two of dry battery required. On the upright board is mounted the electric bell, also a hook shown in detail in the diagram. To the back of the clock are screwed two pieces of metal separated by a strip of mica insulation, with a large hole to fit over the hook as shown. When the clock is set on the box with the metal strips over the hook the front metal strip touches the hook and the back one touches a spring fastened to the upright board. From the spring a wire runs to one terminal of the bell; from the other terminal of the bell a wire runs to one side of the battery. From the other side of the battery a wire runs to the hook. The only break in the circuit, therefore, is the mica insulation between the strips.

To complete this break and cause the bell to ring at any desired time a brass strip



A "FOOL PROOF" ALARM CLOCK

is mounted on the alarm shaft of the clock and when this shaft begins to turn at the predetermined time this brass strip turns



ELECTRICAL CONNECTIONS OF THE ALARM CLOCK

and its edge rubs across the edges of the two metal strips before mentioned and the circuit is completed, ringing the bell.

POPULAR ELECTRICITY WIRELESS CLUB

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

A Simple Wireless Telephone Set—Inductive System

By A. B. COLE

Many experimenters have their own wireless telegraph stations, but comparatively few have constructed wireless telephone apparatus. The purpose of the present article is to show how to build a simple wireless telephone set at small expense.

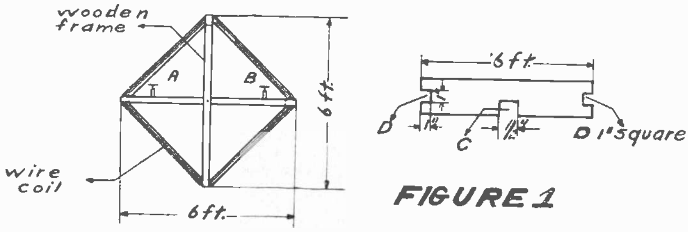


FIGURE 1

The outfit is of the "inductive" type, that is, speech is transmitted from one station to another by means of the electro-magnetic action of one coil, carrying current, upon another coil. One way of explaining the principle underlying the operation of the set is as follows—if we have two coils of wire, one of which is carrying alternating or interrupted direct current, an electromotive force will be set up in the other coil if the planes of the coils are nearly parallel. The induction or spark coil is a familiar example illustrating this principle. The primary coil is carrying interrupted direct current, and the electromotive force induced in the secondary coil produces the spark at the terminals of this coil.

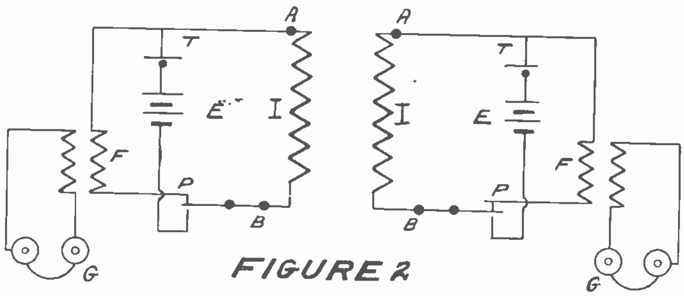


FIGURE 2

Now if the secondary coil is moved away from the primary, still keeping the planes of the coils parallel, or nearly so, electromotive forces will still be induced in the secondary coil, but will become weaker as the distance between the coils is increased.

The primary and secondary of the induction coil are replaced, in the wireless telephone outfit, by two coils of wire six feet in diameter, one of these coils corresponding to the primary, and the other corresponding to the secondary of the induction coil. The wire used is No. 18 single cotton covered copper magnet wire, of which four pounds are required for each coil. Each coil has forty-three convolutions. The wire is wound on wooden frames constructed as shown in Fig. 1. Each frame is made from two wood strips, 6 feet by 1½ inch by ½ inch. A slot (D), one inch square is cut in each end of each strip to hold the wire. A slot (C), ¾ inch deep by ½ inch wide is cut in each strip, so that the strips may be fitted together. One end of each coil terminates at a binding post (A), and the other end terminates at a binding post (B), both of which are mounted on one of the strips of each frame.

The connections for the two coils are shown in Fig. 2, where (A) and (B) represent the same binding posts as in Fig. 1, and (I) represents the coils of wire. (T) is a telephone transmitter, of the type known as "long distance," or "solid back." This is a standard transmitter, and may be purchased from any electrical supply house. (E) is a battery of eight or 10 good dry cells, or five storage cells; (F) is a telephone induction coil, supplied by any electrical supply house under the name of a "750 ohm telephone induction coil"; (G) is a telephone receiver having a resistance of about 1000 ohms, and must be wound with copper wire to obtain satisfactory results. A pair of good 500 ohm wireless receivers serves the purpose very well. (P) is a push button, known as a "double contact" push. The spring of this push button is normally in contact with an upper contact point, but when the button is pressed, contact with this point is broken, and connection is made with a lower contact.

The transmitter, push button and batteries may be mounted on a box or in any way which the user may desire. A good way to do this is to mount the transmitter and button on a wood box, which is fastened to the frame of its coil, and to have the batteries on the floor or in a separate case, connected to the transmitter and coil by means of flexible lamp cord.

From Fig. 2 it will be seen that when the button is pressed at one station, the receiving induction coil is disconnected from the coil (I) and the transmitter and batteries are connected. The operator may now speak into the transmitter, and speech will be reproduced in the telephone receivers at the other station. When the operator finishes speaking he removes his finger from the push button, and the other operator presses the button at his end, which connects his transmitter in circuit.

The double contact push button is of considerable value here, as the transmitter can be connected in circuit only when the button is depressed, which condition eliminates heating the transmitter, as is often the case when the operator for some reason or other forgets to disconnect his transmitter when he has finished speaking. This push button also serves to keep the receiving instruments in circuit and ready for use when the transmitting instruments are out of circuit.

It will be found that the best results are obtained, over a distance of from ten to fifteen feet when the planes of the coils are nearly parallel, and when conversation is carried on over greater distances than this the planes of the coils should be turned slightly from the parallel position.

Conversation can be carried on between two or more stations up to distances of from forty to fifty feet, using the set described above, without any ground wire or any connection whatever between the stations, and if a few walls of the building or other obstructions are between the stations they make little difference in the operation of the set.

By increasing the diameter of the coils (II), the distance over which the set will operate will be increased, and increasing the amount of wire on the coils also serves the same purpose.

Such an equipment as the one described above has value mostly as an interesting experiment.

Inter-mountain Wireless Association

The Inter-mountain Wireless Association was organized October 22 by D. R. Adams and Mr. Ritchie at the home of the former in Salt Lake City, Utah. The object of the association is to further the arts of wireless telegraphy and telephony in the Intermountain region. A constitution and bylaws have been adopted and the following officers elected: President, E. L. Bourne of the Nat. Guard Signal Corps; secretary, D. McNichol; treasurer, J. G. McCullom. All persons living in the Inter-mountain states are cordially invited to join, and may do so by communicating with D. R. Adams, 219-5 East St., Salt Lake City.

A part of the equipment of the new $3,000,000 police headquarters in New York is to be a wireless telegraphy outfit operated from the dome. It is expected that branch stations will be established in outlying districts of the city and in other counties, so that if wires fail, communication may be maintained.

What One Can Do Others Can Do

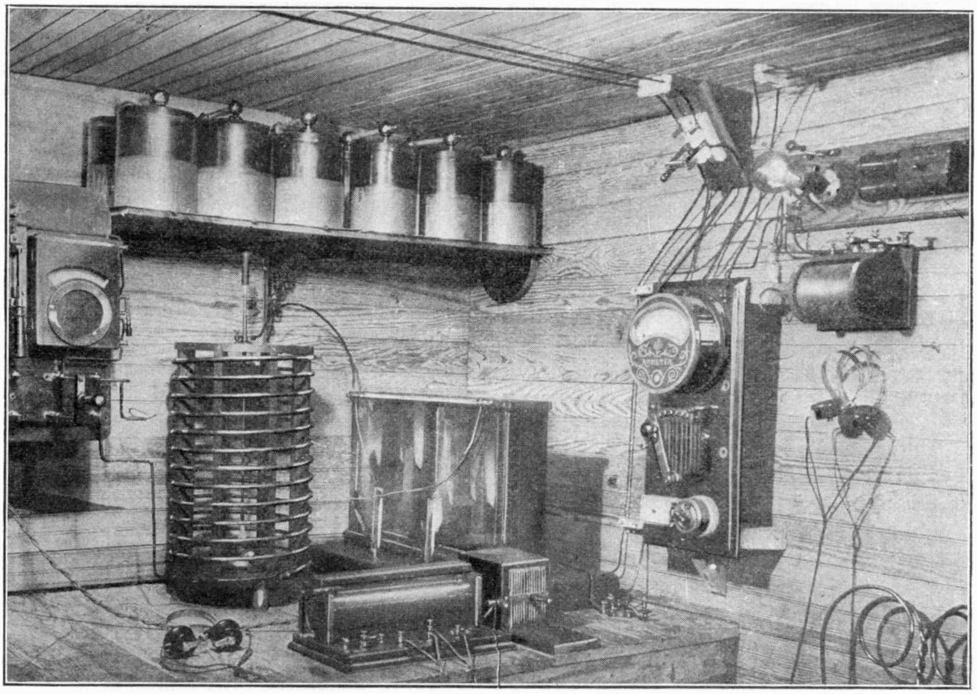
To the Members of P. E. W. C.:

I enclose a photo of my wireless station. While I realize that there are hundreds of stations that are more complete, still there are numbers of them not so large and powerful, and this photo and description might be of interest and encouragement to others who are laboriously traveling the same road.

I began this station eight months ago and have made each instrument, in both transmitting and receiving, at least three times, each time making decided improvements. I never saw a wireless station, and at the time I started I knew absolutely nothing about wireless. All the knowledge I have was procured from *Popular Electricity, Modern Electrics* and *Electrician and Mechanic.* I also received valuable assistance from The Wireless Equipment Co. of West Arlington, Md.

My source of power is the commercial current—110 volts, 60 cycles a. c. On the right of the photo you see the switchboard which contains cut-out, fuse block, ammeter and variable "kicking coil." Ammeter registers as high as 60 amperes; kicking coil varies from five to 40 amperes, with eight steps of five amperes each. This coil gave a great deal of trouble and was simply a matter of "cut and try" of about 14 times.

The transformer is in the large zinc lined case that just extends above the table, and is immersed in oil. It weighs complete, with case and 35 gallons of oil, 400 pounds. Primary is No. 4 D. C. C. wire, 200 feet. Secondary is 50 miles No. 32 D. C. C. wound in 60 sections, 10 inches in diameter and ¼ inch thick.



AN AMATEUR STATION VALUED AT $1,000

I use either of two condensers, glass plates 12 by 14, two thicknesses, connected series-multiple; or 12 one gallon leyden jars connected the same way. Notice the two glass tubes which bring the secondary terminals out of the transformer.

The helix is 12 inches in diameter and 15 inches high and is wound with No. 0000 solid copper with 1½ inch centers on turns. The spark gap is inside the helix and has zinc tips one inch long and ¾ inch in diameter.

On the left is the D. P. D. T. switch, ground switch, and hot-wire ammeter. The ground goes straight down from the switchboard and is soldered to the water pipe (No. 20 fiber covered wire). Aerial leads through brick wall in hard rubber tube, two feet long and ½ inch thick lined with porcelain. Hot wire ammeter registers 25 milliamperes when sending and is made of No. 36 copper wire. Total capacity 30 milliamperes.

Transformer has a capacity of 4½ to 5 K. W. In transmitting I use a one-inch spark gap and the spark is one inch thick. By means of the variable kicking coil and adjustable condensers and spark gap I can transmit from 100 to 1000 miles with corresponding current consumption.

The receiving station consists of two sets of phones, each set wound to 3000 ohms and when connected in series makes 6000 ohms resistance, double slide tuning coil, silicon detector, variable and fixed condenser. Fixed condenser is concealed in base of coil; variable condenser is shunted across ground and aerial.

With this set I have received from San Juan, Porto Rico—a distance of 1800 miles, and it is easy to "listen in" when Key West, Fla., is talking to Galveston, Texas. Chicago and Cleveland are also easily heard. I was very much interested when I, at 8:30 received a message from a vessel off the Atlantic coast giving the time, 9:30. I got it an hour before it was sent, but of course. they had eastern time and I central.

All of my instruments are made of black walnut and by me, with the valuable assistance of my very dear friend, Thomas Daly. The only things not homemade are ammeter, detector and phones.

I value my station at $1000. Receiving distance 2000 miles; sending distance 1000. I have used my transmitter very little because I did not want to "butt in" and possibly create confusion.

Will some one be kind enough to furnish me with a complete list of government, commercial and experimental stations with their power and call letters. In exchange I will be only too glad to furnish any one the benefit of my experiments, gratis.

My aerial is composed of 4 wires 200 feet long. 50 feet high at one end and 125 feet at the other.

The photo only shows a part of my experimental apparatus. On the same table, to the left, I have an open-core transformer, with 25 miles of No. 32 D. C. C. wire also in oil. This operates a very large Tesla coil, also in oil, which in turn lights an 8-inch X-ray tube. And in addition it excites a smaller Tesla coil, not in oil, with which I am able to perform all of Tesla's experiments. These two Tesla coils are controlled by a common condenser. All of these instruments, as well as the wireless, are regulated by the kicking coil and each set is thrown in or out by the D. P. D. T. switch which is directly above the ammeter. E. F. WAITS.

Corinth, Miss.

[By sending 10 cents to the Government Printing Office, Washington, D. C., you may obtain a copy of the pamphlet "Wireless Telegraph Stations of the World", which gives the names and locations of the important commercial and government stations, their capacities, call letters, etc.—EDITORIAL NOTE.]

WIRELESS QUERIES

Answered by A. B. Cole

Wave Length of Tuning Coil

Questions.—My tuning coil has 75 turns of wire and 16 inches to the turn, the wire is No. 18 double cotton covered. (A) How many meters wave length would the tuning coil respond to? (B) How many meters would the same coil respond to with enameled wire about the size of No. 20 cotton covered?—F. R., Arkansas City, Kan.

Answers.—(A) Your tuning coil will respond to a wave length of about 800 meters, if you use an aerial 50 feet long, and to a correspondingly greater wave length if a longer aerial is used.

(B) If the coil is wound with No. 20 enameled wire, it will respond to a wave length of about 1200 meters with the above aerial.

Condenser for Receiving Circuit

Questions.—(A) Would a condenser consisting of six glass plates 4 by 15 inches and tinfoil pasted on with a margin one-half inch all round and a terminal one inch long be suitable for receiving, the set being set in a box with melted paraffin poured in? (B) Is brass wire more suitable than copper for sending helix?—I. G., Brooklyn, N. Y.

Answers.—(A) Yes, but would advise you to use at least four more plates, to insure best results.

(B) No, except that it is more springy, and therefore better mechanically.

Tuning Coil; Condenser Capacity

Questions.—(A) What are the proper dimensions for a tuning coil and how is the wave length computed? (B) What is the capacity in meters wave length of a tuning coil three inches by 13 inches with 350 turns of No. 24 D. C. C. wire? (C) How is the capacity of a condenser determined, in microfarads? Give formula with glass and paraffine as dielectrics.—R. L., Beloit, Ohio.

(A) Diameter, two inches, length, 10 inches. The most reliable method we know of computing the wave length to which a coil will respond is to set up the proper instruments in connection with it, and receive signals from a station emitting a known wave length. Observe the part of the coil in use under such condition, and compute the maximum wave length to which the coil will respond by comparing the length in use to the total length of the coil. The method of multiplying the length of wire on the coil by four is far from accurate, as the wave length depends not only on the length of wire, but also on the insulation, the diameter of the coil, and the core.

(B) About 3000 meters if used in connection with an aerial 50 feet long.

(C) The capacity of a condenser is determined by more or less complicated laboratory methods by comparison with a condenser of known capacity. There is no reliable formula involving glass and paraffine dielectrics, as the composition of these materials varies greatly.

Long Distance Receiving and Transmitting

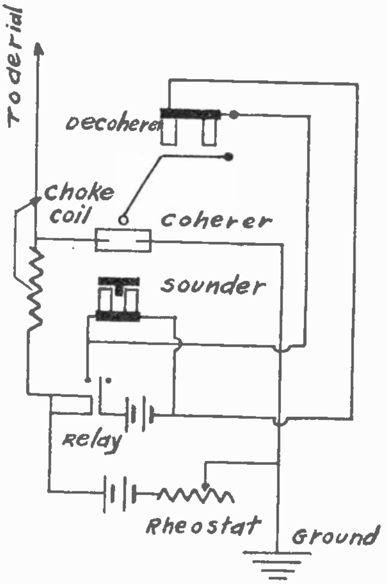
Questions.—(A) What instruments will be needed to receive 2,500 miles? (B) How far will a two K. W. transformer send? A three K. W.?

Answers.—(A) To receive 2,500 miles will require the best of apparatus, this should include receiving transformer, two slide condensers, one stationary condenser, a good detector and a pair of 1,500- or 2,000-ohm receivers used in connection with a clear 125-foot aerial.

(B) The distance covered by a two or three K. W. transformer would depend so much upon all other conditions, that it would be impossible to give a reasonable answer to this question. One K. W. sets have been heard at a distance over 1,000 miles at night. This of course is done under the best of conditions. A good three K. W. set working under fair conditions at night could be relied upon to cover from 300 to 400 miles.

Marconi Receiving Set

Questions.—(A) I have a relay wound for 35 ohms; could I use it on a wireless call system? (B) Could a tuning coil be used on a Marconi receiving set? (C) Please give diagram for Marconi receiving set, consisting of a relay, batteries, coherer and decoherer, sounder, rheostat and choke coil. —S. W., Indianapolis, Ind.



CONNECTIONS OF MARCONI RECEIVING SET

Answers.—(A) Yes.

(B) Yes, and to advantage.

(C) See diagram.

Wireless Telephone; Pan Cake Tuner

Questions.—(A) Can the lighting current (110 volts A. C.) be used to feed an arc for producing a wave train for wireless telephony? (B) Can the ordinary aerials be used? (C) Must one electrode be water cooled? (D) What type of detector should be used? (E) Is there any special method for wiring the receiving circuit? (F) Explain the pan cake type of tuner.—F. E. H., Ottawa, Ont

Answers.—(A) No.

(B) Yes.

(C) Not necessarily, but preferably.

(D) Any detector used for wireless telegraphy will do. The mineral type, such as perikon, give good results.

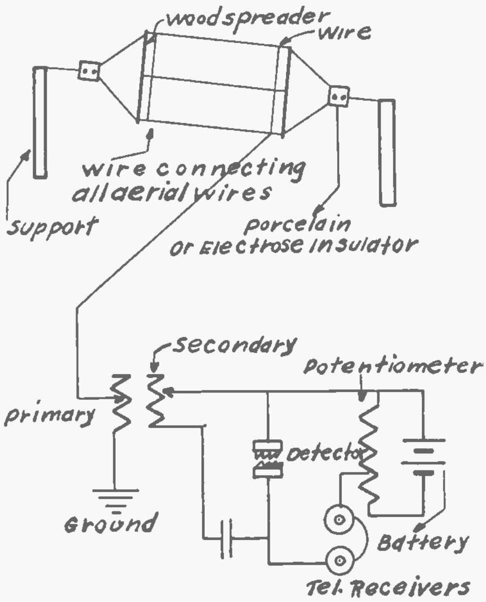
(E) Same as for wireless telegraphy.

(F) Pan cake tuner consists of two flat spirals of insulated copper ribbon, having variable contacts so that a greater or less number of turns may be used. The two spirals, or "pan cakes," may also be moved with respect to each other, thus forming essentially a variable coupling tuning coil.

Connections of Receiving Station

Question.—I have the following equipment: 88-foot antenna, 53 feet high, 42 feet lowest point; 3 wires No. 18 bare copper; loose coupled receiving transformer; potentiometer; tinfoil condenser; silicon and perikon detectors; 1500-ohm receiver; I cannot make the apparatus work. Will you kindly give me a plan showing how to connect the instruments. What improvement could I make in this equipment?—O. I., Attleboro, Mass.

Answer.—See diagram below for connecting the instruments. The equipment con-



CONNECTIONS OF RECEIVING STATION

sists of the proper apparatus to insure good results, but as you do not state the make or construction of the apparatus we cannot tell whether your trouble is that you are not sufficiently familiar with the use of the equipment or whether the apparatus itself is at fault. We suggest that you read the article entitled "A Variable Coupling Tuning Coil," in the January number, for the proper design and operation of your tuner.

One-Sixteenth Inch Spark Coil

Question.—Give dimensions of core for 1-16-inch jump spark coil, also size and amount of wire for primary and secondary winding.—E. S., Wilson, N. Y.

Answer.—Core—5 inches long, $\frac{3}{8}$ inch diameter. Primary—Two layers of No. 20 single cotton covered copper wire. Secondary—One ounce No. 36 single cotton covered copper wire.

U. S. A. Field Service Outfit

Question.—Please give diagram showing how the U. S. A. Signal Service sets are connected for use in field work.—C. G., Seattle, Wash.

Answer.—The U. S. A. Signal Corps uses

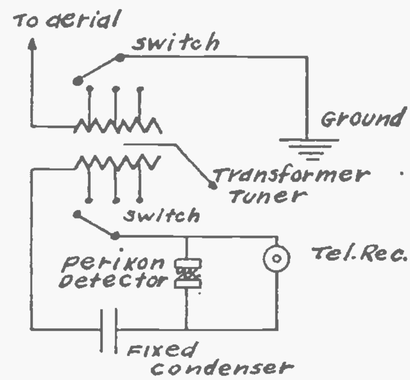


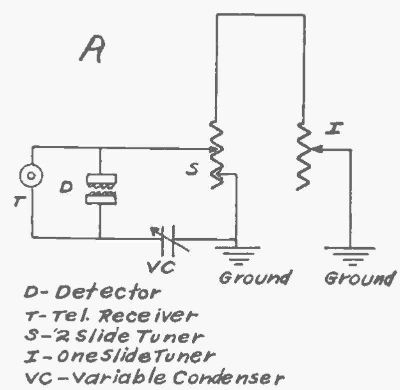
DIAGRAM OF FIELD SERVICE OUTFIT

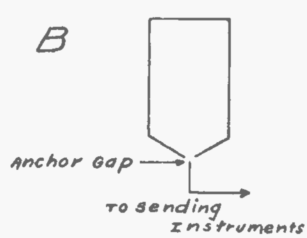
several systems in field work, and the diagram above shows one of the latest types, using the perikon detector.

Sending and Receiving Connections

Questions.—(A) Please give diagram of receiving set connections for a loop aerial. My set contains a 75-ohm receiver, two slide tuning coil, perikon detector and variable condenser. (B) Please give diagram for sending, using same aerial.—D. J. B., Brooklyn, N. Y.

Answers.—See diagrams A and B.





QUESTIONS AND ANSWERS

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

Three Phase System

Question.—Please explain the three-phase system, giving diagram of alternator winding, and also the principle of the operation of the induction motor.—E. P., South Bend, Indiana.

Answer.—In direct current systems the flow of current is in one direction and may be represented by a horizontal straight line. In

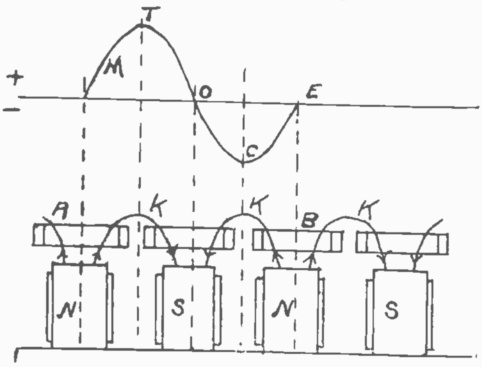


FIG. 1

alternating current systems the direction of the flow is continually changing. The generating apparatus is called an alternator, and for three-phase systems is wound with three distinct coils on the same armature, and located 120 degrees from each other. This armature will generate three equal E.

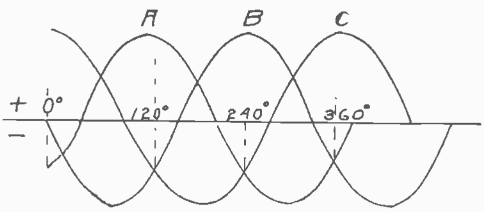


FIG. 2

M. F.'s differing in phase by 120 degrees. Fig. 1 shows the field poles of an alternator laid out, for illustration, in a straight line. The field poles are excited by an independent direct-current machine called an exciter. In Fig. 1, the curved lines (K. K. K.) indicate the direction of the lines of force from pole to pole. Consider one coil moving in front of the pole pieces. The E. M. F. may be represented by the curved line (M). With the coil in the position (A), the lines of force are threading their way through it in one direction as indicated by the arrow heads. As the coil moves, the E. M. F. rises to a point (T), then, as the coil approaches the pole (S), drops to zero and takes

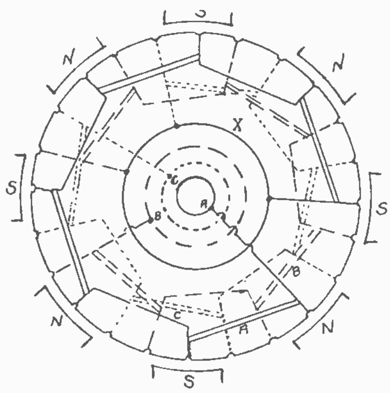


FIG. 3

a negative direction, the lines of force now flowing through the coil in a direction opposite their movement when the coil was at (A). Proceeding from the south pole to the north pole the line (O C E) Fig 1 indicates the values and direction of the E. M. F. A three-phase circuit may be represented by Fig. 2, three alternating currents, one for each armature coil being shown by curves (A), (B) and (C). On a bipolar machine, single phase, one coil, one revolution, 360° completes a cycle. On a multipolar, each coil passes through a cycle by passing a pair of poles. A cycle is one complete set of values, + and — through which an electromotive force or current passes, as represented in Fig. 2.

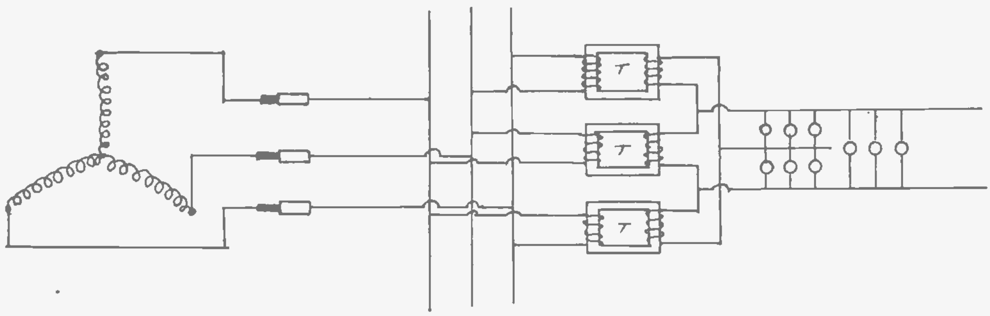


FIG. 4

The frequency is the number of cycles passed through in a second. The period is the time of one cycle. The number of alternations is twice the frequency. If (P) is the number of pairs of poles on an alternator, (N) the revolutions per second of the armature, and (F) the frequency of the E. M. F., then

$F = P \times N.$

Fig. 3 shows the arrangement of the windings on an alternator of a three-phase system. Note that one end of each coil is connected to a slip ring and the other end goes to a common connection (X). This machine is Y wound. From each slip ring is brought out a wire, three in all, called phases (A), (B) and (C). Between any two phases the voltage is the same, and with a balanced system each wire in turn acts as a return or sort of neutral.

Fig. 4 represents, in general, the arrangement of an alternating three-phase system supplied by a high voltage alternator, transformers being used to step down to lights and motors. The transformers are delta connected, and with this arrangement the loads on the three branches should be balanced.

A synchronous motor is almost identical in construction with a corresponding alternator, consisting of a field and armature, either of which may revolve. Such motors have separately excited fields.

To understand the action of an induction motor, suppose a direct current motor armature with current sent through it. With an excited field the armature will turn. Now suppose the brushes removed and the ends of the armature coils connected to a common copper ring. Next, revolve the field around the armature instead of allowing it to remain stationary. The lines of force must then revolve and set up an E. M. F. in the armature conductors. With these conductors short circuited, currents are set up in them and these currents react on the field and produce a drag on the armature. This revolving field pulls the armature with it. The field may be revolved by mechanical means, or the magnetic poles are so connected as to continually shift the field around the armature.

In a three-phase system

$P = 1.73 \times E \times I \times P.F.$

in which P = total power delivered,
E = E. M. F. between each pair of mains,
I = current in each main, and
P. F. = power factor.

D. C. Machines in Parallel

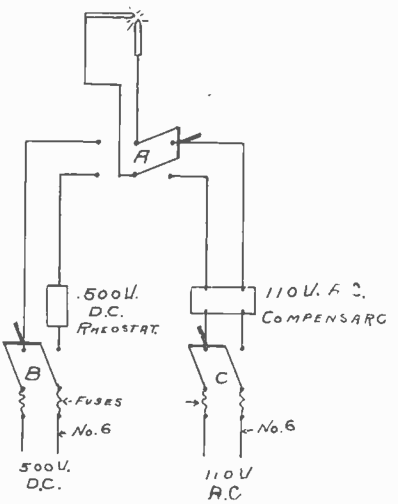
Question.—Will you tell me how to connect a 20 K. W. and a 7½ K. W. direct current generator of 110 volts in multiple? The machines are driven by separate engines.—H. E. W., Indianapolis, Ind.

Answer.—Connect the positive lead of each generator to a common positive bus-bar, and make a similar connection of the negative leads to a negative bus-bar. Each generator must have a switch and fuses in the leads. Now if one generator is running and it is desired to throw in the other, first with the generator switch open bring the second generator up to the voltage of the other generator, then throw in the switch. The second generator will then take its share of the load. If your machines are shunt generators their parallel operation is an easy matter, the connections being made as above stated and the voltage being controlled by a field rheostat. If your machines are compound wound, connect the positive brush of one to the positive brush of the other by a cable of the same size as the mains, this being the equalizer. Other connections are as made for shunt dynamos in parallel.

Moving Picture Arc Lamp Current from Two Sources

Question.—Will you explain how I can use 110 volt alternating current, and also 500 volt direct current on the same arc lamp (moving picture) by using some sort of a double-throw switch; both connections to be made to provide for any emergency, or a breakdown of one source of supply?—C. D. P., Wichita, Kas.

Answer.—The diagram shows how connections may be made in the cut-out cabinet of the lamp booth. By the arrangement of



CONNECTIONS FOR MOVING PICTURE ARC

the double-throw switch, (A), it is impossible to throw but one kind of current on the lamp at one time. Switches (B) and (C) are so arranged as to cut the current off the transformer or rheostat without going to the building service switches. It will be necessary to buy or have made a 500 volt rheostat for your lamp. Regarding the A. C. side see the article on "Current Economy for Moving Picture Arcs" in the September, 1909, issue.

Voltage Drop; Electroplating

Questions.—(A) Please state the distribution of the drop in a 110-volt circuit with two eight candle-power, 110-volt lamps connected in series. (B) Please give a good solution for copper plating, with voltage and current required.—L. L. K., Theresa, N. Y.

Answers.—(A) The lamps would divide the voltage between them, each taking 55 volts.

(B) The subject of "Electroplating" is thoroughly discussed in an article which appeared in the June and July, 1909, issues, and which will give you the information.

Rectifier; Arc Lamp Current; Dry Batteries; Bell-Ringing Transformers

Questions.—(A) How can I change 2, 3, 5 and 10 volts A. C. to direct current? (B) Do open and enclosed street arc lamps operate on direct or alternating current? (C) How many volts do "flaming arc" lamps take? (D) Do flaming arc lamps operate on alternating or direct current? (E) Which is the positive pole of a dry battery, the zinc or the carbon? (F) Do bell-ringing transformers used on 110 volts alternating current operate on the principle of an induction coil or a resistance coil.—S. A. H., Chicago.

Answers.—(A) Run an alternating current motor on the circuit and with this drive a direct current generator, from which take the current desired.

(B) There are direct-current, open and enclosed arc lamps, and alternating-current, open and enclosed arcs.

(C) 45 to 50 volts at terminals of lamp for constant current series, and 50 to 60 volts at terminals for constant potential multiple operation. The current consumed is from 8 to 12 amperes.

(D) The lamp must be designed for the current on which it is to be used. Lamps are built for both A. C. and D. C.

(E) The zinc is the positive element.

(F) The bell-ringing transformer operates on the principle of an induction coil without an interrupter.

Lightning Arresters on Insulated Wires; Grounding Cable Sheaths and Messenger Wires

Questions.—(A) Is it necessary to use a lightning arrester to protect a telephone when heavy insulated wire is run from the central office to the telephone? (B) Is it best to have the lead sheath of an aerial telephone cable thoroughly insulated from the ground? (C) Should the messenger wire be grounded?—L. S., Athens, Ont.

Answers.—(A) Decidedly, yes. If the line is long enough to require protection, the mere insulation of the wire would not protect either it or the phone from a lightning discharge.

(B) It is best to have the lead sheath thoroughly grounded as a protection from lightning and other causes. You would find it very difficult to insulate a cable as they are generally suspended by metal clips from the messenger wire.

(C) Ground the messenger wire. It is best to do so for the above reason; also you would find it hard not to do so because generally either one or both ends terminate in guy anchors or stubs thoroughly grounded.

Alternating Current

Questions.—(A) Will an alternating current generator excite its own field? (B) How do you connect the armature sections of an alternating current dynamo, three-phase, with the slip-rings? (C) How should three phase circuits be connected to lamps.—K. H., Litchfield, Ill.

Answers.—(A) Not with its own current which, of course, is alternating. Alternators are provided with an independent direct-current dynamo which supplies current to

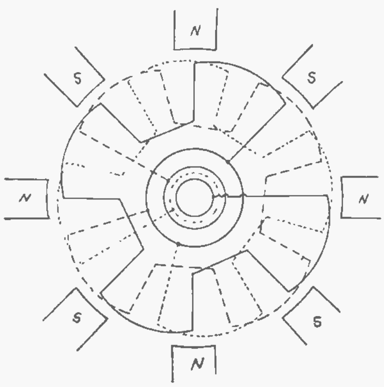


FIG. 1

the field coils. By another method, an exciter is used to magnetize the alternator fields sufficiently to give the rated voltage at no load, and in addition a small D. C. rectifier or commutator is mounted on the shaft

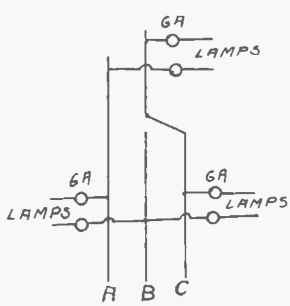


FIG. 2

near the collector rings and from this a series coil is run on the fields which furnishes the magnetism to supply the voltage to overcome the armature impedance as the load comes on.

(B) See Fig. 1 showing connections for a star or Y wound armature. The common connection is omitted in a delta wound armature.

(C) Assume 110 volts between phases on a three-phase system. The load should be distributed so that the phases are balanced. Fig. 2 shows how this may be done by using two and three-way cut-out blocks.

Chemical Automatic Telegraph

Questions.—(A) Will you please state what chemicals are used in recording telegrams on sensitive paper ribbon, so that this paper will under the pen change color when current flows through the pen? (B) Will the action occur whether the ribbon be wet or dry?—E. B., San Jose, Cal.

Answers.—(A) The principle of chemical telegraphy is that of decomposing the electrolyte through which the current is made to pass, and leaving by this decomposition a mark on the paper. Potassic iodide dissolved in water, will have the iodine separated by a current made to pass through moist paper, and a brown line will be left by the pen point. In practice the following solution is used: 1 part potassic iodide; 20 parts starch paste; 40 parts water. A platinum pen should be employed with the solution. A second solution with which a steel or iron pen is used is made as follows: 5 parts prussiate of potash; 150 parts ammonic nitrate; 10 parts of water. In this mixture the potash is to supply the acid to attack the pen, forming prussian blue, and the nitrate absorbs moisture from the air, keeping the paper in good condition. The solution is made a better conductor by adding a very little dilute sulphuric acid. The resistance from the pen point and across the paper to the cylinder is about 275 ohms with this last electrolyte.

(B) The paper must always be slightly moist for satisfactory operation, this being provided for in the solution.

Copper Plating on Carbon

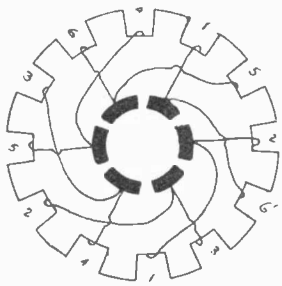
Question.—What is the easiest way that I can copper plate carbon?—E. I. S., Marlboro, Mass.

Answer.—You should find this a very easy job. Use a plain water solution of copper sulphate and a copper anode. Use a weak current for plating. Connect the carbon of the plating battery to the copper plate, and the zinc of the plating battery to the carbon you wish to plate; or, use a low candle power lamp in series with the direct current lighting circuit, making sure to connect the positive wire to the copper plate in the plating bath.

Bi-Polar Motor; Spark Coil Secondary; Transformer Heating; Storage Battery

Questions.—(A) Please explain how to wind a bi-polar motor having a 12-slot armature and six commutator segments. Give size of wire to use. (B) Is soft annealed wire which can be purchased in hardware stores good for ring armature banding? (C) Can double cotton-covered wire be used for the secondary of a jump-spark coil instead of silk covered wire? (D) I have made a small transformer as described in the November, 1908, issue, and after using it a short time it heats considerably. How can this be remedied? (E) Where can I buy torpedo lead for making a storage battery? (F) If a storage battery has been short circuited, how can it be repaired, so as to retain a charge again?—C. J., Chicago, Ill.

Answers.—(A) See diagram. It is not possible to give the size and quantity of wire



BI-POLAR MOTOR WINDING

for the field and armature without knowing the area and length of the pole pieces, as well as the data on the armature. The voltage upon which it is to run should be given and also the desired horse-power.

(B) Yes. Fine brass wire is also satisfactory.

(C) Silk covered will give better results, but single cotton-covered wire soaked in paraffin or wax may be used.

(D) One of the causes for heat losses in a transformer core is the setting up of eddy currents in the iron. Sheets having a thickness of .014 are used on high frequencies. Finer wire for the core in your case might be used. Are you sure you are not overloading the transformer?

(E) Take up the matter with some lead company. The classified telephone directory will assist you. This lead can be had in any size you specify.

(F) In removing storage batteries from service they are short-circuited after the electrolyte has been replaced with water. If "shorted" with the electrolyte in the cell, sulphate would form. Overcharge the battery by charging at the normal rate until it shows 2.6 volts per cell. Then decrease the current to one-half the normal rate, and continue the charge until the cells show 2.7 volts each, then continue charge twenty or twenty-five minutes longer. This will reduce any sulphate which may have formed.

Armature Building; Winding a Tri-polar Armature

Questions.—(A) Will an armature made in a single piece work as well as one which is not so made? (B) How should a tri-polar armature be wound? (C) How should the field be wound and connected? (D) Should wire on the armature be the same size as that on the field?—C. H., Sullivan, Ill.

Answers.—(A) Tri-polar and quadri-polar armatures are frequently made of cast iron; however, those built up of laminations or stampings are in every way to be preferred, eddy current losses being much reduced.

(B) See diagram in the article "Construction of a Laminated Motor" in the May, 1909, issue.

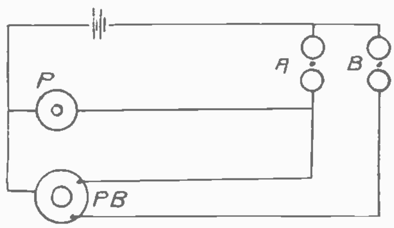
(C) Described in article mentioned in answer (B).

(D) In all cases this will be determined by the voltage and power for which the motor is designed.

Bell Diagram

Question.—Given, two bells and two push buttons. I want one push button to ring only one of the bells, while the other push button rings both bells, neither bell to be single stroke. Please give diagram.—J. O. B., Portland, Oregon.

Answer.—The diagram shows bells (A) and (B). Push button (P) will ring bell



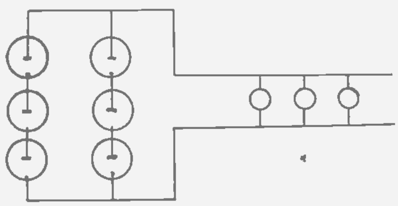
BELL DIAGRAM

(A) only. Push button (PB) has two separate contacts, one for each bell, both of which are closed by pushing it, thus putting battery on both bells. When (PB) is open the two contacts are not common.

Dry Batteries and Lamps

Questions.—(A) How many four and one-half volt lamps can I light with eight dry batteries? (B) Please give diagram fo. connecting these lamps.—W. S., New York City.

Answers.—(A) It will depend upon the ength of time that you wish the lamps to light up. Dry cells are not recommended for continuous service.



DRY BATTERIES AND LAMPS

(B) The diagram gives the number of cells, lamps and connections. Each cell is assumed to give 1.5 volts.

Batteries and Small Lamps

Questions.—(A) Please describe the Gordon cell giving its size. (B) I have a six-volt six-candle-power tungsten battery lamp. Please tell me the best battery to use on same.—S. B., Waldron, Mich.

Answers.—(A) See answer to A. C. H. in the January issue.

(B) Six-volt storage batteries are manufactured which will run one light such as you have for 70 or 80 hours without recharging, and if you are where you can recharge such a battery we would advise its use.

Antique Plating

Questions.—(A) How can I make a plating solution for plating antique or green? (B) In plating a stick pin, how do they get the face of a man's head yellow, and a band around his head, green?—P. H., Springfield, Ill.

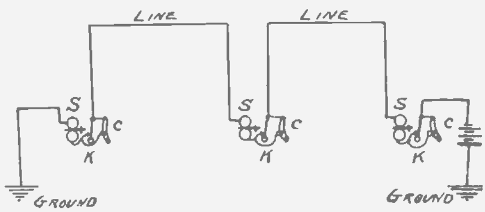
Answers —(A) This is not done by plating in the ordinary sense of electroplating, but is done by dusting certain pigments over a sticky lacquered surface. These pigments are various oxides and salts of copper, iron, nickel and other metals. The metal to be "antiqued" is first lacquered, and when the lacquer is nearly dry, but still sticky, the color is sprinkled on or applied with a tuft of cotton. Some colors are produced by simply corroding the metal with acetic and other acids.

(B) The face is first lacquered and colored, then the band is colored after the face is dry.

Installation of a Short Three Instrument Telegraph Line

Questions.—I am about to install a three instrument telegraph line about one-half mile in length. (A) Please explain how to install the line correctly. (B) Is it necessary to use relays? (C) Are the instruments wired series or multiple?—L. F. B., Tallman, Mich.

Answers.—(A) Connect the instruments as shown in diagram. The outside line is a single wire. The batteries are of the closed circuit type (gravity cells). The sending keys, (K) are normally open and make circuit only when depressed. The circuit switch (C) is kept closed except when sending and shunts the key (K). The armature of the sounder (S) is always down except when sending or when the switch (C) is accidentally left open, "killing" the line. The grounds for the return are preferably made to water pipes. Use rather high resistance sounders so as not to wear out your batteries too quickly. Install some sort of lighting arrestor at each instrument. Probably the best form of lightning arrester for this use is to provide two flat pieces of carbon separated by a thin piece of mica with a few holes punched through it, or by dry silk. Connect one carbon to line and one to a ground.



(B) It is unnecessary to use relays except for a line several miles long.

(C) The instruments are all in series. Telegraph systems are all series systems.

Equalizer Connections on Generators

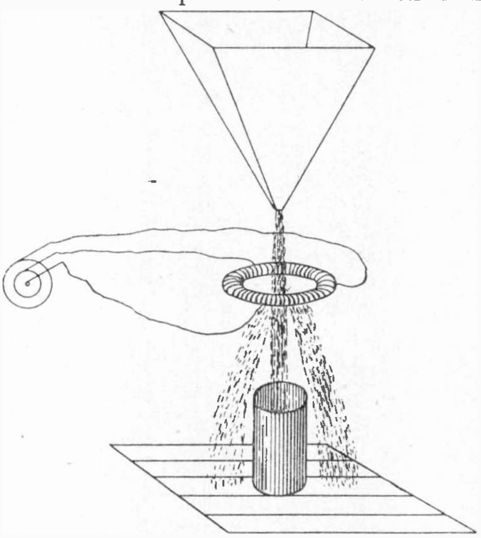
Question.—In connecting two compound generators to run in parallel does it make any difference whether the positive or negative brushes are connected together by the equalizer?—R. E. G., Minneapolis, Minn.

Answer.—In practice, the equalizer is run between the positive brushes, but it would do just as well if the negative brushes were so connected. However it is necessary to see that the equalizer connects those brushes to which the series coils are attached, and also to see that these brushes are of the same polarity on each machine.

NEW ELECTRICAL INVENTIONS

Unique Magnetic Separator

A strikingly original form of electromagnetic separator for separating magnetic metals from mixtures containing them is shown in the illustration, and is the invention of G. D. Rogers of Gloucester, Mass. He uses a continuous coil of wire bent around in the form of a ring. To this wire coil are connected the three terminals of what is called a three-phase circuit. Electricians



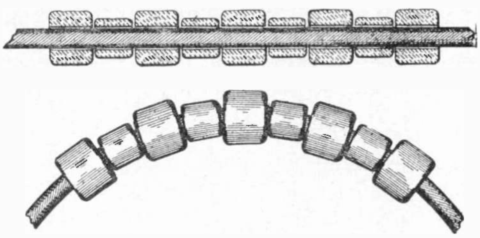
UNIQUE MAGNETIC SEPARATOR

will understand that such a circuit is one which has impressed upon it three distinct current impulses during each period. These current impulses cause the wire coil or solenoid to take on the properties of a magnet and there is created within the circle a magnetic field. The fact that the three current impulses strike the coil successively at three equidistant points on its circumference causes the magnetic field to rotate.

Mr. Rogers has found that such a magnetic field exerts upon magnetic substances falling through it an outwardly directed force which causes them to fall outward and away from the perpendicular. The crushed ore, magnetic sand or whatever is to be separated is therefore caused to fall through the ring.

Protected Lamp Cable

A new idea for the protection of a flexible cable or conducting cord for lamps is shown in the illustration. Flexible beaded cables are generally used in connection with arc lamps for connecting the movable parts in such manner that when the sides of the cable come in contact with the different parts of the lamp, which is almost unavoidable, no



PROTECTED LAMP CABLE

short circuit or ground can be made. In order to afford sufficient protection the beads on the cable must be of fair size, and if these beads are all of uniform size, as has heretofore been the case, and the cable is bent sharply, which is frequently necessary, there is exposed a considerable portion of the bare cable, which is liable to lead to short-circuits or grounding. The flexibility of the cable is also limited by the requisite size of the beads.

According to this invention, small and large beads are arranged alternately upon a cable, and thereby the danger of short-circuits is largely decreased, and in addition the cable is made more flexible. Emile J. Guay, of Lynn, Mass., is the inventor.

Hot Box Alarm

A novel alarm for hot bearings consists of a small tube and bulb containing mercury, so arranged that rise of the mercury with temperature closes an electric bell circuit and attracts the attention of the attendant. The apparatus is attached to the bearing in a box two inches square. When many bearings are being watched, an ordinary electric bell indicator can be used.

Notes on Patent Infringement

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

Use of equivalents (Concluded)—Repairing or Re-Constructing Worn-out Article, by Unauthorized User; Contributory Infringement; Definition.

Repairing or Reconstructing Worn-out Article. By Authorized User.—Where a machine is patented as a whole, one who has the right to use, but not the right to construct, may, so long as the identity of the machine is not destroyed, make repairs or replace the worn-out parts, but can neither build a new machine, nor reconstruct an old one under the guise of repairs.—Thomson-Houston Electric Co. v. Kelsey Electric Specialty Co. (C. C. A.) 75 Fed. Rep. 100.

If a Part of a Machine is Patented Separately, it cannot be replaced without the consent of the patentee. Shickle, etc., Iron Co. v. St. Louis Car Coupler Co. (C. C. A.) 77 Fed. Rep. 739.

Replacement of a Temporary Part.—But a part which, although necessary to the operation of a machine, is temporary in its relation to the whole structure, and which the inventor contemplated would have to be renewed at intervals, may be replaced.—Morgan Envelope Co. v. Albany Perforated Wrapping Paper Co. 152 U. S. 425, even though it is novel, and covered by the claims of the patent.—Farrington v. Board of Water Com'rs, 4 Fish. Pat. Cas. 216, 8 Fed. Cas. No. 4,687.

By Purchaser of Old Parts.—The purchaser of the parts of a patented article which has been taken to pieces has no right to reconstruct and use or sell the article.—American Cottontie Co., v. Simmons 106 U. S. 89.

Making and Selling to Licensee or Repairer.—It is not an infringement to manufacture and sell to a licensee, or to a person entitled to make repairs.—Johnson Railroad Signal Co. v. Union Switch, etc. Co. (C. C. A.) 55 Fed. Rep. 487; reversing 52 Fed. Rep. 86. Thomson-Houston Electric Co. v. Kelsey Electric R. Specialty Co., (C. C. A.) 75 Fed. Rep. 1005.

Unlawful Possession of Patented Article.—Mere possession, when unlawful, may be sufficient to justify an injunction restraining use, whether or not it affords ground for damages.—Adair v. Young, 12 Ch. D. 13; United Telephone Co. v. London, etc. Telephone, etc., Co. 26 Ch. D. 766.

Contributory Infringement. Definition.—Contributory infringement has been defined to be "the intentional aiding of one person by another in the unlawful making or selling or using of the patented invention. —Thomson-Houston Electric Co. v. Kelsey Electric R. Specialty Co. 72 Fed. Rep. 1016.

By Sale of Element of Combination.—A person is liable as a contributory infringer when, without authority, he makes or sells an element or ingredient of a patented combination with the intent that it shall be combined with the other elements or ingredients for the purpose of infringing the patent, or with the knowledge that it will be so used.—Thomson-Houston Electric Co., v. Ohio Brass Co. (C. C. A.), 80 Fed. Rep. 712.

By Sale of Appliances or Materials for Process.—The same rule applies to the unauthorized sale of appliances or materials for the unlawful use of a patented process, and to the unauthorized sale of machinery which is useful only for making a patented article.—Loew Filter Co. v. German American Filter Co. (C. C. A) 107 Fed. Rep. 949; American Graphophone Co. v. Hawthorne, 92 Fed. Rep. 516.

By Sale of Unpatented Article.—The sale of unpatented articles is not rendered an infringement by the mere fact that they are intended to be used in effecting the purpose of a patented device. Such a sale becomes an infringement, however, when made with knowledge of a restriction imposed by the patentee that such article may be used in connection with his patented machine only when purchased from him.—Heaton-Peninsular Button-Fastener Co. (C. C. A.) 77 Fed. Rep. 288.

By Making Machine Which Becomes Infringement in Hands of Third Person.—The maker of a machine which is not an infringement, and is not intended to be one, is not liable as an infringer if the machine becomes an infringement in the hands of a third person, either by accident or the natural wearing of the parts, or by the act of such third person; but he is so liable, if, with intent to infringe, he makes a colorably different machine, which will inevitably become an infringement in the course of usage, or which can easily be so adjusted as to infringe. American Diamond Rock Boring Co. v. Sullivan Machine Co. 14 Blatchf. (U. S.) 119, 1 Fed Cas. No. 396; Holbrook v. Small, 2 B & A. Pat. Cas. 396, 12 Fed. Cas. No. 6,595.

Presumption of Intent to Infringe.—When the thing sold is incapable of use except in connection with the patented invention, the mere sale is sufficient to establish infringement, it being presumed in such case that there is an actual concert for that purpose between the parties to the sale.—Westinghouse Electric Co. v. Dayton Fan, etc, Co. 106 Fed. Rep. 724. But the sale of a thing susceptible of innocent use is not an infringement, unless it is shown that it is in fact designed to be used in committing an infringement.—Edison Electric Light Co. 15 Peninsular Light, etc. Co. 101 Fed. Rep. 831.

BOOK REVIEWS

AUTOMOBILE TROUBLES AND HOW TO REMEDY THEM. By Charles P. Root. Chicago: The Charles C. Thompson Company. 1909. 219 pages with 14 illustrations. Price $1.50.

At the very beginning of this book we find a very helpful table for diagnosing the troubles of an automobile. An automobile is subject to a host of "troubles," like the human machine. These troubles have "symptoms;" the symptoms have "causes." The table outlines, therefore, in parallel columns, first the failures, then their symptoms, then their causes. In the body of the book these troubles are taken up, one by one, and analyzed from start to finish. The volume is very substantially bound in leather, of convenient pocket size.

SPONS' WORKSHOP RECEIPTS. Vol. II. London: E. & F. N. Spon; (New York: Spon & Chamberlain). 1909. 544 pages with 259 illustrations. Price $1.50.

The second volume of this very valuable reference library for mechanics, electricians and artisans has appeared. The scope of the work was outlined fully in the October, 1909, issue. The present volume includes names from "Dyes and Dyeing" to "Japan and Japanning."

SHOP TESTS ON CAR EQUIPMENT. By Eugene C. Parham, M. E., and John C. Shedd, Ph. D., New York: McGraw Publishing Company. 1909. 115 pages with 55 illustrations. Price $1.00.

The authors approach the difficult project of indicating shop tests in a very thorough and satisfactory manner. The various measurements, such as current, pressure, resistance, etc., are taken up and diagrams clearly setting forth the connections are given so that mistakes should be almost impossible. Miscellaneous tests such as bar-to-bar commutator measurements, differential voltmeter tests, locating grounded or faulty conductors, etc., receive careful attention. Then follow a list of general precautions to be observed in testing, also methods of treating flesh burns from electrical causes and means to artificially stimulate respiration. The volume ends with a series of 296 questions which, as a general review, cover the work gone over in the preceding chapters.

GENERAL LECTURES ON ELECTRICAL ENGINEERING By Charles Proteus Steinmetz, A. M., Ph. D., Schenectady: Robson & Adel. 1909. 284 pages with 48 illustrations. Price $2.00.

The series of lectures set forth in this book was delivered by the author before Union University, and the use of mathematics has been entirely avoided, thus making them intelligible to those not familiar with the mathematical branch of the electrical sciences. The book covers, first, the general features, including the various uses of direct and alternating current, the commercial frequencies, and the selection of systems for different purposes. The subject of distribution is next considered and the cost item is gone into carefully. Transmission is treated so as to bring in the high voltage problem as affected by harmonics, resonance, oscillation and surges, The discussion of the motive power including water and steam turbines, together with interesting details of operation are taken up together with protection and control. Electricity as applied to traction service and lighting is also discussed in excellently clear and easily comprehendable form. A further chapter on electrochemistry is well worth careful perusal.

ON POLYPHASE SUBJECTS

Prize Story Contest

We will give three prizes for the best three stories on the subject of "Experiences of an Electrical Salesman"—First prize, twenty-five dollars; second prize, fifteen dollars; third prize, ten dollars. In addition we will pay one cent per word for stories contributed in this contest which we find available for publication, whether they be prize winners or not. The contest will close March first.

The stories must be not under 1000 words or over 2000 words long. The manuscripts must be typewritten, and no manuscript will be returned unless postage is enclosed. The stories must be confined to actual experiences connected with the selling of electrical apparatus, although names and localities may be fictitious if so desired.

Every man of the grip worthy of the name remembers with pride some pet incident in his selling experience—a large and long-coveted order which he was able to "land" through some train of unusual and perhaps humorous circumstances; through the exercise of unusual diplomacy or some ingenious and maybe adventurous way of getting at the right man in the right way. Stories of incidents such as these are the kind we want in this contest—brimful of "human interest."

Electrical Definition Page

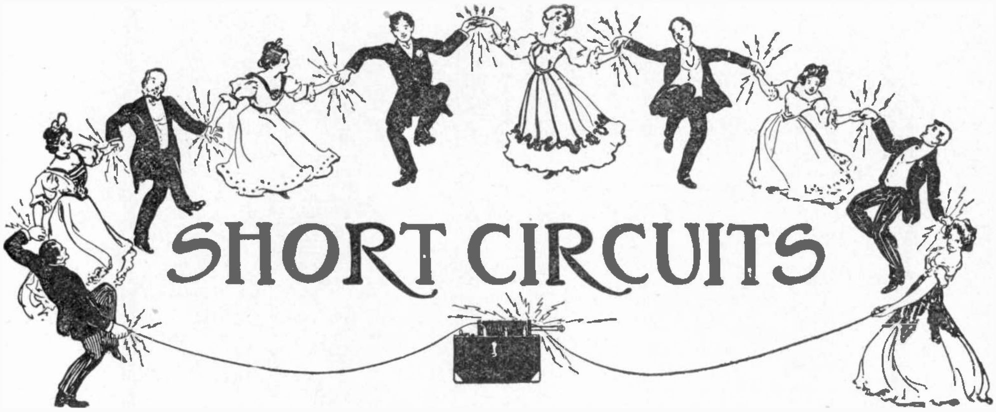
"Why do you have the same definitions end each number? Why not have new ones each issue and in time have a complete dictionary?" Just recently one of our subscribers asked these questions and the same have come up on previous occasions. The reason we have done this in the past has been, as we thought, to make the page of the most value possible in interpreting the reading pages of each issue as it came out. The page as it now stands contains definitions of the most commonly used electrical terms—covering all electrical terms which would be likely to come up in any issue. They are right there, from A to Z in every number, ready to turn to, and there is no necessity to look in back numbers.

However, we don't propose to let our opinions stand against those of the majority of our readers. We are here to please you and instruct you wherever possible. To do this we must know your desires and your opinions on matters such as this. So in the matter of this definition page; we will put it to a vote. How many want it continued just as it is? How many want it run in serial form so that they may finally obtain a fairly complete dictionary of the most commonly used electrical terms and phrases?

Mr. Miller's Articles

The average electrician is never so happy as when he is "learning something" as told in the words of practical power house experience. No man is perhaps better qualified to give practical information of this nature, in "plain English," than Mr. Warren H. Miller, who, though he is a highly technical engineer himself is warranted not to talk "over the heads" of practical men. He has consented to write some articles for POPULAR ELECTRICITY, the first one of which will appear in the March issue under the title of "Coupling Big Alternators in Parallel."

Those of you who are electricians will find that it will explain hitherto knotty problems in a way they were never presented to you before. Those of you who are not electricians will find intensely interesting the methods which must be employed to make great dynamos or generators work side by side and pump their current into the same line, when if any one of the big fly-wheels is as much as three-eighths of an inch out of its proper position of turning, all the meters will be soaring like a flock of gulls. And, more than that, all the lights and motors on the city lines will be acting as if possessed.



SHORT CIRCUITS

The householder smothered his wrath and descended to the basement. "Are you the plumber?" he asked of the grimy looking individual who was tinkering with the pipes in the cellar.

"Yes, guv'nor, answered the man.

"Been long in the trade?"

"'Bout a year, guv'nor."

"Ever make mistakes?"

"Bless yer, no, guv'nor."

"Oh, then, I suppose it's all right. I imagined you had connected up the wrong pipes, for the chandelier in the drawing room is spraying like a fountain and the bathroom tap's on fire."

* * *

Her Father (irately)—Young man, do you know that you've been calling on my daughter since seven o'clock?

The Tarrying Youth—Yes, sir. But she has been sitting on my hat for the last three hours and I didn't want to tell her.

Her Father—Then, hereafter, don't keep your hat on your lap. Hang it on the rack in the hall.

* * *

Mrs. Bart—My husband got a letter today saying something dreadful would happen if he didn't send the writer a sum of money.

Mrs. Smart.—My husband gets dunned for his bills, too.

* * *

He sipped from her lips the nectar,
As under the moon they sat,
And wondered if ever another man
Had drunk from a mug like that.

* * *

The teacher was describing the dolphin and its habits.

"And children," she said impressively, "a single dolphin will have 2,000 offspring."

"Goodness!" gasped a little girl in the back row. "And how about the married ones?"

* * *

A little girl, aged three, had been left in the nursery by herself, and her brother arrived to find the door closed. The following conversation took place:

"I wants to tum in, Cissie."

"But you tan't tum in, Tom."

"But I wants to."

"Well I's in my nightie gown, an' nurse says little boys mustn't see little girls in their nightie gowns."

After an astonished and reflective silence on Tom's side of the door, the miniature Eve announced triumphantly, "You tan tum in now, Tom; I tooked it off!"

* * *

Jimmie giggled when the teacher read the story of the Roman who swam across the Tiber three times before breakfast.

"You do not doubt a trained swimmer could do that, do you, James?"

"No, sir," answered James; "but I wondered why he didn't make it four and get back to the side his clothes were on."

Toward the close of a recent lawsuit in Massachusetts, the wife of an eminent Harvard professor arose and with a flaming face timidly addressed the court.

"Your Honor," said she, "if I told you I had made an error in my testimony, would it vitiate all I have said?"

Instantly the lawyers for each side stirred themselves in excitement, while His Honor gravely regarded her.

"Well, madam," said the Court, after a pause, "that depends entirely on the nature of your error. What was it, please?"

"Why, you see," answered the lady, more and more red and embarrassed, "I told the clerk I was thirty-eight. I was so flustered, you know, that when he asked my age I inadvertently gave him my bust measurement."

* * *

"You look so pale and thin. What's got you?" "Work. From morning to night and only a one-hour rest." "How long have you been at it?" "I begin tomorrow."

* * *

A young father was performing his regular Sunday morning task of washing the twins. As the day was warm and sunshiny the function was taking place on the back porch. As he meditatively soused the twins up and down in a tub of water two small boys of the neighborhood, who were always on the job when anything new took place, rushed frantically up to the paling, yelling at every jump, "Hey, Mr. Jones, don't drown the pups. Give 'em to us if you don't want 'em."

* * *

"Where are you from?" inquired the New Yorker.

"Los Angeles," said the man from California.

"Oh, I see," exclaimed the Empire State inhabitant. "So you're from the West. Well, I've been West some myself. Now last year I was out as far as Cleveland and stopped a while at Pittsburg. I was all around out West."

"Is that so?" said the man from Los Angeles with a great show of interest. "Well, I was up East myself not so very long ago. I was in Denver and Salt Lake City, and all around. It's strange we didn't meet."

* * *

"Well, my man," said a military doctor to a young Irish soldier who had been on low diet for a long time, "how do you feel now?"

"Oh! much better, sir," answered the soldier.

"Could you eat a small chicken today?" asked the doctor.

"That I could, sir," said the soldier.

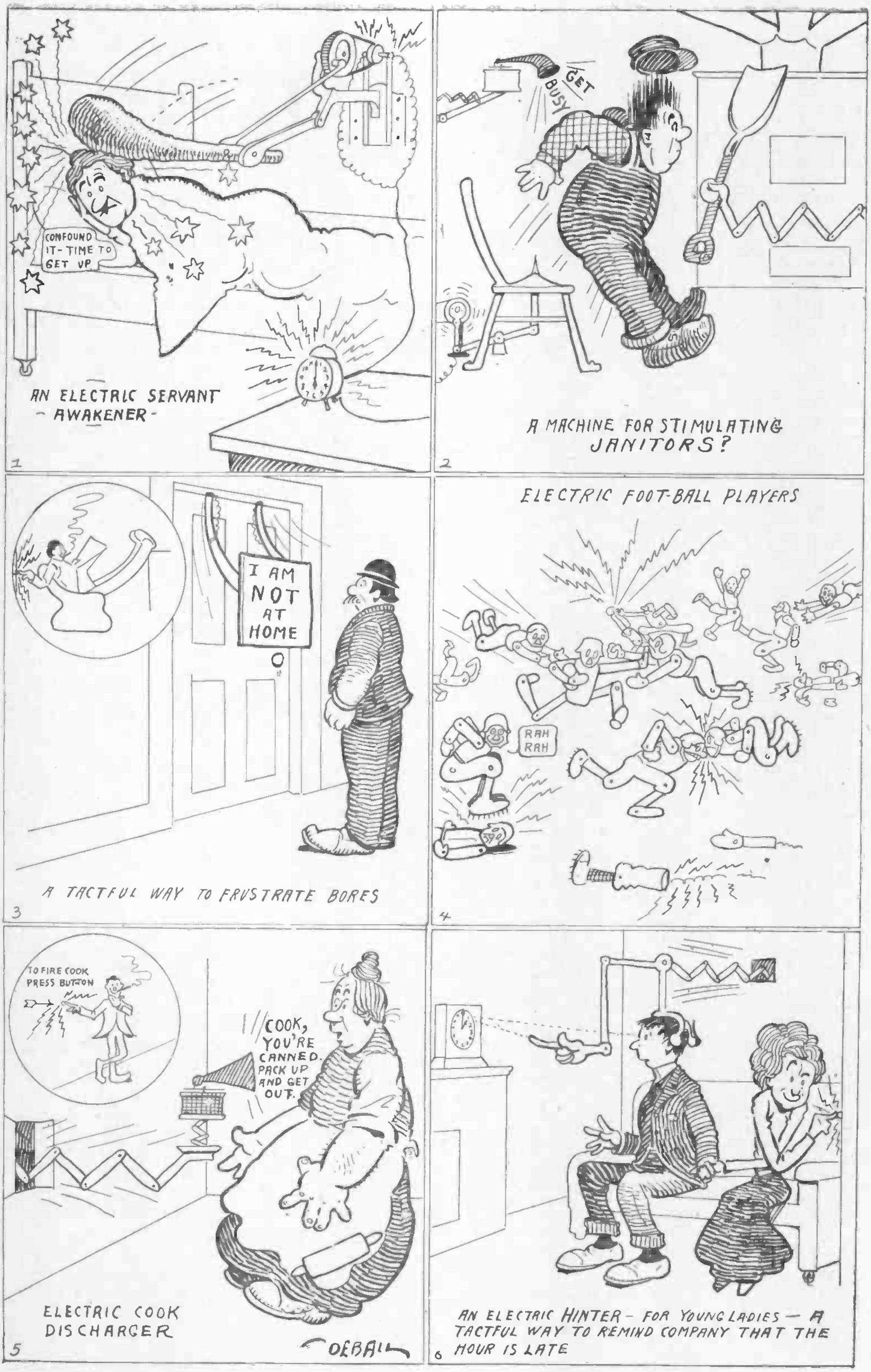
"What would you like it stuffed with?" asked the doctor.

"Please," replied the hungry patient, "I would like it stuffed with another."

* * *

"And now," said the teacher, "we come to Germany, that important country governed by a kaiser. Tommy Jones, what is a kaiser?"

"Please, ma'am, a kaiser is a stream of hot water springin' up an' disturbin' the earth."


CONFOUND IT-TIME TO GET UP
AN ELECTRIC SERVANT - AWAKENER -
1
GET BUSY
A MACHINE FOR STIMULATING JANITORS?
2
I AM NOT AT HOME
A TACTFUL WAY TO FRUSTRATE BORES
3
ELECTRIC FOOT-BALL PLAYERS
RAH RAH
4
TO FIRE COOK PRESS BUTTON
COOK, YOU'RE CANNED. PACK UP AND GET OUT.
ELECTRIC COOK DISCHARGER
5
AN ELECTRIC HINTER - FOR YOUNG LADIES — A TACTFUL WAY TO REMIND COMPANY THAT THE HOUR IS LATE
6

FIVE DAY

ELECTRICAL DEFINITIONS

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

Accumulator.—See secondary battery.

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

Ammeter.—An instrument for measuring electric current.

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

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

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

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

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

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

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

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

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

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

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

Circuit.—Conducting path for electric current.

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

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

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

Condenser.—Apparatus for storing up electrostatic charges.

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

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

Dielectric.—A non-conductor.

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

Direct Current.—Current flowing continuously in one direction.

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

Electrode.—Terminal of an open electric circuit.

Electromotive Force.—Potential difference causing current to flow.

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

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

Farad.—Unit of electric capacity.

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

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

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

Generator.—A dynamo.

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

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

Kilowatt.—1,000 watts. (See watt.)

Kilowatt-hour.—One thousand watt hours.

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

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

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

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

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

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

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

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

Potential.—Voltage.

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

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

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

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

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

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

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

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

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

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

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

Storage Battery.—See secondary battery.

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

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

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

Volt Meter.—Instrument for measuring voltage.

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

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

Hard Labor for Life ?

having to leave home? *That* is the way. It is the way that meets *your* special case. The *terms* are made to suit *your* means. The *time* is arranged to suit *your* convenience. The *training* is adapted to fill *your* needs. If you are willing, *mark the attached coupon* to learn all about it.

That the I. C. S. can help you is shown by the 300 or so letters received every month from successful students who VOLUNTARILY report *better positions and salaries as the direct result of I. C. S. Help.* During November the number was 375. Mark the coupon.

Next month, next week, tomorrow, *even an hour hence* may be too late. Mark the coupon *now* and so take the first step to escape life-long servitude. Marking it entails no obligation—it brings you full information and advice regarding the way to *your* success. ***Mark the coupon NOW.***

FREEDOM

I certainly can speak very highly of your Institution, and through its help I have advanced my salary some 300 per cent. I am now with the Wheeler Cond. & Engineering Co. of New York, as Engineer on the road, and give your schools a good deal of the credit, backed up by an apprenticeship with the Providence Engineering Works.

I would be nowhere without the instruction in the Mechanical Drawing connected with my course.

WM. LONSDALE,
97 Arnold Street, Providence, R. I.

At the time of my enrolment I was engaged as helper in a Montreal Machine Shop at $6.00 per week. Since then I have held many important positions in Canada and U. S. as Chief Engineer and Superintendent with an *8-fold increase in salary*. Am at present General Superintendent, Department of Mines and Minerals, for a large Canadian firm.

My opinion of the Schools is that they supply the only practical way or means of obtaining the necessary technical education for the large class who, like myself, had not the opportunity of obtaining a university education.

JOSEPH BRADLEY,
71 St. Francois-Xavier, Three Rivers, Quebec, Can.

INTERNATIONAL CORRESPONDENCE SCHOOLS,
Box 1102 SCRANTON, PA.

Please explain, without further obligation on my part, how I can qualify for the position before which I have marked X.

General Foreman	Banking
R. R. Shop Foreman	Electrical Engineer
R. R. Traveling Eng.	Machine Designer
R. R. Trav'g Fireman	Electrician
Locomotive Engineer	Mining Engineer
Air-Brake Instructor	Mine Foreman
Air-Brake Inspector	Foreman Machinist
Air-Brake Repairman	Chemist
Mechanical Engineer	Assayer
Mechanical Draftsman	Architect
R.R. Construction Eng.	Bookkeeper
Surveyor	Stenographer
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Name __________

Employed by __________ R. R.

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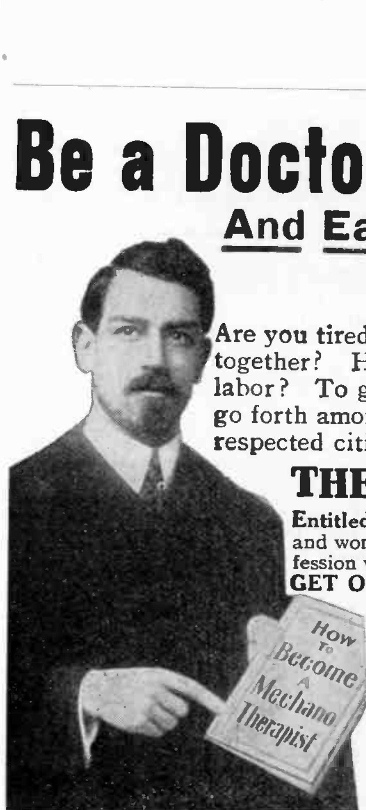
City __________ State __________

Be a Doctor of Mechano-Therapy

And Earn $3000 to $5000 a Year!

You Can Learn in Class or By Mail.



Are you tired of working for wages which barely keep body and soul together? Have you the ambition to enjoy the profits of your own labor? To gain social prominence and financial independence? To go forth among your fellow men with your head up—an honored and respected citizen of your locality?

THEN SEND FOR OUR FREE BOOK

Entitled "How to Become a Mechano-Therapist." It tells how every man and woman, with an ordinary, common school education, can acquire a profession within a few months which will insure financial independence for life. **GET OUR BOOK**—it costs you nothing.

What is Mechano-Therapy?

Mechano-Therapy is the art, or science, of treating disease without drugs. It is similar to Osteopathy, but far superior, being the latest, up-to-date method of treating disease by the Natural Method. It heals as Nature heals—in accordance with Nature's laws.

The Mechano-Therapist is a drugless physician and a bloodless surgeon. His medicines are not drugs, but scientific combinations of food, circumstance, idea, water and motion.

The Mechano-Therapist is skilled in compelling the body TO DO ITS OWN HEALING with its own force, rather than with poisonous drugs of the old school practitioner.

CAN I LEARN IT?

Have you asked yourself this question? We answer, unhesitatingly, YES.

If you have so much as an ordinary, common school education, you can learn.

If you have the ambition to better your condition—to earn more money—to have more leisure—you can learn.

Nor does this require years of patient study to learn Mechano-Therapy—we can teach you in a very short time, so that you may enter this profession—and when you do, you begin to make money. No text books are required, beyond those furnished by us. We supply all lessons and necessary text books free of cost to you. No apparatus is used. You do not even need a place to work. All you require is your two hands.

A Personal Word

From the President of the College.

Have you ever thought of going into business for yourself?

Then send for my FREE book. It will tell you how others are enjoying a life of luxury, while putting money away in the bank. How YOU can not only gain independence, but be a benefit to humanity and a highly respected citizen with an income of $3,000 to $5,000 a year.

All I ask is that you send me the coupon below for my FREE book. You can then decide, in the privacy of your own home whether you wish to embrace the opportunity which I offer you, or whether you will continue to plod along the balance of your days slaving for others.

Splendid Money-Making Possibilities

in Mechano-Therapy for Ambitious Men and Women

No matter what your occupation may be Mechano-Therapy offers you a new uncrowded field for improving your social position and money-making powers. Hundreds of men and women in all walks of life have taken up Mechano-Therapy and many of them are today independent, earning big money and gaining social prominence in their communities.

If You Possess a Common School Education

Mechano-Therapy Holds Out Equal Opportunities for Men & Women to Earn Big Money

The earnings of the Mechano-Therapist are limited only by the amount of time given to the business. Every community offers plenty of business opportunity for the energetic workers to establish themselves in money-making positions.

Age is No Bar to Your Success

We Teach You in Your Own Home

We can teach you an honorable and profitable profession in a few months, which will insure your financial independence for life. We can make you master of your own time—to come and go as you will—an honored and respected citizen, with an income of $3,000 to $5,000 a year. We teach you this pleasant, profitable profession by mail, right in your own home, at your own convenience, and without interfering with your present duties. It makes no difference how old you are, any person—man or woman—with just an ordinary common school education, can learn Mechano-Therapy. It is easy to learn and results are sure. It is simply drugless healing. A common-sense method of treating human ills without dosing the system with poisonous drugs—that's all. We have taught hundreds of men and women who were formerly clerks—farmers—stenographers—telegraph operators—insurance agents—railway employes—in fact, of nearly every known occupation—old men of 70 years who felt discouraged and hopeless—young men of 20 years, who never had a day's business experience—salaried men, who could see nothing in the future but to become Oslerized—laboring men, who never realized that they had within themselves the ability to better their conditions. Write for our FREE book, which explains all—today.

Cut Out This Coupon and Mail It Today

AMERICAN COLLEGE OF MECHANO-THERAPY,
Dept. 923, 120-122 Randolph Street, Chicago, Ill.

GENTLEMEN:—Please send your book, "How to become a Mechano-Therapist," free of cost to me.

My Name..

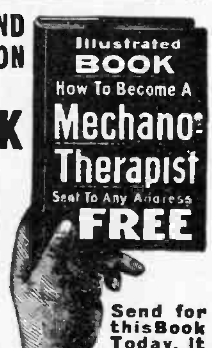
My Post Office..

R. F. D. or St. No..................................State..........
(Write name, town and state very plain)

SIMPLY SEND THE COUPON FOR THIS FREE BOOK

Try to realize what this opportunity means TO YOU. If you are contented, and willing to drudge for others all your life for a mere pittance, our proposition may not interest you. But if you have a spark of manhood or womanhood left—any ambition whatsoever to improve your condition socially and financially, learn this pleasant profession. It will make you independent for life. *It is so easy—so VERY easy—to get all the details—without trouble or expense. Simply sign and send us the coupon now.*

AMERICAN COLLEGE OF MECHANO-THERAPY
Dept. 923, 120-122 Randolph St., Chicago, Ill.



Send for this Book Today, It is FREE

These Men and Women

GRADUATES OF THE

American College of Mechano-Therapy of Chicago

ARE ALL SATISFIED AND ARE EARNING BIG MONEY IN THE WELL-PAID AND UNCROWDED PROFESSION OF

MECHANO-THERAPY

Read These Letters

We have many hundreds of letters on file in our office similar to these from professional men, ministers, teachers, clerks, stenographers, laborers—in fact, almost every occupation is represented.

These People Have Succeeded—Why Not You?

The Oldest Student—Seventy-Six Years Old—Says: "Lessons Easily Mastered."

J. H. Conway, M.-T., writes:
"Lessons are easily learned by anyone with ordinary intelligence and a common school education.
"I am seventy-six years old—most likely the oldest student you have."

"I Make $10 to $15 Per Day, and Work Seven Days a Week."

Dr. F. W. Leslie, M.-T., writes:
"I make from $10 to $15 a day, and work seven days a week. I am busy all the time."

A Prominent European Instructor Says: "Your Course is Most Complete."

Edward Arffman, M. T., writes: "I passed a four years' course of learning in hospitals, served in the Danish Royal Life Guards, was a physical director, took three-year course in Examination, Theory and Practice in Europe, and now have earned my diploma in Mechano-Therapy. Thanks for it. Your course is most complete."

"I Am Getting a Good Practice in Mechano-Therapy."

Dr. Sam Levy, O. D., M.-T., writes:
"I am doing a good business and getting a good practice in Mechano-Therapy, which goes good with my profession of Optometry."

"Time Spent and Price of Tuition a Fine Investment."

Rev. F. E. Hall, M. T., writes:
"The time spent and the price of tuition in your course will be a fine investment. I put the principles I learned into practice and demonstrated the wonderful facts."

Mechano-Therapy Worked Wonders Even in the Hands of a Beginner.

Anna M. Davis, M. T., writes:
"I surprised myself by accomplishing a number of successful cures. Your course is so complete in every way that the student who has earned a diploma should be thoroughly competent to take his place among the other practitioners of the healing art."

Your Instruction Beyond My Expectation

Dr. Louis H. Luetten, M-T., writes:
"I thank you and the school for the good you have done me through your instructions, which have been beyond my expectations entirely."

Received $2.50 to $5.00 for a Single Treatment.

P. W. Dyment, M. T., writes:
"In my one year's practice I have never given a single treatment for less than $2.50 and the most was $5.00."

Makes $25 to $30 Per Day

E. L. Stout, M-T-D., writes: "I now get patients from four different States, and make as high as $25 to $30 per day. I feel that in Mechano-Therapy there is financial success for all."

Self-Supporting Women Should Take Up Mechano-Therapy

Elizabeth J. Mars, M-T., writes:
"I would recommend any self-supporting woman to take up Mechano-Therapy as a profession. The lessons are easy and plain, and there is no trouble in understanding them."

Income $15 Per Day; Formerly a Blacksmith

W. S. McClure, M-T., writes: "I heartily endorse your college and recommend it to others. The man who induced me to take a course in Mechano-Therapy was formerly a blacksmith with an ordinary education. Today he is practicing Mechano-Therapy with an average income of $15 a day."

"I Am Doing Very Well."

Elizabeth S. Rosensteel, M. T., writes:
"The course given by your college is plain, clear and easily comprehended. Anyone with an ordinary education can soon master the course. I have succeeded in every case and am doing very well."

Successful Financially; Scores of Satisfied Patrons

C. Alfred Davy, M-T-D., writes: "I get results beyond even what I had anticipated. I have scores of satisfied patrons and of the financial end I have no cause to complain. I recommend your course as thorough and practical."

Doing Better Financially in Mechano-Therapy Than Formerly in the Profession of Electrical Engineering,

John E. Lydon says:
"I have done better financially since I entered the profession of Mechano-Therapy than when I formerly followed the profession of Electrical Engineering. There is no doubt of one's success in Mechano-Therapy if the instructions as taught are carefully followed."

One of Our Most Successful Graduates, located in New York City, writes:
"I cleared $80.00 above all expenses in four days' time."

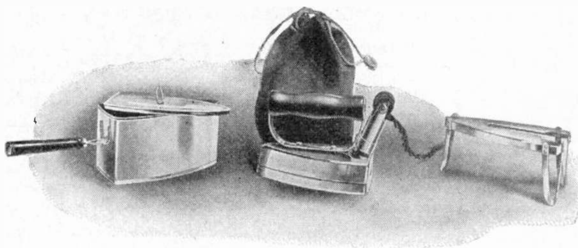
WHY BE A WAGE SLAVE—WHY BE A DRUDGE FOR OTHERS?

Try to realize what this opportunity means to you. If you wish to become independent of job hunting and employers, if it is your hope to have a profitable business of your own, Mechano-Therapy offers to you this very minute a grand opportunity for self improvement, social and financial success. There is no other profession that a man or woman can enter in the same short time or for as small an amount of money that will pay one-fourth as well as Mechano-Therapy.

Send for the free Book—read it—then decide for yourself. Use the coupon on the page opposite.

The Electric Traveling Utility Outfit

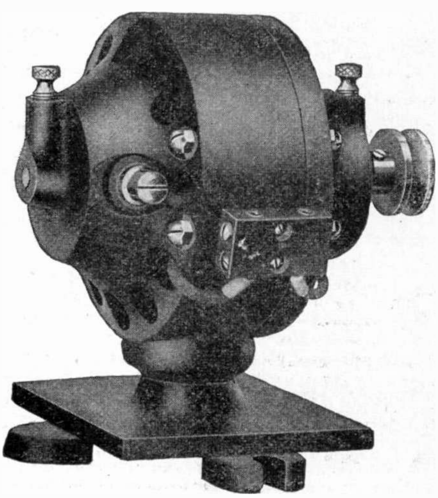
Total Weight of Complete Outfit only 3¼ pounds



Price, Express Prepaid, only $6.50

This handy little electrical outfit is simply ideal for travelers. Can be used in hotels, on board steamers, at summer cottages and it is always convenient at home. It consists of a 2½ pound iron, at the base of which is a curling iron heater; a 1½ pint metal dish, fitted with tight fitting lid and detachable handle;

The stand holds the iron in the ordinary position while in use for ironing, and holds the iron upside down for cooking, making the iron an electric stove. The entire outfit comes in a dainty ooze leather bag with 8-foot connecting cord and plug. **Price, Express paid, $6.50.**



Small Electric Motors

This Motor will develop approximately 1-30 H. P., and will operate on 110 volts, both direct and 60 cycle alternating current. Is very efficient for operating various toys, window displays, small buffing, grinding and polishing wheels, etc. Consumes about same amount of current as 8 c. p. lamp.

Strongly constructed; laminated fields; laminated armature; 12 section commutator; uses a regular 3-16 inch carbon brush; equipped with compression grease cups, and bronze bearings, assuring perfect lubrication. Weight, 4¼ pounds; height, 5 inches. **Price, express paid, $7.00.**

Other Things Electrical

Shaving Mirror	$4.25	Water Heater	$5.00 up
Hot Water Cup	4.25	Heating Pad	5.00 up
Curling Iron Heater	3.20 up	Coffee Percolator	10.50 up
Curling Iron	3.85	Chafing Dish	10.50 up
Bread Toaster	3.85 up	Massage Vibrator	26.00 up
Luminous Radiator	16.00	Foot Warmer	7.80 up

The above sent express prepaid at prices given.

ELECTRIC SHOP {Michigan and Jackson Blvds.} **Chicago, Ill.**

CLASSIFIED ADVERTISING

Advertisements in the section of Popular Electricity, will cost 40 cents a line, cash with order, and in order to secure proper classification must be in this office the first of the month preceding date of issue

Vibrate Your Body And Make it Well

VIBRATION FOR THE RACKING BACKACHE OF WOMEN

You have no *right* to be sick.

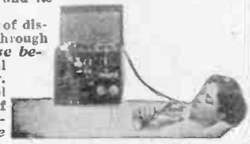
Pain, suffering and disease are unnatural, they are *wrong.* It is your *duty* to be well. Don't try to *stand* pain—*CURE IT.* No matter *what* ails you—even if others have told you that your case was *incurable—DON'T GIVE UP HOPE.* The great natural forces, *Vibration and Electricity,* are curing more people today *than all the drugs and doctors in the world put together.*

THE WHITE CROSS ELECTRIC VIBRATOR combines *both* of these great natural curative agents. It gives you yonr choice of Vibration, Faradic and Galvanic Electricity, either separately or in combination, just as you wish. It relieves pain *instantly,* and its *cures are permanent.*

The White Cross Electric Vibrator cures the *cause* of disease. It sends the rich, red blood leaping and coursing through your veins and arteries *straight to where the disease begins.* It tones up your nerves and muscles and every vital organ. It makes you *fairly tingle with the joy of living.*

Don't neglect the FIRST symptoms. If you feel "run down," "out of condition," if you just feel "out of sorts" generally, *something is wrong.* The *most serious* diseases creep upon you unawares. *The White Cross Electric Vibrator* fills your body *so full* of vigorous, robust health that pain and disease cannot find a foothold.

Curing Stomach Trouble with Vibration.



Combined Electric Bath and Vibratory Treatment.

FREE BOOK
"Health and Beauty"

SEND TODAY for the magnificent free book, "Health and Beauty." This valuable work tells you all about the human body in health and disease *in terms so plain, so clear,* that anyone can *understand.* It tells you how you can *get* well and *keep* well, no matter *what* your trouble is. This book was not written for surgeons and physicians, but for *you.* Every page, every line, is thrillingly interesting.

Besides, this book tells you all about the wonderful *White Cross Electric Vibrator*—what it has done for thousands of others and what it will do for you. It tells you about the *very special offers* which we are making, *for just a short time,* on this wonder-working instrument, and how you can get a *White Cross Electric Vibrator* on a *genuine free trial.* Your name and address brings this intensely interesting book by return mail. Sign the coupon and mail it to us at once.

Making the Hair Beautiful with Vibration.

CURES THESE DISEASES AND MANY OTHERS

Headache	*Nervous Debility*
Catarrh	*Bright's Disease*
Insomnia	*Heart Trouble*
Toothache	*Deafness*
Indigestion	*Stomach Trouble*
Rheumatism	*Scalp Disease*
Neuralgia	*Constipation*
Earache	*Lumbago*

All these and dozens of other chronic and acute diseases instantly relieved and permanently cured by Vibration and Electricity. Get our wonderful free book, "Health and Beauty." THEN you will know.

Vibrating Chair Free

With the *White Cross Electric Vibrator,* you can transform any ordinary household chair into a Vibrating Chair, equal *in every respect* to those used in the big hospitals and sanitariums. You can give yourself the same treatments, including the *famous Swedish Movement* treatments, that specialists and sanitariums charge $2.00 to $3.00 apiece for. This is only one of the many marvelous things that can be done with the *White Cross Electric Vibrator exclusively.*

Send Coupon Today For Free Book

DON'T DELAY A MINUTE. Whether you are *sick* or *well,* you should send for this book *anyway.* You cannot tell when you *may* need it and need it *badly.* When you do there will be no time to send for it. Learn *today* what vibration will do for you—for all your loved ones. Learn all about its wonderful health-giving powers. Learn how you can save all doctor bills and cure yourself right at home without expense.

SEND NO MONEY, just your name and address on the coupon. *But write today.*

LINDSTROM, SMITH CO.
253 LaSalle Street
Dept. 1402 CHICAGO

SIGN AND MAIL THE COUPON TODAY

LINDSTROM, SMITH CO., 253 LaSalle St., Dept 1402 CHICAGO

Without obligations on me, please send free, prepaid, your book "Health and Beauty," on treatment of disease by Vibration and Electricity. Also free trial offer.

Name.........................

Address.........................

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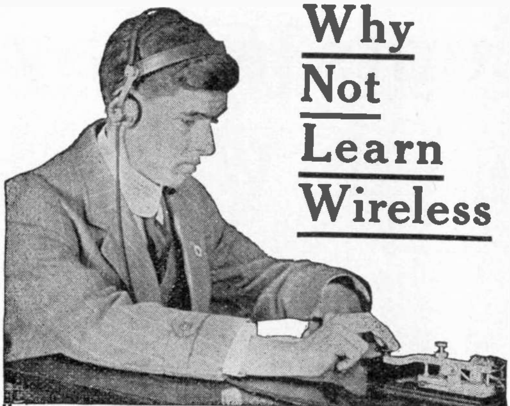


Why Not Learn Wireless

¶ All over the country today the big wireless telegraph and telephone corporations are endeavoring to get reliable, trustworthy operators.

¶ The demand is greater than the supply—good men are scarce. It's the golden opportunity for the young man of brains and ability.

A Complete Course for Wireless Students

The American Wireless Institute, which is the most complete school of its kind in the United States, is now preparing hundreds of young men and women to fill positions of trust as wireless operators.

We teach by the only satisfactory method—practical working experience. Our study rooms are filled with complete wireless instruments—students get the actual experience of sending and receiving messages.

We educate our students in Wireless construction in all its branches—teach them the proper care and use of all instruments in Wireless work.

Wireless Operators Get Big Salaries

The pay for Wireless operators and engineers ranges from $60 to $175 per month, according to ability.

But this is not all—think of the vast opportunities offered in the Wireless field, for the young man who is industrious and reliable.

Big corporations, with millions of capital, are entering this field and there is absolutely no limit to the advancement offered to the man with push and ability.

Every young man who is mechanically inclined should have our catalog—it gives complete details of our course—shows you plainly how we teach you to become a Wireless operator.

Positions Waiting for Our Students

We are continually receiving at our office, requests from every part of the country for trained men, and it is an easy matter for us to find good positions for our students as fast as they fit themselves for practical work.

Don't let this chance slip by. Sit down right now and write for our prospectus. We will send complete details by return mail.

AMERICAN WIRELESS INSTITUTE

27 William Street **New York, N. Y.**

Wireless Club

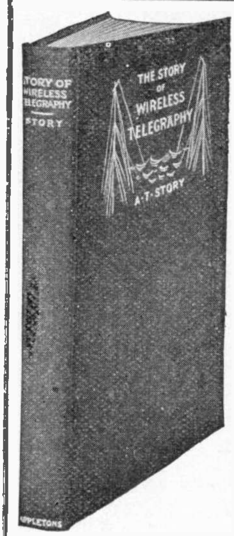
If you are a Wireless Operator or are building Wireless Telegraph Equipment you will want to join

Popular Electricity Club

Send for particulars and membership blank.

You will also want this splendid

WIRELESS BOOK



THE STORY OF THE WIRELESS TELEGRAPH

Non-Technical
In Plain English
Illustrated

Sent with one year's subscription (new or renewal) to Popular Electricity for $1.50

Popular Electricity Pub. Co.

Monadnock Block :: CHICAGO, ILL.

I enclose herewith $1.50, for which enter me for one year's subscription to **Popular Electricity** and send me The Story of Wireless Telegraphy.

Name..................................

Address................................

City...................................

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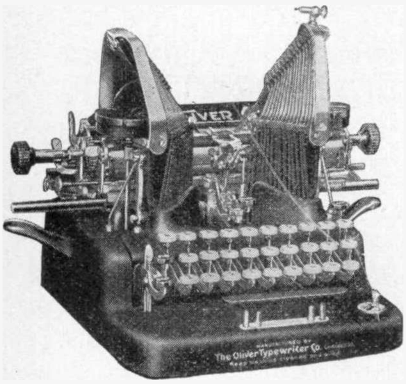
Seventeen Cents a Day

Buys an Oliver Typewriter!

This amazing offer—the New Model Oliver Typewriter No. 5 at *17 cents a day*—is open to everybody, everywhere.

It's our new and immensly popular plan of selling Oliver Typewriters on little easy payments. The abandonment of *longhand* in favor of clean, legible, beautiful *typewriting* is the next great step in human progress..



Already—in all lines of business and in all professions—the use of *pen-and-ink* is largely restricted to the writing of *signatures.*

Business Colleges and High Schools, watchful of the trend of public sentiment, are training a vast army of young people in the use of Oliver Typewriters.

The prompt and generous response of the Oliver Typewriter Company to the world-wide demand for *universal typewriting*, gives tremendous impetus to the movement.

The Oliver, with the largest sale of any typewriter in existence, was the logical machine to take the initiative in bringing about the *universal use* of typewriters. It *always* leads!

Save Your Pennies and Own an Oliver

This "*17-Cents-a-Day*" selling plan makes the Oliver as easy to *own* as to *rent*. It places the machine within easy reach of every *home*—every *individual.* A man's "cigar money"—a woman's "pin money"—will buy it.

Clerks on small salaries can now afford to own Olivers. By utilizing spare moments for practice they may fit themselves for more important positions.

School boys and school girls can buy Olivers by saving their *pennies.*

You can buy an Oliver on this plan at the regular catalog price—$100. A small first payment brings the machine. Then you save 17 cents a day and pay monthly.

And the possession of an Oliver Typewriter enables you to *earn money to finish paying for the machine.*

Mechanical Advantages

The Oliver is the most highly perfected typewriter on the market—hence its *100 per cent efficiency.*

Among its scores of conveniences are:

- —the Balance Shift
- —the Ruling Device
- —the Double Release
- —the Locomotive Base
- —the Automatic Spacer
- —the Automatic Tabulator
- —the Disappearing Indicator
- —the Adjustable Paper Fingers
- —the Scientific Condensed Keyboard

Service Possibilities

The Oliver Typewriter turns out more work—of better quality and greater variety—than any other writing machine. Simplicity, strength, ease of operation and visibility are the corner stones of its towering supremacy in

- —Correspondence
- —Card Index Work
- —Tabulated Reports
- —Follow-up Systems
- —Manifolding Service
- —Addressing Envelopes
- —Working on Ruled Forms
- —Cutting Mimeograph Stencils

Can you spend 17 Cents a Day to better advantage than in the purchase of this wonderful machine?

Write for Special Easy Payment Proposition or see the nearest Oliver Agent.

4166

The Oliver Typewriter Co., 47-55 Dearborn St., Chicago, Ills.

10 DAYS FREE TRIAL

We will ship you a **"RANGER" BICYCLE** on approval, freight **prepaid**, to any place in the United States *without a cent deposit in advance*, and allow **ten days free trial** from the day you receive it. If it does not suit you in every way and is not all or more than we claim for it and a better bicycle than you can get anywhere else regardless of price, or if for any reason whatever you do not wish to keep it, ship it back to us at our expense for freight and you will *not be out one cent*.

LOW FACTORY PRICES We sell the highest grade bicycles direct from factory to rider at lower prices than any other house. We save you $10 to $25 middlemen's profit on every bicycle. Highest grade models with Puncture-Proof tires, Imported Roller chains, pedals, etc., at prices no higher than cheap mail order bicycles; also reliable medium grade models at **unheard of low prices.**

RIDER AGENTS WANTED in each town and district to ride and exhibit a sample 1910 **"Ranger"** Bicycle furnished by us. **You will be astonished** at the *wonderfully low Prices* and the liberal propositions and special offer we will give on the first 1910 sample going to your town. **Write at once** for our *special offer*. **DO NOT BUY** a **bicycle** or a pair of **tires** from *anyone at any price* until you receive our catalogue and learn our low prices and liberal terms. **BICYCLE DEALERS**, you can sell our bicycles under your own name plate at double our prices. Orders filled the day received. **SECOND HAND BICYCLES**—a limited number taken in trade by our Chicago retail stores will be closed out at once, at **$3 to $8 each.** Descriptive bargain list mailed free.

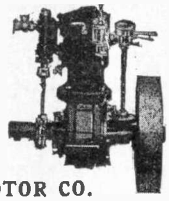
TIRES, COASTER BRAKE rear wheels, inner tubes, lamps, cyclometers, parts, repairs and everything in the bicycle line at **half usual prices. DO NOT WAIT**, but write today for our *Large Catalogue* beautifully illustrated and containing a great fund of interesting matter and useful information. It only costs a postal to get everything.

Write It Now. MEAD CYCLE CO. Dept. G234 CHICAGO, ILL.

---

2 to 25 hp. 1 to 4 cyl. PERFECTION ENGINES $29 to $450 Marine and Stationary

The most powerful, efficient, highest grade, finest finished engines in the world for the money. Sold under a binding guarantee to give satisfaction.

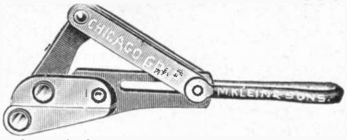


2 H.P. $48 Complete

Send at once for handsome Catalogue and make us PROVE our claims. The 2 H. P. illustrated is a wonder. Order today or write.

CAILLE PERFECTION MOTOR CO.
1315 2nd Ave. DETROIT, MICHIGAN

KLEIN'S NEW "CHICAGO GRIP."



Is the Best, Cheapest, the most Powerful and Useful Wire Grip on the market. It is made of steel throughout, and Nickel Plated. It is a well proportioned and thoroughly reliable tool. It is just the right shape to handle quickly. It is light, and when placed on the wire will hold itself in place. It can be pushed out on the wire, so as to get as much slack as necessary, and it pulls straight, leaving no kinks in the wire. It covers all the essential points required of a grip to do good work, on either copper or iron wire.

No. 0358 holds Nos. 10 wire to the smallest, each $1.90 net
No. 358A holds Nos. 6 wire to the smallest, each 2.00 net
No. 358C holds Nos. 0 wire to the smallest, each 3.30 net
No. 358E holds Nos. 0000 wire to the smallest, each 5.00 net

We can furnish any of the above grips with pulleys, extra. We also make this style grip for insulated wire. Write for copy of our catalog and discount sheet, showing all kinds of tools for Electrical Construction Work.

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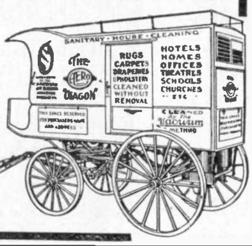
$2,000.00 to $3,000.00 A YEAR IN VACUUM CLEANING BUSINESS

A steady, sure, permanent income of from $2,000 to $3,000 a year is easily and quickly established in cities from 5,000 up, with the Aero Vacuum Cleaning Power Wagon. Running expenses are small and profits remarkably big. Safer, more profitable than any other line of staple investment. Makes money from the day wagon arrives. $1,000 starts you. The Aero Power Wagons are standard—established by years of test. The only apparatus of enough power to do effective commercial cleaning. Send for wagon catalog. Largest builders in the world of Built-into-the-house Vacuum Cleaning Systems. Send for "Stationary Plant" catalog, stating kind and size of building.



American Air Cleaning Company
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Delivered East of Omaha and North of Ohio River
Pipes and Registers Extra

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The entire outfit **must satisfy** you or you pay nothing. Isn't this worth looking into? Could we offer such liberal terms if we didn't know that the **Hess Furnace** excels in service, simplicity, efficiency, economy?

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Your name and address on a post card is sufficient.

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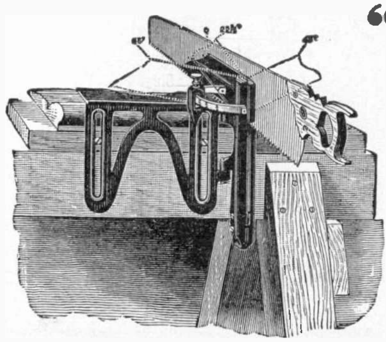

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Meets Every Requirement

Can be used on a scaffold or ladder as well as on a bench. Cuts any angle---special or regular. Needs no special saw. Lightest box made. Can be instantly applied. Made so that it is attachable to inside or outside work without a special attachment. Weighs only 2 pounds $2.50 each. Your dealer or

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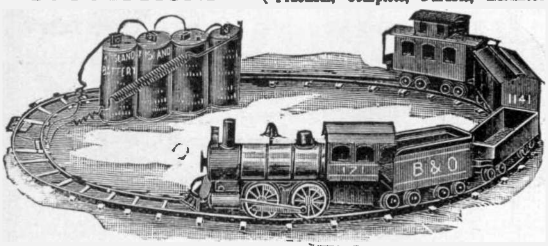

EVERY boy in the country can easily *own* a railroad. Costs little and pays big dividends in fun. Our Models of **Locomotives, Trains, Trolley Cars, Dynamos, Lamps, etc.,** are practical and durable inventions. Equipped with dry batteries, no acids or liquids used, perfectly safe and harmless. Electrical toys instruct as well as amuse.

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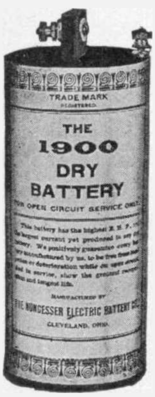

Which can only be proven by its use, at which time you will agree that the high electro-motive-force and great efficiency make it the best battery on the market.

This cell is made with the view of obtaining the longest possible life under the most exacting requirements.

Recommended especially for **Experimenters, Small Wireless Outfit, Gas Engine Ignition, Telephones** and all open circuit work.

Write today and secure our catalog, which gives full particulars regarding sizes and prices.

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FOR THE { HOME, OFFICE, STORE or FACTORY

¶ Our Pacific Portable Lamp may be attached to any convenient fixture, bracket or drop light and easily carried to the desired point in a room.

¶ The lamps are adjustable and can be raised and lowered at will.

¶ The hoods are so arranged that the light can be thrown at any desired angle.

¶ **This lamp has no equal for convenience—durability** and it will be found a necessity—not a luxury.

¶ When once used it is impossible to do without one.

¶ **Price complete, ready for use—$5.00**

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TESTED APPARATUS Means the Elimination of Faults in Your Product.

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Illumination tests made anywhere.
Secondary standards of candle-power furnished.
Facilities furnished to experimenters and investigators.

We have recently added to the above, coal testing, and are now prepared to make approximate analyses and calorific determinations on samples of coal, promptly and accurately.

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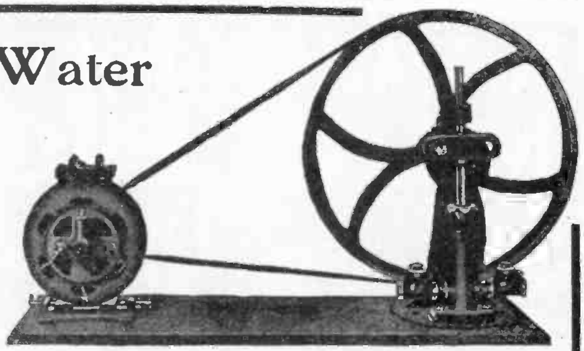

You can have running water anywhere on one condition — that you have electricity available to run the Motor. Water — all you want of it — at any time — in every room in the house, in the stable, factory or office, by use of a

Jarvis Electrical House Pump

Disconnect the Pump and you have all the power needed to run the feed mill, corn sheller, churn, washing machine, cream separator and for scores of other labor-saving purposes. Where electricity is available this outfit is invaluable—especially for country residences, hotels and clubs. A special outfit for every need. Tell us what your requirements are—we'll tell you what combination will best suit you.

There are hundreds of JARVIS OUTFITS in use—each and every one giving entire satisfaction. Write to

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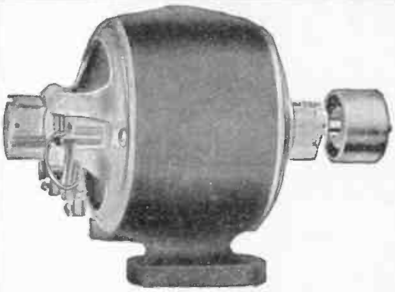

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for Motor Boats, Country Homes, Stores, Small Factories and Laboratories.

We have the best and most complete Lighting System for such purposes ever made.

We furnish a High Grade Dynamo, Switchboard and Storage Battery.

It will pay you to write to us at once. Our Lighting System has some very interesting features about it, some of which are: first low selling cost, simplicity, durability and economy.

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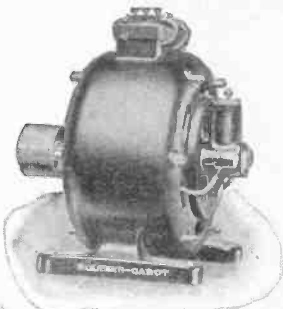

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Our Engineering department is especially equipped for this purpose, and therefore guarantee you satisfaction.

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What progress have you made in providing for the future of yourself and family? Are you satisfied with the results? If not, **now is the time to turn over a new leaf and get a new start.** We are offering you a chance to better your conditions and provide for future emergencies.

We Start You in a business of your own right in your own town. Every man or woman, no matter how humble, is entitled to at least the profits of their own labor. If you have the ambition to better your condition—to be somebody—to provide for yourself and family—to enjoy success, happiness and prosperity—we can help you. Sign and send the coupon now.

Our Business is the manufacturing of canvas gloves and mittens. The demand for these goods has increased by jumps and bounds, way beyond our ability to manufacture them. For that reason we are compelled to look for outside assistance and are willing to help others, who are willing to help themselves, to get a start in this business. There is room today for **ten** canvas glove factories where we have **one** now. Start a factory with our help.

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Immense Profits are made in this fascinating business. The McCreery Brothers started only a few years ago without a cent. Today they have thousands of dollars, own their own large factory, have interests in others, and do an enormous business. They have started a few other men and women in the glove business, and they will help you to start, too, furnishing you with the necessary equipment for starting free, and teaching you the secrets of the business.

Unlimited Demand There is no class of goods for which there is such a steady demand as for canvas gloves and mittens. Everybody uses them—the farmer, the mechanic, the doctor, the lawyer, the merchant, the laborer—in every section of the country—from Maine to California and from Minnesota to the Gulf.

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Millions of Pairs of canvas gloves are being sold. Somebody is getting the profit on these goods, *why not you?* Come with us and let us start you in this profitable, legitimate business which with a reasonable amount of light work and attention should make you a prosperous factory owner in a short time. **Each Member of the family can help**—father, mother, son and daughter can each do their share and as the business grows and develops help can be obtained on the outside. It is to your personal advantage, to the advantage of your pocket book to learn all about this wonderful offer we are making. All you need is the use of an ordinary sewing machine. We supply the other necessary equipment without cost. No matter how small or how large your town; no matter what section you live in, there is always room for a factory. You can start at home or in a small store room nearby. You can work all or only part of the time and can engage others to work for you.

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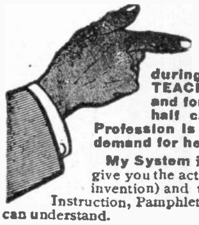

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during spare time, evenings at home. I CAN TEACH YOU and will GUARANTEE satisfaction and for the small sum of Ten Dollars and payable half cash and balance in 30 days. The Auto Profession is the coming profession. There is a big demand for help in all its branches and good pay.

My System is entirely new and different from others. I give you the actual **practice** on my models (a new European invention) and the "how and why" is learned from my simple Instruction, Pamphlets and Charts; so simple a boy ten years old can understand.

DYKE'S AUTO INSTRUCTION is something new, wonderful, clever and instructive.

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"I have never found anything as thoroughly adequate *and easily comprehended* as your course."—H. D. Haynes, Auditor of the Union Central Life Insurance Company, Cincinnati, O.

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We have hundreds of letters from customers all over the world and we have reproduced several of them in our Free Pamphlet right from the originals in order to convince you.

See These Models—They Work—There are two sides to each Model and some of the parts are made of actual metal.

If we could prepare you so that you could drive a car, repair autos and launches, in fact so thoroughly understand the subject that you could open a repair shop if you wanted, don't you think it would be ten dollars well invested.

DON'T YOU BELIEVE WE CAN TEACH BY MAIL?

Then let us have the pleasure of sending you a new pamphlet, just out, with reproductions of original letters from Doctors, Lawyers, Clerks, Mechanics, Ministers and others—Let us show you—

HOW WE TEACH YOU:

by **a** system of **Working Models** of Engine, Carburettor, Magneto, etc., that actually work, and our **interesting Lessons and Charts.**

Just Imagine, having in your room an **engine cut in half** and with each and every part lettered and numbered, also a Carburettor and Magneto lying on your study table while you study our interesting course—that's practically what we give you in our **working models.** You will play with these models like a boy with a toy and the more you play the clearer the subject will be to you.

In Addition we give 24 lessons, which are so interesting you will finish them all—they are illustrated with 34 large clear **charts.**

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Dyke's Course is the only course in the world which can successfully be taught by mail.

Mr. DYKE was the first Auto Supply man in America and built the fifth successful Automobile in this country. His experience is embodied in this course. Mr. Dyke made a special trip to Europe to secure additional matter for this great Course. The working models were designed and are made in Europe by a leading mechanical artist.

No matter how much you would pay you could not possibly get a course equal to this one.

SPECIAL TRIAL OFFER. Send us **$5 Cash** and your promise to pay the other $5 in 30 days. We will then send you the Course and will give you two days' time for inspection and if you don't like it return.

FREE INSTRUCTIVE PAMPHLET SEND FOR IT TODAY

CLASS BUTTON and DIPLOMA with each course.

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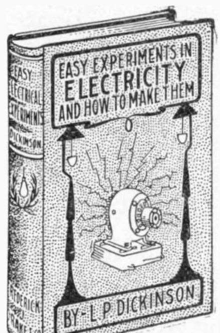

This is one of the most valuable works ever published.

Written in simple, easily understood language, fully illustrated with cuts and working drawings.

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Shows you how to make all kinds of batteries, electric bells, rheostats, condensers, large and small induction coils, an electrophorus, an automatic circuit closer; how to construct and use telegraph and telephone instruments, measure electrical resistance and pressure and make and use galvanometers and voltmeters.

Gives detailed directions for building a 1-20 horse power motor, explaining exactly how to make each of the various parts and assemble them correctly. Shows you how to do electro-plating at home, design a small dynamo, build an electric engine, an electric locomotive, a model fire alarm telegraph, make simple arc lamps, and light lamps by electricity. Also how to make an electric bomb, electric gyroscope and other electrical toys, etc., etc.

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And every one of these things is a bargain. We guarantee that no other house—either cash or credit—sells any one of these articles as low as we quote. We send all goods on approval, so you may return them if you find that this claim is not true.

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Finely finished and constructed in mission style. Chairs are upholstered in genuine fabricord leather. Every piece made of selected kiln-dried oak. $1.50 first payment, 75c monthly payments. Total price, $11.75.

All Four Pieces $11.75

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We will send anything you want on approval, and you may use it a month before even deciding to keep it. If it is not satisfactory—in price, style and quality—you may return it and we'll pay the freight both ways. The transaction will not cost you a penny.

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Cut out this coupon and state in it which catalog you want. Mail it to us before you forget it, and see what amazing offers you get.

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Spiegel, May, Stern Co.
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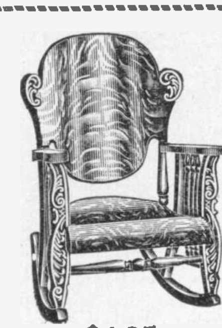
K-8018—Park Folding Go-Cart.

With entire steel running gear. Has cane seat and English leather hood, cloth lined. $1.50 first payment, 75 cents monthly payments. Total price, $8.95.



$4.35

K-5472—Quarter-sawed Oak Roll Seat Rocker.

Has shaped back and front posts. Full roll quarter-sawed oak seat. Decorated with handsome carving. 75c first payment, 50c monthly payments. Total price, $4.35.

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Will Lend Tone to Your Library, Parlor, Den or Office

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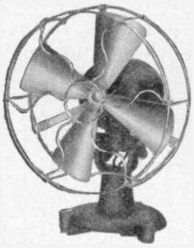
Consumes little more than half the current taken by an incandescent Lamp

Large Wind Out-Put

HAND-SOMELY FINISHED



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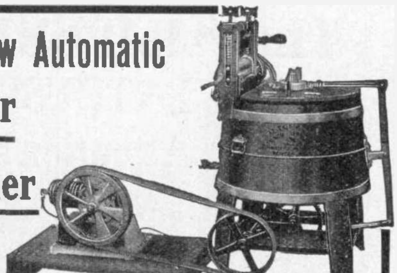

"The Automatic Power Washer" is specially adapted to be driven by a gasoline engine, counter shafting or motor which can be fastened to either the wall, floor, or any convenient out-of-the-way place, so that your washing is done automatically.

These machines are manufactured in two different types—"A" and "B." Type "B" is our latest type and is equipt with all of our latest improvements, including our reversible wringer which eliminates your clothes from becoming torn by the wringer rollers.

Write today for descriptive matter and prices.

Automatic Electric Washer Co.
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Speed the Work on Washday!

Use the 1900 Motor Washer a Month—at Our Expense!

The Washday "bugbear"—**DRUDGERY**—has been cornered, captured, **routed!** It has worried women since they first bent their backs to the task of washing clothes. And women still toil like galley slaves, fighting the demon of **Dirt**.

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Now comes the new way—the swift, efficient, smooth-working 1900 Motor Washer—a marvelous machine that lifts the entire burden from the shoulders of womankind!

Just a "twist of the wrist" and **presto!** the washer **starts!** **In 6 MINUTES—or less—your tubful of clothes is CLEAN.** The 1900 Motor Washer does **BOTH WASHING AND WRINGING**—quicker, better, cheaper than it was ever done before. A fine wringer goes with the outfit.

1900 Motor Washer
(Electric or Water Power)

Runs for 2c a Week

Two cents a week pays for Power to run either the Electric or the Water Motor Washer. We have both styles. If your house is wired for electric light or supplied with running water you should accept our remarkable offer of an outfit on

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The test will prove this the greatest Washer in all the world. It not only does washing and wringing, but

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The Portable Electric Motor will operate mangle, sewing machine, grindstone, vacuum cleaner, ice cream freezer, fan, polishing machine, etc. The Water Motor will do the same if pressure is sufficient.

Get One On Trial!

See the clothes made spotlessly clean in six minutes! See the wringing done! Try the Motors for running various light machines. **Remember—at our expense and risk!** Easy payments if you decide to keep it.

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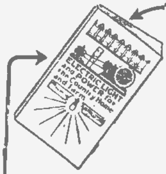

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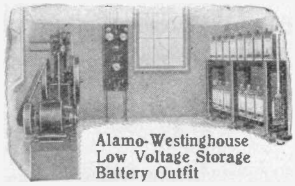

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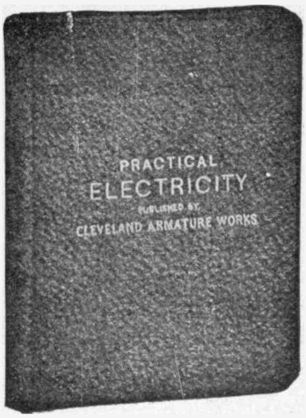

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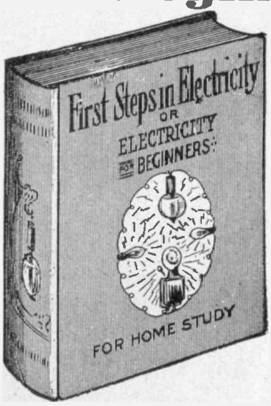

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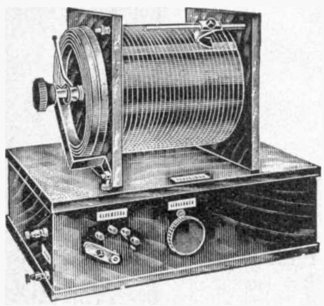

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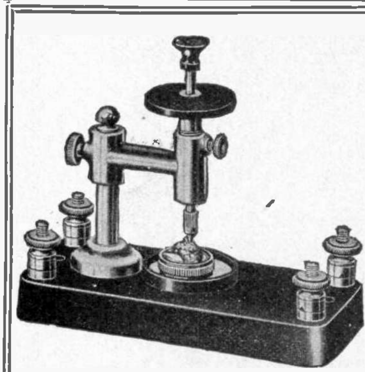

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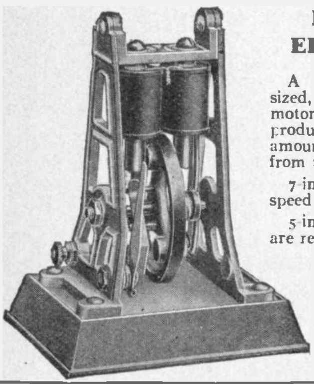

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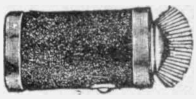

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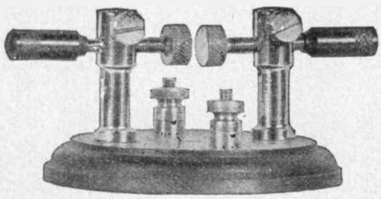

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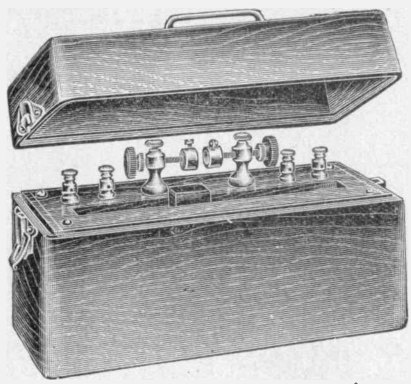

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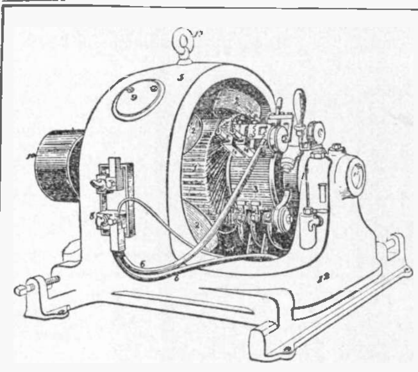

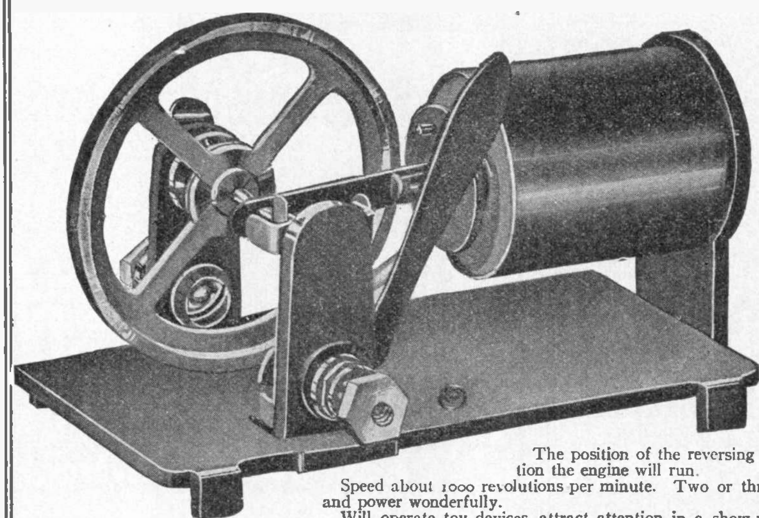

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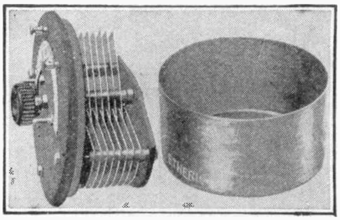

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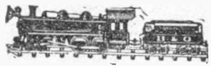

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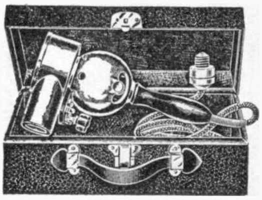

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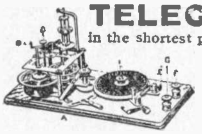

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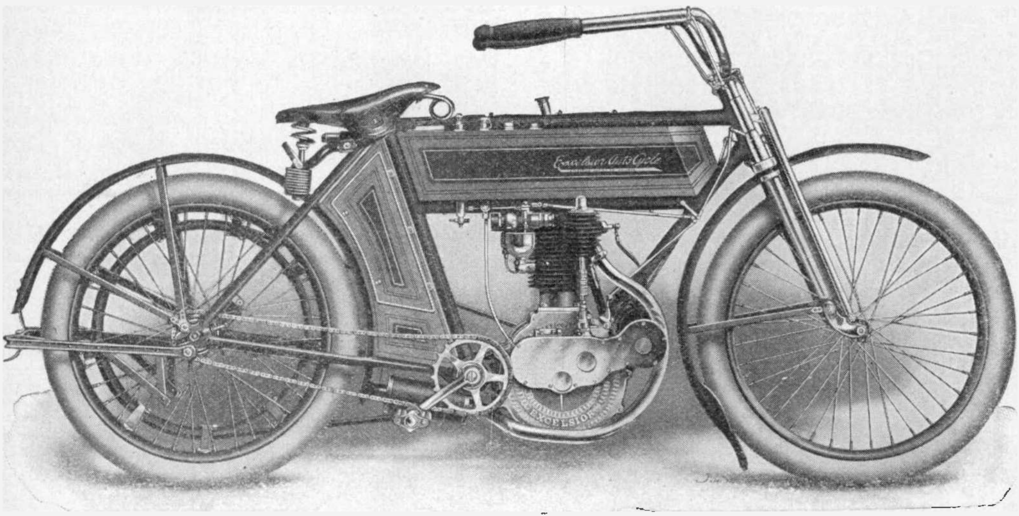
EXCELSIOR AUTO-CYCLE

BETTER THAN EVER FOR 1910



No Product of human skill and ingenuity has ever exceeded the record of the

EXCELSIOR AUTO-CYCLE

Designed and built by men who know, thoroughly tried and proven before being offered to the public, it **made good** and has become universally recognized as **the leader of American motorcycles.**

No changes in the 1909 model were found necessary and but few advisable, but we have added such refinements as mechanical force feed oiling system, valve silencer and the lowest saddle position ever attained in a road machine.

Our advance catalog H 10 tells all about this and the new **Excelsior Twin** that will excel all other motorcycles as the **Excelsior 30-50** excels all other single cylinders.

EXCELSIOR SUPPLY COMPANY

Established 1876 **233-237 Randolph St., Chicago, Ill**