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Vol. II

APRIL 1910

No. 12

POPULAR ELECTRICITY

IN PLAIN ENGLISH

HENRY WALTER YOUNG, Editor

Vol. II APRIL, 1910 No. 12

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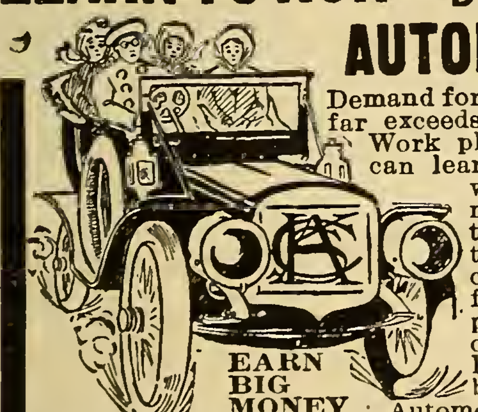

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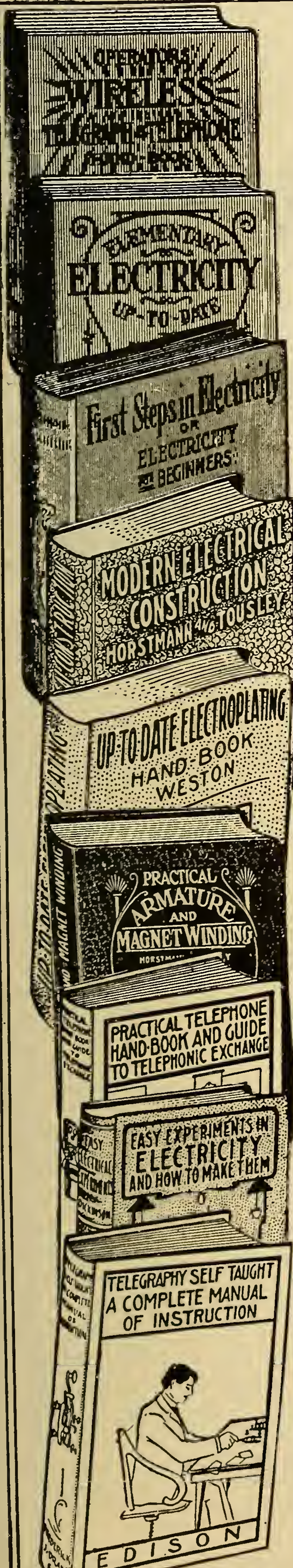

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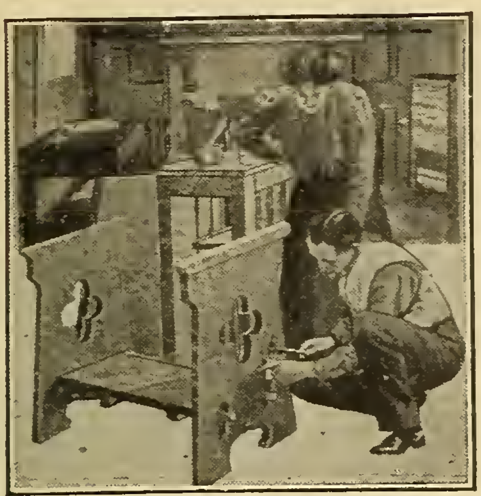

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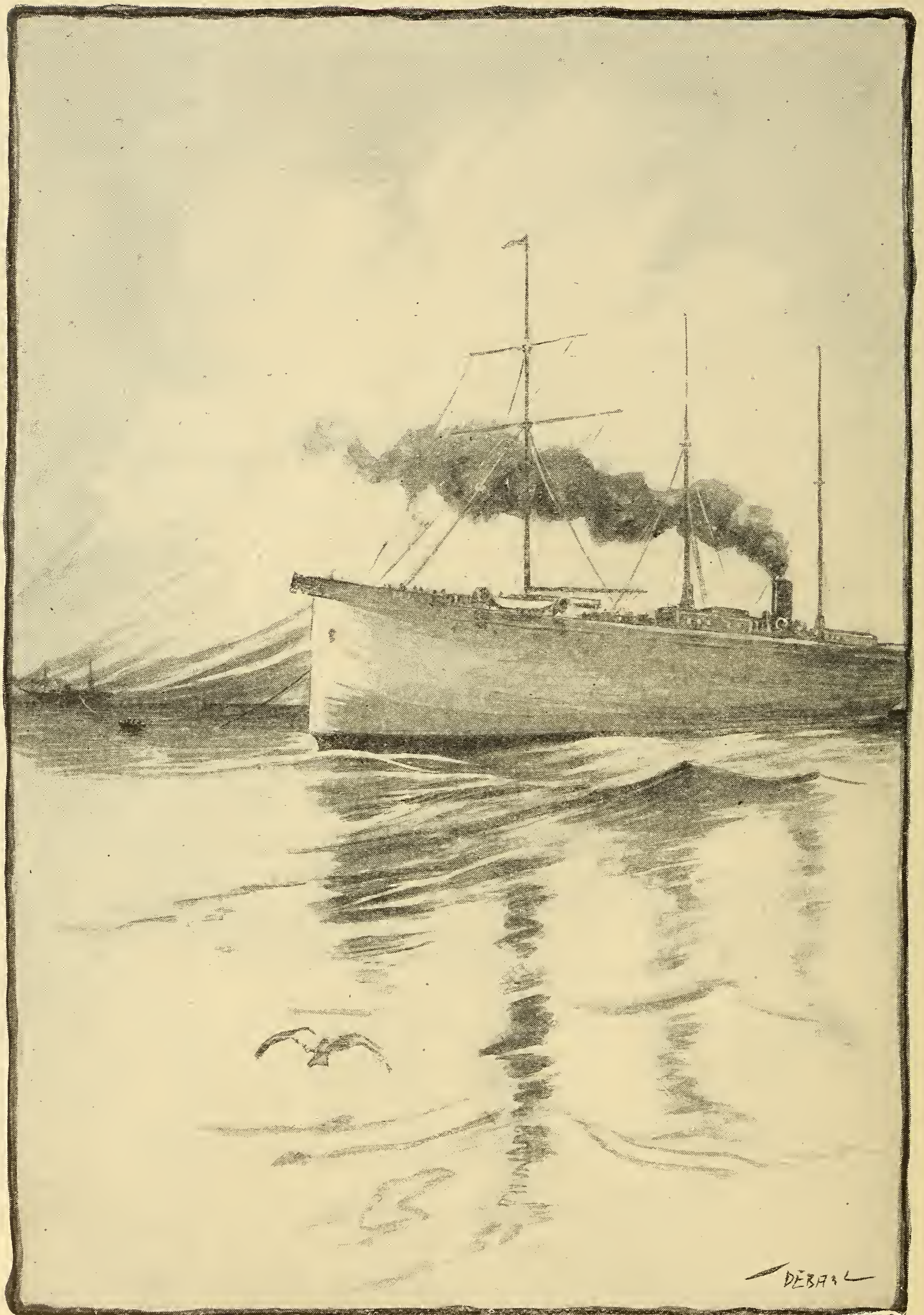

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THE CABLE WAS HAULED FROM OUR FRIEND'S TANK INTO OUR OWN

POPULAR ELECTRICITY
IN PLAIN ENGLISH

VOL. II APRIL 1910 No. 12

Telegraph-Cable Repairing on a Christmas Day

By DR. A. E. KENNELLY, Professor of Electrical Engineering, Harvard University

On board a submarine-cable repairing steamer there are no holidays while the work lasts, nor is Sunday a day of rest. From the necessity of the case work goes on without interruption, watch and watch, until the cable operated upon is completed, and the final splice is slipped from the bows.

Some five and twenty years ago, a cable ship, on which I served as electrical engineer, was engaged on the Indian Ocean, in repairing a cable between Aden and Bombay. The cable had suddenly broken, interrupting a message in the middle of a word. By electrical measurements, continued with very little rest during several days at Aden, I had arrived at a satisfactory estimate of the position and distance of the fracture. The captain and I had marked off the assigned point on the chart, and the vessel, after steaming to the appointed spot far out of sight of land, lowered a "mark buoy" to keep the position. The cable had broken in fairly deep water. Soundings indicated over a mile of depth. Cables are repaired occasionally in three miles of water; so this depth gave us no alarm.

After some days of fishing with the grapnel, steaming slowly to and fro across the line of cable, with about a mile and a half of grapnel rope, we succeeded in lifting the cable on the Aden side of the break. We found the Aden end in good electrical and mechanical condition, and we buoyed it; that is, we lowered it back to the bottom, fastened to the moorings of a large cable buoy that floated on the surface of the sea with more than a mile of rope hanging below it. We then spent more than a week fishing eastward of this buoy for the Bombay end, with very ill luck. The bottom was very rocky and we hooked rocks repeatedly, but no cable. On one occasion, when evidently dragging the grapnel up the face of a deep-sea precipice, we found more than half a mile of difference in depth between soundings taken at the bow and stern of the ship. That is, the lead reached bottom from the ship's stern, on the top of the cliff; but another lead lowered from the bows at the same time reached bottom half a mile deeper, over the sunken cliff. It was easy to understand how the cable had broken in this vicinity.

After losing time, rope and grapnels on this forbidding but deeply submerged rocky region, we decided to shift our fishing ground gradually further to the east, or Bombaywards. We finally hooked the cable on Christmas eve, about thirty miles east of the Aden-end buoy. The bottom here, although somewhat deeper, we found to be soft and smooth, a great comfort to drag the grapnel over after our harsh experiences on the rocks during the previous week. It so happened, however, that we were short of spare cable on board.

A cable-repairing vessel commonly carries a few hundred miles of new spare cable in her tanks. This stock is available for replacing old and defective cable in repairs. But we had been long in commission, and our stock had run low. We had only some thirty miles in the ship. We had been driven by rocky bottom further and further from the Aden end, in this repair, until it was becoming doubtful whether, when we picked up the Bombay end, we should have enough on board to reach back to the Aden-end buoy and complete the repair. However, in cable work, one has to take good weather while it lasts, and to do one's best, trusting to effort and good fortune.

All through the watches of the night before Christmas we steadily lifted the cable with the big winch. As the grapnel-rope came up, fathom by fathom, we knew from its tension that the cable was coming up with it. At last, when Christmas day dawned, the grapnel was at the bows, with the bight of cable hanging from it. Soon two chains were fastened to the cable, one on each side of the grapnel, the tension of the bight taken on these chains, the grapnel slackened down and lifted in, the cable sawn through by the boatswain, between the chains, the short western end slacked away, and the eastern, or Bombay end taken to the winch. A few turns of the drum, and this end was on the deck. Active hands soon opened up the end, to get at the electric core of guttapercha-covered copper strand. A wire from the testing room was quickly twisted on. In a few moments we had called and received answering signals from Bombay. A few minutes more, and tests showed that the cable between ship and Bombay was in excellent electrical condition.

Clearly the next thing to do was to splice the Bombay end on to the ship's cable in the tank, and to pay out all there was on board towards the buoy on the Aden end, thirty odd miles away. There was not enough to reach that buoy even on a bee line, to say nothing of the inevitable slack, or excess, that is sure to be laid down in such depths. Besides, we did not dare to follow a bee line, because that would inevitably lay the new cable over the old hilly and rocky bottom, where it would probably soon break again. It was imperative to follow a detour, over a smooth bottom that our previous soundings had located. We could, at best, only expect to buoy the end of the ship's cable a few miles away from the Aden-end buoy. The Bombay- and Aden-end buoys might then be floating in sight of each other, but how should we fill in the gap? We had hopes of using the short western end now hanging from the bows, if we could pick it up safely, and if it were long enough; but we felt very doubtful about it. So the sun rose over the eastern horizon, and found us splicing the Bombay end to our tank cable with anxious forebodings, and no very Christmas spirit.

A joint and splice is a tedious affair of two or three hours, especially in the tropics, where the new and soft guttapercha cover has to be hardened by immersion in an artificially cooling mixture, before the harsh steel wires are laid over it. While the splice was being made, we hanging motionless over the Bombay end, a steamer came into sight on the southwestern horizon. She advanced in such a manner as gradually to indicate that she would pass us about a mile to the south. Imagine our surprise when, long before we could flag-signal her, it became apparent, from her big wheels at bow and stern, that she was a cable steamer like ours. Very soon we remembered that the repairing vessel of another cable company was shortly expected to arrive at Bombay from Zanzibar. She probably had plenty of new cable in her tanks. The management of the cable company to which she belonged was closely connected with that to which our ship belonged, so that if we could only secure authority for a transfer of a few miles of cable from her tanks to ours, our distress would vanish. The question was how to secure the needed authority?

The managing director of our company, in London, was ordinarily always accessible to important messages from the cable-ships, at any hour of the day or night; but we knew that he would probably spend Christmas at a remote little town in Scotland. Could we reach him by wire in time? The approaching cable-ship might sympathize with us in our predicament, and might be willing to stay by us for a few hours, at most; but she could not be expected to give any cable to us without explicit orders to that effect from her owners in London.

Without delay we prepared as brief a message as possible, addressed from our ship to the managing director, pointing out the urgency of our need, the unlooked for presence of the other vessel, the favorable opportunity of fine weather, and begging for orders, on both ships, to effect a transfer of the necessary cable. At the end of the despatch, a brief but urgent request was appended to all cable stations en route to London, for the prompt handling of the message and of the expected reply. In a few minutes we had signalled the message to Bombay, through the cable at our bows, and Bombay sent it westwards to Aden, over a duplicate intact Bombay-Aden cable. The message was soon spelling its way to Great Britain by successive stages at Suez, Alexandria, Malta, Marseilles and London. At each of these stations the message would be regularly transcribed afresh. We had sunrise about four hours before London, so that the day was still young in Scotland. We believed the message would reach London in less than half an hour, and would then be sent on by the postal telegraph system to Scotland. What would then happen? Would it be promptly delivered, and an answer awaited? Or would it hang fire for hours, owing to some misconnection? The issue was vital to us. If we received a few miles of cable, we might hope, with good luck, to complete our repair of the Aden-Bombay cable that day. If not, it would be hard to say when we might finish it.

Meanwhile, our hopes lay in coaxing our passing cable ship to bide with us until such time as orders might come. She was probably as much astonished to see us as we had been to see her, for we were out of the track of regular steamer traffic. After a time, we saw her course slightly alter, so as to approach us more closely. As soon as she came within flag-signalling range, for this was long before the days of wireless telegraphy, we sent up column after column of bunting to the masthead, telling of our predicament and of what we had asked for, by wire to London. She slowed down, as she neared us, and we finished the message with Morse code from the steam whistle. She stopped about a quarter of a mile off, lazily lifting on the smooth ocean swell. Would that reply come from Scotland while she was in the mood to stay?

Neither captain desired to leave his own ship, so it was arranged that I should go over, in a small boat, to the other ship and tell, in person, the story we had already signalled. If I could think of any good stories, long ones, with plenty of collateral detail, I was incidentally to tell them, so far as they would go. Any proceeding short of piracy on the high seas, that would keep that ship from running away before she gave us cable, would be heartily endorsed.

I was soon on the gangway of the other ship, and received a cordial welcome. They saw the cable hanging from the bows of our ship, and could observe that we were "flying light," our Plimsoll-mark being far above the water. They sympathized with us in our straits, and were quite willing to stop and "communicate" with us for a reasonable time, in the hope of receiving orders to help us.

At last, after an interval that seemed a small era, but was actually only about two hours, the welcome reply came to us from the managing director in Scotland, over the cable from Bombay. Yes, certainly, take the needed cable, with an accompanying order to the other ship to give what reasonable assistance in the way of cable that safety would permit.

According to the story we heard in England some months afterwards, the telegraph operator in the little Scotch town was much surprised to receive our urgent despatch on Christmas morning, and made every effort to deliver it speedily to the managing director. That gentleman was not at his usual residence, but the messenger located him in church, and surprised the congregation by charging up the aisle. The managing director is said to have kept to his pew, but to have sent back the reply by the messenger, written in pencil on the fly-leaf of a hymnbook. This reply came back, retranscribed at Carlisle, London, Marseilles, Malta, Alexandria, Aden, Bombay, and our ship's testing room.

The managing director's orders, clear and laconic, were the best Christmas greeting from him we could have wished. At once, the scene changed with us. The other ship went to quarters with alacrity. A long coil of stout heaving line was placed in our small boat, and the latter returned to our ship, paying out the heaving line as it came.

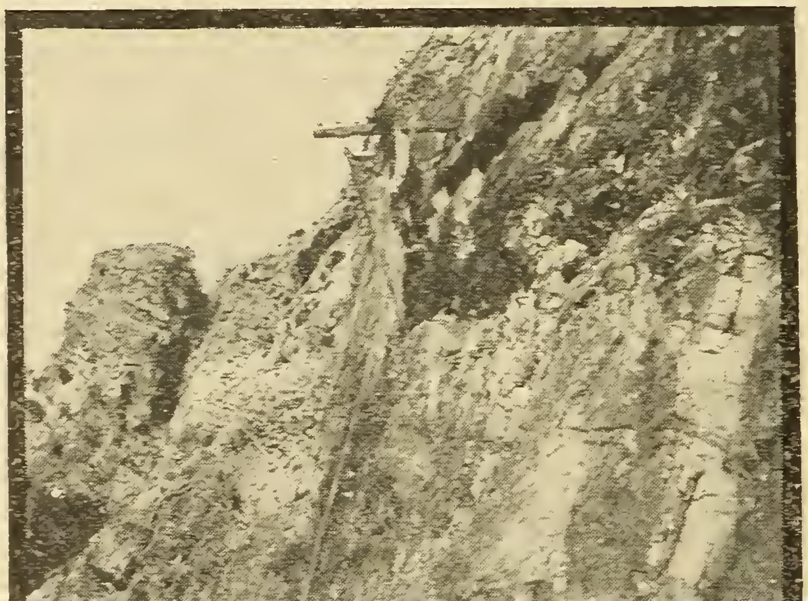
On reaching our vessel, the heaving line was taken to the winch, and the end of the cable from our friend's tank was thus hauled into one of our tanks. She helped the cable out over her bows with her winch, and we hauled it in over our stern-sheave; so that there was a slack loop of nearly half a mile of cable between the two ships. We were then able to telegraph messages to Bombay by the cable over our bows, and messages to our friendly visitor by the incoming cable over our stern. In a few hours we had taken cable enough to be safe for all reasonable contingencies. Our friend then cut the cable on her forecastle, and let the end go with a farewell message through the core. We picked it all up and spliced it on to the cable in the other tank. Away went our friend on her course for Bombay, with our blessing to her speed. We let go the short western cable, now no longer worth delaying over, and steamed westwards for the Aden-end buoy, paying out cable as we went.

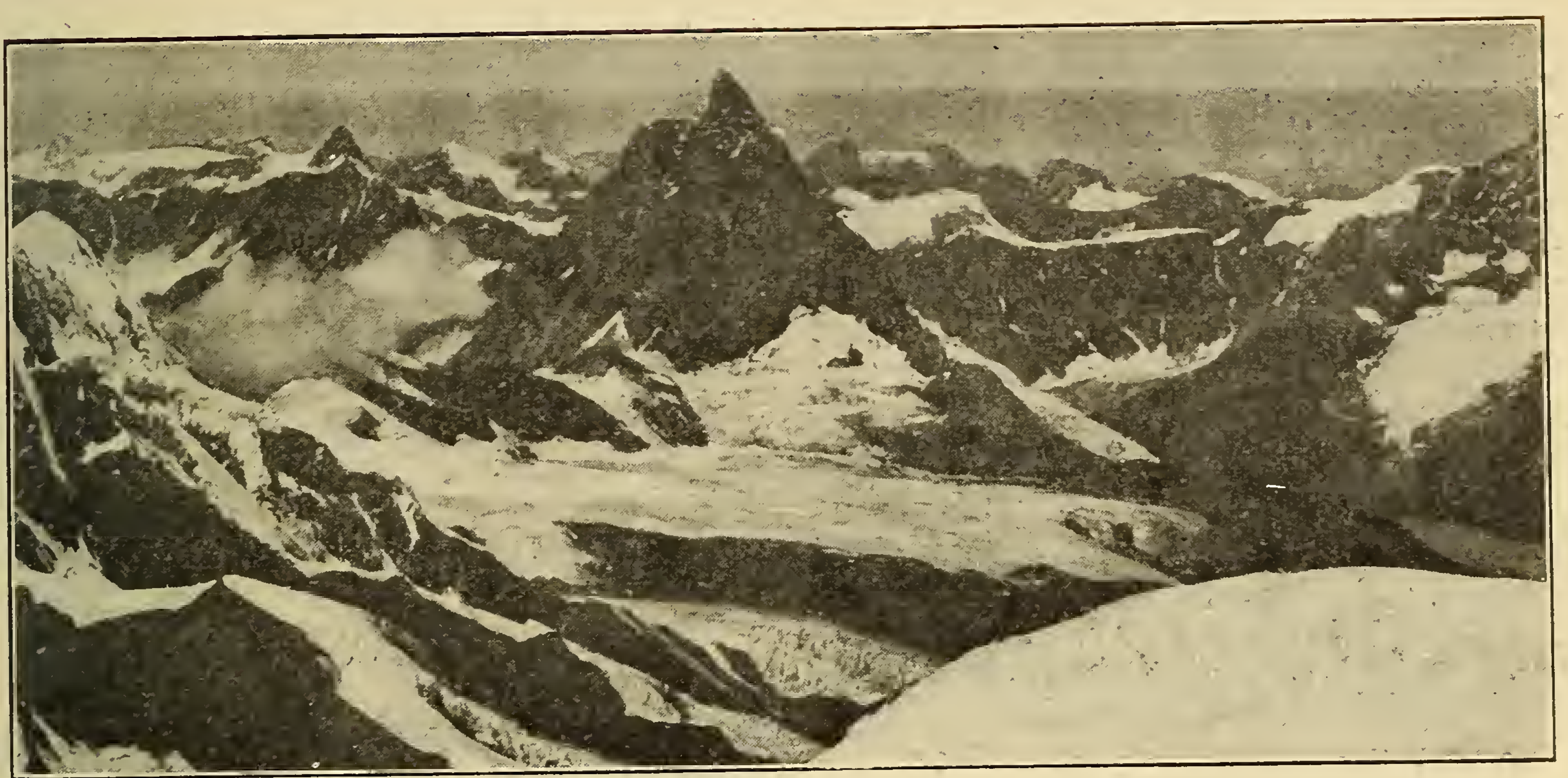
All went well with our fortunes that day. We reached the Aden-end buoy late that afternoon, and picked up the end attached to its moorings late that evening. Before midnight the Bombay and Aden ends, in good electrical condition, were married in a final splice, that was let go from our bows with a sigh of relief from all hands. The repair was finished, and we had a mile or two of cable left in the tank.

When I think over the inherent improbability of our repair taking place at the point on the line of cable where the course from Zanzibar to Bombay intersects, of the other vessel's happening to be ordered on that course quite independently of our work, of her happening to pass just in the nick of time, during fine weather and broad daylight, all on Christmas day, it is hard for me to shake off the early belief of childhood that Santa Claus really exists, or to escape the hazy idea that he can occasionally make his appearance under two masts and a smokestack.

Hazardous Line Construction

The line of the Colorado Telephone Company extending to Canon City goes through some rather ticklish places in the Royal Gorge as shown in the pictures. This line is eight miles long and for three miles of this distance it follows along the precipitous sides of towering mountain walls. In some cases the line work had to be done by men in chairs lowered by ropes from some accessible crag. The cross arms in such cases were fastened horizontally by drilling holes in the rock in which to stick the ends of the arms. The men hung in the chairs required from an hour to a whole day to drill one of the holes.





Two Months on the Summit of Mount Rosa

By DR. ALFRED GRADENWITZ

Those acquainted not only with the incomparable beauties of the Alps but also with the inclemency and terrors of their highest peaks will have some difficulty in realizing how human beings may spend two months' time every year among these lofty heights under hardships similar to those of arctic travelers, and even utilize every moment of their voluntary seclusion for meteorological researches of a highly scientific character.

Still less will they conceive of the possibility of constructing on a point towering far above all human abodes, an institute fully equipped with all the requirements of modern observatories.

Yet, this has been achieved by the valorous scholars of Mount Rosa Observatory.

Few branches of science have, during recent years, made such powerful strides as that commonly known as cosmical physics; being an application of pure physics and chemistry to the very wants of the universe and especially our globe.

Now, it is impossible to get any notice of the phenomena taking place in those far-distant worlds which fill up the firmament, other than through the intermediary of the light rays given out by them, and as, on passing through the lower strata of atmosphere, these rays undergo a number of changes and deformations, only observatories placed on high mountain summits are likely to yield any useful data as to the constitution of the universe. As regards meteorology proper, which on account of its immediate practical bearing is of special interest to man, a number of local factors, such as the configuration of the ground, presence of water sheets, vicinity of mountain chains, forests, deserts, steppes, etc., profoundly influence the temperature, pressure, moisture and electrical condition of the air as well as the direction and speed of winds. On these very factors is based our knowledge of the changing condition of atmosphere and accordingly the giving of weather forecasts which is the practical aim of applied meteorology.

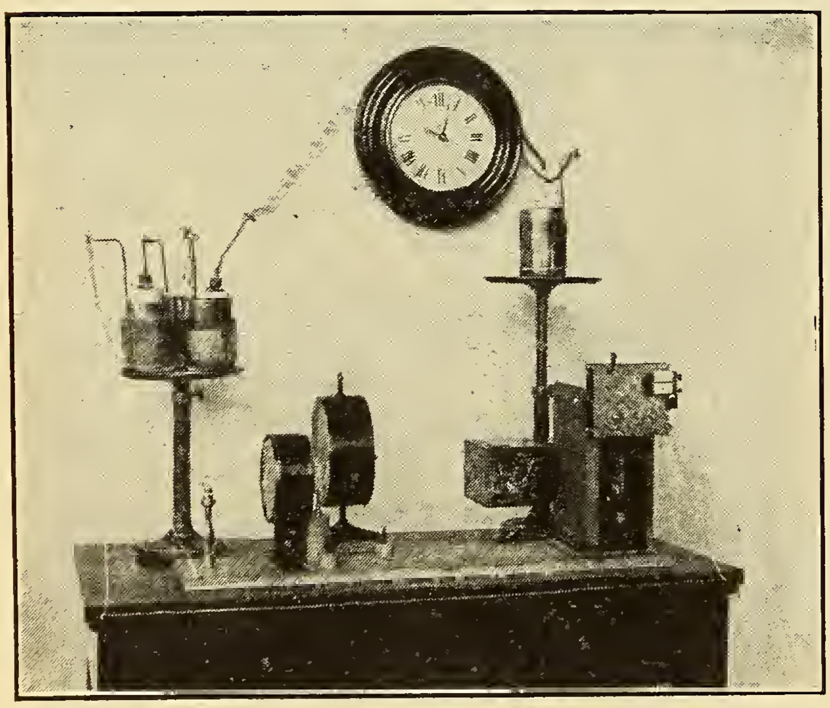
Only those who have at some time of their life been dazzled by snow storms on those giddy heights, stung by the fierce prickling due to atmospheric electricity, carried along by violent gales, deafened by the tumult of near-by lightning and witnessed a hurricane raging on Alpine summits, will be able to conceive of the terrific intensity of meteorological phenomena. In fact, the phenomena going on underneath are merely the countershocks of those occurring above the denser part of the atmospheric envelope.

The Queen Margherita Observatory is built on the highest point but one of all Europe, viz., on the summit of Mount

Rosa, at 13,680 feet above sea-level. It is so absolutely isolated from all sides that observations carried out up there are, unlike those made on the foot or the slope of mountains, quite unaffected by the influence of the ground. From great height, the eye looks down vertically to the bottom of an abyss more than 6,000 feet in depth, while bridging the immeasurable distance of an unbounded series of chains and mountains,

ARRANGEMENT OF THE EIGHT-ROOM OBSERVATORY

that subside by degrees towards the Lombardic plain, or dominate the central Alpine circle whose range is marked by no apparent limit. In fact, the horizon embraced from the observatory is about 125 miles in radius, comprising unknown wonders of dusky rocks, unexplored precipices, delicate cirri of forms endlessly renewed, and wide stretches of clouds that frequently reach



PHOTOGRAPHIC SELF-RECORDING ELECTROMETER

up to the observer's feet, and of rounded cumuli, shaped by the sun into masses of incandescent balls which the moon converts into a region of silver mountains and valleys.

In fact, a spot better adapted for investigations of the sun's activity, of the electricity of air, of winds, storms, and the whole multitude of heavenly phenomena, as well as those partaking of terrestrial life, could hardly be imagined.

This observatory, which belongs to a system of four meteorological stations situated at 3,600, 7,644, 9,000 and 13,680 feet respectively, is constructed of wood, with double walls separated by an interval of 30 inches, preventing too rapid a dispersion of the inside warmth, while offering a better resistance to the extraordinary violence of winds.

In order to be protected against lightning, the observatory has been coated entirely with copper-sheet from the ground to the roof, exclusive of the doors and the inside of

FOURTEEN DEGREES CENTIGRADE BELOW ZERO IN THE OBSERVATORY

the floor. It thus forms a cage entirely enclosed, and from the electrical point of view presents an absolute safety. The metal envelope is provided with a number of sharp points serving as additional lightning arresters and is connected to the ground as well as possible by means of braided copper strands carried along the mountain slope.

As seen from one of the cuts the observatory comprises eight rooms—the dormitory of the Alpine Club, kitchen of the Alpine Club, observatory kitchen, observatory dormitory, director's room, physiological laboratory, physical laboratory and meteorological observatory proper.

In order to form a permanent connection with the outside world, Dr. C. Alessandri, director of the observatory, conceived the idea of installing a telephone plant that connects the station with the remaining meteorological stations of Mount Rosa as well as with the plain, thus making the observatory the highest telephone station in the world.

The laying out of the telephone wires obviously was a task extremely difficult and dangerous, the more so as the weather was uniformly bad. At the upper end of the line no telephone poles are used, the insulation of the dry snow being considered sufficient to protect the wires.

The scientists working at the observatory have to provide themselves with sufficient food to last during the time (sometimes several weeks) when, in consequence of bad

CARRYING BOXES OF INSTRUMENTS UP MOUNT ROSA

weather, no communication can be had with the outside world.

As the temperature on those heights is even lower than in polar regions—being practically always below zero, while even in the summer months the thermometer falls to temperatures below 20° C. very efficient stoves had to be provided to maintain a tolerable temperature in the interior of the observatory. After denaturated alcohol heating had given rather poor results, a premanent-fire anthracite stove was installed.

One of the most serious troubles the inhabitants of the observatory are exposed to is mountain sickness, from which only a few on those heights are exempt.

Storing Electrical Heat

So far the storage battery has been the only device for storing up electrical energy (in the form of chemical energy) so that it could be used as required, and the storage battery has not been developed to a stage to make it practicable for the household. As a result the electric light plant must be built with a capacity sufficient to meet the demands of the moment of all the patrons of the company, which demands result in high "peak loads" at certain periods of the day.

Realizing the difficulty of perfecting an apparatus for storing electricity, G. G. Bell, a London engineer, and member of the British Institution of Electrical Engineers, conceived the novel idea of storing heat energy instead of electrical or chemical energy as in the case of the storage battery.

Briefly, Mr. Bell proposes to supply a house with a device which will consume an equal amount of current during the whole 24 hours, thus more than quadrupling the efficiency of the machinery in the power house by making it produce useful current all the time instead of having a large amount of equipment idle save during an hour or two a day.

The apparatus consists of an iron block some 18 inches high and a foot in diameter. This block is encased in magnesia, so that no heat escapes. In the center of the block is placed a removable electric heating unit in several sections. When the heating unit is raised to a very high temperature it heats the block which will remain heated indefinitely except for what heat is taken from it for cooking, etc.

When the householder turns on his lights the current is automatically cut off from the heater in sufficient quantity to supply the lights. When the lights are turned off the current begins to work on the block once more. When ironing day comes, the electric iron is turned on, and the amount of current necessary to heat the iron is withdrawn from the supply to the heater.

The heater itself serves for a variety of purposes. In its original form it was designed for hot water alone. Its present development not only does away with tanks and kettles, but provides hot air, steam or hot water for heating, with a great saving of space, and provides unlimited heat for cooking.

Electrical Securities

By "CONTANGO"

THE GENERAL SITUATION—SMALL AND LARGE PLANTS

"Electrical securities," to quote so eminent authority as Frank A. Vanderlip, president of the National City Bank of New York, "particularly electric light securities, are among the most recent types of investment upon which the public is now asked to pass judgment almost every day of the week. Electrical undertakings of all kinds have grown more rapidly than any other form of industrial activity. The electric lighting business has more than doubled in the past five years, and that means it has in it a future and vitality, that are bound, of course, to carry it to enormous proportions."

Mr. Vanderlip refers to the extraordinary poplar interest now manifested in all things electrical, and to the favor with which the banks generally regard electrical securities, and indeed, recommend investment in them to their patrons. As a matter of fact, those who have been active in the field of electrical endeavor have for years foreseen the splendid future now in part being realized, and for many years past those who may be termed as being on the "inside" have eagerly sought investments in electrical enterprises.

It is indeed the electrical age, and it is the wide-spread electrical expansion now going on that the president of the National City Bank doubtless has in mind.

It is not only the day of the electric lighting plant, but also that of the trolley, and east, west, north, and south the lines projected, to be built, and being built, come whirling forward thicker than autumn leaves in Vallambrosa.

The great development in the use of electric power also seems to offer a continued growth that is quite likely to be as rapid as has been the case in the lighting field. Moreover, it is the telephone age, and every farm house in the country is fast being put in touch with its neighbor and the world at large by means of this method of communication, and as yet not all the telephone lines are joined in one big system. For better or worse there are still many private lines and independent companies, many of which grow and thrive apace without outside assistance. The point of it all is that this tremendous expansion in electrical enterprise means a constant call for an enormous amount of money, which sooner or later must come out of the pockets of the general public.

It is then the purpose of this series of articles to take up carefully each phase of the present-day very important question of electrical securities, and show the remarkable opportunity now presented to prospective investors by examining into present conditions and indicating the probable future growth.

The total investment in electric light plants alone has now passed beyond the billion dollar mark. Five years ago there were some four thousand companies with a total investment of, say, $700,000,000. And yet with all this extraordinary increase in the past five years, already noticed, there is in reality comparative darkness on the part of the investing public as to the real character and quality of the enterprises into which all this money has gone and is going.

As to the electric railways there is, too, practically little more knowledge of a general or popular nature concerning the worth and possibilities of their securities.

Let there be light. For the opportunity of the century is before us if it is only properly brought to light.

Of the trolley lines, it may be said briefly at this time that, of those actually built and brought to the state of working, the majority are susceptible of remunerative development if adequately connected up as part of comprehensive systems, and therein will be found their best future.

With the electric light and power undertakings it is a different story. The business has been almost uniformly profitable in the past, the market for the product developed with extraordinary rapidity, and, in point of fact, the business has been one of the few to pass through the various panics without serious results to income.

In the years gone by, investors at large have perhaps been slow to put their money into such companies. But it has really been through lack of thorough knowledge of conditions. Therefore the attitude of the mind of the average investor is at this time the most important point in the development of the electric lighting field.

While it is true that the tendency is towards combination and the creation of large corporate securities, creating really great enterprises whose securities are readily absorbed by the big banks and bond houses, yet it is very possible and very profitable for small electric light plants to be built and operated successfully, extending their scope from time to time as demands are made upon them. It is in such enterprises that the present active interest in electrical securities of all kinds will find its best outlet and greatest opportunity. The small plant established on a cash basis in a town of even so small a population as 6,000 offers one of the most satisfactory chances at the present time.

As to the hesitancy of the general investor to take up electrical securities in the past, aside from the lack of intimate knowledge, "investors," to quote Mr. Vanderlip again, "have hesitated a good deal in giving full confidence to such securities because of conditions inherent in the nature of the business.

"Up to a few years ago, the electrical development was so rapid that the method and cost of production did not settle down to anything like a standard rate. No one knew at what moment some genius might come along with a new invention in dynamos or lamps that would make scrap of the best plant so far erected; a matter of great discouragement to the bondholder, and partly explaining why comparatively so few electrical light securities were found on the bond lists of any of the great security exchanges in the years gone by."

"Then there has been the question of overhead wires and franchises of little security against competition."

"These difficulties are now in a rapidly increasing measure being removed. There is standardization of methods and cost of production. Wires are run in conduits, the acquisition and control of which render illegitimate and irresponsible competition more difficult.

"We are, therefore, I believe, entering upon an era in which investors will look with increasing favor upon electrical securities, and in which the funds available for electric development will be obtainable with much greater ease and at much lower rates than before."

Mr. Vanderlip has also expressed himself of the opinion that the public is fast recognizing that its rights are best safeguarded by granting monopoly privileges to these public service companies and then subjecting the monopoly to reasonable regulations. An attitude at once recognized and appreciated by the investor.

Another reason why electrical securities have not been so popular with investors has been the lack of the "general marketability" of such securities, i. e., the seeming lack of ability to transfer or dispose of them in case of need. But it is far different today. It is indeed the day of electric bonds, and there is now a wide market for securities of this nature. In fact, when conditions of permanency, fair size and economical operation have been established a security has been created that will make more than favorable comparison with any security returning a similar rate of interest.

The careful investor will of course closely look into, and analyze the concern, the securities of which he contemplates buying, in this connection it is the intention to and make this series of articles of direct help by discussing frankly and simply the whole matter of such stocks and bonds. It will be explained exactly what they are. The usual manner of financing, lighting plants and trolley lines will also be brought out with the best way to bring about s endid results. All this in direct easy terms) that any one may understand the kind o securities offered, the interest that should be paid, and also enterprises that might be considered doubtful and therefore to be avoided, by reason, say, of excessive rates of interest offered or other like points, will be touched on.

For example, it is the opinion of the authorities that the earnings of a given company must reach twice its interest charges, and that even that figure of net earnings must only be reached after a fair charge has been made for maintenance, and after an adequate reserve has been set aside for renewals and a depreciation fund. Expenditures for renewals must not be placed under operating expenses. In other words a proper and normal, steady growth must be indicated.

The large number of lighting plants has perhaps somewhat held back the tide of general investment in electrical enterprise. The $1,200,000,000 or so, according to the Government report, invested in them, has been divided among some 8,000 or 10,000 plants. To understand securities of such a nature and number has been beyond the comprehension of the average investor, without definite information and special knowledge. Now, however, for the reasons already alluded to, there is a decided change, and the average investor is much more readily interested, with corresponding opportunity for the wide awake bond house.

Though this is not an age of diversion of interest and isolation, but one of concentration and consolidation, particularly in the case of electrical undertakings, yet there is splendid opportunity for small plants in comparatively small places provided they are in control over a fair area, well populated. Competitive isolated plants in the large centers of population are doomed to go, for under such conditions it is only from a large business able to produce economically and charging low rates that there is any ultimate hope of salvation. These indeed are the two main phases of the electric light situation—the big central station in the large centers and the small plants in small towns. In a future article special attention will be given to them; and in addition there have to be considered:

Electric light and power concerns.

Trolley lines and systems.

Hydro-electric power supply undertakings.

But it must be reiterated that the whole fundamental principle of the electric lighting and power business rests in the fact that it is naturally a one company business—be it in small or large centers—and the harm of unwarranted or needless competition must be clearly shown up and the economic advantages of combined management over large areas demonstrated. Individual companies and their securities may also be discussed as illustrative of the points mentioned.

As to hydro-electric power supply undertakings they are producing new conditions. To quote Mr. Vanderlip once more—:

"The utilization of great waterpowers, which are now being so rapidly developed, will tend toward a combined management covering a large area. The progress that is being made in long distance transmission is of the greatest importance in this direction. Indeed, in my opinion, the next era of distinct development in the electric lighting field will come as a result of the progress made by technical experts in economical long distance transmission. With great power stations located in the heart of the coal districts on the one hand, or drawing their energy from the great water power plants on the other, the problem of the cheap production of current would seem to be pretty well solved. If current thus produced can be economically distributed over a very large area, as indeed it is now being in many sections, the way will be open to securing the economies of a concentrated management and the added advantage of large corporate issues, and that combination should result in large profit to the business venture, and in a high degree of satisfaction to security holders. For the tendency of the times is, it seems to me, distinctly in the direction of recognizing the naturally monopolistic character of the electric lighting business."

There are in truth many very attractive and desirable investment opportunities in electrical securities these days, and an effort will be made in these articles to bring them to the attention of the public, popularize them and show investors how to discriminate.

Electric Light and Power for Country Homes

By LOUIS A. PRATT

PART III.

In the preceding chapter wiring methods were described and it will now be possible to determine the material necessary to order for this part of the work and have it ready when the rest of the equipment arrives. We will next proceed to the determination of the actual plant, taking up methods of charging batteries which has a relation to the voltage of the system used.

METHODS OF CHARGING BATTERIES

There are three methods of charging batteries, namely: direct from generator, through resistance, or with use of a booster.

For domestic service, where the plants are small in capacity, the booster system may be eliminated. Three standard equipments for strictly lighting and for lighting and power service, are here described:

1. A low voltage system, which may be known as a strictly storage battery lighting system, for use with low voltage tungsten lamps, of 27½ or 30 volts. The battery will consist of 15 to 18 cells, depending upon the distance of the storage battery from the center of distribution of the lighting system, and the size of the wire. If the engine and the battery are to be installed in the house, 15 or 16 cells will be ample. For this system the special low voltage generators, 30 to 50 volts, should be obtained. When charging the battery in this case there will be no loss through resistance, since the required voltage may be obtained direct from the generator.

2. This system consists of engine, 110-volt generator and storage battery for 30-volt lighting system, the battery to be charged from the 110-volt circuit through resistance. This combination system is intended for use where the current is to be distributed about the place for power purposes, the higher voltage being required for the power distribution, while the house lighting will be done from the 30-volt battery and not direct from the generator. The switchboard for use with this system will provide for two circuits, properly protected with fuses, one for 110-volt power circuit and the other for battery and 30-volt lighting circuit.

3. This system consists of engine, 110-volt generator and battery for 110 volts, and it can be used for both lighting and power. The battery being for 110 volts (56 cells), and there being no voltage booster employed, it will need to be divided into two sets of 28 cells each and these sets charged in parallel through resistances, as previously explained.

This will make a very flexible system, it being possible to furnish current to lamps of the lighting system, at the same time current is furnished for power distribution, direct from the generator, the battery being either on charge or cut out of the circuit; or, if necessary, it is possible to discharge the battery in parallel with the generator, the generator voltage to be adjusted (by means of a field rheostat) to correspond with voltage of the battery. This method, of course, would require closer attention on the part of the operator, but in this way it will be possible to care for an increased lighting load, in case general illumination is required for some special function, which illumination would require more current than either the generator or battery alone would be able to furnish.

HOW TO DETERMINE SIZE OF PLANT

In selecting an electric lighting plant, including storage battery, considerable variation may be made in the size of the engine, generator and storage battery necessary for supplying a certain amount of electric light or power.

The capacity of the plant should in any case be somewhat in excess of the total amount of work to be done, but the size selected should depend to some extent on whether it is considered expedient to do the entire lighting, or work, from the storage battery during the hours when the engine is not running, or whether the heaviest load is to be taken from the engine direct and the battery only used as a reserve for lights, or a small amount of power, during hours when the engine is shut down; or, again, whether it is expedient to run the engine and battery in parallel, that is, taking the current from both the generator and battery during the time of the heaviest load.

As conditions vary with every installation, there is no simple rule by which the size of engine, generator and storage battery may be determined. To give an idea of what may be expected or depended upon for different styles of installation, we here describe three typical plants:

First: We will consider a small domestic lighting plant where there is little or no power used except for lighting. This plant may consist of a three horse-power vertical engine with $1\frac{3}{4}$ kilowatt 30 to 50 volt generator and a 16-cell storage battery with a capacity of 15 amperes for eight hours or twenty-two 16 candle-power 30-volt tungsten lamps for eight hours. Fifty of these lamps may be installed for lighting house, barn and premises.

This plant will be practically ideal in its operation for this amount of lighting, and a small amount of power may be taken from the engine direct, or small motors, such as sewing machine motors, fan motors, etc., may be run from the storage battery. It is hardly probable that all 50 lamps would ever be burned at the same time during an entire evening. However, if they should all be used at the same time the battery would have a capacity sufficient to supply current for nearly three hours. If, however, it is desired to burn the full number of lamps for a longer period, the engine can be run in parallel with the battery. In this case, even though a hit-and-miss engine is used, perfectly steady light is secured. Where a larger number of lamps than 50 is desired for special occasions, 75 or 100 lamps can be burned by operating the battery and engine in parallel. Switchboards are provided with switches for such operation. It is probable that for an ordinary evening not over 10 lights will be burned on an average of $3\frac{1}{2}$ hours each. This would make a total of about 35 lamp-hours, and as the total capacity of the battery is 175 lamp-hours, it would only be necessary to charge the battery twice a week under these conditions. The charging may be done at regular intervals, or it may be found later that there is other work which can be profitably done from the engine and the battery charged at the same time. In any event, only a very small amount of attendance is necessary to keep the battery fully charged and the electric current ready for instant use.

Second: We will consider the installation of a larger plant, where the engine is to be used for power during the day, and a storage battery installed for lighting during the evening and during hours when the engine is not running. For this plant a 15 horse-power engine may be selected with the same $1\frac{3}{4}$ kilowatt generator and a 16-cell storage battery, as in the first plant. If during the day, the engine has a regular load of less than 15 horse-power, the surplus power can be utilized to run the generator and charge the storage battery. Either a throttling or hit-and-miss governor engine may be used, as the lighting will be taken only from the storage battery, and therefore the close regulation given by the throttling governor engine is not essential. The results which may be expected from the storage battery will be the same as with the smaller plant, except that it may be charged while the engine is doing other work amounting to perhaps 12 horse-power, with practically no extra amount of attendance, and a small, but efficient, lighting capacity can thus be abtained at practically no additional expense whatever.

Third: We will consider the installation of a plant on a large farm or estate, where there is the heaviest class of farm machinery to run at various times, and, also, a considerable amount of lighting is required. For this plant a 20 horse-power Alamo standard throttling govenor engine, a $12\frac{1}{2}$ kilowatt Westinghouse Type "S" generator, and a 56-cell storage battery for 110-volt lighting and power circuit, having a capacity of 20 amperes for eight hours may be selected. Current is to be supplied for one 25 horse-power motor, one five horse-power motor and one two horse-power motor required for operating machinery on the premises. There may be a large number of lamps installed at various points, so that the 110-volt circuit is more desirable than the 30-volt circuit, on account of the distance the current has to be transmitted. Tungsten lamps should generally be installed, but some carbon filament lamps of small candle power may be more desirable in some out of the way places where they are only occasionally turned on.

The capacity of the storage battery would be sufficient to operate forty 16 candle-power carbon filament lamps for eight hours, or about fifty 32 candle-power tungsten lamps for eight hours. This capacity is somewhat in excess of the requirements for lighting, but this is desirable if power is also to be taken from the battery from time to time when it is not expedient to run the engine.

You will note that one motor is of larger capacity than the capacity of the engine. This motor is provided for extra heavy work. Motors have a larger over-load capacity for a short time than gasoline engines, and if the heaviest work to be done is between 20 and 30 horse-power, with 30 horse-power as the maximum load, the necessary current may be obtained by running the engine and battery in parallel. If the battery is fully charged on the start it may be called upon for 10 horse-power in addition to the capacity of the engine, so that for a short time with the use of the 20 horse-power engine and storage battery, 30 horse-power may be taken from the largest motor.

If a considerable amount of ordinary work is done with the five horse-power motor, under the average conditions, power for this motor will be taken from the engine and the storage battery can be charged at the same time. However, if it is not convenient to run the engine, this motor may be operated from the storage battery for several hours without discharging the battery sufficiently to interfere with an average evening's lighting being done without re-charging the battery.

The current for the two horse-power motor will ordinarily be taken from the battery and it may be run at any time without serious consideration of the current which it consumes.

The descriptions of the above plants are merely intended as suggestions as to the style of installation best suited for varying conditions.

USES OF ELECTRICITY FOR COUNTRY HOME AND FARM

It is hardly necessary to point out the many and varied uses of electricity on modern farms or in country homes, but it may prove of interest to describe briefly some of the various devices which have been perfected since the electric current has been brought to serve man's every day needs, in the shape of convenient power as well as for illumination. The large illustration shows the devices described in the following paragraphs and many others.

In manufacturing plants the use of individual electric motors for operating machinery has for some time been recognized, both from the standpoint of economy in the use of current, and in doing away with unsightly, complicated and power-consuming shafts and other transmission equipment, so in the use of the electric current for operating farm machinery, the individual motor makes the use of this power practical at any point where needed, at the lowest possible expense. Portable motors can be moved from point to point and attached to different machinery when the service of that particular machine is required. To anyone familiar with farm requirements, the advantage of this is at once apparent.

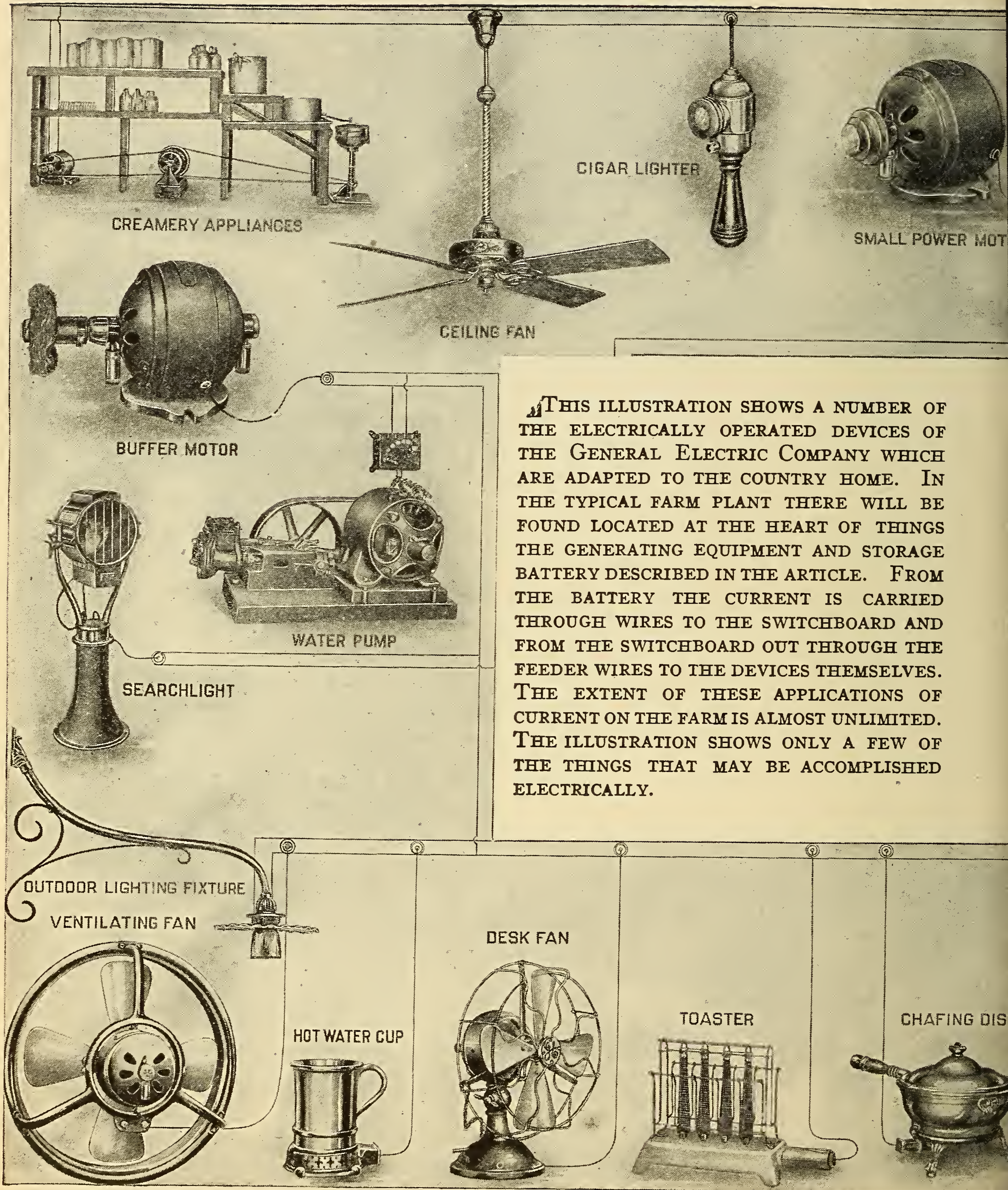
In the line of household utilities, the percentage of work which can be done by electricity is being rapidly increased, and a few of the most important and serviceable devices of this character are here described.

For the laundry, the electric iron is not only a perfect laundry iron, but also a lady's iron, for ironing fine linens and delicate laces. It can be used in the boudoir, or in any comfortable room in the house where there is a lighting socket. It is convenient to carry when traveling, for pressing mussed garments. When sewing, it can be used as a pressing iron right in the sewing room, thus saving time and steps to and from the kitchen or laundry. The iron heats perfectly by electricity, and remains always at the right temperature. It heats itself only and not the room, as does a stove. It is made in five, seven and nine pound sizes.

The most modern and satisfactory types of washing machines are now sold with electric motors as a part of the equipment. The motor-driven machine is almost as great an improvement over the hand-driven as is the latter over the open tub and washing board. A modern motor-driven machine will wash a tubful of clothes in from 10 to 15 minutes, and when they are washed the same power wrings them dry.

The electric sewing machine motor, which gets its current from the lighting socket, does away entirely with the pedaling of the sewing machine. Without it, easy running is the best that can be said of any machine; with it, any machine becomes self-running. It converts the treadle, which has been accountable for so much fatigue and backache, into a foot rest.

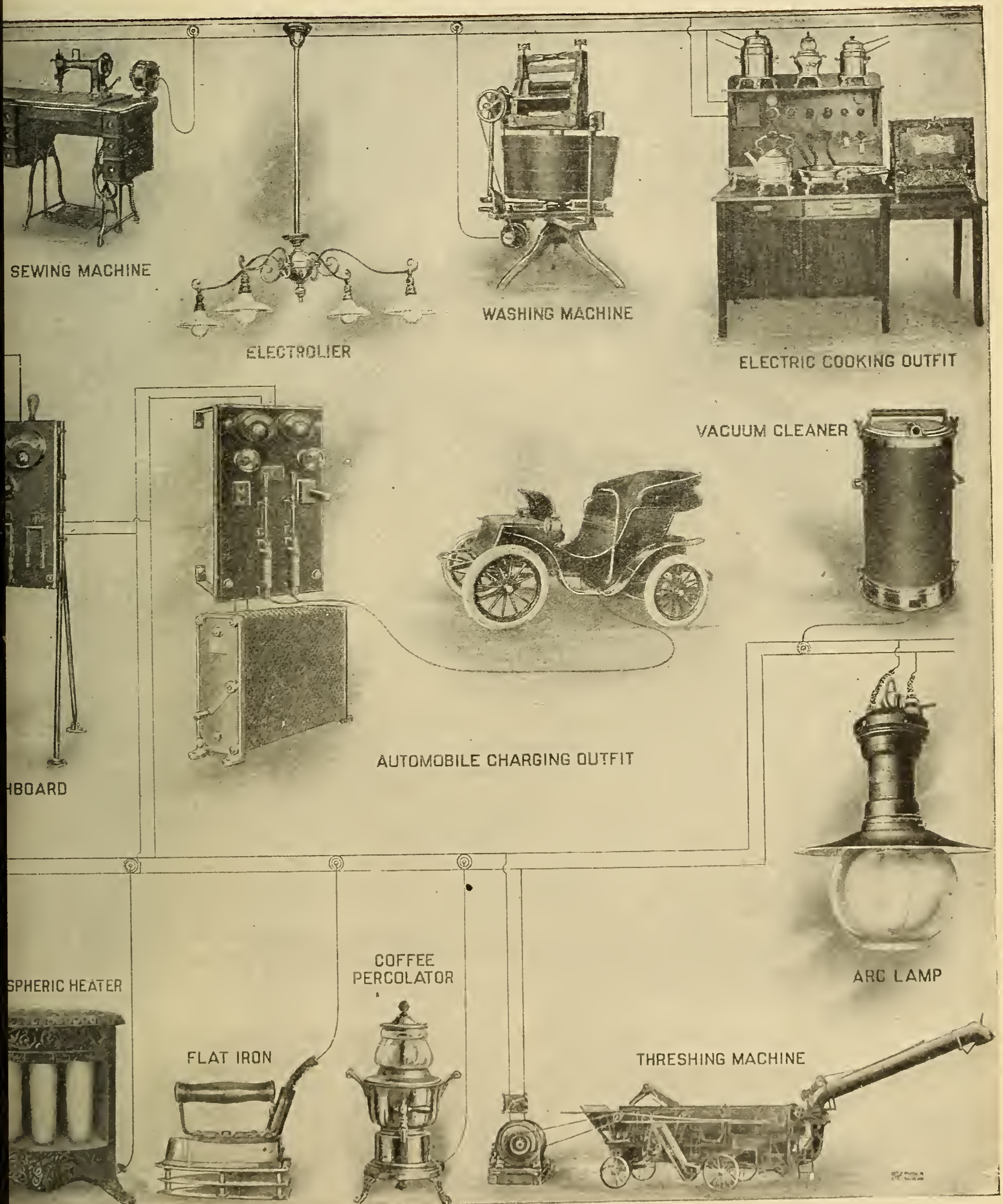
The motor fits any machine and can be operated by any woman. All that is required is to turn the switch to start and stop it. The speed of the machine is regulated by a slight pressure of the foot. The motor consumes no more current than a 16 candle-power carbon filament lamp.



THIS ILLUSTRATION SHOWS A NUMBER OF THE ELECTRICALLY OPERATED DEVICES OF THE GENERAL ELECTRIC COMPANY WHICH ARE ADAPTED TO THE COUNTRY HOME. IN THE TYPICAL FARM PLANT THERE WILL BE FOUND LOCATED AT THE HEART OF THINGS THE GENERATING EQUIPMENT AND STORAGE BATTERY DESCRIBED IN THE ARTICLE. FROM THE BATTERY THE CURRENT IS CARRIED THROUGH WIRES TO THE SWITCHBOARD AND FROM THE SWITCHBOARD OUT THROUGH THE FEEDER WIRES TO THE DEVICES THEMSELVES. THE EXTENT OF THESE APPLICATIONS OF CURRENT ON THE FARM IS ALMOST UNLIMITED. THE ILLUSTRATION SHOWS ONLY A FEW OF THE THINGS THAT MAY BE ACCOMPLISHED ELECTRICALLY.

The electric radiator furnishes heat in its simplest and most convenient form. There being no combustion, it is absolutely cleanly and sanitary. It is an ideal heater for cool spring and fall days when the regular heating system furnishes too much heat for comfort. During the winter its glow serves admirably to add cheer to the steam heated room.

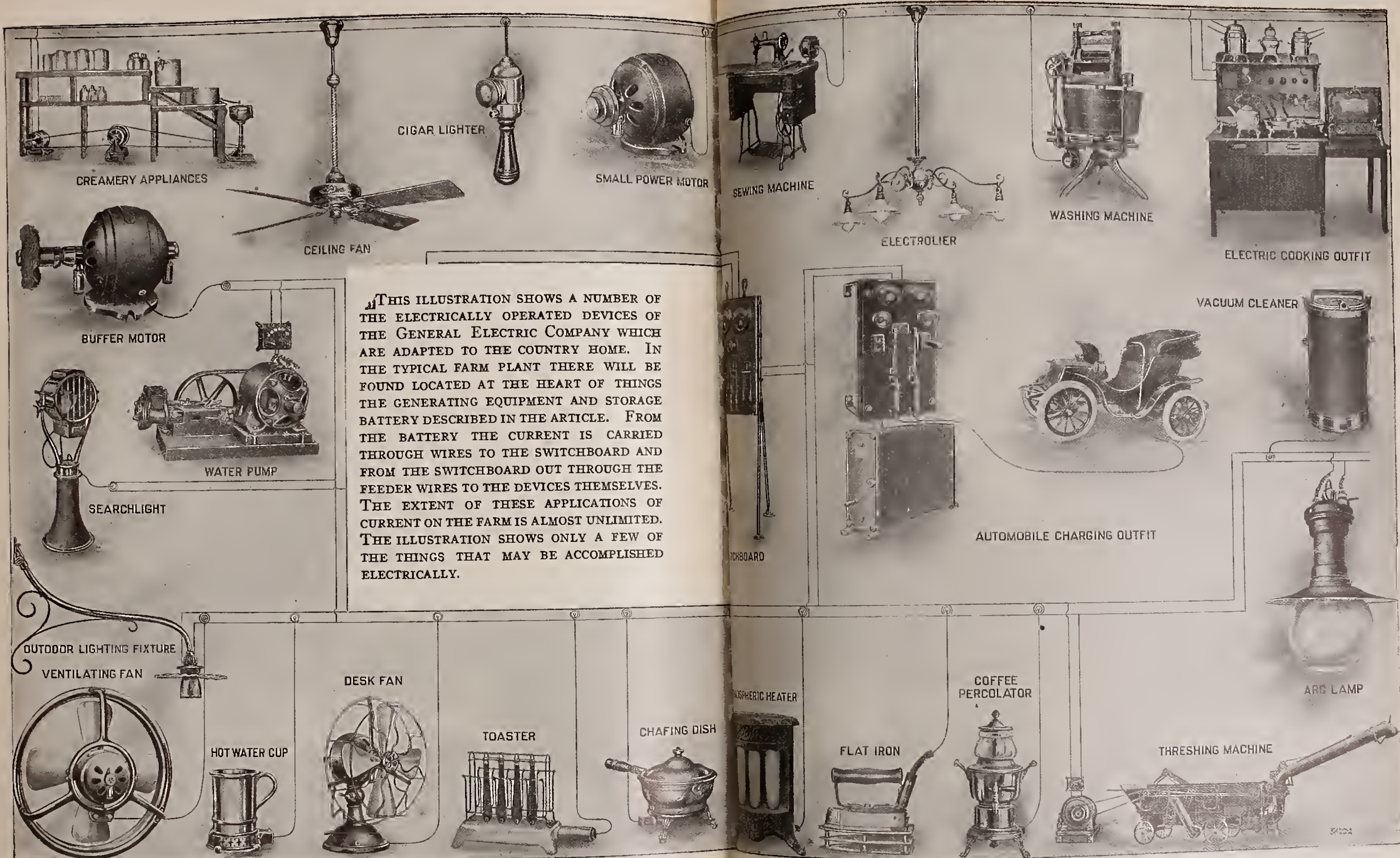
The electric house fan is noiseless and for this reason is a desirable fan to use in the sick chamber. It can be used in one



room on the table and in another as a wall fan.

A single demonstration of vacuum cleaning generally leads to the adoption of this method. Sweep a nine-by-twelve rug as clean as you possibly can with broom and carpet sweeper; then apply a good vacuum cleaner. The quart or more of dirt that it will suck up and convey into its receptacle is a convincing argument.

No method of making toast is so satisfactory as the electric. The electric toaster



This illustration shows a number of the electrically operated devices of the General Electric Company which are adapted to the country home. In the typical farm plant there will be found located at the heart of things the generating equipment and storage battery described in the article. From the battery the current is carried through wires to the switchboard and from the switchboard out through the feeder wires to the devices themselves. The extent of these applications of current on the farm is almost unlimited. The illustration shows only a few of the things that may be accomplished electrically.

The electric radiator furnishes heat in its simplest and most convenient form. There being no combustion, it is absolutely cleanly and sanitary. It is an ideal heater for cool spring and fall days when the regular heating system furnishes too much heat for comfort. During the winter its glow serves admirably to add cheer to the steam heated room.

The electric house fan is noiseless and for this reason is a desirable fan to use in the sick chamber. It can be used in one room on the table and in another as a wall fan.

A single demonstration of vacuum cleaning generally leads to the adoption of this method. Sweep a nine-by-twelve rug as clean as you possibly can with broom and carpet sweeper; then apply a good vacuum cleaner. The quart or more of dirt that it will suck up and convey into its receptacle is a convincing argument.

No method of making toast is so satisfactory as the electric. The electric toaster stove makes delicious golden brown toast right on the dining table. In addition to a wire grid for making toast, some forms are provided with a steel plate for making griddle cakes and for cooking small portions of almost anything.

Where electric current is available on large dairy farms, it can be used to operate any of the present styles of milking machines. With the milking machine one man can milk from two to six times the number of cows in the same length of time that it is possible for him to milk by hand. The different styles of machines now on the market take from a one-half to three horse-power motor for their operation.

Elementary Electricity

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

CHAPTER XXIV.—ELECTRIC HEATERS

As we have already seen, the passage of an electric current through a conductor is invariably attended by an increase in its temperature. The heat so produced may be either non-luminous or unaccompanied by light, or luminous or accompanied by both heat and light.

The quantity of heat produced by the passage of an electric current depends on the amount of electric energy that produces it. The rise of temperature depends both on the rapidity with which the heat is produced and the rapidity with which it is dissipated or lost. The increase of temperature is most rapid when the electric current begins to pass through the conductor. The increase of temperature, however, does not continue, the loss of heat becoming more nearly equal to the increase until finally, when these two quantities equal each other, the temperature remains constant.

An electrically heated body can part with or lose its heat in three ways; i. e.:

(1) Its heat is carried off by any body that comes in contact with its surfaces. This manner of losing heat is known as conduction. An electric conductor that has been insulated by covering it with cotton, silk, rubber or caoutchouc, loses its heat mainly in this way. So, too, a conductor of the above character, provided with an outer covering or sheathing of lead, loses its heat mainly by conduction.

(2) When the heated body is surrounded by a gas or liquid, as when a bare wire or conductor is placed in the air or in water, it gives up its heat to the molecules of liquid or gas that come in contact with its surface. This causes an expansion of the liquid or gas that sets up currents called convection currents, the heated liquid or gas moving from the conductor towards the colder portions of the mass. This process is called convection.

(3) No matter whether the heated body be bare or covered it will lose a certain proportion of its heat by what is known as radiation. In this case it sends off waves that radiate or move in all directions from the heated body and so carry away the heat to cooler parts of the surrounding medium.

The quantity of heat required to raise the temperature of a given amount of different substances varies, but is constant for the same substance. In order to raise the temperature of one pound of water one degree Fahrenheit, an amount of energy, 778 foot-pounds or 1055 joules, must be expended. And this is true whatever may be the source of the energy that is so expended. It may have been produced by mechanical, by chemical, by electrical, or by magnetic means. But in every case the expenditure of 778 foot-pounds or 1055 joules will be required to raise the temperature of one pound of water one degree Fahrenheit.

In order to determine the amount of heat produced by the passage of a given quantity of electricity through a circuit in a given time, a device known as the electric calorimeter is employed. The simple form of this instrument, represented in Fig. 153, consists of a thin wire (MN), placed in a glass vessel nearly filled with water. A thermometer (T) is passed through a cork in the top of the vessel so as to bring its bulb near the center of the liquid. In this manner, the amount of the increase in the temperature of the water that has been produced by the passage of a given current in a given time, can be measured.

The quantity of heat is measured in heat units called calories, a calorie being the amount of heat required to raise the temperature of one gramme of water, one degree Centigrade. Consequently, if the weight of water in the glass vessel of the calorimeter is known in grammes, and the quantity of electricity passing is known in amperes, from the increase in temperature as indicated by the thermometer, the quantity of heat produced in calories can be obtained.

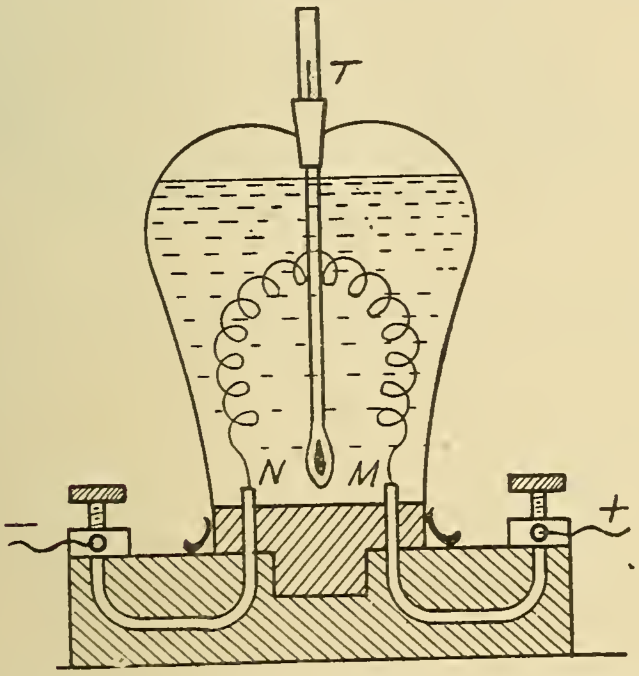


FIG. 153. SIMPLE ELECTROMETER

The amount of heat liberated by the passage of an electric current is proportional to the square of the current strength in amperes multiplied by the resistance of the circuit in ohms. If a current of ten amperes passes through a circuit whose resistance is four ohms, the amount of energy expended will be ten multiplied by four, or four hundred watts. Or, since one watt equals .24 calories per second, the total quantity of heat generated is equal to 400 x .24, equals 96 calories per second.

The actual increase, or rise in temperature produced in any conductor by the passage of an electric current, depends on the following circumstances, i. e.:

(1) On the amount of heat liberated in the conductor.

(2) On the nature of the medium surrounding the conductor.

(3) On the character and temperature of bodies in the neighborhood of the conductor.

The amount of heat liberated in a given length of conductor depends:

(1) On the electric resistance of that length of conductor.

(2) On the current strength passing through that length.

(3) On the extent of surface of that portion of the conductor, or, in other words, on both its length and diameter.

(4) On the nature and condition of the surface of the conductor.

The heating effects produced by an electric current are employed in practice for a variety of purposes, such as electric heaters, electric furnaces, electric radiators, electric stoves, electric soldering irons, fuse wires, etc.

So far as its actual efficiency is concerned, an electric heater is unable to compete with a coal fire or gas stove. If the electricity employed in the heater coils be obtained by steam power, as is generally the case, it would of course be more economical to burn the coal directly to produce the heat than to burn it under a boiler, use the steam generated to drive an engine, the engine to drive a dynamo, and the current produced by the dynamo to heat an electric heater.

But there are cases in which the use of an electric heater is more economical than the use of a coal or gas stove. An electric heater can be placed in operation by the mere closing of a switch, and the highest temperature it is capable of producing obtained in a few minutes. Then, when the heat is no longer required, it can be turned off almost instantly by the opening of the switch.

The above is not the case with the coal or gas stove. A stove requires a long time before it can be brought to the required temperature, and when the heat is no longer required, it takes a long time to extinguish the fire economically. For this reason, therefore, there are a number of electric heaters suitable mainly for cooking purposes that can compete economically with coal and gas stoves. The actual amount of heat required to prepare a cup of coffee or tea, or to broil a steak, is comparatively small, and this amount can be readily obtained and the current turned off when the cooking is done. But in the case of coal or gas cooking stoves or ranges an amount of heat far in excess of what is necessary for either of the above mentioned services is produced. Nor indeed is this limited to cooking devices, since an electric air heater, turned on for a quarter of an hour or so, will comfortably heat the air of a small room, and when the heating is no longer required the heat can be turned off, while in the case of the hot air heater the fire in the furnace must be kindled many hours before its use is actually required.

Another advantage possessed by electric heaters is to be found in the fact that they do not vitiate the air. There are no noxious gases or products of combustion given off by the electric heater as in the case of the gas stove or coal furnace.

The actual temperature to which a given current of electricity can raise a conductor depends on the value of its resistivity or electric resistance per unit of length. A certain current strength passing through a given resistance produces a definite quantity of electricity. Since a short thin piece of wire of a certain kind of material may possess the same electric resistance, as a long stout wire of another material, it is evident that the liberation of the same quantity of heat in these two different conductors will produce very different temperatures. The shorter the wire, the higher the temperature to which the conductor will be raised, and the longer and stouter the wire, the lower the temperature.

The construction of the electric heater is exceedingly simple. It consists practically of a coil or coils of wire of some material that is not readily fused by heat. The heating coil is arranged so as to be able readily to give its heat either to the air that comes in contact with it when the coil is intended to act as an air heater, or to a mass of metal or iron with which it almost comes in contact, only being separated from it by a thin layer of some non-conducting material such as porcelain.

When properly constructed an electric heater is an exceedingly efficient device. Indeed, its efficiency is far greater than that of any other electric device. Practically all the energy of the electric current is converted into heat energy.

Various shapes are given to the coils of electric heaters. Sometimes they are in the form of flat spirals applied to the surface of a metallic plate by the use of fused glass or porcelain, which, when cooled, hardens and holds the coils to the plate at the same time insulates contiguous turns from one another, so necessitating the current to pass through the entire coil from one end to the other.

Heating coils of the above description are efficient in action, since all parts of the surface of the coil come almost in contact with the metallic plate to be heated. They possess the disadvantage, however, that when fused or burnt out it is difficult to replace them. A modification, therefore, has been adopted whereby the heating coils consist of an edgewise-wound spiral of special resistance ribbon, suitably insulated between the separate turns, and enclosed in a mica-lined copper cylinder. When a heating coil burns out it can instantly be replaced by a fresh coil.

In order to obtain a large heating surface the heating coil is generally made fairly long. The material of which it is constructed consists of some material that possesses a high electric resistivity. Galvanized iron wire is commonly employed for large car heaters and German silver wire or other suitable alloy for most other heater coils. For the heating of street cars, the cabins of ships, and the small rooms of houses, the electric heater possesses marked advantages over coal gas stoves, since, as already stated, it can be turned on only when heat is needed and turned off when the heat is no longer needed.

The electric heater is employed in the kitchen, for culinary purposes, in the form of stoves, broilers, toasters, coffee and tea kettles, waffle-irons, etc., etc.

In all of these devices the heater consists of various heating coils placed inside a short cylinder that is provided with a flat upper surface on which the vessel in which the cooking is to be done is placed. In order to obtain the greatest efficiency from a heater of this character, it is necessary that the pan, pot, kettle, or other device in which the cooking is to be done, shall be provided with a perfectly flat base so that it can come at all points of its surface in contact with the heating surface of the electric stove.

In most cases electric heating devices are provided with a number of separate heating coils. When so arranged it is possible rapidly to vary the quantity of electricity passing by the use of what is known as a temperature-regulating switch. This is a switch by means of which the resistance of the heating coils can be varied by coupling the separate coils in series, multiple, etc. In this way a marked saving is possible in the amount of current employed since by arranging the regulating switch when the current is first turned so that a powerful current passes, the heater is brought to its highest temperature in a few minutes, when a smaller current will suffice to keep the heat fairly constant.

Fig. 154 represents a form of electric heater known as the portable stove or disk heater. Here the heating coil is placed inside a short metallic cylinder provided with a flat base, and is connected with an electric

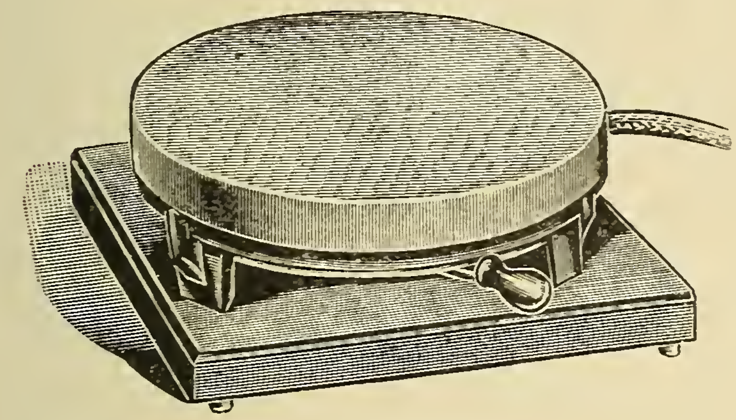


FIG. 154. ELECTRIC DISK STOVE

source by means of conducting wires represented at the right-hand side of the figure. The temperature-regulating switch is represented in front of the figure. Such a stove reaches its full temperature two minutes after the strongest current is turned on.

There is also what is known as an electric griddle cake cooker and toaster, which in construction does not differ from that of the portable stove save in dimensions and shape. An electrically heated cooker and toaster is especially suited for the cooking of griddle cakes. The electric resistance of the heating coils is proportioned so that a temperature of about 700° F. is obtained. Cooking by such a device is attended by the most satisfactory results by reason of the uniformly high temperature ensured.

FIG. 155. DISK STOVE AND TEA KETTLE

In the electrically heated tea-kettle, Fig. 155, an electric stove is provided with a tea-kettle furnished with a flat bottom so as to ensure good contact with the upper surface of the stove. This device is provided with a three-point temperature regulating switch.

In the electric chafing dish, a construction similar to that of the electric stove or disk heater is employed. Here a chafing dish with a perfectly flat bottom rests on the upper part of the stove. This pan can also be employed for frying, for the heating of soups, or for the boiling of water.

The electric device known as the farina boiler, Fig. 156, is of efficient service in the kitchen. It consists of an outer vessel of heavy nickel-plated copper. The inner vessel is made entirely of porcelain. A heating coil consisting of nickel-plated copper, is placed directly in a water bath surrounding the porcelain pot in which the cooking is done. A three-point temperature-regulating switch is employed.

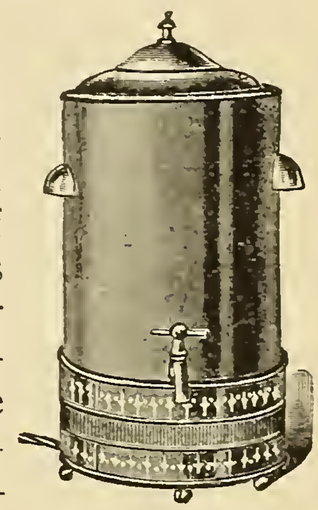


FIG. 158. HOT WATER URN

It will be observed that the above form of heating device differs from the others in that the heating is effected by means of

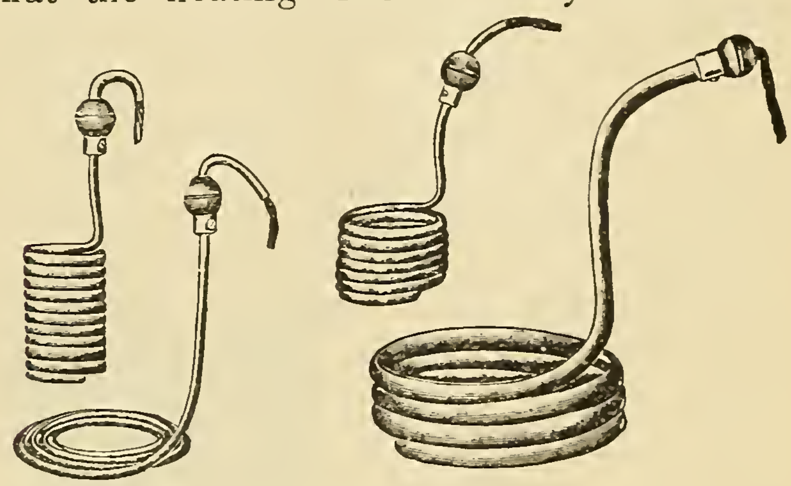


FIG. 157. IMMERSION COILS

what is known as immersion coil heaters. These are devices whereby the current is sent through coils of wire that are placed directly in the liquid to be heated. Four coils of this type are represented in Fig. 157.

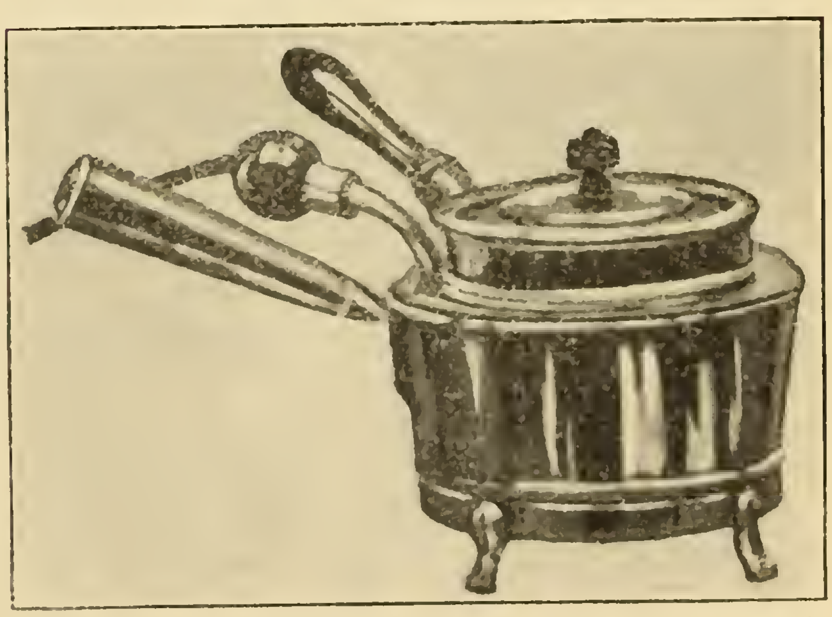


FIG. 156. FARINA BOILER

They are made either in the cylindrical or flat form, for use with both alternating and direct currents as may be necessary by the character of the current employed in the house.

In the device known as the electric hot-water urn, a nickel-plated copper vessel is provided, as shown in Fig. 158, with immersion-coil heaters for rapidly raising the temperature of the water, so as to bring it to the boiling point.

In the electrically heated oven a hot-air space is employed for baking, and other processes generally carried on in the ordinary oven. The electrically heated oven possesses marked advantages over ovens in which the heat is obtained by the burning of coal, gas or oil; for, the electrical oven is devoid of noxious gases, and, moreover, it is possible readily to obtain in them varying temperatures and to maintain them constant for any length of time.

The electric oven is provided with a heat regulating switch. Generally, too, a device known as a pyrometer is employed in which a needle is moved over a graduated arc by the expansion of a rod of metal exposed to the heat, indicating the temperature by its position on the scale. Such an electric oven is represented in Fig. 159. As is generally the case, this oven is provided with a number of separate heating coils, so connected with a temperature-regulating switch as to enable one or more of the coils to be cut out, or all the coils arranged in series or in parallel. Since, under such circumstances, the temperature produced will depend on the position of the temperature regulating switch, it is possible to use this switch in place of the pyrometer to indicate the temperature.

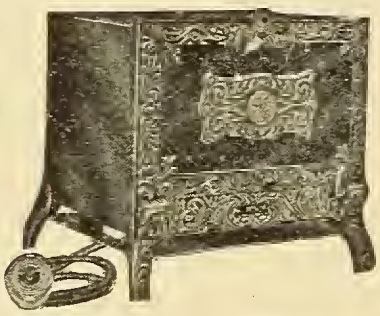


FIG. 159. ELECTRIC OVEN

(To be Continued.)

Dr. Acheson Receives Perkin Medal

Dr. Edward Goodrich Acheson of Niagara Falls was presented with the Perkin medal at the meeting of the New York Section of the Society of Chemical Industry. Dr. Acheson is one of the foremost men in the development of electro-chemical processes and he is the inventor of the process of making carborundum and artificial graphite by electric heat.

X-Ray as Dental Detective

Some years ago one of the most prominent oculists of Cleveland had a patient whose right eye was unaccountably inflamed. Persistent local treatment did not seem to help the trouble, which was evidently due to causes not seated in the eye itself, yet the lady seemed otherwise in perfectly normal health. Finally, almost in despair, the oculist sent her to a dentist whom he knew to be exceedingly painstaking in his examinations. The dentist's inspection showed the teeth to be in almost ideal condition, with no ready indications of trouble, but a more searching scrutiny disclosed a slight and almost wholly concealed abscess at the root of her left eye tooth. While he was treating this in the usual manner, the eye gradually improved so that both dentist and oculist discharged their fair patient at about the same time.

A year later the lady's other eye began to show a similar trouble. Remembering her previous experience, she did not bother the oculist at all but went direct to the same dentist who had handled her case so well before. He carefully scrutinized the corresponding tooth on the opposite side of her mouth, but search as he would, not a sign of even the slightest abscess or other trouble was to be seen. However, the logic of the previous experience had strongly impressed both him and his patient, so with the lady's consent he drilled right down into the root of the healthy tooth; and sure enough, there was an abscess too faint to show at the gums or even to make the tooth ache, yet influential enough by pressing on a certain nerve to affect the opposite eye. By curing this tooth ailment he promptly cured the eye also, thus again showing not only that there was a connection between the two, but also that serious difficulties might be caused elsewhere in the body by tooth troubles which could not possibly be discerned in the ordinary manner.

Such cases might arise over and over again and how was he to locate the seat of the trouble without boring into sound teeth? Would the X-rays locate them? A few trials soon showed that they would and this dentist gradually became one of the best patrons of an X-ray operator who now is specializing on radiographs of the teeth. The method is simple enough, but the results are often surprising.

Where Electricity Stands in the Practice of Medicine

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

CHAPTER IV.—RHEUMATISM, GOUT AND ARTHRITIS DEFORMANS

There is no disease in which a greater variety of remedies has been employed than in rheumatism. For this reason it is not strange that electro-therapeutic measures have come in for their share of use.

In acute rheumatism of the joints they are of comparatively little value, except in connection with the usual methods of treatment, but in muscular and chronic rheumatism they have proved of exceptional value. It is to be borne in mind that our definition of electro-therapy embraced the application of all electrically operated devices used in the treatment of disease, thus including electric light baths, vibration, etc.

If I did not believe conscientiously in the real value of electricity in rheumatism I should not include it in this series, but on the other hand to assert that electricity is in any sense an unfailing cure for rheumatism is quackery.

Acute articular rheumatism, also known as inflammatory rheumatism or rheumatic fever is a very common disease. It is probably the most painful disease flesh is heir to.

It is characterized by swelling of the joints, which is non-suppurative, that is, there is no primary tendency to form pus. It is a constitutional disease, and involves the whole system, and is not limited to a local condition merely. The fever is irregular, and profuse and very acid sweats are present.

It is especially prone to shift from joint to joint and to involve other organs. In more than half of the cases the heart becomes affected. This is usually in the form of endocarditis, which means an inflammation of the lining of the heart. As a matter of fact, the inflammation is almost always limited to the valves.

Rheumatism is usually preceded by a sore throat, such as an attack of tonsilitis. This is one reason for our present theory that rheumatism is an infectious disease, with the infectious agent unknown, although some success has attended efforts to identify it.

The older theory that lactic acid was the cause has been given little credence of late. Like the question of the hen and the egg, it is impossible to say which came first; whether an excess of lactic acid causes rheumatism or rheumatism causes an excess of lactic acid.

Rheumatism is confounded frequently with rheumatic gout, (called arthritis deformans or rheumatoid arthritis) and there is a strong belief among the laity that it is caused by an excess of uric acid in the system, which is a condition present in gout.

Rheumatism affects especially fibrous and serous tissues. Of itself it is rarely fatal, although a fatal termination through some of its complications, such as disease of the heart or pneumonia, occurs sometimes. The mortality rate is less than three per cent.

Rheumatism is most common in the early months of the year.

In a series of 514 cases reported by Barstow, 337 were in males and 177 in females. Of these cases the knee-joint was affected in 351; the ankle in 256; the wrist in 125; the shoulder in 116; foot, 109; hand, 97; elbow, 78; hip, 44. Frequently the disease is symmetrical, that is, both knees or both wrists or both ankles will be involved.

Impoverishment of the blood (anemia) is quickly produced by rheumatism.

The cause of rheumatism as stated above is not definitely known, but the frequency with which tonsilitis ushers in the attack renders the theory of infection probable, and the tonsil is looked upon by many physicians as the gateway through which the disease secures a foot-hold. One of the principal reasons for believing this to be an infectious disease is the similarity between its symptoms and those where a known infection exists.

In acute articular rheumatism, which, by the way, means rheumatism of the joints or articulations, the electrical treatment is of value principally in the relief of pain, through the application of high candle-power electric lights, either incandescent or arc, which also possess some germicidal properties.

In acute muscular rheumatism, of which the most common examples are lumbago and stiff neck, vibration and the spark from the high frequency vacuum tube have cured many cases, and we are justified by clinical experience in warmly advocating their use.

I have made more than one skeptical doctor a convert to the value of these methods by applying them in his own case.

Incandescent or arc light baths, through the radiant heat evolved, are equally useful, and static sparks are similar in their effect to high frequency sparks.

Muscular rheumatism affects the voluntary muscles, which are those muscles whose action is directly under the control of the will. It also involves their point of attachment to the bones and those sheets or bands of connecting or investing tissue called fasciæ. It bears various names according to the part affected. Thus a "stitch in the back" which is located in the lower part of the back, in the region of the lumbar joints of the spine is called lumbago. If it involves the muscles of the side and back of the neck it is called by physicians tortycollis; by the laity, "stiff neck."

Differing from articular rheumatism, this is entirely a local disease, and is brought on by a sudden chilling after violent exertion, or by sitting in a draught, and is more common in individuals who are of gouty or rheumatic tendencies.

Prolonged vibration over the seat of the pain will always afford relief. The high frequency spark is particularly useful and all electrical devices which generate intense, but dry, heat. Galvanism is advised by many authorities, also the sinusoidal current.

In chronic articular rheumatism we have stiff and painful joints to contend with. The swelling is usually slight if it exists at all, and fever ordinarily is absent.

Weather changes affect the pain, which also is increased by movement and generally worse at night. There is a strong tendency to deformity about the joints. In these cases vibration has given the best results, and high frequency sparks, auto-condensation, faradism and electric light baths are indicated and may be employed to great advantage, according to the individual case.

Gout is a disease caused by faulty or disordered nutrition, and it is accompanied by acute and painful inflammation of joints.

There is an excess of uric acid and the normal ratio between uric acid and urea is greatly decreased. There is also a deposit of a sodium salt about the joints. One theory of the cause of gout is imperfect oxidation of food-material and deficient elimination of waste products.

There is no question but the use of fermented liquors and the abuse of one's system through over-eating, and insufficient exercise are the most common exciting causes. The disease is more frequent in men than in women, and there seems to exist in certain families, a predisposition to gout. We call this a gouty habit.

The big toe joint is commonly the seat of acute attacks of gout and the right side is more often involved than the left.

In chronic gout the deposit of chalky material in and about the joints is marked and these "chalk-stones" may be found in various parts of the body. They are common about the knuckles and in the ears. Dyspepsia is an almost constant symptom and acute attacks of gout become more and more frequent.

Since faulty elimination and disturbed nutrition are so evidently concerned in the production of gout, it naturally suggests to us that those electro-therapeutic measures which increase nutrition and elimination would be directly indicated.

Of these there is none better than the high frequency current of D'Arsonval given by auto-condensation. (See illustration in February number of Popular Electricity.) And as auto-condensation is the treatment for arterio-sclerosis (hardening of the arteries) which is so commonly a symptom of gout, this treatment is still more positively indicated. It must not be given during the acute attack as it will only aggravate the pain, but should be given ten or fifteen minutes daily between attacks.

The disturbed proportion between uric acid and urea is altered still more during a period of two or three weeks, when it rapidly returns to normal.

High frequency sparks; static electricity in form of wave or of brush or spark discharge, and the sinusoidal current are all useful, on account of their beneficial effect on metabolism and disturbed nutrition.

During the acute attack the high candle power lamps are the only electro-therapeutic measure I would advise.

The value of various salts of lithia in this disease has caused them to be administered electrically as well as by mouth.

One method is to immerse the affected part in a two-percent solution of lithium chloride attached to the positive pole of the galvanic current, the circuit being completed by large pads on the patient's back connected to the negative pole. The lithium is thus carried in by cataphoresis, as it is strongly attracted toward the negative pole.

Arthritis deformans, commonly called rheumatoid arthritis, because of its supposed relationship to rheumatism, is a chronic disease involving the joints. Frequently those peculiar bony joints known as Heberden's nodes are present.

Heberden's nodes, named after the physician who first described them, are small bony growths or "knobs" occurring on the fingers. The word arthritis signifies inflammation of a joint.

The disease has been considered an incurable one and the deformity resulting from it has been beyond the reach of medical skill. Benefit has been obtained from vibratory massage, hot air treatments, and recently the successful use of the X-ray has been reported by several conservative men.

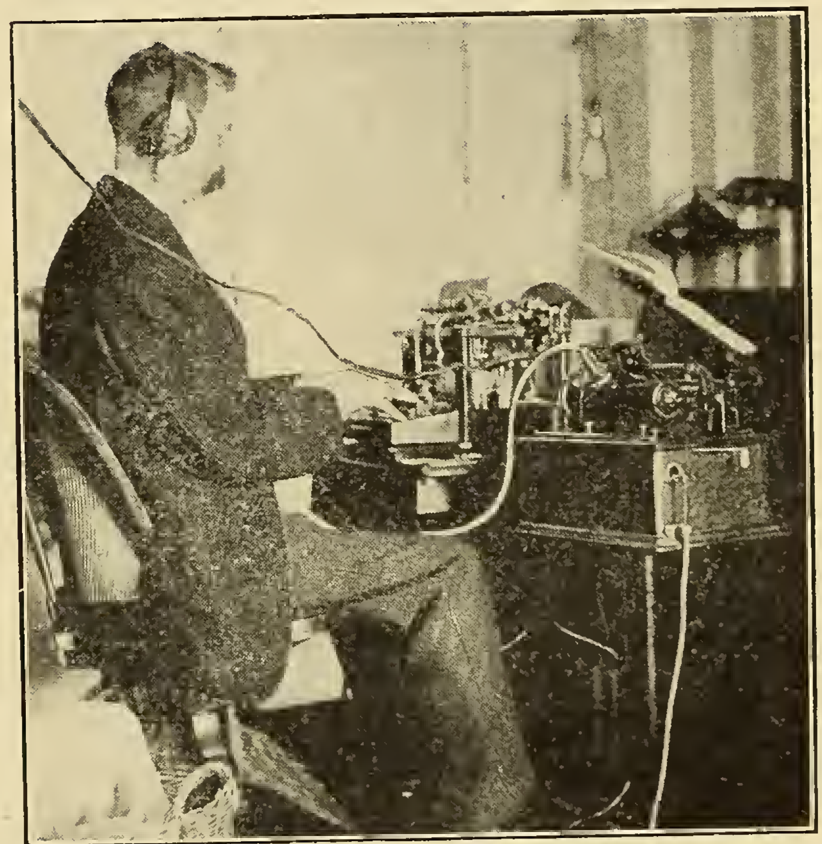
(To be Continued.)

Phonographs in Reporting Debates

One of the most ingenious uses to which the electrically-operated phonograph has been put in the business and professional world is found in the employment of the talking machine as the aid of the official congressional reporter. Indeed, without the assistance rendered by these machines the present system of reporting the debates of our national legislature would be almost an impossibility.

The United States Senate and United States House of Representatives are notoriously the most difficult bodies in the world to report verbatim. The stenographic record of every word spoken on the floor of the chamber of each body is made by a corps of a dozen expert shorthand writers—six in the Senate and six in the House—who by reason of their exceptional proficiency receive salaries of $6,000 per annum for an average of six months' work a year. These official reporters work in "shifts" in taking down debate—that is, they relieve one another at frequent intervals.

It is in the translation and transcribing of the shorthand notes made during the heat of debate that the business phonograph renders such assistance, in behalf of economy of time and labor. Upon retiring from the legislative chamber after an interval of reporting the official reporter immediately reads his notes, or rather the translation of them into a phonograph. This done, he is enabled with scant loss of time to return to the scene of debate and relieve the reporter on duty there who forthwith goes through the same procedure.



TRANSCRIBING FROM AN ELECTRICALLY OPERATED PHONOGRAPH

With this plan in operation the detailed report can be prepared at leisure from phonographic dictation by the typewriters to whom this portion of the work is assigned, and in an emergency requiring the quick preparation of a typed report for transmission to a senator or representative for correction, it is possible to distribute the phonograph cylinders among several typists and thus secure simultaneous work on a lengthy speech or discussion. At the headquarters, respectively of the Senate and House reporters, are "shaving machines" for resurfacing the obsolete phonograph records in order to fit them to be again used for dictation. The shaving machines, like the phonographs themselves, are operated from the electric light circuit.

Talks with the Judge

HE IS MYSTIFIED BY CIRCUIT-BREAKERS AND AIR PUMPS

As I rounded the corner one evening on the last lap of my homeward journey I caught up with the Judge who had just left an Evanston car. I could see by the way he walked, with head bent down and a puzzled look upon his face, that he was confronted with another electrical problem.

Sure enough, with hardly a "How do you do," he sang out: "There are two things that are always happening on that car that I'm blamed if I can understand. I want to know how that pump, or whatever it is, under the car, can start up and chug away while the car is standing still and nobody moves a lever of any kind. And I also want to know what that thing is up over the motorman's head that every once in awhile goes off with a flash and a bang and makes all the women say, 'Oh mercy.' I do know this much—the pump has got something to do with the air brakes. But what the othe thing is for I haven't the least idea. Maybe it was put up there by the motorman to show how little we common passengers know about electricity, and to give us the impression he is saving our lives at the risk of his own as he reaches up and yanks it back into place as nonchalantly as if he were scratching his ear."

All the Women Say, "Oh, Mercy!"

"One thing at a time, please," I said as I fell into "synchronism" with his step and his conversation. "We'll settle the pump first, for it is a pump, as you surmised, and it pumps air under pressure into a long cylindrical tank under the car, from which it is used as required to operate the air brakes. It won't be necessary to explain the operation of the latter for you are probably already familiar with this wonderful system devised by Mr. Westinghouse.

"But every time air is taken from the tank to operate the brakes—the motorman does this with the little handle at his right hand which he nurses so carefully while he is stopping the car—the pressure in the air tank goes down, and soon would be so low that the brakes could not be operated. This air must then be replenished every little while by the air pump, which in turn is driven by an electric motor—not the motor that runs the car.

"Of course it would be foolish in these days of automatic machinery to set a man to watch the pressure gauge and start up the motor when more air was needed. The motorman, too, has his hands too full to take care of the controller, the air brake valve and the track sander. Give him another lever to take care of and he would be "bushed" on a hard run, to borrow a rural expression.

"So the starting and stopping of the pump motor is made automatic. The motor is operated by current from the trolley, and normally its switch is open and is held open by the air pressure conducted through a pipe from the tank and acting on the under side of a little piston working in a cylinder. When the pressure falls below the given value the piston falls, under the action of a spring, until a contact attached to it closes the motor circuit. Then the motor starts up and the pump works away until the pressure in the tank is raised to normal again and the piston forced up, opening the contact and shutting off the current to the motor.

"That's all there is to it. The reason the pump runs so much during the time when the car is at rest is because the motorman has a moment before used air out of the tank to stop the car.

"Now as to the little affair that causes the flash over the motorman's head, followed by subdued shrieks within the car. It is not a source of danger at all but is in reality a sort of electrical safety valve, called a circuit-breaker. You will notice that it opens most frequently when the car is starting up or is climbing a grade at too fast a clip.

"At such times the motors take a great deal of current—much more than during ordinary running. A railway motor, being what is known as a series motor, is a fiend for eating up current when it has a big job on hand like starting a car full of people too suddenly. And it will literally work itself to death trying to make good. The motor has no way of complaining to the motorman when it has more than enough to do and the latter keeps turning on the "juice." This is when the circuit-breaker takes a hand.

"The circuit-breaker is an automatic switch. The handle which you see the motorman throw over after the circuit-breaker has 'blown' carries, inside the little asbestos lined box, a pair of very springy copper brushes which bear against two copper blocks, closing the circuit so that current can get to the motors when the controller handle is moved. It takes quite a push to bring the handle over, but it is finally held by a little catch.

"Next you will ask, 'What releases the circuit-breaker?'

"This is done by what is called a solenoid, also located inside the little box. It is simply a coil of very heavy wire through which the current must pass in order to get to the motor. Working inside this coil is an iron plunger which is connected to the catch which releases the circuit-breaker.

"Following a well-known principle of electricity, when current flows through such a coil a plunger of iron in the coil will be drawn still farther in, the strength of the pull varying directly with the amount of current flowing in the coil.

"What happens, then, when the motor takes too much current for its own good? The current through the coil gets so strong that the iron bar is drawn up sufficiently to trip the catch and the circuit-breaker flies open with a noise like a pistol shot. The flash comes from the arc which is drawn between the opening contacts.

"Who'd ever thought they would go to that much trouble to take care of a motor," said the Judge as we parted.

Electrically Made, Electrically Used

Is there not a peculiar fitness in the growing use of aluminum wire for electric circuits, as instanced by its adoption for long distance transmission lines at Guelph, Nelson, Toronto, Winnipeg and other Canadian points? If any metal deserves to be called electrical, it is aluminum, since its very existence as a metal depends on electrical processes. Small batches of it were made by other methods over eighty years ago, but it took electrolytic processes to make even the first commercial quantities on a small scale.

That was 55 years ago when the current had to come from primary batteries, so it is no wonder that the metal as then made in France brought ninety dollars a pound, almost a third the price of gold.

American progress during the last fifteen years has perfected electrical methods for producing aluminum of about 99 per cent purity, and while this is comparatively weak in large shapes, it becomes much stronger when drawn into wires. Then its lightness much more than makes up for its lower conductivity (as compared with copper) so that it is growing to be a commercial article for transmitting the very currents that are needed to free it from the oxides and fluorides with which it is found to be chemically combined when mined.

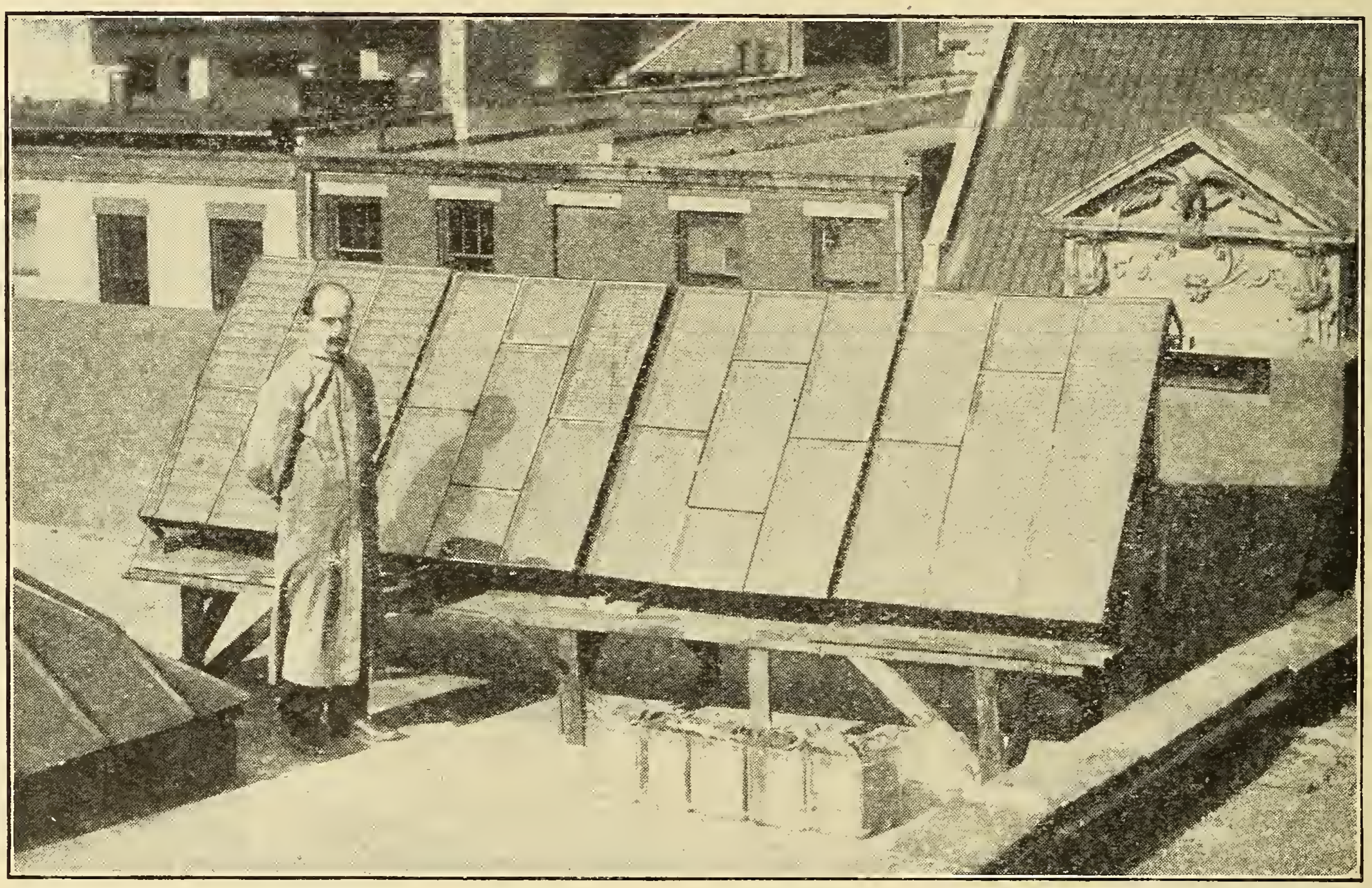
Generating Electricity by the Sun's Rays

By VICTOR H. LAUGHTER

About a year ago there was considerable comment about Mr. George S. Cove's device for generating electricity from the radiant energy of the sun. The only device described at the time was in a sense rudimentary when compared with the improved solar electric generator which Mr. Cove has recently put in operation on the roof of his new laboratory in the historic Maiden Lane, New York.

It is not claimed that the new apparatus is perfect or even that it uses a very large proportion of the energy contained in the rays which strike upon its surface, but Mr. Cove has satisfactorily demonstrated to many engineers and electrical experts that the so-called thermo-couples constructed from the peculiar alloys which he uses make possible a machine very much more effective in every respect than the antimony-bismuth thermopile or any other known caloric device, as it goes further than the mere transmutation of heat rays into an electrical manifestation. For clearness it may be stated that a thermopile or thermo-couple consists of a junction of two dissimilar metals, which when placed in an electric circuit and heated will cause a current to flow through the circuit.

The first practical apparatus which Mr. Cove constructed at Somerville, Massachusetts, consisted of 976 thermo-actinic units connected with storage batteries in which it stored, in the light of subsequent developments, a comparatively feeble current, which was sufficient, however, to operate several tungsten lamps of low voltage.



MR. COVE AND HIS SUN ELECTRIC GENERATOR

Many improvements in the shape, arrangement and composition of "plugs," meaning the thermo-couples, in the insulating material and in the method of connection have greatly increased the efficiency of the machine.

Recently the inventor set up an improved generator in New York which consisted of a frame of 16 square feet, containing 1804 plugs, each having about one square inch exposed to the rays of the sun under strips of violet glass, while the other end was sheltered beneath the apparatus.

Very careful tests of this type showed that the device was capable of generating one horse-power to 272 square feet of surface in contact with the direct rays of the sun, equivalent to 2.75 watts to each square foot.

This machine was improved by a system of convolutions which increased the metallic surface under the glass about three times in the same horizontal area, so that a surface of 96 square feet develops over eight watts to the square foot, which makes the apparatus practical in a small way for small lighting plants even in its present stage of development.

These results, of course, are unthinkable in connection with the ordinary thermopile, as resistance in the external circuit causes rapid diminution of the amperage. With Mr. Cove's device resistance seems to cause no more decline in the flow of current than might be expected in the use of electricity from any other source.

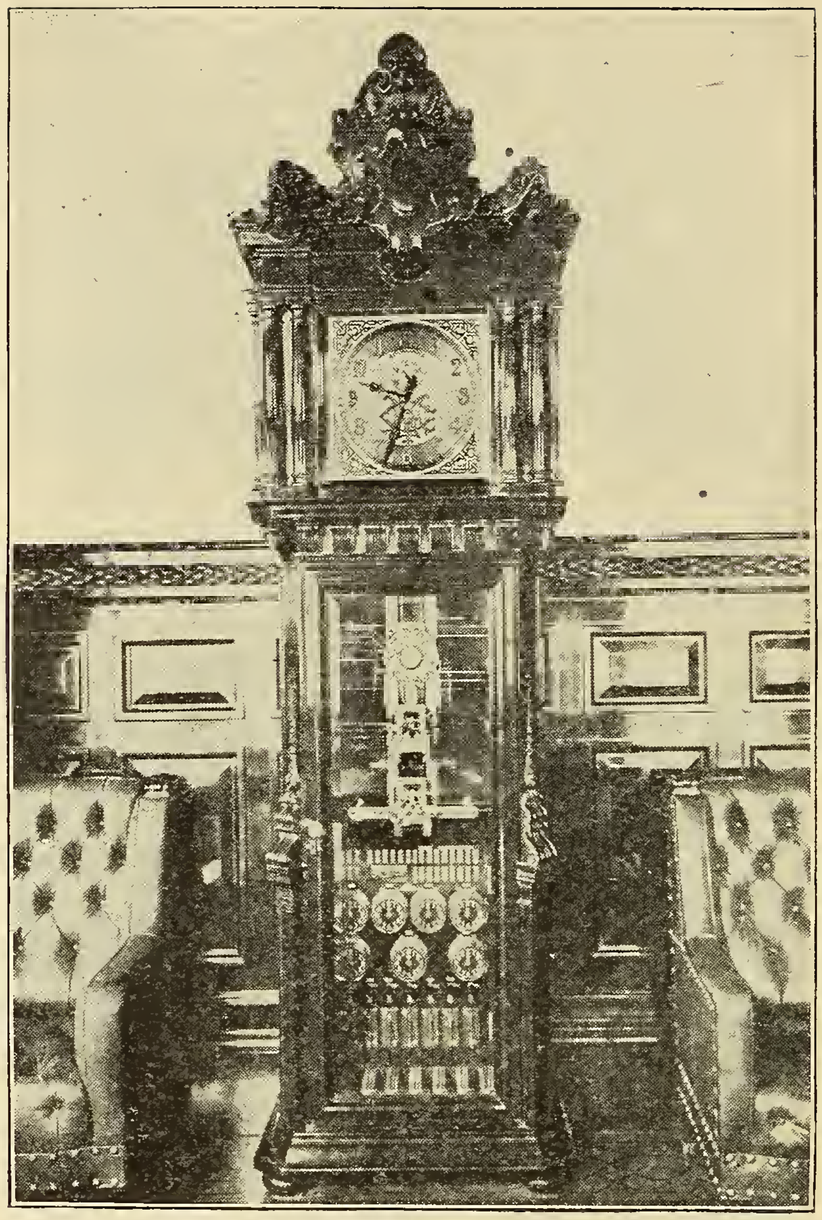
Most Wonderful Clock System Ever Built

By JOSEPH B. BAKER

Gleaming in lines of burnished gold against the evening sky, the tower clock of the Metropolitan Building, facing on Madison Square, New York City, is one of the horological marvels of the present day. New Yorkers take pride in showing out-of-town visitors the tall white tower and its clock—especially at nightfall, when to the music of the chimes sounding the quarters is added the flashing of the time from the lantern at the topmost point, seven hundred feet above the street. By day and night, from as far as they can be seen at all, the four giant dials can be read, and far above the city's din every fifteen minutes the bells announce the flight of time to all within earshot. And the red and white flashing beacon sends the same message far afield, readable on a clear night by all within a radius of fifteen miles. The whole constitutes quite the most remarkable clock system that has ever been built.

THE METROPOLITAN TOWER AT NIGHT

The tower clock dials, illuminated at night by many incandescent lamps, are 26 feet six inches in diameter, with numerals four feet high and minute marks 10½ inches in diameter. The hands, driven by an electric motor, are 17 feet and thirteen feet three inches long, respectively, and weigh, together, 1700 pounds. The four bronze bells constituting the hour-strike and the chimes have an aggregate weight of 13,500 pounds, and the flashing lantern is equipped with red and white incandescent lamps mounted in an octagonal lantern of an aggregate candle-power of over 22,000. The clock system includes, beside the four tower dials, hundreds of other secondary clocks distributed throughout the offices and other rooms of the building. All of this mighty horological equipment is electrically actuated and controlled from a single "master clock," which is itself electrically self-winding, requiring no touch of human hands from one years' end to the other.



SELF-WINDING MASTER CLOCK

This master clock is situated in the magnificent Directors' Room of the Metropolitan Life Insurance Company, on the second floor of the building. It is contained in a beautifully carved mahogany case, 12 feet high, matching and harmonizing with the costly furnishings of the room. This clock movement, which is the soul and center of the entire system, is a mercury pendulum movement of the very highest grade, with a non-tarnishing silvered dial and gold-plated ornamentation. Behind a large plate-glass door in the case are transmitters, mechanically controlled from the master clock, for operating the distant tower movements, the other secondary clocks, the chimes and hour-strike, and the flashing equipment. Every secondary clock circuit is brought out through an adjustable resistance and a pilot-clock movement, so that any desired set of clocks may be cut into service from the master clock and without going to the secondary clocks themselves, by manipulating press-buttons in the case.

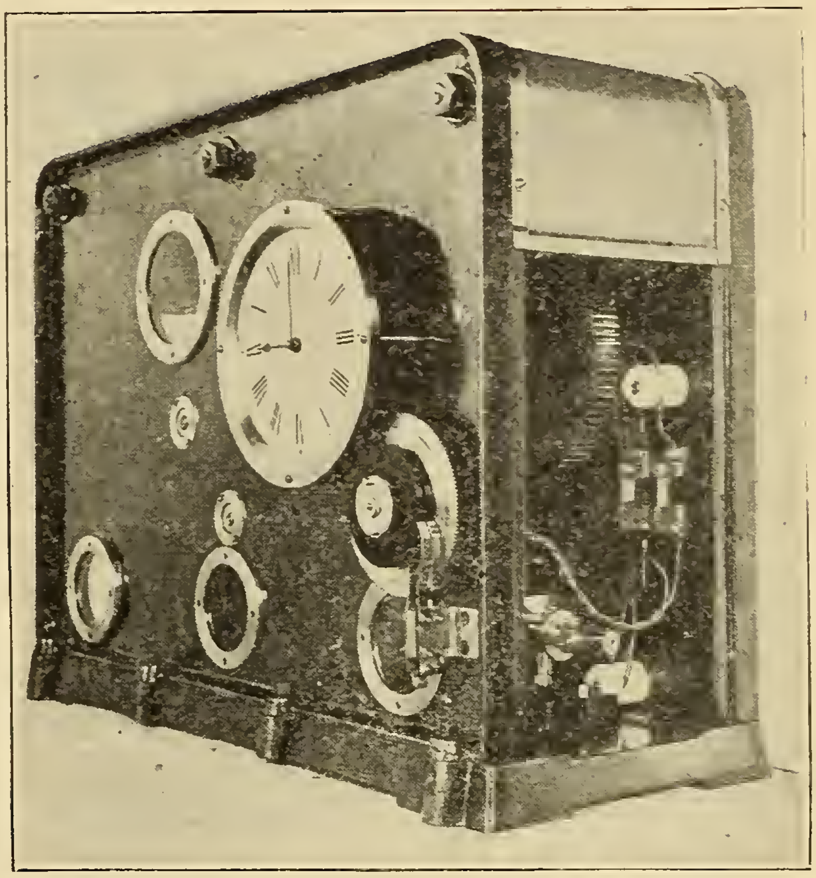
Leaving the master clock ticking solemnly away in its splendid surroundings, let us take the express elevator to the twenty-sixth floor of the tower and enter the clock-room behind the west dial. Here are the panels on which are mounted the delicate relays, operated from the master clock and themselves actuating heavy magnetic switches mounted on another set of panels near by. The front of the room opens out into a ferro-concrete casing, some 30 feet square and projecting out about 30 inches from the wall of the tower. This is the tower dial, with its numerals and minute-marks cut through the front wall and glazed with heavy plate wire-glass through which a birdseye view may be obtained of the city and Hudson River and the distant Jersey hills. The landscape looks far enough below, though here we are only half-way up the tower! Sliding shutters at the dial center give access to the backs of the monster hands—of steel-frame construction with copper casings—and through a slide in each hand near the point of attachment to its arbor the lamps which light the hands up at night may be reached. The hands are faced with polished wire-glass, and each is fitted with a pair of ingenious rolling carriages on which are mounted "linolite" lamps, giving the effect of a nearly continuous double line of light. The lamp carriages run on rails on a track in the structure of the hands, and are hinged together in sections, so that they may be withdrawn through the slide for the purpose of renewing the lamps. At the center of the minute-hand is a glass-faced boss containing a center cluster of ordinary bulb lamps.

The illumination of the dial itself is by an indirect method designed to give the most brilliant and at the same time the most distinct tower clock lighting in the world. The entire interior of the dial casing is painted a permanent dead-white having high reflecting power for diffused light. Two concentric circular rows of 20-candle-power tungsten lamps, two hundred in all, are mounted in front of curved reflectors of corrugated, silvered glass, which throw all of the direct rays against the rear wall of the casing. By this means the glass fronts of all of the numerals and minute-marks are strongly and evenly lit up, yet without any glare or blurring of the dial as seen from the outside of the tower at night. By day also, when the space back of the dial is unlighted, the numerals cut through the dial contrast well with its white surface.

The massive hands of each tower dial are carried on a set of "dial works" consisting of a steel shaft and sleeve running on ball bearings and driven by an electric motor. The "dial movement" containing the motor and its gearing is also equipped with an automatic cut-out device which turns the illumination off at 20 minutes before sunrise and on at 20 minutes after sunset, with the progressive advance of the season. There are no cumbrous weights and pulleys to operate the hands of the clock—the little electric motor, obedient to the control of the master clock and its relays and switches, starts up once every minute and runs for fifty seconds, driving the minute hand through one minute-space on the big dial during each run. Two motors are employed in each tower movement, either one alone being well able to drive the hands, and a centrifugal tell-tale device, mounted on the shaft, being used to signal to the Chief Electrician's office in case of "trouble" on either motor.

The electric "torch" on the tip-top of the tower is also turned on and off by the same automatic device that controls the dial illumination. From the magnetic switches in the clock-room, which are operated by the tiny contacts at the master clock, heavy feeder cables carry the current which flashes the time all through the night—one, two, three and four red flashes for the four quarters and one white flash for each stroke of the hour. The white light, given by 88 large incandescent lamps with uncolored bulbs, burns continuously except just before the time to announce each quarter-hour, at which time it is extinguished preparatory to the flashing.

When one has gone all over the building and seen the various parts of the clock system in operation, one is better prepared to examine the master clock, with its faithful pendulum the prime mover of all these wonderful horological details. In charge of so many functions as the master clock is, there is "something doing" all the time in the



ELECTRICALLY DRIVEN TOWER MOVEMENT

array of beautifully finished gleaming mechanism. Let us watch the chimes transmitter, which consists of a little brass cylinder with four pairs of accurately adjusted platinum contacts bearing upon it and arranged to be closed in a certain order by the rotation of the cylinder. Once every 15 minutes, and a sufficient time before the even quarter-hour, a rod moved by the main transmitter releases the cylinder, allowing it to rotate and close the contacts for the proper quarter-hour chimes. The timing of these contacts is such as to cause the first stroke of the hour bell to occur accurately on the hour, allowing plenty of time beforehand for the chimes to strike their four "measures" and get through. The hour-strike transmitter is mechanically operated from the chimes transmitter.

Suppose the time is a little before two. As we watch, the drum of the chimes transmitter begins to turn, and one after another all of the four contact fingers are kicked up into the air. The sound of the answering tower bells comes down to us, but tardily, on account of the great distance; but it is a kind of music simply to watch the changing measures marked by the dancing bits of metal. Before we realize it, the motion ceases, and we turn our glance to the hour-strike mechanism. Its contact fingers close and open twice, in leisurely succession, followed by the booming notes from the 7000-pound B-flat "announcing bell" from its place on the forty-fifth story.

Down at the Power House

By FRED R. FURNAS

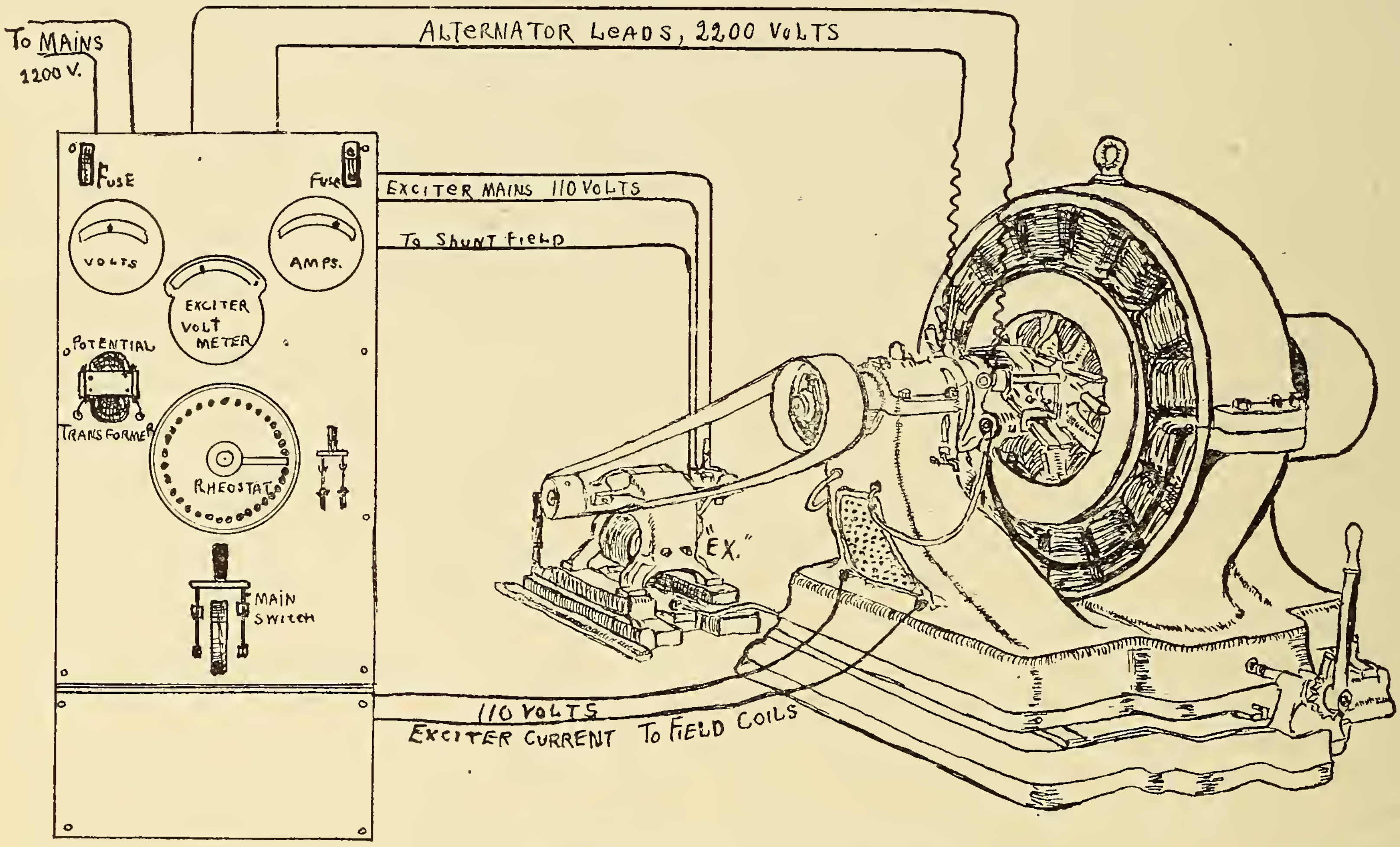
The old electrician was preparing to start up for the night run. The telephone had been interrupting our conversation for some twenty minutes, with frequent demands from various parts of the little city to "please turn on the juice."

Not deeming it advisable to ignore these requests any further, the old man stepped to the door of the boiler room and "looked at the steam." Finding this at the correct pressure, he casually remarked to his fireman that he would have to "hump himself" up to about eleven o'clock, on account of the extra load that would be thrown on that night by the street carnival lighting display.

Turning to the big Corliss engine, he admitted steam to her cylinder slowly and gradually. Her 16-foot flywheel began to revolve faster and faster and one of the alternators, belted to high speed from the countershaft, began to hum in shrill crescendo, louder and louder. One of the two dynamos was used only in heavy emergencies, being thrown in or out with a large friction clutch.

When the speed had risen to the right proportions, as indicated by the exciter voltage, the old man donned a pair of rubber gloves and clapped in the main switch. As the big dynamo caught its load, the shrill howl changed to a deep groan, for it was the habit of the natives of the little city to throw in or snap on, according to the kind, their switches, connecting the lights at the first hint of darkness. Consequently, a heavy load was thrown on the power house from the start.

The system in use was 2200 volts, single phase alternating current generated at the power house, and distributed over the city at that pressure. At residences and stores it was stepped down by transformers to 104 volts for the lamps.



THE POWER HOUSE EQUIPMENT

In the downtown district, where the heavy localized consumption of current permitted, larger transformers, with correspondingly higher efficiencies, were used; each one feeding current to several stores and offices.

The electrician now proceeded to raise the pressure in the mains to 2200 volts. It may interest the reader to know how the voltage of a high pressure alternator dynamo is controlled and regulated. For this purpose the drawing is referred to. By means of the rheostat on the switchboard, the old man cut out resistance in the field circuit of the little direct current exciter (EX), thereby increasing the voltage of this little dynamo. This increased voltage or pressure forces a larger current from the small machine through the field magnet coils of the big alternator, which increases the magnetic flux, or amount of magnetism in its iron cores. The windings on the revolving armature of the alternator, sweeping through this magnetic field, generate a current, the voltage of which depends upon the strength of this magnetic flux. Thus by varying the voltage of the little "exciter," the pressure of the alternator may be varied at will.

The electrician now proceeded to oil up first the alternator and then the exciter, adjusting the brushes on the latter and, with some caution, applying commutator compound to the rectifier and collector rings of the former.

Twenty-two hundred volts is not considered a high pressure in these days when we have transmission lines carrying 120,000 volts, but it is sufficient to kill almost as quickly as the latter named pressure and the old electrician was accordingly careful to stand on the raised wooden platform and keep one hand behind his back. Going over to the switchboard, he noted that the ammeter registered 30 amperes in the main circuit, and by a little mental calculation he knew that the alternator was delivering around 80 horsepower.

His engine was rated at 200 horse-power, and he expected to crowd her to full capacity when the carnival lights were thrown on. The peak or maximum load under ordinary conditions was about 100 horse-power, and one dynamo could usually carry the entire load without undue overheating, as this peak load seldom lasted more than one and a half hours: between 8:30 and 10:00 o'clock.

On this particular night, however, machine No. 2 had to be thrown in and this the old man proceeded to do, so as to get her ready for business. Being alternating current generators, they must be "synchronized" or placed in step with one another. This means that when the current of the machine in operation is flowing in one direction (and it reverses 120 times per second at a frequency of 60 cycles) the switch connecting the two machines in parallel must be closed at the instant that the incoming machine's current coincides in direction of flow, with that of the first machine.

The electrician watches the synchronizing lamps glow and darken, as the alternators, unharnessed, as yet, assist and oppose each other in turn. When the fluctuations have slowed down to about one beat in every three seconds, he throws in the switch in the middle of one of the dark intervals of the lamps, and thenceforth the machines keep step and work together in perfect harmony. But he must watch the voltage of each machine occasionally and keep each at the same value, otherwise heavy cross currents will flow between the alternators. This would be a waste, as the engine would be developing power that never left the power house.

The ammeter suddenly jumped from 53 to 72 amperes, the lamps dimming; and the electrician was here, there and everywhere, adjusting the voltage, watching the engine, steam and instruments. Evidently, in the matter of stringing festoons of lamps over the streets at intervals, the capacity of the power plant had not been closely inquired into, for the current climbed steadily up to 75 amperes, and the engine was already overloaded. The old electrician, however, had another card up his sleeve, in the shape of a motor generator set of 30 kilowatts connected to the 500-volt direct current trolley feeders of the city railway.

This machine converted the 500 volts direct current such as is used by street cars into 104 volt alternating current. In less than half an hour the old man had "banked" three 10-kilowatt transformers to "step up" this 104-volt pressure to 2200 volts, connected them to his motor-generator set, cut off his New York street mains from the alternators and thrown his "imported juice" on that line.

The two alternators, which had heated up to an uncomfortable degree, were now able to "get away with it," and having everything running smoothly, even the fireman, the old man sat down by the switchboard again and lit his pipe.

Living Candelabra

Remarkable electrical effects are produced in some of the scenes of "The Three Rivals," a pantomine presented in the Circus Schumann in Berlin, Germany. In the castle of the hero, the "Knight of Champagne," red flames, made by projecting electric light

LIVING CANDELABRA

through fluted ribbons burn on the candlesticks. Under the columns of the palace, standing on pedestals, are gold bespangled maidens and pages carrying candle-sticks and giving the appearance of living candelabra as shown in the picture, which is reproduced from Mitteilungen der Berliner Elektricitäts-werke.

Northern Lights May Be Electrified Neon

Professor Elihu Thomson points out that there is ample evidence that the illumination of an aurora occurs at a great elevation in the atmosphere. One of the latest revelations regarding it is that one of the newly discovered gases, neon, is concerned in the display. Every element, when rendered luminous, exhibits a certain line in a spectroscope different from those shown by other substances. The spectroscope is useful in telling the composition of things. It has recently been noticed that the lines observed during an auroral display correspond with those obtained when neon is tested in a laboratory. Neon is one of the constituents of the atmosphere, but it exists in very small quantities, and, owing to its extreme lightness, rises to a high level. It is very sensitive to an electrical discharge, as has been proved by repeated experiments. Whether the electric disturbance comes directly from the sun or is produced indirectly by a derangement of the earth's magnetism, it is hard to say, but in either case, the neon shows that some electric force is at work.

Railway Car Like Halley's Comet

One of the unique advertising features connected with Chicago's recent Electrical Show was an electrically illuminated street car, the first Chicago has ever had for exploitation purposes. It was put together in the shops of the Chicago City Railway and was operated over the South Side lines and the "through routes," covering the North and West sides, from 4:30 to 10 o'clock p. m. It attracted much attention as a brilliant advertising "stunt." During the rush hours several nights the car stood on

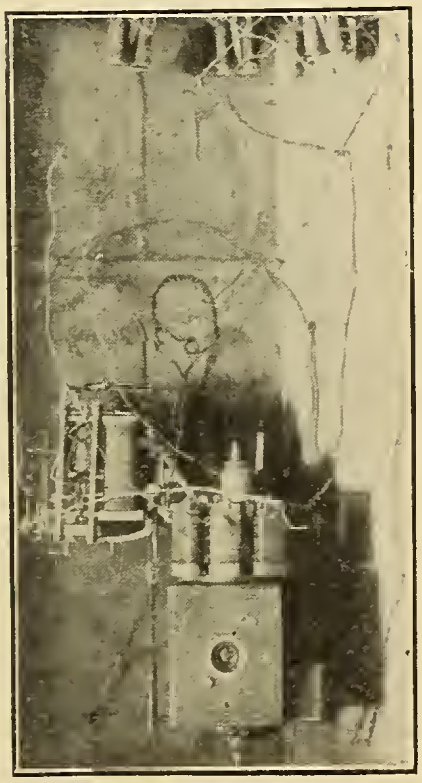
ELECTRICALLY ILLUMINATED CAR

the Madison Street "spur" track, just off State street, where it was seen by thousands of workers on their way home. The car was put together in twenty-four hours' time, otherwise more elaborate effects would have been employed. As it was this electric car looked like Halley's comet coming down the street.

Cleptograph Camera

The tangle of electrical instruments and wires shown in the picture appears to be rather "messy," but it is said to be a real electrical and mechanical detective when it comes to photographing thieves and recording the time of their operations. It was designed by Signor G. B. Epifanio Camusso of the Cassa di ' Risparmio de Pinerolo in Italy.

It consists of a photographic camera and a system of wires and contacts properly distributed over the windows, doors and curtains of the room to be protected. As soon as the thief enters the house or office or touches any article of value a contact is unconsciously made by the stranger and the camera does the rest.



CLEPTOGRAPH

The Cleptograph automatically directs itself towards the burglar who has involuntarily made the contact and after having opened the objective shutter, it ignites the magnesium powder arranged to supply the flashlight, and then closes the objective after the exposure has been made. The film is automatically exchanged and a new charge of powder made ready, at the same time registering the exact hour and minute of the theft.

All of these divers operations are completed in far less time than is required to describe them, and the apparatus is almost instantly ready for taking another view, as soon as the intruder touches some other contact.

As an invisible detective the cleptograph thus follows any and all motions of the thief in order to prepare a set of authentic and irrefutable documents to assist the police in their search for the criminal. The camera and working parts may be boxed in and concealed from the burglar, all except a small opening to allow the scene to be photographed through the lens.

Simplest Alarm of Them All

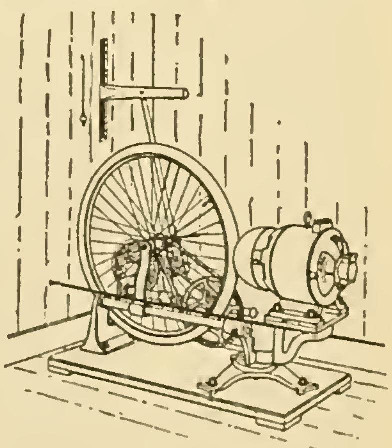
The ordinary alarm clock will vibrate and move around over a smooth surface when the alarm is going off. You can make use of this fact in making a very simple electric alarm.

Through the top of a box put two screws the distance apart of the feet of the clock. The screws should be counter sunk slightly. Connect the points of the screws to a battery and bell so that the circuit will be closed when the two feet settle on the two screw heads.

Now wind and set the alarm, place one clock foot on one screw and the opposite foot very near to the other screw. When the alarm goes off the foot will move over and drop on the screw, closing the circuit and the electric bell will ring till disconnected. One trial will show which way the clock moves with the vibrations.

Rotasphere for Organ Blowing

The rotasphere is a novel English device for the application of electric power to organ blowing. This apparatus utilizes the old-fashioned bellows movement for "raising the wind" as required by a full sized organ instead of using rotary fan blowers as usually employed when electric motors are installed for this purpose. The ordinary reciprocal bellows movement is obtained and worked as indicated by a sprocket reducing gear and chain, driven by a small electric motor. An aluminum hemisphere is employed on the end of the motor armature shaft, driving the apparatus through a pneumatic tired wheel.



ROTASPHERE

It will be seen that automatic regulation of the wind supply to the requirement of the organ is obtained by varying the point of frictional contact between the hemisphere of the motor shaft and the tire. This is accomplished by swiveling the motor and attached hemisphere through an angle of 90 degrees by means of a chain and reacting spring which are under the direct control of the bellows movement.

Quicksilver Not Quick Electrically

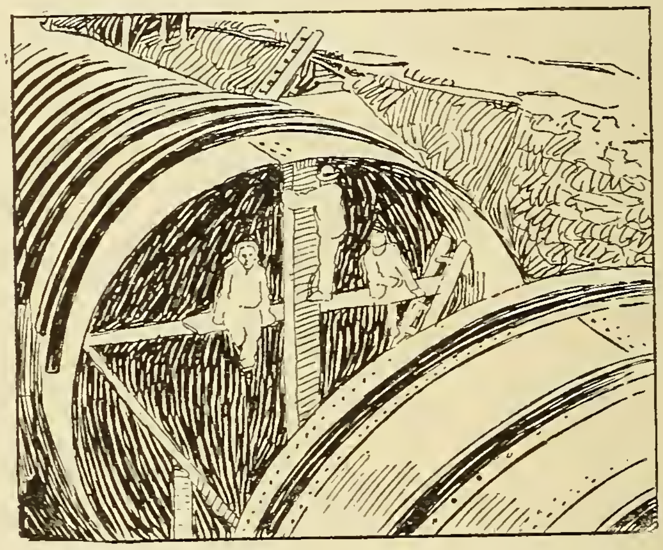
Anyone who has handled that unusual metal, mercury, which is a silvery liquid at our ordinary temperature and which speedily splits up into countless globules when spilled on a floor or table, will understand why it is also called "quicksilver." But quick as it is in subdividing itself into globules, it is not so speedy in electrical ways where it is surpassed for certain classes of work even by that sturdy metal, platinum.

Having so long been used in thermometers for indicating temperature within range of the eye, and being itself a good conductor it was natural that mercury should be tried and used also in "long distance thermometers." Thus in large theatres where every effort is made for the comfort of the audience, it is important that the engineer in charge of the heating and ventilating should note the temperature in various parts of the theatre without leaving his post. This has been accomplished by placing regular mercury thermometers at various points in the building, each with wires inserted at the upper and lower end of the glass tube. The upper wire is of such length as to be just out of reach of the mercury at a temperature of, say, 68 degrees, and both wires connect with a battery and an annunciator in the engineer's room. Then when the mercury rises beyond the desired normal, it closes the circuit and signals to the engineer who can reduce the supply of heat for that part of the house.

While this method is perfectly practical it has had the objection of being slow in giving the desired indication. It might be five or ten minutes after an abnormal change in temperature before the engineer was informed of it, and meanwhile the improper heating would continue. To improve on this, something more rapid in action than mercury was needed and this has been found in platinum wire when used in a somewhat different manner. Instead of connecting a thermometer to the wires at each "station," a simple platinum wire is used as a resistance through which a current flows from the regular electric light circuit to a sensitive ammeter in the engine room. This platinum wire being exposed to the air, changes rapidly in resistance with every variation in temperature, either up or down, and each change in resistance makes a corresponding difference in the reading of the ammeter. Recent tests in a modern theatre showed that the same temperature variation which took five minutes to actuate a mercurial device, showed itself by the platinum resistance method in three seconds. In other words, platinum proved a hundred times as speedy for this purpose as the sprightly metal which we popularly call the quicksilver.

Conduit for Electric Cables

The drawing herewith shows an immense conduit tube being put in by the Ontario Power Company of Niagara Falls, N. Y. The conducting cables for carrying the elec-



EIGHTEEN FOOT CABLE CONDUIT

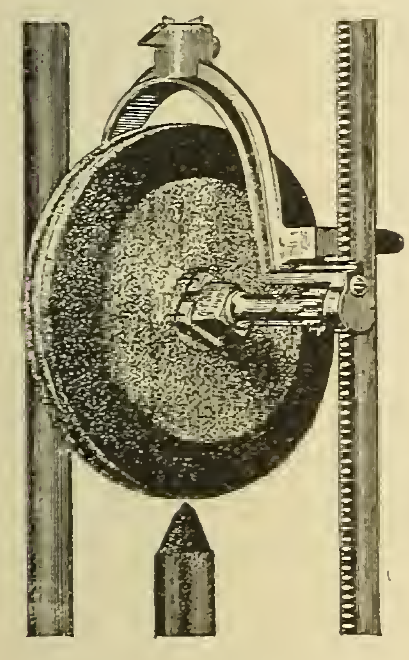
trical energy generated at the plant of the Ontario Power Company will be carried in this underground conduit to the plant of the Hydroelectric Power Commission of Ontario where it will be delivered, on contract, at 12,000 volts' pressure. The tube is of steel 18 feet in diameter.

Signaling to Mars

An electric light of 4,000,000,000,000 candle power would be necessary to signal to Mars, according to Prof. Mietke, a German scientist. To produce such a light would require an electrical plant hundreds of thousands of times larger than any ever built; and we are not anxious enough yet for conversation with our neighbors to undertake it. On the other hand, if the inhabitants of Mars possessed a telescope which would magnify 10,000 diameters he estimates that they could see the signals as light points if we only had a "little" lamp of say 360,000,000 candle power. This might be operated for a few thousands of dollars an hour -and still we are not very anxious.

A Carbon Disc Arc Lamp

One of the great problems of the early arc lamp manufacturers was that of making their lamps burn all night. Even a twelve-inch upper carbon was entirely consumed in about eight hours, so that the lamp could not be burned from dusk till dawn unless it was retrimmed at about midnight. Brush, who invented the arc lamp, solved the problem by making a twin lamp in which one pair of carbons was automatically switched into action when the other pair had burned low.



CARBON DISK ARC LAMP

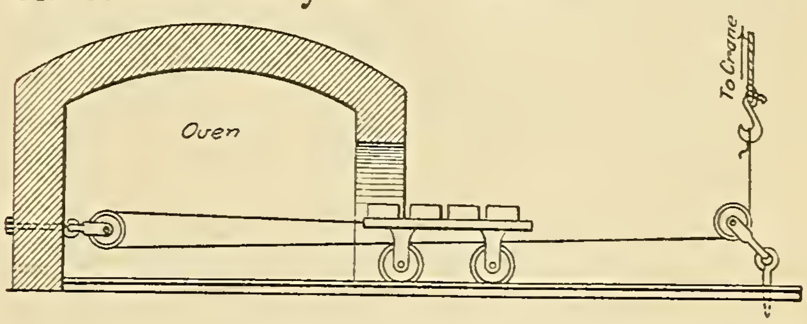
Then when his patents barred others from doing the same, one of the New England Yankees who did so much for arc light development designed a lamp with the upper (or more rapidly consumed) carbon in the shape of a carbon disk which would easily burn for a full twenty-four hours. A rack on one side of the supporting frame rotated the wheel slowly as the carbons were consumed, so that it made one revolution every hundred minutes, and the whole lamp was considerably shorter than the twin carbon types. Later on, the use of an enclosing globe to maintain a partial vacuum in the globe was made practical by Louis Marks, enabling the old shape of carbons to be burned ten times as long as before. The carbon disk type of lamp thereby became merely a historical curiosity, but it is interesting even today as showing how cleverly an inventor managed to evade a patent when the same threatened to monopolize the making of lamps for all-night arc lighting.

Snow on African Wires

That the unusually heavy fall of snow and sleet during January should have broken some electric light wires in various parts of the United States and of Canada is not surprising, but our part of the globe has not been the only one to suffer. The southern hemisphere was some five months ahead of us in that respect, for on August 17th snow fell at Johannesburg in South Africa to a depth of over a foot, breaking down trees as well as many electric light wires. In this country line wires are commonly made strong enough to stand a considerable added weight of snow or sleet, but this had not been thought necessary in the diamond mining section, so the unusual occurrence of a heavy snowfall preceded by sleet was too much for them and that evening even the theatres in Johannesburg had to close for lack of light.

Charging Foundry Ovens with An Electric Crane

In modern foundry practice, large ovens are commonly used for two purposes. One is for annealing hard iron castings which are to be made "malleable." The other is for drying or even baking the moulds themselves when they are to be used for certain



CHARGING FOUNDRY OVEN

classes of castings. In either case the materials are commonly loaded on four-wheeled trucks which can be run right into the oven.

Instead of moving these heavily loaded trucks in and out of the ovens by hand, some foundries are now utilizing the electric traveling cranes with which they have to be equipped if they are to handle large castings economically. To do this, a rope fastened to one end of the truck is passed over a pulley hooked to the rear wall of the oven. The rope is then run back under the truck to another pulley placed in the path of the traveling crane and up to the crane hook. Then when the hook is raised, it pulls the truck into the oven as you can see from the cut.

To pull the car out, the rope is attached directly to the other end of the truck. In either case no more elaborate equipment is needed than merely the two tackleblocks, two hooks suitably located in relation to each oven door and an ample length of rope.

Novel Church Attraction

Now that the electric sign has become so prominent among business people as a means of attracting trade, a pastor of a certain church thought out an advantageous scheme of using an electric sign.

ELECTRIC CHURCH SIGN

The picture shows the "Welcome" sign over the door. The idea has been much admired by the congregation and the public, and other churches may follow in the adoption of the electric sign as more attractive than the ordinary painted sign.

Did Edison Make Good?

Every now and then we see items making the rounds of our newspapers in which the writers question the ability of our modern inventors to keep their promises. Of course there is a large class of theorists, wild predicters and unscientific experimenters whose promises must be discounted heavily. But when it comes to men of established reputation and men who are cautious in their predictions, it may be well to remind them of similar doubting articles that circulated through our press some thirty years ago. Here is a typical one which appeared in the Philadelphia Bulletin:

"If Mr. Edison wishes public faith in that electric light of his to remain steadfast, he will have to give an early demonstration of the truth of his claim that it is a practical success. When he first announced that he had solved the problem of dividing the light and of adapting it to domestic uses, there was a general inclination to accept the story with absolute confidence, because Mr. Edison had proved by his previous inventions that he could achieve some things which had been regarded by other men as impossible. But, after all, the proof of the pudding is in the eating. So the world, after waiting patiently for the public display of an invention which sent gas stocks down as soon as it was heralded, will be disposed, unless Mr. Edison shows his hand, to suspect that the Edison Electric Light and the Keeley Motor will have to be ranked together as enterprises which contain much more of promise than of performance!"

Just what the Philadelphia papers wrote when Edison did make good, history sayeth not.

Anesthesia by Electricity

Doctor Louise Robinovitch, the Russian physician, who has become prominent in this country through her demonstrations of electrical anaesthesia, recently managed the electrical part of an operation on a human subject in St. Francis Hospital, Hartford, Conn.. Heretofore her experiments have been upon animals, but in this instance a man had four frost-bitten toes amputated while his leg was made numb below the knee by the electrical process.

Doctor Robinovitch's plan consists of sending an interrupted current of electricity through the affected part of the human body to be operated upon. No other part is affected. A current at fifty-four volts was used in this instance, reduced to one-tenth of that amount. The interruptions of the current were estimated at 20,000 a minute.

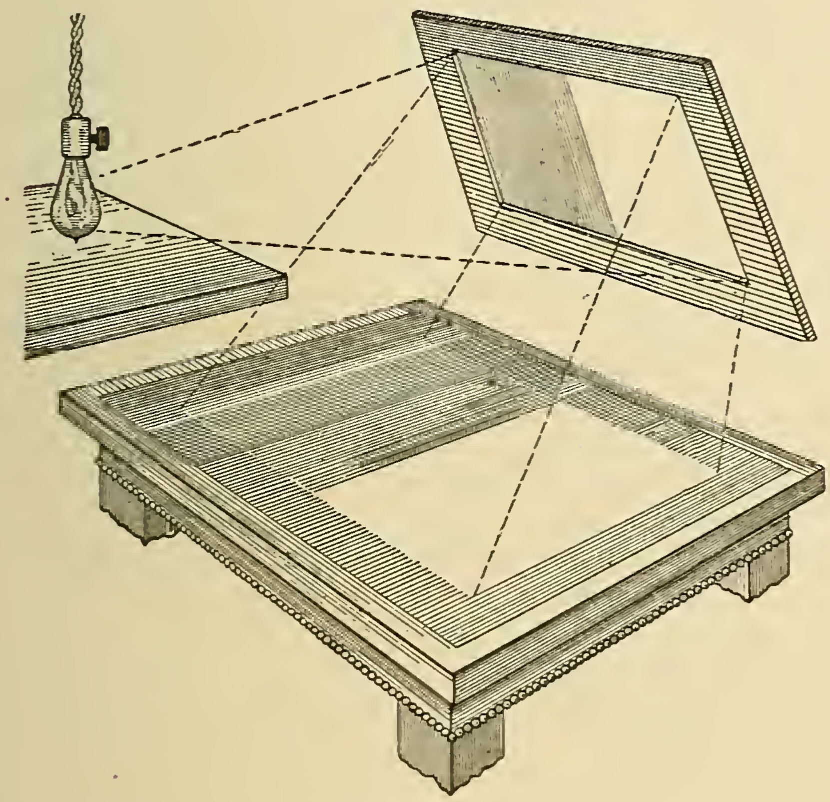
The secret of the use of the device is in correctly applying the electrode to the nerve that controls the affected part. Doctor Marcus M. Johnson, the surgeon who performed the operation, said there were no bad after-effects, and the patient suffered no pain. He declared that the feat marked an epoch in anaesthetic surgery and that other forms of anaesthesia were likely to be entirely supplanted by Doctor Robinovitch's process.

Radium to Be Made More Quickly

Sir William Ramsay is said to have discovered a process whereby radium can be made from pitchblende in six or seven weeks instead of in as many months. The total quantity of radium which has thus far been recovered for scientific use throughout the world is estimated not to exceed one-fourth pound. The total stock in the London Hospital is only about 16¼ milligrams.

Does Dust Hamper Reflectors?

If housekeepers and storekeepers realized the effect which a regular weekly or fortnightly cleaning of reflectors and shades has on the amount of light made available by them, they would insist on this cleaning, just as they insist on a regular scrubbing of their floors. How dust cuts down the amount of light distributed from a lamp (for which light you have to pay whether



A SIMPLE TEST OF REFLECTING SURFACES

it is well utilized or not) is easily shown by the simple experiment pictured herewith:

Take a mirror which has been allowed to gather dust either by neglect or by being laid on the floor when a room is being swept, wipe half of it carefully but leave the other half covered with dust. Lay a sheet of white or light colored paper on a table near a lamp, but screened from the direct light of the lamp by a board or book. Then place the mirror so that it reflects the light of the lamp to the paper, when the difference in reflective power between the cleaned and the dust-laden halves of the mirror will show clearly on the paper.

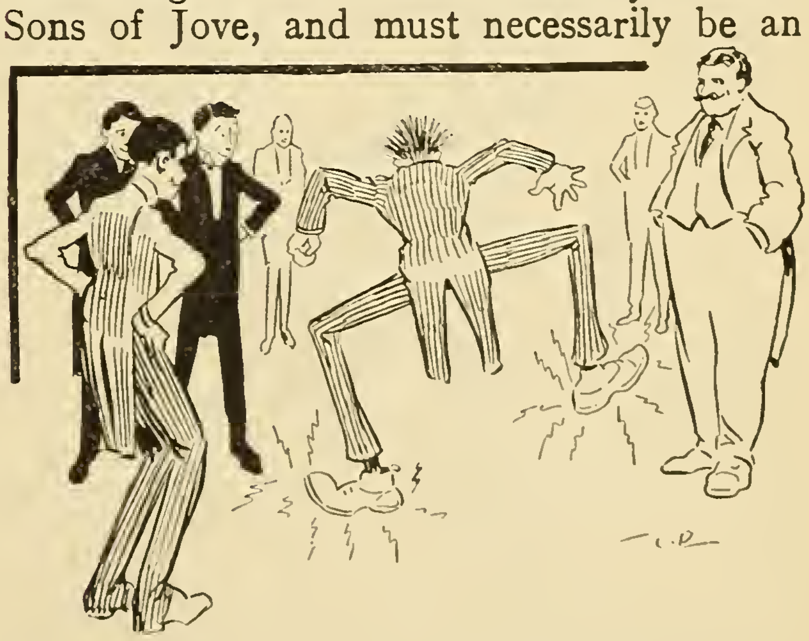
For best results, the lamp should be screened either by an opaque shade or by heavy wrapping paper, so that its light will be shed only on the mirror, and there should be no other lights in the room. Otherwise some of the light diffused from the walls and ceilings will also reach the sheet of paper and spoil the contrast which this experiment may show to the surprise of many an otherwise neat housekeeper.

Energy, A Product of Mass and Velocity

The energy or power of a moving object is proportional not only to its weight or mass but to its velocity as well. Microscopic particles projected at high velocities have an energy equal to that of a much heavier body traveling at a slow gait. This is the reason that radium possesses such enormous energy. The particles shot out from it, although they are microscopically small, travel with the velocity of light. Rankin said that a spider web running over pulleys with the velocity of light would be capable of running all the machinery in England. We also know that a small stream of water at enormous velocities will tear down mountain sides as in the hydraulic system of mining. Remembering these things it is then not so hard to conceive how electric current, which has a velocity equal to that of light, is capable of transmitting thousands of horsepower over an insignificant wire.

Rejuvenated Sons of Jove

You will often run across a jolly looking individual who wears a button on which is a figure which looks like a little red devil. He belongs to the Order of the Rejuvenated Sons of Jove, and must necessarily be an



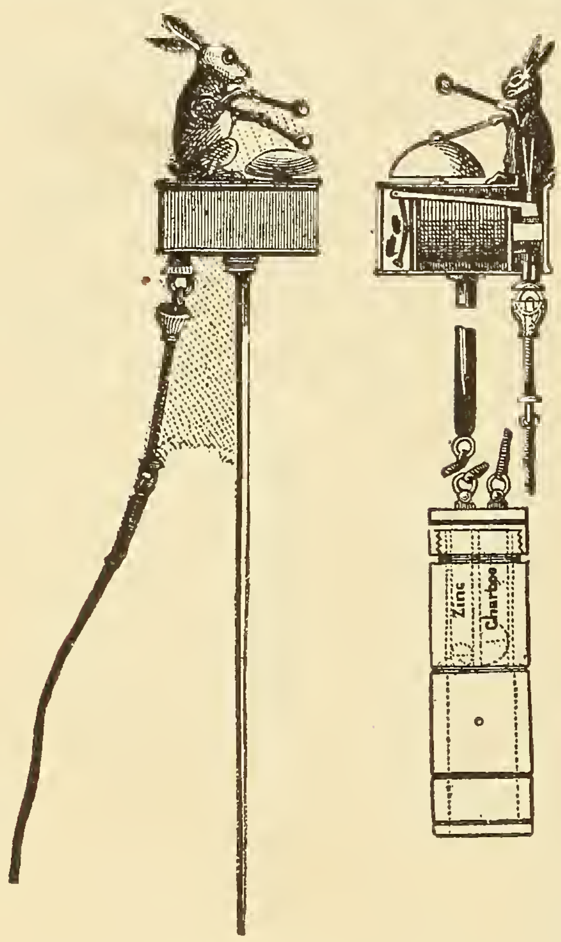
electrical man. The order is national in its scope and includes electrical salesmen, engineers, inventors, manufacturers and others engaged in electrical callings. Every once in awhile the order holds a "rejuvenation"—they had one at the last electrical Show in Chicago. It is told about that they had a pair of "electrical shoes" there, through which the luckless initiate, before his rejuvenation was esteemed complete, received most startling shocks.

Electric Tape Mends Water Pipes

One of our regular contributors reports that he has found ordinary "friction tape," as used for wrapping wire joints, to make an effective temporary bandage for leaky water pipes. Being unable to reach his favorite plumber at a time when a leaky pipe threatened to ruin the ceiling below it, he gave the leaky spot a heavy wrapping of tape and was surprised to find that even on a hot water pipe this makeshift did good service for a week or ten days at a time; which shows another advantage in having an electrical experimenter right in your own house in times of emergency.

Electrical Easter Rabbit

Electrically lighted scarf pins have been made for years in America as well as in Europe, and some of these pins have been in the shape of owls or other animals with



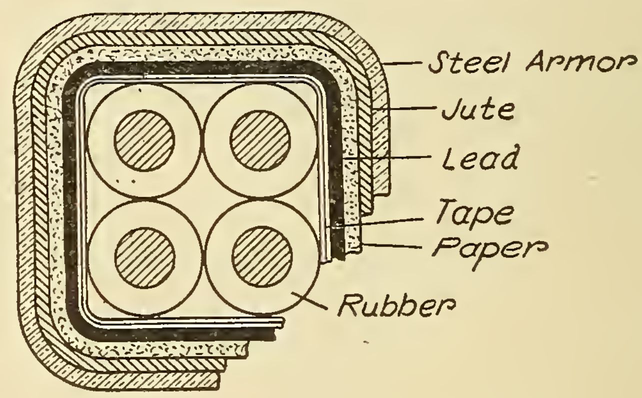
ELECTRICAL EASTER RABBIT

eyes that would light up when the wearer pressed a pocket switch.

But some of the French jewelry workers have gone further by devising scarf pins and brooches with parts moved by tiny electromagnets. For instance, one firm put out some Easter rabbit pins, scarcely larger than the cut, with the rabbit apparently seated on a little box with a small gong before it. This box contained a pair of electromagnets connected by fine wires to a switch and a pocket battery, the latter being somewhat larger in proportion than here pictured. On pressing the switch, the rabbit hammered a tinkling tune with both paws. Owing to the large amount of hand work on it, this must have been a costly article, and fortunately for our pocket books, it did not appear right in the midst of the "chestnut bell" craze which some of our readers will remember. The cut is from an old and now rare volume of "La Nature."

Signal Cables for Australian Mine

Where electric signals are used in mines, they protect not only vast property interests but also the lives of scores and sometimes hundreds of workmen. It is therefore



SECTION OF SIGNAL CABLE

doubly important that the signal wires should be guarded against injuries of any kind, such as may come to them either by abrasion or by the action of moisture and of the various chemicals emcountered underground.

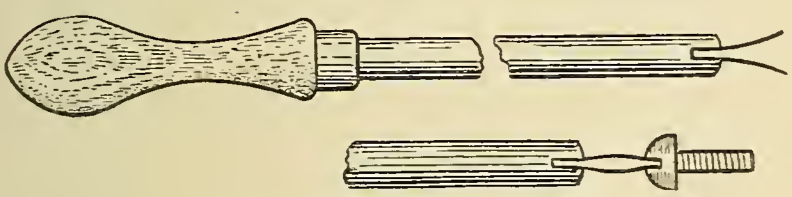
The wires used for this purpose in certain Australian mines are protected either in pairs, or sometimes in fours, by six successive wrappings. First come rubber and tape to give good insulation, then a sheathing of lead to keep the moisture out. Next a further insulating wrapping of a specially prepared paper, then a layer of jute as a mechanical protection and an outer steel armor.

Electricity Makes Dead Dog Bark

Dr. Marage of Paris, by means of slight currents of electricity has caused the larynx of a dog after it was dead to bark exactly as if the animal were alive. The effect was simply a physiological one due to the contraction of the muscles of the vocal organ under the electrical influence.

Handy Electrician's Screw Driver

For starting screws in places that are hard to reach with both hands the little device shown in the cut will be found useful. Any kind of a wood handle will do. A piece of 1-8 or 3-16 iron rod is set firmly in the



HANDY SCREW DRIVER

handle and a deep saw slot made in the end. Then take two pieces of clock spring and set them in the slot with a little solder, so that their ends spring away from each other. The springs when bent together will catch and hold the screw and, if properly made, will drive the ordinary machine screw or small wood screw clear to the head. For larger screws it may be used for starting only, heavier material being used for the springs for doing heavier work.

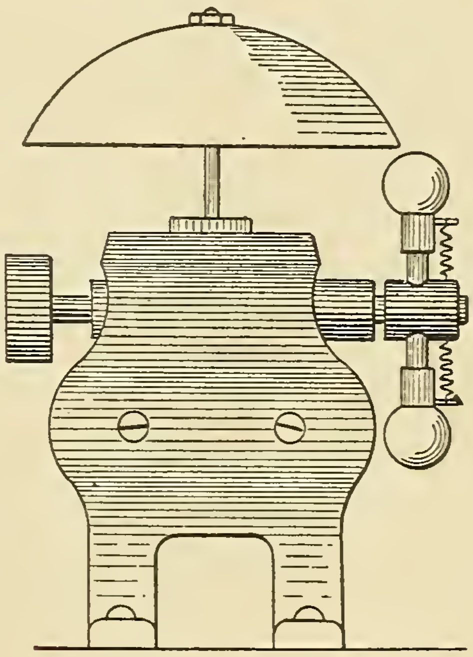
Pump That Needs No Watching

One of the most valuable applications of electric motors is to the performance of operations which are of so rare occurrence as to make the presence of an attendant an expensive luxury. For such service electricity is an ideal source of power, as it admits of automatic control, is always ready for instant use, and costs nothing except when it is being used. There is no delay waiting to get up steam and its use is not attended with odor, noise, or steam. The motor and controlling apparatus occupy very little space and may be installed on the wall or ceiling where it will be out of the way. Such a device becomes a servant that needs no watching and never forgets.

An excellent example of the utility of the electric motor equipped with automatic control is its application to the operation of pumps required to maintain a certain water level in a tank. If the water level falls below a certain predetermined value the controlling device, worked by a float, automatically closes the motor circuit and the pump continues to operate until the water level is raised to a predetermined value, when current is cut off and the motor stops.

Motor Electric Bell

This strikingly original form of electric bell is designed more especially for fire-alarm service. D. Foster Hall of Springfield, Mass., is the inventor. The device consists of a small self-starting motor, with an arm connected to the armature shaft. This arm carries two sliding weights on each end which act as strikers and are held in place by spiral springs on the arm piece. These springs are sufficiently strong to overcome



MOTOR ELECTRIC BELL

the centrifugal force of the motor when at full speed. These strikers should just strike the edge of the gong when running. This bell can be used in any place or position where the old style bell is used. Three dry cells are sufficient power.

Faking High Voltage Sparks

"All is not gold that glitters"—nor is all high voltage that gives a fierce and crackling spark. Last fall a London music-hall performer who claimed to give the marvelous exhibition of coolly taking a shock of 30,000 volts, astonished large audiences night after night. One man who thought that this self-styled "medical electrician" had discovered wonderful secrets paid a fancy price to become his pupil, only to learn that the pretended expert was a faker. The suit through which the deceiver was ordered to return the tuition money showed that in his public performance he used a type of high frequency apparatus built for college and hospital work, which gave a harmless spark. Then to get his impressive effects, he cleverly used fireworks paper which crackled and flared in addition to this spark.

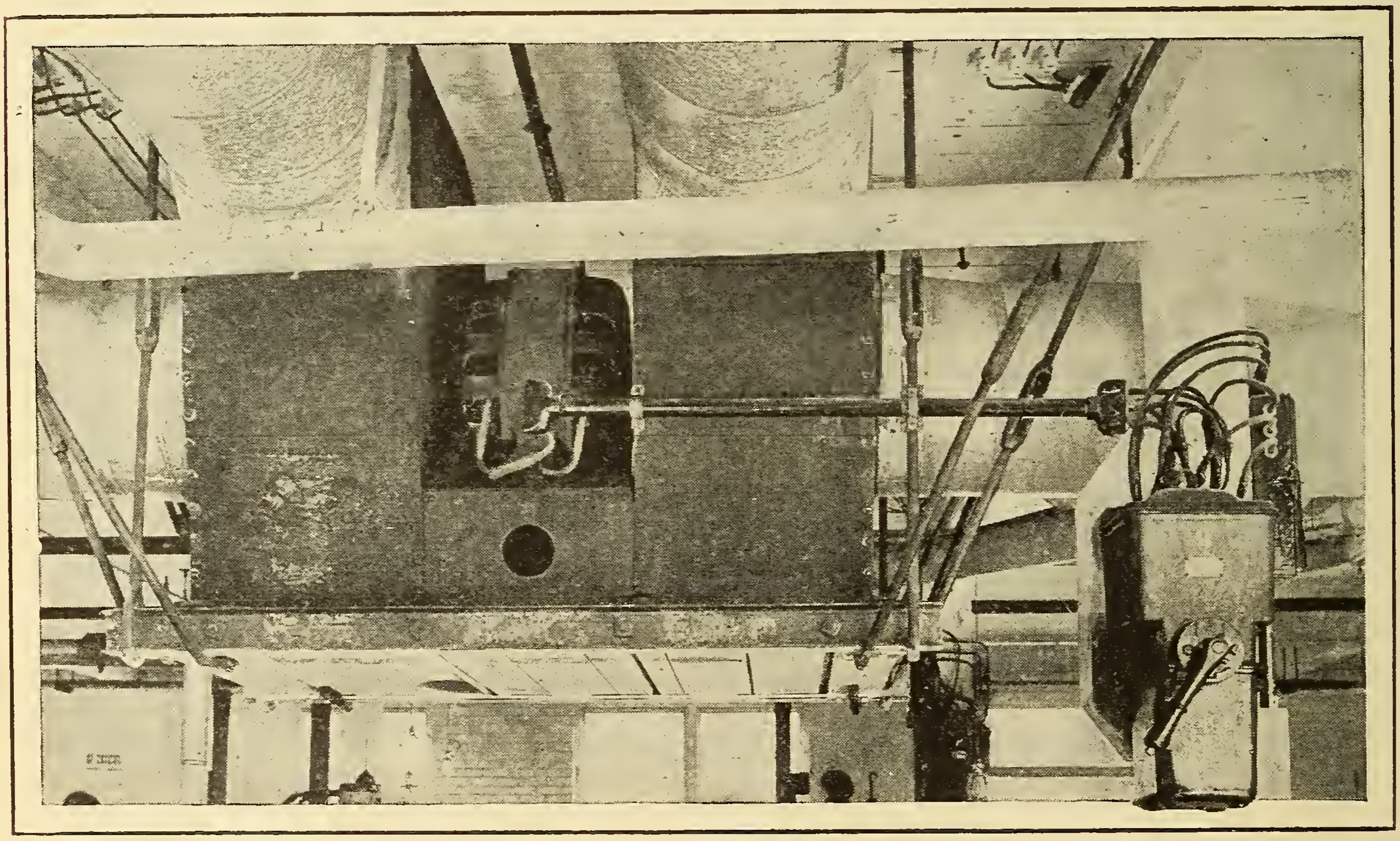
ELECTRIC CURRENT AT WORK

NEW DEVICES FOR APPLYING ELECTRICITY

Motors in Wood-Working Plants

By S. ADAMS

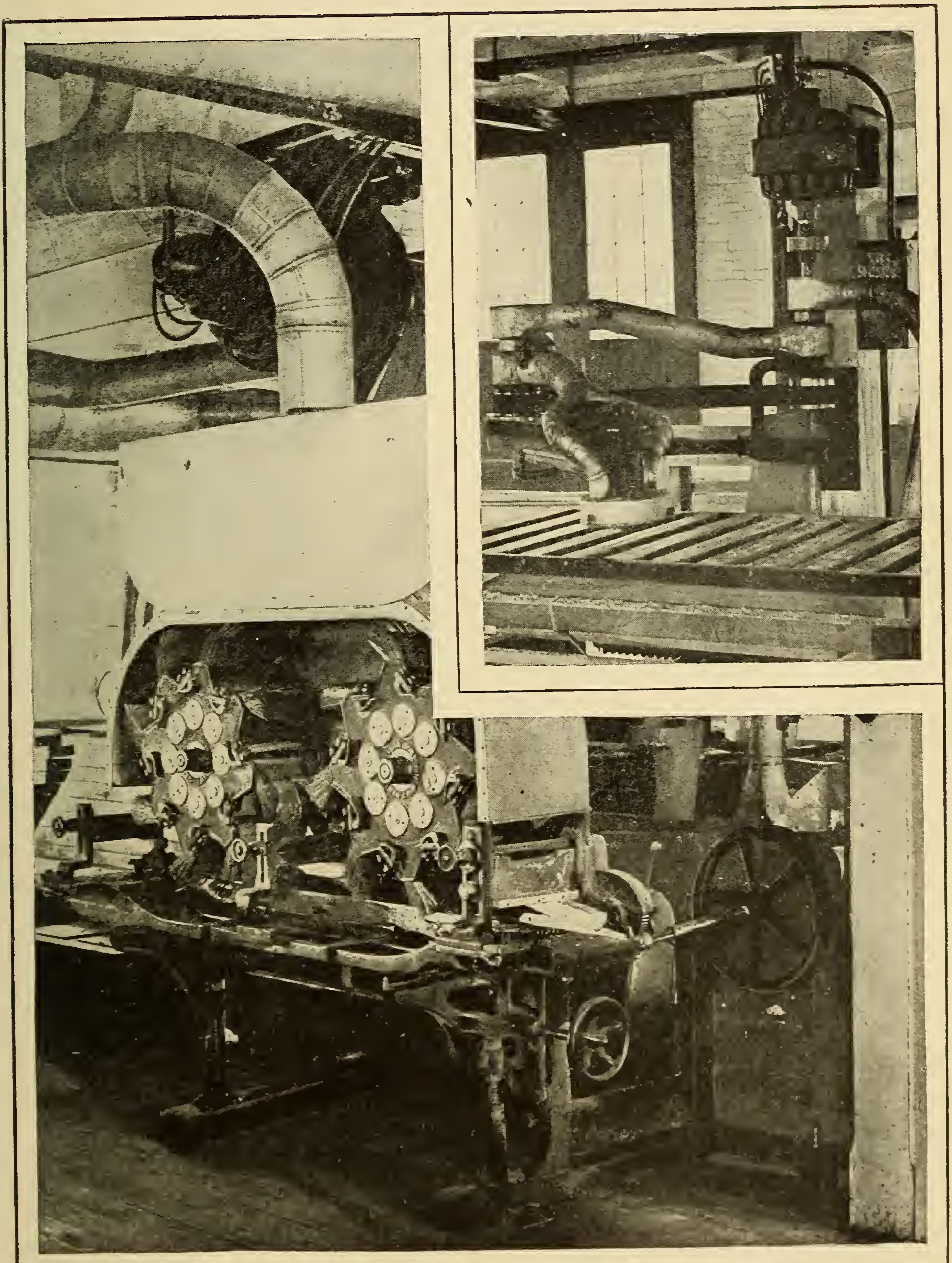
No one familiar with electricity doubts that it is the ultimate solution of the power problem of the future. The advantages of the electric motors which utilize the power are many, but frequently the most important advantage is found after the application has been made. The usual advantage is that the motor, because it can be started and stopped so readily, saves much power, in a manner similar to electric light which may be turned on and off so easily. But in many cases the convenience of the power is of far more importance than the saving in the cost, and again the motors may be found to make the machines produce more than when driven by any other form of energy and hence effect a material economy of much greater importance than the cost of power.



MOTOR DRIVEN EXHAUST FAN FOR COLLECTING SHAVINGS

Use of motors in woodworking plants is particularly interesting in that it illustrates how deceiving casual inquiry may be. At first thought it would appear that the cost of steam power would be low because all the refuse produced in the shape of kindling wood, shavings and saw dust would be burned with some coal under the boilers and reduce the fuel bill to a low point, while electric power would be costly as it would need to be purchased from a company some distance away burning only coal.

But that such is far from the case may be seen from the installation illustrated. Formerly the fuel bills amounted to over $60 per month without consideration of any other items for power, while at present the electric power bills amount to about $120 per month.



SURFACE SANDER AND MOULDING SANDER AT WORK

If this were all to the question, steam power would still be driving those machines, but not only is more work being done by the mill and a shaving collector system used, but all the shavings, refuse, wood, etc., above those required for the heating system, are sold to local stables, ice houses, etc., or baled in a baling press and shipped out in car load lots. The sale of this refuse amounts to $90 per month, which makes the total monthly cost of power but $30, which, for an installation with a total installed horse-power of 231, is absurdly low.

There are numerous other items, some of which may be mentioned showing the advantage of electric motor drive. The workmen before were constantly troubled by slipping belts because of the difficulty in tightening belts from a line shafting, and consequently the machines did less work than now when the motors provide a positive drive. The greatest convenience for starting and stopping each machine is provided by a starting switch for the motor located close to the machine itself, so that there is no excuse for running a machine when not actually in use. The elimination of much overhead belting clears the room of obstructions and provides better light and ventilation and permits more ready handling of the material to be worked. The power is more reliable, the fire insurance rate has been reduced, the surroundings for the men have been made more agreeable so that they work more easily and hence better, and the quality of work turned out is improved by the steadier speed of the machines.

The adaptability of individual electric motors for different requirements is well shown in the illustrations of machinery used in this planing mill formerly driven by a steam engine with many belts and considerable shafting. The amount of work necessitated an increase in the size of the factory, and the old power plant was dismantled and the power purchased from a central lighting and power station. They left only the boilers which are used for low pressure steam to supply heat in winter and as required for the dry kilns. Thus all danger from boiler explosion is eliminated and the fire risk very materially reduced.

In one instance a jig saw was used, with a motor mounted on the lower side of the table top and belted to the crank shaft which drives the saw. The starting switch is also located on the under side of the saw table, so that the motor may be started and stopped with the greatest convenience. The usual method consists in belting from the line shaft.

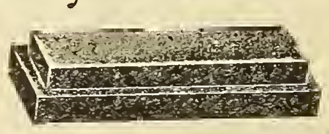
The special machine for sandpapering moulding embodies two wheels on which are mounted eight broom-like affairs faced with a sheet of sand paper cut into narrow widths. These brooms revolve and brush the sandpaper over the moulding as it is pushed through. The motor is mounted on the ceiling and belted to a counter shaft below the machine, the belt being protected by a wooden guard. The sander is shown with the side open to allow inspection of the interior.

A different type of sanding machine is used for flat work. It consists of a flat disk of sand paper mounted on the flat side of the wheel, which may be rotated at a high speed. The wheel is supported by an elbow arrangement so that it may be moved over a wide area. The motor as may be seen in the illustration is mounted on a post used for supportnig the roof and is of the vertical type. Air from a distant suction fan is exhausted through the galvanized sheet iron pipes and draws every particle of dust up and away from the work on the principle of the vacuum cleaner, with which we are more or less familiar.

This blower system is a very interesting part of the plant and is shown in one of the pictures. There is a double fan driven by one motor. This sucks in air through one system of pipes which go to the machines, and blows it out through another system, and delivers the shavings and saw dust to the room where they are baled up for shipment.

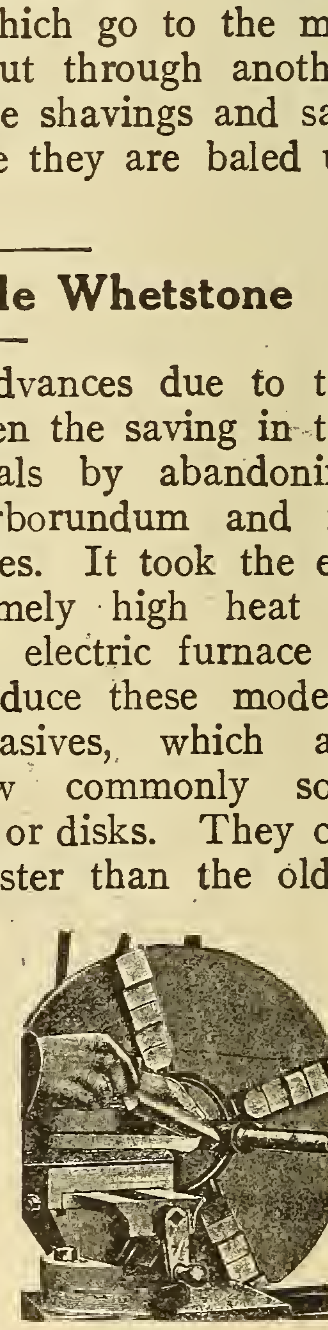
Electrically Made Whetstone

One of the great advances due to the electric furnace has been the saving in the cost of grinding metals by abandoning emery wheels for carborundum and its allies. It took the extremely high heat of the electric furnace to produce these modern abrasives, which are now commonly sold in the shape of wheels or disks. They cut even steel so much faster than the older materials used for either grinding or sharpening, so it is logical that they would also do for hand use if made in suitable shapes.



SILICON CARBON WHETSTONE

This is being done with another product of the electric furnace, silicon carbide, which is now offered either in the plain slip forms or mounted in wood, as substitutes for the familiar whetstones.

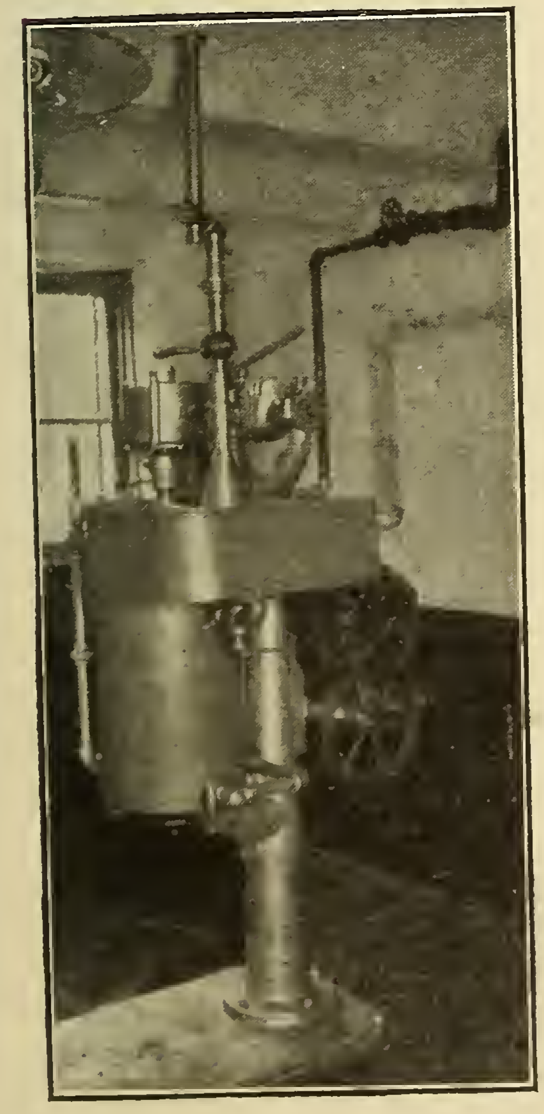


SILICON CARBIDE FILE

Lathe tools can also be sharpened by what the German makers call a "silicon carbide file" without being removed from the holder and therefore without changing the set of the tool. This ability to sharpen tools right in place must mean a considerable saving of time and adds still another to the long list of ways in which electrical progress is helping to reduce manufacturing costs.

Ice Cream Making On a Large Scale

Ice cream is no longer looked upon as a mere frozen dainty for summer consumption. It may now be classed as an important food stuff. In large cities well-equipped factories have been built to supply the demand. There is such a plant in Altoona, Pa., having a capacity for making and storing 3000 gallons of ice cream daily.

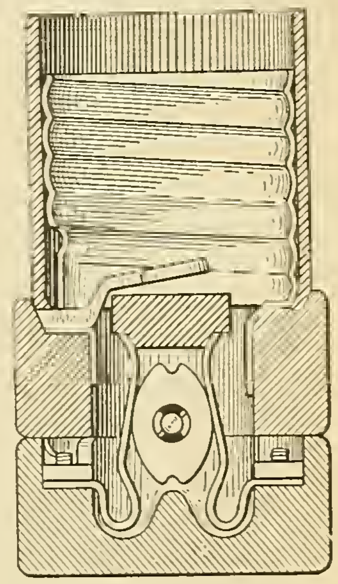


UPRIGHT ICE CREAM FREEZER

Electric current is used in all the important processes. There must be artificially cooled rooms for keeping the cream and hardening the finished product. The big compressor for furnishing this refrigeration requires a 50 horsepower motor. In the ice-cream making department there are two Duplex ice-cream mixers having a capacity of 150 gallons each. These mix the ingredients ready for the freezers. Directly underneath the mixing room is the freezing room containing two upright cream freezers like the one shown in the cut, having a capacity of 60 gallons each, driven by Westinghouse motors. After being partially frozen in these machines the cream is run into delivery cans of various sizes.

A Safe Lamp Socket

It is absolutely impossible to get a shock in turning on and off this new type of electric light socket and in many cities its use is permitted over radiators, pipes, bathtubs, etc., where the rules are very stringent regarding such installations. Examination of the diagram will show wherein the safety of the P. & S. socket lies and how it would be impossible, even if you were standing on a perfect "ground," to get a current through your body in handling the switch.



SAFE LAMP SOCKET

In the center you will see a little oval cam. This is of porcelain, an almost perfect insulator, and turns when you turn the switch button. When it is turned over to the horizontal position the two springs are pressed over and make contact with the little vertical metal strips on the inner side of the porcelain shell.

In any incandescent lamp one terminal of the filament is connected with the threaded brass shell at the base and the other to the metal button or knob at the end of the lamp. When you screw the lamp into this socket the button is forced against the brass strip which extends obliquely out into the middle of the socket. The screw threads of the socket and lamp also make electrical contact.

To the two screws in the lower end of the porcelain base are connected the two wires of the electrical circuit.

Suppose now that the lamp is screwed in place. No current will flow through it with the porcelain cam in the vertical position. When the cam is turned over by the switch button, however, the two vertical metal springs are forced over and make contact with the metal strips in the sides of the shell. Now let us follow the current: It enters, say, from the left hand wire, goes through the screw and vertical spring to the left hand vertical strip and from there runs over along the oblique, projecting member to the button on the end of the lamp. From there it passes up through the lamp filament, heating it to incandescence, and then passes out through the screw threads of the lamp to the threaded portion of the socket, down the right hand vertical strip to the right hand spring and out over the other wire.

The lower part of the socket is all porcelain. The threaded part is protected by insulating material, and the switch button is protected from the current-carrying parts by the fact that the cam is of porcelain. Therefore you couldn't get a shock if you were to try.

The Pay-As-You-Go Meter

Perhaps some of you have never known that there is such a thing as a prepayment meter which enables you to pay for your electric current as you go along, but there is, and it operates upon the coin-in-the-slot principle.

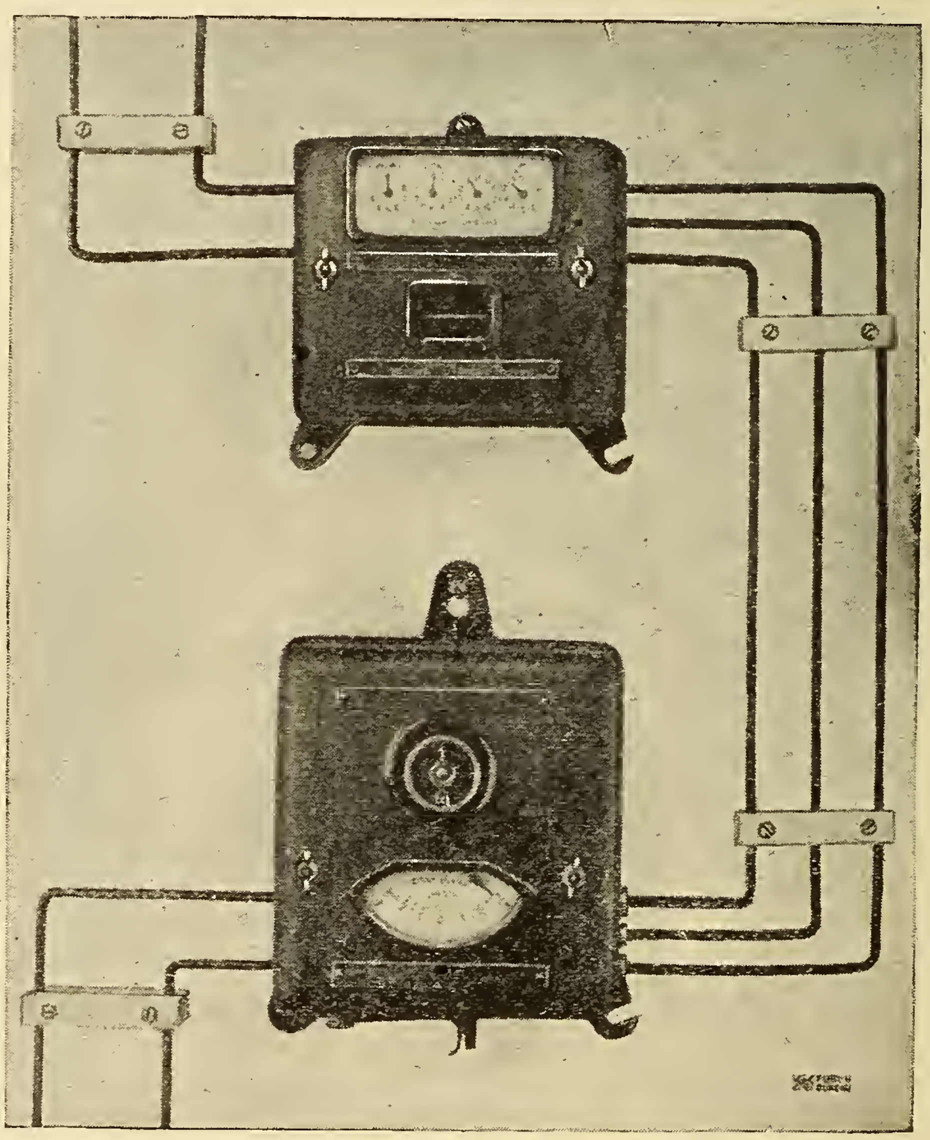
The prepayment device made by the General Electric Company is supplied either in combination with or separate from the regular meter. The attachment which goes with an ordinary meter is shown in the diagram. It consists of four principal parts—the escapement train, coin device, switch and rate device, and may be installed in any part of the house most convenient to the user.

When it is desired to make an advance payment the winding knob is turned so that the arrow points upward. A quarter dollar is then inserted in the slot and the knob turned to the right, the coin serving as a key which operates the mechanism within the device, turning the registering wheel and placing the coin to the credit of the consumer. If the circuit is open when the coin is deposited, the same motion of the knob which moves the registering mechanism closes the circuit switch contained within the case of the attachment.

The dial of the combined prepayment meter is enlarged and contains in addition to the standard marking, a scale marked in plain figures over which a pointer passes, indicating the number of coins remaining to the credit of the depositor. When the meter has a separate prepayment attachment, the dial showing the number of coins standing to the customer's credit, is placed on the attachment.

When the first coin is deposited and the knob is turned, closing the main switch, the pointer rests opposite the first division on the scale. If a second coin is deposited before the current purchased with the first coin has been consumed, a second motion of the knob will bring the pointer opposite the second division on the scale. Twelve coins can thus be deposited consecutively, after which the slot is automatically closed, and further prepayment cannot be made until the value of one or more coins has been consumed.

Whenever energy to the value of one coin has been delivered through the meter, the escapement is released (mechanically in the combined device, and electrically in the separate device) turning the pointer back one division. This process continues until all the energy for which prepayment has been made has been delivered. Thus the depositor can ascertain at any time how much energy can be obtained without further prepayment.



PAY-AS-YOU-GO METER

When all the energy has been delivered, the circuit switch is opened and no more current can be obtained until further prepayment has been made.

Physicians' Vibrator

All of us are more or less familiar with the ordinary electric vibrator, a small self-contained instrument held in the hand of the operator. A somewhat different type is shown in the picture and which is used in physicians' offices. It is very powerful in its effects and is sure to get down to the seat of the trouble, no matter how deep it may lay in the bones and tissues of the body.

It operates on alternating current, the motor being carried on a portable stand. The long flexible shaft attached to the revolving motor shaft drives the vibrating instrument in the operator's hand.

In speaking of the uses of an electric vibrator from the medical standpoint it may be of interest to state that the best medical authorities maintain that when a function or an organ is diseased the nerve center controlling the same usually shows undue sensitiveness to deep pressure or vibration.

HIGH POWER VIBRATOR

It therefore follows that a good vibrator becomes a most important aid to diagnosis by locating the sensitive spots along the spinal processes and at other important nerve centers.

Hot-Air Treatment for Rheumatism

Hot air is known to be helpful in relieving rheumatism and the Germans have further discovered that it may be successfully applied for this purpose by the use of an electric blower ordinarily used as a hair drier. Such blowers now on the market are made to deliver heated air as well as cold air when desired.

TREATING DOG FOR RHEUMATISM

A writer in *Mitteilungen der Berliner Elektricitäts-Werke* describes how this has been done to bring health and relief to dogs that are suffering with rheumatism. The beautiful collie lying in the chair seems to be enjoying his electrical hot air treatment and finds relief from pain.

Other domestic animals suffering in the animal hospitals were also subjected to the treatment; for example, horses with lame shoulders, and they also seemed to obtain considerable relief.

Giant Hammer-Head Crane

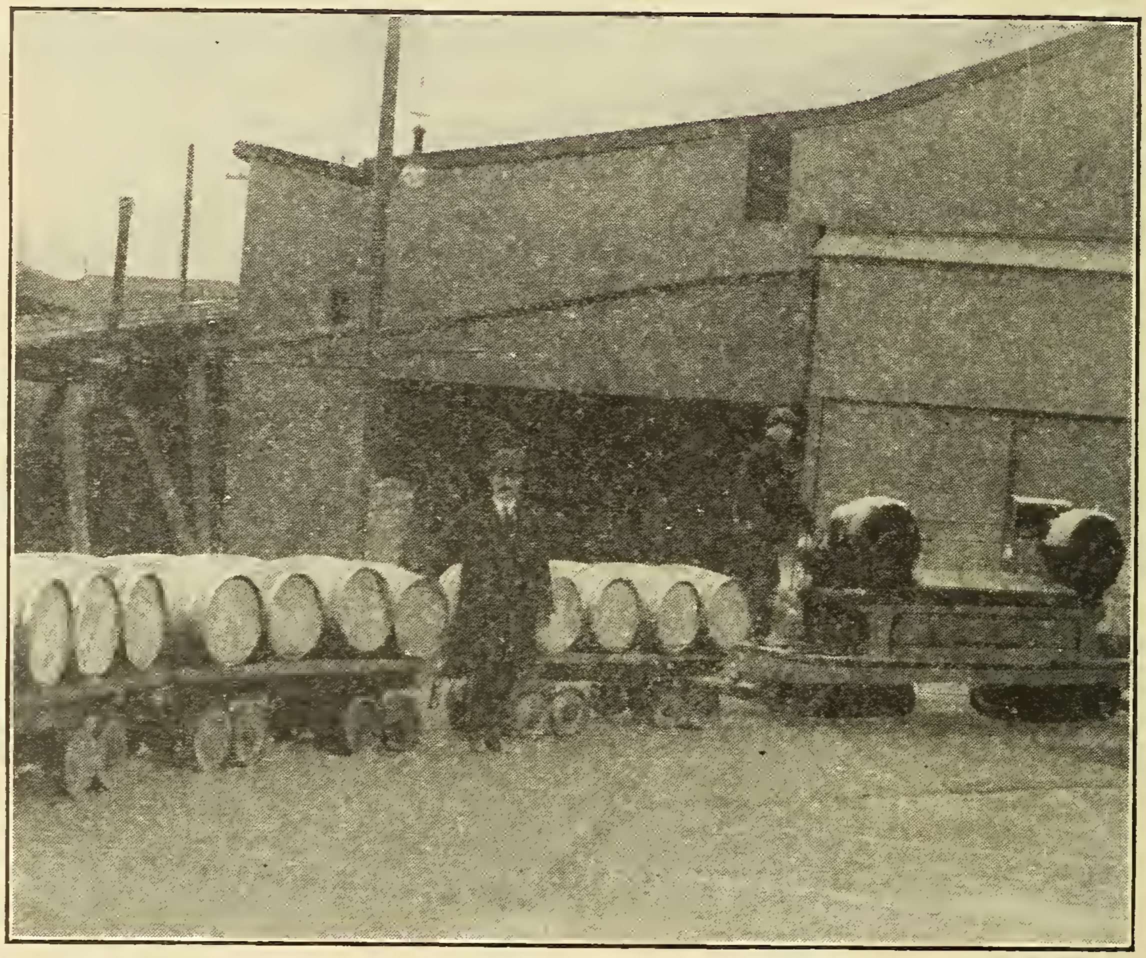
An immense electric crane has been installed at Akunoura, Nagasaki, in Japan, for the Mitsu Bishi Dockyard and Ship Works. This is the largest crane in the Orient. It is 177 feet high and has a lifting capacity of 150 tons. Five 50-horsepower motors are required to operate it. One man can work the crane from a cabin beneath the girders.

An Electrical Man-of-All-Work

A unique electric storage battery locomotive is in service at Constable Hook, N. J., handling ingots and copper ore at the works of the Orford Copper Company. The motors are of the enclosed type and the storage batteries require no attention during working hours. It is maintained that the cost of operation for haulage is far less than with animal power.

The narrow gauge locomotive weighs four tons and is designed for a track having a gauge of 21½ inches. It measures 70 inches high and 56 inches wide over all, the total length being 12 feet, and it travels at a speed of from one to four miles an hour.

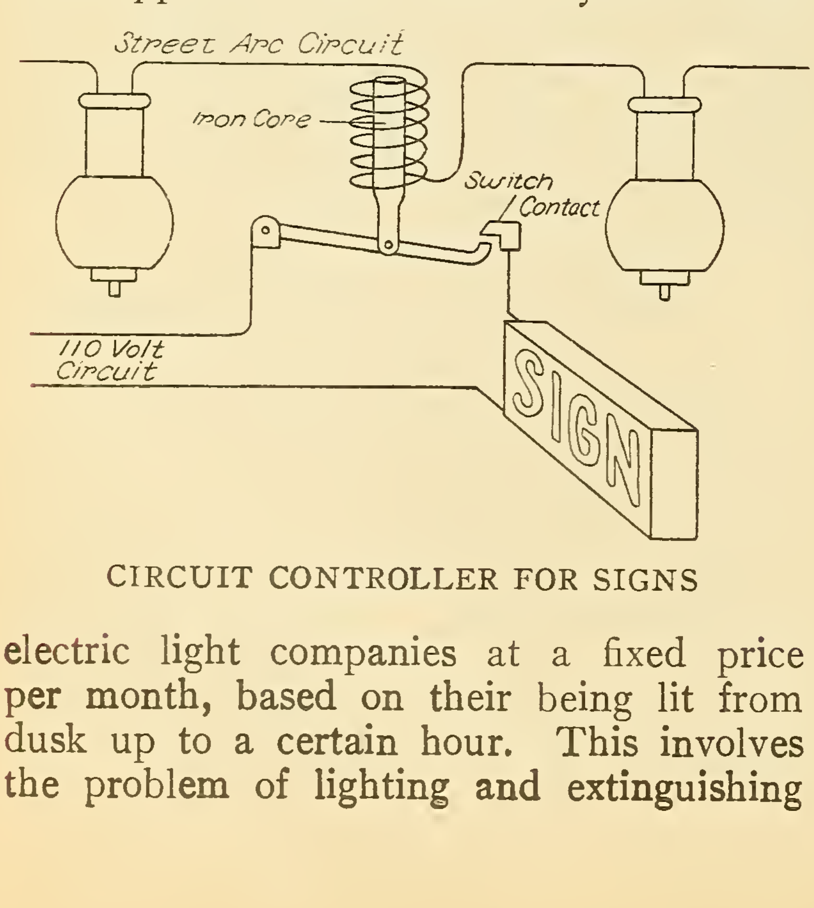
It is surprising, however, the amount of work this little locomotive will do. It will haul 50 tons on the level, 25 tons on a one per cent grade and 15 tons on a two per cent grade.



FOUR TON NARROW GAUGE LOCOMOTIVE

Where One Circuit Controls Another

Most of the electric signs, which have proven such effective business bringers to live stores in large as well as small cities, are supplied with current by the local



CIRCUIT CONTROLLER FOR SIGNS

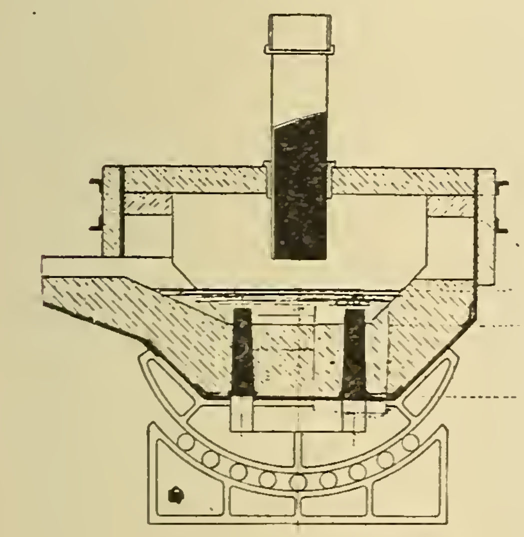
electric light companies at a fixed price per month, based on their being lit from dusk up to a certain hour. This involves the problem of lighting and extinguishing them all simultaneously, which is commonly done by means of time switches, or clocks which actuate a switch whenever a certain hour is reached.

Now there are some cities where the street lights are turned off at midnight and when such a city has a number of signs that also are to run only till midnight, it would seem logical that both should be run from the same circuit. But safety will not permit this, as the close spacing given to the wires inside the signs will not allow of insulations that would be ample for the high voltages generally used for the street lighting, so the current for the signs must come from low voltage circuits.

However, a shrewd electric light manager in the west has done the next best thing, by letting his street lighting circuit switch the current on and off the signs, so that these signs burn only during the regular street lighting hours. To do this he simply connects his street lighting circuit (which is a series arc light circuit) with a solenoid at each sign, the core of each solenoid being attached to a switch. When the lighting circuit is started up, the solenoid raises the core, the principle of the solenoid coil being that an iron core placed partly in the coil will be drawn in still farther when current flows around the coil. The drawing up of the core closes the switch so that current will flow from an ordinary 110-volt circuit to the sign lamps. Then when the street lights are shut off, the solenoid ceases its pull and a spring (or gravity) opens the switch. This plan, which is shown in principle in the cut, saves the expense of having a man wind the time switches, as the solenoid switches need no attention. Of course the method is applicable only where the city is willing to waive the crime-preventing power which good street lamps exert even more after midnight than during the evening hours.

Three Electric Smelting Furnaces

The temperature of the electric arc as formed between the carbon tips in arc lamps is somewhat above the melting point of iron. Therefore if iron ore, pig iron or scrap iron are placed in a receptacle which contains an electric arc and which is closed so that the heat cannot escape, the heat of the arc will melt the iron. There are many localities where iron ore abounds but where the cost of coal for heating the ordinary cupolas is out of reach. Whenever such a locality has ample waterpower available, the electric furnace can be used for the smelting.

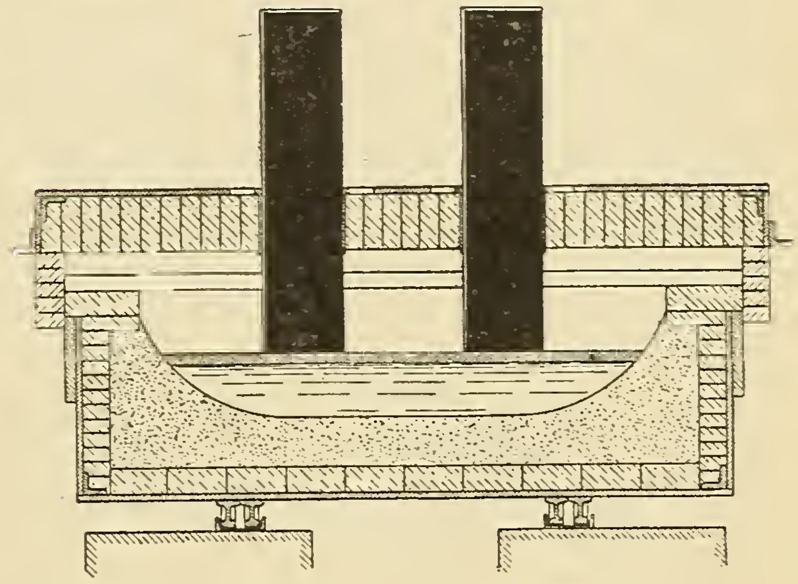


GIROD FURNACE

In this field, as in most of the chemical and allied lines where progress depends more on slow plodding than on sudden spurts of ingenuity, continental Europe has been in the lead. Over thirty years ago one of the Siemens brothers patented the first smelting furnace in which metal was melted by being placed in the path of an electric arc. Since then a large number of other types have been brought out both experimentally and commercially, and of these we are picturing three typical forms.

In the Stassano type the arc plays between the tips of two carbons projecting through the walls of the furnace above the level of the ore or metal. The whole furnace is rotated by the vertical pinion shown in the cut, connection being made to the terminals by brushes and rings. On alternating circuits three carbons are used, the voltage in either case being between 100 and 110. The carbons enter through packing boxes cooled by water and are adjusted by hand.

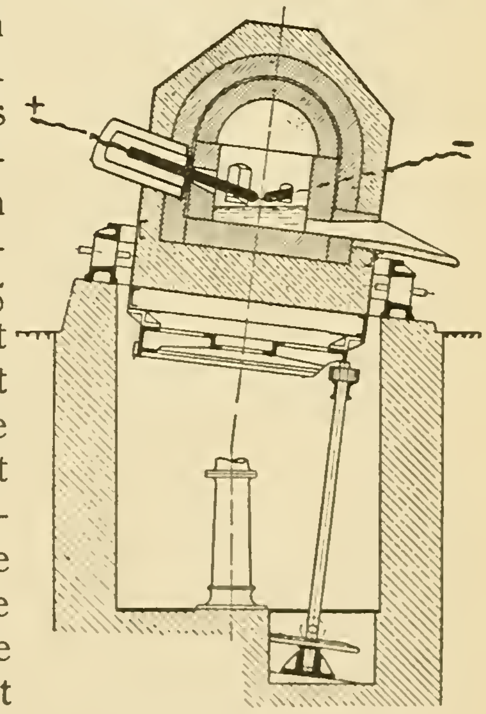
Instead of having the arc directly between



HEROULT FURNACE

the carbons, the Heroult furnace has it between each of the carbons and the molten metal. Both carbons enter through the removable dome or cover of the furnace which operates at 100 to 110 volts.

The third type, that of Girod, goes still further in placing a pair of iron terminals under the molten ore or metal, so that the arc must pass from the upper carbon through the metal to reach the submerged terminals. This furnace is designed for use on alternating currents at 60 to 75 volts, and is set on rollers so that it can easily be tilted to pour out the liquefied contents. It has the great advantage over both of the other types that it practically does away with the leaking of current through the walls of the furnace. These walls have to be of materials that will withstand high degrees of heat and such materials usually become poorer in insulating qualities as the temperature rises. Then if both terminals are in adjacent parts of the furnace wall, as in the Stassano and Heroult types, it is difficult to prevent considerable current from leaking through.



STASSANO FURNACE

Electrical Men of the Times

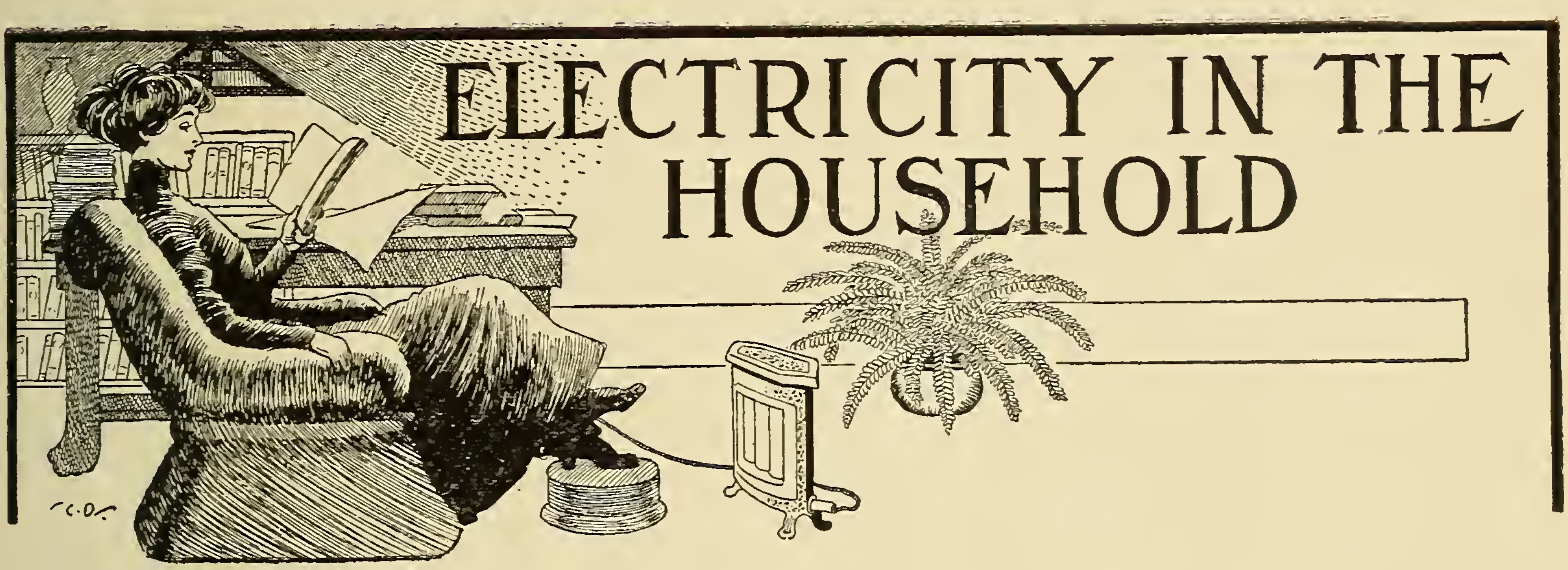
DR. A. E. KENNELLY

Among the leaders in the study and application of electricity in the United States a high place must be accorded Dr. A. E. Kennelly, professor of electrical engineering in Harvard University. Dr. Kennelly is a man of scientific attainments, and he has an international reputation. Among the men who investigate electrical phenomena and on whose work the determination of electrical units of measurement is based this resident of Cambridge, Mass., is known and honored.

Dr. Kennelly was born in Colabah, Bombay, India, December 17, 1861. He was educated in University College School, London. The bent of his mind was early exhibited, for we find him in 1875 and 1876, while still a mere boy, assistant secretary of the Institution of Electrical Engineers in London. In the latter year he entered the service of the Eastern Telegraph Company as operator, and two years later was made assistant electrician. By 1880 he was chief electrician on board a cable-laying ship, and for the next seven years he was engaged in the work of laying submarine cables in various parts of the world. During this time he received a gold watch for participation in the swift repair of a cable in 2300 fathoms of water and was also awarded a decoration by the Khedive of Egypt for his services in laying a cable into the port of Suakim on the Red Sea.

In 1887, at the age of twenty-five, the young Englishman passed to another stage of his career by coming to this country and entering the laboratory of Thomas A. Edison at Orange, N. J., as Mr. Edison's principal electrical assistant. For several years Dr. Kennelly was associated with the great inventor, and in 1892 he was consulting electrician for the Edison General Electric Company. From 1893 to 1900 the subject of this sketch was in partnership with Prof. E. J. Houston, in Philadelphia, the firm being Houston & Kennelly, consulting electrical engineers. In the year last named Dr. Kennelly was electrical expert to the Signal Corps of the United States Army, and in 1902 he was the engineer in charge, for the Mexican government, in laying the Vera Cruz-Frontera and Frontera-Campeche cables. Since 1902 he has been professor of electrical engineering at Harvard.

Dr. Kennelly has served two terms as president of the American Institute of Electrical Engineers (1898–1900), and is a member of a number of other learned and technical societies. He was a United States representative and vice-president at the International Electrical Congress of 1900 in Paris and a United States delegate and general secretary at the International Electrical Congress of 1904 in St. Louis. He has honorary degrees from the University of Pittsburg and Harvard University and has taken out about ten patents for electrical inventions. He has contributed largely and valuably to technical literature, and in his own name, or jointly with others, has written about twenty books on varied applications of electricity. Few engineers have done more useful work.



Again a Woman Had Her Way

By FLORENCE LATIMER

Hello! Ah, hello, Edith! How are you this morning? How am I? Oh, honey—I'm miserably happy.

Tell you about it? Yes, I suppose I could, only I'm always afraid somebody's on the line besides ourselves. Anyway I'll risk it.

Hugh and I had a regular "argument" this morning, and he said some mean things about "driving us all to the poor-house."

"What was it all about?" Simply because I insisted on having that electric range—you know the one I've been so crazy about—and *he* calls that an "extravagant whim." Now that just shows how far-sighted a man is.

Happy? Oh, yes, hilariously happy because it's here, just the same. And mind you, my dear, it's here to stay!

No, he doesn't know it yet, but I have a scheme—you know he's been crazy to have some of his friends out to a real, old-fashioned southern dinner, and you know how I've always discouraged the idea because I could never rely on a maid to cook it.

"Cook it myself?" Not on a *gas* range! No, thank you!

But now, things are different, my plan is to telephone these friends of his, your "worser" half included, ask them out to dinner to-night, and if you will come over and help me, we will prepare a dinner on this range that will smoothe his ruffled spirits and at the same time convince him that my new electric range is a real "joy forever"—and then "we shall see, what we shall see."

You'll hurry, won't you, dearie? You know it's late now, and I'm so anxious that this dinner be absolutely perfect. But how could it be anything else with this range to cook it on? Now while you are getting ready I shall telephone to the gentlemen all. Isn't the telephone the greatest invention ever? I wonder how we lived before we had them, don't you? All right, dear. Good-bye.

Now let me think—What shall I have? Tomato soup, barbecued lamb, stuffed potatoes, corn pone, banana salad, coffee, and an old-fashioned sweet potato pie.

Oh, there's Edith now. Come up.

"Did I telephone them?" Well, I should say I did, and they all seemed eager to accept, and are coming, every mother's son of them, all "delighted, I'm sure," etc.

Oh, won't Hugh be surprised?

But, my dear, I've got to put him in the best possible humor before I tell him what I've done, and you know the most direct way to a man's heart! So listen, I'm going by the way of an electric range.

Come out and look at it. Isn't it a beauty? And look, Edith, all these cooking utensils to go with it. Look at this broiler and that waffle iron. Oh, I know I shall enjoy cooking *now*.

"Expensive?" Not very. I know it looks like quite a sum to put in a cooking stove, but, my dear girl, stop and think a moment. In three months I can save it in a maid's salary, and aside from that I can cut down my grocery bill one-third.

You agree with me, don't you? Yes, I knew you'd see it. That's because you're a woman.

The cost of electric current is a question that always comes up. But if you use common sense along with your electric range there are a great many ways by which you can economize on "watts." For instance, with the oven heat alone, an ordinary dinner may be cooked. While the meat is being roasted, the potatoes baking, the tomatoes may be slowly simmering (in the oven) for the soup, also the peas which have been seasoned and put into a covered pan. Of course the corn bread and the pie are cooked in the oven also. So you see by using judgment you can generally get up a good meal without having all the stew pans, water heaters, frying pans, etc., going at once. A wasteful woman might do this and run up large current bills. But she would do just the same if she were using a gas range and there would be the same "kick" about gas bills.

"I want to put him in the best possible humor"

Now you want to know how to concoct these southern dishes that you've heard so much about. Well, we will begin with the tomato soup.

We'll take the tops of two bunches of celery (I mean the leaves). Boil in about one quart of water until it is reduced to one pint. Strain through a colander, and add one quart of tomatoes, into which throw a liberal pinch of soda (to keep the milk from curdling), and a small onion cut fine. Simmer slowly (in the oven, of course) until about ten minutes before the meal is served, then strain the whole through the colander into one quart of sweet milk; season with salt, pepper and about one large tablespoonful of butter, allow to come to a boil and thicken with one tablespoonful of flour stirred into a cup of sweet milk. I'm going to let you take care of that part. But you must listen while I tell you about the other things so that you can qualify when it comes to southern cooking.

To barbecue the lamb, rub well with salt, pepper and a tablespoonful of flour. Place it in a roasting pan, and over it pour one quart of warm water, one-fourth cup of vinegar, one-fourth cup of butter and a liberal dash of cayenne pepper. Roast slowly until well done. Serve with mint sauce.

Wash thoroughly six or eight rather large potatoes. Place them in the oven to bake and when done cut through lengthwise, nearer one side, scrape the skins free of potato without breaking them. To the potatoes add a piece of butter, the size of an egg, salt, two tablespoonfuls of cream or rich milk, beat white and light, and put back into the skins. Now print them with a fork and brown in the oven. They must be served hot.

"Mammy's corn pones" come next. To three cups of white corn meal add one teaspoonful of salt, one-half teaspoonful soda and one tablespoonful of lard. Mix with the meal thoroughly, then wet with buttermilk to the consistency of soft bread dough. Form into small pones, place in a row on a hot greased griddle and print with two fingers. Bake a nice brown and serve while hot.

Always remember that in the South we use the pure white corn meal. Never the yellow kind.

For the banana salad, place on each small plate a crisp lettuce leaf. Slice a banana through lengthwise and sprinkle with fresh roasted peanuts chopped fine and over all a mayonnaise dressing made from the following recipe:

To the yolk of each well-beaten egg (use as many as you desire) add one tablespoonful of vinegar, dash of salt, mustard, and paprica or cayenne pepper. Stir well together and cook in a double boiler, stirring all the while. When thick add a piece of butter and beat until almost cold. This will keep for a week and may be thinned with cream as needed.

Now for the sweet potato pie. Take three medium sized sweet potatoes boiled done. While hot peel and press through the colander, add a piece of butter the size of an egg, one small cup of sugar, one-half cup of rich milk, the yolks of four eggs, well beaten, one teaspoonful of vanilla, and a pinch of cinnamon. Beat until light and smooth. We'll bake them in open crusts and when done cover them with a meringue made of the whites of four eggs beaten to a stiff froth, adding four tablespoonfuls of sugar and a few drops of lemon juice or extract. These go in the oven again for a few moments to brown lightly.

Now, you see, Edith, our dinner is nearly ready. While we've been putting things together time has been flying. You remember, don't you, that it was exactly five o'clock when we began? Now it is almost 6:30. They will be here directly. I asked them for 6:45.

Doesn't everything look good?

Oh! look, Edith! They are coming now, and he's with them. But I'm not afraid. Just wait till he tastes our deliciously cooked dinner and knows how very little "fuel" it took to prepare it, he will be urging all his acqaintances and friends to "invest in an electric range and save money," and you know "Money well spent brings sweet content."

* * *

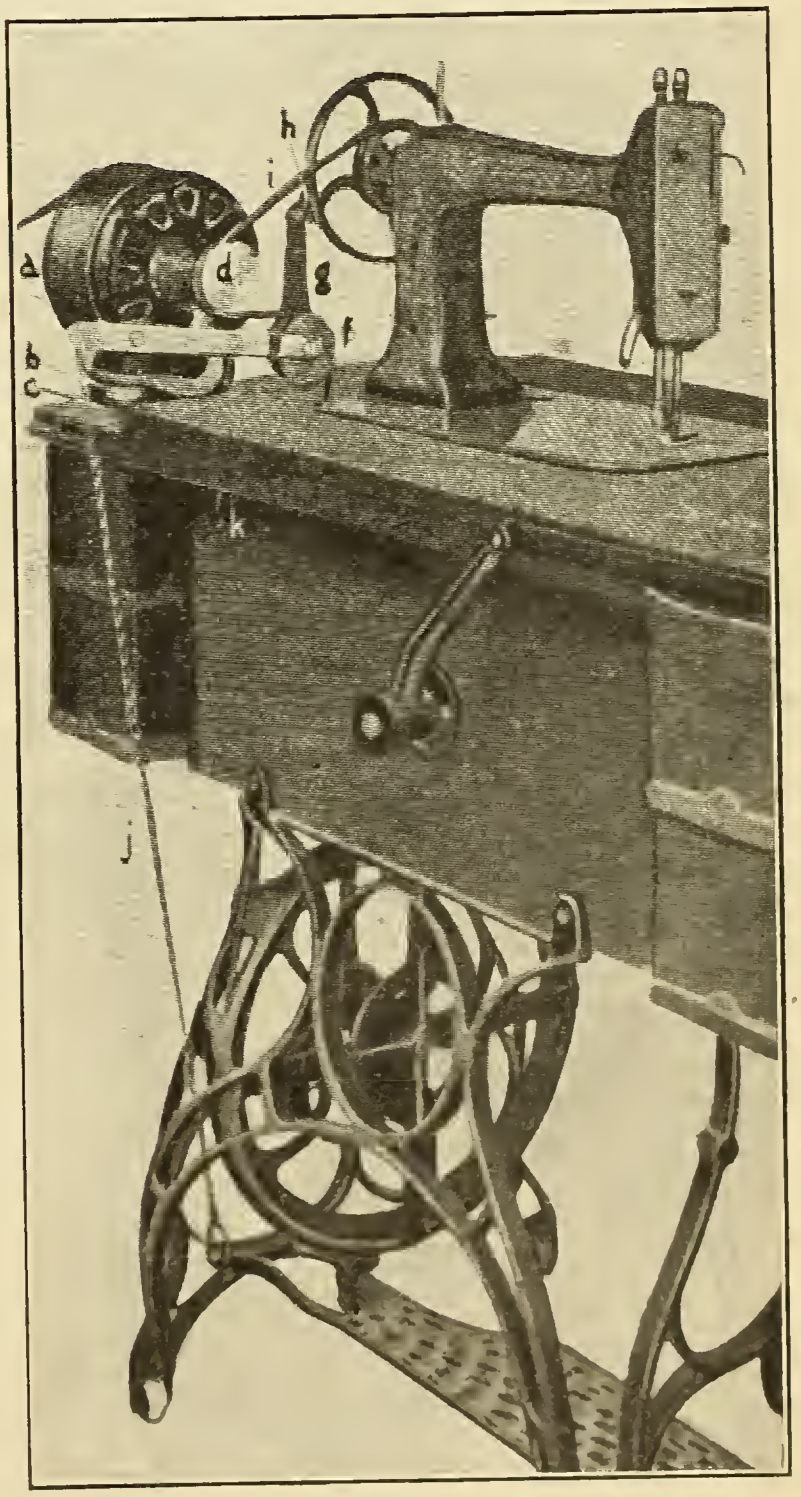
Ting-a-ling—Ting-a-ling. Hello! This you, Edith? Yes, this is Florence.

"Is he going to let me keep the range?" I should say he is—after the way things went off last evening. He said he guessed we might as well, seeing that this is the Electrical Age, anyhow.

And do you know—I had to laugh—he's bound he's going to have one of those new electric shaving mugs and one of the electric shaving mirrors. He started to work bright and early this morning so he could stop in at the electric light company's display room and pick them out.

Sewing Without Effort

Our mothers were delighted with the advent of lighter running machines driven by foot power and thought them a great improvement over the old hand operated kind of the early days. Even so, however, the work meant and still means bent backs and weary muscles and the strain has only



MACHINE RUN BY A LITTLE MOTOR

too often proven too much for mothers with an already over-crowded day. But dressmakers are expensive and usually the work was done in spite of pains and aches.

All this can be done away with now if only one has electricity in the house, and the cost of the equipment is little more than is paid to a seamstress for a single visitation. Little motors have been devised that will run the machine, leaving you only the responsibility of properly guiding the cloth under the needle.

Certain makers have designed the frames of their machines so as to accommodate motors made especially for their make. These are neat and effective and in great demand. Another motor has been made to go on over the hand wheel of certain machines and it, too, is very successful. Still a third is made to fit all machines, old and new, and the Westinghouse Company which is making it has found it difficult to supply the demand.

One of these motors is shown mounted on an ordinary household sewing machine. We have lettered the parts for easier reference. The motor itself is labelled (a) and is mounted on a slotted base (b) with a felt pad (c) to prevent its scratching the table. If desired the motor can be taken from the base by pulling out a little spring. Usually, however, it is left in place ready for instant use. A very ingenious scheme has been devised to drive the hand wheel, the belt, (i), running over a little grooved pulley (d) on the motor and being given the proper tension by another small pulley (f) which can be moved up and down by means of a chain (j) attached to the treadle. The rod which usually runs from the treadle to the fly wheel is disconnected and removed. A spring keeps the arm (e) raised and this keeps the belt loose by lowering the idler pulley (f). If the motor is started its pulley simply turns in the loose belt and the machine does not move, for in addition to the belt being loose a little brake is also pressed against the hand wheel at (h), the arm (g) being attached to the arm (e) and operated by the same spring. If, now, the treadle be slightly depressed the idler pulley is raised and the belt tightened and at the same time the brake is lifted from the hand wheel. The motor is running at full speed but the tension on the belt is slight and its grip on the motor pulley accordingly not very great. The result is the machine runs very slowly. If more pressure is applied at the treadle greater tension is put on the belt and the machine goes faster. Finally the tension is sufficient to eliminate the slip and the machine runs faster than it is possible to make it go by the old foot-power system. Any speed can thus be maintained from a single stitch to this highest speed and the machine can be stopped instantly by releasing the slight pressure on the treadle.

Electric Irons as Little Stoves

In a certain boarding house full of girls in the city of Boston there was great elation when one of them discovered a new use for the electric flatiron. With most of these girls strict economy had to be practised and

when they found out that they could get a small electric iron to press out their laces and even shirt waists they were quick to invest their savings in one of the little economizers. But one of these same girls, with a bit of inventive genius, quickly discovered that the iron could be turned upside down and converted into a small stove. On its flat surface she easily boiled water, made fudge and even fried eggs and did other cooking.

Greater Than the Wash Tub

Five pretty girls devoted to the study of domestic science went into a laundering competition for an hour with five colored washerwomen, at the recent Electrical Show in Chicago. The latter used the old-fashioned washboards, tubs and wringers while the girls operated the new style electric washing machines and wringers. The girls took their time—the colored women worked like Trojans. If they washed half as many clothes in that hour as the five girls did with the electric machines they were to get $100. The suds flew fast and furiously with the colored women, but they lost the $100, although they were well compensated for the hour's work.

Electricity a Servant of Stage People

By ALICE DOVEY—WITH LEW FIELDS IN "OLD DUTCH"

I am no electrician. I don't even know what a watt is, much less a kilowatt hour. But I do know that electricity does a great many things for we stage people, and we find it a convenience and an amusement in more ways than one.

Perhaps you may think that the women you see on the stage don't have a longing occasionally for the little things of domestic life which mean so much to a woman—are not half frantic sometimes to get on an apron and mix up something to do a little cooking. I suppose the desire is inborn, for women have cooked ever since Noah's little house-boat party.

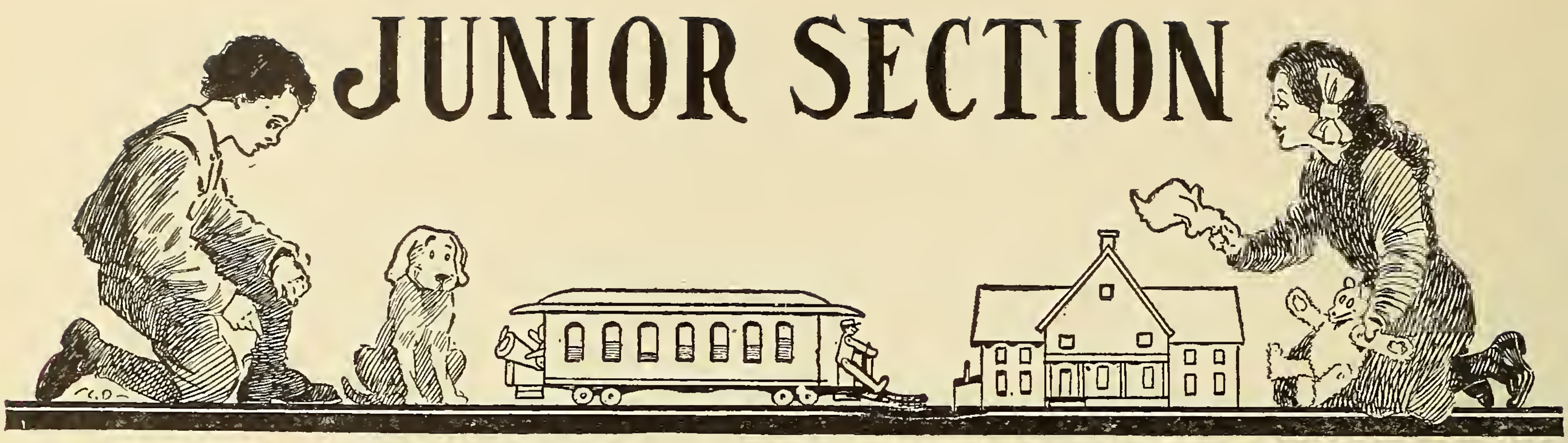
Anyhow I know I have my complete electric outfit and you should see what I can "manufacture" with even a toast-stove, a coffee percolator and a chafing dish.

It's easy, of course, to order a breakfast brought up to one's room in the morning. But there are a whole lot of times that I find I would rather get up and fix up a little breakfast for myself. All the utensils are convenient as can be and it only takes the turn of a switch to set them going full blast.

A CHAFING DISH PARTY FOR TWO

Then, too, after the show in the evening, it gets monotonous always going out to a cafe for the dinner we all feel we must have after a hard evening's work. I enjoy a little chafing dish party in my room as well as the girls blessed with their own homes—and my friends do too.

Another time at which I find my electrical utensils very convenient is after matinee performances. I have them in my stage dressing-room on those days and frequently do not go to the trouble of putting on street clothes and going out between the afternoon and evening performances, but prepare a little lunch right there.



An Electrical Laboratory for Twenty-Five Dollars

By DAVID P. MORRISON

PART IV.

After completing your electrolytic rectifier and transformer you will find yourself badly in need of some form of ammeter and voltmeter for making current and voltage measurements. There are numerous forms of instruments, differing in construction, principle of operation, range of indication, etc., that may be constructed and used to indicate the electrical pressure between two points, or the current flowing in a circuit.

All of the instruments that are suitable for direct current measurements cannot be used for alternating current work, while all alternating current instruments, ammeter and voltmeters, can be used on a direct current circuit, but their indication is not as a rule as accurate as on an alternating current, due to the disturbing effects of stray magnetic fields, etc. The instruments should be constructed so that they can be moved about without changing the accuracy of their indication. They are often called "portable ammeters" or "portable voltmeters." The instruments described in this article are of the "portable" type and will be much more satisfactory than those whose position must be accurately adjusted before they will give a correct reading.

The following description applies to an instrument that can be used on direct current but not on alternating current. It may be used as an ammeter or a voltmeter, depending upon the connection of the moving system. It will be found here that considerable mechanical skill will be required as quite accurate machine work must be done on the various parts. Almost every boy, however, has a friend in some machinist or else has a school shop equipment at his disposal where he will be allowed to do this part of the work.

Secure a piece of steel 1½ inches wide and about 5-16 inch thick and 13 inches long. Now bend this piece into a horseshoe form shown in Fig. 29. (Part of the curve is not shown in the drawing.) Have a blacksmith do this for you.

File out the opening between the two ends perfectly smooth and make it of a uniform diameter at all points. File the ends off so that they are parallel, which can be determined by placing a straight edge against both of them at the same time. Drill two holes in each end as indicated at the right in Fig. 29, which is looking at the ends of the magnet. These should be 1-16 or 3-32 inch in diameter and tapped to take a small machine screw. Also drill four other holes one in each edge and near the ends. These should be of approximately the same size as those drilled in the end, and tapped to take small machine screws as in the previous case. You are now ready to harden your magnet.

Secure a piece of round iron that will fit snugly in the opening between the ends of the bar. Then get from the blacksmith a pair of large tongs with flat jaws that will grip the ends of the bar and hold them firmly against the round iron core. Place the magnet in a good hot fire, with iron core between poles, and heat it uniformly to a cherry red;

then grip it with the tongs very tight and plunge into a bucket of water, holding the ends against the iron core with the tongs until thoroughly cooled. In this way your magnet will not be bent out of shape while tempering. It will be almost impossible

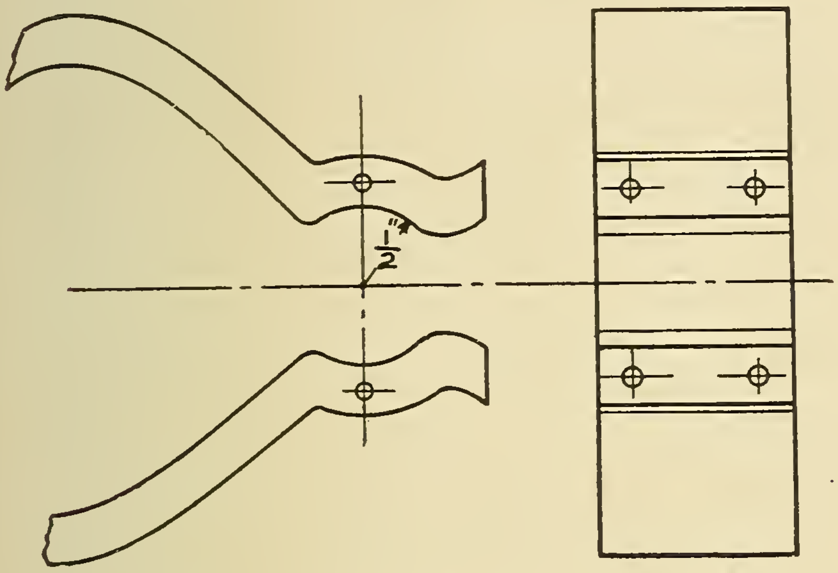


FIG. 29. THE PERMANENT MAGNET

for you to make any changes in the magnet after it is hardened.

Your magnet may now be magnetized. This can be done by placing its ends in contact with the poles of a powerful electromagnet, or by winding quite a number of turns of rather large wire around it and passing a strong direct current through this winding. The strength of the magnet may be increased when it is being magnetized by tapping it gently.

Now cut from some soft iron a cylindrical piece 1¼ inch long and ⅜ inch in diameter. Round off its edges and drill two small holes in one side and tap them to take small machine screws. This piece is to serve as a core for the moving system to rotate about, and will be mounted rigidly in the center of the opening between the poles of the magnet. The number of magnetic lines passing from one pole to the other through the circular opening is greatly increased by the use of this iron core, as it is a much better conductor of magnetic lines than air.

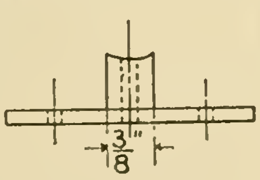


FIG. 30

Mount the iron cyclinder as follows: Cut from some ⅛ inch sheet brass a piece 1½ inches wide and two inches long. Drill four holes in this piece to match those in the ends of the magnet and mount it in place with the four machine screws. This piece must always be made of brass or some other non-magnetic material. Solder on the inside of this piece another piece of brass of the form shown in Fig. 30. The side of this piece of brass next to the opening between the poles should be filed out so that it will fit the curvature of the iron core and it should be of such a thickness that the core will be exactly in the center of the opening between the ends of the magnet, when it is fastened to the brass support. Drill two holes in this brass support to match those in the iron core and fasten the core with the two machine screws. It would be best not to drill the core until after the brass has been drilled as the holes can then be easily matched.

To construct the moving system you should proceed as follows: Secure some thin aluminum and roll it out until it is only a few thousandths of an inch in thickness. Then cut from it a piece 5-16 inch wide and 4⅝ inches long. Bend this piece around a wooden core of the dimensions shown in Fig. 31, making a lap seam at the joint.

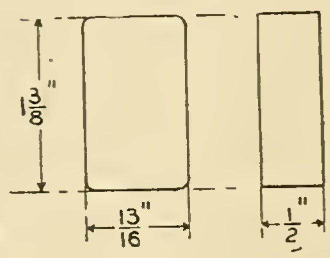


FIG. 31

Now cut from some 3-64 or 1-16 inch steel rod two pieces ½ inch in length and file one end of each to a point. After these pieces

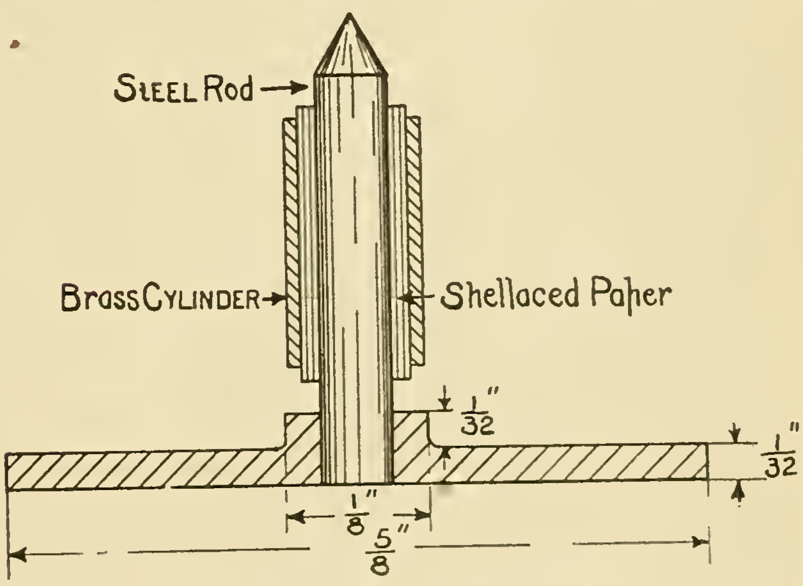


FIG. 32. PIVOT FOR THE MOVING SYSTEM

have been pointed they should be well tempered. Next cut two pieces from aluminum or brass whose dimensions correspond to those of the lower cross section portion in Fig. 32. Drill a hole in the center of each of these pieces of such a size that the unpointed end of the steel rod will have to be forced into them. After the rods are put in place wind around them three or four turns of good quality paper, shellacing each layer. Two thin brass cylinders about ¼ inch in length that will fit tight on the outside of the paper you just wound on the steel rods are now made.

Cut from some very thin spring brass a pointer and solder it to the end of one of the brass cylinders as shown in Fig. 33. The needle should be balanced by placing a small quantity of solder on the short end.

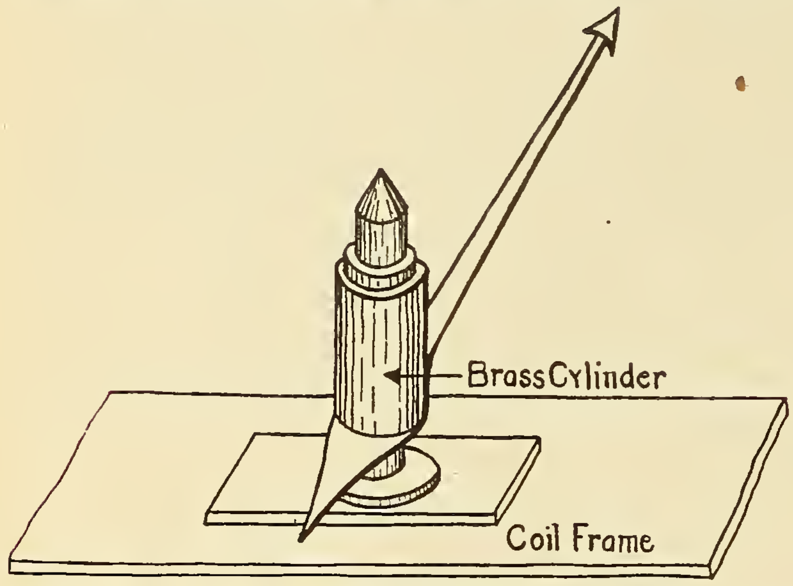


FIG. 33. HOW THE NEEDLE IS MOUNTED

Put these cylinders in place first shellacing the paper, and allow them to remain undisturbed until thoroughly dry. Now fasten these pieces carrying the points to the ends of the aluminum frame with some jewelers wax or shellac, placing the needle perpendicular to the plane of the coil. Fig. 34 shows how they are mounted. You must use great care in seeing that the pivots are exactly in the center of the frame. Otherwise the coil will rub on one side when mounted in its bearings.

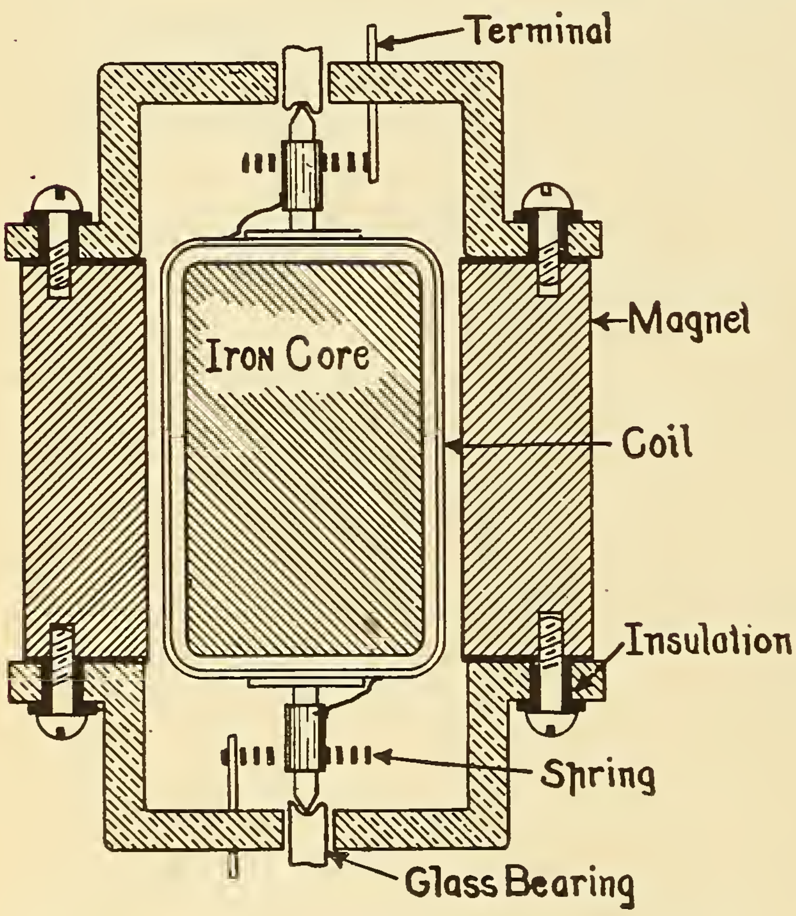


FIG. 34. MOVING SYSTEM MOUNTED IN THE BEARINGS

Place two or three layers of tissue paper on the outside of the frame shellacing it in place and then wind on about thirty turns of No. 36, or smaller, B & S gauge single cotton covered wire. The ends of this winding should be soldered to the two brass cylinders on the steel rods as shown in Fig. 34.

Secure from a jeweler two fine spiral springs and solder the inside ends to the brass cylinders near their outer ends. They will lie horizontally as shown in Fig. 34. These springs should be so arranged that one tends to wind up and the other to unwind when the coil is rotated, and their outer ends are fastened. Be careful in doing this soldering not to heat the tube too much as you are likely to loosen it from the frame. Before winding on the wire it might be well for you to take the frame off of the wooden core and see if you have the pivots in the center of the ends. They can be easily changed now but it would be almost impossible to do so after the winding is in place.

After the winding and springs have all been put in place you must balance the moving system by supporting the coil in a horizontal position on the two pivots. Add ballast to the lighter side until the coil is practically balanced. You can use beeswax for this purpose. The moving system is now complete and ready to be mounted in its bearings which can be made as follows:

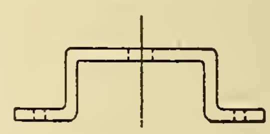


FIG. 35

Secure two pieces of brass ⅛ inch thick, ⅜ inch wide and three inches long and bend them into the form shown in Fig. 35. Drill a hole in each end of these pieces to match those drilled in the edges of the magnet. These pieces must not make electrical contact with the magnet, hence insulating bushing and washers should be used around the screws holding them in place.

Cut two circular disks of cardboard that will fit in the opening between the magnets and place these pieces in the opening between the poles of the magnet one near each edge. Now pass a needle through the center of these disks and mark the point where it comes in contact with the brass supports just made. All the various parts should be marked so that they can be put back together always in the same way. Drill in these supports a 3-16 inch hole with the points you located in the above manner as centers. These openings are for the bearings in which the steel points are to operate.

The bearings can be made from glass tubing as follows: Place the end of a piece of tubing whose outside diameter is about ⅛ inch, in a gas flame and heat it until the end softens and runs together. Hold the tube in a vertical position with the heated end up and allow it to cool, and there will be a tapered opening like the bottom of a wine bottle formed in the center of the end of the tube. After experimenting a little while you will be able to produce very good bearings. These ends should be cut off about ⅜ inch in length and they can be mounted in the openings in the brass strips as shown in Fig. 34 by means of some jeweler's wax or common sealing wax. You must be patient in adjusting the bearings as the operation of your instrument depends a great deal upon them. The ease with which the adjustment of these bearings can be made may be increased by mounting them in a hollow screw that is threaded to fit the openings, in the brass supports, which must also be threaded. A lock nut placed on these screws will serve to hold them in place after the adjustment is made.

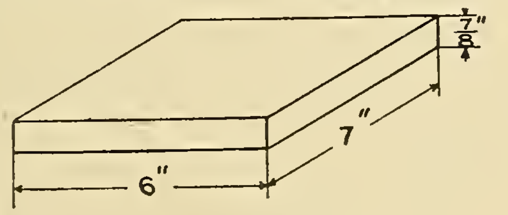


FIG. 36.

Cut from some well seasoned cherry or other close grained wood a piece whose dimensions correspond to those given in Fig. 36. This piece is to serve as a base for the instrument. The magnet and moving system can be attached to this base by means of several pieces of brass bent over the magnet and fastened to the base with screws. There should be several blocks of wood mounted on the base for the magnet to rest upon so that the lower support for the moving system will not touch the base. It might be well to cut grooves in these blocks for the magnet to fit in as that will also reduce the likelihood of its moving out of position.

A heavy piece of cardboard should now be mounted under the needle that is to serve as the scale. The needle as it is mounted will point out into the curved portion of the magnet. This cardboard should be of such a size that the needle will move through about sixty degrees from its zero position to the extreme position. Draw two arcs on this cardboard with the pivot of the moving system as a center. The radius of the outer circle should be a little more than the length of the needle and the radius of the inner circle should be about ¼ inch less than that of the outer one. The length of these arcs depends upon the movement of the needle or pointer.

The outer ends of the two springs should now be soldered to two pieces of brass that are fastened to the supports for the bearings. These pieces of brass form the terminals of the instrument. These springs should be soldered when the needle is in the zero position which results in there being practically no tension in either of them.

In using this moving system as a voltmeter it will be necessary to connect some resistance in series with it, the value of this resistance being determined of course when the instrument is calibrated. A small wooden spool can be mounted underneath the scale and inside of the magnet upon which this resistance can be wound. It, no doubt, would be best to use German silver wire for this resistance as the volume of wire required for a given resistance is considerably less than when copper is used. A number of different coils can be placed in series with the moving system, this changing the value of the deflection produced by a given voltage.

The construction of the case will be left entirely with the boy building the instrument.

Binding posts should be provided for making connections to the instrument and should be mounted outside the covering for the moving system.

To calibrate your instrument, to be used as a voltmeter, you will need a voltmeter whose indication is known and has its scale marked. You no doubt can borrow an instrument from some one to be used for this purpose, and it will be called a "standard." Connect your instrument in parallel with the standard, making sure you have sufficient resistance in series with the moving system to prevent its being injured by an excessive current flowing through it when the two instruments are connected to the source of electromotive force. You had best start with very small values of electromotive force which will reduce the likelihood of the instrument being injured. Then adjust the voltage impressed upon the two instruments in parallel until the standard reads three volts; this can be done by means of a resistance connected in series with the instruments. Now change the resistance in series with the moving system of your instrument until the indication corresponds to a full scale deflection making sure the standard still reads three volts. When this adjustment is secured, make a fine mark on the scale directly beneath the needle. Then reduce the voltage impressed, noting the readings of the standard and at the same time marking the position of the needle corresponding to each value of voltage read on the standard. Thus your instrument is capable of measuring up to three volts. The instrument can be made to indicate higher voltages by placing additional resistance in series with the moving system. Fig. 37 shows the connections of a moving system so that a full scale deflection corresponds to three different voltages. The terminal marked (C) is common to the three circuits, and each of the circuits has a separate coil that is used in making the adjustments.

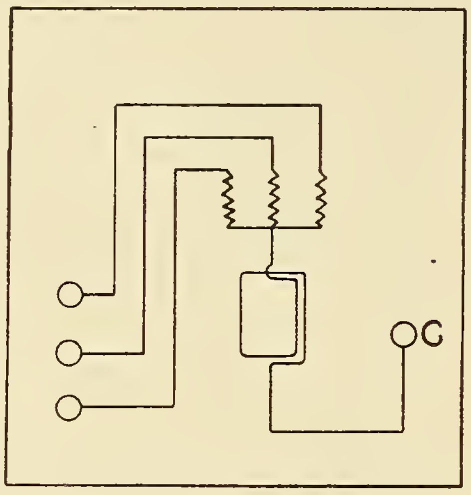


FIG. 37. CONNECTIONS

This same moving system may be used as an ammeter to indicate the current in a circuit by connecting it in parallel with a resistance called a shunt.

The current divides in the two circuits inversely as their resistances, hence the current flowing through the moving system can be adjusted by varying the resistance of the shunt. The instrument can be made to indicate any value of current by varying the resistance with which the moving system is connected in parallel. To calibrate the instrument you must connect a standard ammeter in series with it and adjust the parallel resistance until the full scale deflection is produced by the desired current. The other points on the scale can be marked by changing the current in the circuit and marking the position of the needle for each indication of the standard. This parallel resistance can be placed inside of the instrument just the same as the series resistance was in the case of the voltmeter. The parallel resistance must be of a much greater current carrying capacity.

[The next article will take up the construction of an ammeter and voltmeter which can be used on either alternating or direct current; also the construction of a simple switchboard.]

(To be Continued.)

Fire and Burglar Alarm

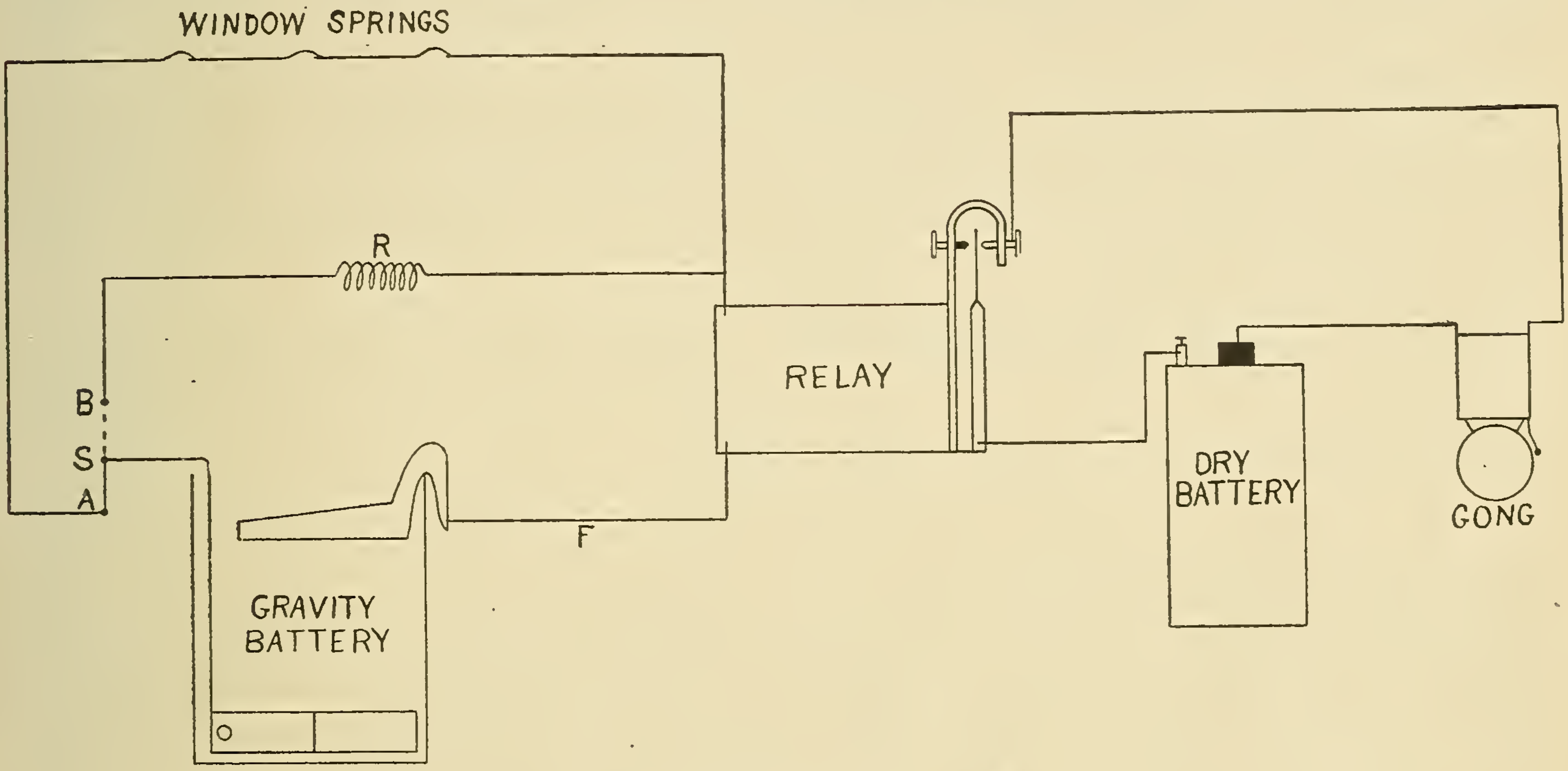
Any one who can work with carpenters' tools and who has an elementary knowledge of electricity can install a fire and burglar alarm in a residence. It will be necessary to fit to each window and door an alarm spring, and these springs may be purchased of any dealer in electrical supplies. The two wires from each spring may be dropped to the basement and there connected so that the springs will be in series. The springs may be so placed that the windows may be left open a few inches for ventilation and the occupants of the house may feel sure that no one can enter the window unknown to them.

If a window is raised above the spring it releases the spring and opens a gravity battery circuit. When this circuit is opened the armature of a relay is released, this armature having hitherto been held up against the relay magnet because of the current which flowed through the magnet coil from the gravity battery. This in turn closes the gong circuit which is operated by dry batteries. For the relay a "pony" telegraph relay may be used. The contact points must be in the reverse position from that in which they are used for telegraphic work in order that the gong circuit may be closed when the gravity battery circuit is broken.

For the fire alarm a strip of tin foil about an inch wide should be clamped with porcelain cleats between two strips of copper. This tin foil is connected in the gravity battery circuit by means of the copper strips and placed over the furnace or wherever a fire is most likely to break out. If the furnace becomes overheated the tinfoil will be quickly burned out, the gravity battery circuit opened, and the alarm sounded.

This alarm is a perfect protection against the common sneak thief though it might not protect against the skilled burglar who has more or less of a technical education. The average home, however, has more to fear from the sneak thief than from the skilled burglar, for the latter confines his attention to buildings in which considerable wealth is known to exist.

There is another form of burglar alarm in which, when a window is opened, the window spring closes a circuit. In this alarm only a dry battery circuit is used. Now it is easily seen that a burglar who might discover that a house was wired for an alarm and could not discover which form of alarm was used would be perplexed, for the very thing which would prevent one kind of alarm from ringing (opening the circuit by cutting the wires) would cause the other to ring.



FIRE AND BURGLAR ALARM

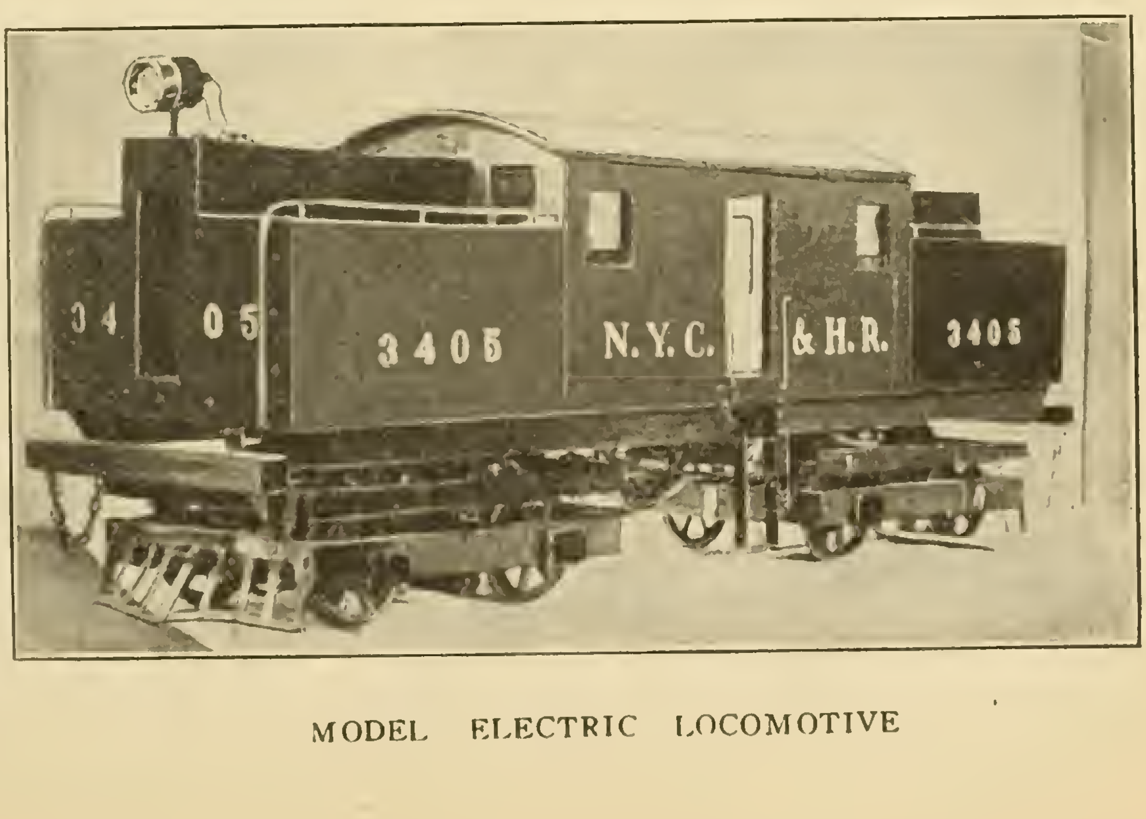
A single pole double throw switch is placed at (S) in the diagram. When the switch is thrown to (A) the window springs are in circuit. In the daytime the switch can be thrown to (B). The current will then flow through the resistance coil at (R) and the windows can be opened without ringing the gong. This is a convenient arrangement for keeping the gravity battery busy when it is desired to open the windows, for, as you may not know, a gravity battery must be kept working on a light load.

Of course a single pole switch can be placed anywhere in the gong circuit. If the tin foil is connected at F, the fire alarm will be in circuit day and night.

Model Electric Locomotive

The accompanying cut shows the model electric locomotive made by Nathan Lord of Boston, Mass., which won the first prize for amateur electric construction at the Boston Electric Show. The locomotive is a fac-simile of a New York Central locomotive and was built by the constructor with nothing more encouraging to help him than a picture cut out of a technical periodical.

Mr. Lord is a high school student and has never seen an actual electric locomotive or studied electricity. He had the idea to build an electric locomotive some two years ago and with the clipping, which gave him an idea of the exterior appearance of the real thing he set to work and devoted the whole of his spare time for the following



MODEL ELECTRIC LOCOMOTIVE

two years in its construction and completed it in time for the electric show.

One of the remarkable things about the model is that it is made of such materials as are at hand in the average household. The body of the locomotive is composed of wood of egg crates, the doors were made of tin from old tomato cans, even the bars and under pinning were made of cigar boxes and thicker material. The locomotive is equipped with journal boxes, hinged doors, glass windows, controller, two motors, third rail contact, headlights, and swivel trucks. The model is two feet long and travels on a four-inch track.

Hand Power for Small Dynamos

If the amateur experimenter has an old discarded lawn mower he can make an excellent hand power device to drive small dynamos. The mower is first taken apart and the roller and connecting pieces, between the two end castings which contain the bearings, thrown away. These two end castings (bb) Fig. 1, are then bolted securely to the wooden uprights (a a) by the lugs or projections which originally supported the roller of the mower.

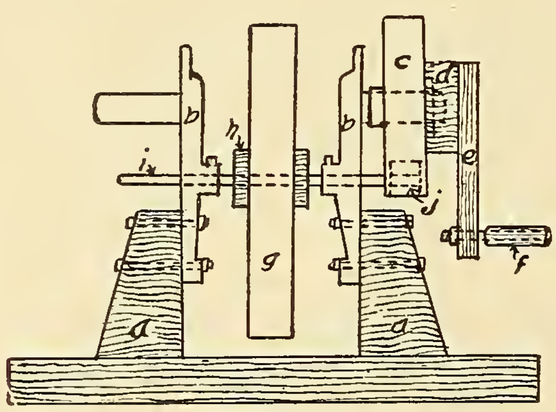


Fig. I

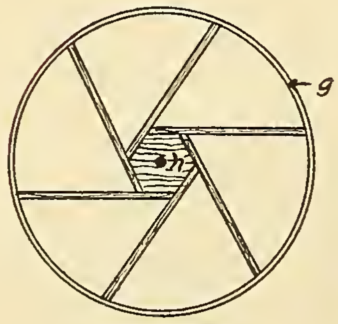


Fig. II

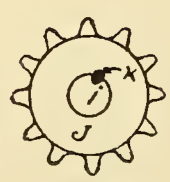


Fig. III

HAND POWER MACHINE

Care must be taken to get the two bearings which support (i) exactly in line so that it will turn freely without binding.

The cutting knife is driven from its shaft and replaced by the large pulley wheel (g) shown in Figs. 1 and 2. The center piece or hub is a block about four inches long, whose ends are six-sided figures. Bore a hole in the center just large enough to drive tightly on the shaft. The spokes are nailed to this hub. The rim (g) may be made of a strip of sheet iron bent in circular form, but a piece of an old cheese box, about two inches wide, makes an excellent wooden pulley face for a wheel about sixteen inches in diameter.

A rachet or some other device is used, generally on the small gear wheel (j) to prevent the knife from turning when the mower is pulled backward. This had better be discarded and the gear fastened permanently to the shaft, by filing a notch on the inside of this gear and a corresponding one on the shaft and driving in a nail, as at (x), Fig. 3.

To one of the mower traction wheels (c) is bolted the wooden block (d) and the crank arm (e). The handle (f) may be part of a broom handle, and it turns easily on the bolt which is fastened at right angles to the end of the crank arm.

A flat endless belt made out of about four thicknesses of good canvas sewed together connects the large pulley (g) to the small pulley on the dynamo.

The speed of the dynamo is of course regulated by the speed at which the crank is turned. For example if (c) and (j) are geared one to six, and the large pulley (g) is sixteen inches in diameter and the small pulley on the dynamo, say two inches in diameter, and it is desired to run the dynamo at 1800 revolutions a minute; then the right speed to turn the crank would be

$\frac{1800 \times 2 \times 1}{16 \times 6}$ or about 38 times a minute.

The type of lawn mower used has gear teeth on the inside of the traction wheel. If the mower at hand differs in construction the reader can make any slight alterations needed for his particular mower. But I think in every case the general plan of mounting can be followed. It will be noticed that only one set of gears or those on one side of the mower is needed, the casting (b) on the left serving merely as a bearing for (i).

JAMES P. LEWIS.

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—Arc System

By A. B. COLE

The construction of a small wireless telephone outfit of the speaking arc type is quite a simple matter if a proper design is followed. The set described in this article is adapted to operate on 100- to 120-volt direct current circuits, but will also run satisfactorily on circuits whose voltages are as low as fifty. The set can not be operated on alternating current circuits.

It has been found that when a telephone transmitter is connected across a choke coil, which is in series with an arc light burning on a direct current circuit, words spoken into the transmitter will be reproduced by the arc. If an impedance coil is placed in the direct current circuit, and the arc is properly connected to an aerial system, as used for wireless telegraphy, the arc will set up oscillations in this system. These oscillations in turn set up electric waves which are radiated in all directions by the aerial, and these waves will affect wireless telegraph receiving instruments at a distance.

In order to make an efficient outfit for this purpose it will be necessary for the builder to follow quite closely the principal dimensions given below, for satisfactory results cannot be obtained nearly so easily in wireless telephony as in wireless telegraphy.

Fig. 1 shows the method of constructing the arc proper. The lower or negative electrode is of carbon, held in a brass tube as shown in the detailed drawing in Fig. 2. This carbon is the same as that used for street arc lights. The upper or positive electrode is made from brass or copper tubing, and has an inlet (I) and an outlet (O) for water circulation within it. Considerable heat is generated at the electrodes of the arc, and greater efficiency is obtained by cooling the positive electrode. The inlet and outlet tubes should be about 1½ inches long.

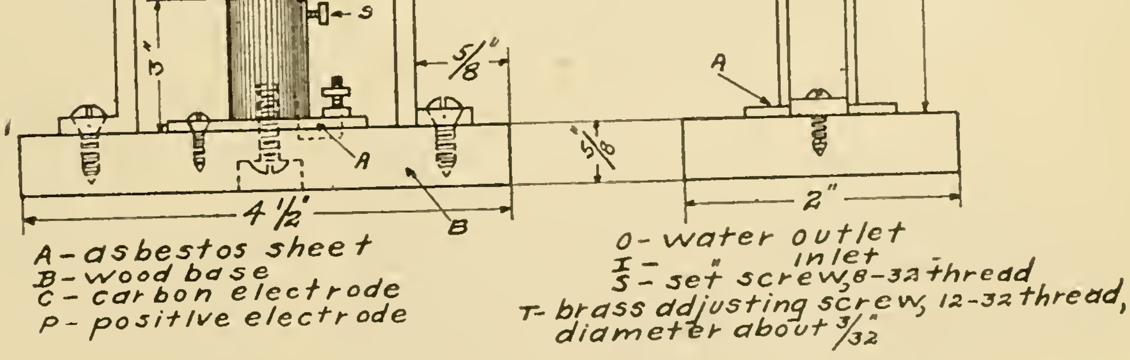


FIG. I. CONSTRUCTION OF THE ARC

When the set is in operation the inlet tube is connected by rubber tubing to a water faucet. A good way to do this is to provide a rubber stopper large enough to fit inside the faucet. A glass tube about

5-32 inch outside diameter may be inserted in the hole in the stopper, and the rubber tube may be slipped on the glass tube. If the stopper has two or more holes those not needed may be closed by inserting glass rods. The outlet tube is connected by means of a rubber tube to a sink or drain pipe, so as to dispose of the water after it has passed through the positive electrode.

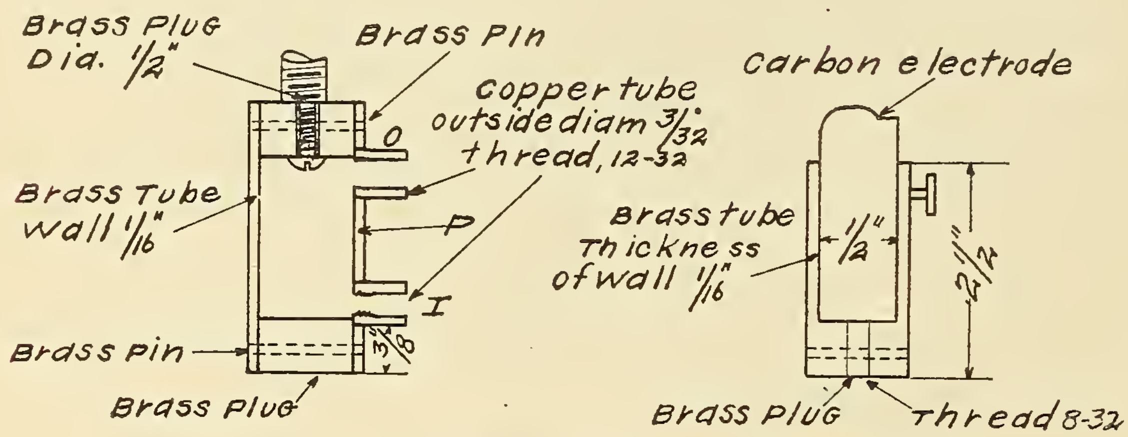


FIG. 2. DETAILS OF CARBON HOLDER

The negative electrode is stationary, and the carbon should always project at least one-half inch beyond its brass holder, so that the arc will be formed on it, not on the brass. The carbon may be moved up from time to time by loosening the set screw (S). The positive electrode (P) may be moved up or down by means of the large fibre headed thumbscrew (T). This screw should be so fastened to the upper plug of (P) that the screw may be revolved without revolving (P). This may be accomplished as shown in the detailed drawing, or in any way the builder desires, so that the cooling water cannot leak out at the point where the thumbscrew enters the plug.

The rheostat shown in the diagram of connections, Fig. 3, is made in the ordinary way, of ten coils of No. 14 German silver wire, each coil containing 95 turns, and each turn having a diameter of ¾ inch. It should be so arranged that any number of coils from zero to ten may be connected in circuit when desired. Any rheostat having a maximum resistance of at least 50 ohms, and a carrying capacity of at least six amperes will do for this purpose.

The choke coil shown in the same drawing consists of 75 turns of No. 12 D. C. C. magnet wire wound on a fibre core four inches in diameter. The telephone transmitter is of the standard type known as a "long distance transmitter." The impedance coil should have an outside diameter of eight inches and a cross section of 1¾ square inches. The core is built up of No. 18 soft iron wire. If the wire is rusty, so much the better. It should be procured as rusty as possible. The core is built up of a large number of separate wires, each of sufficient length to give the core the above diameter. The ends of the wires are butted up against each other and are held by a fibre tube about two inches long and 1½ inches in diameter.

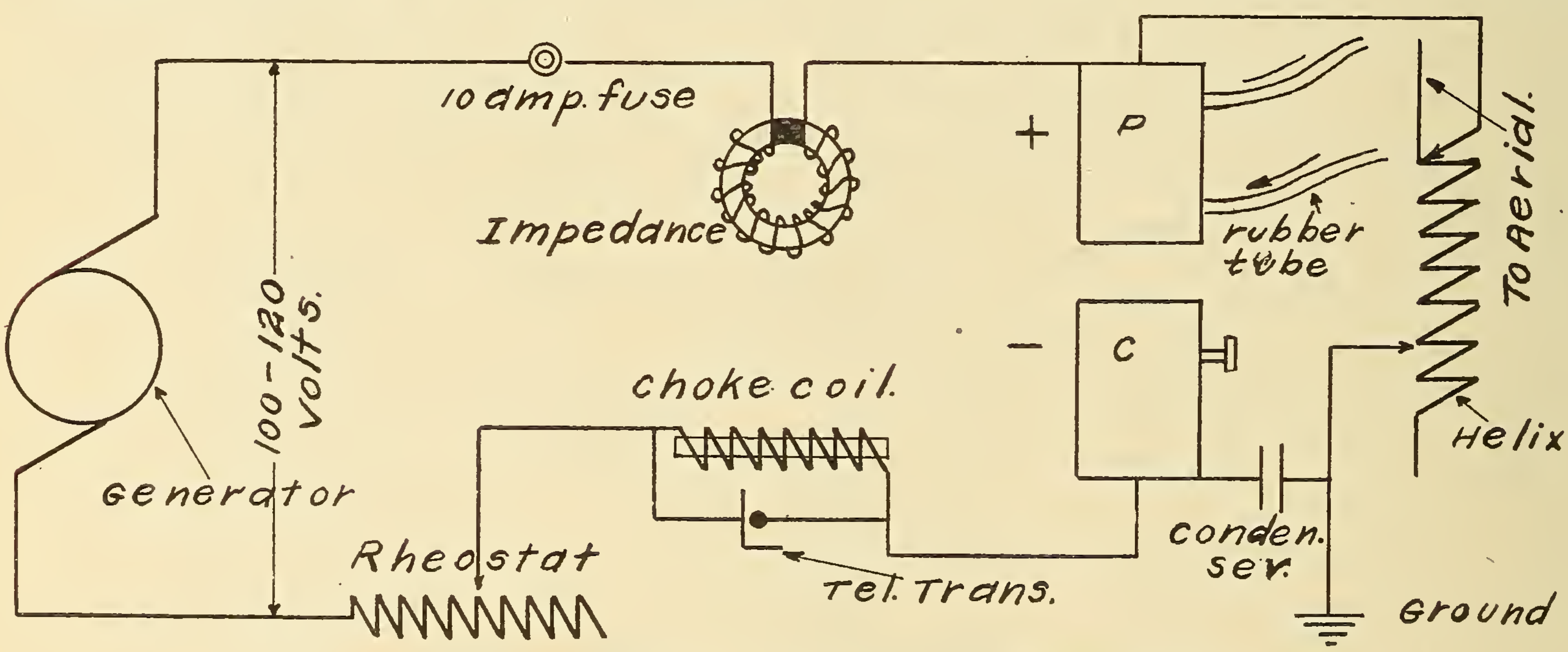


FIG. 3. CONNECTIONS OF WIRELESS TELEPHONE

An easy way to form the core is to wind a number of wires around a drum to give them the proper shape and length, and then to cut them off and insert them in the fibre tube. After the core has the proper diameter the wires may be held in place by wrapping ordinary insulating tape around them. When this has been done three layers of

No. 12 D. C. C. magnet wire should be wound on in the same way that any electromagnet is wound.

The ten ampere fuse shown in Fig. 3 should not be omitted. When using the set be sure that water is flowing at a sufficient rate through the positive electrode to keep it comparatively cool.

The general theory of the operation of this set is as follows: When any sound strikes the transmitter diaphragm it vibrates in accordance with the intensity and frequency of the sound wave. This vibration is transmitted to the carbon granules, thereby increasing and decreasing the resistance of the transmitter as a whole. The variation in resistance causes a variation in the current flowing through the choke coil and the arc. Of course the variations are very small compared to the current flowing in this circuit, but nevertheless are sufficient to cause the original sound to be reproduced by the arc.

Variation in the arc current causes electrical oscillations to be set up in the circuit including the arc, the condenser, and the helix. When this circuit is properly related to the aerial-ground circuit a maximum quantity of electrical energy is radiated by the aerial. The relation of the above circuits is varied as in wireless telegraphy by moving the variable contacts of the helix from one turn of wire to another. A Geissler tube may be inserted in the aerial circuit to show when a maximum quantity of energy is being radiated, or a hot wire ammeter may be used for the same purpose if available. The purpose of the impedance coil is to prevent the oscillations generated at the arc from flowing through the circuit including this coil, the generator, the rheostat and the choke coil.

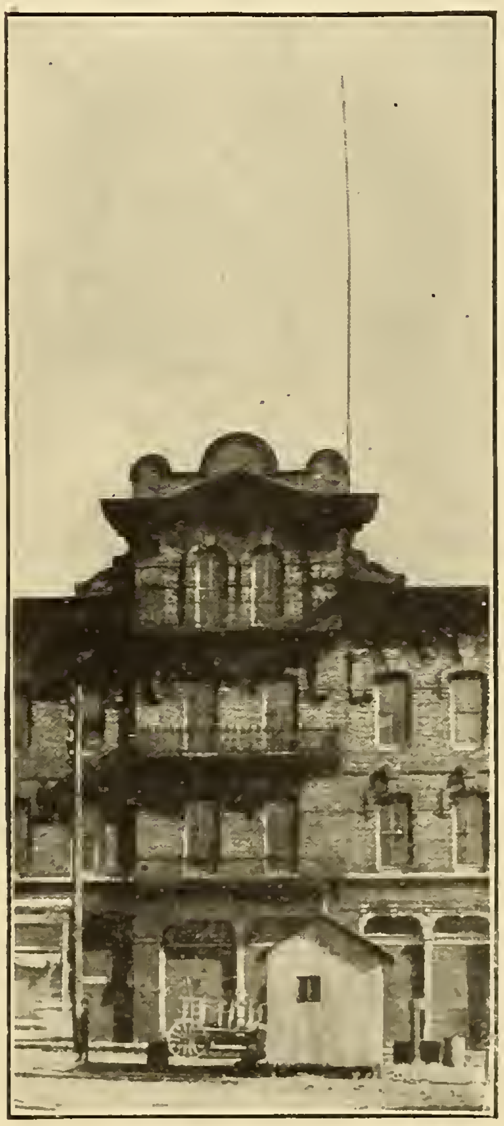
This set may be used for purposes other than that of wireless telephony. One inventor has used several arcs in series, placed in parks and amusement places. The telephone transmitter was placed before a phonograph, and the music was reproduced by each arc. The set worked very well and attracted considerable attention. In this case the arcs were self regulating.

The builder of this set will find it very instructive, and will, no doubt, be able to devise many experiments, which may lead to important discoveries. The arc system of wireless telephony is practically the only one used at the present time.

If the above set is well constructed, and with a good aerial, the owner should have no difficulty in working over distances of four or five miles.

Suggestions for Aerials

In the February issue of Popular Electricity was printed a letter from Mr. E. F. Waits describing a very complete amateur station which he had built. In a subsequent letter he informs us that as a result he has received dozens of letters from those interested in wireless and has made many new friends. He makes some further interesting comments in his second communication which we are glad to quote, as follows:



"I enclose a photograph of the main support of the aerial. This may also be of interest to some one who has trouble in that line. This pole is a common gas pipe, in three sections, each one being about 18 feet long. It simply sets on a board which is made to fit the roof and is held in place by three guy wires at each joint. The bottom pipe is 2½, the center two, and the top 1½ inches, inside diameter. On top is a "T" to which is fastened the two top guy wires and the pulley. Through the pulley runs a 7-strand steel cable for raising and lowering the aerial. From the ground to the top of the pole is just 125 feet. The guy wires make this pole so rigid that it could be climbed if it should ever be necessary.

"In using a silicon detector, did you ever drill a small hole in the end of the brass contact screw and insert a piece of gold? A piece of old spectacle temple is just the right size and quality. Try it.

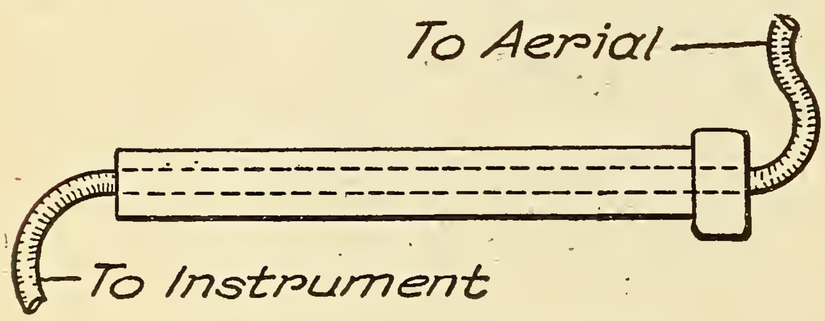
"If the two boys, who were in Chester, Pennsylvania, will write to me, I would like to know the size and kind of apparatus they were using one night last November. 'We are at the dock in Chester, Pa. We are having a big time in Chester, Pa. How is things with you?'

"You were evidently talking to someone in Philadelphia, a distance of only 10 or 12 miles, and it seems to me that you were wasting a lot of energy, as I am over 900 miles away and heard you very plainly."

A Leading-In Insulator

It is an absolute necessity that all wireless stations no matter how large or small should have a leading-in insulator that will "hold" the discharge without leakage. The insulator described below will take the discharge from transformers up to three kilowatts and induction coils up to 25 inches. It will cost about 50 to 75 cents.

The materials needed in its construction can be purchased in any electrical supply



LEADING-IN INSULATOR

house. They will consist of one unglazed porcelain tube 14 by two inches, knobbed at one end and with walls three-eighths of an inch thick; one pound of red sealing wax.

The tube should be boiled fifteen minutes in paraffine to remove dampness, then cleaned of superfluous paraffine. When cold shellac the outer wall and as much of the inner wall as can be conveniently reached with a small brush. It should then be allowed to dry and harden. The leading-in wire (high tension cable preferably) should be put through the hole; allowing about two feet to protrude from the knobbed end of the tube for aerial connections, and from the other end to attach to the lead to the instruments.

Next, pour the sealing wax around the wire till the tube is filled up flush with the ends. After this has cooled shellac the tube and a foot or so of the projecting wires.

GEORGE F. WORTS.

Marconi Receives Nobel Prize

The Nobel prize for physics was this year awarded jointly to Guglielmo Marconi of London, and F. K. Braun of Strasburg University, Germany. The prize, which amounted to $40,000, was divided equally. The privilege of awarding it is maintained by the Swedish Academy of Science. Mr. Marconi received the recognition for his research and development work in the field of wireless telegraphy.

WIRELESS QUERIES

Answered by A. B. Cole

Questions sent in to this department must comply with the same requirements that are specified in the case of the questions and answers on general electrical subjects. See "Questions and Answers" department.

Simultaneous Use of One Antenna for Two Wave Lengths

Question.—Is it possible to use one antenna for two sets of different wave length working at the same time?—J. G. H., Omaha, Neb.

Answer.—Yes, in fact every untuned set sends out many different wave lengths whenever the key is depressed. Probably the best arrangement for your purpose would be a double transmitting set consisting of two coils or transformers, two keys, two spark gaps, etc., using two transmitting transformer tuners, the secondary of each tuner being connected to the aerial.

Condenser Calculations; Re-Winding Receiver

Questions.—(A) What would be the capacity of a condenser having 45 sheets of tinfoil (35 square inches of active surface per sheet) with paraffined paper as dielectric? (B) How is the capacity of a condenser determined? (C) How could I make a variable condenser for a receiving set? (D) Is an aerial consisting of four strands 50 ft. long the same in efficiency as one with two strands and 100 ft. long? If not which is best? (E) Could I rewind an ordinary pony receiver to get a high ohmage (1000 or more) and get good results? If so what kind and size of wire should be used?—E. B. E., Elizabeth, N. J.

Answers.—(A) The capacity of such a condenser depends on several factors and the only satisfactory way to determine it is to measure it.

(B) By somewhat complicated laboratory methods involving comparison with a condenser of known capacity. We expect to publish an article on this subject in the near future, as the method is too long to be described here.

(C) Two metal tubes, one about three inches in diameter, and the other a little smaller, should be arranged so that the smaller may slide into the larger. Each should be eight inches long, and they should be separated by paraffined paper. Solder a binding post to each, and use these for the condenser terminals.

(D) If the height of both the above aerials is the same, the former will be better for transmitting, and the latter better for receiving.

(E) This depends on the construction of the receiver, and as you do not advise the make, we cannot say, since in some cases you would obtain no better results.

Construction and Operation of a Morse Register

Question.—Please show how to connect a Morse register with a silicon detector, double slide tuner, and fixed condenser, also how to make a Morse register.—W. B., Brooklyn, N. Y.

Answer.—Connect the register in place of the telephone receivers in the diagram in answer to J. S. C. in the January issue. A battery of two or three dry cells should be included in series with the register. See answer to R. T. in these columns. A Morse register consists of a pair of electromagnets with an armature which carries a pen, which touches and makes a mark on a strip of paper when the armature is drawn down by the magnets. The paper is moved steadily past the pen point by clock work.

Detectors and How to Connect Receiving Apparatus

Questions.—(A) How shall I connect the following receiving set: 140 foot aerial 40 ft. high; one single slide tuning coil, one double slide tuning coil, two large fixed condensers, two variable condensers, one small induction coil, silicon detector; one pair 750 ohm receivers? (B) What would be the receiving radius of such a set? (C) Would a silicon work better and be more sensitive with a potentiometer and battery? (D) Which is the most sensitive an electrolytic, silicon or carborundum detector?—F. S., Benton Harbor, Mich.

Answers.—(A) See diagram in article in Jan., 1910, issue on "Condensers in the Receiving Circuit."

(B) About 400 miles.

(C) Yes, carborundum and perikon being the types of thermo-electric detectors which are improved by the use of a battery.

(D) The electrolytic is considered the most sensitive of the three.

Wireless Aerials

Questions.—(A) Does it take more power to operate a wireless with a 6-strand antenna 100 feet long than a four-strand antenna 40 feet long? (B) Which is the best for sending and receiving an aerial 60 feet high at one end and 20 feet at the other end and 100 feet long or an aerial 60 feet high at both ends and 40 feet long? (C) What is the best location for a wireless on a hill or on the level?—N. W. P., San Francisco, Cal.

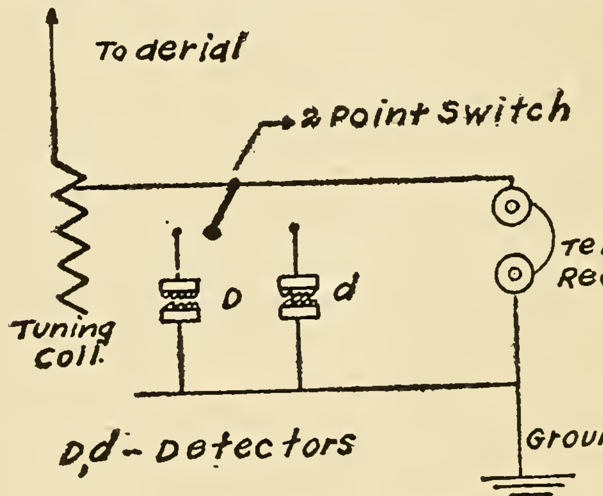
Answers.—(A) Not necessarily more power required, but will radiate more energy, and therefore will be suitable for a more powerful set.

(B) The former aerial will be better.

(C) The better location is on a hill.

Detector Switch

Question.—Please give diagram showing how to connect two detectors to a switch, so that each may be used at will.—A. S. H., New York, N. Y.



DETECTOR SWITCH

Answer.—See diagram.

Use of a 150-Ohm Relay

Question.—Can you give me an idea of how I may use my 150-ohm relay to receive up to 12 miles without making a polarized relay.—R. T., Germantown, Pa.

Answer.—We do not recommend the use of an ordinary 150-ohm relay for this purpose. Most relays are not sufficiently sensitive to very weak currents. We often receive inquiries as to how a silicon or other mineral detector may be caused to operate a recording device, and you may be thinking of doing this, but even if you intend to use a coherer as the sensitive instrument we do not believe you will have satisfactory results, for the coherer cannot be depended upon for working over such long distances, while mineral or electrolytic detectors in connection with sensitive telephone receivers will operate over several hundred miles. Recording devices, such as the Morse register, cannot be operated by the above mentioned detectors. Any progressive experimenter who invents a device to record distant wireless messages will find a large field for the invention, since the practice at the present time is to have operators on duty continually.

Short Distance Buzzer Equipment

Questions.—(A) Will you describe the aerial to be used with the short distance buzzer equipment described in the January issue in answer to H. B. H.? (B) Would you advise the use of a battery in the receiving circuit of buzzer set? (C) What style and what resistance in ohms should I use?—M. L. S., Northampton, Mass.

Answers.—(A) The aerial should consist of at least four parallel wires. No. 14 aluminum wire will do very well. Connect all wires together at each end. The wires may be separated by a wooden rod, commonly known as a "spreader." Place the aerial as high as possible, 60 feet from the ground will do. Make the wires as long as possible. Forty feet is an average length. Insulate the aerial well from all conducting objects by means of glass or porcelain insulators. At the lower end of the aerial connect a No. 12 copper wire to all wires, and lead this wire into the house through an insulated tube.

(B) No.

(C) Any ordinary door bell or buzzer will do; they generally have a resistance of one ohm.

Wireless Telephone

Questions.—(A) Should electricity be able to run through a transmitter all the time or only when talking into it, especially in a wireless telephone. (B) I have an aerial made from No. 14 aluminum wire, four strands 50 feet long, 65 feet at one end, 40 feet at the other. Will this aerial do for a wireless telephone?—B. R., Jr., Tropico, Cal.

Answers.—(A) No, since the grains of the transmitter tend to fuse together under this condition.

(B) Yes, very well, for short distance work.

Unusual Wireless Phenomena

Questions.—I have been receiving from a commercial station and when it stopped I opened my battery switch, cutting off the current. In another minute I heard another station faintly. (A) Why was that? (B) Does the message jump the switch? (C) When I closed the switch again I could hear nothing. Was it because I had no potentiometer? (I used only a carborundum detector.) (D) When I open my battery switch and then take a connection off the pole of the battery and tap it lightly on again it clicks in the receiver (with the switch off). Why is that? (E) The other night I heard two women talking (very faintly) in my receiver which was puzzling to me. I looked at my aerial and saw a telephone wire running about 15 feet away. Can you give an explanation of this?—G. L., Chicago, Ill.

Answers.—(A) Because carborundum may be used without a battery, and your telephone receivers were probably connected in some way across the detector.

(B) The signals may possibly leak across the material of the switch base, especially if this base is of slate.

(C) When you closed the switch again you probably jarred the detector, throwing it out of adjustment.

(D) When you make and break the battery circuit the tendency in most detectors is to make them more sensitive.

(E) Simple induction between the telephone wire and your aerial. This is explained fully in the February number of this magazine under a "Simple Wireless Telephone Set."

Quarter-Inch Spark Coil

Question.—Please give dimensions for a quarter-inch spark coil.—C. K., Chicago.

Answer.—Length of core, 3¾ inches; diameter of core, ⅜ inch; primary wire, No. 23 B and S gauge; number of layers of primary coil, 2; secondary wire, No. 36 B and S gauge; number pounds secondary wire, ¼. Condenser: number of sheets, 40 (2 in. by 1½ in.); battery voltage needed, 2.

How a Spark Coil Should Be Operated

Questions.—I am experimenting with wireless apparatus and have a zinc spark gap, no ground connection. (A) Should the zinc pieces be pointed? (B) Should a condenser be used on the receiving end, if so where should it be placed? (C) When I connect my condenser across the spark gap my coil gives a massive white spark, but will not work my receiving apparatus. When I disconnect the condenser it gives a small blue spark and works the receiver. Can you account for this?—E. P. B., Pataskala, Ohio.

Answers.—(A) If you use pointed terminals the spark will be longer than if round or flat pieces are used. A heavy, fat spark is best for wireless.

(B) See article "Condensers in the Receiving Circuit" in the Jan., 1910, issue.

(C) The condenser seems to be too large for the coil and is absorbing too much of the energy.

Tuning Coil

Questions.—(A) How much, what kind and what size of wire gives best results for a tuning coil? (B) How thick would the core be and how many turns should I make?—G. H. C., Washington, D. C.

Answers.—(A and B) About one-half pound wound on a wooden core two inches in diameter, and ten inches long, gives excellent results. Single or double cotton covered wire may be used, but we recommend enameled wire since it is easier to make the sliding contacts touch the wire at all positions, because of the ease with which the enamel insulation is removed. No. 20 wire is a good size, and will give you about 250 turns on the above coil.

Sending Helix with Double Winding

Question.—Is it possible to make a sending helix embodying a primary and secondary winding? If so, please give general directions for making same, also what are its advantages.—S. W., Indianapolis, Ind.

Answer.—Sending helices embodying a primary and a secondary winding are used to a small extent, and they have the same advantages as the variable coupling tuning coil or transformer. See article "A Variable Coupling Tuning Coil," January issue.

The primary may be wound on a fibre or glass tube four inches in diameter and ten inches long. The primary is of No. 10 hard drawn copper or brass wire, wound in a spiral, with consecutive turns one inch apart. The secondary winding, or No. 12 wire of the same material as the primary winding, is wound on a fibre or glass tube of an outside diameter of three inches and a length of twelve inches. Consecutive turns of this winding should be ¾ inch apart. Any kind of contacts the builder wishes may be used for both windings. Two contacts should be made for each winding.

Aerial Insulation

Question.—When I bring my aerial wire near the binding post of the spark coil I get about a half-inch spark. Is this caused by poor insulation on the aerial wire?—D. C., Henderson, Ky.

Answer.—This sparking between the aerial wire and the binding post of the coil is due to the fact that ordinary insulation is not sufficient for the high tension currents used in wireless work, and it shows the necessity of insulating the aerial and its leading-in wires very well. These wires should be supported by glass, porcelain, or other good insulating material at all points where they might touch any conducting object.

Receiving Radius

Questions.—150 miles away is a commercial station, power 35 kilowatts, 1250 meter wave length. About 100 miles of this distance is over water. (A) Can I hear this station with the following outfit: electrolytic detector, tuning coil, fixed condenser, potentiometer, two 75-ohm receivers, a two-wire aerial 50 feet high and 75 feet apart? (B) What change in the above would be necessary, if any?—D. B., Ft. Myers, Fla.

Answers.—(A) You should have no difficulty in hearing the above station with your outfit.

(B) The use of a higher aerial or one consisting of three or four parallel wires will increase the receiving radius of the set.

Receiving Transformer

Question.—In a receiving transformer have the number of turns of wire on primary and secondary any relation to each other and is there a rule for the different gauges of wire on each?—T. S. R., Brooklyn, N. Y.

Answer.—The number of primary and secondary turns of a receiving transformer is generally about 2 to 3. There is no fixed rule for the different gauges on each, but the secondary generally is wound with wire from two to eight sizes smaller than the primary. Both these windings should be of fairly large wire, so as to decrease heat losses, which, although small, lower the efficiency of the instrument.

Operation of Spark Coil on 110 Volts

Questions.—(A) What apparatus would be necessary to enable me to use 110-volt alternating current on a one-inch spark coil? (B) What instruments would increase the receiving power of a silicon detector and a pair of 75 ohm receivers? (C) Does zinc make a better spark gap than brass?—E. S. G., St. Joseph, Mo.

Answers.—(A) Most one-inch coils can be run on 110-volt A. C. circuits without the use of any intermediate device, and in this case they are nothing more nor less than open core transformers. If you operate the coil in this way, you should screw down the interrupter tight, as otherwise you will burn up the contact points.

(B) The use of a good pair of 1500-ohm telephone receivers in place of those you are now using will give you better results.

(C) Zinc is nearly always used for spark gaps by operating wireless companies, but personally we have found little difference between the efficiency of zinc and brass for this purpose.

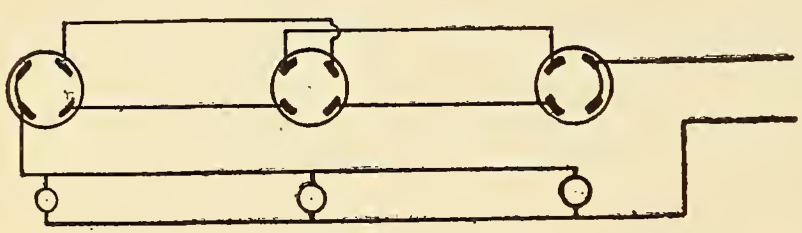
QUESTIONS AND ANSWERS

Use of this department is free to readers of Popular Electricity, but attention will not be given to questions which do not comply with the following rules: All questions must be written in the form of a letter addressed to the Questions and Answers Department and containing nothing for the other departments of the magazine; two-cent stamp must be enclosed for answer by mail, for space will not permit of printing all answers; the full name and address of the writer must be given.

Twin Conductors; 500-Volt Wiring; Elevator Annunciator Diagram; Controlling Lights from Three Points; Measuring Wire

Questions.—(A) Under what conditions may twin conductors be used? (B) If called upon to increase the pressure on an old wiring system from 220 to 500 volts, what would be necessary in the way of changes on the old wiring? (C) Please make a sketch showing how to wire up an elevator annunciator for six floors. (D) Give diagram explaining how to control three hall lights from any one of three points. (E) A copper wire 1.25 inches in diameter. What is its circumference in inches? Its cross-sectional area in square inches? Its cross-sectional area in circular mils.—F. E. K., Asbury Park, N. J.

Answers. — (A) Quoting the National Electrical Code, Rule 24-d, "Twin wires

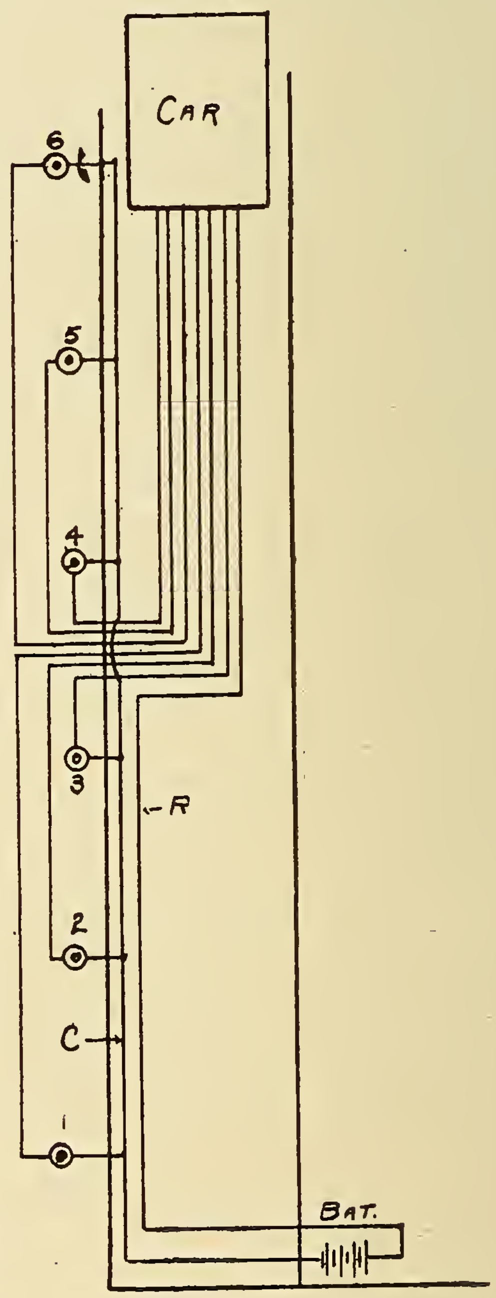


CONTROLLING LIGHTS FROM THREE POINTS

must never be used, except in conduits, or where flexible conductors are necessary."

(B) If you will refer to the Code, a copy of which may be obtained on request by writing to the Board of Underwriters in any large city, you will find that the general rules for wiring apply to low-potential systems and are the same for all voltages of over ten volts and less than 550 volts. We are assuming that this is not trolley current. Motors operating at 550 volts must be thoroughly insulated by wooden base frames, or have the motor casing permanently grounded. Switches and fuses would have to have spacing in accordance with the higher pressure. Switches are usually built for 126 to 250 volts, and for 251 to 600 volts, the spacings varying with reference to current carried also, Code Rule 52-l. Code Rule 53 covers this same point as to fuses.

(C) The diagram shows battery (B A T), common wire (C), and a return wire (R). From the middle point of the shaft the wires are run into a seven-wire cable which goes to the bottom of the car and up the side into the annunciator. The return wire (R) is connected to one side of each drop magnet, and the other side of the coil is connected to the wire in the cable that corresponds to the number of the floor as noted on the face of the annunciator.



ELEVATOR ANNUNCIATOR DIAGRAM

(D) See diagram. The outside switches are three-point, and the center switch a four-point.

(E) The circumference of any circle equals the diameter times 3.1416. 3.1416×1.25 inches = 3.927 inches, circumference. The area of any circle is one-fourth of the diameter squared multiplied by 3.1416. $\frac{1}{4} \times (1.25)^2 \times 3.1416 = 1.225$ square inches. The diameter of any wire expressed in thousandths inches if squared gives the cross-sectional area in circular mils. Hence, $(1250)^2 = 1{,}562{,}500$ circular mils area.

Electric Apparatus for Removing Hair

Question.—Kindly describe how to make an electrical apparatus for removing hair from the face. I have a medical coil. Will it be of any assistance?—A. H. S., Brooklyn, N. Y.

Answer.—Your medical coil will be of no use in the construction of this apparatus, as the faradic current has no electrolytic effect. The current strength required to remove hair is that furnished by three or four dry cell batteries, which should be so adjusted by means of a rheostat that they can be thrown into the circuit one at a time. The best apparatus for this purpose is the galvanic wall-plate, or the portable dry cell galvanic battery, with a milliammeter to measure the exact amount of current, the required amount varying from ten to 30 milliamperes.

The method of application is to introduce a steel needle attached invariably to the negative pole of a galvanic battery, and pass this needle alongside of the hair down into its root, an average distance of perhaps 1-32 to 1-16 of an inch. The current is then turned on gradually in accordance with the amount of pain produced, up to not more than four dry cells, nor more than 30 milliamperes, if a meter is used. In a few seconds little bubbles will appear at the side of the needle, and after an application of from 20 to 30 seconds the current is turned off and the needle removed, when by taking hold of the hair with a pair of tweezers it should pull out easily from the skin. If it sticks and does not come out readily the needle should be introduced again and the process repeated. Its principle depends upon the production of an alkaline caustic by the negative pole which destroys the hair follicle, and when this has been successfully accomplished the hair comes out without requiring any force, and the end of the root will be found blackened by the action of the current. Too many hairs should not be removed at one time close together on account of making the spot too sore. The after-dressing should be some simple antiseptic such as peroxide of hydrogen. No scar will follow the use of the negative pole, but if the positive pole should inadvertently be used a firm scar will result and also the needle will stick in the skin and be difficult of removal. Owing to the fact that the hair often curves abruptly just below the surface of the skin, there will be some instances where the hair will be burned through, but the root not destroyed; these hairs will grow again.

Ampere-Hour Capacity of a Dry Cell

Question.—How long will a 2½ by 6 inches dry cell last on a 2½-volt miniature lamp if the lamp is burned only 10 or 15 minutes at a time?—A. D. C., Maysville, Ky.

Answer.—Dry cells vary somewhat as to voltage and current supplied depending on the make. The voltage of one cell is about 1.5. The new Excelsior dry cell, 2½ inches by 6 inches, is rated to give 6 to 8 ampere-hours; the extra quality cell to give 10 to 12 ampere-hours. Not knowing the make of your cell we cannot answer your question more definitely. It might be said further, however, that dry cells of the ordinary size should not be used where a current greater than .15 ampere is required. A 2½-volt lamp requires about 0.2 ampere, so that using the first cell above mentioned the lamp will be supplied with sufficient current at the proper voltage for 40 hours.

The capacity of a storage cell of battery is rated in ampere-hours. The normal rating for cells of battery accepted by all battery manufacturers is the number of amperes a cell is able to supply on discharge for eight hours. When we speak of a twenty-ampere cell we mean a cell that will deliver 20 amperes for eight hours, and the cell has a capacity of 160 ampere-hours.

Double-Pole, Double-Throw Switch

Question.—What is a double-pole, double-throw switch.—H. D., Mishawaka, Ind.

Answer.—A double-pole, double-throw switch is a two-blade knife switch usually installed so as to be operated in a horizontal position. Contact jaws at the left and another pair at the right are provided. This switch may be used when two sources of current enter a building, the blade studs being connected to the motor or light mains. Throwing the switch to the left uses current from one source, and to the right connects to the second source.

Making a Small Storage Battery

Question.—Please give information regarding the construction of a small storage battery.—E. E. H., Minneapolis, Minn.

Answer.—To make a storage battery after the type of the Plante cell, get two plates of thin sheet lead about 1-16 inch thick, 36 inches long and six inches wide. At the end of each plate fuse a lug. The plates should be roughened on both sides by pounding with a coarse file. Next get some rubber at least ¼ inch thick or more, and cut into

½ inch strips. Lay three of these strips on one plate and upon these strips place the other plate. On top of this plate place three more rubber strips. Next make a cylinder of wood one or two inches in diameter and a little longer than the plates are wide, and soak with paraffine. On this cylinder roll the lead plates and hang in a glass or porcelain jar. In the jar place ten parts of water and one part sulphuric acid. Next the forming process must be applied. This consists in charging the battery in one direction up to about 1.9 volts, then reversing the current and charging in the other direction. After this has been done several times the plates become spongy and their surface is increased. Now mark one terminal positive (+) and always charge thereafter in but one direction. Ordinarily the discharge rate of a storage cell is .04 ampere per square inch of surface of positive plate, considering both sides of the plate, and the discharge may be figured about four ampere-hours per pound using the total weight of both plates as a basis.

Electric Current for Destruction of Moles and Warts

Question.—How is electric current applied to destroy moles and warts?—C. C. D., Georgetown, Ohio.

Answer.—In the removal of moles, warts and other small growths by the galvanic current the negative pole is always employed. A steel needle is used in a handle supplied by the manufacturers for purpose of electrolysis, and the wart or mole is transfixed by the needle, at its base, on a level with the surface of the surrounding skin. The current is then turned on gradually to the extent of possibly 30 or 40 milliamperes of current, if a milliammeter is employed, which is preferable. The current is allowed to pass for a minute or a minute and a half, depending on the size of the growth, and the quantity of bubbles that appear alongside of the needle, showing its activity. The needle then should be withdrawn partially from the growth and thrust in at a somewhat different angle, until the whole base of the growth has been subjected to the electrolytic effect of the alkaline caustic, which the negative pole liberates.

Sometimes it is found convenient to turn off the current, withdraw the needle and then introduce it again at right angles, and allow the current to pass as before. The object of this process is to destroy the blood vessels supplying nourishment to the growth, when it will shrivel and fall off in a few days. If the growth has a small stem it is much more easily destroyed than when it is flat with a broad base. The growth whitens out as the current passes through it, but afterwards becomes black and shrivels up. No treatment is necessary after the needle is removed other than the simple application of peroxide of hydrogen. If the first treatment has not been sufficient, a second treatment may be applied at the end of five or six days.

Transformer Questions; Two-Phase Operation; Low-Voltage Lamps

Questions.—(A) In a toy transformer from which a number of voltages can be obtained, is the wattage consumed always the same regardless of the voltage used? (B) In a large transformer does the amperes consumed on the secondary change the amperes flowing in the primary? (C) Can an ammeter be placed on the primary circuit to show the amperes consumed in the secondary? If so, how is it possible, for as I understand, there is no connection between the primary and secondary coils? (D) Would either pair of a two-phase circuit be considered single phase? (E) If a motor operates on two-phase, must the current be brought from two transformers? (F) If the current from each transformer were 110 volts, would the above motor be called a 110-volt, two-phase, or a 220-volt, two-phase, motor? (G) What voltage is best for isolated plants where storage batteries are used? (H) Are low voltage lamps as economical as high voltage lamps?—P. J. F., Sigourney, Iowa.

Answers.—(A) Large transformers have a higher efficiency than small ones. On full load a one kilowatt transformer has an efficiency of about 95 per cent, while a 15 kilowatt transformer has a tested efficiency of 97 per cent. The efficiency of any transformer is very low when the energy delivered is small; this efficiency increases as the output increases and reaches a certain maximum. Beyond this point the efficiency decreases because of the increase in the copper losses. The wattage taken by any device depends upon its resistance, and the voltage improved upon its resistance, the current being thus determined.

(B) Any change of current taken from the secondary of a transformer produces a proportional change of current flow in the primary.

(C) Yes. The readings will however have to be corrected or rather reduced for the efficiency of the transformer; that is, for the core losses, in order to show the secondary current. In other words it would be necessary, if accuracy is desired, to know the efficiency of the transformer for the loads on which readings are desired.

(D) Two-phase alternators have two similar and independent single-phase windings on the same armature, so placed that when the electromotive force in one winding is at its highest, the electromotive force in the other winding is zero. Two-phase machines are usually provided with two sets of collector rings, one set for each phase.

(E) By one arrangement a transformer is connected to each phase and secondaries are run to each phase of the motor. Both phases are independent throughout. This plan is used on a two-phase four-wire system.

(F) The motor would be rated according to the voltage between the two wires of one phase.

(G) The answer to this question will depend upon the amount of money to be invested in a storage battery equipment. Cells should not be discharged below 1.75 volts. For a 110-volt system $\frac{110}{1.75} = 63$ cells would be required. Batteries are most used in connection with two-wire and three-wire, 110-volt or 220-volt direct current systems.

(H) Yes, practically so, if operated at their rated voltage. Any given type of lamp made in various sizes for varied candle-powers is rated in watts per candle-power.

Phase; Lamps in Series; Spark Gap

Questions.—(A) What does the word "phase" mean in electricity? (B) What number of lamps in series are needed to reduce 110 volts to 50 volts? (C) How can the voltage of a dynamo be increased? (D) What voltage does it take to make electricity jump across an air gap?—C. H., Pheonixville, Pa.

Answers.—(A) The word "phase" is used to denote relation. To illustrate, suppose two channels connecting with the sea, one channel narrow and rugged, the other smooth and deep. As the tide ebbs and flows in these two channels, the difference between the high and low tide in the first channel will be greater than in the second. We may speak of this as lag in phase of the tide in the first behind the tide in the second channel. Alternating currents, as they flow, build up and tear down magnetic fields. This is called self-induction. Because of it, the alternating current in any wire lags behind the electromotive force. This again is a lagging in phase of the current behind the E. M. F. If two separate coils be wound on an armature and their ends be connected to four slip rings, two single phase circuits are formed differing in phase according to their relative position on the armature.

(B) It will depend upon the voltage of the lamps. Two 30-volt lamps will do the work. Why not use one 52 volt lamp. This will allow 62 volts at the terminal of the circuit, and this lamp is more common than lamps of smaller voltages.

(C) By increasing the number of turns in each coil on the armature, and by decreasing the resistance of the field coils by using larger wire, thus increasing the flux.

(D) See answer to A. R. H. in the September, 1909, issue.

Changing a Magneto Generator to a Motor

Question.—I have an A. C. dynamo and wish to make it an A. C. motor (110 v.). It is very much like a magneto. An armature wound with No. 36 silk covered wire revolves between two permanent magnets. Please give size of wire, etc. —H. L. S., Lewiston, Idaho.

Answer.—You do not give sufficient data for an intelligent answer. We doubt if your machine will operate as a motor at all. If the armature has a single pair slot as in a telephone magneto you cannot make a motor of it. Before wasting time on it, connect it in series with an eight or sixteen candle-power lamp with your available source of A. C. current. If it won't run you cannot make a motor of it. If is does run, disconnect it and then find out what voltage it gives as a generator. Then count the number of turns of wire on the armature and take off or add to the turns proportionally to give 110 volts.

Rewinding a 52-Volt Induction Motor for 110 Volts

Question.—I have a 52-volt 60-cycle induction motor, ¼ h. p. The stator has 36 slots and is wound with 1¼ pounds of No. 21 D. C. C. wire, 900 turns in all. Please give me the data for rewinding the same for 110 volts 60 cycles.—A. Z., Detroit, Mich.

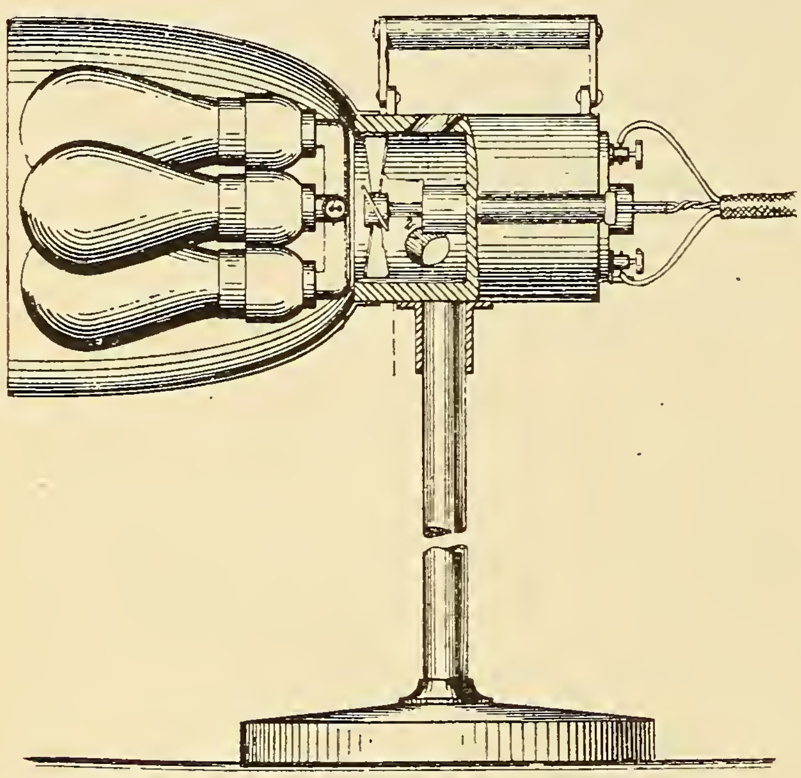
Answer.—Rewind with 1904 turns of No. 24 D. C. C. wire.

Note that 900 is not an even multiple of 36.

NEW ELECTRICAL INVENTIONS

Electric Hair Dryer

This hair-drying device, which is the invention of W. A. Soles of New York City, is designed for use in hair-dressing establish-



ELECTRIC HAIR DRIER

ments, barber shops, etc. It is arranged to insure drying of the hair by heated air and under the invigorating influence of artificial light. As seen by the cut there is a sort of bell-shaped reflector containing three incandescent electric lamps, immediately behind which is mounted a small electric motor driven fan. The air is thus projected outwardly over the lamps and heated in the passage to a considerable degree.

Theater Without Usher

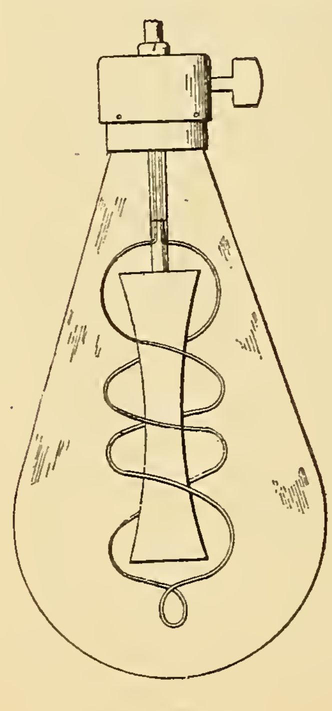
To facilitate seating of the audiences of moving-pictures theaters and other amusement halls where there are no reserved seats Paul T. Kenny of New York City has patented a system of electric lamp signals to designate unoccupied seats. The house is so arranged that the visitor must travel certain aisles to get to certain rows of seats. Each seat is provided with a lamp which remains lighted as long as the seat remains unoccupied. As fast as the seats are occupied the lamps go out. The lamps being adjacent to each row of seats in a section the unoccupied seats are determined at a glance. When each section is full a turnstile in the aisle leading to that particular section is automatically locked. When one or more seats are vacated and persons wish to leave, the turnstile is unlocked. All the seats are connected by circuits with a signal board in the ticket seller's booth and as soon as all the seats are occupied

THEATRE WITHOUT USHERS

the ticket seller sees it at a glance and the "All Seats Occupied" sign is displayed.

Novel Light Diffuser

The latest type of light diffuser for incandescent lamps is contained within the bulb. As shown in the diagram the filament is mounted spirally around a hollow glass body having a concave surface. The faces are covered on the inside with a reflecting substance. The bottom of the reflector is also concave and reflects a certain percentage of the light downward. Charles H. Crutchfield of New Boston, Tex., is the patentee.



NOVEL LIGHT DIFFUSER

Notes on Patent Infringement

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

Of Patents for Designs; Of Patents for Machines; Of Patents for Manufactures; Of Patents for Processes

Of Patents for Designs.—*In General.*—A design patent is infringed by a subsequent design which presents substantially the same appearance or produces the same effect upon the eye. The method by which the similarity of appearance is produced is immaterial. Where substantial identity of appearance exists, it is of no consequence that the figures in the infringing design are smaller than in the patented design.

Use of Part.—The taking of a part of a patented design may be an infringement, provided the part taken is covered by the patent. But where the patent is for a combination of old parts with new, it is not infringed by the taking of the old parts only, and the substitution for the new parts of others which are not equivalent thereto.

Test of Identity.—The test to be applied is not the eye of an expert, but that of an ordinary observer giving such attention as is ordinarily given by purchasers of the article which embodies or contains the designs. Hence, if such a person would be deceived into buying one article, supposing is to be the other, the design first patented it infringed by the latter, notwithstanding differences in detail between the two. But if such a person would not be so deceived, there is no infringement, despite the fact that the differences are slight. This rule has been construed to mean that the purchaser must be one giving special attention to the design and not to the article simply.

Use of Different Name or Trade Mark.—The use of a different name or trade mark in connection with an infringing design does not render it any the less an invasion of the patentee's exclusive right.

Of Patents for Machines.—*In General.*—A patent for a machine is infringed by a subsequent machine which is substantially identical therewith, notwithstanding colorable, evasive, or formal differences between the two machines, that is, by an arrangement of mechanism which performs the same services and produces the same result by substantially the same means, operating in the same or substantially the same manner.

No Matter How Closely Infringement May be Approached, it is avoided if the substance of the patented machine is not taken. Thus, a machine is not an infringement when it performs substantially different functions, or performs the same functions in a substantially different way, or produces a substantially different result.

Identity of Principle.—Substantial identity exists when the alleged infringing machine embodies the principle of the patented machine. Where there is diversity of principle there is no infringement. When used in this sense "principle" means "mode of operation," or, in other words, the operative cause by which a certain effect is produced.

In Applying this Test of Infringement, inquiry should be directed to those parts of the machine which really do the work, so as not to attach undue importance to other parts which are only used as a convenient mode of constructing the entire machine.

Identity of Effect or Result.—Identity of effect or result does not constitute infringement unless it is produced by the same or substantially similar means. But where there is identity of means it is sufficient if the result is the same in kind though not in degree.

Substitution of Equivalents.—The substitution of a known mechanical equivalent for one or more of the devices or parts of the patented machine is an evasive difference, insufficient to avoid infringement.

Of Patents for Manufactures.—*In General.*—A patent for a manufacture is infringed by a subsequent manufacture which is substantially identical therewith, that is, which serves the same purpose and accomplishes the same thing by the use of substantially the same means operating in substantially the same manner—notwithstanding formal or colorable differences, such as the substitution of equivalents.—But there is no infringement when there is a substantial difference in purpose, means, mode of operation, or result.

Use of Different Materials.—When a patent is *limited* to an article made of a specified material, it is not infringed by any similar article made of a different material.

Identity of Process.—A patent for a product produced by a particular process is not infringed by a similar product produced by a substantially different process.—But if the patent covers the product only, and not the process, it is infringed by a substantially similar product produced by an entirely different process.

Of Patents for Processes.—*In General.*—A patent for a process is infringed by a subsequent process which invokes the same principle, and accomplishes the same result by the use of the same or substantially the same means. Where the substance or essence is taken, infringement is not escaped by colorable or evasive changes.

Identity of Means.—A patent for a process is not infringed by a subsequent process which accomplishes the same or a similar result by the use of substantially different means. Hence the identity of two processes is not established by the similarity of their products, although such similarity may tend to prove identity. But if the patented invention is substantially taken, infringement is not avoided by a mere variance from the best manner of practising it.

Use of Part and Substitution of Equivalents.—A process which omits one or more characteristic features or essential steps of the patented invention without substituting equivalents therefor does not infringe. But it does infringe if a step is only colorably omitted, or if a known equivalent is substituted for an omitted step. A process which produces the result contemplated by the patentee of a prior patented process, by the use of only such of the described means as are essential to that end, is an infringement.

Transposition of Steps.—A mere transposition in the order of the successive steps of a patented process is sufficient to avoid infringement.

Addition of Steps.—The use of a patented process is none the less an infringement because of the employment of something else in addition thereto.

Use of Different Apparatus.—Where a patented process is neither dependent upon, nor limited to any specific apparatus or machinery for carrying it into effect, it is infringed by the use of different apparatus for practising the same process even though such different apparatus is patentable as an improvement.

BOOK REVIEWS

MAVERS' WIRELESS TELEGRAPHY AND TELEPHONY. By William Maver, Jr. New York: Maver Publishing Company, 1910. 366 pages with 258 illustrations. Price $3.00.

This is the fourth edition of Mavers' valuable book and it is thoroughly abreast of the times. While the theory of wireless communication is by no means slighted the author has paid particular attention to the practical side of the subject and has made a work which is excellent alike for the practical worker and the student. There are practical descriptions of the latest improvements in wireless telephony and telegraphy with excellent diagrams to enable the reader to follow out and make and connect up apparatus. An Amateur Department has also been added in this last edition, which will be found of great assistance by the young experimenter who wishes to build his own equipment.

Each subject has been treated both from a theoretical and a practical standpoint in simple language and without mathematics. The result is a comprehensive account of the history, theory, apparatus, practical operation, practical applications and prospects of wireless telegraphy, which it is thought cannot fail to be instructive and profitable to the technical student, the general reader and the investor.

DYKE'S TROUBLES, REMEDIES AND REPAIRS OF THE AUTOMOBILE AND GAS ENGINE. By A. L. Dyke. St. Louis: A. L. Dyke, 1909. 308 pages with 320 illustrations.

This covers the automobile question from leather top to tire and everything in between —engines, engine troubles, ignition systems, lighting systems, accessories, etc. It tells how to choose cars for different requirements, how to discriminate among second-hand cars, how to prepare your car for the road, how to drive it, how to "baby" it, how to use stern measures, when to coax it, when to command it. Then there's a very useful feature embodied entitled the "Workshop and Motor House." Almost every man that really enjoys a car also likes to tinker around in a shop of his own. This chapter has some very good hints on simple shop practice.

ON POLYPHASE SUBJECTS

AFTER TWO YEARS

This issue completes the first two volumes of Popular Electricity. Thousands of our readers have been with us practically from the first and we are sure that they will agree that there has been a steady improvement in the magazine. To them and to later subscribers we hold forth the promise that greater improvements are forthcoming.

In the first place the volume of reading pages will be increased, indeed ten additional pages have already been added in this issue, and in the March issue, while plans are in progress which will make necessary further enlargement before the third volume is completed.

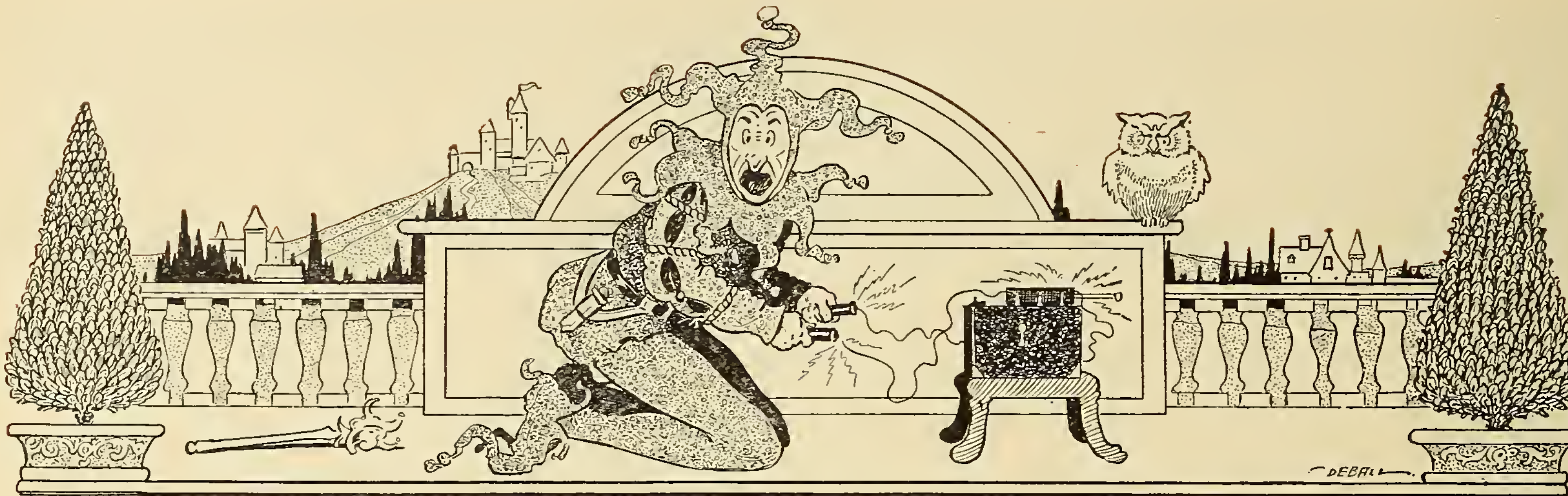
Although in a magazine of the character of Popular Electricity the things of scientific and practical interest relating to the production and use of electric current must be given the place of primary importance, still, we believe, there is also a place for a limited amount of material of a fictional nature—a good serial story and some short stories now and then. As a consequence, the May issue, beginning a new volume, will contain the first installment of an electrical story by Edgar Franklin, who needs no introduction to the general magazine reader. This story will tell of the thrilling experiences of two young Americans in a little Wisconsin town, who start out to build and operate an electric light plant as a business venture and for the general betterment of conditions in the community. Of course, they run into unforeseen difficulties and are all but down and out when a startling discovery is made which brings them out triumphant. This story, as well as others which are to follow, is necessarily based upon an electrical subject.

"Electrical Securities" is a subject upon which most people are not as yet fully informed. Over a billion dollars is invested in the electric lighting industry in this country. The number of plants is steadily increasing, and of the immense capital required a good portion must come from the small investor. It is well, therefore, to make a study of electrical securities and find out just what they represent and how they stand in the financial world. In this issue begins a series of articles under the above title which will tell in "Plain English" the facts concerning this form of investment.

Readers of the Wireless Department will be pleased to know that a serial article is in hand by Alfred P. Morgan which will tell how to build a complete high power sending and receiving equipment; one which will compare favorably with commercial apparatus. This will begin in the May issue.

In response to a query printed in this department in the February issue many requests have been received to publish the electrical definitions in a serial form; that is, print different ones each month, with more elaborate explanations, until finally, by saving the copies, a fairly complete electrical dictionary may be obtained. This will be done and the most frequently employed electrical terms fully defined.

Biographical sketches of "Electrical Men of the Times" will be continued from month to month, lending inspiration to the younger element to emulate those who have been conspicuously successful in the electrical field.



SHORT CIRCUITS

A man who had been sojourning in an insane asylum had just been pronounced cured and told he could start for home in a day or two. He sat down immediately and wrote a letter telling the joyful tidings. Moistening a stamp to place on the envelope he dropped it accidently, only to see it shoot across the floor, up the wall and across the ceiling. With an air of great dejection he sat down, pulled out the letter and added a postscript: "Oh hang it! I can't come home. I'm crazier'n ever."

The stamp had fallen on the back of a roach.

* * *

A young woman from the city had been staying on a ranch up in the cattle country for a few weeks. Seeing some calves running across a pasture, she exclaimed, "Oh! what pretty cowlets."

"Yes, miss," drawled the ranchman, pulling his mustache to conceal a smile, "they are pretty, but them's bullets."

* * *

Miss Up-to-date—I want to see some of the latest costumes.

Floor Walker—Have a seat, Madame, and wait a few moments—The style is just changing.

* * *

Teacher: Johnny, can you tell me how iron was first discovered?"

Johnny: Yes sir.

"Well! Just tell the class what your information is on that point."

"I heard father say yesterday that they smelt it."

* * *

"Come indoors immediately!" called the nurse to a small boy whose father was going out. "You won't go to heaven if you're so naughty."

"I don't want to go to heaven," was the aggrieved reply; "I want to go with father!"

* * *

"Why don't you go on the picnic?"

"Ah, I'm too tired. Let's soak a few sandwiches in emonade and eat 'em on the kitchen floor."

* * *

Three Irishmen were stopping at a second-rate hotel and one of them imbibed so freely at the bar that he had to be carried to his room, in which also slept a negro in a separate bed. His comrades, as a practical joke on him, proceeded to paint the Irishman's face black. In the morning when awakened by the proprietor, he got up and happened to catch sight of himself in the mirror. "Oh, bejabers," he exclaimed, "if the blamed idiots haven't gone and woke the darky by mistake!"

And he crawled back into bed.

* * *

Elsie—Why is Clara always so short of money—didn't her father leave her a lot?

Madge—Yes; but, you see, she's not to get it till she's thirty, and she'll never own up to that.

* * *

Most southerners are gallant. An exception is the Georgian, who gave his son this advice:

"My boy, never run after a woman or a street car—there will be another one along in a minute or two."
—Everybody's.

The venerable farmer with the tobacco-stained whiskers and furrowed brow climbed aboard the limited and shambled into the smoker.

"Mister," he drawled, when the conductor halted before him, "is that thar two-cents-a-mile rate good on this train?"

"It is," replied the conductor brusquely. "Where is your ticket?"

The old man fumbled in the depths of an ancient shot-bag.

"Ain't got no ticket, mister," he said slowly, "but here is two cents. I never rode on one of these pesky fliers, and I just want to feel the sensation. Put me off after I've rode one mile."

* * *

Milton—Gibson doesn't seem to be getting rich at poultry raising.

Bilton—No; but he says his hens have taken to eating their own eggs, and he has hopes that they'll become self-supporting.

* * *

It was on a Superior street car, and the handsome young man had arisen from his seat as the pretty girl entered.

"Oh, please!" she twittered, "don't get up. Keep your seat, pray do!"

The young man looked at her admiringly.

"Well, that's mighty sweet of you, little girl," he said, "and I hate to turn down a bid like that. But, honest, I've got an important date, and here's where I get off. Call me up by 'phone some day, won't you?"

When we left the car she was still blushing.

* * *

Examination papers alway provide a fund of amusing reading. Following are some of the slips of school boys:

"George Eliot left a wife and children to mourn his genii."

"The capital of Russia is St. Petersburg on the Duma."

"Henry I died of eating palfreys."

"Louis XVI was gelatined during the French revolution."

"If the air contains more than 100 per cent of carbolic acid it is very injurious to health."

"The earth is an obsolete spheroid."

"A deacon is the lowest kind of a Christian."

"Horse power is the distance one horse can carry a pound of water in an hour."

* * *

Judge—You are a taxpayer.
Talesman—Yes, sir; I am.
Married or single?
Married three years last June.
Have you formed or expressed any opinion?
Not for three years, your honor.

* * *

Mr. Jones had recently become the father of twins. The minister stopped him on the street to congratulate him.

"Well, Jones," he said, "I hear that the Lord has smiled on you."

"Smiled on me," repeated Jones. "He laughed out loud at me."


THE LITTLE DARLING HAS SUCH STRONG LUNGS
1
JOHN IS SO SAVING
NO. I NEED IT ALL MYSELF
CANT I HAVE A PIECE OF CANDY?
2
THE IDEA! I'LL GO TO MRS. JONES AT ONCE AND HAVE WILLIE PUNISHED
MA - WILLIE JONES INSULTED ME — I SLAPPED HIM AND HE CALLED ME A NAME
3
JOHNIE IS SO INDEPENDENT
ME FIRST!
4
I AM BLIND
I'M SAVING ALL MY MONEY TO BUY ME A SLED
I DONT BELIEVE IN WASTING GOOD MONEY ON BEGGARS
5
WHEN HE GOT OLDER
WELL I PAID MY FARE DIDN'T I ?
DEBALL
6

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.

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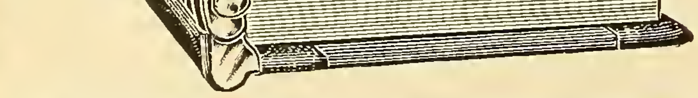

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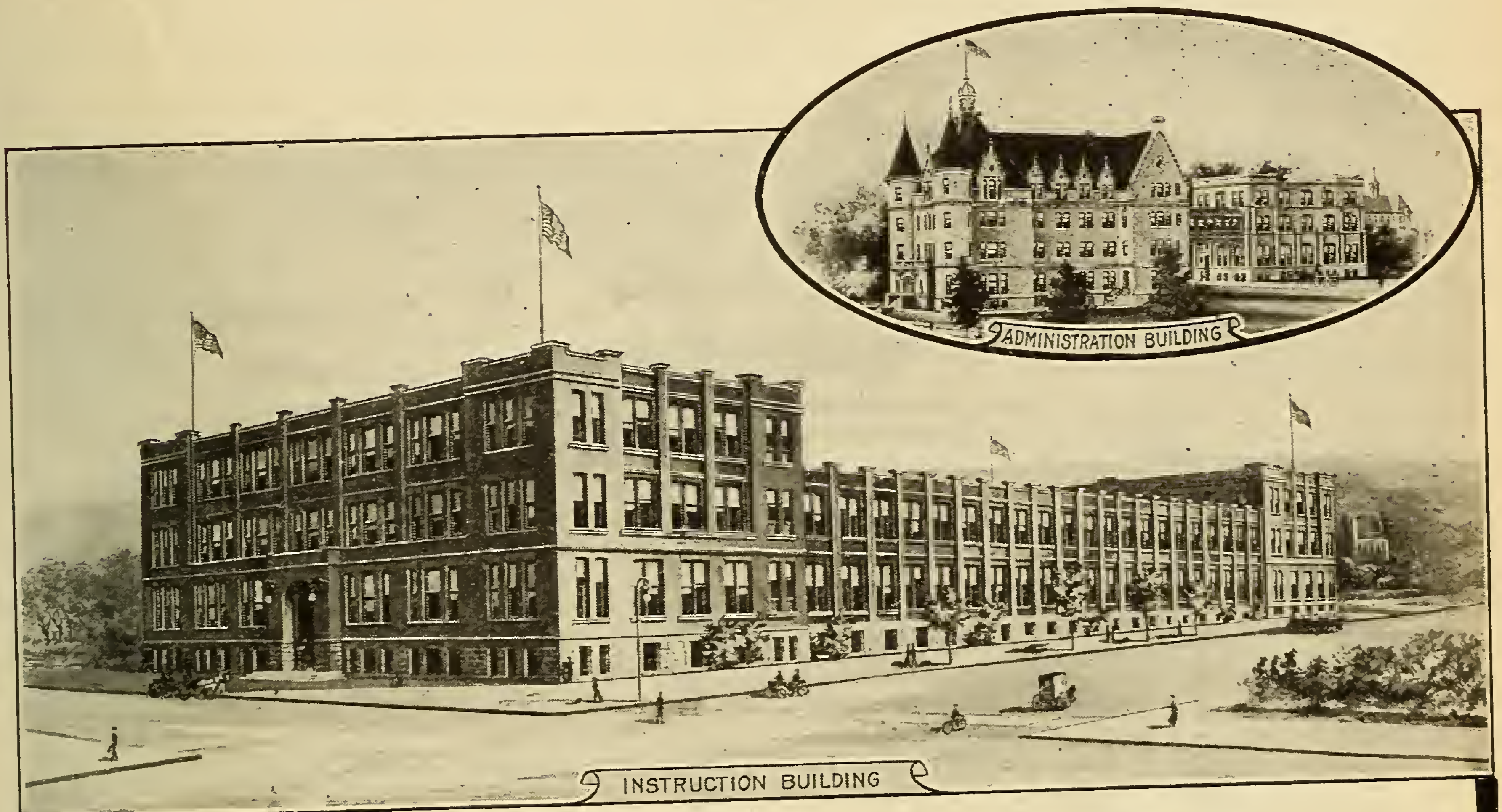

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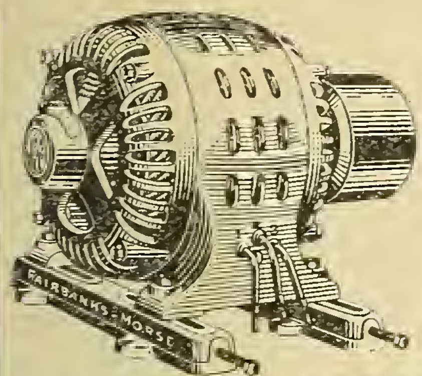

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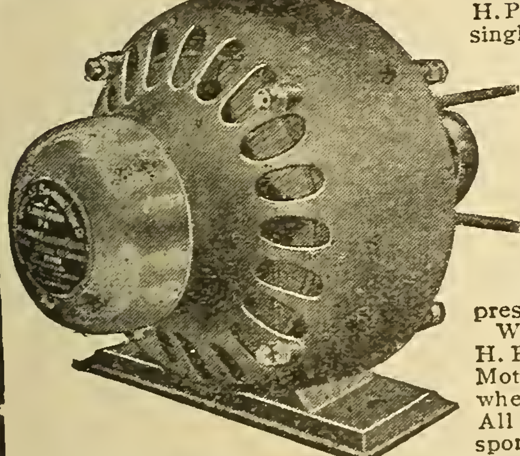

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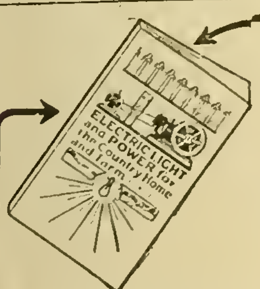

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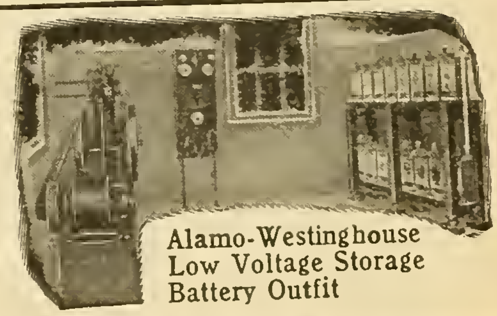

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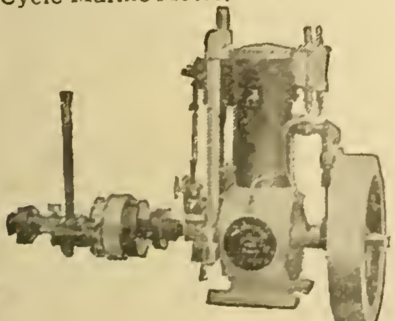

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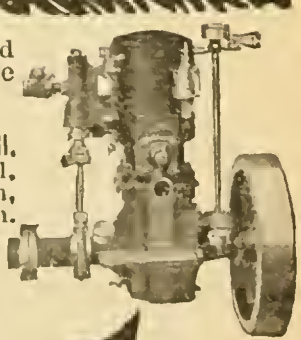

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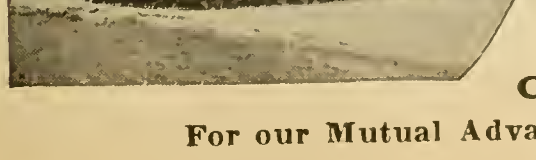

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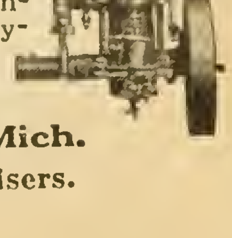

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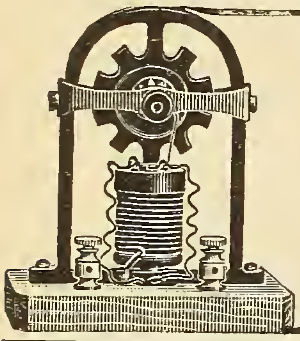

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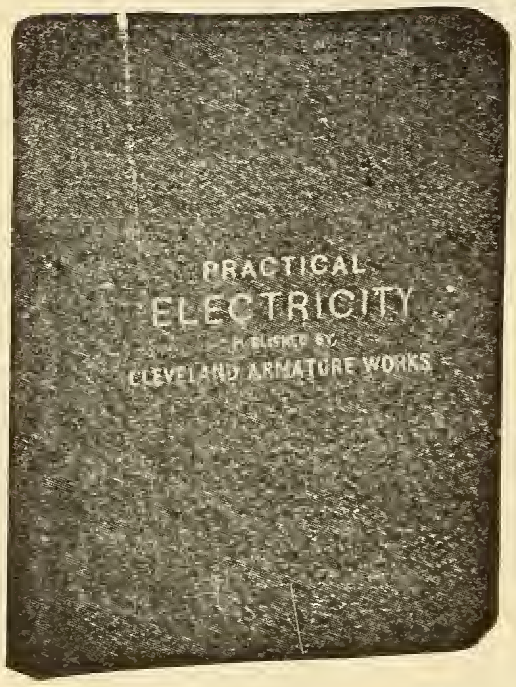

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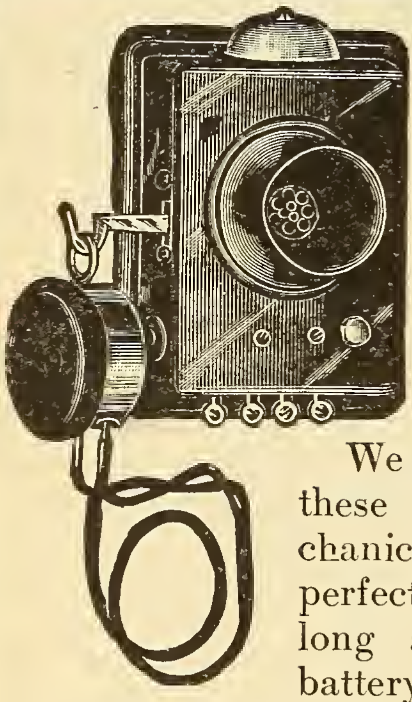

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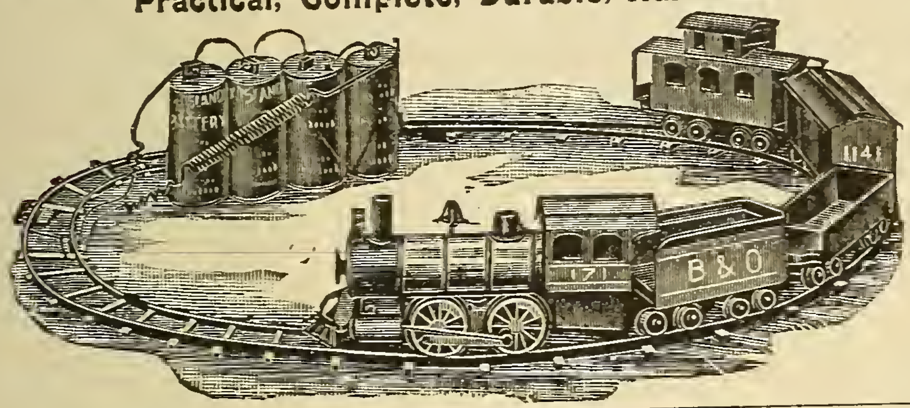

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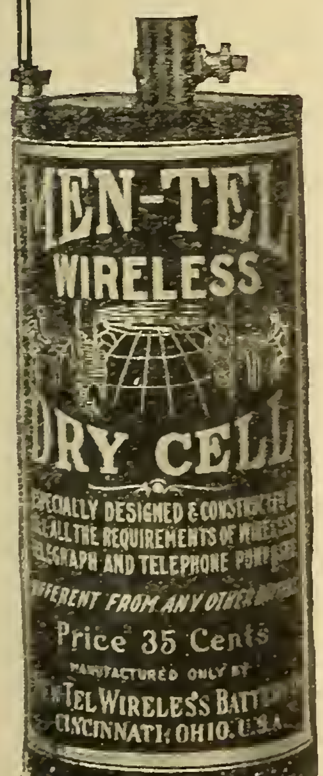

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Write today for Circular 11

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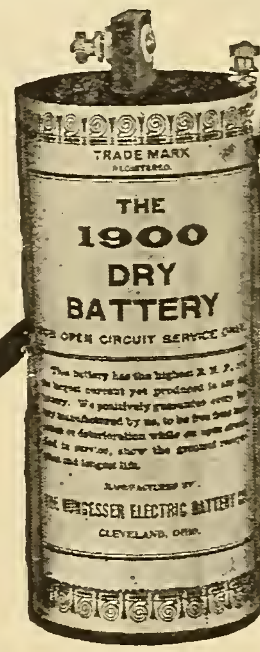

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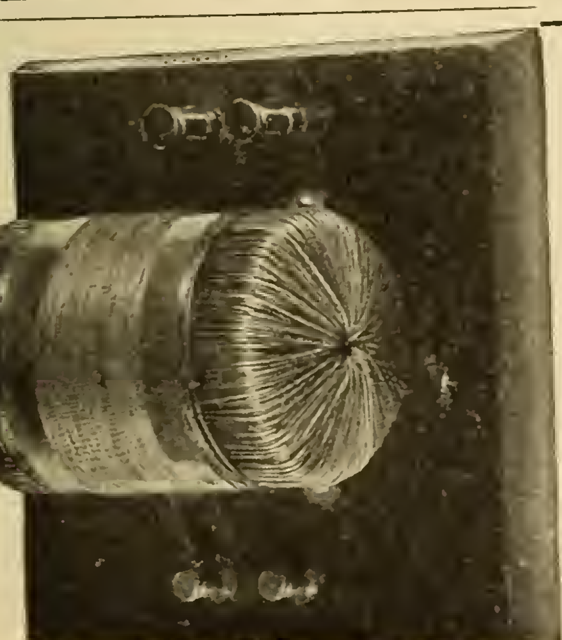

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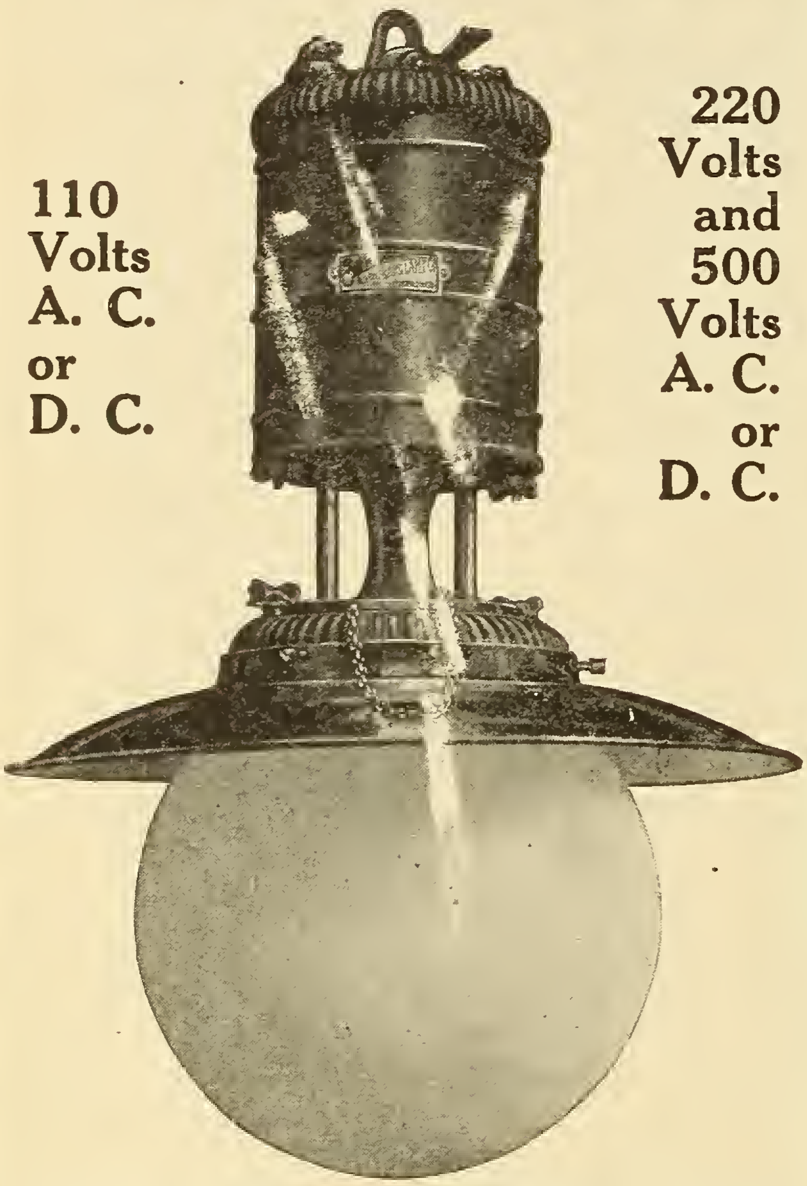

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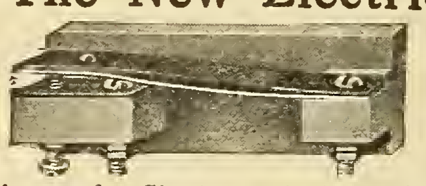

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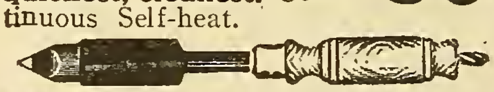

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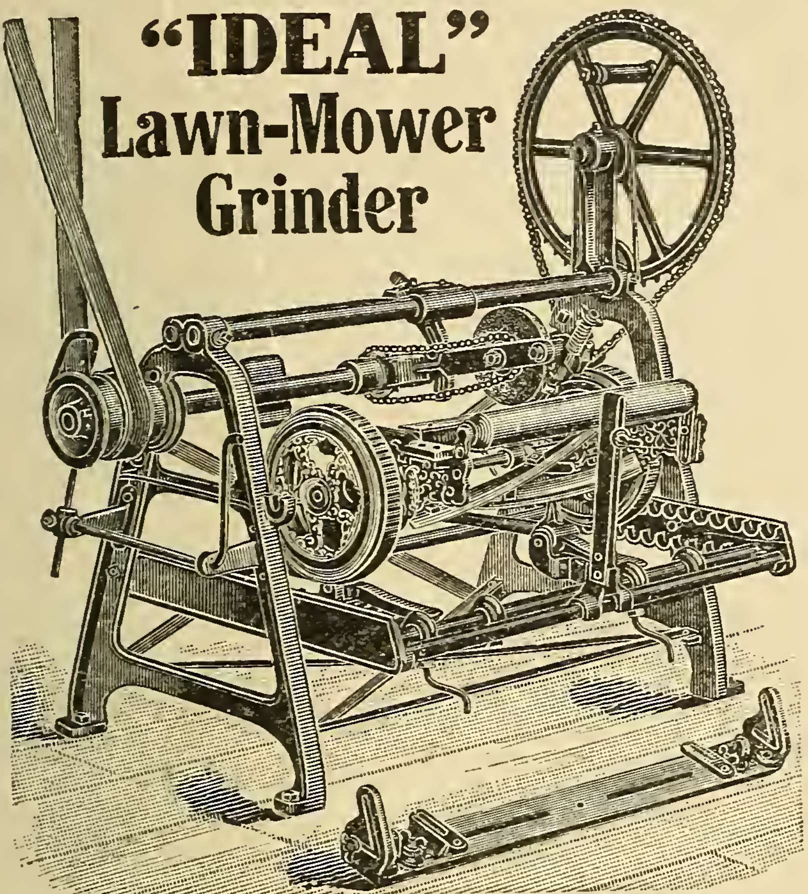

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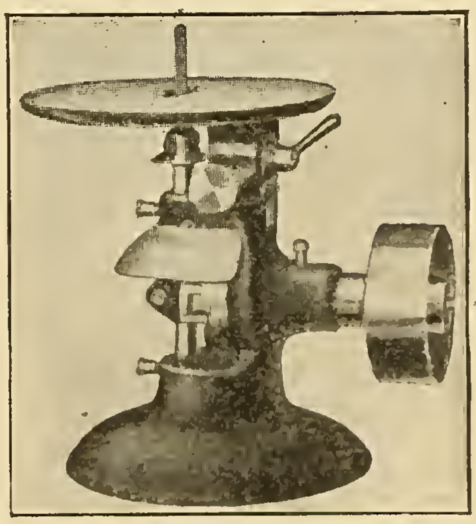

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The Washing When You Have An
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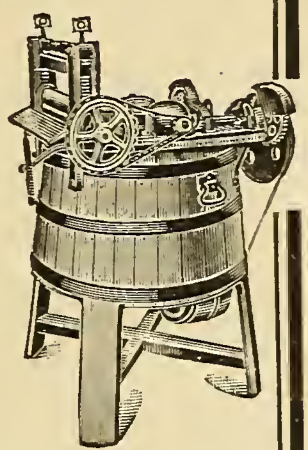

which is operated from the electric light circuit used in your home every day, and is so arranged that connection can be made to any electric lamp fixture, and by turning the button the balance of the wash day trials can be forgotten at the small cost of only ONE ONE-HUNDREDTH OF A DOLLAR.

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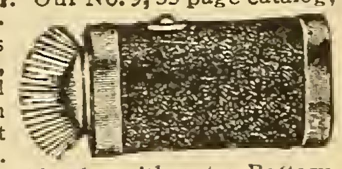

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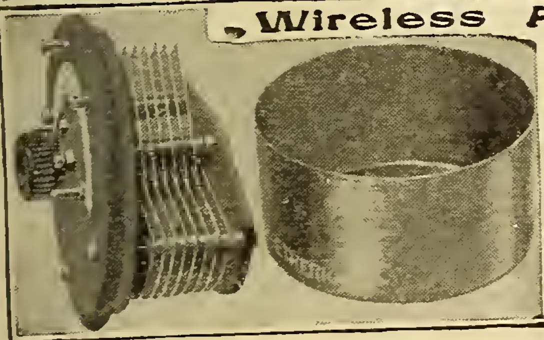

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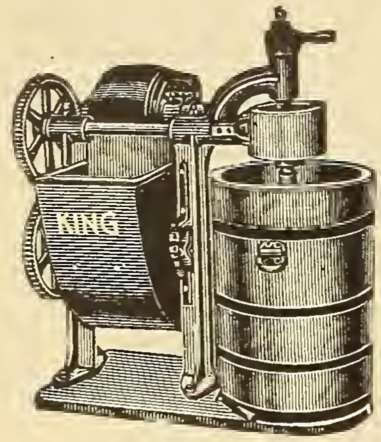

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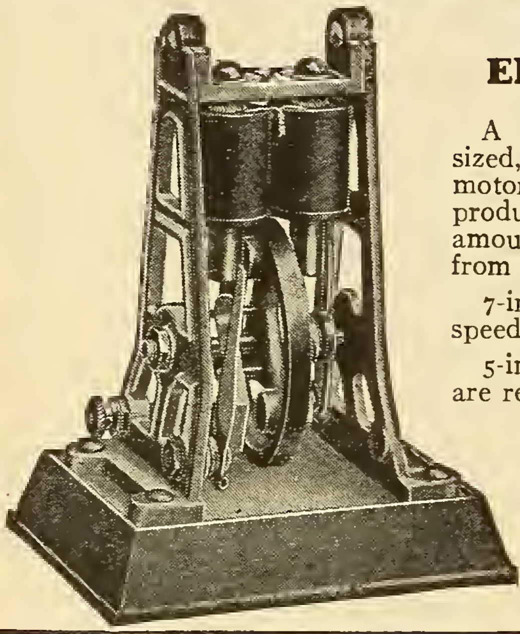

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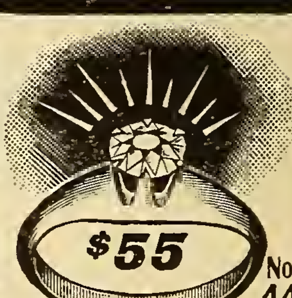

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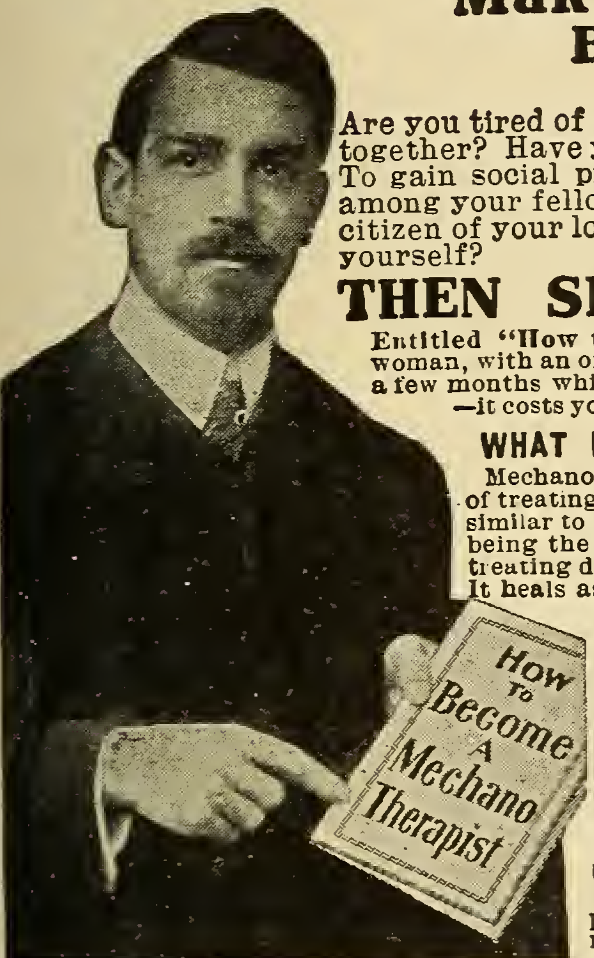

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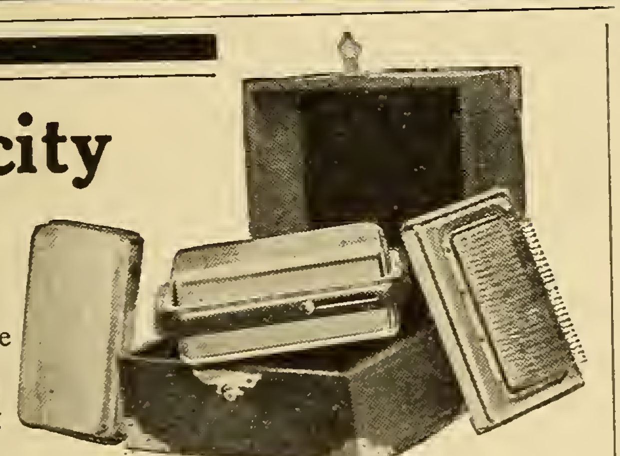
Electricity as a Remedy



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which not only has no wires, plugs liquids, but is so compact, simple and convenient that it **fits the hand.**

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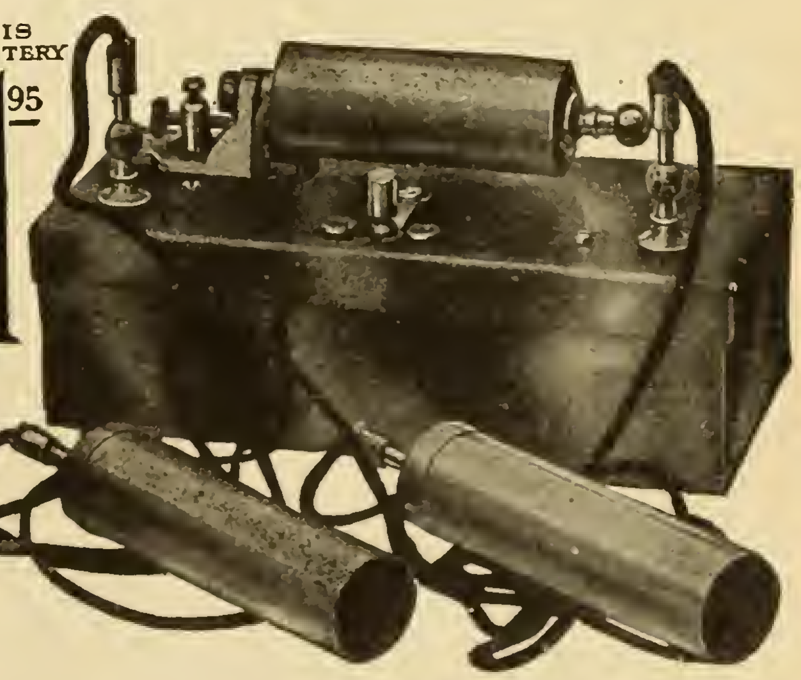

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