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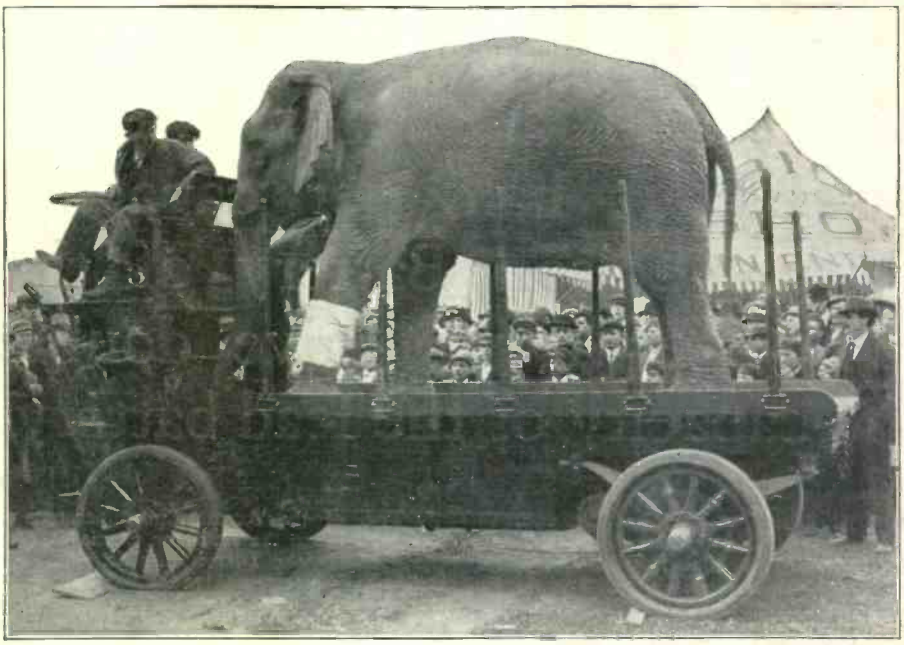
EDISON CAST CONCRETE HOUSE

IN THIS ISSUE

POPULAR ELECTRICITY

IN PLAIN ENGLISH



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See p. 379

Vol. III SEPTEMBER 1910 No. 5

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Electrical Talks—Flash No. 3

EACH month there will appear in the advertising section of this publication our ideas and views—possibly some suggestions—on the selling of electrical manufactured articles to the ultimate buyer—the consumer.

Time was—in the beginning of things—when we all thought it unnecessary to even breathe to anybody but ourselves the mysteries of electricity and the uses to which it can be put and the various accessories which by their use will create economy, save trouble and be more convenient to the average person and solve the many mechanical troubles which the public is entirely unfamiliar with.

A successful man once said to us that it pays to read and listen to anything and to everybody—what they might say and do and write—as there is always some good in everything and the good can be put to profit.

We offer these articles in the same spirit that the electrical jobber, manufacturer and dealer and in fact anybody interested in the electrical industry may throw away the poor thoughts and keep the good ones.

This industry has not, as yet, received a good start. It's just beginning. We propose to begin with it and to be there at the finish, doing in the meantime everything we can for the good of the game and last but not least, the profit of Popular Electricity.

POPULAR ELECTRICITY.

OCTOBER NUM-
CONSUMERS GUIDE

Every Advertiser, Manufacturer, Jobber, Dealer, Central Station and Consumer should become interested in the October issue—

The demand from hundreds of thousands of buyers of Electrical Devices for information has compelled this publication to exploit in its October issue the marvelous development of Electrical Appliances to the man who buys—the consumer.

Never in the history of a class publication such as Popular Electricity, has such an undertaking been attempted which will be of direct benefit to the manufacturer and buyer.

No increase in Advertising Rates
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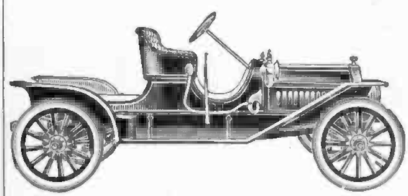

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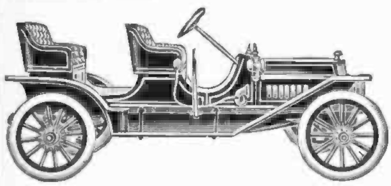
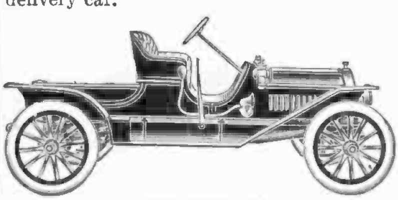


FAMILY CAR

Into a comfortable family touring car—or by the addition of a wagon box into a roomy delivery car.



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The 1910 Model Schacht Invincible is really

Three Cars in One

Runabout
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All for the Price of One Car

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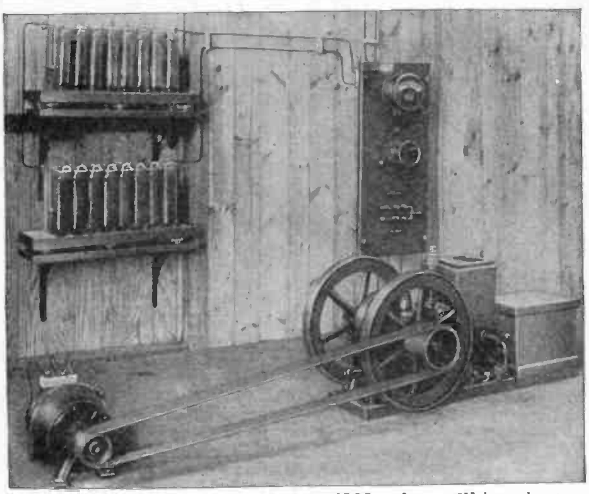

Every suburban home, farm, factory, hotel, etc., not reached by a public lighting station can now have, at a small expense, all the advantages of electricity which are enjoyed by city inhabitants.

This Company has designed small electric lighting plants, that are inexpensive, require small space, can be set up and operated by anyone and give an absolutely dependable and continuous service,—day or night.

These plants consist of a small gas engine, dynamo, storage battery and switchboard. It is only necessary to run the engine a few hours occasionally to charge the battery.

The storage battery used is the

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This battery is a very important part of the plant, since it furnishes the current when the engine is not running. It is the same battery used by the large electric lighting companies, railways, telephone and telegraph companies, etc.—the most widely used of all storage batteries.

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1889 **PHILADELPHIA, PA.** 1910

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POPULAR ELECTRICITY

IN PLAIN ENGLISH

HENRY WALTER YOUNG, Editor

Vol. III — September, 1910 — No. 5

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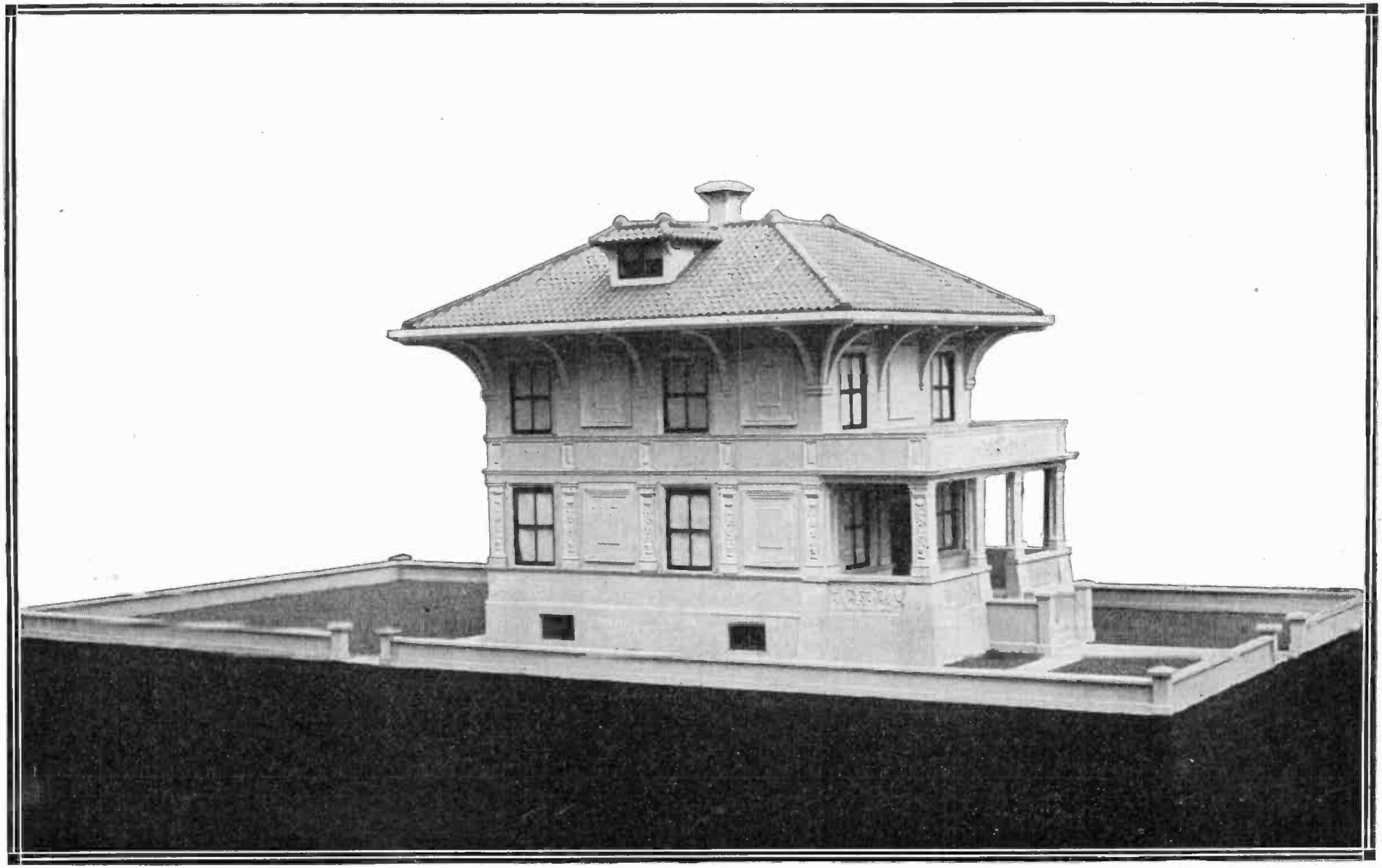


MODEL OF THE EDISON CAST CONCRETE HOUSE

Popular Electricity
In Plain English

VOL. III SEPTEMBER 1910 No. 5

The Edison Cast Concrete House

By W. H. MEADOWCROFT

For many years past Mr. Edison has been much interested in the betterment of homes for workingmen and their families, realizing the onerous and unsanitary conditions under which vast numbers of them are at present compelled to live, with apparently little outlook for permanent improvement.

After some meditation on the subject, he began to think up a plan which would provide for families of small income a class of homes that should not only be substantial and thoroughly sanitary, but at the same time handsome and conducive to self-respect, and, last but not least, suited to a modest pocket book, either for rental or ownership.

The outcome was the conception of a concrete house to be cast in moulds so as to form one inseparable piece from cellar floor to tip of chimney. To crystallize his ideas and bring them into practical shape, Mr. Edison consulted architects, and also put a force of engineers, draughtsmen, pattern makers, mechanics, sculptors, and concrete experts at work to carry out the investigations he had made. After about eight years of thought and experiment all this has resulted in the evolution of plans for a sample type of house of which the model is shown in the frontispiece.

This model represents the character of the house which Mr. Edison will construct of concrete. He believes it can be built by machinery, in lots of 100 or more at one location, for a price which will be so low that it can be purchased or rented by families whose total income is not more than $550 per annum. It is an attempt to solve the housing question by a practical application of science, and the latest advancement in cement and mechanical engineering. With this idea in mind he has conducted a large number of experiments. These experiments have proven that it is possible to cast a house complete in six hours by pouring a very wet mixture of gravel, sand and cement into iron moulds having the form of a house, and after the removal of the forms or moulds, leave standing a complete house with a fine surface, plain or ornamental, *all in one solid piece*, including the cellar, partitions, floors, roof, stairs, mantels, veranda—in fact everything except the windows and doors, which are of wood and the only parts of the house that are combustible.

The house is to be heated by boiler and radiators in the usual manner; the plumbing to be open and jointed by electric welding.

The experimental house has the partitions arranged to give, besides the cellar, two rooms on the first story (one to be used as a living room and the other for a kitchen); the second story to have two rooms and bath; the roof story to have two rooms. When large numbers of houses are made, the partitions can be changed to make more rooms. Once the house is cast, however, no changes can be made—nothing but dynamite could be used to remove the partitions without great expense.

Well-made concrete, employing a high grade of Portland cement, is the most lasting material known.

In Italy, at the present time, there exist concrete structures made of old Roman cement, constructed more than a thousand years ago, and which are still in a good state of preservation.

Concrete will last as long as granite, and is far more resistant to fire than any known stone.

The iron moulds for the full size house are, at the present time, about 60 per cent completed, and it may be possible that before the coming fall they will be finished and the first house cast. If successful, Mr. Edison will use the forms to cast a few sample houses, to prove how, with a few simple additions to the iron forms, a great many variations in the type of houses can be made. For instance, by changing or subtracting iron sections, the house can be made smaller and cheaper. By adding sections, the number of stories can be increased, or the house can be widened or lengthened. By a few additional forms, the whole appearance of the veranda can be changed. A contracting company having the smallest unit possible to permit of cheap and rapid production, must have six sets of moulds with the other necessary machinery. From these iron sections, almost any variation in the size, appearance and ornamentation of a row of houses can be made. The concrete could be tinted with any color, but the general type would be the same. The units might be divided and thereby three complete moulds for one type of house and three sets for an entirely different type, would be secured.

This scheme of constructing houses cheaply and in quantities does not permit of the building of one house at a time, for the reason that the moulds are heavy and costly to move from one place to another. The machinery necessary to handle the materials as well as for the erection of the iron moulds is also large and expensive.

The hardening of the cement requires four days. While one house is hardening, the men would either have to remain idle or be laid off during this period, and this would not be practicable; whereas, if the full minimum unit of six sets of moulds and machinery were in operation, the thirty-seven men necessary could be employed continuously erecting, pouring, and removing forms from one lot to another, at a minimum of expense.

Mr. Edison believes that houses of the type shown in the model can be built for $1,200 each, in any community where material excavated from the cellar is sand and gravel, so that it can be used. If the sand and gravel must be obtained elsewhere, the cost will be much more. A change in the forms may be made so that a house can be built that will look just as well, but smaller, at less cost. On the other hand, by addition to the forms, houses costing $2,000 or $3,000 or more, can be built.

To give a rough idea of the cost, Mr. Edison estimates that six sets of iron forms for the house he is to build will cost about $25,000 per set—a total cost of $150,000. The cranes, traction steam shovel, conveying and hoisting machinery, he estimates will cost $25,000 additional, making a total investment of $175,000. With this machinery 12 houses per month can be made every month in the year, with the aid of one foreman, one engineer, and 35 laborers. This gives 144 houses per year for the unit. If he can prove this, then the labor cost per house will not exceed $150.

Allowing six per cent interest and four per cent for breakage on the cost of the forms, and six per cent interest with fifteen per cent depreciation on machinery, the yearly expense will be about $20,000. Dividing this into 144, the number of houses built in the year, gives approximately $140 per house, for cost of moulds and machinery. Two hundred and twenty barrels of cement will be mixed with the sand and gravel excavated from the cellar, and will provide sufficient material to build the house. Allowing $1.40 per barrel for cement, adds a further sum of $310. The reinforcing steel rods cost $125; and the heating system and bath $150. These items total $875. This leaves a margin of $325 between that sum and $1,200 to provide for doors, windows, painting, etc., and the correction of any possible defects.

If the houses are smaller and 225 can be built in the year for the same investment and labor, it will be easy, from the above data, to approximate the cost per house; the same is true with larger size houses.

These houses will be waterproof and damp-proof. The roofs, after the forms are removed, are to be painted with a paint made of cement tinted with red oxide of iron, which hardens and never deteriorates. Cement can be tinted to any color, or any shade of that color, and the inside or outside can be painted, and is permanent. The cost of the paint for the whole house, inside and out, including roof, will be very small.

Should the experiment succeed, Mr. Edison will furnish all plans and give full license to reputable. building corporations without cost, as he is not making these experiments for money.

Mr. Edison thinks the age of concrete has started, and believes he can prove that the most beautiful houses that our architects can conceive may be cast in one operation in iron forms at a cost, which by comparison with the present methods, will be surprising.

When this can be done even the poorest man among us will be enabled to own a home of his own—a home that will last for centuries with no cost for insurance or repairs, and be as exchangeable for other property as a United States bond.

The Human Heritage

By E. M. SMITH

YEARS are but moments in eternity, and a century is a short time to the dead or sleeping, yet at the present rate of discovery and invention unbelievable changes in the life and customs of men will in that time have been made. What bodily changes took place after that day when two of us mutually agreed to submit to the experiment of brain inoculation with the new drug Nervine is not a matter that concerns us now; we only know that we were able to look into the future from a vantage point never before gained. Our brains resumed their normal functions one hundred years later while our bodies remained invisible. We became spirits of another age; moving, seeing, thinking in the far away future.

Waking from so long a stupor we are dazed and all is blank until we grow accustomed to our surroundings. We are far away in space but everything appears as we always thought it would. Land and water is distinguishable from our great height above. Gradually cities and rivers can be seen but we shortly discover that our view is disturbed by a horde of objects in the air. We naturally conclude that some strange bird has developed since our time, but our conclusions are soon corrected, for even at our distance we soon perceive that the flying creatures are entirely mechanical. They appear to have limitations as to the heights above the earth to which they can attain. We therefore hurriedly drop to their plane for we are controlled with the pernicious curiosity of our day.

The inhabitants of the air are now all about us. They are a new craft to our eyes. Never have we seen their like before. They are built on entirely novel lines with extreme variance in shapes. Some are long and rakish as for speed, while others are commodious and extremely massive. They all skurry hither and thither, shooting upward, dropping downward, racing straight away or curving gracefully, leisurely through the air. Flying is evidently now. the ordinary pastime. The whole world must have become as thoroughly accustomed to flying as we were to the motor car.

Invisibly we board one of the largest. It is a palace, it contains many decks, is wide, comfortable and extremely stable. There is absolutely no motion, no rolling, not even slight careening as it turns upon its course. There is no vibration. What is its power? Surely not steam for there is no smoke. Our desire to know so overpowers us that we can not spare the time to see the people nor examine the luxuries of the great craft.

Into the bowels of the ship we hasten. We search in vain for an engine room or even a dynamo room, but we do find a compartment amidship just under the upper deck of which spins a horizontal wheel. Its construction is the very lightest possible. It is made of material resembling platinum and consists of hub, spokes and rim. Its diameter equals the widest dimensions of the vessel. Its axis is vertical and the power somewhere above. This wheel is rigidly supported by beams extending to every quarter of the ship. Our first discovery shows us that the gyroscope has yielded a secret of which our 1910 monorail inventors have absolutely no knowledge. It overcomes gravity in addition to assuring stability. Above this silent spinning wheel we look for the force which propels it. We find on the upper deck a small house containing the only machinery the craft contains. At a glance the secret is laid bare—Electricity—the marvelous force of which we made such use yet knew so little. Our descendants have wrested from Nature's store greater, vaster and more useful knowledge. They have snatched the unseen power from the air without the use of generator or other mechanical device. They have learned that free in the air are positive and negative elements. The only requisites to control being some simple device to attract the two in proper quantities. This they do by pushing upward a slender pole of cunning workmanship. The material of the pole with its shining needle point whispers a siren song to the warring elements which with the humility of a stricken lion give their power into man's keeping to be used in whatever strength and volume he chooses.

Every craft is equipped with the collecting pole as it is called, the machinery, at its base, receiving its power direct and thereby impelling the great horizontal wheel. Smaller wheels are found fore and aft which enable the craft to rise or drop at will of the navigator. A long slender rudder gives direction. The steering wheel has been abandoned. In its place electric buttons operate the rudder and all mechanisms.

For a few moments we stand in awe of this monster of the air whose very existence depends upon a slender pole which, while glistening and peaceful, forces from the limitless space above a dynamic power greater than the development of many engines of our day. We tremble when we glance below. Far above the solid earth we float. The distance is appalling and momentarily we shudder at the possibility of suddenly being projected through space. We think ourselves human like the many happy, light-hearted aboard and look with horror at the great distance.

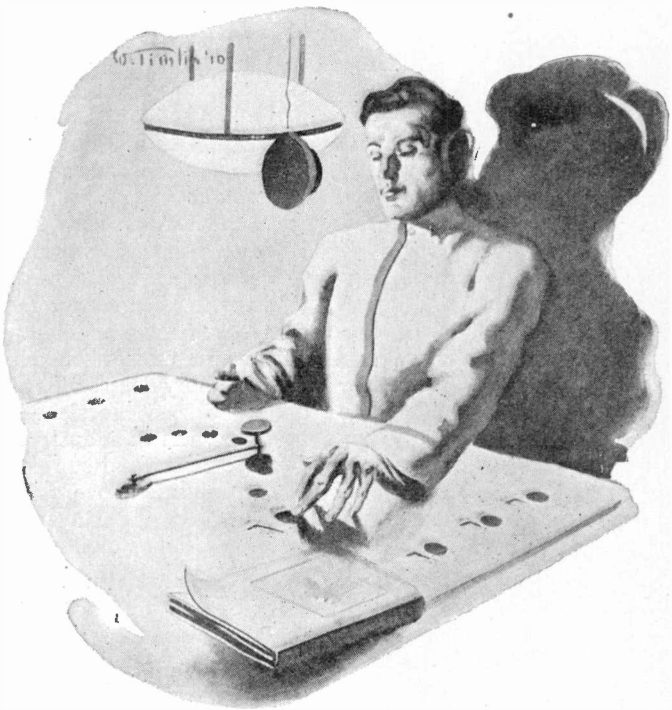
Our ship doesn't turn turtle nor do we see other similar craft meeting with any accidents whatever. A very remarkable feature of this mastery of the air is the fact that there are no collisions, though the flying wonders travel at incredible speed. They pass and repass each other, darting above or below or sidewise at will, traversing a pathless universe. Our minds can not comprehend the marvel of such infallible navigation. Our first experience with impending disaster left us breathless and inert with fear. Our mammoth craft is headed directly toward a sister ship. On and on they come, making collision inevitable. Yet they pass in safety. We do not appear to change our direction in the least, neither does the other craft, yet we do not collide. At the same time smaller ships slip by above and below us. What can the secret be? Another incomprehensible wonder to our narrow undeveloped minds. Yet so simple. Our successors calmly utilize a physical law of electricity that like repels like. Laws of aerial navigation therefore prescribe that each craft shall cause to radiate from itself a repelling force which acting upon other bodies makes collision impossible. This repelling force is constant and under no condition can two aerial crafts come closer to each other than a prescribed distance. Consequently there can be no traffic in the air between vessels.

As we near our goal we see the Great Lakes and are glad to come back home. We choose Chicago, but are astounded at its cleanliness. No heavy pall of smoke overhangs it. In fact the air is so clean that for a time we think the great metropolis has ceased its manufacturing industry. In our day the stock yards vomited smoke enough to affect the entire adjoining country, but now the air is as sweet as a clover field in haying time. We no longer wonder at the cause. We know it is the all-powerful, invisible electric current, and as we draw closer to the city we recognize the slender poles tipped with their sparkling points.

Trains shoot about the country as of old, but they use one rail only. Their speed is much greater than trains of our day though the passenger traffic appears much lighter. Nearly all the trains we see are freights. People evidently prefer aerial travel.

We hover close to the ground witnessing the marvels of this new world. Changes are so pronounced that we see little of the old regime. We of today had but suggested. Our successors are the masters. Streets and buildings and means of locomotion there are, but, oh so changed. Pavements are of indestructible concrete reinforced with metal new to us—traffic is under strange regulations and the vehicles are all of modern type—the air is full of traffic and the maelstrom of humanity in the great canons of streets is a dizzying sight, for the buildings rise on all sides so far overhead as to appear to fade away into the vanishing distance.

All streets are on a level with basements which extend out to the curbs. Above are the sidewalks, the outer portions of which are traveling platforms moving at a rate of about three miles per hour, traveling in opposite directions on the two sides of each street, crossing on girders and passing over or under each other at varying heights. Pedestrians are safe from street crossing accidents and can travel leisurely or at considerable speed on the moving platforms. There are no street cars, but an aerial line of transportation is maintained. At convenient points landing stages are built above the sidewalks and reached by moving steps. In the streets below, vehicles corresponding to our autos but far more commodious speed along, being protected from accident by adaptation of some physical law similar to the repelling force of the aerial ship. We do not have time to enquire. There is so much to see and do that we can not be tempted by insignificant detail.



EVERY SIGNAL WORKED OUT ON THE KEYS

One thing paramount and unforgettable is the evident peace of mind and contentment emphasized by every face we scan. The people are all happy and satisfied and we soon learn the cause.

Competition has been supplanted by governmental control. The government is the employer very largely, but private enterprise is not stifled. It is not only allowed but encouraged under absolute restrictions as to costs of material, wages, hours, salaries, selling prices and even dividends. There is no over production or waste. All natural resources are conserved and protected Man has learned the meaning of real human charity and the value of living in harmony with fellow man. Everyone knows that the other is working and living under exactly the same conditions as himself. There is no occasion for "putting over a deal," consequently unalloyed contentment. Utopia indeed. Can you imagine a grander sequel to our own nerve racking, life destroying daily endeavor to get the best of our neighbors? Welcome the day though its coming has taken a hundred years to accomplish.

Fearing lest we might awake we hurry away from this vortex of human achievement and seek a home in a quiet suburb. As we pass over the city we rejoice at its prosperity. There are no slums, no tenements, no hovels—all the great mass of humanity is housed comfortably, but the city has spread over an enormous territory and we have a long journey to arrive at the more open country.

The house we choose contains every species of luxury one can possibly dream of and yet it does not appear to house a rich owner, for there are degrees of wealth still. Some houses are far more pretentious than others. This is a middle man's home, a worker for the Government.

Let us dip a little deeper into these dreamland realities. My lady wishes to order her dinner. She no longer must, perforce, harangue her cook nor complain against the tardiness of the delivery boy. She simply 'phones her caterer (the Government again). She tells him what she wants and how she wants it served. At the appointed hour she and her guests or family repair to the dining room where the food is delivered to her through pneumatic tubes. If a maid is employed the outlet is at a serving table, if alone, the tube places the dishes on the table. The food is perfectly cooked and is delivered in sealed receptacles like thermos bottles. All plates and silver come by the same route and return when the meal is completed. Could anything be simpler? There are no servants. There is an equality disturbed only by mental ability and even then there is no bragging nor conceit. The master minds do not secure greater joy of living.

In the drawing room with the family we continue to view in wonderment the new life, electric buttons abound, each properly labeled. Warm or cool breezes are equally easy to secure, but the telephone shows the greatest advance. As in our day we commanded the air currents to carry our wireless telegrams, so do we find our descendants talking to their friends but with the utmost ease. Every house or suite of offices, factory or store, is equipped with a separate compartment known as the 'phone room. Where space is valuable this room is a mere closet but at the home it is luxuriantly furnished where the speaker sits and simply talks at an instrument on the farther wall which in turn transmits to the air waves. The method of making connections is the most interesting feature. A small instrument with keys like a typewriter is used. These keys represent code signs. Every one is designated by an individual code signal. This signal is worked out on the keys by pressing the proper ones. The signal is sent broadcast throughout a prescribed district. If your party is within the limits of this district she or he is notified through the medium of a small pocket instrument which is always carried about the person. Repairing to the nearest 'phone room the speaking connection is made. No one can cut in on your conversation for the little key board permits of only one combination at a time. Very simple, isn't it? And such a comfort. You can lie on the couch or do your fancy work and talk. The telephone is operated and maintained by the Government and every house in the land obtains the service with no direct expense.

We find other uses for the 'phone room. The new life has discarded some of our standard institutions and introduced decidedly novel features. There are no theaters nor music nor lecture halls. Actors perform on a stage without an audience. Bands play in a band room just large enough for its own accommodation while a public man delivers his lecture in his own home or in specially equipped rooms in public buildings. The entire audience listens and watches, each in his own 'phone room, for every motion, grimace, sign and sound is accurately transmitted to whomsoever desires. On a peculiar surface which resembles crusted glass the movements are produced. The telephone connection transmits and receives. Thus does the actor perform before immense audiences while every ripple of applause or otherwise is immediately carried to him. The theater, music and public speaking are at the command of all.

Many are the marvels of which we can not speak owing to the lack of time. We are loath to leave this Arcadia of our dreams. We, therefore, must simply conclude by calling attention to the fact that the fount of this wonderful metamorphosis is electrical power wrested from the elements with most extraordinary ease. Throughout the city are to be seen the slender poles converting into channels of industry the power of the wind and rain and sun—whatever is a part of the universe above. So it is all over the country and the Government absorbs all expense. Every living soul may use it as he chooses. The supply is inexhaustible and wasteless, and happy is mortal man.

* * *

In fact Electricity is the earthly manifestation of a Creator who loves his people and loving them has brought them through the Desert of Israel to a perfect existence. Happiness is the human heritage; discord and petty strife is a strange sight though not entirely eradicated. One hundred years is a short time to make over the human mind. Therefore there still remains a gradually lessening few who cling to the past and complain against the new order of things. They can not accustom themselves to seeing their neighbors always happy and contented. Such is the age in which we now live—the age of infant Electricity, but mark my word, vast changes are sure to transpire in our short lives and now that we have awakened from our electric dream I ask you to recall my reading of the future when you look down upon mortals from your throne.

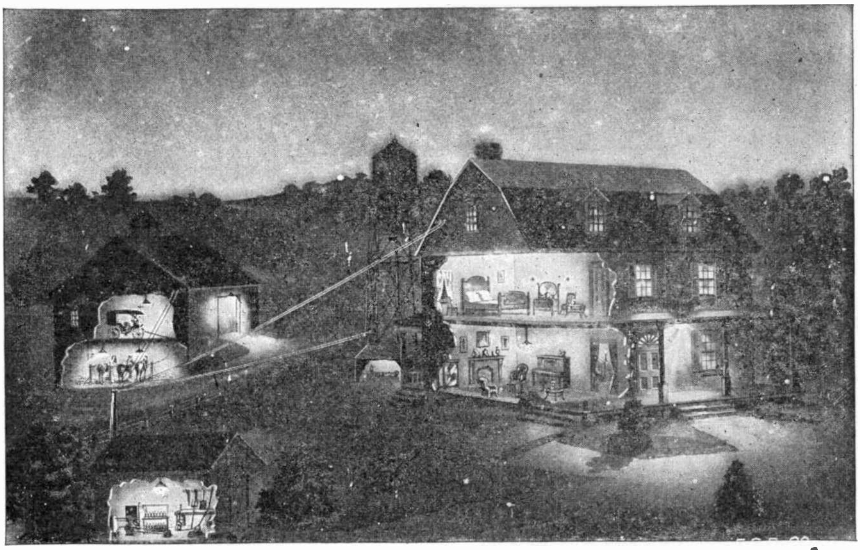
The Farmer's Light and Power

It happens now, when we ride through the country after dark, that we often come to farm houses as brilliantly lighted by electricity as any in the heart of a big city where the blessings of electric current are popularly supposed to be confined. From where the electricity is obtained is not at first evident, for no transmission line leads to the premises from the distant town. Yet there stands the house with its welcoming porch light and bright interior, and at a little distance away stands the barn where brilliant lights, which are not lanterns, come and go suddenly in different parts of the structure—now in the barn stairway, now up in the hay mow, now down in various parts of the great basement, as the farmer moves about doing the evening "chores."

The answer to all this is that the prosperous farmer will have electricity and not being able to buy it as a commodity, as does his city brother, he makes it himself. In the corner of some workshop or out building you will find the little plant driven by its throbbing gasoline engine, and from it the conducting wires lead to every building on the premises.

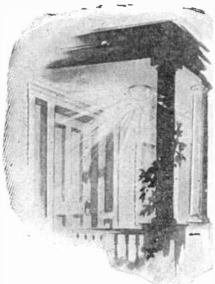
With the introduction of the tungsten lamp, which came a few years ago, the greatest step was taken toward giving the farmer electric light. This lamp affords the same amount of light as the ordinary carbon filament lamp, with about one-third the current, so naturally smaller engines, dynamos, and batteries are required to light a group of buildings, and an equipment so reduced in size comes within the means of the average farm owner.

It is hardly necessary to dwell upon the advantages of electricity for lighting, already so well realized. Flaming oil lamps and lanterns, with attendant match lighting have been the cause of numberless fires. With the introduction of electricity these hazards disappear. A comparison, too, of the old and the new illuminants in quality of light is useless—there is no comparison.



THE "LAY-OUT" OF A FARM LIGHT AND POWER PLANT

A farm lighting plant, such for instance as that furnished by the Electric Storage Battery Company of Philadelphia, consists, first, of a small gasoline engine of standard manufacture. Such an engine is reliable, economical in the consumption of fuel, is easily kept in order and does not require either constant or expert attention. A muffler is attached to the exhaust pipe so that it is practically noiseless while running. The engine can be started when desired and left to run as long



as may be required, it not being necessary to watch or care for it while in operation.

Country residents or farmers often have an engine for running a pump or other farming machinery, which, if of suitable design, can be utilized for running the dynamo, thus saving a very considerable part of the cost of the lighting equipment.

The source of electricity for a lighting plant is the electric dynamo. It is connected either direct to the engine shaft or else a short belt is used. The wires running from the dynamo go first to a simple switchboard and from there to the storage battery

The engine develops mechanical energy, which is transformed into electrical energy by the dynamo. The storage battery acts just like a water tank; it is a reservoir which stores electricity to be supplied whenever needed, so that it is unnecessary to run the engine and dynamo continuously in order to have electric light at all hours of the day and night.

The length of time which an engine must be operated and the frequency of operation are determined by the size of the storage battery and the amount of electricity required for the operation of lamps or motors after the engine is shut down. Storage batteries are furnished that require charging once each day, larger batteries require charging only once in two or three days, and others still larger will store current for a week or more. Batteries require an engine to be run from four to ten hours to charge them, the time depending upon how much electricity has previously been used from the battery.

A storage battery of the type used for small lighting plants is made up of a number of glass jars in which are suspended properly prepared lead battery plates, the jars being filled with an acid solution called the electrolyte. The jars and plates compose a cell.

The cells are placed on trays on a rack, or set of shelves, usually of two tiers. A battery for a 15 light plant consists of nineteen cells, which may be arranged on two substantial shelves, one above the other, each shelf being about 2½ feet long and one foot wide, with head room of 2½ feet. A larger battery would be installed on a two tier rack, occupying a floor space of about nine feet by one foot and six inches.

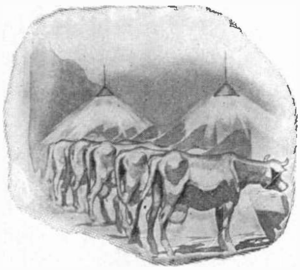
The cost of wiring a house varies considerably, due to the different methods employed in installing the wires. If it is desired to have all the wires out of sight, they can be run between partitions, and outlets made in the ceilings or walls at desired places. This is known as the concealed method of wiring. Wires can be run in wooden moldings, which are painted to match woodwork, and therefore are not conspicuous. This is known as the molding method of wiring. In cases, however, where the appearance of wires is not objectionable, as in barns, stables, cellars or attics, the exterior or exposed method of wiring considerably reduces the expense. Wiring, where there are approximately ten or more lights to install, can be done at from

$2.00 to $2.50 per light, which includes wire, lamp socket and lamp and all necessary material except the fixture.

Electric lighting plants can be furnished for any number of lamps that may be desired. The cost of a plant will vary with the number of lamps that are burned, but an approximate idea of the expense involved is given. As an illustration, a lighting equipment suitable for an ordinary sized home requiring the installation of from 15 to 20 lamps, consists of a small gasoline engine with a suitable generator, a storage battery of "chloride accumulators" and a small switchboard, and can be purchased for approximately the sum of $400. This price includes a complete plant with the exception of incandescent lamps, fixtures and wiring.

The cost of installing this plant, including freight, labor, incandescent lamps and wiring, with the exception of fixtures (chandeliers), would be approximately from $75 to $125. The storage battery of this plant would be of sufficient size to furnish the evening lighting, morning lighting when desired, and for supplying one or two lights during the night in case of illness, or for some other purpose, as is described in the next paragraph. At other hours of the day, any considerable amount of light or power would be taken direct from the dynamo.

The running of the engine for charging the battery can be done at any convenient time. In cases where current is also furnished for electric motors for operating cream separators, pumps, washing machines, etc., which are used during the day, the engine is usually run while the motors are being used, during which time the battery is also charged, so that after the motors have been shut down the electricity stored in the battery is ready for furnishing lighting at other times. On special occasions, such as parties or receptions, when it is desired to burn all the lamps continuously, the engine can be kept running and the electricity generated by it, together with that previously stored in the battery can be united and the plant will then furnish ample current for special illuminations.



The operating cost of an electric lighting plant is practically covered by the cost of the fuel required to run the engine. A one-horse power gasoline engine will cost about $2\frac{1}{4}$ cents per hour for gasoline running at full load, assuming gasoline to cost 18 cents per gallon. This means that electric lighting can be supplied where 15 lights are installed for from four cents to eight cents per day.

Pre-electric Trolleys

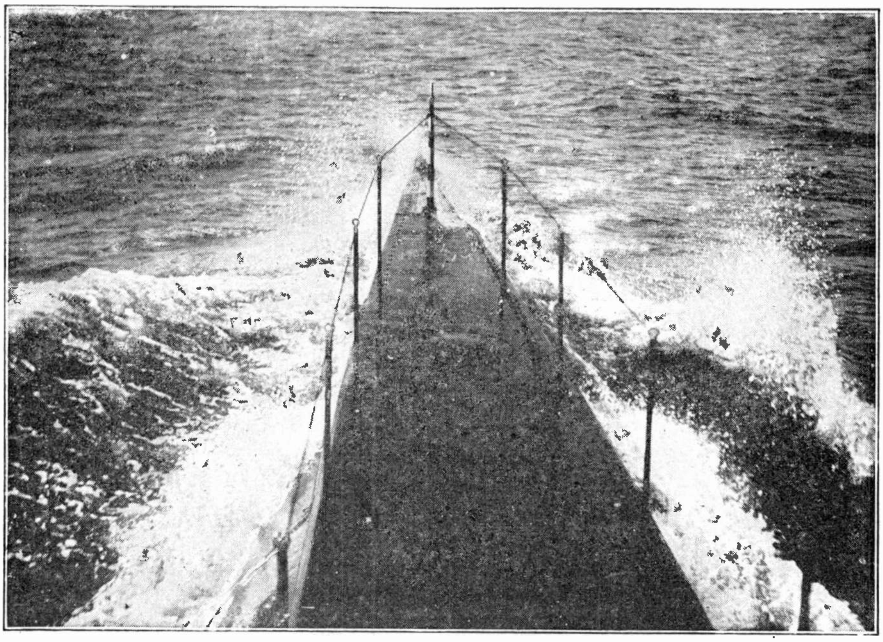
So closely is the word "trolley" connected nowadays with swift electric cars that most people assume it to be a distinctly electrical term and one suggestive of speed in its origin. This is far from true, for the old French word from which it is derived means "to ramble, stroll or drag about." Allied to it was the Welsh word "troell," meaning a wheel or pulley. This more nearly suggests the contact part of our modern electric cars, but the word trolley itself was first used in England to designate a handcart and later a truck. Thus the steam propelled car introduced into British India in 1876 for carrying repair or inspection crews along the Oude and Bohilkund Railway was called a "trolly." Six years later when Daft and Van Depoele began to instal electric railways with overhead wires, they used the term "trolley" (adding the *e* which the British had omitted) to denote the contact wheel which takes the current from the wire.

Electricity and the Submarines

BY FRANK C. PERKINS

With almost feverish haste the naval departments of the principal "civilized" nations of recent years have been building battleships of constantly increasing size and gun power. At first it was a race for supremacy between the gun maker and the armour plate maker with the former generally a little ahead. As the years went by the effectiveness of the torpedo, charged with the high-power explosives of modern times, began to be recognized and so the torpedo boat was evolved, the little "fly-by-night" scourge which was for a time the terror of the governments which were sinking millions in the construction of battleships. It wasn't long, however, before the high-power searchlight, which could turn night into day for a radius of several miles about a ship, and the torpedo boat destroyer, of marvelous speed and armed with rapid-fire guns, together came near putting the torpedo boat out of business, and left the gun makers and the armour plate makers to renew their interrupted race without fear that their labors would go for naught.

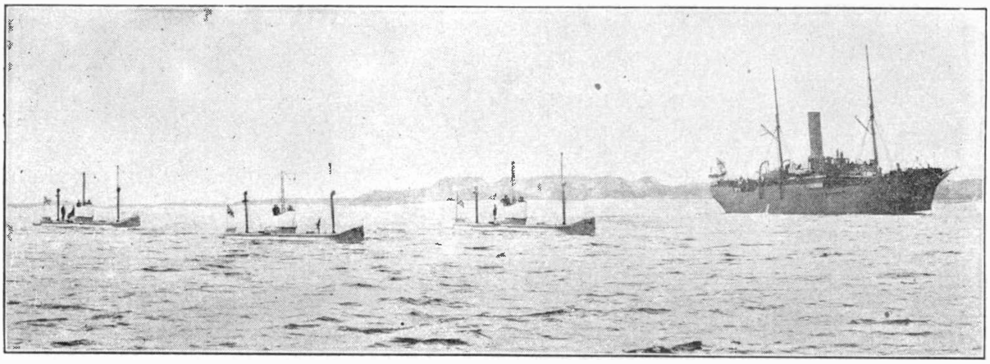
Then men found that a boat could be made that would float on the surface or dive and swim for miles beneath—with that same ominous little torpedo tube sticking out in front. Once more there was consternation and with good cause, for one of the submarines, if it could manage to poke the torpedo into the hull of a battleship, could easily send a thousand men and five or six millions of dollars worth of gun boat to the bottom of the sea.



HOLLAND SUBMERSIBLE MAKING 13 KNOTS PER HOUR

As no "counter irritant" has yet been discovered for these latest underwater weapons of naval warfare, all the nations are building submaries and experimenting with them, firing men out of the torpedo tubes to see if they can get to the surface before they drown and similar "stunts."

Electricity is one of the principal factors to make possible the submarine boat. For men to live under water, of course, air is required. Now a furnace for a steam boiler, or any kind of internal combustion engine consumes air, and if steam or gas engines were used for under water propulsion the radius of action of the boats would be



A FLEET OF RUSSIAN SUBMERSIBLES

greatly decreased as they would be obliged to come to the surface sooner for a new supply of oxygen. So the general plan adopted is to use petrol engines to propel the boat when running on the surface (petrol will not explode like gasoline), the engines being also used to drive dynamos which in turn charge storage batteries. Then when the time comes to dive beneath the surface the engines are disconnected from the propellor and the latter is driven by motors which obtain their supply of electricity from the storage batteries. The latter also provide current for lighting the interior. Therefore, when the boat is traveling under water the only oxygen consumed is that breathed by the men. Some of the submarines, it is true, have vertical air pipes and travel part of the time just beneath the surface, with the pipe protruding; but when total disappearance is required the only available air is that contained in the hull.

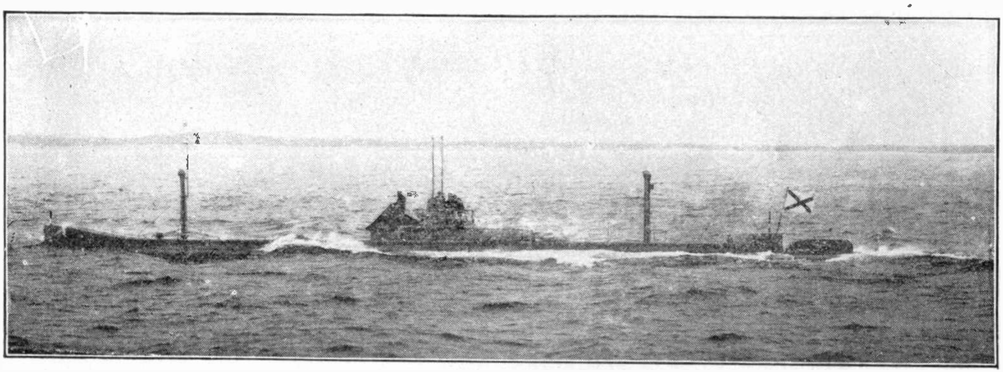
In order to dive under water it is necessary to let water into certain air compartments until the boat sinks. Here again the storage battery is a help rather than a hindrance, because its weight helps to carry the boat down without making it necessary to displace quite so much of the precious air.

The Russian flotilla of submarine boats has probably as great a variety of designs as any country in the world. Almost every class of submersible has been tested by that nation. The Bubnoffs and Beklemischeffs types are intermediate size submarines making a speed of 15 knots under water, but while Russia has found these designs to attain most satisfactory speeds they are said to have been troublesome and inefficient.

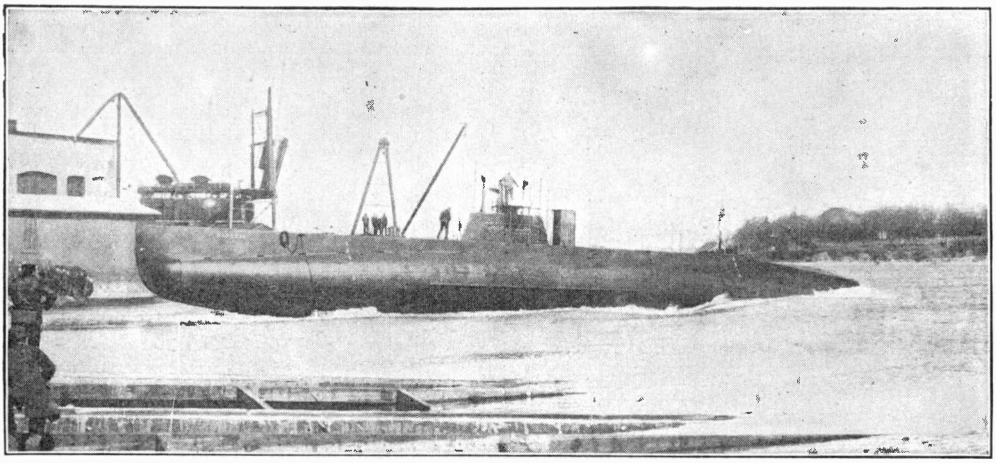
It may be stated that the Russian flotilla includes a number of Hollands and Lake Submarines.

The illustration on the preceding page is a partial view of one of the Holland type submersibles, built for the Russians and capable of making 13.1 knots.

The "Karp," "Kanibala" and "Karas" are three other Russian submersibles. They



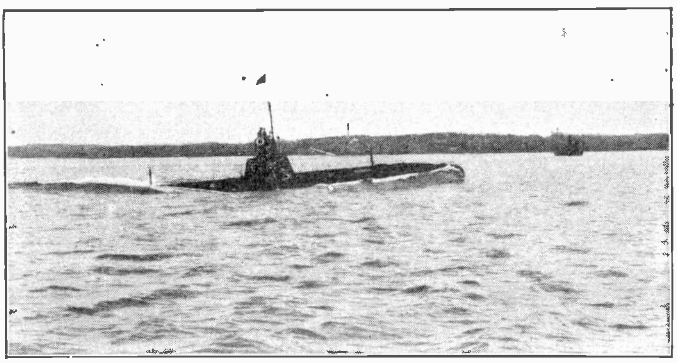
RUSSIAN SUBMERSIBLE "KARP"



LAUNCHING THE "NORWHAL"

are designed for quick diving and great stability and radius of action.

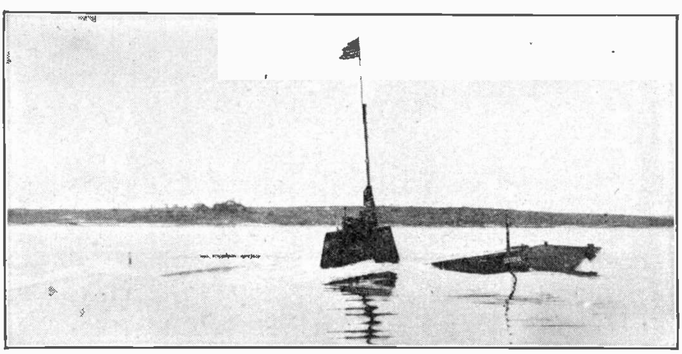
The total length over all of these boats is 131 feet with a breadth of ten feet, a surface draught of eight feet two inches and a surface displacement of nearly 200 tons. The submerged displacement is about 236 tons, a submerged speed of nine knots per hour being attained and a surface speed of 11 knots per hour. The propulsion is by electric motors when the boats are submerged and by oil engines when the boats are operating on the surface.



AMERICAN SUBMERSIBLE "OCTOPUS" AT FULL SPEED

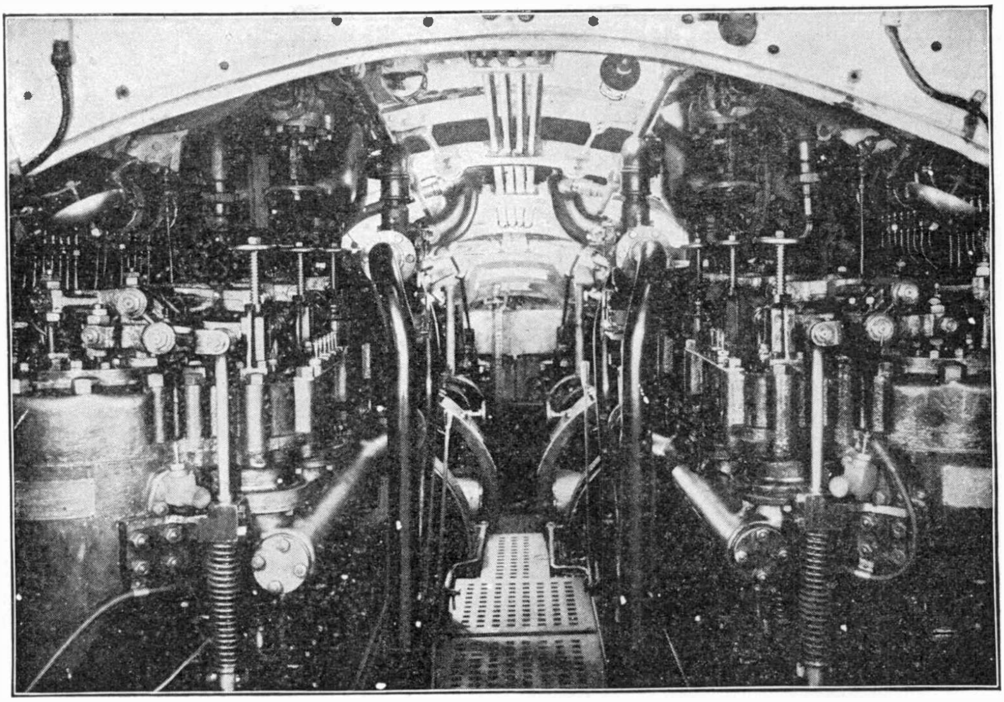
All dangers of explosion are eliminated by the use of petroleum as a fuel and the arrangement of the fuel tanks outside of the hulls of the submarines. The armanent of these three submersibles includes three torpedoes and one 18 inch torpedo tube.

An idea of the compact arrangement of the machinery and the little space left for the men may be gained from the view in the engine room of one of the Holland boats.



AMERICAN SUBMERSIBLE "OCTOPUS" RISING

An Italian submarine of the "Squalo" type has a total length over all of nearly 140 feet and an extreme beam of about 17 feet the hull free board being nearly four feet. The free board to the top of the conning tower is 10 feet 9.75 inches and its surface trim draught 6 feet 10.5 inches. The surface displacement when



THE ENGINE ROOM IN A SUBMARINE

the submarine is fully loaded is 180 tons and it has a reserve of buoyance in light condition of 60 per cent of displacement. This type of Italian submersible has eight bulk heads and a safety drop keel of 13 tons, the hull is designed to withstand submergence to a depth of 150 feet and the boat is driven by three propellers. The maximum power of the electric motors on these boats is 190 horsepower and the submerged speed nine knots per hour.

It will be of interest to compare the above data with the American submarine torpedo boats "Narwhal" and "Octopus." The Holland type submarine torpedo boat "Narwhal" is provided with engines of 300 horse power, the submersible making 13.1 knots per hour. The "Narwhal" has a total length of 135 feet, and together with the "Stingray" and "Tarpon", each measure 105 feet in length, was launched at Quincy, Mass., at the Fore River Ship-yard.

The U. S. submarine "Octopus" has a total length of 105 feet and a diameter of 13 feet 9 inches. It has a surface displacement of 240 tons and is provided with engines of 560 horse power, the electric motors being capable of developing 360 horse power, and providing a submerged speed of ten knots per hour. So strong is the shell of this boat, that a depth of 200 feet may be reached without danger of collapse.

Impromptu Elephant Ambulance

While helping to push a heavily loaded wagon out of the deep mud at Piqua, Ohio, the elephant, "Tillie," belonging to one of the big circus companies, had the misfortune to strain a tendon in her left front leg. The swelling rendered expert attention necessary, bandages and liniment being immediately applied for temporary relief. As no veterinary was available at this town, an electric auto truck was ordered by telegraph to be ready at the next stopping point, South Bend, to transport the elephant from the circus show grounds to the veterinary hospital, where the necessary surgical attention was available.

The picture on the front cover of this issue shows Tillie about to take her first "joy ride." She weighs only 8,000 pounds, not too much for the big electric truck to handle with ease.

Elementary Electricity

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

CHAPTER XXIX.—THE NERNST, MERCURY-VAPOR, AND VACUUM-TUBE INCANDESCENT ELECTRIC LAMPS

Improvements in the efficiency of incandescent electric lamps by the use of materials, that can be safely raised to a higher incandescence than the ordinary carbon filament, have been made with other materials than the tantalum and tungsten described in the preceding chapter. These additional materials can be raised to temperatures greater than the tantalum or tungsten filaments. They are, therefore, capable of ensuring very high efficiencies, as well as marked improvements in the color values of the light produced.

The first of these incandescent electric lamps we shall describe is known as the Nernst incandescent electric lamp. Its operation is based on the fact that many substances that are fairly good insulators at ordinary temperatures, acquire good conducting powers as their temperature is increased. For example, a piece of ordinary glass tubing when no warmer than ordinary atmospheric temperatures, will permit but a very small electric current to pass through it. When, however, it is raised to even below a dull redness, it begins to conduct electricity, and, as its temperature rises from the electric heat liberated in it by reason of its resistance, its conducting power so rapidly increases that the amount of current flowing through it will rapidly raise its temperature to an intense incandescence that will even melt it.

In the Nernst incandescent electric lamp a small rod or pencil is made from a mixture of oxides of magnesium and certain rare earths, such as yttria, zirconia, thoria, and ceria, together with some suitable binding material. The rods or pencils are then dried, roasted and provided with leading-in wires of platinum, fastened into the ends of the rods. These rods form what are known as glowers. They have a length of about an inch and a diameter of about the thirty-second of an inch.

The glowers of the Nernst lamp can be safely exposed to the air when raised to high incandescence. So far as their life is concerned it is not necessary as in the carbon filament to place them inside a lamp globe in which a vacuum is maintained. In order, however, to protect the glowing rods from blasts of air, which would tend to produce an unsteadiness in the light they emit, they are placed in a lamp globe.

As we have seen, it is necessary to heat the glowers in order to make them electrically conducting. This was originally done by holding a lighted match near them. Even this slight increase in temperature was sufficient to permit enough current from the mains to which the glowers were connected to place the lamp in operation. This method, however, was not only tedious but also impracticable owing to the fact that the globes had to be temporarily removed from the glowers before starting, and, where a group of glowers were employed, as is generally the case, too much time was needed to place the lamp in operation.

Nernst electric lamps as now made belong to a type known as the automatic lamp, from the fact that a heating coil is provided to raise the temperature of the glower for starting. The heating coil consists of platinum wire wound on a porcelain cylinder and placed near the glower.

In actual operation an electric current of sufficient strength is passed through the heating coil to raise the platinum wire to a red heat. With this heat only a short time is required to raise the temperature of the glower sufficiently to permit the operating current to flow. In well constructed lamps the time required is only about one minute.

In the early history of the Nernst lamp a difficulty was experienced that at first sight seemed to render its continual operation impossible. When the lighting current began to flow through the glower, its electrical conducting power, and consequently its temperature, increased so rapidly that but a few moments were required to fuse and volatilize it. The difficulty, however, was obviated by the ingenious invention of what is known as the ballast or steadying resistance.

The operation of the ballast or steadying resistance is based on the fact above referred to that the resistance of metallic conductors increases with their increase in temperature. It was possible, therefore, by connecting a coil of iron or other metallic wire in series with the glower, to arrange their respective lengths so that the changes in resistance would balance one another; for, the decrease in the resistance of the glower and the increase in the resistance of the metallic wire might be made a constant

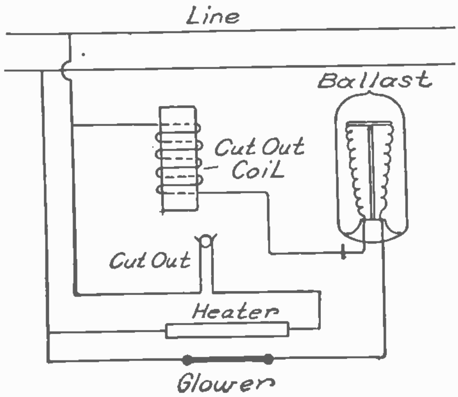


FIG. 185. CIRCUIT CONNECTIONS OF THE NERNST LAMP

sum, so in this way the current passing through the circuit would remain constant.

The circuit connections of the Nernst lamp are represented in Fig. 185, for a single heater glower and ballast together with the electro-magnetic cut-off. Here, as will be seen, the glower and heater coil are connected in parallel with the constant potential supply mains, while the ballast coil is connected in series with the glower and the electro-magnetic coil whose armature operates the electro-magnet.

In order to ensure good electrical connection with the separate glowers the platinum leading-in wires are provided with small aluminum plugs at the ends of the wires that are connected with the glowers.

As to the efficiency of the Nernst lamp, a single glower will produce an amount of light equal to that of a little more than two standard 16 candle-power incandescent carbon lamps. Since each glower requires the consumption of about 84 watts, it is operated at an efficiency of about 2.4 watts per candle, or about two-thirds the amount of energy required to produce the same quantity of light in the carbon filament.

When first placed on the market, the Nernst lamp had a length of life shorter than that of the carbon filament lamp. It is now claimed, however, that by improvements introduced into their manufacture, they can be made with a useful life equal to that of the carbon lamp or 800 hours.

A serious objection to the Nernst lamp is found in the fact that the lamp rapidly blackens by the deposition of platinum black on the porcelain disk, so that frequent cleansings are necessary.

The high temperature to which it is possible safely to raise the Nernst glowers results in the production of color values for the emitted light so near those of sunlight as to make this lamp especially suited for use in all places where true daylight colors are required, such as in stores where colored fabrics are sold, or in manufactories where they are made.

The Nernst lamp is generally constructed with a number of glowers placed in the same

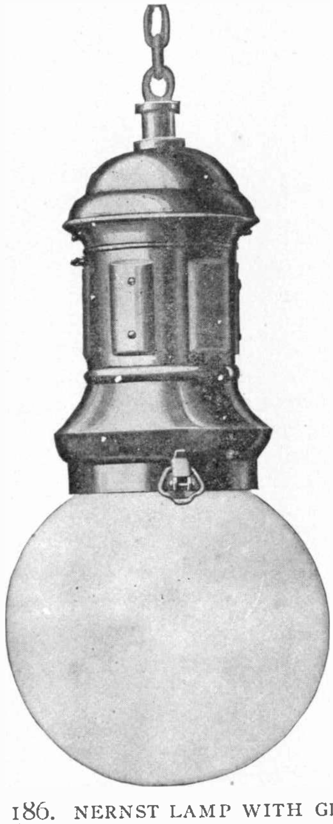


FIG. 186. NERNST LAMP WITH GLOBE

holder inside the protecting globe. In Fig. 186 is shown a Nernst lamp of the six glower

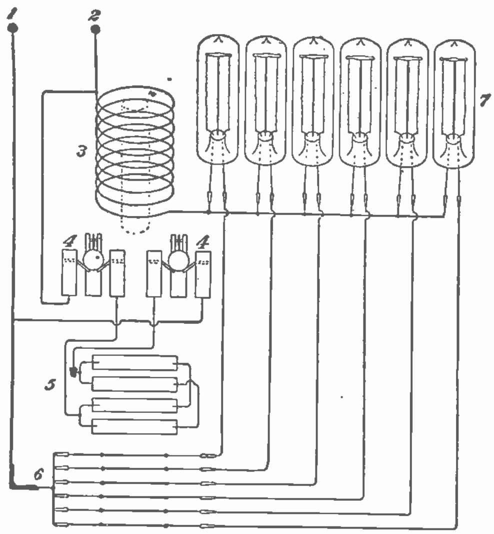


FIG. 187. CIRCUIT CONNECTIONS OF A 6-GLOWER LAMP

type suitable for the lighting of large areas. It has a protecting globe to cover the glowers.

The circuit connections of a six-glower Nernst incandescent electric lamp are shown in Fig. 187. In this figure the glowers are represented for convenience as being placed together. The heaters are shown at (5), the glowers at (6) and the ballast at (7), there necessarily being a separate ballast for each glower. A small glass globe, known as the heater case, is supported by spring clamps around the glowers. The heater porcelain is the name given to a porcelain disk placed immediately above the heater. It is on this disk that the coating of platinum black before referred to occurs.

While no practical method has as yet been discovered for preventing the deposition of platinum black on the porcelain disk, yet the ease with which it may be removed is greatly increased by coating the surface with a thin layer of white paste that can readily be removed by a scraper or stiff brush.

The Nernst electric lamp is operated either by direct or alternating current. Since, however, the glower is subjected to electrolytic decomposition, which is of course smaller when alternating current is employed, this current is used in preference to direct current.

Materials capable of being raised to exceedingly high temperatures, that have been employed with more or less success for the incandescing materials for electric lamps, are the vapor of mercury, and atmospheric air or other gases. These materials are placed inside glass tubes in which they are raised to as high an incandescence as possible. It will of course be recognized that the incandescing material of this character cannot be made in the form of filaments or threads, but occupies the entire space within the containing glass vessels, which are generally cylindrical or tubical shaped.

Beginning with a description of the mercury-vapor lamp, it is interesting to note that although this form of incandescent lamp was invented at a comparatively late date by Peter Cooper Hewitt, of New York City, yet it was first actually employed in a less practical form as early as 1856 by an Englishman named Way. Way's lamp may be regarded as a variety of arc lamp, in which one of the electrodes consisted of a stream of mercury.

The mercury-vapor incandescent lamp, or, as it is generally called, the Cooper Hewitt lamp, after its inventor, consists, as shown in Fig. 188, of an exhausted glass tube through which a stream of mercury can be made to flow from one end to the other. The connections are such that the liquid mercury forms the cathode or electro-negative terminal while the anode or electro-positive terminal is connected with a mass of iron.

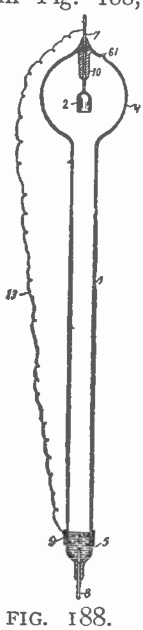


FIG. 188. COOPER HEWITT LAMP

The glass tube is about four feet in length and about an inch in diameter. It is exhausted to a high vacuum and then hermetically sealed by the fusion of the glass. As in the case of most other incandescent lamps the platinum leading-in wires employed are sealed in the parts of the tube through which they pass.

The lamp may be hung in any position. Generally speaking, however, it is hung in an inclined position as shown in Fig. 189.

Although a high vacuum is maintained within the Cooper Hewitt lamp tube so far as air is concerned, yet the tube is necessarily filled with a varying amount of mercury-vapor. The tension exerted by this vapor,

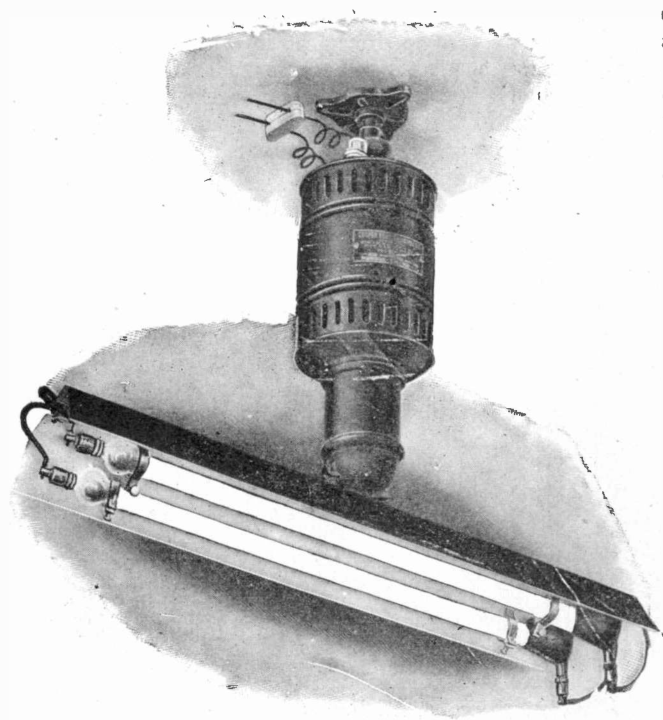


FIG. 189. COOPER HEWITT LAMP IN OPERATION

enced from the unsteadiness and flickering of the light. It was soon found that this difficulty arose from the fact that the current entered the surface of the mercury cathode at a single point; that it was the dancing of the current over the mercury that caused the unsteadiness. The fault was remedied by placing the leading-in wire inside the cathode bulb so as to terminate slightly above the mercury surface. When so placed the discharge of the current takes place through the wire and the unsteadiness disappears.

The Cooper Hewitt lamp is operated by direct current having a pressure varying from 100 to 150 volts and the current strength is about three and a half amperes. It is possible, however, to connect a number of lamps together in series so as to employ a higher voltage.

As already mentioned, the

or the quantity of vapor per unit of volume, depends on the temperature. Since the lamp operates at its maximum efficiency under a certain mercury pressure, a device has been provided that automatically regulates this pressure. This device consists in the use of a comparatively large bulb or chamber known as the condensing chamber. Owing to the extended area of the walls of this chamber, the heat is more readily dissipated, and the temperature within the tube kept cooler or lower than it would otherwise be.

The higher electrode is usually provided with a pull chain. When it is desired to start the lamp the higher end is pulled down until it is lower than the other end. As soon as it contains an excess of mercury that has flowed into it from the other end, it is permitted to resume its original position, so that a flow of mercury occurs. This flow is attended by a breaking of the mercury column into a spray, containing numerous gaps across which the current jumps and light begins to fill the tube.

In the early manufacture of the Cooper Hewitt lamp much difficulty was experi-

Cooper Hewitt lamp requires the maintaining of a high vacuum inside the lamp tube. The presence of this vacuum can readily be tested, since, as is well known, if mercury or other liquid be permitted to fall through a tube containing a vacuum, it produces a sharp metallic click, while the presence of even a small quantity of air, providing as it does a cushion against which the liquid may fall, prevents this sound being produced.

As would be expected, since there is practically no limit to the temperature to which the mercury vapor can be raised, the efficiency of the Cooper Hewitt lamp is high so far as the number of candles per watt is concerned. Owing to the extended surface of the tube from which the light is emitted, this lamp is capable of producing a uniform illumination. Hewitt experimented with a number of different vapors, but found the light emitted by mercury vapor to be the greatest for the same expenditure of electric energy.

The Cooper Hewitt lamp, however, is unfortunately open to the objection that it is markedly deficient in the red rays of the spectrum so that colored objects examined by it display colors entirely different than when illumined by sunlight. At the same time, the fact that this light is especially rich in the actinic rays or the rays required for photographic work, makes this lamp especially suited for use by the photographer. Moreover, the light is not painful when employed for reading, for work in the drafting room, or, to a certain extent, for work in machine shops.

When employed by the photographer, the Cooper Hewitt lamp is generally arranged in the form of a skylight, as shown in Fig. 190. As will be seen, this consists of five Cooper Hewitt tubes, each of these is 45 inches in length, and an inch in diameter, mounted in independent wooden holders provided with white-enamelled reflectors. These holders are mounted in a wooden frame, four feet in width and five feet in height. The resistances for operating the tubes are placed across the back of the frame. The circuit connections are such that the tubes may be used independently, or in different groups.

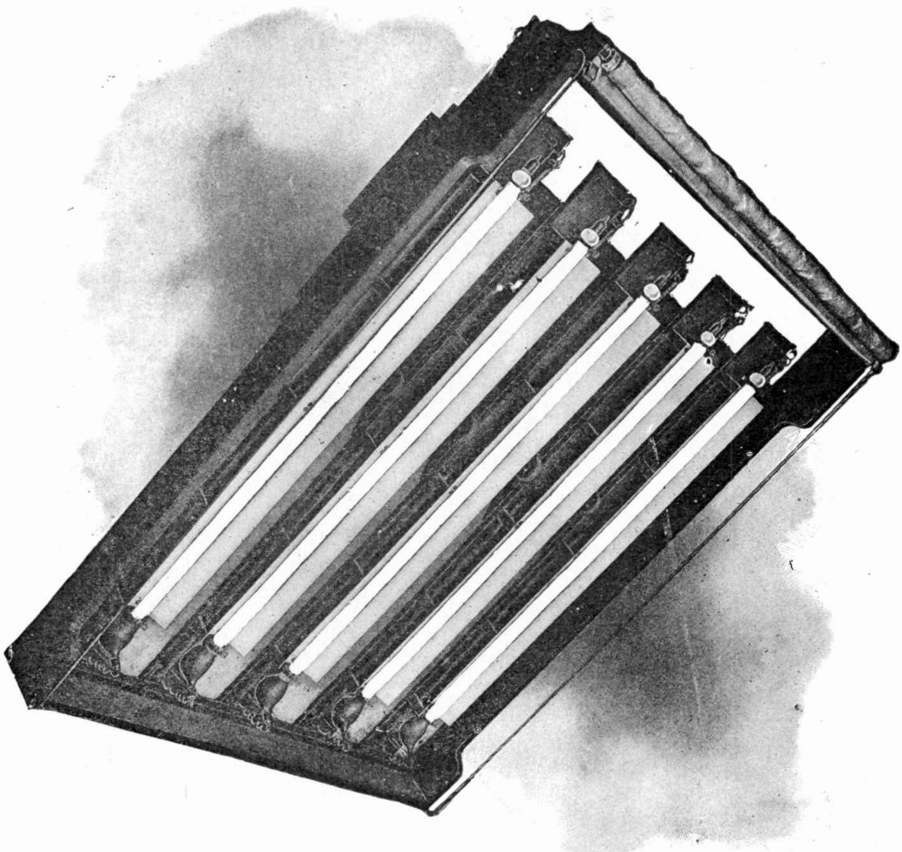


FIG. 190. COOPER HEWITT LAMPS AS PHOTOGRAPHER'S SKY LIGHT

Owing to the high actinic power of the light of the Cooper Hewitt lamp, a photographer provided with this method of illumination is independent of the weather. It has been found in practice that the results obtained, when the ordinary glass skylight is discarded, are equal to the best work done by sunlight.

Photographic work employed for taking the pictures employed in the moving picture apparatus, requires a high and uniform illumination, since such pictures are taken

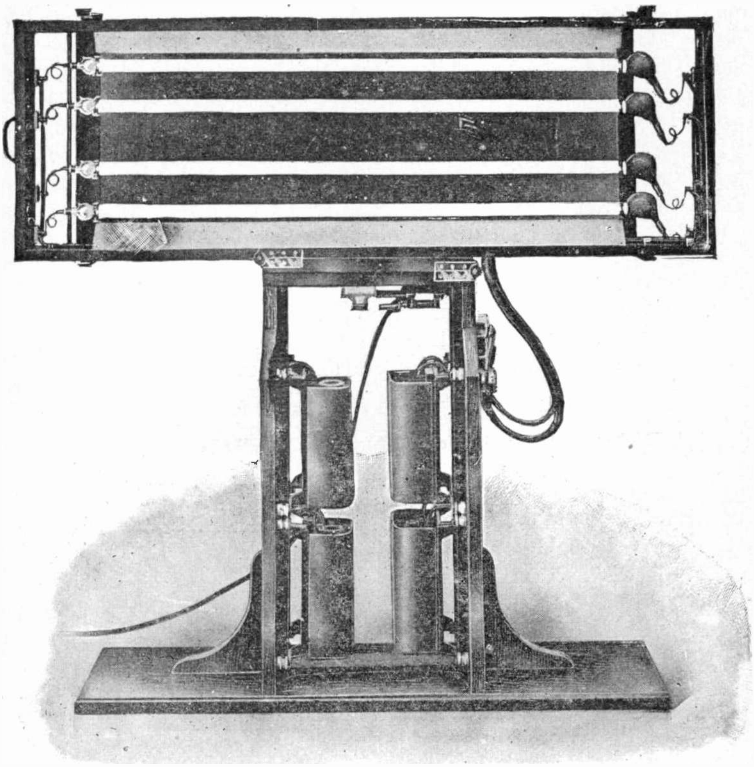


FIG. 191. COOPER HEWITT LAMPS FOR PHOTOGRAPHIC PRINTING

of vacuous spaces, various luminous effects are produced. As early as 1709, Hawkesbee obtained light by passing electric discharges through rarefied air in glass vessels. This light was sufficiently bright to permit large type to be easily read.

In the well known Geissler tube, which consists of sealed glass tubes containing only moderately high vacuua, the passage of a discharge through the residual gaseous atmosphere is attended by luminous effects. Unfortunately, the actual amount of light so produced is comparatively small.

at the rate of about 1,000 per minute. When these pictures are taken in the entire absence of daylight, eight skylights with eight tubes will so light a small stage that excellent pictures can be obtained at the above rapid rate.

Where artificial light is employed for photographic printing, the arrangement of the tubes is as shown in Fig. 191. When the outfit consists of four tubes, placed four inches apart, between centres, a printing area of 16 by 42 inches is obtained.

For photo-engraving, an outfit consisting of two tubes, placed four and a quarter inches apart and mounted on a holder with white-enamelled reflectors is employed. A device of this kind is shown in Fig. 192. Besides the above, Cooper Hewitt lamps are suitable for photographic enlarging and also for blue-printing.

A form of incandescent electric lamp employing a gaseous substance such as ordinary air is capable of giving excellent results. It has long been known that when electric discharges of high electromotive force are passed through the residual atmospheres,

In the vacuum-tube system of lighting, devised by D. MacFarland Moore, by means of various ingenious devices the light produced in the above manner has been so greatly increased that vacuum-tube lamps are capable of being employed for artificial illumination.

In the Moore system of vacuum-tube lighting exhausted glass tubes are employed instead of the lamp bulbs.

Since the surface emitting the light is extended, and the character of the light closely resembles that of daylight, this method of lighting

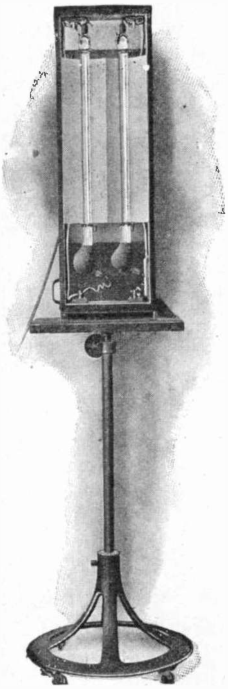


FIG. 192. COOPER HEWIT LAMPS FOR PHOTO-ENGRAVING

would seem to be very promising. The following description of the Moore vacuum-tube system, from a well known electrical magazine, contains a statement of some of the advantages that are obtained by the use of this system:

"For illuminating the interior of a dwelling or structure, the portions of the glass tubing, which contain the luminous column from which the effective illumination is obtained, may be distributed in any desired way throughout the whole interior of the dwelling or structure. Then one or more tubes, with the conducting caps or terminals may be brought from within the illuminated spaces or areas to an exterior cabinet or receptacle where their conducting caps can be located out of harm's way, and in immediate connection with the source of energy. Or if desired, the energy may be carried into a building, and suitable transforming devices located in sealed wall pockets within the same, the terminals of the tube being located in the same manner in the pockets, while the luminous portion of the tube may extend over or through the areas to be lighted, being distributed in any desired form or manner.

(To be concluded.)

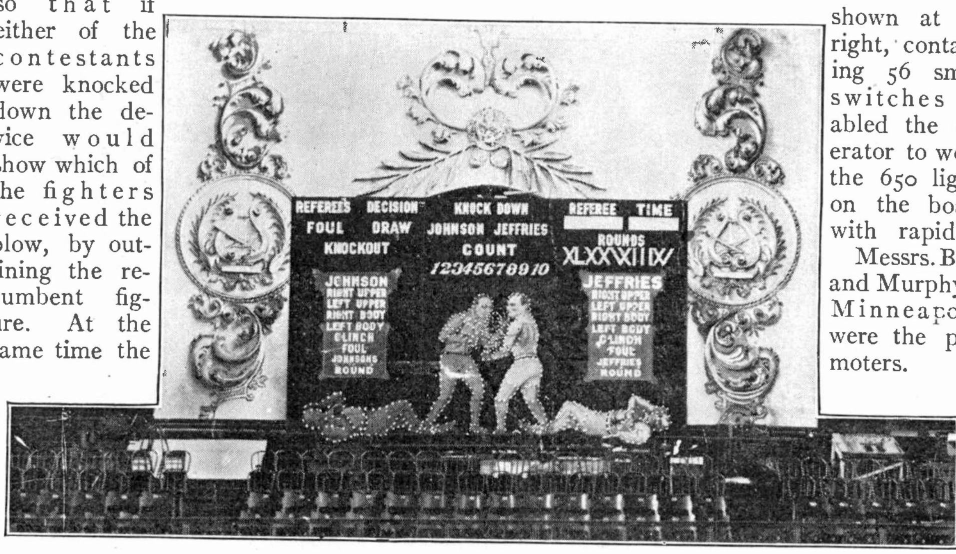
RENO FIGHT RETURNS SHOWN ELECTRICALLY

The Chicago fight fan who wished to get in as close and realistic touch as possible with the Jeffries-Johnson battle at Reno on July 4th had only to visit the Coliseum, where applied electrical science gratified his desires.

The picture shows an electric board which was used to illustrate the progress of the battle and which was mounted in the balcony of the Coliseum. It was 15 by 24 feet and in the center were illuminated figures nine feet in height outlined by small electric lamps so arranged that every blow struck in the encounter was reproduced at once on the board by the flashing on and off of various sets of lamps. Provision was made so that if either of the contestants were knocked down the device would show which of the fighters received the blow, by outlining the recumbent figure. At the same time the name of the fighter who delivered the blow was flashed on the board, and the words "knock-down" also appeared, the referee's count being indicated by illuminated numbers. The blows delivered were shown by numerous lamps arranged between the opponents to show the position of the arms.

Provision was also made to show by lights a foul, draw, or referee's decision. In case of a clinch the name of the one forced to clinch appeared in lights at the left or right of the board. At the end of each round the number of the round was indicated and the name of the man in whose favor it was conceded to be. An inclined switchboard shown at the right, containing 56 small switches enabled the operator to work the 650 lights on the board with rapidity.

Messrs. Burr and Murphy of Minneapolis, were the promoters.



ELECTRIC BOARD FOR SHOWING FIGHT RETURNS

Prominent People and Their Electric Autos

By WALDON FAWCETT

Every day finds greater dependency placed upon the automobile by the prominent men and women in all walks of life—busy folk with whom time is always at a premium and whose manifold social obligations and business, professional or official responsibilities crowding close upon one another, necessitate some vehicle that spells both quick conveyance and ready recourse. For many such sorely pressed individuals the modern motor car has filled a long felt want. In proof, witness the case of leading physicians in many of our large cities who, prior to the development of the Twentieth Century self-propelled vehicle were obliged to keep constantly in service two or three horses, "changing off" as a steed became exhausted just as the pony express riders of pioneer days used to change mounts during their relay rides.

The celebrities of the country have shown the greatest variety of taste in indulging their preferences for different types and models of automobiles, but a person who had not investigated the subject would be bound to be surprised were there statistics to show what a large proportion of electrics are to be found in the private garages of the famous and the near-famous. Nor is the use of the electric in this sphere by any means confined to the women of the households, although it is well known that the car which derives its energy from a storage battery has much to commend it to the fair sex not only on the score of ease of manipulation but also because there is no danger of operator or passenger soiling the daintiest of gowns. To be sure, the electric is preeminently adapted for city use, but your average celebrity wants a "town car" and for that matter several recent exploits by electrics, for instance the run on one charge over the notoriously bad roads between Washington, D. C., and Baltimore, indicates that the electric has some capacity as a touring car even without the aid of Edison's new battery.

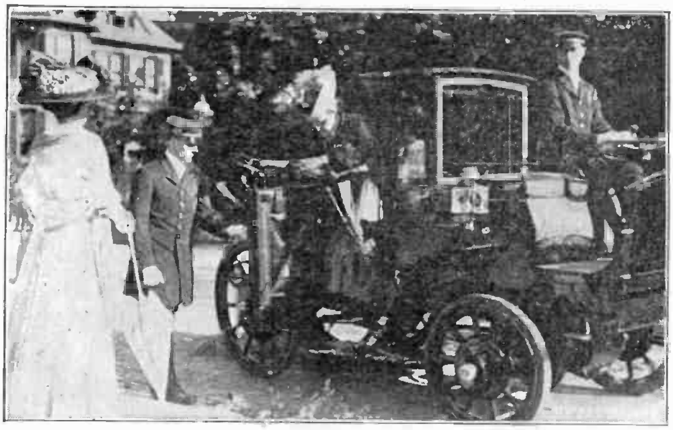
The President of the United States has several electrics in the garage at the White House. One of these is a phaeton which was purchased for the use of Mrs. Taft, but ill health overtook the First Lady of the Land and in consequence the operation of this natty machine upholstered in the official blue and bearing a representation in colors of the seal of the United States, has devolved upon Miss Helen Taft, the only daughter. The other Presidential electric is a package and baggage wagon which is employed to transfer the Presidential baggage to and from railway stations, for carrying parcels, etc. This car, which has a carrying capacity of 1,000 pounds, has a $2\frac{1}{2}$ horse-power motor with 300 per cent overload capacity.

The women of the Roosevelt family are enthusiasts on the subject of the electric automobile. The former Miss Alice Roosevelt soon after her marriage to Representative Nicholas Longworth received from her husband an electric car. She has made use of this machine continually, invariably driving it herself, and when Congress is in session she makes it a regular practice to motor to the Capitol daily about the time her husband may be expected to conclude his legislative labors. Other electrics frequently seen at the United States Capitol are those of Senator Wetmore, Senator Depew and others.

Oddly enough, perhaps, the electric rather than the high power steam or gasoline touring car is the favorite vehicle of the two most prominent bachelors in Federal officialdom—Postmaster-General Frank H. Hitchcock and John Barrett, the director of the International Bureau of American Republics. In the Cabinet circle the electric is generally popular. George von L. Meyer, Secretary of the Navy and the wealthiest member of the President's official family, has ample means to indulge in whatever type of horseless vehicle pleases his fancy, but his preference for the electric has remained unshaken and his two daughters—conspicuous because they always dress exactly alike—have an electric of their own which is in almost constant use.

Among the members of the Diplomatic Corps—the foreigners stationed in this country as the official representatives of sovereigns and governments—the adoption of the American-made electric automobile has been extensive. The Dean of the Corps, Baron

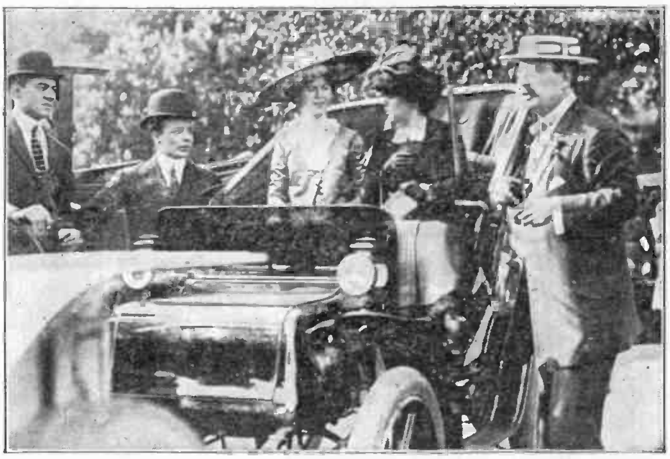
German diplomats—Lieut. von Bruening, attache of the German Embassy, at the lever, accompanied by A. C. Horstmann, attache of the embassy.



The electric automobile of Senator Wetmore.

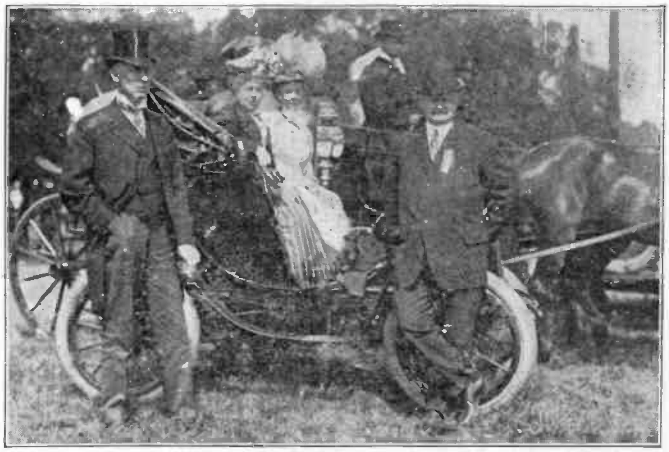
The President's electric baggage and package wagon at the White House.

A Roosevelt electric auto-party. Right to left—L. Anderson, Alice Roosevelt Longworth, Mrs. Theodore Roosevelt, Jr., Theodore Roosevelt, Jr.



The Misses Meyer, daughters of the secretary of the Navy, in their electric automobile.

Left to right—Perry Heath, capitalist and politician, Mrs. Conway, his mother-in-law, Mrs. Heath and P. V. DeGraw, Fourth Assistant Postmaster General.



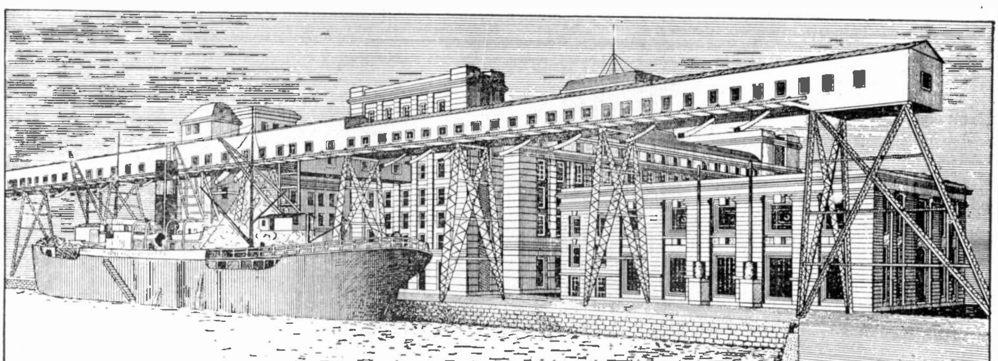
Hengelmuller of Austro-Hungary and the Baroness Hengelmuller have made extensive use of the electric and so have many of his colleagues, not forgetting the Chinese diplomats, especially Mr. Yung Kwai, the Secretary of the Chinese Legation, and his American wife. However, the particular stronghold of the electric automobile in our official "foreign colony" is the German Embassy, not only the Ambassador, Count von Bernstorff, but several of the secretaries and attachés owning and operating cars of the magic current.

Legion, indeed, is the name of the women prominent in official and social circles who make use of electric automobiles. Mrs. Larz Anderson, the Boston heiress, has one of the finest electric phaetons in America. It has space with other cars in perhaps the finest private garage in the United States—a $25,000 structure that accommodates seven cars. Mrs. John Hay, widow of the late Secretary of State; Mrs. George Pullman, widow of the car builder; Mrs. Albert Clifford Barney, who inherited the millions of the Pike family of Cincinnati, and Mrs. Walsh, widow of the Colorado "mining king," constitute a quartette of wealthy widows who own electric autos which in some instances were built specially to their order. Comparatively few of the prominent people who own electrics keep them at public garages. Indeed, one of the advantages of this type of motor car—with its freedom from dirt, noise and odors—is that it can be kept unobjectionably on the premises of the most restricted city residence where, perforce, the garage must be very close to the dwelling, if not, in effect, a part of it. Some devotees of electrics, as, for instance, Madame Hauge, the wealthy American widow of the late Minister of Norway to the United States, have had a garage for electrics provided as a "lean to" of the mansion proper—the electrical charging equipment thus being under the owner's personal direction at all times.

ELECTRIC GRAIN HANDLING IN ROUMANIA

Fancy a pair of fireproof grain elevators, each with a storage capacity of 35,000 tons of grain; a dock alongside these elevators 2000 feet long; an elevated conveyor and shute structure capable of loading the grain simultaneously into five vessels behind one another (or into ten ships if placed in two rows); a series of 18 parallel tracks for taking railroad cars to the elevators, docks and to the power station from which all the conveying and other machinery is driven electrically: Does not that sound like Electrical America? Like some gigantic enterprise worthy of Duluth, Chicago or Seattle?

Yet it is neither on the Great Lakes nor on the Pacific coast that we find this particular instance of progressiveness, but over on the Black Sea in one of those little known countries which occasionally send some of their brightest young men to us as unappreciated immigrants.



SHOWING SIZE OF ROUMANIAN ELEVATORS

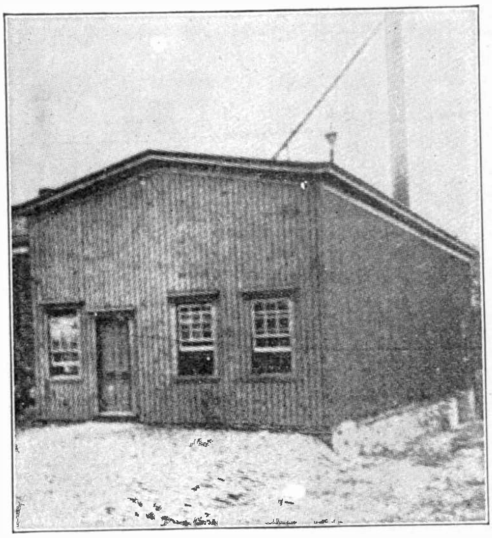
The Story of Sunbury Station

By W. S. ANDREWS

Towards the close of the year 1882 Mr. T. A. Edison requested the writer to have some tests made on a new system of electrical distribution which he had invented. This was no other than the famous "three-wire" system which has since come into almost universal use where electricity is distributed for light and power purposes.

The tests desired by Mr. Edison were simple, so they were quickly made and the results were found so satisfactory that immediate steps were taken to put the new system into practical commercial service.

The picturesque little city of Sunbury on the Susquehanna river away up among the hills of Pennsylvania was selected for the plant, and a force of workmen was sent there early in 1883 to build the lighting station, erect the pole lines, and "wire" the stores and dwellings.



THE SUNBURY STATION, 1883

The "station" was a small wooden structure located some distance from the business center of the town and it comprised a boiler room, engine and dynamo room and a meter room.

The boiler was of the Babcock and Wilcox type and the generating plant consisted of two "L" dynamos belted to a high speed Armington & Sims engine, the total capacity being about 650 10-candle-power incandescent lamps. The "bus-bars" were made by straightening out some No. 000 copper wire left over from the line construction, and these wires were fastened to the wooden sheathing on the station walls with iron staples without any attempt at insulation and with the fond idea that this was exactly the right thing to do. The switchboard instruments consisted of two voltage indicators which were connected by "pressure wires" to the end of the three-wire "feeder" where it joined the "mains" at the center of electrical distribution, also one ammeter which was interpolated in the "neutral bus" to show how the system "balanced." As compared with instruments now in every day use, these indicators were of crude construction and doubtful accuracy. They were, however, the very best product of that period, having been designed especially for the purpose by Mr. Chas. L. Clarke, and made by Bergmann & Co.

The installation of the electrical apparatus was intrusted by Mr. Edison to Lieut. F. J. Sprague and the writer, and the work was completed on July 4th, 1883. Mr. Edison had arrived in Sunbury the previous day, and it was planned to start the electric lighting plant commercially on the evening of the fourth.

About 5 p.m. therefore preparations were made for starting, but the dynamos refused to "pick up." "There must be a loose connection somewhere," said Mr. Edison, but they were all carefully examined and found tight and sound. Matters began to look rather doubtful for "lighting up" that evening, when it was suggested that there might be trouble on the outside wires. They were accordingly disconnected from the station "bus" and the engine was again started. This time the dynamos worked all right, proving that the trouble was outside of the station. Mr. Edison and the "gang" therefore went out on a tour of investigation, leaving the writer to mind the station. In a short time a "cross" between two "feeder" wires was discovered and quickly straightened out. Fortune now smiled on us, the outside lines were again connected, the lamps in the station came steadily up to candle power and a general rush was made "down town", by all hands that could be spared.

The "City Hotel" was the largest "wiring job" and we found it radiant with the new light. Expectant excitement had given place to loud expressions of wonder and delight among the townspeople who thronged the hotel, and thus was the first Edison three-wire central station started up on the Fourth of July, 1883, amid the firing of cannon cracke s and other pyrotechnical displays common to that day.

Mr. Edison remained in ,Sunbury for about a week after the starting of the station, to give instructions regarding the handling of his new electrolytic meter and to study in general the electrical and commercial operation of his new system.

The meters were of the old style Edison type wherein the current is measured by the loss in weight of one of the two zinc plates by electrolytic action. At the end of the first month, the meter plates were collected and weighed, and the bills were calculated from the loss in weight of one plate. Most of the amounts thus made out came very close to the estimated figures, but a meter in a large clothing store indicated that about $200.00 worth of current had been used. As this was an impossible amount, a bill based on a moderate estimate was sent in. The meterman spent several anxious days and nights trying to think out where the mistake had occurred, for Mr. Edison had firmly imbued him with the belief that the meter was infallible. At length it suddenly dawned upon him that he had weighed the meter plates to a tenth of a milligram at the station, but on arrival at the clothing store he found that the copper wires connected to the plates were too long to go into the meter case, so, without any thought as to the consequences, he just clipped off an inch or two of copper wire, which represented about $150.00 worth or more of electricity when measured by loss of weight. Moreover he found the pieces of copper wire that he had cut off, and on weighing them up and making proper allowance he found that the "faked" bill that had been presented was not far from being correct.

Like many of the earlier of the Edison stations, the Sunbury plant was started at sundown and ran until daylight, thus saving the expense of paying two shifts of engine and dynamo attendants.

At this time (1883) no such fittings as "fixture insulators" were known and it was common practice to fasten the electric wires to the outside of gas fixtures with tape or string and connect to sockets, which were screwed to attachments held in place under the gas burners. Rubber insulated wire was unknown, cotton covered wire soaked in paraffin or coated with white lead being all that was available. The latter was commonly termed "Underwriters' wire," although it was occasionally called "Undertakers' wire" by would-be humorists

The insulation of these wires was naturally rather weak and it was no uncommon occurrence to see bright sparks snap between a gas fixture and the attached wire during a thunder storm, to the astonishment and alarm of the uninitiated.

Shortly after the Sunbury station was started a heavy thunderstorm occurred early one evening. A breathless messenger rushed into the lighting station while the storm was at its height, and gasped out that the "City Hotel" was on fire. Naturally the writer lost no time in getting there. He found the proprietor and his guests standing out in the street, exposure to the pouring rain being considered vastly preferable to being burnt up by electricity.

Going into the Hotel office, bright sparks were observed at short intervals snapping between the gas fixtures and the electric wires. One or two "short circuits" at weak spots had "blown" a few fuses, but the points of low insulation being thus eliminated no further damage was done, and the snappy sparks were harmless.

The writer after taking in the situation went out and assured the crowd that there was no danger to be feared from the electric sparks around the fixtures, so with some trepidation a few of the bolder spirits ventured into the hotel. Some explanations naturally were requested and in order to restore a measure of public confidence in the electric wiring, which was naturally blamed for the scare, the writer had to strain his conscience to some extent in stating that the hotel had certainly been struck by the lightning, and that in all probability it would have been burnt to the ground had it not been protected by the electric wires, which provided an easy passage for the lightning to the ground.

This incident was reported to Mr. Edison and it led to the invention of "insulating joints" by our late lamented friend Mr. Luther Steringer. These joints, being screwed between the grounded pipes and the gas or electric fixtures, prevent the leakages which so much alarmed our friends in Sunbury. In various shapes and sizes, but with no important improvements these insulating joints are still universally employed, their use being stringently enforced by the National Board of Underwriters.

The interior wiring of the Sunbury electric lighting station, including the running of three-wire feeders the entire length of building from back to front, the wiring up of dynamos and switchboard and all instruments together with busbars, etc., in fact all labor and material used in the electrical wiring installation amounted to the sum of $90.00. The writer received a rather sharp letter from the New York Office, expostulating on this "extravagant expenditure," and stating that greater economy must be observed in the future! Our ideas of expense necessary to proper central station equipment have undergone considerable expansion since the early days of the Sunbury plant.

The two "L" dynamos originally installed on this plant gave regular commercial service for about 20 years, and were then set aside for occasional use as spare machines. Together with the original Armington & Sims engine, they were sent to the St. Louis Exposition in 1904 and formed an interesting item in the "Collection of Edisonia" there exhibited. They were then practically in as good operative condition as when they were first installed in 1883, this bearing testimony to the rugged and durable structure of the original Edison dynamos which were admittedly built for long service rather than for elegant appearance.

Lightning and Blast Furnaces

The smoke from a blast furnace in operation contains a good deal of water and carbon dust and often extends upward to a considerable height. Repeated instances of lightning entering the chimney and passing down through the furnace charge, through the pig iron and to earth seem to indicate that the column of hot air, moisture and carbon issuing from the chimney furnish a better conductor for a lightning discharge than a lightning rod, judging from the instances where the rod remained undisturbed by the lightning stroke.

Dynamo Building an Exact Science

The days of the "cut and try" method in dynamo designing have long been left behind, at least in so far as our customary types of generators are concerned. Planning them has become a most exact science in which every factor entering into the design must be carefully considered and in which every effect can be closely estimated before the real building begins.

For instance, in armatures it is generally desired that the temperature after running for hours at full load shall not exceed 140° F. (or 60° C.) and as the resistance of the wire increases with the temperature, this resistance has to be figured for the expected maximum temperature. Then allowances have to be made for the cooling influence of the air on the outer layer (or for air-cooling in a ventilated armature), for the heating due to eddy currents set up in both the copper winding and the armature core, and for heating due to magnetic hysteresis. These factors are all interwoven with each other, also with the shapes and sizes of the field magnet and its polepieces; these relationships have been worked out in the form of fairly exact curves and formulas, by which the designer can be guided. That is why so highly efficient types can be designed on short notice, for it is only an exact art that permits the ready obtaining of predetermined results.

Electric Bleaching Preserves Health

Will electrolytic bleaching some day be compulsory in place of the now common use of chloride of lime by laundries as well as paper mills? Perhaps it is too early to predict this, but no one can deny that the fumes arising from the chloride of lime make it unhealthy to handle and that it leaves an obnoxious residue when used for bleachign purposes. When this residue is allowed to run into a stream (a situation not unusual even in this enlightened country) it pollutes the water, killing the fish and often undermining the health of the adjacent community.

With the electrolytic method there is no such objectionable residue, nor is there any danger to health in handling the needed materials which are simply water and common salt. Incidentally it also saves time as there is no waiting for the chloride of lime solution to clear itself.

Talks With the Judge

THE ELECTRO-MAGNET

"When I was a boy I had a horseshoe magnet to play with," remarked the Judge reminiscently. "It was simply a piece of iron which would pick up needles and other small pieces of steel or iron. To me and to most people a magnet is a magnet, and when one is spoken of our minds immediately revert to that little horseshoe. But lately, since I have been reading up a little on electricity, at every turn I come across the word 'electro-magnet.' Now what is an electro-magnet? If it is the same as an ordinary magnet why in thunder do they want to complicate things and puzzle us by calling it an electro-magnet? When a writer in a Sunday Supplement story is telling a yarn about some mysterious application of electricity and he comes to some tough thing to explain he says it is done by electro-magnets, or may be a 'maze' or a 'myriad of electro-magnets,' knowing very well that the layman will swallow it and nine times out of ten never stop to question what an electro-magnet is."

"There, there, don't get excited, Judge," I replied. "There is no intent to mystify. The electro-magnet is a little different from the ordinary magnet with which you were wont to satisfy your youthful desire to study into the laws of Nature—and which desire, I might say, does not seem to have abated along with the hair on your well proportioned cranium. Before explaining further what an electro-magnet is I might take the opportunity to say that it is some way connected with and indispensable to almost every application of electricity which you see about you. Take all of the electro-magnets out of the world and every dynamo and motor would cease to hum; the telegraph would click no more; the telephone would become 'dead' as the proverbial door nail and after an evening of mildest Apollinaris and lemon seltzers you still would stab at the button of your door bell to no avail.

Our Minds Revert to that Little Horseshoe

"There are two kinds of magnets—the 'permanent magnet' and the 'electro-magnet.' The former is the common or 'garden variety' known for centuries. It is a bar of rather hard iron or steel which, once magnetized, will retain its magnetism a long time, although its lifting or attractive power is comparatively weak at best. The latter is what might be termed an 'artificial magnet,' that is, we may put the magnetizing force into it or take the force away at will.

"This is the way in which an electro-magnet works: We know that a wire carrying electric current has formed around it a field of magnetic force, which is strong in proportion to the strength of the current flowing in the wire. The theory is that this field of force is of the nature of invisible lines of force encircling the wire, and as you look along the wire in the direction in which the current flows the lines are circling around the wire in the direction in which the hands of a clock move.

This you must understand is theory, so far. No one can see the lines of force, but the theory fits the facts of phenomena which we are able to observe, and as long as the theory does not 'fall down' before the results of actual experiment we may safely base our arguments upon it.

"Now if you take that same wire which is carrying current and form it into a spiral coil you have what is called a 'solenoid.' Remember that the lines of force are still encircling the wire in each individual turn of the spiral. Therefore the tendency is for all these lines of force to thread down through the hollow spiral and up along the outside, or vice versa, depending on which end of the solenoid you are looking at. Then, strange to say, the solenoid, as a whole, takes on the properties of a bar magnet. That is, one end of the solenoid is a north pole and the other a south pole. Suspend it carefully by its middle and it will point to the north magnetic pole of the earth the same as a compass needle. All this, remember, is due to the current flowing in the wire. There is no permanent magnet present.

"Then, just one step further and we have an electro-magnet—slip inside the coil a bar of iron. Now turn on the current and the iron bar becomes a powerful magnet—hundreds, perhaps thousands of times stronger than any permanent magnet ever made, depending on the strength of the current flowing in the wire and the number of turns of wire in the coil—called the 'ampere-turns.' Turn off the current and the iron ceases to be a magnet except for a very little magnetism left in it, called residual magnetism. The explanation is that the lines of force threading through the coil saturate the iron with magnetism to a far greater extent than any other known way of magnetizing.

"Thus you see an electro-magnet means simply a bar of iron around which is wound a coil of wire, the wire carrying a current of electricity.

"But what marvelous things that discovery brought about. It made practicable dynamos and motors, for the 'fields' of these machines are nothing more than electro-magnets wound with many turns of wire and forming between their poles magnetic fields of great intensity in which the armatures turn. The sounder of a telegraph instrument which clicks off the messages is an electro-magnet, the iron cores becoming magnetized and drawing down the armature only when the distant operator presses his key and sends current through the coils around the cores. In a telephone exchange, back of the switchboard, there are thousands of electro-magnets working. When you take your receiver from the hook you allow current to flow around their coils. Their little cores then become magnets which attract armatures, thereby closing little local circuits which light the lamps on the switchboard so that the operator knows when you take down your receiver, when you hang it up, when your party answers and all that. Again great electro-magnets are used to lift pig iron, steel rails, cargoes of nails, etc.

"In fact, as I have said, you can scarcely name an electrical operation that is not in some way dependent on an electro-magnet."

Light Motors for Air Ships

Now that new types of storage batteries are increasing the output per pound of battery and thereby reducing the weight of battery required for a given supply of energy, it will not be long before we may expect a return to electricity as a source of power for aerial vehicles. The original electrically driven balloon as navigated by the Tissandier brothers in 1884, and as pictured in our July issue, had a motor weighing 121 pounds, which developed a maximum of only 1½ horse-power. This weight ratio of 80 pounds per horse-power was speedily cut down by other experimenters so that by 1887 another French investigator, Trouvé, of storage battery fame, brought out one weighing only 3⅛ ounces and giving 1-38 horse-power—a ratio of a trifle over 7½ pounds per horse-power!

Since that time there has been a lull in the development of light motors for aerial navigation, due largely to the persistently prohibitive weight of the needed batteries, which weight has only lately been reduced to more reasonable figures. Thus while the primary battery used by the Tissandiers weighed over 300 pounds per horse-power-hour of output, we can today secure storage batteries of one-twelfth that weight for the same available energy. Now the question is, how much have the developments of the last 23 years taught us to reduce the motor weight below the mark set at that time by Trouvé?

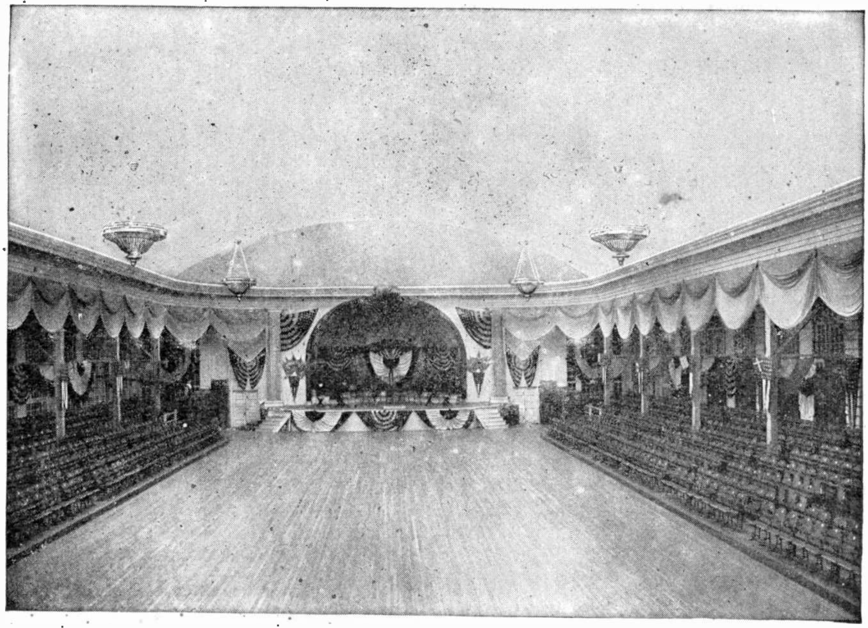
Indirect Illumination for the Steel Pier

The interior of the auditorium of the Steel Pier at Atlantic City, N. J., shown in the picture, will be familiar to many, as there are from one to two million annual paid admissions to the pier. This auditorium is used for dancing, conventions, musicales, exhibits, and on Sunday evenings for sacred concerts.

The direct lighting previously used was very unsatisfactory, and the management was desirous of securing the most comfortable and efficient illumination possible. In casting about for a proper method, Mr. Bothwell, the manager, hearing of the beautiful results secured in the South Shore Country Club Auditorium, of Chicago, by the "Eye-Comfort" indirect system of illumination, visited that city for the express purpose of an investigation, and as the result he ordered a similar installation.

The finest print can be read comfortably at any point in the room on the pier. A person can enjoy to the fullest any event now held in this place, being entirely relieved of the irritating, annoying glare so commonly experienced in auditoriums of almost every size.

This interior is 161 feet long by 100 feet wide, containing 16,100 square feet, the ceiling being 36 feet eight inches high in the center, and gradually sloping to the sides which, directly over the seats, are 27 feet from the floor. The ceiling is wainscoted and painted white, having no beams or other obstructions. The sides of the building are practically all glass. The musicians' platform, as shown, is 31 feet in width by 25 feet in depth. This platform is illuminated with a row of incandescent lamps around the upper part of the shell, which are hidden from the hall by a curtain for the purpose. They are, however, but seldom used, as the indirect illumination from the main auditorium is sufficient for the ordinary uses.



INDIRECT ILLUMINATION IN THE STEEL PIER, ATLANTIC CITY, N. J.

Twenty of the diffusing type of reflectors were grouped in each of the six fixtures, each containing a 100-watt Mazda lamp and hung six feet from the ceiling. This gives a total consumption of 12,000 watts, or that of 240 ordinary 16 candle-power carbon filament lamps. The skeleton fixtures are encased in artistic composition bowls. As is known such composition fixtures can be given any metallic finish to harmonize with the decorations in any interior.

Where Electricity Stands in the Practice of Medicine

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

CHAPTER IX.—STATIC ELECTRICITY

When Thales, more than 600 years before Christ, discovered that amber when rubbed attracted small objects, the electricity he produced was static electricity; electricity produced by friction. The modern static machine is an elaboration of the principle of frictional electricity, plus induction or influence.

There are several types of static machines, the reader being referred to any text-book on physics for description.

When I make the statement that the use of static machines is on the wane, I shall call down upon my head vials of wrath from the many users of these machines throughout the country. My statement, however, is not based on the therapeutic value of the machine, nor intended to discredit the latter.

One great reason for the popularity of the static machine has been the fact that it produced its own electricity and could be operated independently of an electric current. Thus in towns where no lighting plant existed or where the same was only in operation part of the day, the static machine was the most suitable machine to use, as it could be run by a gasoline or water motor or even by hand power.

The rapid spread of electric plants, so that few cities are without current, together with the great improvements made in induction coils, is largely responsible for the decreased demand for static machines.

In addition, the static machine calls for considerable care and frequently fails to work at a crucial period so that coils have grown in favor with the medical profession for X-ray and high frequency work.

There are many physicians who believe the effect of the static current itself to be purely psychological; that is, suggestion. Others ascribe to it properties that would make it useful in practically all known diseases.

Between these two we find the truth. The static current is capable of producing a definite physiological action upon the system, although at the same time there is undoubtedly some result due to suggestion, just as there is with most medical measures.

The static machine produces and delivers a current of high voltage but low amperage. It is not our province to go into the physics of the machine, but to consider the nature, physiological effects and use of its discharges. The latter have been classified as convective, disruptive, and conductive.

A summary of the methods of administration included under each is as follows:

a. Convective
1. Positive or negative static insulation.
2. Static spray.
3. Static breeze.
4. Brush discharges.
5. Vacuum tube discharges.

b. Disruptive
1. Direct spark.
2. Indirect spark.
3. Friction sparks.
4. Leyden jar sparks.

c. Conductive
1. Static induced current.
2. Wave current.

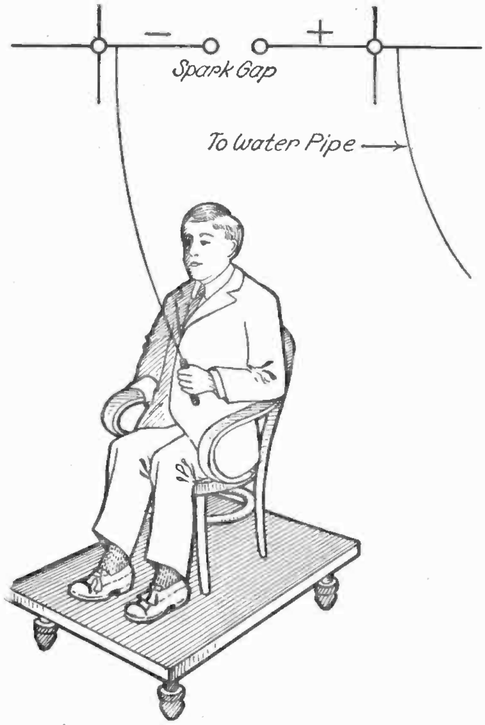
In static insulation the patient is seated in a chair on the insulated platform and then connected with either the positive or negative terminal of the machine, according to the effect desired, while the other pole is grounded, that is, attached to a water or gas pipe or other conductor communicating with the earth. The terminals are first separated beyond sparking distance.

Positive insulation is stimulating; negative insulation soothing.

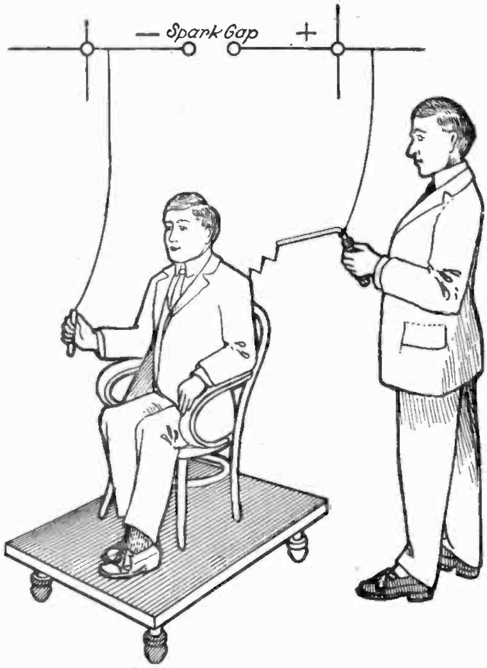
In the static breeze the patient is also upon the insulated platform and connected to either pole, while the other is connected to the metal rod supporting the crown electrode, the latter being a foot or two above the patient's head.

When the spray is given the arrangement is similar, but instead of the crown the attachment is to a pointed electrode held in the operator's hand by means of an insulated handle. As this point is brought near the patient a fine spray is produced.

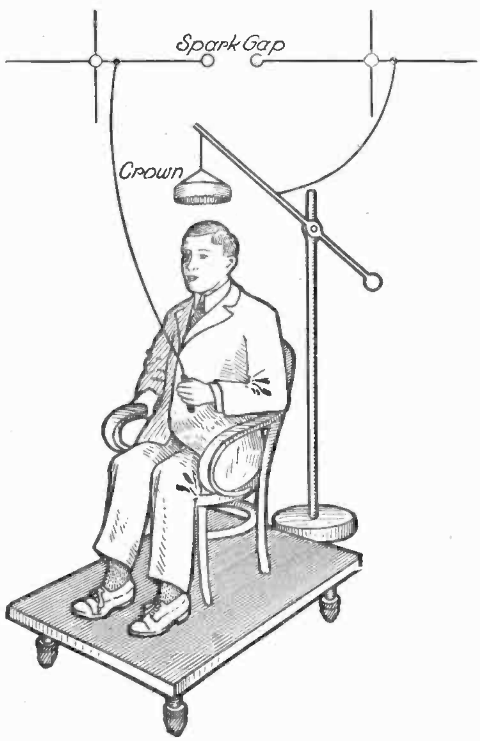
With brush discharges, a soft wool is interposed, so that the electrode discharges through it.



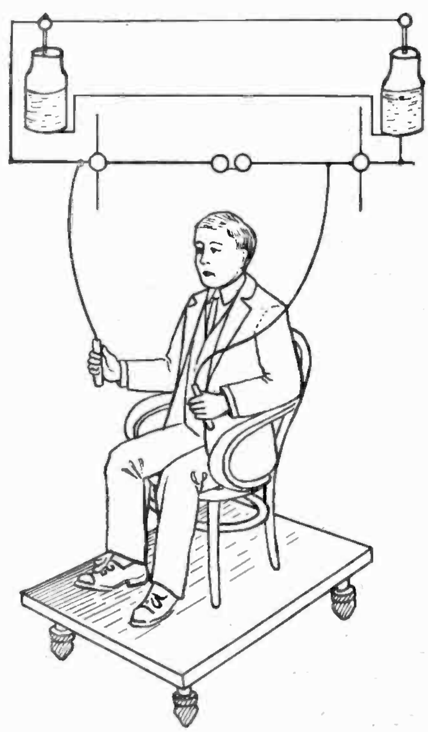
STATIC NEGATIVE INSULATION



DIRECT SPARK



STATIC BREEZE OR SPRAY



STATIC INDUCED CURRENT

When vacuum glass tubes are used the patient need not be on the insulated platform. The tube is attached to the negative terminal and the positive is grounded. The prime conductors (terminal sliding rods) are in contact, being separated slowly until the desired amount of current is produced.

When direct sparks are employed the platform is brought into use. The patient is attached to the positive terminal; prime conductors widely separated; and a ball electrode used by the operator. The direct spark is painful.

The indirect spark is not as severe and is obtained by grounding the negative side of the machine and then attaching the cord from the ball electrode also to a "ground," such as the water pipe.

In employing the static induced current the patient may or may not be placed on the platform. The prime conductors are touching; the Leyden jars on; their outer layers connected to metal electrodes in contact with the skin over the areas to be treated. The sliding rods are then very slightly separated, or preferably a muffler (a small spark gap in a glass tube) is hung over them which admits of greater regulation of the distance. Powerful muscular contractions are produced by this method.

With the wave current, the insulated patient is connected to a positive terminal and negative is grounded. Use Leyden jars; slow speed; insulated platform three feet or more from machine; Prime conductors at first touching and then very slowly and slightly separated.

The general effect of static electricity is analogous to high frequency currents. The effect on the circulation is to lower arterial tension and lessen the frequency of the heart's action. At the same time the volume of the pulse is increased.

There is an increased elimination of carbonic acid and the respiration is improved.

On the nervous system a soothing effect is customary. There is a general increase in nutrition and metabolism and in the bodily secretions. There is also increased elimination of urea.

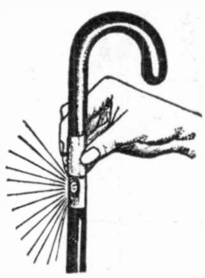
In using the static machine it is necessary to know the polarity of the terminals. There are several rules for this, but the simplest and most reliable one that I know of is the use of a round piece of wood (such as a section of a broom handle), placed in contact with the terminal when a spark is passing. If it is the positive, the spark runs around or follows the wood, if it is the negative the wood apparently repels the spark.

The static machine must be kept free from moisture or it will not work. Keeping chloride of lime in a porcelain dish inside the case is the method ordinarily employed.

(To be continued.)

An Electric Light Cane

Carrying a pocket flashlight has one drawback for the fastidious dresser: it may in time draw the pocket out of shape, besides always bulging it out. For such a man the cane form solves the problem, consisting as it does of a cane with a slender flashlight inserted near the handle. By sliding or turning a metal sleeve as shown in the illustration, the current is turned on and the miniature lamp sheds its beams on the way or on the keyhole.

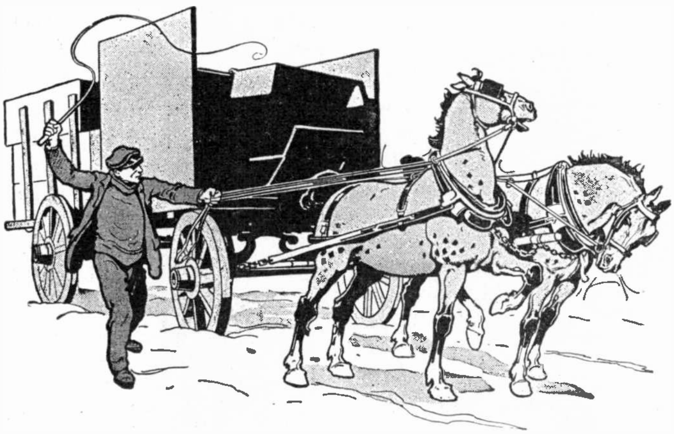


Three-minute Stair Lighting

In this country the average landlord either turns the hall lamps off altogether at midnight, or else leaves only a very dim illumination. The German owner of apartment buildings is perhaps wiser, for he considers the dim lighting insufficient and yet does not want to light the halls brightly all night long. What he does is to light the halls and staircases brightly until midnight, after which time a system of pushes enables any late comer to turn on all the lights for a period of three minutes, at the end of which time the lights go out automatically.

The whole system of hall and stair lights is controlled by a pendulum clock so adjusted as to turn the hall lamps on and off at the desired hours. In turning them off it switches the current to the emergency lighting circuit which is controlled by a pushbutton at each stair landing. Pressing any button operates a little clock-switch which turns on all the stair lights and automatically turns them off again at the end of three minutes, though the time can be adjusted to a shorter or longer period if desired.

The Problem and the Solution



THE PROBLEM

No more forceful statement is made in Mr. Edison's article in the June Popular Electricity than this:

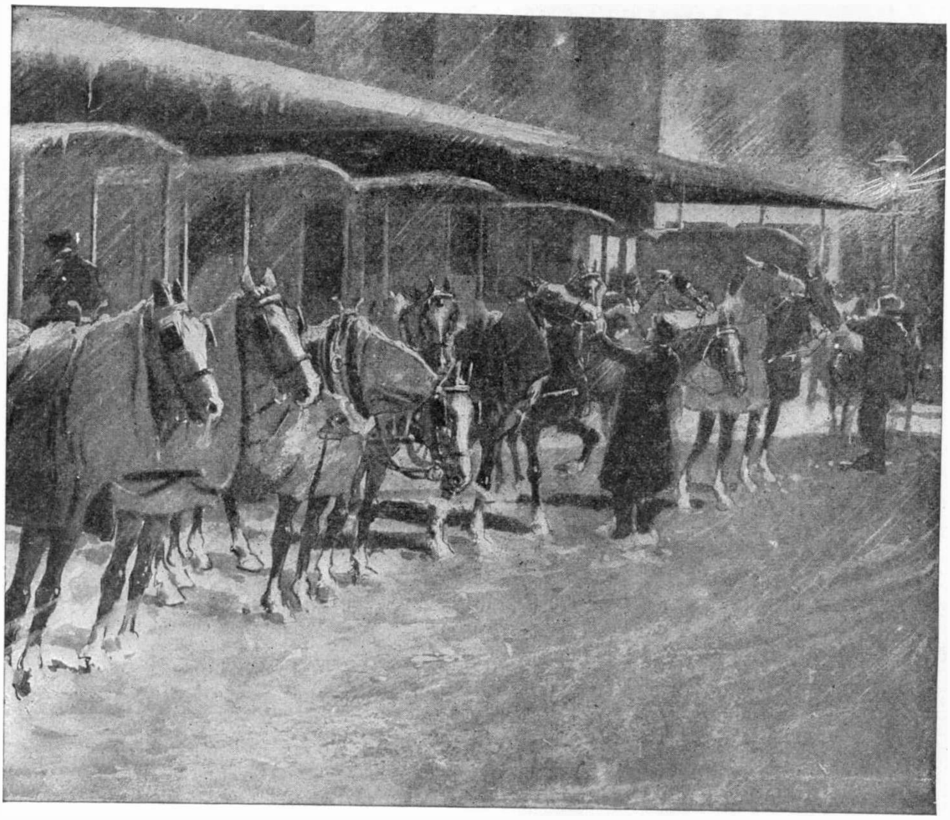
"There is absolutely no reason why horses should be allowed within city limits, for between the gasoline and the electric car, no room is left for them. The cow and the pig have gone, and the horse is still more undesirable."

The two pictures on this page tell the story of electric motor vehicle economies—the ability of a power wagon to do the work of twice as many horse drawn trucks by reason of its greater power. By inference we realize the reduced fixed charges for stable room and attendance, fewer delays and greater capacity to meet emergencies.

From the civic viewpoint one has visions of clean streets, reduced spread of disease germs by street dirt, of emancipation from overcrowded thoroughfares and the unceasing din and confusion of congested traffic.

Motor vehicle economies are largely measured by the pay roll. It costs more to keep a motor truck than a horse truck, but it costs no more *to man* one than the other and the motor does twice as much work. The motor truck reduces the delivery and stable pay roll from 30 to 50 per cent. That's where the main saving comes.

THE SOLUTION



CONTRAST THIS FAMILIAR SCENE WITH THE POSSIBILITIES OFFERED BY THE UNIVERSAL ADOPTION OF ELECTRIC WAGONS

The limit of a motor truck's economies is the limit of the driver's physical capabilities. The average motor wagon can make more delivery stops than any driver can handle. Viewed as a business organization problem, a change from horses to motor trucks gives full play to executive ingenuity in getting 100 per cent work out of every pay roll dollar.

Time and again have these statements been borne out in actual practice. Why, then, are struggling teams of horses permitted on the streets of cities? They move slowly and require twice the space of an electric vehicle, thus adding to the congested traffic conditions which are daily becoming more alarming. In spite of the work of anti-cruelty societies cruelty to animals still exists.

The answer lies in the fact that people are slow to make changes so radical as would be the universal adoption of electric trucks even when such changes would result in actual economy.

But nevertheless, the day is sure to come eventually.

As the electric car in the past has revolutionized passenger traffic in our cities, so is the electric vehicle even now revolutionizing the trucking and delivery business.

Stand on a crowded down-town corner and see the electrics thread their way in and out among the teams. Or perhaps late in the afternoon, on some tributary street leading off into the suburbs, watch for the great trucks from the department or wholesale stores, piled high as small houses with their five or six tons of boxes and crates and see them whiz by as fast as the street cars are allowed to go. Then ask yourself the question:

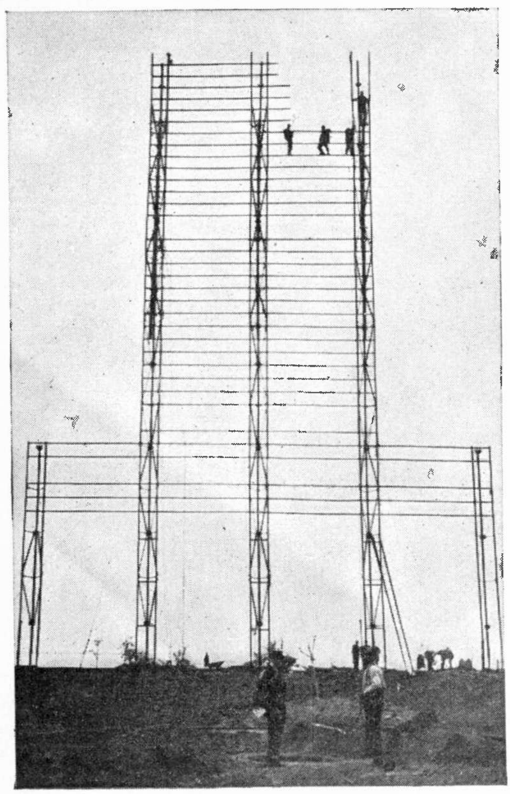
"How many more years shall we give the horse?"

LARGEST SIGN IN THE WORLD

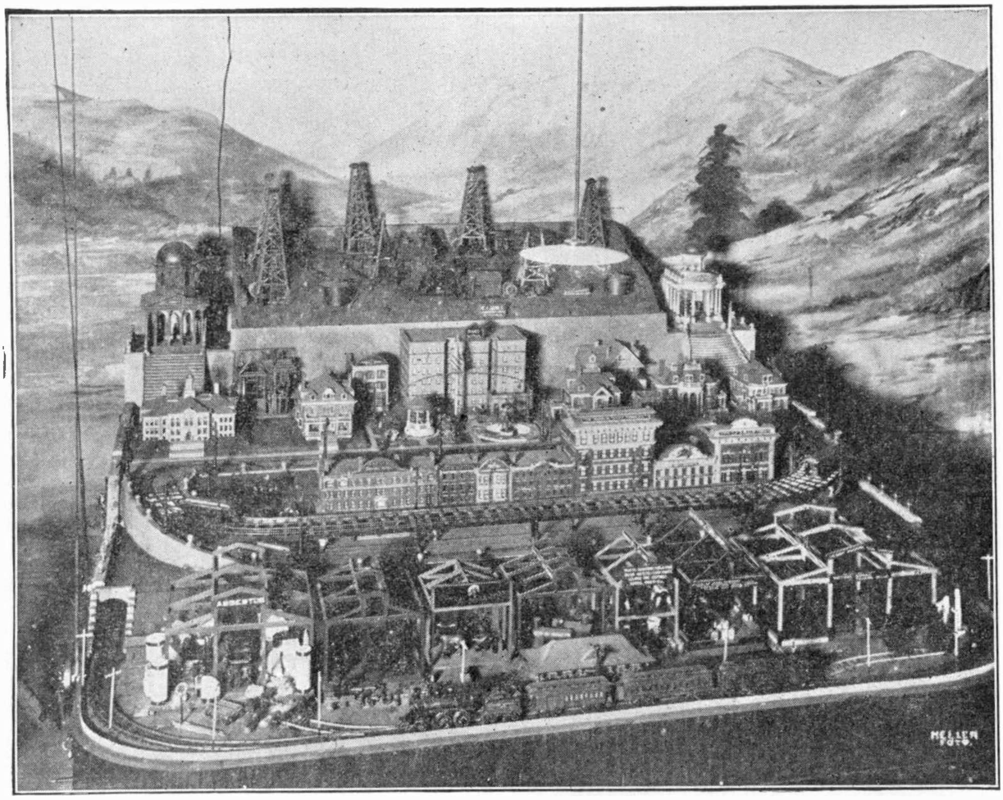
For three years preparations were under way for the thirty-first triennial conclave and grand encampment of Knights Templars of the United States, which was held in Chicago, August 7 to 13.

These pictures, show the beginning of the task of transforming the city, which was to entertain no less than 100,000 visitors, into one vast red and white installation of thousands of electric lights. These were arranged to represent the various emblems of the visiting knights and bring back by flaming arches and battlements the architecture of medieval days. The electrical work for this great spectacle was installed and patroled by the Thomas Cusack Company, S. W. Van Nostrand of that company and Gorham B. Coffin, acting for the conclave committee, planning the features.

Located on the lake front Park was the most stupendous undertaking of all—the construction of the official badge of the encampment reproduced in colors and studded with more than 4,000 tungsten lamps. Something of its immensity is conveyed by the picture showing the men upon the steel work, which placed the helmet at the top of the badge 133 feet in the air. To support this, the base measured 64 feet across and rested on concrete piers six feet square extending to a depth of 18 feet into the earth making the emblem the largest and highest electric sign in the world.



THE GREAT EMBLEM SIGN RISING TO A HEIGHT OF 133 FEET



A CITY IN MINIATURE

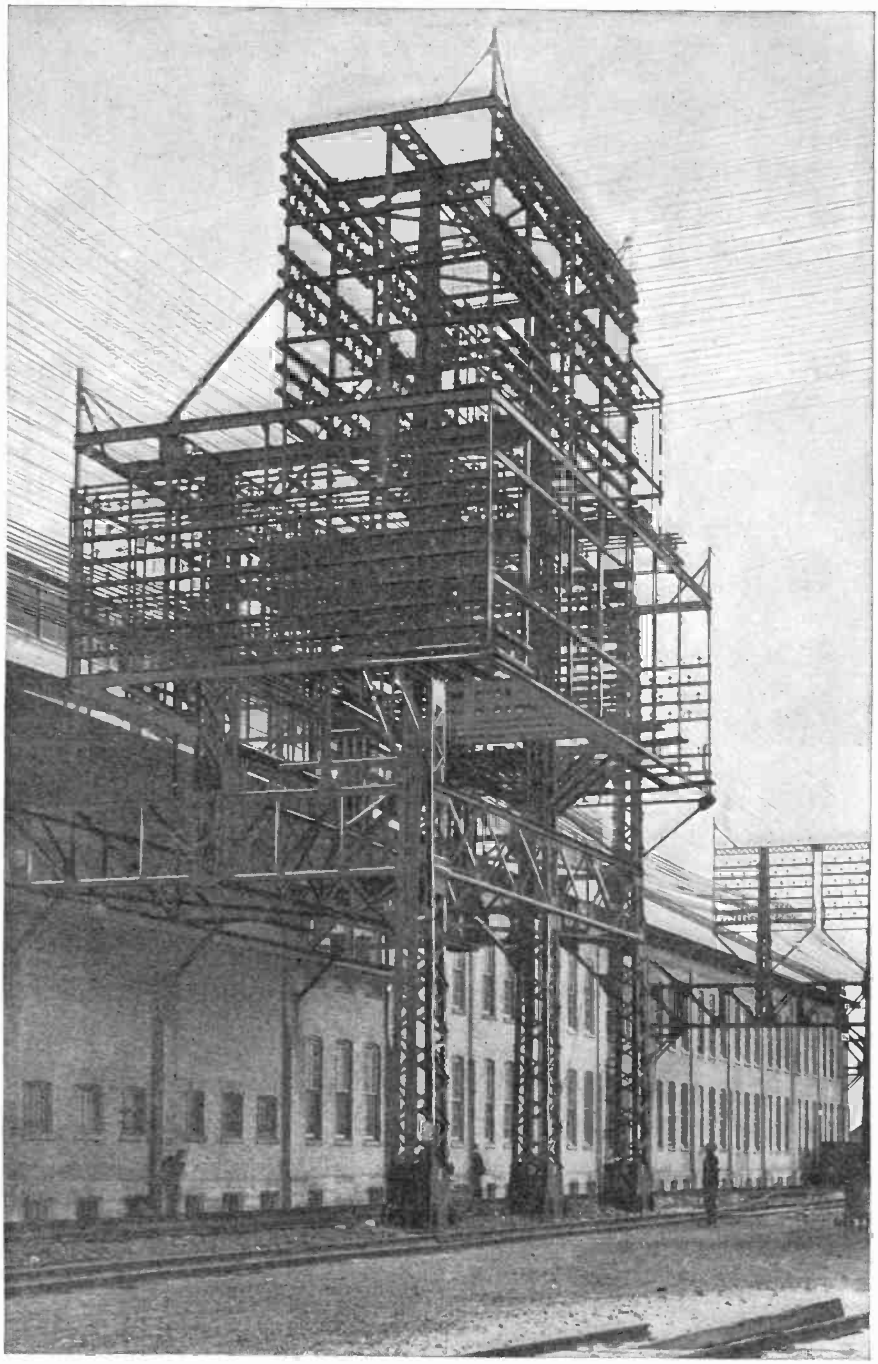
Some years ago Chas. Mihleder of Franklin, Pa., conceived the idea of representing in miniature a city perfect in detail as far as possible.

Eight years of patient work and study were required to carry out the idea, which is here shown in a picture taken at Riverview Park, Chicago, where the model city is on exhibit.

Built on an inclined plane, the city covers an area of 225 square feet, but was so carefully planned that even with its four miles of electric wire it can be taken down and packed ready for shipment in less than an hour. The stores, dwellings, and public buildings are exact representations of these buildings in Franklin, Pa., while the industries of the city including the adjacent oil fields, are portrayed.

During his lecture Mr. Mihleder says, "I did not build my city to a scale but made it pleasing to the eye. To make the workmen in the factories and on the streets more life-like I went out with watch in hand and counted the strokes per minute of men handling shovels and picks. I watched the carpenter, the blacksmith and the men at planers and drill presses and then proceeded to arrange my miniature men to move at the same rate. Not only this, the machines at which they are working are correct models of the actual machines and are running at standard speeds. But here I found trouble. A single shaft run by an electric motor turns at 50 revolutions per minute under the platform and from this I had to work out a way of getting 20 different speeds and make everything automatic in operation after the current was turned on."

The passenger train emerges from the tunnel, stops at the station for a few seconds, then enters the tunnel, from which now comes a freight train. As night comes on the factories cease running, the cars on the elevated railroad light up, then the streets, the park, the electric fountain, the stores, dwellings, city hall and opera house, until with 700 tiny 6-volt electric lamps illuminating the town one can readily imagine he is looking down upon a real Lilliputian city.



ONE OF THE STATION TOWERS, INDIANA STEEL COMPANY'S 32,000 KILOWATT PLANT, GARY, IND.

A Steel City Wire Tower

Gary, Indiana, has come to be a synonym, almost, for the place where "Steel is King." In this city whose growth has been so rapid electricity has played a large part, and in its application only the most substantial and sturdy apparatus is able to stand the strain. To carry current to numerous motors which are used in every conceivable labor-saving way, high voltage wires are strung upon steel towers like the one here shown just outside of the 32,000-kilowatt station of the Indiana Steel Company. The numerous wires from the station, carrying current at 6600 volts, are attached to G. & W. porcelain pot heads, some of which can be seen in the tower connected to outgoing mains. Frequently a double set of mains is provided so that in case of a breakdown in one set, wiremen may enter the tower and transfer the cable ends to the adjacent set with little loss of time so valuable where thousands of men are employed.

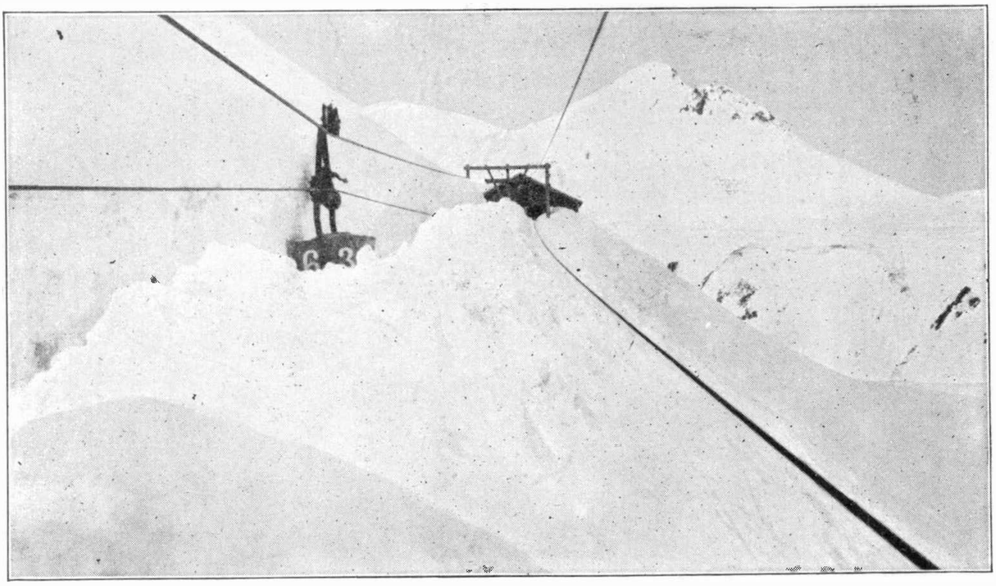
To and From the Gold Prince

Cold and snow and high altitudes present no insurmountable obstacles when it comes to the quest for gold, as indicated by the unusual photograph here reproduced. The picture shows how ore is transported from the Gold Prince mine, at Animas Forks, Colo., across Mastodon Gulch to an angle station on Treasury Mountain 8,250 feet away. From the mouth of the mine two endless cables lead down across the gulch and back again. The upper one is stationary and carries the weight of the ore cars which are suspended by little two-wheeled trolleys as shown. The lower cable is a traveling one and the cars are provided with grips to seize hold of it. Ordinarily the cars are moved by gravity, the angle station being some 187 feet lower than the mine. The loaded cars travel down one side and drag the empty ones up the other side by means of the traveling cable.

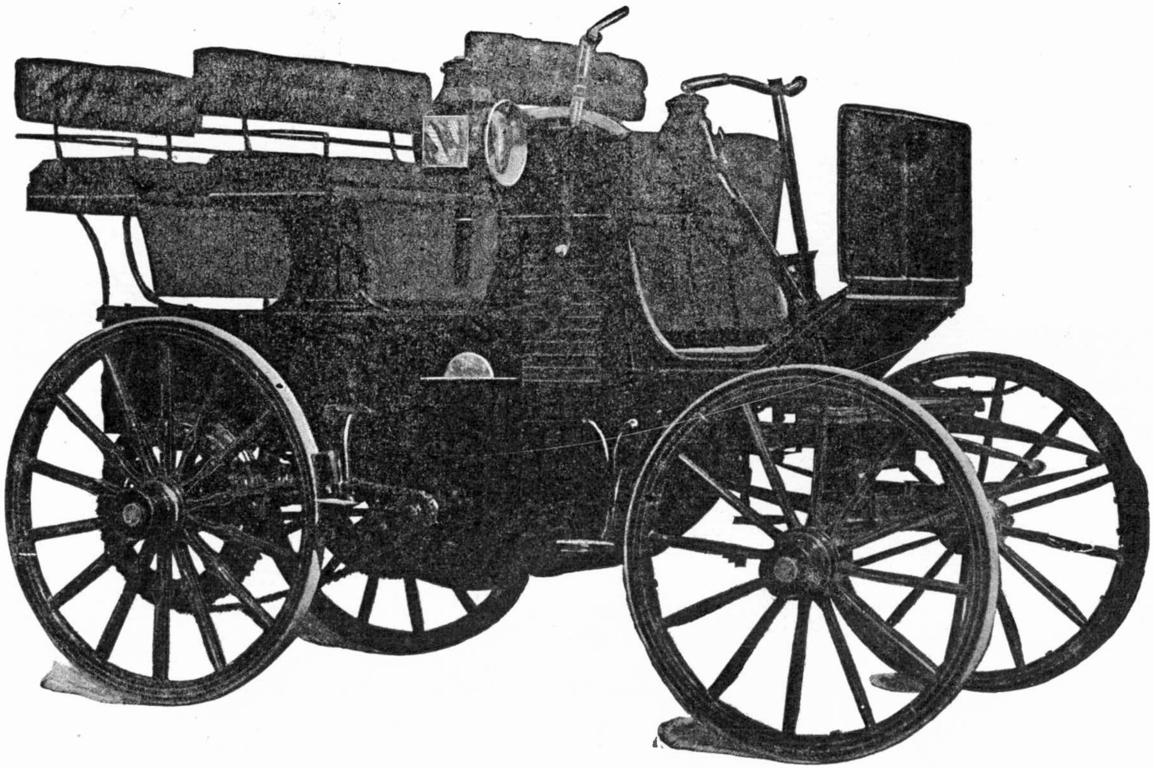
But oftentimes the cars must drag their way through great drifts of snow and they will not run by their own weight. Recourse must then be had to a 40-horse power electric motor which drives the lower cable round and round on its bearings.

There is also a Red Cross car for transporting sick or wounded men. They are not to be trusted to gravity, so the motor is always brought into play when there is such a load to transport.

The ordinary buckets are of 10 cubic feet capacity and each holds about 1,500 pounds of ore.



TRANSPORTING ORE FROM HIGH ALTITUDES



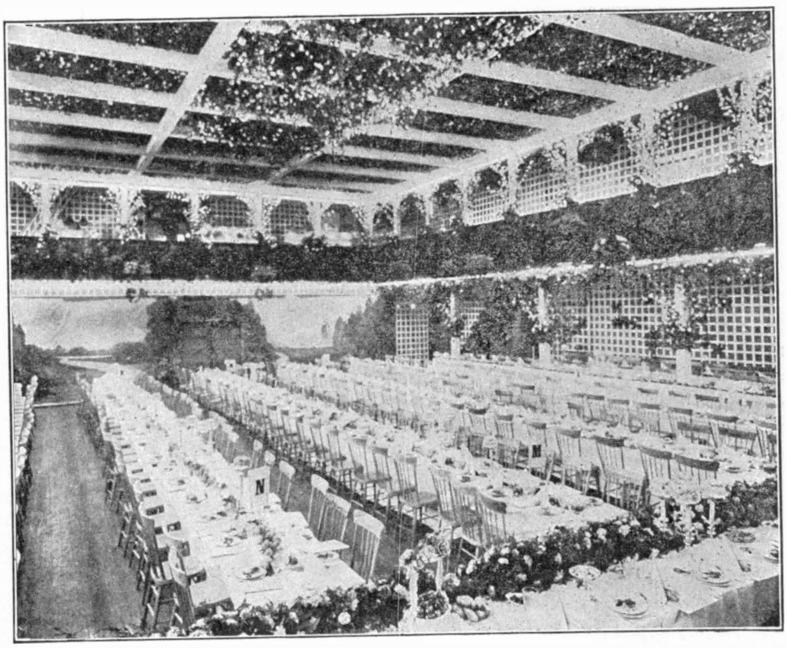
FIRST ELECTRIC AUTOMOBILE IN THE UNITED STATES

Nineteen years ago the first electric vehicle was built by the Holtzer-Cabot Electric Company of Boston, for Mr. Fiske Warren. Considered today in the lignt of modern automobile construction the machine is a decided curiosity. The carriage weighs 1500 pounds and seats six or eight persons. A battery of 44 chloride accumulator cells, 11 in series, making four sets, are distributed in the body of the wagon, a controller being arranged to provide for three speeds, 5, 8 and 15 miles an hour, using a 7½ horse-power motor weighing 450 pounds to furnish the power. Great care was used in the construction to make the car substantial and fit for rough roads and hill climbing. The wheels are provided with ball-bearings, and two 10-candle-power electric lamps are installed for side lights.

Tubes of Light at the Taft Banquet

The problem of how to welcome fittingly a United States President was solved with great success by the Decorating Committee of the Passaic, N. J,, Board of Trade on the occasion of President Taft's visit to that city last May. It was done by providing a banquet hall illuminated and decorated in a novel and unsurpassed manner.

The Passaic Turn Hall was converted into an Italian Pergola for the banquet and false framework was constructed for the ceiling, and upon this were strewn branches of artificial apple blossoms. The illumination was provided by two long tubes of the Moore light—one around the ceiling of the Pergola and the other supported from the edge of the balcony. Each tube was 162 feet in length of clear glass and 1¾ inches in diameter. Nitrogen was used as the gaseous conductor—producing a beautiful rose-yellow color.



BANQUET HALL ILLUMINATED BY MOORE TUBES

The room had been transformed into a wonderful bower. Birds sang in a mass of flowers and shrubbery serving as a background for the continuous tubes of the Moore light. Never was setting more beautiful for a public function. President Taft commented again and again upon the remarkably soft yet brilliant illuminating effect of the light and displayed genuine appreciation of the great beauty of the banquet hall, declaring its decorations to be unexcelled by any he had ever seen in all of his travels in various parts of the world. Since it was the first use of the light for such an occasion, it is not surprising that he called it "unique."

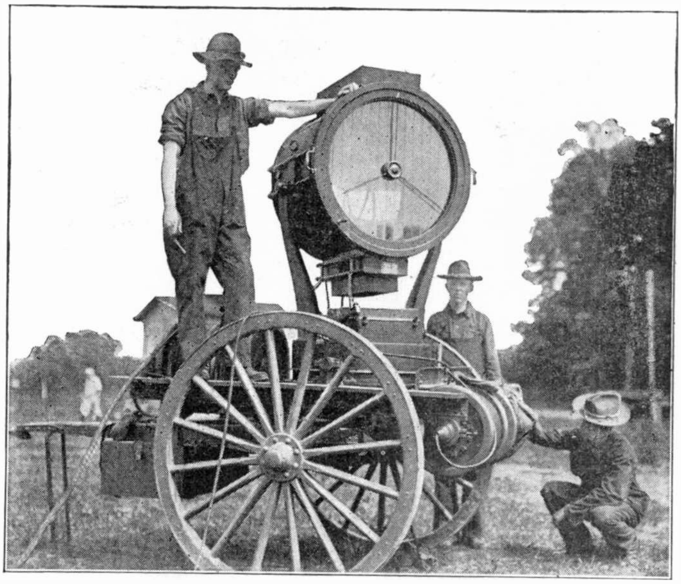
What Is a "High" Voltage?

Twenty-five years ago the terms high voltage and low voltage were commonly used to distinguish between the series arc circuits and the multiple incandescent circuits. The latter were generally circuits of 50, 100 or at most 110 volts, while the arc generators ran up to 2500 or sometimes 3000 volts. Later on the arc dynamos were gradually increased in size until it was possible to get over 6000 volts from a single machine, which was thought to be a really *high* voltage.

When alternators came into the field, first at 1100 and 2200 volts, it was not long before they were used with step-up transformers raising the voltages to 5,000, 6600 or 11,000. In more recent years the voltage thus used has often been 22,000. Meanwhile several firms undertook to build alternators with armatures wound for voltages that had been thought prohibitive. Thus the plant at Paderno has alternators running at 15,000 volts, while the Hungarian firm of Ganz & Co. has lately built some giving 30,000 volts at the armature terminals. Doubling or trebling these voltages by step-up transformers is easy, so it is evident that we have not yet reached the top in voltages, nor can we tell the dividing line.

Automobiles as Engines of War

The United States War Department has during the last few years introduced for military service a variety of war automoblies. In the case of most of these classes of self-propelled vehicles Uncle Sam has merely followed in the footsteps of European nations. Now, however, the Yankee army has the distinction of having blazed a path in the development of yet another important class of military motor cars. There has lately been constructed for our fighting forces a searchlight automobile truck and engine. A novel feature of the truck is the provision of an electric motor for each of the four heavy wheels that carry this 10,500-pound car. Each wheel is a driving wheel, the power being applied direct to the periphery of the wheel. Losses of electrical power are reduced to a minimum. The car is fitted with an electrical brake; operates equally well backward and forward, being capable of a speed of 16 miles per hour, and is characterized by complete absence of shock in starting or speed changing.



ELECTRIC SEARCHLIGHT AND TENDER ON WHICH IT IS CARRIED

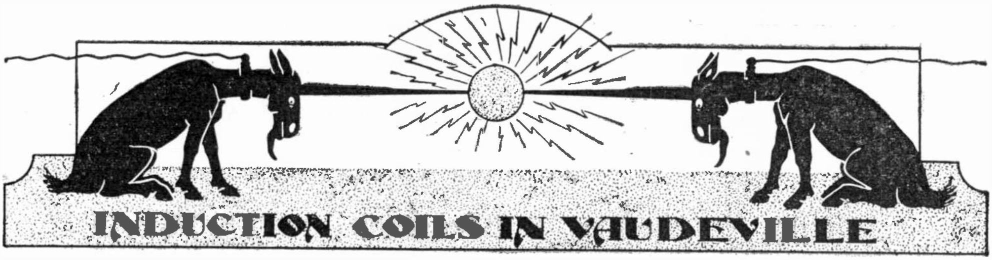
tender that is the first adjunct of the kind ever successfully operated by any army in the world. Various foreign powers have been experimenting for some time past to devise a motor vehicle that would transport and furnish illuminating power for search lights, but the American officers were the first to perfect a design that has proven thoroughly satisfactory under all the varying conditions of road and campaign service.

The Army's new truck and tender is electrically operated, and whereas the magic current could, if desired, be supplied from storage batteries, as in the case of the ordinary electric automobile, this war machine is designed to generate its own electricity through the instrumentality of a gasoline

Ordinarily the electric searchlight of the outfit is carried on a tender attached at the rear of the truck, but if desired a second searchlight can be mounted on the rear of the motor car proper. The new car, the experiments with which have been under the direction of Lieut. W. H. Rose of the Corps of Engineers of the United States Army, requires only three men for its operation under military campaigning conditions. The truck has traversed hundreds of miles of very indifferent country roads; has traveled over soft ground; has readily run over a log ten inches square; climbed a 25-per-cent grade and, on one occasion, was operated continuously on country roads for twelve hours without a halt.

THE AUTOMOBILE TRUCK, TENDER AND SEARCHLIGHT UNDER WAY. ON THE OPERATOR'S SEAT BESIDE THE DRIVER IS LIEUTENANT ROSE, U. S. A., WHO HAS GENERAL SUPERVISION OF THE EXPERIMENTS

GETTING READY FOR ACTION



INDUCTION COILS IN VAUDEVILLE

Some one has aptly said that it is the artist's business to beautify Nature. Then if, as Shakespeare expressed it, the stage is "holding, as it were, a mirror up to nature," that mirror should reflect the unmeasured charms of life rather than its scientific exactnesses. The cold and immutable laws of Nature may pervade the play but they must be kept in the background, else the artistic effect and the popularity of the show is spoiled. Indeed, the playwright may take liberties as to dates, localities or other details, his historical settings may be quite erroneous, but as long as the charm is there for ear and eye and mind, these digressions from the cold facts are freely overlooked.

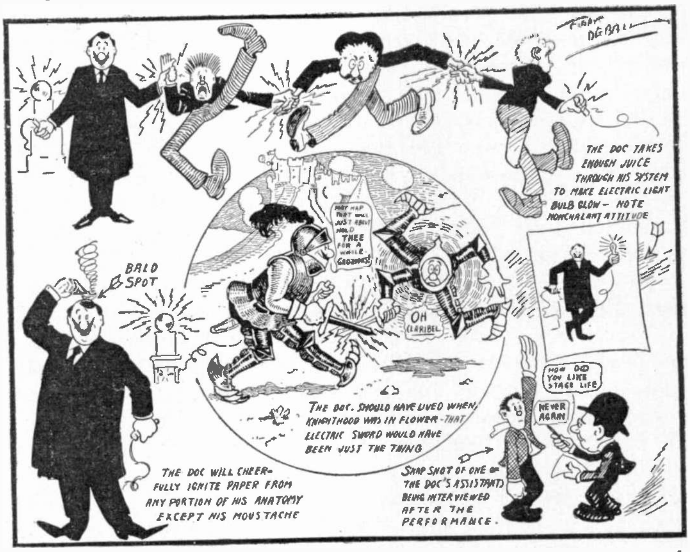
Probably that is why it is the imaginative fiction writers and not the accurate historians that give us our plays on historical themes, since some of the petty facts of a real situation generally spoil its poetic beauty if followed too closely. That is true even to a higher degree when we turn to science instead of history; for no matter how fascinating the wonders of science may be, their sequence and relationships cannot equal in dramatic effect what an imaginative writer would have them do. The patrons of a theatre go there to be entertained rather than instructed, to see artistic climaxes and unexpected changes rather than a carefully traced obedience to any laws. Hence the place of electricity on the stage has been that of an unnoticed means to scores of fascinating effects rather than an observable exhibit of its powers; and when the rule is broken by some one showing electrical apparatus in a theatre, it need not surprise us if he embellishes, distorts and even falsifies some of what he presents. Nor need we be surprised to find such a showman singling out only one piece of apparatus for the particular group of effects out of which his clever imagination builds an entertaining half hour. This in the case of a now popular vaudeville performer is the induction coil, although a host of electrica devices might be implied by his modest (?) card, in which he introduces himself as an electrical wizard, "the man who conquered electricity."

Imposing in stature as well as speech, cleverly gifted of tongue, he comes to the footlights of the dimly lighted stage amid the flash and snap of three huge induction coils. Yes, and midst their sparkle, too, for they are so fitted up with spark gaps, extra brass domes and what not as to give the impression of a capacity all out of proportion to their real strength. The crackling stops and the professor bows, beginning his wondertale of original devices said to be "covered by Royal Letters Patent in every civilized community" and of his having trained himself to safely handle voltages which would be fatal to ordinary mortals. If showy size, flashy brass knobs and appropriate stage mountings constitute invention, he might truly have indulged in some patenting. But the audience does not care. His convincing talk sounds good and many of those who 25 or 30 years ago knew induction coils as their most popular pieces of experimental apparatus may not even recognize the stage version.

Indeed, it is a long time since our home apparatus building in the electrical line was practically confined to making some primary batteries, a crude telephone receiver and an adjustable "shocking coil," which latter furnished amusement rather than instruction to the household. Fitted with handles, such a coil freely amused any evening gathering by the facial expressions and the muscular contortions of the party who was suddenly treated to an unpleasant strength of the induced current. Often we would join hands to give the same voltage to all, so as to be fair in the matter. Had one of us merely made believe that he was participating but really shielded himself from it, he would have been despised as a faker.

Yet when the same is done on the stage with elaborate settings, the audience applauds and hails the deceiver as an "electrical wizard!"

The eight or ten young men who volunteered to assist him on the stage and whose antics when treated to a series of unpleasant shocks afforded fine entertainment for the audience, may think him a wonder to never flinch while passing such currents on to them. And a wonder he would be, if the current really passed through him from the tip of one outstretched hand to the other, as he pretends that it does. For a well dressed man, the professor's long cuffs are becoming, but why does he keep pulling them out instead of drawing them back, as men usually do? Because they will slide back occasionally and in doing so they might expose the bracelets which he wears on each wrist, connected under his coat by an insulated cord through which the current can flow from one bracelet to the other without passing through his body at all. To touch one bracelet unnoticed to the terminal of the coil is mere play, while the other is easily reached by the hilt of a fencing foil or wand held in his hand. For variety, he may place the victim's hands on his shoulders so that the current can jump through his coat from the cord connecting the wristlets while the professor's right hand is entirely free.



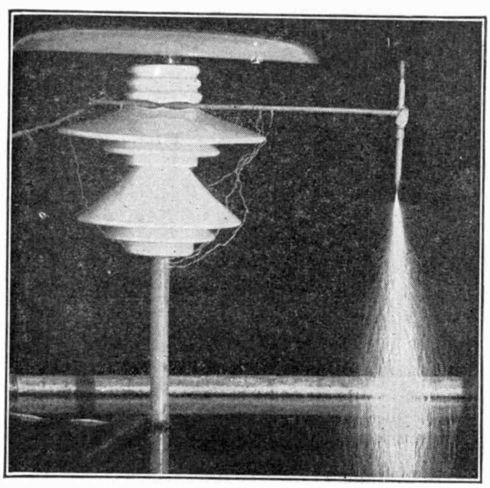
Or he may let the unwary touch the bracelet itself, as in an amusing turn for which many a hypnotist may envy him. "Can you biff the palm of my hand with your fist?" he asked of an able-bodied volunteer. "Then try it a few times until I say 'go.' If you strike my palm again after I say 'go,' I will give you a hundred dollars." The volunteer pounds the extended palm repeatedly while the professor reaches his other arm around to the terminal of the coil, standing (as usual) on an insulating platform. Then, just as he says "go," he shoots his arm out so that the would-be boxer strikes the bracelet instead of the palm, getting a shock that cramps the volunteer's arm muscles. To see the latter hop around, vainly trying to thrust out the arm which is so tensely contracted, makes good fun for the audience, while the professor can easily smile for he can truthfully say in the slang of the day: "It never touched me!"

Accompanied by clever talk and if need be, by ready repartee, such fakery makes pleasant entertainment for the spectators, most of whom think the professor a wonder. For does he not pass sparks through himself which, so he assures his audience, are twice as dangerous as those which electrocute ordinary mortals? Are not the sparks of the current passed through him so intense that he can light paper with the same? If the audience does not guess that the paper was chemically treated so as to be almost ready for spontaneous combustion, that is not his fault. And did he not likewise light an incandescent lamp with the current through his body? Some of those present can testify to its being a bona-fide carbon filament lamp, for it was passed around among them. But the cloth draped tongs with which the stage assistant held the lamp were not offered for inspection, else some one might have found a compact storage battery which could light the filament brightly while the professor was dazzling his audience with irrelevant sparks.

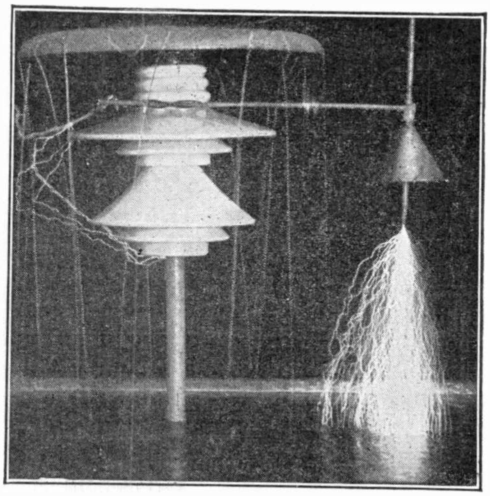
At each step the listeners are more amused and less particular as to the truthfulness of the so-called wizard, who in turn grows bolder in his deceptions. Had he started by treating the unsuspecting volunteers to shocks through an insulated cable to which he pretends to convey the current through his body, many an observer might have wondered to what the other end of the cable was connected. Now no one thinks of doing so. The cable itself may lead direct to the coil which the assistant starts into action while the professor only pretends to tap it. What matter? The audience roars anyhow. Clever amusement, not scientific accuracy was what it came for and for this the familiar induction coil is ample when formidably staged by a clever and not too scrupulous manipulator. And what if the wonderful developments of the last three decades have been ignored in it, for could not exactly the same show have been offered thirty years ago? That only proves how slowly the nontechnical world utilizes what electrical workers have so plentifully devised and how much more we may expect when the myriad developments of the past three decades are more generally employed for our pleasure hours as well as our working time.

Testing High Tension Insulators

The insulators which support the wires from pole to pole on an electric line are most carefully made and tested, especially if the wires are subjected to thousands of volts pressure. The illustrations show one way of making these tests. The insulator carrying one wire to the end of which is attached a pointed conductor, is supported



TESTING A HIGH TENSION INSULATOR



GIVING AN INSULATOR THE RAIN TEST

over a tank of water. The other test wire from the transformer lies in the water and when pressure of from 70,000 to 150,000 volts or more is applied, a dangerous, brilliant, hissing arc passes from the pointed conductor to the water often breaking around the insulator. To get as near actual conditions as possible artificial rain is produced in these tests, as shown in one of the pictures, and its effect noted. The testing voltage employed is always two or three times the pressure for which the insulator is designed so as to insure its safe operation.

Renewing Worn Out Lamps

Were you to examine carefully a worn out carbon filament lamp probably the points that would attract your attention would be the filament, broken, or very ragged and thin, and the bulb coated with a layer of carbon dust. As the base, bulb and leading-in wires are in such a condition as to be again used the lamp need not be thrown away but may be subjected at a lamp renewing factory to a process somewhat as follows: The tip of the glass bulb is removed and with the admission of outside air the carbon deposit is burned off the inside by applying heat to the outside. The old filament is now removed through the opening and another one inserted and connected to the leading-in wires by a paste made of powdered carbon and molasses, other methods giving way to this way of connecting on account of its simplicity and cheapness. The bulb is now exhausted of air and sealed with a blowpipe, the brass and globe are cleaned and the "renewed" lamp goes out to begin life over again.

Electrified Stage Costume

If there is any line in which novel effects are continually craved, it is that of the stage costumer. Thanks to light and therefore easily carried storage batteries and to miniature lamps, quite a variety of beautiful effects have already been obtained, particularly in marches and fancy dances. Where sword contests form part of the play. the thrilling flashes between the blades have been produced electrically. But no ambitious costumer will want to stop with past attainments, hence the method recently originated by Frau Thaniel of Charlottenburg (a suburb of Berlin) will be welcomed by theatrical men.

FRAU THANIEL S SCHEME FOR AN ILLUMINATED COSTUME

Those who have watched the researches of the probable voltage of lightning flashes will recall that one investigator proved experimentally that a long series of short gaps could be jumped by a voltage far below that needed to produce an arc across the total distance. Frau Thaniel utilizes this multi-gap principle by sprinkling costumes with finely divided metallic powder applied in streaks and connecting the ends of each streak or stripe to a current of small amperage but of high voltage and high rate of oscillation. If this current is turned on while the stage is darkened, the myriad flashes between the fine metal particles make the costumes appear as if enveloped in ribbons of lightning and the effect is said to be as electrifying to the audience as it must be to the costume itself.

Wire Chiefs Meet

The display of new instruments and paraphernalia used in the telegraph and signal department of railroading was the feature of a banquet given by the association of railway telegraph superintendents in convention at Los Angeles. The banquet rooms must have reminded the delegates of their own offices when they entered, for signal bells were ringing and telegraph relays clicking, while a miniature railway running across the rear of the room supported two small locomotives which, traveling back and forth, operated a number of block systems and semaphores along the line. A number of technical papers were read. Several of them dealt with the introduction of the telephone in train dispatching and the opinion of the delegates seemed to be that the telephone will soon supersede the telegraph for this department of railroading. Another subject of discussion was in regard to having conductors deliver telegrams taken from the wires of railroad companies, to passengers aboard their train.

A Ton of Platinum

It is an interesting fact, perhaps not generally known to the general public, that precious metals such as platinum, gold and silver, and even precious stones such as diamonds, are used extensively in the manufacture of telephone apparatus. The Western Electric Company, the largest manufacturer of telephones in the world, uses upwards of one ton of platinum each year. When it is considered that the value of platinum is 30 per cent greater than that of pure gold, it will readily be seen that this expensive precious metal would not be used extensively unless results justify it.

Ancient Tarsus Electric Lighted

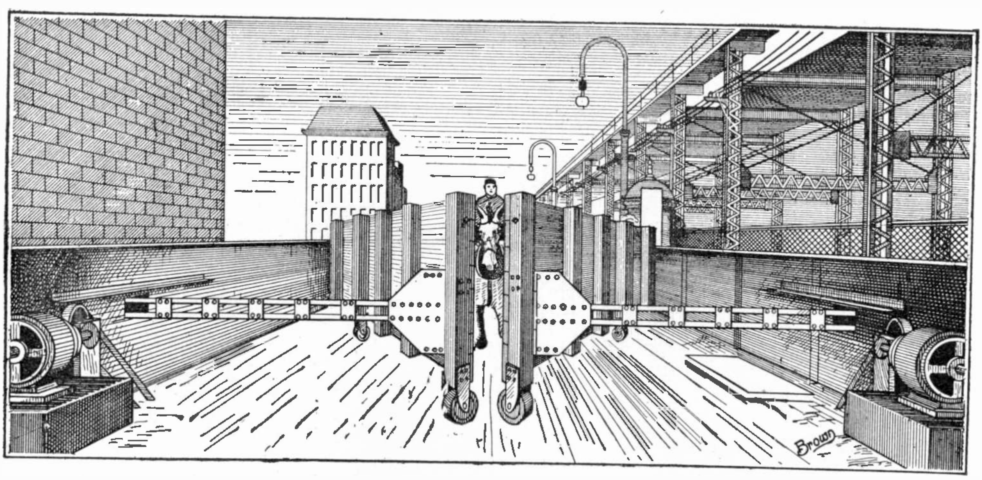
So accustomed are we to seeing the cities of Palestine pictured as they were many hundred years ago, that to think of them as enjoying the results of modern progress and invention is almost impossible.

Were the Apostle Paul to return today to the city of his birth he would gaze with wonder, for in place of the torches of olden days he would find electricity sent from a plant on the Cyndus river lighting Tarsus. About its streets are 450 lamps, while 600 incandescent lights are used in the homes of the people.

Bridge Gate to Stop Runaways

The Williamsburg Bridge, New York, in this illustration, on account of its wide roadways and lack of trolley cars seems to have acquired an unusual record in the matter of runaways, far exceeding the number on Brooklyn Bridge. In four years 185 runaways took place, 53 horses were killed and 47 injured, while at the same time 96 persons were injured.

On April 14, 1910, a "runaway gate," the idea of a laborer on the bridge, was put into operation. The device consists of two leaves built of plank as shown, 40 feet long and six feet nine inches high, mounted on wheels. The officer in charge needs only to close a switch which sets in operation motors which cause racks and pinions to push the two ends of the leaves toward each other forming V with the opening facing the direction from which traffic oming, xcept that a spac 11½ inches through which a man may pass is left at the apex. In the one runaway which occurred since its installation the horse started 150 feet distant, and by the time it had reached the gate the leaves were nearly closed. The horse breaking away from the harness passed through the opening without injury, leaving the wagon in the apex of the V. The leaves swing back parallel with the sides of the bridge when not in service.



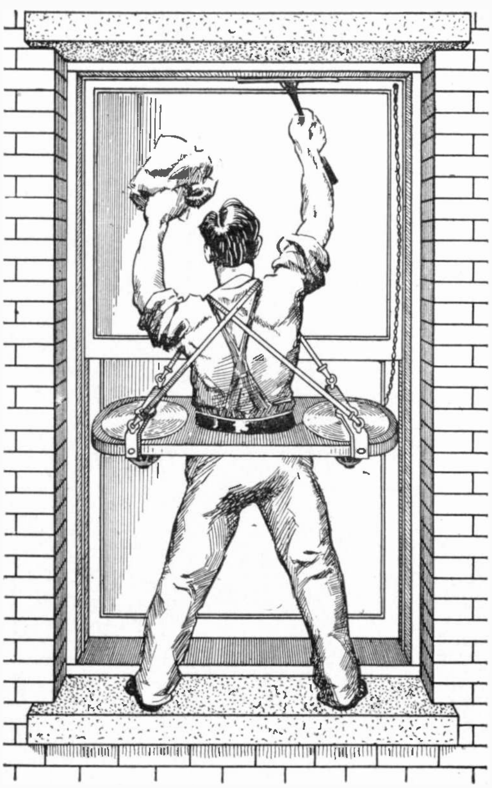
GATE TO STOP RUNAWAYS ON WILLIAMSBURG BRIDGE

Measuring Temperature in Concrete

How does the temperature of a solid concrete wall vary as the wall dries out and hardens? This question is to be answered with reference to the concrete masonry in the walls of the locks at Gatun, Panama canal, by burying six iron bulbs, containing a coil of wire, in the concrete, and bringing out two lead-sheathed, copper wires to connect to an indicating instrument, which is portable. The resistance of the circuit will vary with its change in temperature because the resistance of all metals is greater or less according to the temperature of the metal. This resistance will be measured at intervals and the temperature read directly on the portable indicator, a small storage battery being used to furnish the current.

Gyroscope for Window Cleaners

According to press reports, an American version of the Brennan monorail system in which a gyroscopic flywheel keeps the car from tipping, will soon be in service. A European inventor has already demonstrated by a test on a fair sized steamer that a similar plan can be used effectively to overcome the rolling of vessels. Now a third has reasoned that the balancing of



THE LATEST IN GYROSCOPES

cars or ships is no more important than that of individuals working under unusual and dangerous conditions. For instance, a man washing the windows of any tall building can work to best advantage if free to lean back somewhat, just as he would do if standing on the ground. Safety straps make this possible to a considerable extent but themselves are hindrances to free working. Were the window cleaner a bloodless machine, we might simply equip his interior with a gyroscopic balance wheel.

Next to this is the external arrangement just patented by Hermann Zoern, an architect at New Brandenburg. He proposes to strap a light frame to the man, carrying a pair of hoops driven at high speed in opposite directions by an electric motor. A practical test of this scheme will be awaited with interest and—attention, prohibitionists!—might not the same plan with a storage battery supplying the energy thwart the unsteadiness of a toper?

An Electrical "What Is It?"

As a pleasant bit of amusement, just ask your friends to guess what this cut shows, or better still try to guess it first yourself. Is it an inkstand? A jewel case for my lady's dressing table? Or a bread mixer? No, it is something far larger and more powerful than any of these—an electric capstan of French design. Unlike most motor driven devices, this does not need a rheostat or a starting resistance, but is controlled by a simple switch. The speed depends entirely on the weight handled, being fast with a light pull on the rope and slow for the heavy ones. The enclosing case has no joints in either the bottom or the sides through which dampness or rain might enter, thus protecting the motor from moisture as well as mechanical injury. The current used is always in proportion to the torque or pull on the rope, hence there is no waste of energy. So successful has this capstan proven that a single French concern has already installed nearly a thousand of them.

"WHAT IS IT?"

Insect Shuts Down Power System

Horn-gap lightning arresters protect the high voltage line of the Nevada-California Power Company supplying current to Goldfield, Tonopah and adjoining towns. On June 23 a small insect known as the "snake-feeder" flew exactly into the spark gap of one of these arresters, and started an arc which resulted in shutting down the whole system. Strange to relate the insect, with its body badly scorched, was found in the gap still showing signs of life.

Didn't Disturb the Wires

Lieutenant Murphy, chief electrician of the Cleveland Police Department, has discovered a man who figures it is easier to build a house over telephone wires than to have the wires moved. The man is Adolph Berkovicz. About two years ago Lieutenant Murphy put up some new wires for his signal system, and his men strung the wires across a vacant lot. Berkovicz, who owned the lot, built a new house on it recently and evidently imagined that the

wires could not be touched, so he built around them. Now the wires enter the south side of the house and come out on the north side.

"In all of my 33 years of experience as an electrician, I never heard of such a thing," said Lieut. Murphy, when telling about it. "The building contractor made a clean job of it though, as the wires are not cut nor damaged in any way. He left a hole about three inches in diameter on either side of the house. Of course we will have to take our wires down."

Josephine and Her Fan

Missouri Chief Josephine is the name of a Holstein dairy cow owned by the Agricultural College of the University of Missouri.

Recently Josephine went out after the world's record in milk and butter production.

After 120 days of heroic effort she made a new mark, giving an average of 50 quarts of milk per day on about 65 cents' worth of food. One of the adjuncts to this test was an electric fan in Josephine's stall by which she was continually blessed with a cooling, fly-dispelling breeze and kept at all times in a milky state of mind. Mr. DeBall, the cartoonist, also hails from Missouri and understands cows.

The Optimist

The Optimist sleeps, electric fans make cool
each sultry night;
He laughs and sings; electric tools make each
day's burdens light.
An Optimist he well can be who values watts
and volts;
Who lets the current drudge and pull and ease
life's daily jolts.

Clock Selling Once and Now

Time was when clocks were bought from the vender who carried the whole stock on his back, crying his ware as he went up and down the streets of one town after another. His assortment was limited and his guarantee of quality meant but little, for usually the itinerant clock seller was one who had picked up only enough of horology to dissemble and reassemble the parts of a clock and to oil the same. Occasionally an experienced clock maker with a taste for the bohemian life would thus take to the road, but usually the clock crier was a poor mechanic from whom people bought because they had no better choice.

The Old-Time Clock Vender

And today? The roaming peddler has entirely disappeared and the clock seller is where we can quickly reach him; for while the machine made parts in modern clocks are more accurate and more durable than the old hand fitted ones, we have grown to expect more and more of the finished article and we look to the dealer to stand back of it. His invitation to us is apt to be itself in the form of a huge clock, electrically lighted to show the time at all hours, and his shelves are replete with scores of smaller types ranging from cheap alarm clocks to electrically wound types which need attention but once a year. No longer do we wait for the clock seller to come to us. We go to him, and to repay us for the trip he gives us the larger assortment, the brightly lighted store in which to inspect the same, and a dependability undreamed of by our grandparents who patronized the itinerant clock dealer.

Steam vs. Electric Engines

The limit of economical load of a railroad train is determined by the power and other qualities of the engine. It follows that if we compare the characteristic qualities of steam and electric engines a general idea can be obtained of the improvements that are made possible by the substitution of electric for steam power on a railroad.

The power that a steam locomotive can develop is limited by the steaming capacity of its boiler, and this limit has been reached: the electric engine power might almost be said to be only limited by the capacity of the central station.

Different types of engines must be used for different kinds of service in steam railroads. An electric engine can be used everywhere, and operated on the multiple unit system two or more engines being made to utilize all of their power. As a source of motive power the electric engine is efficient. Its total weight is utilized for adhesion. Its rigid wheel base need not be longer than in any one of the cars it pulls.

Its tractive effort is exerted on a larger number of wheels and motion is obtained by a continuous turning motion instead of a reciprocating motion—thus sparing shocks to the frame and other parts. This tractive effort is larger per ton-load on each of the axles.

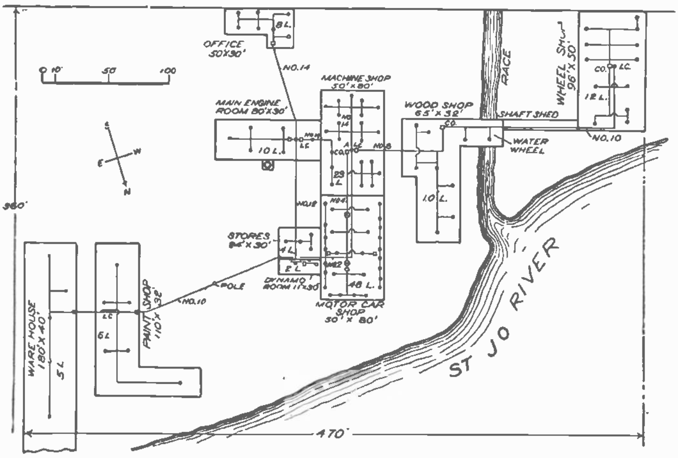
FOR PRACTICAL ELECTRICAL WORKERS

HOW TO MAKE AND OPERATE ELECTRICAL DEVICES

Design of a Small Lighting Plant

By ARREN H. MILLER

Many that are interested in electricity have not the advantage of a technical education, but are studying it for its own sake. As exact knowledge of its principles increases, it adds to the pleasure of the study to now and then derive some pecuniary benefits from that knowledge, and to find that men value it in dollars and cents. The ambitious one usually begins with bell-wiring and telephones or wireless. Presently the chance comes to him to install a small motor somewhere, and he learns something about starting-boxes and shunt-fields, as he connects up and starts the installation himself. He also becomes acquainted with the ways of inspectors and the workings of that elastic body known as the National Electric Code. Having got that far without the college education, it is more than likely the chance will come to him to light some small factory out of the reach of city current, and he has his first real engineering problem to solve. One of the writer's earliest electrical jobs was just such a problem as this, and the story of its solution may be of interest to others who are treading the same paths.



HOW THE WIRING WAS LAID OUT

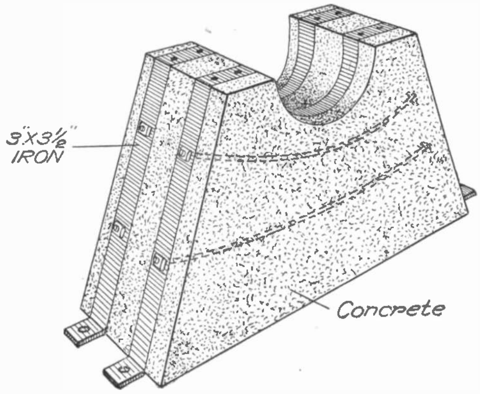
A large and powerful motor car company, having driven its neighboring rival to the wall, had acquired by amalgamation, all the buildings, land and business of the weaker company. When we were sent to plan a general rejuvenation, on every hand throughout their works could be seen the traces of bitter poverty, of a grim fight against lack of capital, a fight to the last ditch before giving in—tools worn out and worthless to turn out good work with, buildings going to ruin for lack of money to renew their rotten underpinnings, no light anywhere but kerosene torches and lanterns, and no heat in the shops to keep the men warm, except here and there an insufficient coal-stove.

After two months spent in re-flooring the shops, putting in concrete foundations, a heating plant, and new tools, the problem of how to light it came up.

There were several buildings, comprising the plant, arranged as in the sketch, and it would take about 150 lamps to light them. Allowing half an ampere to the lamp, 75 amperes would be required, and to send that much current from the power-house of the large works, about a mile away, would take very heavy and expensive copper cables, as the following little sum would serve to indicate—:

$$\frac{2 \times 10.81 \times 75 \times 5200}{10} = 845{,}000 \text{ circular mils,}$$

or about two miles of 900,000 circular mil cable, nearly an inch in diameter. To explain the formula, which is standard for

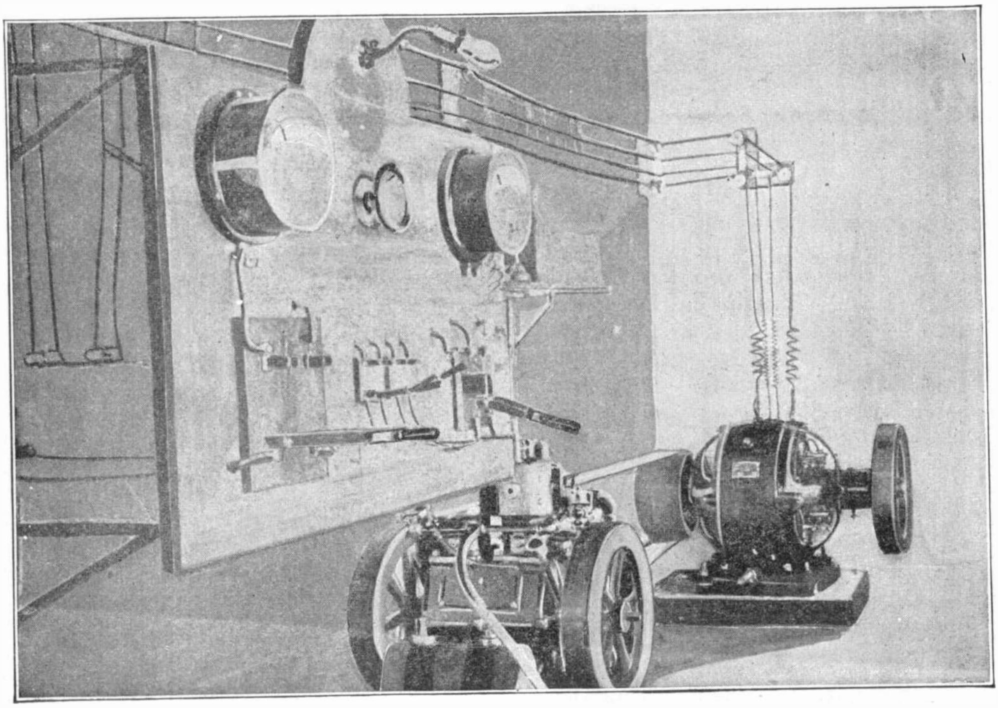


CONSTRUCTION OF THE ENGINE FOUNDATION

"drop," 2 x 5200 is the total length of wire, and 10.81 the resistance per ampere of a mil-foot of it. Multiplying by 75 gives the total resistance for 75 amperes in mil-feet, and dividing by 10 per cent drop gives the size of the wire in circular mils to carry the current and deliver it with the drop allowed. It may also be explained that a mil is 1-1000 of an inch and a circular mil the area of a circle 1-1000 of an inch in diameter.

As these enormous cables were out of the question, means had to be devised to drive a small generator at the new works themselves. Their main power was a water-wheel, and a little consideration of the ups and downs of this prime-mover prejudiced one against hitching a dynamo up to the shop shafting anywhere. The best plan seemed to be to use one of the small gas-engines manufactured by the large car works. Using a 7½ kilowatt, 115-volt dynamo, the 12 horse-power gas engine—two-cylinder, two-cycle, 900 r. p. m.,—would furnish ample power, and could be furnished at one-fifth the cost of a regulation outfit.

But, the minute the writer proposed to use the little two-cycle motor-car engine, there were howls of disapproval, principally on the score of the uneven speed of the engine. The general opinion was that the lamps would jiggle and flicker, and was summed up by an old wiseacre of a pipe-fitter, who held up his kerosene torch and prophesied that I would be lucky to get



INTERIOR OF THE PLANT

even that much light out of it! Even the general manager would not sanction the use of the motor-car engine except with the proviso that I get up some kind of a regulator to take care of the varying speeds of the engine under different loads. He suggested some sort of a solenoid, acting on the carburetter or timer handle, but left it for me to think over and report. I never did have any faith in such teasing little devices, and presently reported that I had the best electric controller ever invented—which was no controller at all! Just a heavy 200-lb. fly-wheel on the dynamo itself. This wheel, revolving at a high rate, would store in itself enough energy to render the electric light plant totally insensible to any sudden variations of either load or driving power, and the only time the carburetter would have to be adjusted would be for large changes in the load, such as at starting up at 4 o'clock and when shutting down at 6:30 when they went off. And it certainly removed all question of the lights jiggling or flickering, so the solenoid idea was abandoned and the work gone ahead with. The flywheel was 18 inches in diameter, with a three-inch face, 2½-inch rim, ½-inch web and four-inch hub, and was finished all over and balanced on the armature. It went on the stub end of the armature shaft opposite the pulley end.

The first care in the installation was to get a proper foundation for the engine. These little, two-cylinder engines could not be balanced very accurately, and would soon shake a wooden foundation to pieces, so I had two 3x½-inch pieces of iron bent in the form of the foundation, and drilled for engine and floor bolts. These were put in a wooden box, also of the form of the foundation, and this was then poured full of concrete surrounding long bolts that stuck inwards from the iron strips. I thus had a massive concrete foundation, cheaper than wood, and the bolts buried in the concrete could be tightened so as to clamp the irons securely to the concrete. It was an excellent foundation and the engine never gave any trouble from it.

The wiring was laid out as shown in the scale sketch, and the mains calculated to the various lamp centers by the ordinary wiring formula: 2 x distance x amperage x 10.81 ÷4 per cent drop. Four per cent of 115 volts is 4.6 volts, leaving .4 volt drop from lamp center to lamp, so no lamp could be more than .4 volt above 110, nor much below it if at any reasonable distance. The lamp center is not the geometrical center of a group of lamps, but the point at the center of gravity of the amperage, so to speak. If the lamps are arranged symmetrically, it will be practically the geometrical center; if unsymmetrically, it will work over towards the biggest group of lamps. For the shops right near the dynamo, it would not do to branch right off from the main passing through those shops, for the voltage would be too high and the lamps overglowed. It was necessary to come back from a big central point as at (A), and then distribute from a lamp center at just a little above 110 volts. The voltage drop to (A) should be about two volts, leaving three for each sub-main, and one volt from their lamp-centers to the farthest lamp on that center.

Some practical "kinks" on wiring may be mentioned here. No wire less than No. 14 is allowed anywhere on the work, except for drops. The work was all "knob-and tube," and to get both wires true and straight without sags and wrinkles, the mains were stretched through the cleats with a pair of small iron pulley-blocks, and the cleats screwed home before slacking off the tackle. The mains were dead-ended at each end of runs with a turn around porcelain spools, as they will sag, even if screwed under the cleats while tight. For the No. 14, running to drops and in outlying spurs, it sufficed simply to pull the wires through the cleats, and then get a heel behind each cleat in turn, taking a twist with the pliers to tighten the wire, and screwing home the cleat with the left hand. Each rosette must have a cleat on each side of it, for good work, and the rosettes should be fuseless and the spurs arranged so as not to have more than ten lamps on each, protected by a six-ampere fuse-plug cut-out where it leaves the main. All sub-mains leaving feeders were protected by a cut-out just a little above the total amperage on the sub-main. Every circuit entering a building must have a fuse and switch, cutting off all the lamps in the building. Passage through all walls must be by unglazed porcelain tubes, and the wire must enter these by drip loops which shed the rain away from the tubes. Landings on buildings were by standard deep-groove insulators on a two-pin bracket with 1½-inch locust pins.

As the trusses of the larger buildings were on 16-foot centers, light, strong runways were devised by the writer, by nailing a piece of 1x4-inch yellow pine to the back of another 1x4-inch pine strip in the shape of a T. This gave it almost as much strength as a 5x4-inch beam.

The layout gave, as you will see, two small feeder lines of 15 amperes, and one large one of 40 amperes. To make a switchboard for them without spending too much money, an oak board was got out at the carpenter shop and slate-base switches mounted on it. The equipment was: one Weston 100-ampere ammeter, one Weston 150-volt voltmeter, both front-connected; a 100-ampere main switch, slate-base, cartridge-fused; a 50-ampere ditto, for the heavy feeder; and two 15-ampere porcelain fuse-plugged switches for the small feeders. The field-rheostat was mounted between the two instruments, and it made a very complete board, amply safe and capable for controlling the current. It was mounted on he wall with iron brackets holding it two feet out from the wall.

The plant started off without a hitch, and required very little adjustment of the carburetter throttle as shop after shop went on, nor did sudden changes of even fifteen amperes in the load have any affect on the speed. The shop foreman adjusted both field rheostat and carburetter on starting up, and in shutting down for the night. The flywheel on the dynamo would run the entire plant for several minutes after power was shut off the gas engine, so great was the energy stored in it.

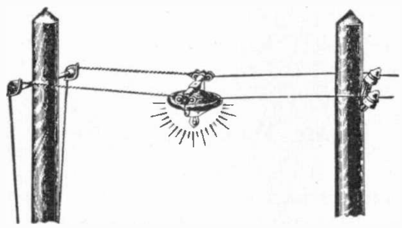
Wires 100 Amperes Will Fuse

A blown fuse is often replaced by a piece of copper or iron wire with, "There, I guess that will hold." This is, of course, bad practice and endangers whatever devices may have been protected. The following table from experiments by Preece give the sizes of wire of different kinds that 100 amperes will fuse:

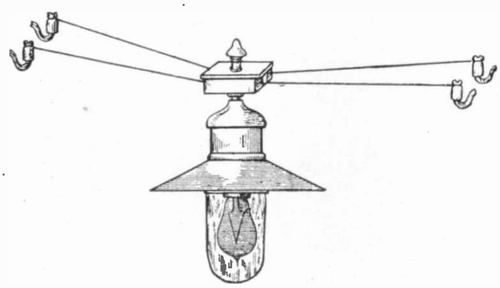
Copper	No. 17 B. and S.
Aluminum	" 15 "
Platinum	" 13 "
German silver	" 13 "
Platinoid	" 12 "
Iron	" 10 "
Tin	" 6 "
Lead	" 6 "
Tin alloy	" 5 "

Tungsten Street Suspension Lamps

If lamps are not used freely along both sides of a street, the ideal location for widely separated lamps is over the center of the street. This center can rarely be reached from a bracket arm as the distance from the pole would be too great for a bracket fixture, and fastening the lamp to a single cross-suspension wire allows it to sway in



American Tungsten Suspension



European Tungsten Suspension

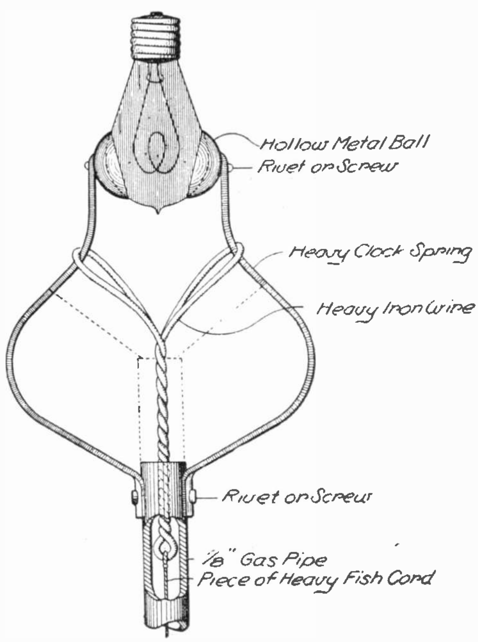
the wind. To avoid this swaying both American and European users have adopted four-way suspensions for street-center tungsten lamps in small towns, knowing that a fixture supported from four points cannot turn over in the wind but must remain level if the supporting wires or ropes are drawn taut.

In the American practice (which was developed at the same time by electric light men in Wisconsin and Iowa without knowledge of each other), the two wires form one side of the suspension. The other side consists of two small cords, usually 3-16 or ¼ inch braided cotton ropes, which pass over pulleys at the opposite pole and down to a fastening near the base of this pole. This permits of raising and lowering the lamp. Both the pulleys and the insulators to which the wires are fastened at the opposite pole are at the ends of steel cross-arms, while an arm of enameled wood spreads the insulators over the hood to which the wires and cords are fastened.

In the European practice, poles are generally prohibited and the fastenings have to be made to the fronts of buildings on both sides of the street. In this case ladder or tower wagon has to be used for replacing a burnt-out lamp, and if the cords stretch or shrink irregularly it is more difficult to readjust the load. Besides, the shape of hood commonly used in Europe concentrates the light under the lamp instead of scattering it widely as in the wiser American practice.

Home Made Lamp Reach

Every electrician who has to care for lamps in fixtures and chandeliers that are out of reach will appreciate this home made lamp reach. Two pieces of heavy clock spring, a piece of ⅛-inch gas pipe, two hollow



HOME MADE LAMP REACH

metal balls which may be had at almost any fixture house, being made from two small ceiling canopies, a piece of heavy iron wire and some stout fish cord are needed to make it. Bend the clock spring as shown in the sketch. The iron wire need not be used if the gas pipe is extended up as shown by the dotted lines, as the string may be connected directly to the clock spring if the end of the pipe is made smooth so as not to wear the cord. Pulling the string draws the two springs together, grasping the lamp, the tension being relieved when the string is released. Wooden handles of various lengths may be provided for attachment to the gas pipe. Rubber may be glued to the edges of the metal cups if difficulty is experienced from breakage of lamps.

O. O. Brooker.

Enamel Insulated Magnet Wire

After several years of experimenting enameled wire has at last been perfected so as to be used successfully for commercial purposes.

In some respects its insulation will stand more rough handling than textile insulation, although in cases where the wire comes in contact with sharp corners or rough surfaces in the process of winding, the film of enamel is injured.

Cotton or silk insulation will char and finally be destroyed by 250° F., whereas the enameled insulation will withstand at least 400° F. for a long period without deterioration and 500° F. for a period of shorter duration.

Another very desirable feature of the enamel wire is the economy of space in winding coils, armatures, etc. For instance, in a coil wound with No. 36 single silk wire, approximately one-half the winding space is taken up by the insulation, whereas with the No. 36 enamel wire only one-fifth of the winding space is so occupied. Therefore, in this gauge about 60 per cent more turns can be wound in the same winding space with enamel than with silk insulation, or the same number of turns can be obtained with a much less weight of enameled wire.

The dielectric strength of enamel insulation is in excess of 75 volts per .0001 inch of insulation which is greater than silk or cotton.

Experiments have proven that enamel insulation does not dry out or become brittle after a long period of usage, also that it is absolutely water-proof and inert to corrosive agencies. It also adheres tenaciously to the copper and has the same elasticity as cotton or silk insulation.

Insulating Materials

ASBESTOS

This is a mineral found extensively in Europe, Asia, Africa, America and especially in Canada. In its natural state it appears in thread-like fibers and is easily crumbled. Its chemical composition not being very uniform its natural color varies from a silvery white to gray and bluish. What suggested its employment as an insulating material was its notable property of being highly fire-retarding. This would make it a splendid insulator where high temperatures are found. Also, its electrical resistance is high. But the fact that it is very hygroscopic makes possible its use only in very dry places. To avoid this loss of dielectric power by humidity it is generally impregnated with water-proof varnishes. Commercially it is generally found as asbestos powder, cloth, cord or board. If the powder is kept to a temperature of 1272° F. for several hours a kind of porcelain-like compound is obtained.

It is the basic component of a large number of patented insulators, which are obtained by adding to the asbestos different percentages of asphalt and glues and can be said to differ from each other only by the color or fineness.

A very good combination is cement-asbestos, a compound which is subjected to a very high pressure and sold in sheets of different dimensions.

Asbestos and caoutchouc from the so-called vulcanized asbestos which resists the action of water and can stand quite high temperatures. While cement-asbestos can be easily worked while keeping all its good dielectric properties, vulcanized asbestos is very hard and difficult to work, for which reason it is sold already shaped.

PORCELAIN

The material entering the composition of porcelain are kaolin (Chinese potter's clay), plastic potter's clay, flint, Cornish stone and feldspath. The percentages used vary with the different manufacturers.

All these materials are mixed with water to a consistency which allows of shaping and finishing into the required form and then after a close inspection for defects they are baked in a furnace at a very high temperature.

For insulators the temperature at which the material is completely vitrified is about 2650° F. The baking operation lasts about 50 hours and the cooling just about as long. The objects are then ready for the enamelling. The enamel components are kaolin, borax, feldspath and white lead and they must be free from any alkali, otherwise the insulating surface would absorb humidity.

Only the so-called hard porcelain is used for insulating purposes and its physical qualities must be extreme smoothness and hardness.

Porcelain resists tension and compression very well, but its elasticity is very low, which makes it so easily breakable. Its electric resistivity is high, but varies with atmospheric conditions, and it becomes a relatively good conductor when heated to red heat.

Bronzed insulators have no particularly good qualities. Their color is obtained by adding red earth to the usual components of porcelain.

"Ivory," which looks like porcelain and is used for clusters and insulations of partially protected places, is obtained by the compression of an earthy material. It is not very vitreous and, when not very carefully enamelled, very hygroscopic, and its only advantage is that of low cost.

Artificial granite competes very much with porcelain for third-rail insulators. It easily allows current dispersion and is very easily perforated and totally unfit for high tension work.

GLASS

Glass insulators are still widely used on American telegraph and telephone lines. They cost less than porcelain insulators and their electric resistivity is, under the same conditions, much higher than for porcelain.

Glass, however, expands and contracts so much under variations of temperature that insulators made of glass break very easily, which would open way to disruptive discharges in high tension work. Moreover, glass has a hygroscopic surface due to the presence of alkaline matter in its composition which makes it absorb humidity so easily as to decrease considerably its insulating resistance.

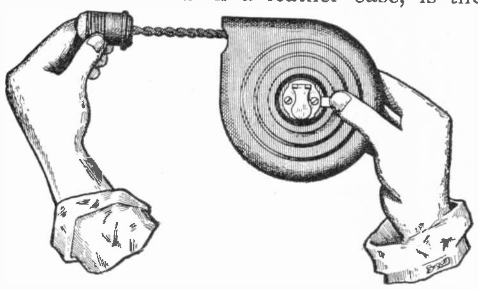
In some tropical countries glass insulators are preferred on account of the fact that birds will not build their nests under them owing to their transparency.

ELECTRIC CURRENT AT WORK

NEW DEVICES FOR APPLYING ELECTRICITY

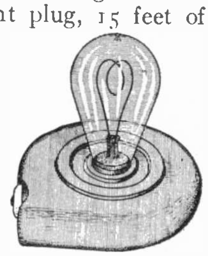
Handy Portable Lamp

"Flexilyte," looking very much like a tape measure enclosed in a leather case, is the



CORD UNWINDS LIKE A TAPE MEASURE

name of the device shown which takes the place of an extension cord and light. Provided with an attachment plug, 15 feet of cord, a crank on one side of the case for winding up the cord and a standard socket in the center on the other side, the equipment affords a convenient, self-supported light and an enclosure for the unused cord.



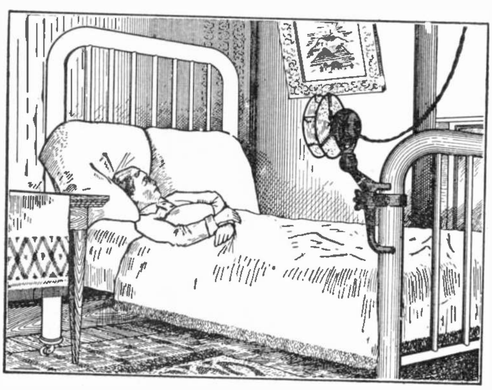
Nerve Saving Ambulances

In no other vehicle must so much consideration be shown to the passenger as in the ambulance; for the person conveyed by it is apt to be not only weak and sensitive to jarring, but under a nervous tension as well. Hospital internes can tell of case after case where a sudden tugging or lurching of the horses drawing a carriage or an ambulance has so affected the nerves of the patient as to retard his normal recovery.

This was to have been avoided by the modern autoambulances, but the gasoline types have only made a bad matter worse by introducing the thump of the motor which, while smoothed down during the speedy running of a well adjusted auto, is still annoyingly jerky whenever the vehicle has to slow up or perhaps stop at a crossing. Then as if that was not enough, there is always the risk of missing an ignition and discharging the unspent gas into the muffler, where the next exhaust may set it off with an explosion loud enough to be heard several blocks off. The recent eastern case where a patient died of heart failure in a gasoline ambulance, literally scared to death by the sudden explosion of gas in the muffler of the auto, may not be as rare as it seems, for a death in an ambulance is apt to be ascribed to the patient's last ailment.

The Bed Post Fan

"Couldn't sleep! Too hot!" And this is a truth often heard in summer among dwellers in hotels and flat buildings. Whether the device here shown was thought out by the inventor during some sleepless night we do not know. However, the Emerson bed-room induction type of fan

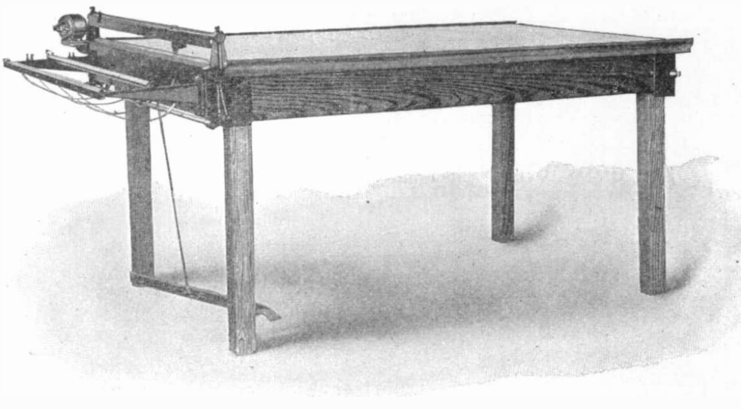


BED POST FAN

so mounted as to be easily attached to any size of post goes far towards providing substantial comfort and is most economical of current. Being but eight inches in diameter, the power required is small and consequently the current consumption low. A flexible joint or swivel allows the breeze to be directed just where desired.

Motor Driven Paper Cutter

In blue printing establishments paper is cut on a table equipped at the edge with a large knife or shear. The picture illustrates a new motor-driven knife device manufactured by the C. F. Pease Co., Chicago. The knife is circular in form and is made to move back and forth along the table edge by the very small motor and miniature rope drive. A switch enables the operator to reverse the direction of the knife at will. Power may be supplied from the ordinary lamp socket.

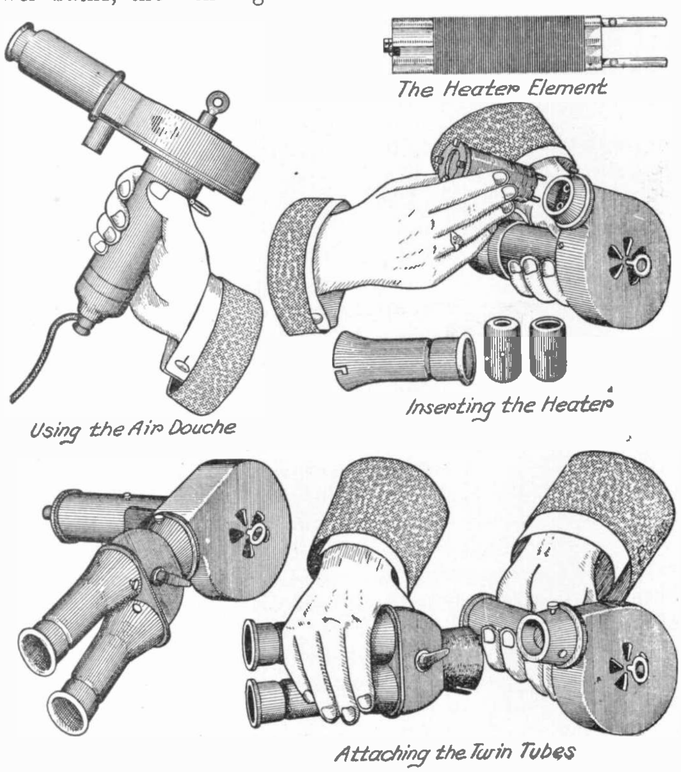


MOTOR-DRIVEN PAPER CUTTER

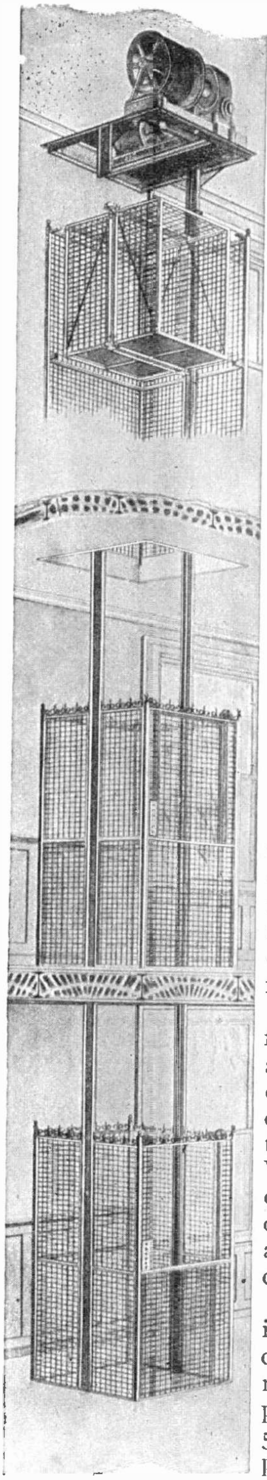
Hot and Cold Air Douche

In a judicious use of shower baths, the most effective stimulus for many purposes comes from the sudden changes from the hot to the cold and vice versa. If similar effects were produced with air instead of water, they could more easily be localized in their application; there would be no danger of scalding and the needed apparatus could be used in many places where a shower bath equipment is not available. As usual, electricity has met these requirements, having been shown the way by the pioneers who made electric hair dryers in which small electric fans blow air through electrically heated tubes.

For medical purposes a similar apparatus will give a hot air application if fitted with a tube of smaller diameter which will concentrate the blast of air instead of scattering it widely as in the case of hair dryers. Slipping a smaller nozzle on the tip of the tube concentrates the blast still more and allows the air to get hotter before leaving the tube. For quickly alternating hot and cold air effects, the single heater tube is replaced by a twin tube fitted with a vane or valve which sends the blast of air either through the cold or the heated tube. Then



HOT AND COLD AIR DOUCHE



by leaving the throttling nozzle off the heated tube, this can be used for drying the hair, or for driving the frost off a frozen window on a winter morning.

Automatic Elevators and Dumb Waiters

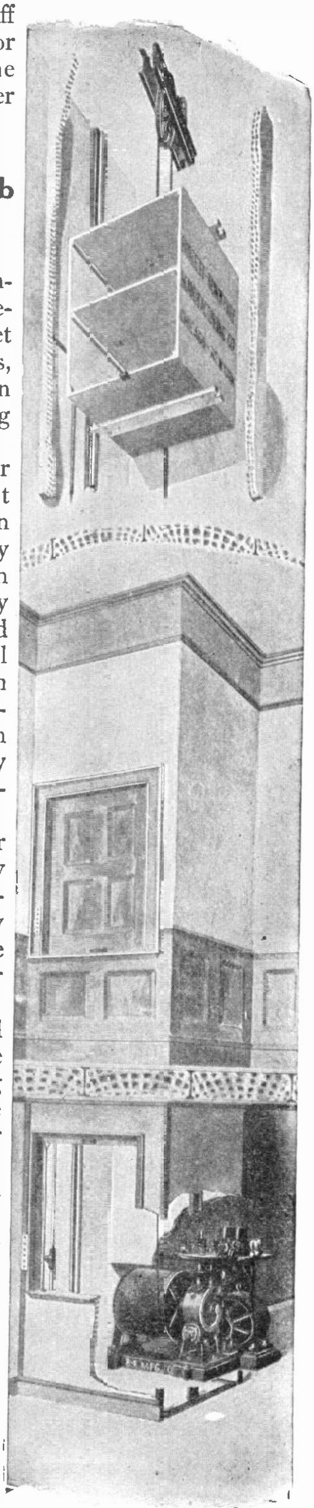
That "necessity is the mother of invention" is well exemplified in the development of elevator service to meet the demands of high office buildings, hotels, department stores, etc., and in this field electricity is rapidly replacing steam.

In the Burdette-Rowntree system for operating dumbwaiters and freight carriers the pressing of a push button assures absolute control of the car. By one plan the car can be controlled from one floor only. It can be sent to any floor from any other floor, when operated from the controlling floor, the control box indicating the last floor to which the car was sent. By another arrangement the car can be controlled from any floor and can be brought to any floor or sent to any floor by simply pressing a button on any floor.

A signal lamp shows whether the car is in motion or at rest and whether any door is open. Signal devices are furnished so that pressing a button on any floor will signal to any person using the car that the car is desired at the floor from which the signal was sent.

Sometimes signal devices operated from the car are used so that before the attendant closes the door, by touching one of a set of buttons in the car, he can signal to the attendant on the floor to which it is desired the car should go. Where desired a bell may be installed on each floor and a set of buttons placed on the control board, so that the operator can call up any floor where the car is unnecessarily detained.

In the matter of safety, if the car is in use or if any door is open, the car can not be started. It might also be noted that loads as heavy as 600 pounds may be carried at a speed of 50 feet per minute while a weight of 150 pounds may be lifted at the rate of 1,000 feet per minute.



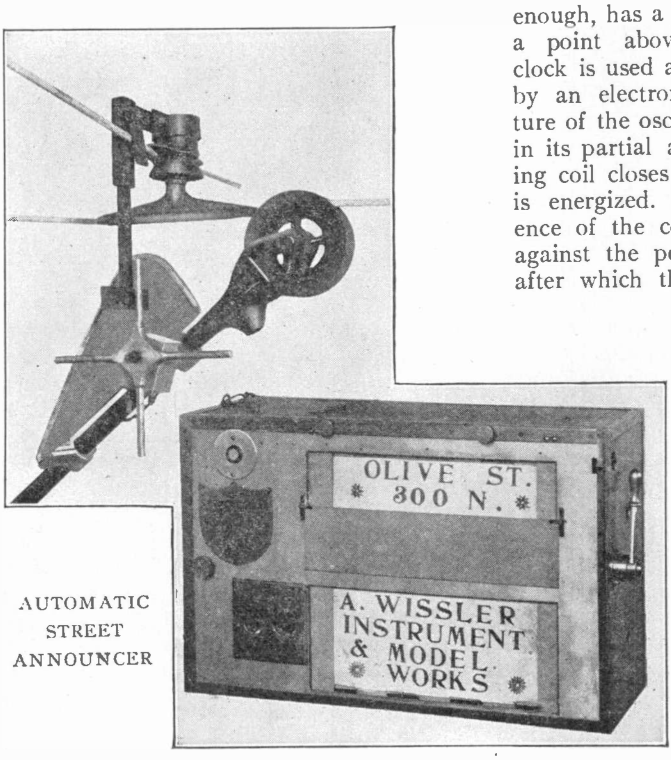
Automatic Street Announcer

The device here illustrated lets you know "where you get off" if you have in mind the nearest cross street to your destination, and does away entirely with the calling of stations and streets on electric railways.

A curtain having the streets printed upon it is unwound from one roller and rolled up on another by a small motor in the box as the car travels along. The second picture shows how this motor is started, the upper end of the trolley pole being equipped with a circuit closer which momentarily closes a circuit by means of contacts hung from the trolley wire support at each crossing.

When the car comes to a cross street the four-armed contrivance mounted on the trolley pole is turned over one position. This momentarily closes the circuit in two wires which run down the side of the pole. Closing this circuit operates an electro-magnet which in turn closes the motor circuit. This motor then runs for a moment and draws down the curtain a notch to show the name of the street.

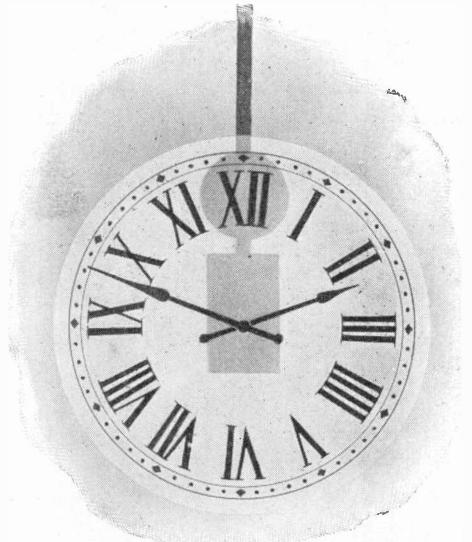
Advertisements may be displayed on the curtain at the same time as indicated.



AUTOMATIC STREET ANNOUNCER

Clock with Pendulum Above

Rudolph Jaegermann, manager of the St. Louis Watch Making School, 5815 Easton Avenue, St. Louis, has patented a new type of electrical clock which, odd



CLOCK WITH PENDULUM ABOVE

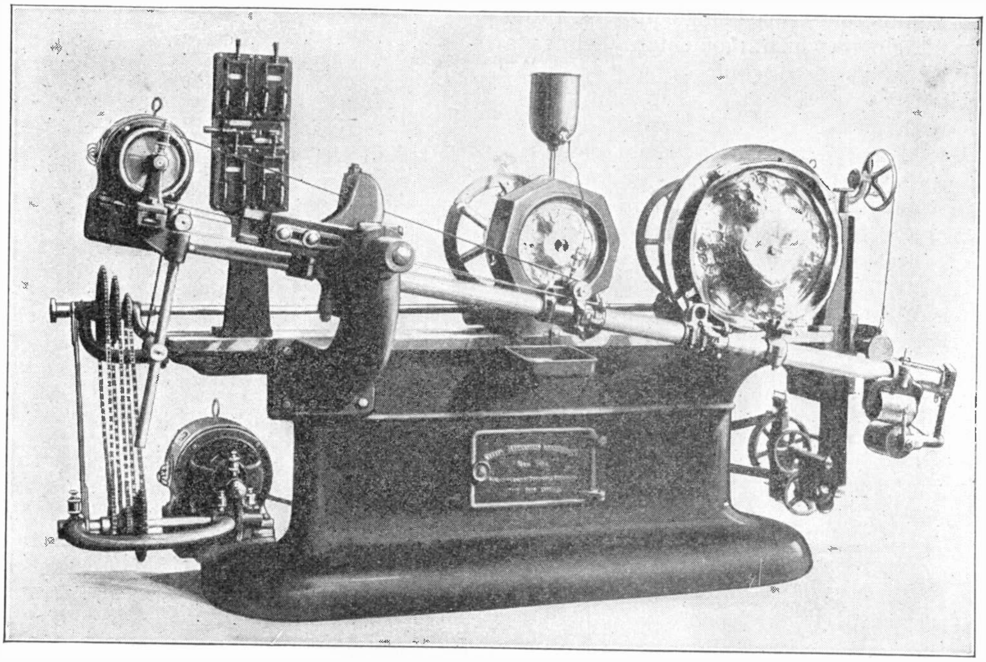
enough, has a pendulum which swings from a point above the clock. An ordinary clock is used and the pendulum is impelled by an electromagnetically operated armature of the oscillating type. The armature, in its partial approach toward the energizing coil closes the circuit by which the coil is energized. Under the attractive influence of the coil the armature is impelled against the pendulum, driving it forward, after which the circuit is broken, leaving the armature free to be returned to its original position under the momentum of the pendulum in its return swing. The swinging pendulum also operates the escapement lever by which the clock mechanism is advanced so no weights or springs are necessary. The picture shows a front view of the clock and mechanism. The face of the clock being of glass the outline of the unique pendulum may be seen in the rear.

Engraving Dies by Machinery

As ordinarily performed, the work of die making demands the most painstaking manual skill. To follow the intricate designs of the patterns from which are reproduced the dies for stamping sheet metal, silverware, hardware, etc., was formerly thought to require an accuracy and refinement of tooling which no machine could duplicate. However true this may still be for the last finishing touches on the highest quality of dies, there are now made engraving machines which relieve the skilled hand of all its former tedious labor, preserving its craft fresh for the finest work; machines which will themselves turn out a very creditable product of tooling without the intervention of any manual agency.

The ingenious motor driven engraving tool of the Keller Mechanical Engraving Co. reproduces on a steel blank (which is later hardened to form the die), the design of the metal pattern carried on the revolving faceplate at the right of the picture. The die, under process of cutting, is shown on the smaller chuck near the center of the machine. Both pattern and work revolve at the same speed, while the double pivoted tool arm, carried on the bracket at the left, is fed back and forth across the pattern and work, its tracing stylus following the relief of the pattern. The engraving cutter, at a less distance from the pivot, thus shares proportionately the movement of the guiding point, reproducing with absolute fidelity, but on a diminished scale, each feature of the design.

The cutting tool is not dissimilar to an acutely sharpened cannon drill, and revolves at a speed of from 5,000 to 8,000 revolutions per minute; being belt driven by the 1/3 horse-power Westinghouse motor mounted on the tool arm. The rotation of the work and pattern, and the motion of the tool arm across the work, are both at comparatively slow feeds for the more accurate and detailed operations. As the cutting operation nears the periphery of the die, it is evident that some reduction in the rate of rotative feed of the work must occur if the die is to be as well finished near the edges as at the center. This variation is accomplished by a parabolic speed governor constructed upon the fly-ball principle, but having its maximum allowable speed controlled through a rod and lever by a special cam bolted on the vertical slide. The friction clutch in the governor thus remains closed up to the maximum permissible speed as determined by



MACHINE FOR ENGRAVING DIES

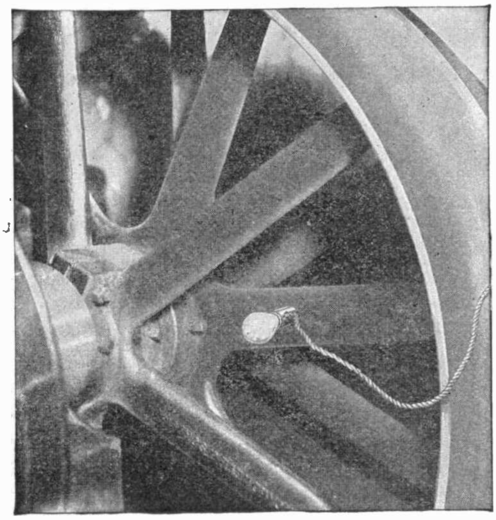
the cam shape, and then releases, keeping the rotative speed within the limit thus set. The rotation of the face-plates and the swing of the tool arm are operated by the $1\frac{1}{4}$-horse-power motor seen at the left on the floor.

Ordinarily two cuts are made in the sinking of one of these dies. The first or roughing cut employs a coarse tracing point and a comparatively large cutting drill, and roughs out the blank following the larger details of the pattern. This relieves the fine cutting point, which is employed on the finishing cut, of the removal of much of the thick material which would dull it for fine work.

During the finishing cut, a very fine tracing point is used, and the cutting tool is sharpened to a diameter proportionately less than the stylus, in the reduction ratio in which the pattern reproduction is to be made. The cutting drill is driven at a speed of from 5,000 to 8,000 revolutions per minute.

Lamp with Magnet Base

The man who holds the lamp while you locate the trouble loses his job if you have a Federal magnetic socket and extension in your tool box. Connect the attachment plug to a near-by socket and by a touch to iron or steel your lamp sticks, as in the illustration, where you place it. You can work with both hands and your helper can do the same.



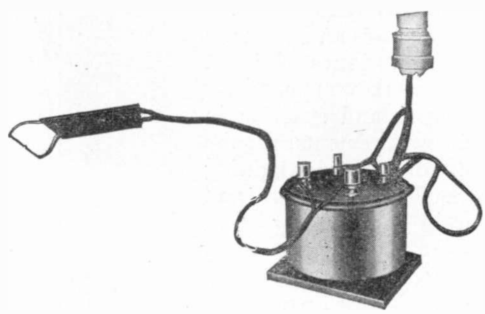
LAMP STICKS TO ANY PART OF A MACHINE

This convenient device consists of a cylindrical socket, $2\frac{3}{4}$ inches long (not including lamp) and $1\frac{1}{2}$ inches in diameter, fitted with a lamp socket in one end and an electro-magnet in the other. This magnet is of sufficient strength to hold the socket firmly at any angle or on any iron or steel body. It is wound separately from the lamp circuit so that in the event of accidental breakage or burning out of the lamp the current still operates to hold the socket in its place.

The lamp is also made for lower voltages so that it may be used on electric automobiles and even on ignition batteries in gasoline machines.

Mer-Maid Hair Singer

We are all familiar with the burning wax taper so common in barber shops for singeing and evening up the ends of the hair.



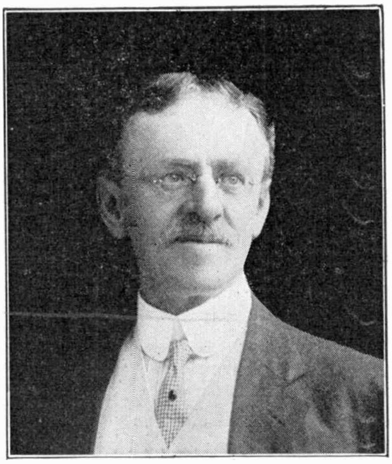
MER-MAID HAIR SINGER

In keeping with the advance in scientific lines this can now be done by using the device here illustrated which consists of a brass box mounted on slate, in which are resistance coils. From two of the binding posts connections may be made by a plug to any alternating current lighting circuit. A flexible card from the other two binding posts passes through a polished fibre handle, supporting two copper wires, between the ends of which is connected a piece of platinum wire. When the electric current is turned on the platinum wire becomes white hot, singeing the hair without danger as from a flame, leaving it much smoother.

Electrical Men of the Times

W. H. MEADOWCROFT

A number of Englishmen have been closely associated with Edison in the course of his wonderful career, enjoying his esteem and confidence, in their various capacities. Among them may be mentioned William H. Meadowcroft, who came to this country from Manchester in 1875. Prior to leaving England he had been employed in a law office, and soon after landing in America he secured employment with the legal firm of Carter & Eaton, New York City. He remained with that firm and its successors for over five years, studying law in that period, and being admitted to the New York bar in 1881. Major S. B. Eaton, of the firm, had accepted the vice presidency of the pioneer Edison Electric Light Company early in the same year, and took up his new duties actively. The work was peculiarly onerous and exacting in its requirements, for the art of electric lighting was wholly new and novel, not merely from the legal standpoint but from every other. In his emergency, Major Eaton summoned the alert young Englishman to his side, and Mr. Meadowcroft dropped the practice of the law to become assistant and secretary to the vice president; a position he held through four memorable and eventful years. Changes came in the administration, but Mr. Meadowcroft continued in association with the parent Edison Electric Light Company and its successors for over 18 years.



This notable period of service included a great variety of work for all of which this man of versatility and energy was found ready. Two years were spent in the legal department, but not less than six and a half years were devoted to the miniature and decorative lamp business of the General Electric Company, a branch of the new incandescent lamp industry that Mr. Meadowcroft himself set going in 1885. Toward the close of the period he took an active part in the creation of the Roentgen X-ray business of the same company. But many other matters received his time and attention, including the development of the early Edison Electric Illuminating Company of New York and the Edison European Company, as well as the work of the various standardizing and other technical committees organized in the pioneer days for operating and systematizing the practical side of the art. He also had a share in the early work of the Edison Ore Milling Company.

Aside from executive duties, Mr. Meadowcroft with unusual literary culture and talent as a writer was prompt to utilize the opportunities that came his way in the creation of a new technical literature. Much of this work has a lasting historical value, to say the least, for we may note that he is the author of the very first pamphlet on incandescent lighting published in America, and that he prepared all the catalogues of the Edison Companies up to 1884. These he supplemented by a number of booklets on kindred topics issued in 1888 and 1889, and followed up by other important catalogues and descriptive pamphlets in later years. Much of this work demanded an expert and accurate acquaintance with the different branches of the electric light and power industry, on both the manufacturing and the operative sides. Thus, for example, Mr. Meadowcroft was intimately familiar with the making of lamps and plant construction, the development of electric signs and the planning of decorative illumination; from which by easy stages he passed to X-ray work and did much of the pioneer experimenting in this country, taking vast numbers of radiographs in connection with surgical cases and examinations of the interior of the human body.

On leaving the General Electric Company Mr. Meadowcroft took up the exploitation of the Perret storage battery as general manager of the company; and then went into other enterprises of the same character; but in 1908 he returned to the old fold, to assist in the preparation of the standard biography of Mr. Edison by Martin and Dyer, to be issued by the Harpers this fall. Out of this congenial work other tasks of equally agreeable nature have grown at the Edison Laboratory, where Mr. Meadowcroft has for the past two years made an exhaustive study of all the records there of the master inventive mind of the century.

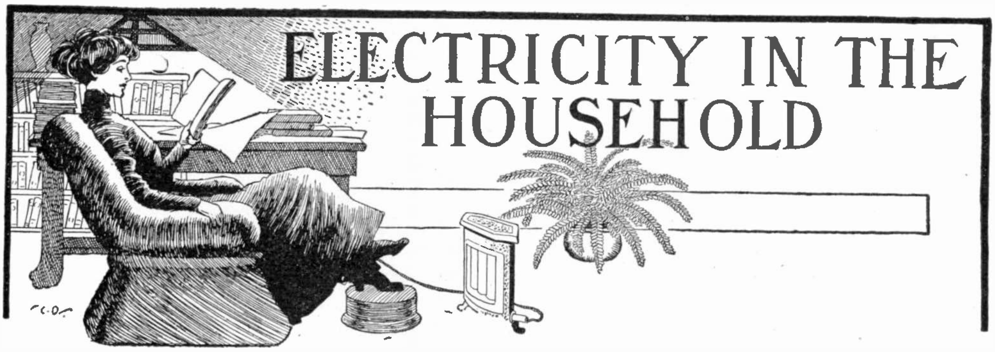
It will be gathered that Mr. Meadowcroft has not only been directly and prominently engaged in the upbuilding of vast modern industries but has helped tell their story. He has a pleasing literary style, and his success in appealing to popular tastes may be judged from the fact that his "A B C of Electricity" has reached a sale of nearly 90,000 copies and is "still going strong." He has written also an "A B C of the X-Ray," which enjoyed a fair sale. In addition to this, he has done a good deal of lecturing on Edison, X-rays, etc., and delivered a series of 24 very successful lectures all over the country, on and with liquid air, at the time of the furore some ten years ago. There is nothing dilletante about the man, but he manages also to get a lot of real pleasure out of very clever amateur theatricals and the practice of vocal music.

The Causes of Fires

In a published article recently a prominent underwriter stated that unquestionably electrical fires are preventable and are almost invariably due to carelessness: either carelessness in the use of inferior material in electrical installations or the careless use of good material at the time the work is being done and later. Proper specifications and inspections of the original installations and periodical re-examinations would beyond a doubt do away with practically all electrical fires.

The following table giving the causes and number of fires in Chicago for the year 1909 shows electricity not to be the gross offender it is so often pictured:

Ashes and hot coals	87
Blown down and ignited	16
Bonfires and burning rubbish	599
Candles and torches, carelessness with	81
Carelessness, not otherwise specified	36
Children playing with fire and matches	82
Chimney fires	435
Christmas trees	18
Cigar stubs and tobacco pipes	81
Defective flues	60
Dry-room overheated	5
Electric wires and lights	231
Engines and boilers, stationary	32
Explosions, alcohol, benzine and naphtha	8
Explosions, chemicals	9
Explosions, dust	3
Explosions, gas	27
Explosions, gasoline and kerosene	74
Explosions, lamps and lanterns	69
Explosions, oil	8
Explosions, oil and gasoline stoves	111
Explosions, water-backs	2
Fireworks	27
Forge, coals from	1
Friction	28
Fumigating	24
Furnaces, heating	156
Furnaces, foundries, etc.	2
Gas jets	99
Gas pipes, leak in	50
Hot iron and molten metals	3
Ignition, alcohol, benzine and naphtha	10
Ignition, chemicals	6
Ignition, gas	35
Ignition, gasoline and kerosene	126
Ignition, grease, oil and meats	79
Ignition, paints and varnish	9
Ignition, tar, rosin and wax	63
Incendiarism, known	60
Incendiarism, supposed	133
Lamp and lantern accidents	48
Lightning	56
Matches, carelessness with	454
Matches, rats and mice with	17
Mischievous children, etc.	62
Open fire-places and grates	34
Overheated and defective kiln	1
Overheated and defective ovens	25
Plumbers' and tinners' furnaces	1
Prairie fires	94
Rekindlings	24
Salamanders	9
Smokehouses, overheated	6
Sparks, chimney, etc.	240
Sparks, locomotive	109
Sparks, river craft	3
Spontaneous combustion	131
Steam-pipes	56
Stoves and ranges	285
Stove-pipes	29
Tailor's goose	2
Thawing water pipes	156
Thawing gas pipes	18
Tramps	5
Unknown	2,225
Total	7,075



The Letters of a Bachelor Girl

By R. GRACELYN EVERETT

DEAREST EDNA:

Do not think that I have forgotten you, for indeed I have not. If you have seen mother you will know why I have not written before. I have thought of you many times, but the work of getting our business started has taken all of my time so far.

You are no doubt curious as to what it is all about. Well, you know that this is called a dirty city, along with the numerous other mean things said about it. This very fact has been the cause of our enterprise.

You see Madge and I were frequent visitors to the one beauty shop in our neighborhood that amounted to anything. We would have been more frequent only it seemed we could never think to make the necessary appointment ahead. The place was always crowded simply because it was the only one in the vicinity, although the service was not at all up to date. Every time I went there I vowed, "never again," One night the water was not hot when she gave me my shampoo and I was so disgusted I fumed. As we were going out I said to Madge, "If I owned that beauty shop it would be a little bit up to date and have a few modern appliances at least."

That struck Madge as a good idea and being a regular business woman she had the scheme had worked out before we were home.

I had a little money laid by before I left home and she had a small amount left her by an uncle. We came to the conclusion, after getting the advice of several other people, that with our combined capital we could start a beauty shop on a modest scale at first, but with all the equipment first class, including the latest electrical contrivances which are a delight to the women who visit these places. We also haunted all the good shops in town and made a careful study of their ways of doing things. The ideas so gained, together with a few original ones of our own, have enabled us to fit out a really fine little establishment. I wish you could see it with its gold monogram sign on the window:

****
* THE HYGIENIC BEAUTY SHOP *
* 879 The Boulevard *
****

Our location is the best on the boulevard and we cater to high class patronage only. We have had the rooms completely redecorated in a delicate green and ivory white. The reception room is furnished with green wicker furniture and a beautiful velvet rug covers the floor. We had some elegant monogramed curtains made which lend an air of distinction.

The thing that will interest you most is our work shop where fine ladies are made even more beautiful. We have two experts on baths and electrical treatments and four smart appearing young girls who attend to the manicuring, shampooing, and hair dressing.

Each girl works in a compartment separated off with coarse white linen curtains hung on shiny nickel fittings. Each compartment has a large mirror fitted with an electric light on each side of the frame.

The furniture and the wood work are finished in ivory white.

The baths are in the rear and are supplied with the very latest devices. We now have many improvements that are not used in the less up-to-date shops, and when we enlarge, as we shall when the business grows to warrant it, we are going to put in one or two electric baths which are now recommended by electro-therapeutic practitioners.

By their use one may not only take a refreshing bath after a hard forenoon's shopping, but may at the same time receive an invigorating current of electricity through the body by means of suitable electrodes in the tub and various forms of sponge and brush electrodes.

We have a shampoo board in each compartment, that fits closely to the neck, on which the hair is thoroughly washed and rinsed. This does away with the hateful system of stooping over a basin and insures more comfort and better work. After washing, the hair is dried with warm air from an electric hair dryer, which can be regulated to any degree of temperature.

And when we have grown a little more—we are not trying to do everything at once—we have in view an electric scalp treatment which will be beneficial to locks which are falling out or losing color. This will require what is called a "static machine," to produce small quantities of electricity at very high voltage or pressure. Then when you sit in a chair under a canopy which is connected to one electrode of the machine and place your feet on a plate connected to the other electrode, you receive a veritable shower of bluish crackling sparks which rain down upon the scalp.

Your scalp tingles under the electric bath and the circulation around the roots of the hair is stimulated, which brings about the desired result.

In the massage departments we of course use electric vibrators, as many prefer them to hand massage and they are in fact quite beneficial from a therapeutical point of

view since they stimulate the nerve centers, and, when the treatment is continued long enough, have just the opposite, or a soothing effect.

In the massage department we also make use of a number of medical battery outfits giving both galvanic and faradic currents. When you grasp the electrode handles you obtain a stimulating current through the arms and body. Or you may grasp one handle and the other may be in the form of a little roller with which you are given an electrical massage. Or a metallic hairbrush is even connected to one electrode and your hair gets an "electric brushing" such as you never even dreamed of before. We also use nothing but electric curling irons. They are both clean and handy, and are time savers as well.

One great improvement that we have installed in our shop of beauty is an ozone air purifier which is a very recent electrical invention. It cleanses the air and keeps it as sweet as the ozone filled atmosphere of the native pine woods. This shop will be hailed with joy by those afflicted with hay fever when the dog days come, on account of this machine.

One of our girls is an expert in the use of the electric needle with which she removes superfluous hair, moles, warts and other small growths. The electric needle destroys the blood supply and causes the growth to shrivel up. Every time I see that outfit I wish that I could have old Mrs. Perkins for a few treatments. Do you remember how her beard used to amuse us?

I wish that you could peep into the manicuring compartments with their cute little white tables on which are desk lights shaded so as to throw the most of the light on the hands and keep the faces in shadow. We were a little extravagant in the cushions on

the tables. We had them made of green velvet and embroidered with our mark. They have been quite a decided sensation with our patrons. These little distinctive touches are a fine means of advertising and amply repay us for our trouble and expense.

When you come on that promised visit we will put you through a full treatment and I know that you will enjoy every minute of it. I know you are interested in what we are doing and wish us success. However, seeing—or rather feeling in this case—is believing, so hurry and come. I can hardly wait till you get here.

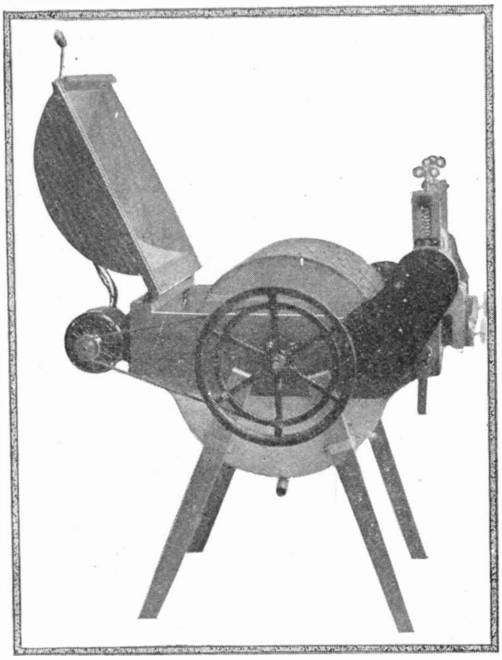
As ever with best love

VIVIAN.

879 The Boulevard.
August 8, 1910.

New Electric Washer and Wringer

In no part of the home are electric labor saving devices utilized to greater advantage than in the laundry. There are many electric washers on the market, but here is a new one which has never been described in this department. The picture shows the



COMBINED ELECTRIC WASHER AND WRINGER

combined electric washer and wringer in the opened position.

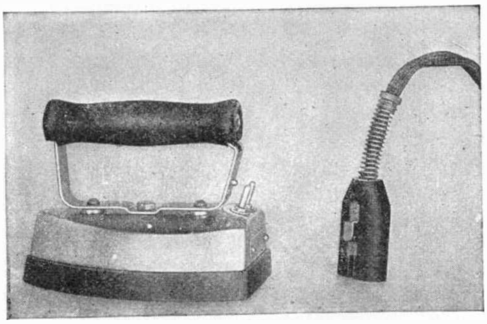
The machine, called the Emperial, combines the good features of the washboard and steam laundry and is built on the plan that it is the lift and drop of the clothes that does the cleaning, hence the more frequent the drop the quicker the work is done. In this machine the cylinder is reversed after each revolution, giving the clothes a thorough shaking and rubbing on the inside corrugations. When the washing is completed a simple shifting device transfers the power to the wringer with no loss of time. All cog wheels are eliminated from the inside of the body of the machine and this prevents spotting the clothes. The revolving cylinder is completely corrugated on the inside and the water receptacle of the machine is made of heavy galvanized iron.

The Latest Electric Iron

The success of an electric iron, or in fact any heating device, depends to a large extent upon the qualities of what is called the "resistor" or heating element. Expert metallurgists in the great laboratories of the General Electric Company sought long and patiently for the right material from which to make this "resistor". After trying hundreds of combinations of metals they discovered a new alloy which seemed ideal for the purpose. This they called "calorite." It has a high electrical resistance, a high melting point and is non-oxidizing. It is ductile and malleable but is not in the least degree brittle. From it are made the heating elements of the new G. E. electric irons, one of which is here shown.

The iron is well suited for light, medium and heavy laundry purposes. It is provided with a leaf heating unit which is spread over a broad path around the edges of the bottom surface so that the heat is delivered most directly to the parts of the iron which first come in contact with the damp material.

Three standard forms of connection are provided, the plain attachment plug, the indicating switch plug, and the permanently attached cord. With light or medium work it is advantageous to control the heat regulation by turning the current on or off as required, depending upon the nature of the work. This may be most readily accomplished by means of the indicating switch attachment plug. For very wet or



THE LATEST ELECTRIC IRON

heavy goods, it is generally necessary to keep the current on continuously. The plain attachment plug may be used where there is an occasional demand for continuous heat, as in the ordinary household. The flatiron with the permanently attached cord is especially recommended for laundries and similar establishments where controlling switches and pilot lamps are located conveniently near the ironing board.

The electric flatiron is made for one heat only. Wherever heat regulation is required it may be obtained by turning the current on or off from time to time as previously referred to. About three minutes are required for the iron to heat up sufficiently for light work.

These irons, which may be attached to any lighting circuit, either alternating current or direct current, where the pressure is not over 125 volts, consume 650 watts of current or about that of about 13 ordinary lamps.

Hughes Electric "Cook Stove

Most of the well known types of electric ranges have been described in this department in past issues, but the Hughes "electric cook stove," as its maker terms it, being a new-comer, possesses some features which many have not heard about as yet.

The stove is made with one, two or three "burners." The switch controlling each burner is arranged to provide for a low, medium or high temperature, while separate coils of wire making up the heating elements of these so-called burners are laid in grooves in a plate of specially prepared material so that their heat is applied directly to the bottom of the vessel which is set upon the plate. Another feature which the separation of the heater coil into parts makes possible is the repair of any one of the sections without attention to the whole element. Any coils burning out within a year after installation are renewed free of charge.

As will be seen upon examination of the picture there is a large oven-like compartment directly beneath the heating elements or plates. This compartment is not used for baking but rather as a warmer. Considerable heat enters this warmer from the heating elements when they are being used for cooking. Then when the current is turned off, if the cooked or partially cooked dishes are placed in the warmer their heat will be retained for a long period and cooking will even be continued at a slow rate, upon the principle of the well-known fireless cooker.

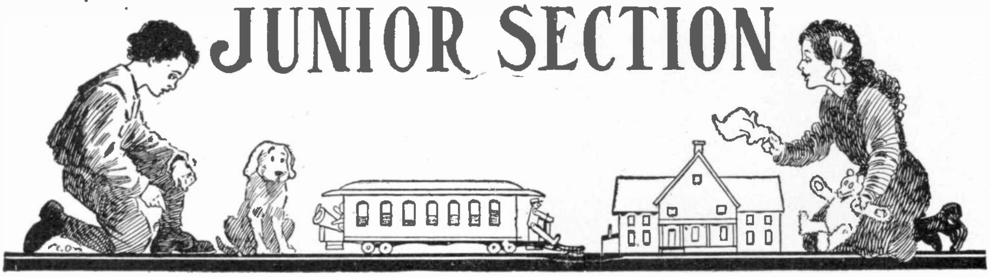
Some types of these stoves have an oven proper, located above the stove top, as in the most modern ranges This is provided with its own heating elements and will do any baking that can be accomplished on a gas or coal range.

Flies and the Electric Fan

There is something about the electric fan which flies dislike. It may be the strange humming noise reminding them of some enemy, or more probably it is the strong current of air which makes it hard for the flies to aviate; but, whatever it is, an electric fan is a first class fly discourager, and, if kept playing in the kitchen, pantry or dining room will surely drive them away.

HUGHES ELECTRIC COOK STOVE

JUNIOR SECTION



Obedience to the Law of the Giant

The Portland Railway Light and Power Co., of Portland, Oregon, has the lowest accident account of all the large electric railway companies on the Coast. This is due to various policies adopted by the company, among which is a unique educational campaign carried on in the public schools. The claim department of the company keeps two of its claim investigators busy with a series of lectures to the students of the schools teaching them the ways and means to avoid accidents from street cars. The idea of the lectures originated with Mr. B. F. Boynton, claim adjuster for the company, and was further elaborated by his daughter, Mrs. Ida P. Newell, who evolved the plan of a safety league among the school children. The lectures are first given in the schools of Portland then league pledges are passed around for the students to sign, one of which is here reproduced. Then each member is given a Safety League pin. Naturally the League and its object and the lectures themselves are talked over at home and the result is that the grown-ups become interested (and really fathers and mothers and big brothers and sisters can profit as much by the lectures as anyone). Thus a very effectual work is being carried on which will prevent the loss of many lives and many a little leg or arm will be saved. Every reader of the Junior Department should read and remember the simple directions which are given in the lecture which follows.—Editorial Note.

Girls and Boys: I appreciate this chance to come before such an audience. During the past two weeks I have had a like privilege and pleasure in talking to about 5,000 pupils in the six grammar schools and the Lincoln and Washington high schools and every day it becomes more interesting to me as I see the deep interest taken by the boys and girls in the plans we have for making our beautiful City of Roses known also to the whole world as the Champion City of Safety for Life and Limb.

A few days ago I went into the Public Library and I saw a special shelf filled with familiar books. It was another mute reminder of the recent passing of one of our greatest Americans—Mark Twain. I turned over the leaves of my old favorites when a boy—Tom Sawyer and Huckleberry Finn, and out of the covers peeped the girl Becky Thatcher and Willie Harper and Huck and Tom—and at once I was struck with the awful difference there was between the lives they lived 50 years ago and the life we live today. Theirs was the simple, natural life; ours the life of activity and multiplied invention. They saw only a slow moving Mississippi steamer or a raft floating down stream. We have a hundred lightning-like servants on every side.

PORTLAND SAFETY LEAGUE

SLOGAN: "Portland, the City of Safety"

SCHOOL________________ DATE________________

TEACHER________________ GRADE________________

MEMBER'S PLEDGE

I pledge myself to do all I can to save life and limb by preventing accidents in connection with street cars, automobiles and other moving objects, by

(1) Using care for myself in not playing on dangerous streets, crossing in front of moving cars, crossing behind cars without looking out for danger on the other side; jumping on or off moving cars; standing on car platforms; putting hands, arms or shoulders out of open windows, and by never picking up or touching a wire hanging low or lying on the ground.

(2) By doing all I can to prevent others from doing the dangerous things named above.

(3) I will wear the SAFETY LEAGUE pin, try to attend the vacation rallies, and work to make Portland known all over the world as the City of Safety as well as the City of Roses.

Pin Issued__________ NAME________________ AGE______

Book Issued__________ ADDRESS________________

Another picture drawn by a New York newspaper man came to my mind and I said I will contrast the old life with the new. It is said, by way of showing how rapid our progress in invention has been, that at the recent Fulton Celebration in New York that

On All Sides He Heard the Honking of Autos

Old Father Knickerbocker came back to New York on the Clairmont—Robert Fulton's first steamboat. They wouldn't let him go ashore for it wasn't safe to have the old man face the dangers of the New Day, but still husky and independent he jumped overboard and started to swim ashore. As he struck out he came face to face with a fast-moving steam yacht—on the other side a couple of motor speed boats barely missed him and a silent electric launch came up behind. Frightened for his life he dove under the water only to face the glaring eye of a submarine. More dead than alive he reached shore and started up Broadway. It was night. A million lights blinded him—on all sides he heard the honking of autos and ringing of gongs. A sightseeing auto came around a corner, a string of electric cars kept going by, an auto ambulance came from another direction, fire and police patrols were whizzing past and in the midst of this the Old Man could think of only one thing—he looked up to pray, but just in time to see that a propeller had broken on an aeroplane and it was coming straight for him. There was only one possible way of escape and he took it. A manhole was open in the street and he jumped down in it and just at the right time to land in front of a subway express going 60 miles an hour.

Now this is exaggerated but it has truth as its essence. The times have changed and we must change with them. Mark Twain said that when he went to school he had only two teachers and as was the custom in his day he gave them both nicknames, and it is from those teachers and their names I want to bring the lesson he learned. He said that one of the teachers he didn't like, because she was always marking him down in his lessons—the other was his favorite schoolmarm. The first one he called "Honesty"—because it was the best policy to do so, whatever his private opinions were—and the favorite schoolmarm he called "Experience" because she was such a "dear teacher."

We want both Honesty and Experience in our school. We want to be honest with you in this matter of preventing accidents and so we come with the results learned from Experience. All education is simply that one thing—experience and the deductions from it. I do not want you boys and girls to learn the lesson that if you put your hand in the fire it will be burned. If I see you drink a glass that I know contains poison, or if I see you in deep water drowning, what should I do? I am not a man if I do not do all in my power to save you, but we want something better than that—something better than Carnegie medals. We want to do away with the need of your getting into such danger. We want to see every school boy and girl in Portland doing the same thing. Ten years ago Bands of Mercy were started all over the country to prevent cruelty to animals—today that is not needed for we have all learned the lesson. I believe with all my heart that now is the time to have an American League of Safety made up of school boys and school girls—50 Portland Bands of Safety, organized to prevent accidents on and off the street cars, by automobiles and a dozen other growing dangers. What I say today may form part of the material for compositions for prizes as well as good memory tests. The Portland Railway, Light & Power Company is instituting a contest in all the grades of all the schools—grade against grade—and so soon as the plan has been perfected you are invited to join this League of Safety and enter the contest. Those who are too young to write the composition may be asked to tell to your teacher or some one appointed

Don't Cross in Front of an Approaching Car

for that purpose what the man said about the Greatest Giant the world has ever known, so remember you have your part.

When I was a little boy my favorite hero was Jack the Giant Killer—I believed in giants then—great, powerful, unseen. Then I grew older and said I didn't believe in giants any more, but today I want to tell you that I know there are Great Giants. I have met them and watched them work, and the greatest of these Giants we call Electricity. We don't know what it is, but it is everywhere—in the rivers—in coal and wood—in the clouds. The difference today is that it is no longer "Jack the Giant Killer" but something better. It is "Jack, the Giant Harnesser," "Jack, the Giant Master." I know the Giant and I know some of the men who have mastered him and made a powerful servant of him. Some of them are here in Portland, and if you want to you can see this Giant working on all sides of you. He pulls your heavy loads, he carries you on the cars, he makes your shoes, your clothing. He lights your school and streets so that the old time night is like day, and in some homes he does the cooking, runs the sewing machine, does the washing and ironing and a thousand things besides. He is a pretty good friend but he is still treacherous and cruel and mighty to destroy if you cross him. Harnessed? Yes, but you touch the harness and he crushes your life out or tears off a limb.

My business calls me very often to scenes that are enough to make any one turn gray. A short time ago I went to the place where a man crossed the Law of the Giant in getting on a car when it is in motion. His car will carry you safely if you obey his rules, but this man tried to swing on and lost his hold and the chariot wheels of the Giant took off his arm and two legs, and he was dead. But three months before, near the same spot, a similar accident happened. A boy was playing tag and ran right in front of the hurrying wheels and he goes through life on one leg and a crutch. But last Friday a school boy on the other side of the river jumped from the steps of the car and started around the back end. Another boy who had jumped off the front end and saw the other car coming yelled a warning to the two boys who got off together. One heeded and the other ran in front of the moving car when it was almost on top of him. No

Don't Cross Immediately Behind a Passing Car

motorman and no invention could have saved the boy from getting a broken leg, and as I saw him yesterday being taken on a stretcher to the surgeon—with his pale, drawn face—I thought how easily it might have been prevented.

Do you know that experts say that no less than 98 per cent of accidents are preventable? That the tens of thousands of lives and limbs sacrificed yearly to the modern Juggernauts

Don't Play Near Fast-moving Vehicles

need not have been lost if care and caution had been exercised? The time has come that it must be stopped. We cannot afford such slaughter from moral, from social, from common sense business grounds. A hundred and twenty-five millions of dollars annually mean nothing compared to the countless heartaches of those injured, and their parents and friends as well. They talk much of the conservation of forests and waterways—better that we should conserve life and limb.

The way is simple—use your head, your hands and your feet. The old railroad signal "Stop—Look—Listen" is a good one yet. It takes control to stop your feet—it is easier just to go on. It takes trained eyes to see a thing right—trained ears to hear danger coming.

Don't Jump Onto a Car that is Moving

RULES OF PREVENTION

It is a fact that men and boys get hurt getting on street cars—women and school girls in getting off the cars. There are exceptions to every rule, of course.

Now, personally, I believe there ought to be a law—an ordinance—against any one getting on a street car while it is in motion. Of course, some people will spit in cars and public places, but most people will not, and the same applies to such a law of safety. I think it should be made just as plain that it is an offense against the public for persons to risk breaking their necks in jumping off cars as the innocent public always suffers when an accident happens. But we have not reached that point of prohibition and prevention yet.

Don't Step Off from a Moving Car

Rule 1. Don't cross a track in front of an approaching car. The car runs on those two ribbons of steel. You have all the rest of the street. Your eye may deceive you. It says there is plenty of time—the car is a half block away—you have done it a thousand times. Don't believe such an eye. It is the good swimmer that is often drowned —it is the man who shoots that didn't know the gun was loaded. Conceit has killed its thousands.

Rule 2. Don't cross immediately behind a passing car, or one that has stopped at a crossing without giving any possible danger on the other side a wide berth. It may be an automobile or a motorcycle or another car.

Rule 3. Don't play on or near the street car tracks or in the road where any fast moving vehicle runs.

These three simple rules are the Law of the Street. I will give you four as short and as simple for the Law of the Car.

Rule 4. Don't jump on a car that is moving. I know what a temptation it is, boys—and sometimes, girls, too—but if you will be safe, "don't."

The power of habit is hard to break, but possibly the worst power for evil in this world is the power of example to others. You may have nimble feet, but how about the other girl or boy watching you do it. If he or she should be up in the hospital next week you may be, indirectly, one of the causes.


Don't Ride Where a Sudden Lurch Will Throw you Off

Rule 5. Don't step, or walk, or jump off a car step when the car is still moving, and this brings me to the one thing especially that I would have you remember and take home to your mothers and sisters. I know it has become a stock joke like the mother-in-law, but it is a most serious fact to thousands of women. If no other point is remembered we are well repaid for giving up some of our business time to these little talks. You can say that a representative of the Portland Railway said that, after long and patient study, we had at last discovered the reason a woman gets off a car backwards, like a Chinaman. Now, understand me, there is no reason under the sun why a Chinaman should get off a car backwards except that he does everything the opposite way, but there is a reason why a woman invariably takes hold of the wrong handle and gets off a car backwards, and it is so simple that any girl or woman can cure herself today by taking my free prescription. I have been watching school girls and working girls and women for some months, and what I say is a scientific fact. The reason a girl and a woman gets down and off backwards is because she has no left hand to use. It is busy carrying the bundle, the purse, the umbrella or the school books that should be shifted to the right hand. Shift and you can't get off wrong. That is, if you face front. To walk off straight is almost as bad as backwards. Just change the parcel to the right hand and you will save half the minor accidents to women.

Don't Hang Out of the Window

Two smaller rules of the car are: (6) Don't ride on the platform where a sudden lurch of the car may throw you out. The painful accident a few months back to the nurse here on the east side would not have happened had she remained inside the car. (7) Summer is almost here. Everybody likes air. The windows are open or the cars are open. Don't stick your heads and hands out the windows or side, as passing wagons, automobiles, etc., may cause painful injury. The last rule is neither of the car nor the street—it is of the Wire.

DO NOT TOUCH A WIRE

After a storm or some accident to the wires, one of them may drop. To cross the Giant then means death or suffering. I know a case where a boy in a nearby city saw a chance to swing in the woods and he swung on a wire that was hanging down, and he lost his right hand, and he can't play base ball, or other things, now or when he grows up. A little boy cutting across a lot saw a nice clean wire and he said to his little sister, "I'm going to take it home for mamma for a clothes line," and he ran to pick it up and his sister saw him drop, and her love made her run to help him, and as she touched him her life was destroyed—by the Giant in the wire.


Don't Touch a Wire

A safe rule of the Wire is this: Every wire you see is a live one. It may not be, but consider it so. My grandfather gave me a safe rule once when I asked him how I could tell toadstools from mushrooms, and you can apply it to any wire you see. He said, "The only way for you to tell if it is a toadstool is to eat it. If it kills you it is, and if it doesn't, it isn't." Today every wire I see looks suspicious—it is a deadly toadstool to me.

YOU OWE IT TO BE CAREFUL

In closing, let me say that you owe it to a lot of people to be careful and prevent accidents to yourself and to others.

You owe it to your fathers and mothers and brothers and sisters, for you make them suffer with you when you get hurt.

You owe it to your school and your teachers, for when you go to the hospital or are sick at home you are getting behind in your lessons.

You owe it, I believe, to the motormen and conductors. They are human. They are serving you the best they can. You get hurt and it hurts them.

You owe it to the great traveling public. We must travel, and, if you get hurt, you stop all the business—all the wheels—and a hundred, perhaps a thousand, persons are delayed until the facts are found out. It is worse than bridge waits sometimes. Then doctors and investigators and a score of others are kept busy just because, in your carelessness, you didn't think to do the right thing.

Of course, you owe it most to yourselves and your futures. You need your health and your hands and feet, if you want to succeed in life.

An Electrical Laboratory for Twenty-Five Dollars

By DAVID P. MORRISON

PART IX.—CONSTRUCTION OF A WHEATSTONE BRIDGE

It is quite essential that you understand the principle of the slide wire and Wheatstone bridges before you attempt to operate them in making measurements of resistance, hence it would be best to study briefly their fundamental principle.

The slide wire and Wheatstone bridges are nothing more than special forms of a divided electrical circuit and if you have an understanding of the relation of the various electrical quantities associated with the divided circuit the operation of the bridge will be greatly simplified. For the benefit of the readers who have had no electrical training the following discussion will give you a very good understanding of the divided circuit. Before taking up the electrical circuit, however, it might be well to illustrate the same conditions by the use of a water analogy.

Let us assume that there is a pipe (P) Fig. 88, carrying a liquid and that this pipe divides at the point (D1) into two branches, (B1) and (B2), and that these two branches unite again at the point (D2). Now it is apparent that there must be a difference in pressure of the liquid in the pipe at the points (D1) and (D2), or there would be no flow through the pipes connecting the two points. Two pressure gauges connected at these points would indicate the pressure in the pipe, and the difference in the readings of these two gauges would be

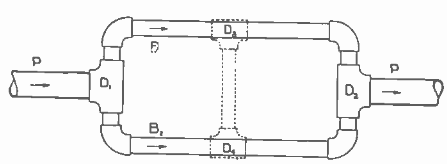


FIG. 88

a measure of the difference in pressure between the points. If the liquid is flowing from (D1) to (D2) the pressure gauge at (D1) will of course have the higher reading. Now the pressure in the pipe will decrease as you move along from the point (D1).

Take a point (D3) on the upper branch such that the pressure in the pipe has a value somewhere between that at (D1) and (D2). Now there must be a point on the lower pipe where the pressure is the same as at (D3). This point could be determined by placing a number of gauges along the lower branch and observing their readings. The gauge whose readings corresponded most nearly to the reading on the gauge at the point (D3) would be nearest the point. Let this point be (D4). Now if these two points are connected by a pipe as shown by the dotted lines in Fig. 88, there will be no liquid flow through it, due to the fact that there is no difference in pressure between its ends. The point (D4) could have been determined by connecting the point (D3) to various points along the lower branch until a connection was made that resulted in no current flowing between (D3) and (D4). When these two points have been located you know that the difference in pressure between (D1) and (D3) is equal to the difference between (D1) and (D4). Likewise the difference in pressure between (D3) and (D2) is equal to the difference between (D4) and (D2). These various pressures will bear the above relation to each other, when the pressures at (D3) and (D4) are the same, regardless of the size, length, form or kind of pipes composing the two branches, because the difference in pressure between the ends of all the various branches connecting (D1) and (D2) must be equal to each other at all times.

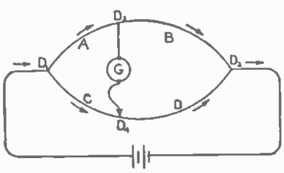


FIG. 89

Bearing the above relations in mind you can now consider the electrical circuit as shown in Fig. 89. The two points (D1) and (D2) are connected with two wires, thus forming a divided circuit.

The current in the main part of the circuit divides at the point (D1), part flowing in one branch and part in the other, and again unites at the point (D2). There will be a difference in electrical pressure between the points (D1) and (D2) and this difference is the difference in pressure between the ends of the two branches. Points to the right of (D1) on either branch will have an electrical potential less than (D1). If you take any point on one of the branches, such as (D3) on the upper branch, there will be a point on the lower branch whose electrical potential is equal to that of (D3). Since there must be a difference in electrical potential between two points to produce a current in a conductor connecting them, you can locate the point on the lower branch whose potential is equal to that of (D3) in the following way. Connect one terminal of a galvanometer to the point (D3) and the other terminal to a wire whose free end can be moved along the lower branch of the divided circuit. There will be a current through the galvanometer, and hence a deflection of its pointer, until the end of the wire is on a point whose potential is the same as (D3) and then there will be no current and hence no deflection. The point (D4) can then be determined by placing the terminal of the galvanometer where there is no deflection. After this point is located you know the following relation exists between the pressures in the two branches. The difference in pressure between (D1) and (D3) is equal to the difference in pressure between the points (D1) and (D4). Also the difference in pressure between the points (D3) and (D2) is equal to the difference between the points (D4) and (D2). The above relations will exist regardless of size, length, form and kind of wires forming the two branches of the divided circuit.

Since the same pressure exists over the two branches and the current in any circuit is equal to the pressure measured in volts divided by the resistance of the circuit measured in ohms, you can see that the currents in the two branches will be to each other inversely as the resistances of the branches. That is, the current in the branch of smaller resistance will be as many times the current in the other branch, as the resistance of the higher resistance branch is times the resistance of the lower resistance branch. The difference in pressure between any two points in an electrical circuit is equal to the product of the current in the conductor connecting them, and the resistance of the conductor in ohms. Knowing the above conditions to exist in all circuits and since the current in the two parts (A) and (B) of the upper branch are the same because there is no current leaving the wire or entering it at (D3), you can readily see the drop in pressure over the part (A) bears the same relation to the drop over the part (B) as exists between the resistance of (A) and the resistance of (B). For similar reasons the drop in pressure over (C) is to the drop in pressure over (D) as the resistance of (C) is to the resistance of (D). Now all of the above relations can be reduced to the following simple statement. The resistance of (A) is to the resistance of (B) as the resistance of (C) is to the resistance of (D). This written in the form of an equation would appear as follows:

$$\frac{A}{B} = \frac{C}{D} \qquad (1)$$

In other words, A is to B as C is to D.

From the above equation it is apparent that if the resistance (A) and (B) are equal (C) and (D) must be equal, or if the relation of (A) and (B) is known, then this same

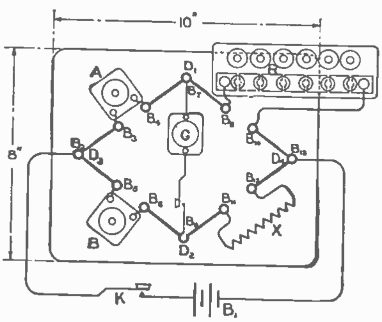


FIG. 90

relation must exist between (C) and (D) when a balance is obtained.

Connect a resistance (R), Fig. 90, whose value is known in series, with a resistance (X) whose value is not known, between the points (D1) and (D2), and connect the same two points with a piece of wire (W). A galvanometer (G) should have one terminal connected between the resistances (R) and (X) and the other terminal connected to a sliding contact (K) that can be moved along the wire (W). A battery (B) should be connected to the points (D1) and (D2). Now the contact (K) can be shifted along the wire until a point is located that causes no deflection of the galvanometer. When this point is found the following relation exists between the various resistances:

$$\frac{A}{B} = \frac{R}{X} \qquad (2)$$

In the above equation the only resistance whose value is known is (R) and the value of the resistance of (A) and (B) must be known, or their relation to each other, so that you can determine the value of the unknown (X). The resistance of a wire having a uniform cross-section will vary directly as the length, hence the relation of the resistance (A) to the resistance (B) will be the same as the relation between the length of the part (A) and the length of the part (B). Since the above relation exists between the resistance of a wire and its length it is only necessary to have one known resistance in order to measure the value of an unknown resistance. The scheme shown in Fig. 90 is that of the slide wire bridge and the parts of the wire (A) and (B) are called the ratio arms, because they give the ratio of the known resistance to the unknown.

The slide wire bridge, however, is more of a laboratory instrument and it is not very convenient for commercial work. The Wheatstone bridge is based on the same fundamental principle as the slide bridge, but the balance is obtained in a different way. Instead of changing the relation between the ratio arms (A) and (B) to obtain a balance the value of the resistance (R), called the rheostat of the bridge, is changed, the ratio remaining constant. Fig. 91 shows what might be termed a students' Wheatstone bridge. The two coils (A) and (B) are the ratio arms, (R) the variable known resistance and (X) the resistance to be measured. This bridge

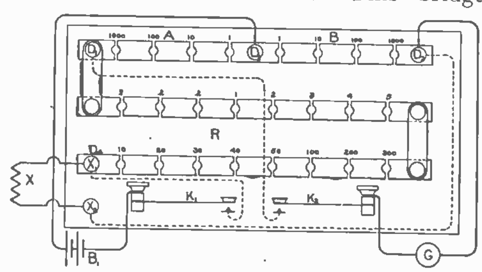


FIG. 91

can be constructed by mounting twelve binding posts (B1), (B2), (B3), etc., on a wooden base whose dimensions correspond to those given in the figure. These binding posts must be connected with pieces of heavy wire as indicated by the heavy lines in the figure or they should be fastened to strips of brass. It would be best to solder all of these connections. The connections of the galvanometer and the battery with respect to the bridge have been interchanged but the results will be the same as in the previous case. The resistance (R) is usually made up of a number of coils of different resistance arranged so any combination can be obtained by manipulating some form of switching device.

All of the coils that go to make up the resistance (R) can be mounted on a wooden base, and their terminals connected to the controlling or switching device.

A simple form of switching device can be made by mounting a number of pieces of brass on a board, with their ends only a short distance apart, and then drilling a tapered hole down between the ends into which a tapered metal plug will fit as shown in Fig. 92. The terminals of any coil can be connected to opposite sides of one of these openings and the coil put in or out of circuit by means of the plug.

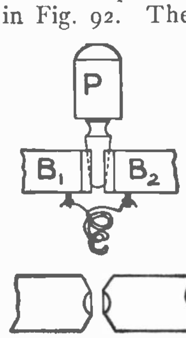


FIG. 92

When the ratio resistances are equal, the value of (R) will be equal to the unknown resistance when a balance is obtained on the galvanometer. Hence the value of the resistance that can be measured with such a bridge when the ratio arms are equal is determined by the maximum and minimum resistance in (R), This range for a given value of (R) can, however, be changed by changing the relation between the ratio arms. For example, if (A) is made ten times (B), then (R) will be ten times (X) when the bridge is balanced. With the above flexibility it would appear that the range of the bridge would be practically unlimited; but the errors in the measurements become greater as the value of the ratio is increased, the measurements being the most accurate when all the arms are as nearly equal as possible. In the commercial Wheatstone bridge the ratio resistances, the rheostat, the galvanometer, contact keys and oftentimes the battery are all contained in one case, thus making it a very portable form of bridge. A diagram of the connections of a simple form of bridge is given in Fig. 93. The ratio arms each consist of three independent coils arranged so that they can be switched in or out of circuit. The various resistances in the bridge are controlled by means of metallic plugs that fit the tapered openings between the metallic blocks such as (B1) and (B2), Fig. 92. The value of the resistance in the rheostat can be anything from .1 ohm to the combined resistance of all the coils composing the rheostat.

Two contact keys (K1) and (K) shown in Fig. 93 can be mounted on the top of the bridge with one terminal connected to the proper place on the bridge circuit, with a heavy lead inside the containing case as shown by the dotted lines, and the other terminal provided with a binding post that can be used in connecting to the external apparatus. An additional binding post (X2) is provided in the lower left hand corner (Fig. 91), that is connected to (D4) in the upper right hand corner, with a heavy wire. By using this additional binding post the two terminals for the unknown resistance are near each other which is quite a convenience sometimes especially if the unknown resistance has very

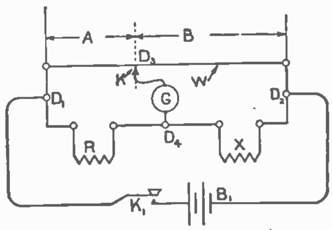


FIG. 93

short terminals. The construction of this bridge would no doubt cost too much for most of the readers and only a few would care to take the time to build it. The pieces of brass on the top of the bridge should all be fastened to strips of hard rubber before they are cut and the holes drilled for the tapered plugs. The dimensions of the various parts and the details of their construction will be left to those making the instrument.

(To be continued.)

Experiment with Carborundum

If you have a wireless coil try this experiment suggested by F. J. Wright and Harold Arntzen. La Junta, Colorado. Clamp a piece of carborundum in the binding post connected to one terminal of the secondary coil, bringing a wire from the other secondary terminal against the other side of the mineral. On operating the coil, instead of the current going through the carborundum as was expected, it jumped around it, lighting up in a manner similar to a Geissler tube. The experiment was made in the dark.

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 will be 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.

About Wireless Legislation

One of these days legislation is going to be passed by Congress regulating the operating of wireless telegraph instruments; either this, or the whole matter will be turned over to a bureau of one of the governmental departments with the power of control. The matter has been brewing for some time as all the readers of this department know.

What has been the reason for the steps already taken in this direction? Why are laws thought to be necessary? A little serious thought will make the reason as plain as day. It lies in the fact that the use of wireless telegraphy as a means of communication is being extended at a rate more rapid than that of progress in the art. In other words, every month sees hundreds or thousands of new stations, amateur, commercial and governmental, put into operation, and nowhere near the same progress made toward new and improved methods by which these stations may be enabled to operate without falling all over each other, so to speak.

As a consequence trouble and annoyance have arisen and each class of operators—amateur, commercial and government—believe that it has a grievance against the others. From the rate at which the number of stations is multiplying this is going to result finally in chaos. The cry which has arisen that the ether is free like the air and that everyone has a right to use it whenever, wherever and however he chooses is fallacy. The air which we breathe is free, under certain restrictions. It is the medium which carries sound vibrations. Suppose then you go into a concert hall where an orchestra is playing. Suppose you take a tin pan and try to accompany that orchestra in your own way. How long would you be allowed to use that free air in such a way—and would it be right?

There is an obstacle in the path of progress and that obstacle is lack of regulations—certain well defined and clearly understood rules of operation which will enable each class of operators to pursue its work for experiment or profit without interfering with the rights of the other classes. To outline the policy, whatever it may be; to make it broad enough to be individual, national, international in its scope is a task of overwhelming proportions and in our opinion one which should be undertaken by the government.

For these reasons, we say again, regulation by law is almost sure to come, and the sooner just regulation comes the better it will be for all. The readers of this department are composed largely of the so-called "amateur" class. Let your efforts be directed toward securing legislation which shall give you your share, and your share only, of the privileges. Let Popular Electricity Wireless Club go on record as one group of amateurs ready and willing to co-operate with the government to secure fair regulation and not be of the class which wants the whole earth, or rather the ether, and sets up a howl that the government is going to crush all the amateurs. Such only hurt their own cause.

Suppose, now, we glance over what has already been done toward the contemplated legislation. The full text of the bills cannot be given here, but enough for you to obtain a general understanding.

On December 6, 1909, the Peters Bill (H. R. 12384) was introduced in the House of Representatives. This bill makes it a punishable offence to (*a*) originate or transmit a false message purporting to be official; (*b*) to emit or radiate electro-magnetic waves of lengths between 375 and 425 meters except when communicating with an official wireless station, and specifying the punishment therefor. This was referred to the Committee on Naval Affairs.

On December 17, 1909, Mr. Roberts introduced a joint resolution in the House (H. J. Res. 95) authorizing the President to appoint a board of seven members: one expert each from the War, Navy and Treasury departments, three experts representing wireless-telegraph and telephone interests, and one scientist well versed in the art of wireless telegraphy and telephony, this board to prepare a comprehensive system to govern the operation of all wireless plants.

On January 27, 1910, Mr. Burke introduced a bill in the House (H. R. 19560) which was referred to the Committee on the Merchant Marine and Fisheries. This bill embodies the filing with the Secretary of Commerce and Labor by every station before beginning operation a sworn statement describing its ownership, location and construction. The Secretary shall preserve these records and issue to each station a number by which it shall be known and which it shall always use in calling.

For uttering, or acknowledging the receipt, of this call to establish communication between stations (between shipboard, between shore, or between shipboard and shore) a wave of 800 meters wave length shall always be used and this wave length shall be used for no other purpose (with exceptions to follow) and shall not continue for more than 15 consecutive seconds, or be repeated at intervals of less than five minutes. Messages shall then be transmitted at over 900 meters or under 700 meters, thus giving a range of about 200 meters for callings only. However, a shipboard station in peril may continue the calling signal as long as peril remains imminent and no other station in range shall use a wave length between 775 meters and 825 meters except to answer the call.

Successive waves in the train shall not differ by more than 20 per cent in amplitude.

No station shall knowingly transmit false distress signals.

For purposes of transacting business the government is given exclusive use of 1,000 and 200 meter wave lengths, and no other stations may use wave lengths within 25 meters on either side of the 200 or 100 meters on either side of the 1,000.

No messages received by a station other than the one for which they are intended shall be divulged.

The President shall have the power to suspend all stations during time of war or public danger.

On March 8, 1910, Mr. Bourne (for Mr. Frye) introduced in the Senate a bill (S. 7021, calendar No. 414) stating that after July, 1911, any ocean going steamer of the United States or any foreign country carrying 50 or more passengers shall carry an efficient radio-communication system and operator, except when plying between coast points less than 200 miles apart. This bill passed both houses and became a law.

On March 17, 1910, Mr. Depew introduced a bill in the Senate (S. 7243) which has passed the Senate and been referred to the House Committee on Merchant Marine and Fisheries, where it will stay until next session. Section 1 of this bill states that a person, corporation, or company shall not operate a system as a means of commercial intercourse by transmitting to or receiving from beyond the bounds of the State or Territory in which it is located except with a license in that behalf granted by the Secretary of Commerce and Labor.

Section 2 says that the Secretary of Commerce and Labor shall determine the form of such license, which shall be subject to regulations established by this act and subsequent acts or treaties of the United States.

Section 3 states that such apparatus while in use be under the charge of a licensed person under supervision of the Secretary of Commerce and Labor.

In Section 4 it is specified that to prevent interference with messages relating to vessels in distress or naval and military stations and private or commercial stations, the President shall establish regulations by designating wave lengths or otherwise.

Section 5 makes interference with the regulations of the act a misdemeanor.

By Section 6 the Secretary of Commerce and Labor shall prescribe the form of applications for licenses.

Section 7 specifies license fees, no fee being required for licenses for the conduct of experimental stations.

Section 8 defines "radio-communication."

Sections 9 and 10 regulate messages relating to ships in distress, and prohibit fraudulent messages.

Section 11 concerns radio-communication on foreign ships in territorial waters.

Section 12 states where trial for offences shall be held.

Section 13 states that the Act shall be in force on and after July 1, 1911, except that the 4th, 5th, 9th, 10th, and 11th sections shall be in force four months after the passage of the bill.

On March 26, 1910, Mr. Green introduced a bill in the House (H. R. 23595, Union Calendar No. 177). This bill has 13 sections and in substance is the same as the Depew bill in the Senate.

Finally on March 29, 1910, Mr. Roberts, from the Committee on Naval Affairs, reported a joint resolution in House (H. J. Res 182, Union Calendar No. 170), which was committed to the Committee of the whole House on the State of the Union. This in substance is the same as Joint Resolution 95 and the board therein provided for is to submit its report and recommendations to Congress not later than the first day of December, 1910.

Now there are all these bills and resolutions pending in Congress. They have been talked over and talked over in the various committees. Experts have come before these committees and given their reports.

In reading over the proceedings of these committee meetings the reports show that the committees have given careful thought to the point that restrictions should not be made so as to crush out the amateur and deprive the art of any service which he may extend in the way of development and improvement.

Of the bills outlined above affecting amateur operation there is no certainty that any of them will be passed as they are. Congress is simply working toward some equitable means whereby wireless may be put on a sound and sane basis.

It would be well for every member in Popular Electricity Wireless Club to write a letter to his congressman pointing out the fact that the rights of the amateur are to be respected in the forthcoming legislation; show how wireless clubs and associations are being formed all over the country the object of which is to help bring about these bettered conditions; impress upon him that a law simply specifying a few wave lengths or restricting interstate operation is not going to better the situation, that something broader is necessary, something sufficiently flexible to adapt itself to the ever changing state of the art; point out to him as many instances as you can think of in which an amateur has actually made a valuable discovery and above all make plain that every right-minded amateur is ready and willing to accept any just regulations which may be necessary so that all may work together.

Lightning and the Aerial

It is worthy of comment that although through Popular Electricity Wireless Club we are in touch with hundreds of wireless equipments we are in receipt of the first letter telling of damage done to such an outfit by lightning. The letter is as follows:

On the afternoon of June 26 lightning struck my wireless station located in the rear of my home, doing damage to the extent of about twenty-five dollars. The lightning struck the wires at the top of the pole, following the leading-in wire to the aerial switch which was open about a quarter of an inch; jumping the gap it passed to the instruments, wrecking them and fusing a No. 12 wire running from the detector to the ground wire. In striking the antennæ it broke off an insulator and buried it a foot in the ground fifteen feet from the pole. The following day with the help of a friend I put things in order and our first move was to install a double-throw switch on the outside of the building so that during a storm or when not in use the aerial could be grounded, as I do not care for any more experience with lightning.

C. M. David.

So far as we are able to learn the underwriters do not impose an increased rate where wireless equipments are in use in a building because no fire loss has been incurred on this account. However, most inspection bureaus enforce rules in this matter similar to those of the Boston Board, requiring a No. 4 B. & S. gauge copper wire so arranged that the aerial may be thoroughly grounded through a 100-ampere knife switch; or, instead, connect the aerial to ground through an approved short-gap lightning arrester.

A High-Power Wireless Equipment

By ALFRED P. MORGAN

PART V.—OSCILLATION CONDENSER

Condensers usually receive so much attention when discussing wireless telegraphy that their construction and principle are well understood. However, in order to make this series of articles, as far as possible, each complete in itself and of value to the lay reader it will not be amiss if these points are taken up.

A condenser ordinarily consists of two coatings of tinfoil separated by an insulating substance termed a dielectric and most commonly composed of paper, mica or glass, depending of course upon the use to which the condenser is put. If the opposite tinfoil coatings are connected to a source of current having a high E. M. F. such as a static machine or induction coil, they will become sufficiently charged so that when connected to a small spark gap, the current will leap across in the shape of a brilliant white spark. To the ordinary eye, such a spark appears to be made up of a discharge which passes in one direction only. But by examining the image cast in a rapidly revolving mirror, it is found to really consist of a large number of sparks passing alternately in opposite directions. It seems as if the first passage of current served to more than empty the condenser and it became charged in the opposite direction, that is, the conducting coatings change their polarity. A second discharge which passes in a reverse direction and also oversteps itself, immediately occurs. This action repeats several times but the *oscillations* or reversals of current die away or become *damped* very rapidly. The actual time consumed by the discharge may take only a fraction of a second but the frequency of the oscillations may vary from 15,000 to 1,000,000 per second.

If a piece of cardboard is perforated by the spark from a condenser it will be found that the hole has a slight burr on either side as if it was formed by an object which passed in both directions. If a card is pricked with a pin, the burr will be found only on one side and on that opposite to the pin.

The charge of a condenser resides on the surface of the dielectric and not on the tinfoil or metallic coatings. If a condenser is charged and the coatings are removed and tested they will not appear to be electrified to any extent. However, upon putting the condenser together again it will be found to be highly charged. If a condenser which has been charged and discharged several times is examined, it will be found that the temperature of the dielectric has increased. The dielectric has actually undergone a strain and expanded or contracted, depending whether it is glass or some resinous body. A condenser does not store electricity but rather *energy*.

A condenser used to generate the electrical oscillations for transmitting wireless messages must withstand a voltage reckoned up in the thousands. Only a few substances are available, commercially, as a dielectric for such a condenser and of these hard or flint glass is by far the best.

Where condensers of small capacity are required for high tension work they are usually made in the form of a cylinder or jar having the inside and outside surfaces partly covered with tinfoil. They are then known as leyden jars. This brings into notice a point which is worthy of discussion, that is, the merits and demerits of leyden jars and the form of condenser usually built up out of sheets of glass known as a plate condenser. The former are by far the most common but are surely giving place to the latter in whose favor lie economy and compactness.

If the condenser is built up of tin foil sheets interposed between glass plates, it is possible to cast it in a solid mass of insulating material or to immerse it in oil and so eliminate all brush discharges from the edges of the tinfoil. Absence of brushing makes it possible to time a station more accurately and save considerable energy which otherwise would be lost.

Another deciding factor in favor of the plate condenser is the lack of blistering. In stations having a capacity of one K. W. or over, the tinfoil on leyden jars quickly becomes covered with blisters so that they must be recoated or their capacity will be

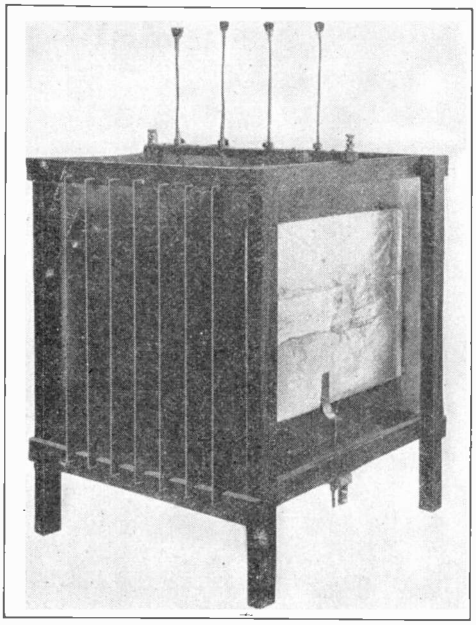


FIG. 51. RACK CONDENSER

so altered as to throw the circuits out of tune.

The condenser illustrated in Fig. 51 is the one built by the author for use with the induction coil which has already been described. If overworked, it will develop blistering and brushing, but the author has found it to operate with entire satisfaction.

It consists of eight glass plates 18 by 24 inches mounted on a rack which permits of their easy removal or inspection. The tinfoil measures 12 by 18 inches which allows a three-inch margin all around the edge. Both sides of each plate are coated.

In selecting the plates take care that they are very good glass, free from lead. Only plates which are of equal thickness throughout should be laid aside for use. Many will be found which are considerably thicker in the middle than at the edges. This is a serious weakness, for condensers are more apt to puncture at the edges than at any other place and so the use of such plates should be avoided.

Before coating the glass plates they should be thoroughly cleaned with warm water and allowed to dry. Cut the tinfoil which should be very heavy, preferably No. 35 gauge, with a sharp knife and a straight edge. Pure shellac varnish made up of anhydrous wood alcohol and white shellac is the only adhesive which should be used for sticking on the tinfoil. Almost all other adhesives will cause trouble. The shellac may be applied with a wide paint brush which is clean. One side of each plate is quickly brushed over with shellac and the tinfoil applied. Immediately roll it down smooth with a rubber squeegee roller such as is used for rolling out photographic prints upon mounts or ferrotype plates. Use great care to exclude all air bubbles. Then coat the tinfoil with shellac along the edges so as to cover a margin about one inch wide all the way around. Do not coat it for any greater distance than this or considerable trouble from sparking between the tinfoil and the connecting clips will be experienced. Each one of the plates is treated in turn until all have been coated on one side only. They are then allowed to stand and the other side coated when the shellac on the first side has dried. Otherwise if the plates were turned over while the shellac was still wet, they will pick up innumerable particles of dust, etc., which will cause brushing and loss of energy. Fig. 52 shows one of the plates with foil in place.

The frame of the condenser is illustrated in Fig. 53. The wood is quartered oak,

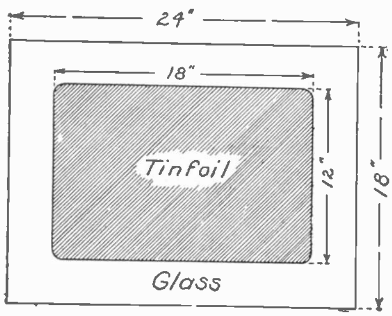


FIG. 52. CONDENSER PLATE

which has been filled and varnished. The four legs (AAAA) are 25 inches long and $1\frac{1}{2}$ by $1\frac{1}{8}$ inches in cross section. The side pieces (CCCC) are $21\frac{1}{2}$ by $1\frac{1}{2}$ by $\frac{1}{2}$ inches. The four members (BBBB) which support the plates are 19 by $1\frac{1}{2}$ by $\frac{1}{2}$ inches. Each contains eight grooves 5-32 of an inch wide and $\frac{1}{2}$ inch deep. The outside grooves are located $2\frac{1}{2}$ inches from the ends. The others are all spaced two inches apart between their centre lines. The two strips (DD) which support the connecting clips are $17\frac{1}{2}$ by $1\frac{1}{2}$ by $\frac{1}{2}$ inches. The frame is fastened together with dowel pins and glue.

The glass plates are slid into the grooves in (BBBB) and held in place by a small wedge of wood which also serves to keep them from rattling.

Connections to the tinfoil on the plates are established by a set of nine adjusting

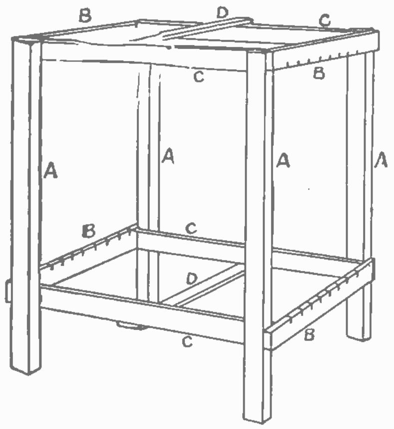


FIG. 53. CONDENSER FRAME

rods and brushes. The brushes are shown in detail in Fig. 54. They are formed out of strips of No. 24 gauge spring brass, $\frac{7}{8}$ of an inch thick and six inches long. The

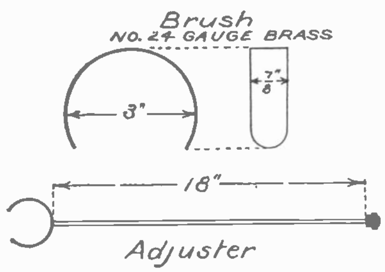


FIG. 54. ADJUSTER AND BRUSH

ends are rounded as in the illustration. Seven of this size are required. They are bent until they coincide with the circumference of a circle having a diameter of three inches.

Two small brushes three inches long bent into a quadrant of a circle having the same diameter are necessary to make contact with the outside plates, as shown farther on in Figs. 57 and 58. Four $\frac{1}{8}$-inch brass rods 18 inches long are soldered to the centers of four brushes as in Fig. 54. The opposite ends of the rod are threaded with an 8-32 die to receive a small composition knob which acts as a handle. The details of the knob are illustrated in Fig. 55. They are obtainable at almost any electrical supply house. The remaining five brushes are soldered to similar rods 12 inches long. Knobs on these are unnecessary.

The adjusters and brushes are supported by nine small connectors shown in detail in Fig. 55. They are formed by cutting an ordinary double connector in halves with a hacksaw and smoothing up the rough edges with a file. The connectors are then soldered to a long strip of brass, Fig. 56, $\frac{1}{2}$ inch wide and 1-16 of an inch thick. Four

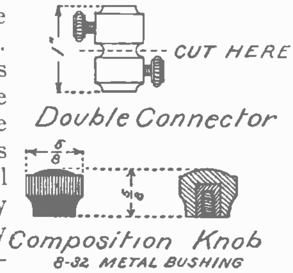


FIG. 55. CONNECTOR AND KNOB

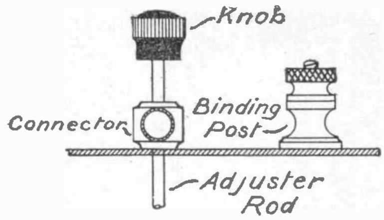


FIG. 56. CONNECTING STRIP

such strips are required—two for the top and two for the bottom. They are mounted on the wooden pieces (DD) Fig. 53, and held in position by two or three small round headed brass wood screws which pass through holes in the brass strip bored for that purpose. A large binding post is soldered to the end of each strip as shown in Fig. 56. A hole must be bored through the wood and brass directly under each connector so that the rods may pass through.

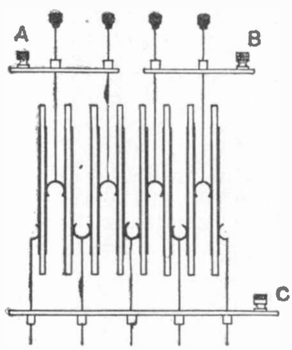


FIG. 57. ASSEMBLY OF PLATES AND CONNECTORS

The adjusters having a knob at one end should pass through the upper strip (D). The brushes should come between two plates as shown in Fig. 57 and make a firm contact with the tinfoil coatings. To adjust the capacity of the condenser it is merely necessary to draw one or more of the adjuster rods until the brushes no longer make contact with the tinfoil. A better idea of how this may be done is shown by Fig. 58.

The best way to use the condenser in connection with the 10-inch induction coil is to have all the brushes in place and use the binding posts (A) and (B), Fig. 57, as the terminals. When used in this manner the plates are connected in series multiple and are not subjected to as great a potential as a simple multiple condenser. When used with the transformer all the brushes should

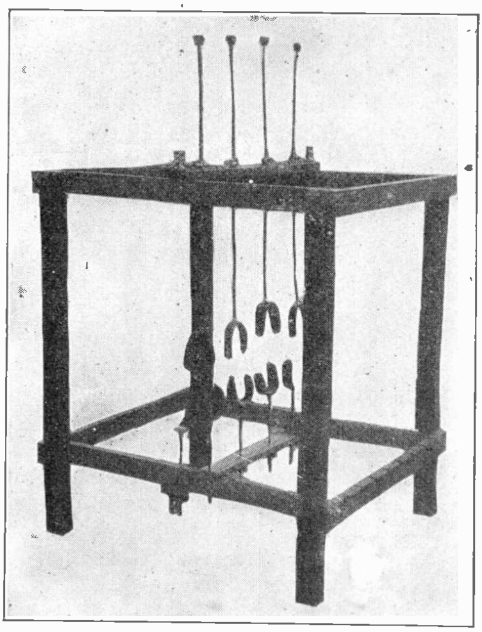


FIG. 58. SQUARE CONDENSER FRAME ASSEMBLED

be in place and (A) and (B) connected together as one terminal. The post (C) forms the other. The plates are then in parallel.

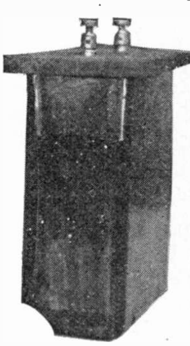


FIG. 59
OIL IMMERSED CONDENSER

The condenser illustrated in Fig. 59 was built to determine the advantages resulting from the use of oil immersed plates. After considerable experimenting it was decided that the "rack" condenser just described was perfectly suitable and gave excellent results as long as it was not overworked. Whenever in an attempt to increase the transmitting range it was forced, brush discharges at once commenced which normally did not take place.

Four units similar to that shown in Fig. 59 were built to form the complete condenser. Each one has approximately

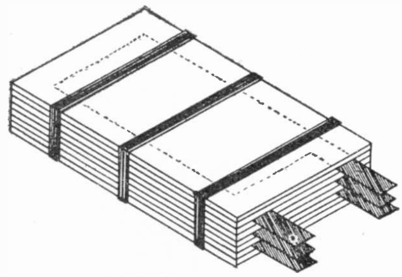


FIG. 60. CONDENSER UNIT

twice the capacity of one of the plates forming the "rack" condenser. The containers are rectangular glass battery jars, measuring $2\frac{1}{2}$ by 8 by 12 inches inside. There is apparently no standard for such jars, each manufacturer of storage batteries using his own size. In case it is impossible

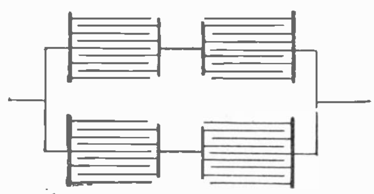


FIG. 61. CONDENSER CONNECTIONS

to secure jars of the dimensions mentioned above, others may be used providing that the conducting coatings are arranged and cut so as to furnish the same amount of opposed surface.

Each unit contains eight plates, 11 inches long, which are just wide enough to slide into the jar when a strong rubber band is placed around them. The conducting coatings which number nine to a jar are cut out of thin sheet copper. They are six inches wide and nine inches long, irrespective of the lug at one corner. This allows approximately a one-inch margin on all sides of the coatings. The units are assembled as in Fig. 60 so that the lugs on alternate coatings come at opposite corners. The plates are bound firmly together by means of three large rubber bands. The lugs are bent down at right angles and a hole bored through into which a 10-24 machine screw may be passed. The screw passes through the base and into the bottom of a large binding post on the cover. The cover is a piece of hard rubber ½ by 3½ by nine inches.

The jars are poured full of boiled linseed oil until the plates are well covered. The four units are all placed in multiple when used with the transformer and in series multiple in connection with the induction coil. Fig. 61 shows the connections

(To be continued.)

Chicago Wireless Club

Meetings of the Chicago Wireless Club are held on the second and fourth Fridays of each month in Room 74, Auditorium Building, at 7:30 p. m. A talk bearing upon wireless telegraphy is given at each meeting and is usually illustrated by chalk drawings.

The Club was organized Dec. 12, 1908, with a membership of 94. Officers: R. C. Dickson, president; John Hair, vice-pres.; H. S. Ayers, treas.; E. W. Muellner, corresponding secretary; Seldon Stebbins, recording secretary. Motto: "Let us all be one." Secretary Muellner, 6603 Langley Ave., is desirous of getting in touch with persons interested who live within a radius of 200 miles of Chicago.

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.

Long Distance Equipment; Rewinding Receiver; Fixed Condenser

Questions.—(A) What instruments are needed to receive 500 to 600 miles with an aerial consisting of 40 wires, 50 feet high at one end and 70 feet at the other? (B) What size ground should be used with above instruments? (C) What size and how much S. S. C. wire would be required to rewind a 75-ohm telephone receiver to 1500 ohms? (D) How can I make an efficient fixed condenser of 4x5 glass plates and tinfoil?—A. R. P., Sterrett, Okla.

Answers.—(A) Perikon or silicon detector, either straight coil or variable coupling tuner, good variable condenser, and a good pair of 500-ohm wireless receivers.

(B) A gas or water pipe will do for a ground. connection, and if neither of these is available, a sheet of copper or zinc may be buried six or eight feet below the surface of the earth in as damp a spot as you can find. The surface of the sheet should be not less than 25 square feet.

(C) Since the bobbins of various telephone receivers are of different sizes, we cannot say. Probably, however, the size of wire best suited to your purpose is No. 46, of which ½ ounce will be required.

(D) In the series of articles on "High Power Equipment" a description will be given of an efficient plate condenser, which, we believe, will answer your question very well.

Spark Coil on 110 Volts

Question.—I understood from your answer to E. S. G., page 45 this volume, that a spark coil could be operated direct from a 110-volt, a. c. circuit by screwing down the vibrator. I cannot make it work. When I close my switch a second I blow the fuse. When I put a 16-candle-power lamp in series I get no spark, though my coil is built to give a one-inch spark. What is the trouble?—H. D., Jr., Bergen Beach, Brooklyn, N. Y.

Answer.—No doubt the reason that your fuse blew is because the carrying capacity of the fuse was too small. We have connected one-inch coils as described, and they have run without blowing a ten-ampere fuse. It is never a good plan to operate a coil on 110 volts, whether in series with an electrolytic interrupter, or direct connected to the mains, if the coil was designed for battery power. We have seen more coils damaged by this procedure than by any other means, and we never recommend doing this. When you screw down the interrupter, and run the coil direct on 110 volts, it is running as a transformer of the open core type, and it is very inefficient. A short flame will be produced at the secondary terminals, but the current consumption will be high. On the other hand, if the coil is connected in series with an electrolytic interrupter, the current consumption is also high, and the high potentials produced in the secondary winding as the current is made and broken by the interrupter are exceedingly dangerous to the insulation of the secondary. An example of the inefficiency of this combination is shown by the fact that the ordinary cheap electroyltic interrupter connected in series with a coil requires at least 20 amperes, or about two K. W., for its proper action. Since good one-inch coils should not consume more than 1½ amperes at 6 volts, or about 1-100

K. W. it is not surprising that some coils are damaged by careless owners.

In your second instance the resistance of the lamp was too high.

Tuning Coil Wave Length; Potentiometers

Questions.—(A) Does the wave length increase as the diameter of a tuning coil decreases? (B) Is a graphite rod potentiometer better than German silver wire? (C) Give dimensions of an 18 per cent German silver wire potentiometer having a resistance of 300 ohms. (D) When building a tuning coil as described in the January, 1910, issue would doubling or trebling the dimensions increase the wave length proportionately?—M. R. R., Merchantville, N. J.

Answers.—(A) The wave length to which the tuning coil will respond varies approximately as the square of the diameter.

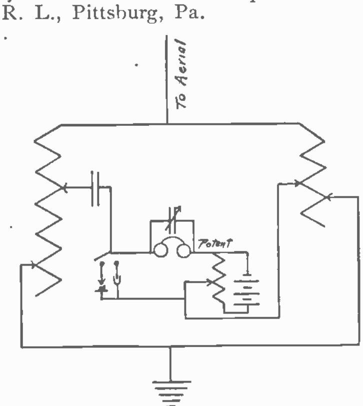
(B) We believe that the latter is as effective as the former.

(C) 167 feet No. 30 single cotton covered, wound on 10 inches of a wooden core 12 inches long and one inch in diameter.

(D) Yes, as pointed out in Question (A).

Connections of Receiving Instruments; ¼ K. W. Transformer

Questions.—(A) Please show diagram for connecting two tuning coils, both double slide, one having 620 meters and the other 140 meters, fixed and variable condensers, potentiometer and battery, silicon and electrolytic detectors, former to be used with or without battery and with 3000-ohm receivers. (B) Would my receiving radius be increased by using a perikon detector? (C) What would be the sending distance of a ¼ k. w. transformer, helix, condensers, etc., presuming sensitive apparatus at the distance station and fairly level country with favorable atmospheric conditions? —E. R. L., Pittsburg, Pa.



CONNECTIONS OF RECEIVING INSTRUMENTS

Answers.—(A) See diagram. To use without battery move the slider of the potentiometer to the end of the resistance rod corresponding to no voltage.

(B) Your receiving radius might be increased as much as 10 per cent, depending on the quality of the zincite of the perikon detector.

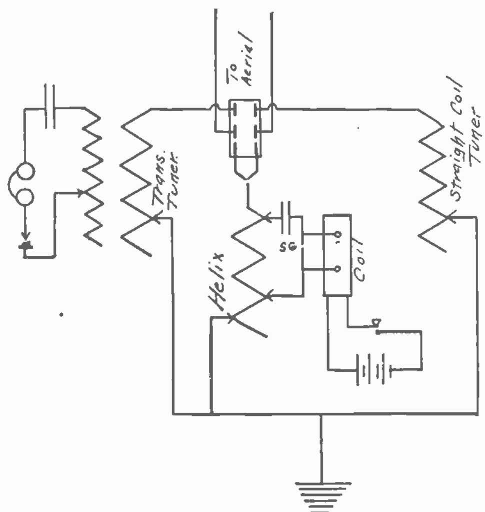
(C) The average transmitting distance of this set would be about 30 miles under the above mentioned conditions.

Looped Aerial and Connections; Anchor Gap

Questions.—(A) Please give diagram showing how to connect a looped aerial, antenna switch, described in May, 1910, issue, fixed condenser, receiving transformer, silicon detector, double head phones. (B) Also show connections for two-inch spark coil, anchor gap and helix with same aerial. (C) How is an anchor gap made?—H. A. T., Artesia, Cal.

(A), (B) See diagram.

(C) An anchor gap may be made by mounting on a base three double screw binding posts, such as are used on the small zinc spark gaps. These posts in an anchor



LOOP AERIAL AND CONNECTIONS

gap are generally mounted 120 degrees apart, so that the ordinary zinc rods, as used in the zinc spark gaps, meet at the center of a circle drawn through the binding posts. An anchor gap with three such rods meeting at a point is generally used in connection with a loop aerial. If the gap is to be used with a straightaway aerial, an ordinary zinc spark gap will do very well as an anchor gap.

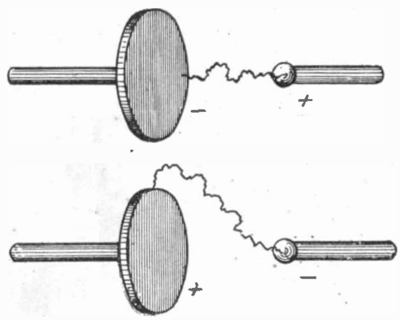
QUESTIONS AND ANSWERS

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 the 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.

Polarity of Induction Coil; Grounding of Lightning Arrester

Questions.—(A) How can I tell which is the positive pole or electrode of a high-frequency induction coil? (B) Is it safe to ground a telegraph lightning arrester to a gas fixture?—J. R. H., Philadelphia, Pa.

Answers.—(A) If a disk be used as one terminal of an induction coil capable of giving a spark across an air gap, and a ball be used for the other terminal, the polarity of the terminals may be determined from



POLARITY OF AN INDUCTION COIL

the behavior of the spark. At the top is shown path of the spark when the ball electrode is positive, and at the bottom its action when the disk is positive.

Another way to determine the polarity is to use fine iron wire for the electrodes. With a short thick spark the wire attached to the negative electrode becomes very hot and may fuse at the end.

(B) No.

Making Fuse Wire

Question.—Will you tell me what metals are used in making fuse wire and how it is done?—W. T., Kenova, W. Va.

Answer.—Lead containing a certain percentage of tin is used for fuses on account of the low temperature at which it melts. Tin fuses at 235° C. and lead at 325° C. Fuse wire is not drawn like ordinary wire but is squirted under pressure after the method used in making incandescent lamp filaments. The dies used are long enough so that the fuse wire on emerging is sufficiently cooled to retain its form.

To Prevent X-Ray Tubes from Breaking

Question.—Kindly advise me how to prevent an X-ray and Crooke's tube from breaking; I have just ruined one of each. The former was melted at one point and the air admitted. How long can they be operated? Must you stop when the cathode becomes red hot?—F. J. R., San Jose, Cal.

Answer.—In answer to your question concerning the life of an X-ray tube, or a Crooke's tube, as all X-ray tubes are Crooke's tubes, it is impossible to know just how long a tube will last, but there are several factors upon which its life depends. If your tube and the generating apparatus are properly adjusted, the target should not become red hot while being used for treatment purposes, but if you send a good deal of current through it in taking a picture it will produce enough heat at this point, as the result of the bombardment of the cathode stream, to make it become red hot.

If the current is still sent through, finally enough heat will be evolved to melt some portion of the tube. The heavier the target the greater the amount of current the tube will take without heating up.

In all probability you have too light a target for the apparatus you are using, or the material employed in the target is not up to grade. With proper apparatus the tube will stand sufficient current to enable you to get a picture before it has become too hot to endanger the tube. If the apparatus generates so much current that it heats the tube before this takes place, the only remedy is the purchase of a tube with a very heavy target, such as is made for the heaviest coils. A tube which is punctured may be repaired, and all of the tube factories do this work.

Therapeutic Solenoid

Question.—Please give instructions for building a solenoid for therapeutic purposes.—C. H. M., Sandusky, Ohio.

Answer.—To build a solenoid in the form of a cage to be used for the administration of the D'Arsonval current by the method of auto-condensation it is necessary to use about number four or six copper wire. It need not be insulated but must be solid copper wire. The best results are obtained when the length and size of wire are properly adjusted to the capacity of the generating apparatus.

The easiest way to construct one of these solenoids is to make a collapsible one. The coils of the spiral should be about three inches apart, therefore, in making a six-foot solenoid, there should be approximately 24 turns of wire. The solenoid ought to be from three to four feet in diameter so that the body when inside of it will not come in contact with the wire. For one three feet in diameter it would take about 250 feet of wire. This should be wound around a drum of that size and allowed to remain there for a few hours so that it will retain its shape, when it is removed and cotton belting is sewed on in strips running lengthwise of the solenoid and about four inches apart, while the turns of wire are kept at a distance of three inches from one another as stated above. If these strips of belting are sufficient in number the spiral will hold its shape nicely. The upper and lower spirals are preferably passed around a wooden hoop or the upper one may be attached to any wooden frame that will hold it firmly. This may be suspended from the ceiling and by means of a rope running to the lower turn of wire, the whole may be collapsed like an accordion or like the old-fashioned hoop-skirt.

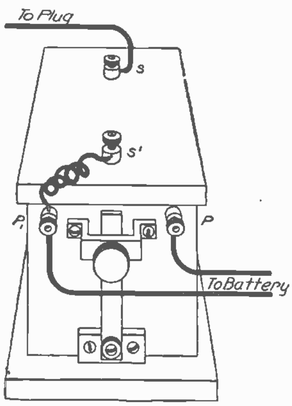
Another method is to construct a cage with a sufficient number of upright posts to make it hold its shape, the bottom part being open. The wire is run around the outside of the cage as before, being held in place by wooden fasteners or metal staples driven over a thick piece of rubber. The whole cage is suspended from the ceiling so that it may be raised and lowered over the patient.

To attempt to construct a door such as is present in apparatus on the market is too difficult for home construction. The upper end of the wire in the solenoid is attached to one pole of the D'Arsonval apparatus and the lower end to the other.

Torque; Induction Coil Connections

Questions.—(A) What is meant by torque? (B) Why in spark plug ignition is one terminal of the secondary coil connected to the primary as in the diagram?—W. C. S., Biloxi, Miss.

Answers.—(A) By torque is meant the force or pull exerted on the armature of a motor which causes the armature to revolve. In a dynamo it is the force whose application causes the armature to rotate.



INDUCTION COIL CONNECTIONS

(B) By so doing one less binding post, S_1, is required, connections being made inside the coil box. A ground wire to the engine frame is then run from P_1.

Electrolyte of Edison Primary Cell

Question.—What is the electrolyte of the Edison primary cell and in what proportions is it used?—G. S., Greensburg, Kansas.

Answer.—Place water in the jar of the cell and sprinkle in granulated potash, stirring until the potash is all dissolved and the solution saturated.

Bunsen Battery

Questions.—(A) What is the construction of a Bunsen cell? (B) What is the amperage and voltage of this cell? (C) How long will this cell last under ordinary conditions? (D) Could it be used to run a medical coil?—E. C., St. Louis, Mo.

Answers.—(A) See "Common Electrical Terms Defined," July, 1910, issue.

(B) This cell will furnish a strong current for two or three hours. Voltage, 1.9.

(C) Requires frequent attention. Difficult to state how long this cell could be depended upon.

(D) Yes, a small medical coil.

BOOK REVIEWS

TWENTIETH CENTURY HAND BOOK FOR STEAM ENGINEERS AND ELECTRICIANS. By Calvin F. Swingle. Chicago: Frederick J. Drake & Co. 1910. 1530 pages with 696 illustrations. Price $3.00.

Thoroughly revised and greatly enlarged from 500 pages in the original edition of 1903, the present volume is one which the practical steam engineer can ill-afford not to have as a part of his working library. The worth of the engineer in any plant is measured by his ability to make tests and calculations which will show where efficiency may be made higher. The author has placed the manner of conducting such investigations and tests in a form to enable the average engineer to understand how to make them. Boilers, boiler setting, draft, stokers, steam, evaporation tests, care and operation of boilers, condensers, valves and valve setting are thoroughly discussed while numerous tables assist calculations. The indicator is well taken care of in 81 pages telling how to use it, with several diagrams of indicator cards on engines of various types, problems being solved for further illustration. Recognizing the present status and the future outlook for the steam turbine the various types are described and illustrated by sectional drawings leaving the reader with a clear idea of this type of motive power. Gas engines, ice machines, electric and hydraulic elevators are given proper attention. For many engineers who are expected to look after the electrical as well as the steam end of a plant, the 476 pages of "Electricity for Engineers" are filled with plain, practical information on the installation and care of electrical equipment from the generators to the lamps and motors—enough for a book in itself. Each subject is followed by a set of questions and answers on the matter considered.

A BRIEF GUIDE TO VIBRATORY TECHNIQUE (Second Edition). By Noble M. Eberhart, A. M., M. S., M. D. Chicago: New Medicine Publishing Company, 1910. 160 pages with 10 diagramatic plates. Price, $1.00.

The present edition of this book has been considerably enlarged and a number of plates added, as well as a glossary. The technique for treating various conditions is brief but progressively arranged and easily comprehended. The theory of vibration is concisely but clearly set forth and the book should be in the hands of every physician employing vibration in his practice.

DYNAMO BUILDING FOR AMATEURS. By Arthur J. Weed. New York: Norman W. Henley Publishing Co. 1910. 83 pages with 64 illustrations. Price, paper, 50 cents; cloth, $1.00.

This is a book well suited to giving the amateur a working plan such that he may without further instruction build a fifty-watt machine. The one described weighs five pounds and at 4,000 revolutions per minute has a capacity of 10 volts and about five amperes. The general and detail drawings illustrating the text are good, while 14 pictures show how to use a turning lathe in the construction.

ELECTRIC WIRING DIAGRAMS AND SWITCHBOARDS. By Newton Harrison, E. E. New York: The Norman W. Henley Publishing Company. 1909. 272 pages with 105 illustrations. Price $1.50.

This is a thoroughly practical treatise covering the subject of electric wiring in all its branches, including explanations and diagrams which are thoroughly explicit and greatly simplify the subject. Practical everyday problems in wiring are presented and the method of obtaining intelligent results clearly shown. Only arithmetic is used. The fundamental principle of drop of potential in circuits is illustrated with its various applications. The simple circuit is developed with the position of mains, feeders and branches. They are treated as a part of a wiring plan, and their employment in housewiring is clearly illustrated. Some simple facts about testing are included in connection with the wiring. Moulding and conduit work are given careful consideration; switchboards are built up and illustrated, showing the purpose they serve for connection with the circuits, and to shunt and compound wound machines. The connections of the various instruments, including the lightning arrester, are also plainly set forth. Alternating current wiring is treated, with explanations of the power factor, conditions calling for various sizes of wire and a simple way of obtaining the sizes for single-phase, two-phase and three-phase circuits.

ON POLYPHASE SUBJECTS

How to Become an Electrical Engineer. Almost every mail brings us letters from boys and young men asking the question: "How can I become an electrical engineer?" Many of these inquiries come from boys who say they have had only a grammar school education; many are from young men now in other lines of work who would like a change, and the title "electrical engineer" sounds well to them; some are from anxious fathers and mothers, seeking to select a vocation for their sons. Almost all of these letters, however, imply almost utter lack of knowledge as to what the title "electrical engineer" implies, and indicate that to the general run of people it means a man who can do wiring, trim arc lamps, wind armatures, run dynamos, etc. Such a man is an "electrician" or an "electrical worker," not an engineer.

In the first place it should be understood that electrical engineering is now on as high a plane as the older branches such as civil and mechanical engineering. It is a profession in the same sense that Medicine and the Law are professions, and no one can become an electrical engineer unless he is prepared to spend as much time, money and effort as he would to become a doctor or a lawyer.

An electrical engineer in the true sense of the word is the man who is capable of planning, executing or supervising the operation of great electrical undertakings.

There are a great many branches of this electrical engineering profession. For instance, there are designing engineers versed in mathematics and the principles of electrical machines, whose work it is to develop new types of dynamos, motors, transformers, lamps, accessories of all kinds, etc., and be ever on their guard to discover new ways and means to bring out more efficient and less costly apparatus. They are mostly employed by the large manufacturing concerns. In ability, productive power and pay they range over a wide field from the young man but a short time out of college, with a good ground work of theoretical knowledge, but as yet with little practical experience, to a Steinmetz, of the class of great research engineers of long experience and great originality who can command salaries as great as a President of the Union.

Then there are operating engineers who have under their supervision the operation of great electric power plants, electric railway systems, etc. They are not the men who start up and shut down the machines or rewind the armatures in the repair shops. They are the men to whom the president or manager says: "Here is a million-dollar power plant," or, "Here is the electric railway system of this city. You are responsible for the operation of the electrical end. You are to see that there are no interruptions to service; you are to make such and such reductions in expenses without impairing service; you are to plan how to build up and increase this system as fast as requirements make necessary."

There are construction and installing engineers on the job where electrical machinery is to be put in and for whom the intricate system of heart and nerves of a great set of steam or water turbine-generators with their countless controlling devices, network of conductors, switchboards, oil switches, lightning arresters—all that and more—have no terrors.

The above are only a few kinds of electrical engineers, there are in addition telephone engineers, electro-chemical engineers, laboratory and experimental engineers, electric signal engineers—and many others, for the profession has many ramifications with room for all manner of specialists.

This in a manner suggests the type and qualifications of the man who is privileged to call himself an "electrical engineer." "How shall I become an electrical engineer?" you ask. There are two ways by which you can attain your heart's desire, if you have the courage and the tenacity of purpose to spend the necessary years at the preparatory work—and good average brains.

One way is by the college route, and as time goes on and the necessity for minds trained to consecutive thought increases it may be said, with very little dissenting opinion, that the college route in the long run is the best one, even if it is necessary to borrow every cent of money which the four years' course will require. Not that the young man who graduates from a technical school at 20 to 23 years of age is a real electrical engineer, but he has received a groundwork of theoretical knowledge and has been taught to use his mind in a way which will enable him to outstrip his chum who sought the same end by a different means.

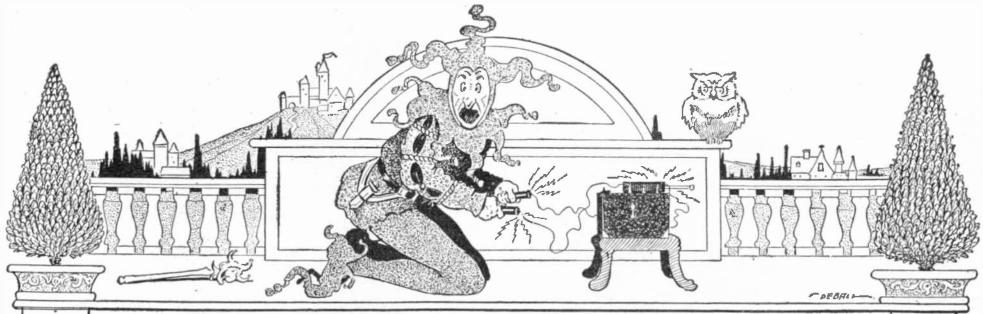
The other way to become an electrical engineer is the "self-made" way, if so it may be termed. Every electrical engineer is not a college graduate. Those who decry a college education as a useless waste of time and money can point to many examples of electrical engineers who have no Alma Mater. These men have become electrical engineers by obtaining the same knowledge by a different method. Each one of them first set his mind on the goal and went after it without the advantage of a "professional trainer." Before he attained that goal by virtue of which his fellow men looked upon him as an electrical engineer and entrusted their work to him, he had put in as much time, as much study, and had burned as much midnight oil, and probably more, than his chum who went the college route. If he had taken a college course he would have more quickly arrived at the pinnacle of his ambition and could have had to look back upon, all his life, the "golden haze of student days."

So much for the "electrical engineer"—the man who by hard effort and long experience is entitled to a position among professional men. But the electrical industry with its billions of invested capital requires additional tens of thousands of men whose qualifications are lower but who nevertheless find lucrative and agreeable employment. Just a few examples may be mentioned to show the great latitude of choice. Let us note, for instance, the variety of electricians and electrical workers required in the telephone industry. In the great factories where telephones and telephone switchboards are made there are first required electrical draughtsmen who make the drawings for the various parts of the apparatus and the complicated switchboards. These drawings go to the various departments of the factory where the equipment is made up by men of whom more or less electrical knowledge is required. The equipment then goes to the testing department where skilled electricians look for and remedy the thousand and one troubles which come up before everything is letter perfect. Then the equipment is shipped and anywhere from a dozen to 100 skilled men are put to work for several months to install it and test out the completed exchange. Then the exchange is turned over to the telephone company and under its manager are line men, wire chiefs, "trouble shooters," etc., all having a certain amount of knowledge of the practical working of electric currents, and it may be added, as a proof of the fascination of electricity—all eager for more knowledge.

The telephone is of course only one field. There are the electric lighting field, the electric railway field, the telegraph and wireless telegraph fields, and many others which we can observe on every hand, all of which require skilled electrical workers.

To those who find it absolutely impossible to prepare themselves for the electrical profession by a special education, these various lines of practical electrical work offer stepping stones to the higher positions. Many electrical workers and electricians are able to advance themselves by constant study and it is from the ranks of these practical men that the "self-made" engineers come. Right at this point the correspondence and trade schools are doing a great work. They teach the working man the principles of electricity, if he follows the courses carefully, and help him to direct his efforts at self-improvement intelligently.

To become an electrical engineer at the same time that you are earning a living at the occupation of an electrical worker or electrician is therefore not impossible, but your mind must be made up to a long, hard grind. It means that you must study outside of working hours. There is a certain amount of theoretical electrical knowledge necessary, a certain amount of mathematics, some chemistry, a great deal of business ability and a hundred and one other things that enter into the composite electrical engineer. This knowledge and these qualities must be developed through personal effort—by reading, attendance at night schools, correspondence courses, by continually keeping your eyes and ears open and by close application and hard thinking.



SHORT CIRCUITS

The young Scotchman never liked his mother-in-law, and this weighed heavily on the mind of his wife, who was ill.

Calling her husband to her bedside, she said to him: "Sandy lad, I'm varra ill, and I think I'm gang to dee, and before I dee I want you to gie me a promise."

"I'll promise," said Sandy. "Whit is it?"

"Weel, I ken that when I dee I'll have a fine funeral, and I want you to ride up in front in a carriage with my mither."

"Weel," sadly responded Sandy, "I gied ye my word, an' it's nae me that's gang back on that; but I'll tell you one thing, ye've spoilt the day for me."

* * *

"May I see my father's record?" asked the new student. "He was in the class of '77.

"He told me when I left home not to disgrace him, sir, and I wish to see just how far I can go."

* * *

"Is there any portion of the fowl you prefer, Major?" asked the hostess, blandly.

"The left wing, if you please."

"The left wing?"

"Yes," returned the major, gazing dubiously at the platter. "I believe it is always good military tactics to bring the left wing of a veteran corps into action."

* * *

"Papa," said the beautiful girl, "George and I are two souls with but a single thought."

"Oh, well, don't let that discourage you," replied her father kindly. "That's one more than your mother and I had when we were married."

* * *

He made a big hit when he sent her six American beauties and wrote on his card, "You're another."

* * *

A traveler in Arkansas came upon a dilapidated farm house back of which was an orchard. In the orchard were a number of razorbacks rushing madly from tree to tree. Puzzled at this strange performance on the part of the hogs, he stepped up to the old woman sitting in the doorway and inquired the cause. Removing the cob pipe from her mouth she said: "Wall, Mister, my ol' man, bein' deaf and dumb, learned them hawgs to come for their feed when he pounded on a tree. But some woodpeckers hev got into the orchard and the hawgs hev been plumb crazy ever since follerin' their pesky rappin'."

* * *

Teacher—Why, Willie, what are you drawing?

Willie—I'm drawing a picture of God.

Teacher—But, Willie, you mustn't do that; nobody knows how God looks.

Willie—Well, they will when I get this done.

* * *

She signed herself "Your affectionate knob." He didn't catch on till she told him a knob was something to a-door.

"Why did you quit coming to Sunday school James?"

"Aw, I had to—I was losin' me standin' wid de gang."

* * *

"Life ain't nothin' but disappointment," groaned the Chronic Grouch.

"Cheer up!" urged the Cheerful Mutt. "Didn't you git $50 for puttin' yer picture in the paper as havin's ben cured o' all yer ills by Bunk's Pills?"

"Yes, I did. An' now all my relatifs are askin' me why I don't go to work, now th't I'm cured!"

* * *

Brother Attix, the Brooklyn contractor, created a disturbance. Said he had hay fever so bad he had to sneeze every time he passed a grass widow. You should have seen Brother Simes rubber.

* * *

A belated traveler who was compelled to stay all night in a backwoods cabin down in the Little River country in Oklahoma says that soon after the frugal meal a tall, gaunt youth of eighteen and an equally sallow and gaunt girl of seventeen, both barefooted, took their hats from wooden pegs in the wall and prepared to go out, whereupon the mother, taking her pipe from between her teeth, said reprovingly:

"Go long an' wash your feet, Levi; you and Looly, both! Hain't you 'shamed to go off to an evenin' party without washin' your feet?"

They obeyed, but as Levi took the washpan from a bench by the door he said with a grumble:

"I'd 'bout as soon stay home from a party as to have to fix up for it."

* * *

A woman fell in love with a homely, shiftless, brainless dub, and she married him.

She told her friends: "He's so handsome, so energetic, so clever!"

That was during the honeymoon. But after a while the honeymoon was over. What then?

Why, she'd said the old stuff so much that she believed it herself. He proved even a worse mut than he appeared to be to outsiders, but what difference does that make? Suggestion and auto-suggestion had done their work.

This is how God makes matrimony successful.

* * *

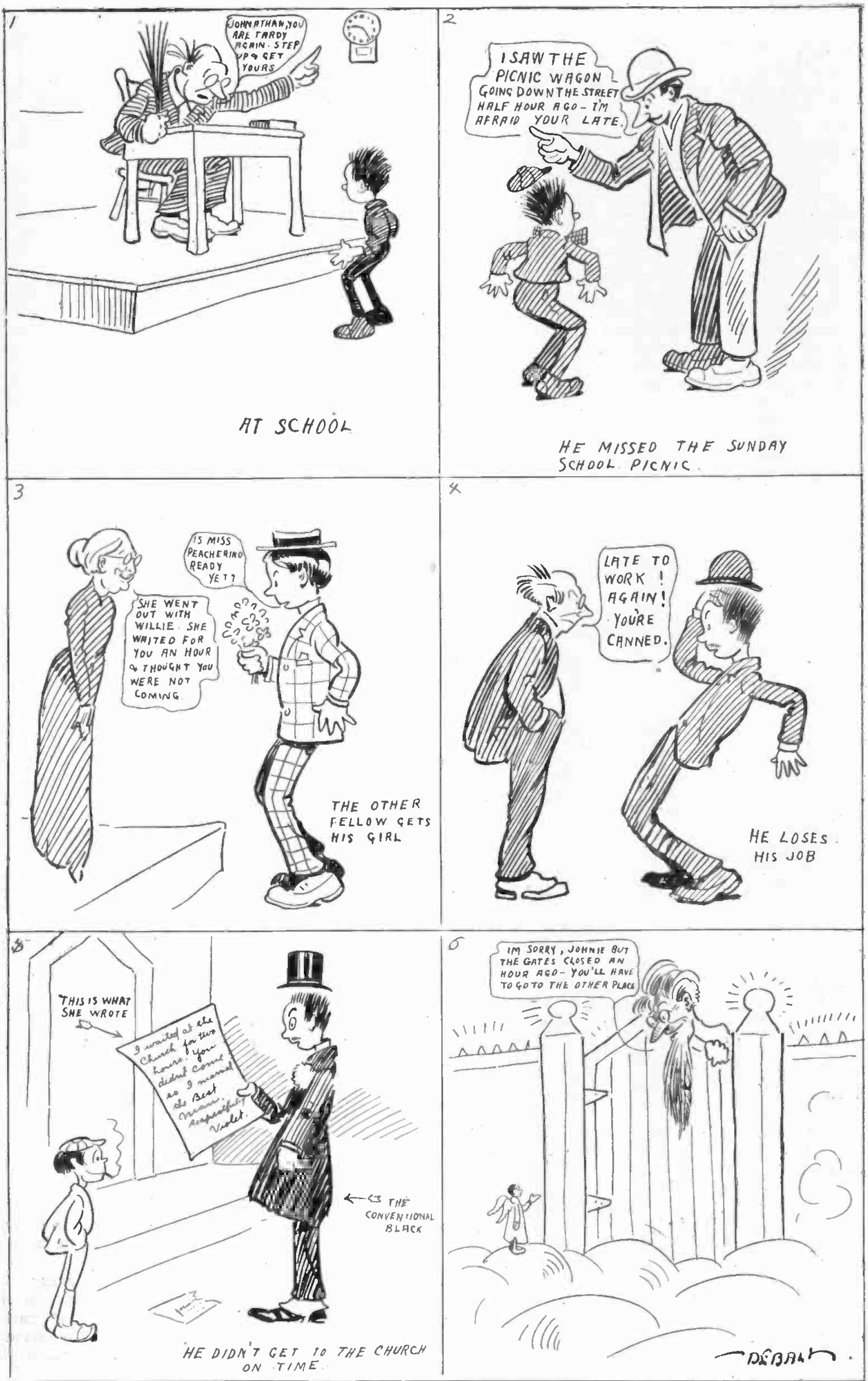
Ethel—Poor Harold—he has brain fever.

Bertie—Impossible. Could a worm have water on the knee?

* * *

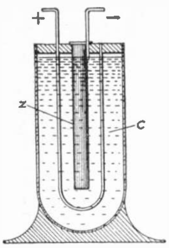
Little Ethel had been very thoroughly impressed with the idea that God could see everything she did, and that she must always be good, for He would know every time she did anything naughty. One day she started out for a walk and her little dog wanted to follow her. She was seen to drive him back several times. Finally she was heard to remark: "Spot, you must go home. It is bad enough to have God following me all the time without having you tagging along."

THE FELLOW WHO WAS ALWAYS LATE



COMMON ELECTRICAL TERMS DEFINED

In this age of electricity everyone should be versed in its phraseology. By studying this page from month to month a working knowledge of the most commonly employed electrical terms may be obtained.



BATTERY, WOLLASTON.—A battery consisting of a plate of zinc surrounded by a thin sheet of copper. Electrolyte, dilute sulphuric acid. (See cut.)

BELL, ELECTRIC.—Bells rung by electricity are classed either as vibrating or single stroke. In the vibrating type the armature of an electromagnet is attached to a spring which holds a contact on this armature against a back contact. When current is turned on the armature is attracted, the circuit is broken at the back contact but the bell has been struck, after which the armature spring draws the armature back closing the circuit and causing the operation to be repeated. On a single-stroke bell no make-and-break contact is provided, the bell being struck only as many times as the circuit is closed by a push-button or switch.

BEADED CABLE.—The wires of such a cable are incased in wooden beads, the whole being enclosed in a leaden sheath.

BECQUEREL RAYS.—Light rays possessing some of the properties of X-rays. They are invisible and verge on the ultra-violet.

BIMETALLIC WIRE.—Wire made of steel overlaid with copper thus providing for strength as well as conductivity. Called also copper-clad or composite wire.

BINDING POSTS.—Metal posts having holes for receiving wires, and screws for securing the wires. Found on cells of battery and electrical testing instruments.

BIPOLAR.—Having two unlike magnetic poles. Applied to motors and generators having two field poles.

BLASTING, ELECTRIC.—The ignition of powder or other explosives by an electric spark or by the heating of a piece of wire placed in the powder and connected in series with the electric circuit.

BLUE-STONE.—The trade name applied to crystallized copper sulphate used in Daniell and Crowfoot (gravity) batteries. Also known as blue vitriol.

BORDER LIGHTS.—Lights arranged in a row in a reflector and suspended between the curtains above the stage in a theatre.

BOUND CHARGE.—Experiments show a state of electrification suggesting two kinds of electricity. Rub a glass ball with silk and bring it near an insulated metal rod. A charge of negative electricity is "bound" on the rod nearest the glass ball while "free" positive electricity is driven to the other end of the rod and may be taken off by touching the rod with the fingers or a conductor. The negative electricity is "bound" by induction from the glass ball and remains.

BOXING THE COMPASS.—The compass has thirty-two points designating directions. Naming these points in order from any point called, or naming the intervening points between two given points is termed "boxing the compass."

BRAKE, ELECTRO-MAGNETIC.—A shoe so arranged as to be drawn against the face of a wheel by the attraction of an armature for its magnet, thus stopping the rotation of the wheel by friction.

BRANCH BLOCK.—A block of porcelain or slate used to take off a branch circuit from a light or power circuit, and arranged to hold the fuses required to protect the branch.

BRANCH CIRCUIT.—One of the secondary circuits into which a main circuit is divided.

BRANCH CONDUCTOR.—One of the wires of a branch circuit. Also a wire in parallel with or forming a shunt with another wire.

BRANDING, ELECTRIC.—Burning in an imprint upon the surface of any object by pressing upon it an electrically heated iron.

BREAK-DOWN SWITCH.—A switch so arranged on a three-wire system supplied by two dynamos that one of the machines can be shut down and the positive and negative leads connected to one terminal of the remaining machine and the neutral to the other terminal by this switch, thus continuing the service. Only one-half the former load can be carried.

BREAK-DOWN VOLTAGE.—The voltage at which the insulation such as air, oil, rubber, etc., used on electrical apparatus can no longer stand the stress and breaking down permits leakage and arcing to adjacent material. The exact voltage at which the dielectric strength of an insulating material fails when subjected to electric pressure.

BREEZE, ELECTRIC.—Applied to the administration of electric treatment in which the patient sitting on an insulated platform is connected to one pole of an influence machine while the other electrode is attached to a metallic crown suspended several inches above the head. Numerous brush discharges take place between the patient's head and the numerous points on the crown.

BREEZE, STATIC.—The silent discharge of high tension electricity. (See Breeze, Electric.)

BRIDGE.—The heavy conductors in a direct current power plant connecting the dynamos in an overhead circuit to the bus bars. Sometimes used also to designate Wheatstone's bridge.

BRIDGE, INDUCTION.—An apparatus to detect the presence of concealed metals. The device consists of primary and secondary coils arranged like a Wheatstone bridge with a telephone across the circuit in place of a galvanometer.

BRIDGE, INDUCTANCE.—Synonym.—Bridge Induction.

BROKEN CIRCUIT.—A circuit which is open either by disconnecting a wire, by breaking same or by opening a switch.

BROWN AND SHARPE GAUGE.—The gauge to which the size of wires is referred in the United States. Its range covers 0000 wire = .46 inch diameter to 40 wire = .00314 inch. Abbreviation, B. & S. G. Also called American wire gauge.

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See what I say under "Typewriters." ATCHISON

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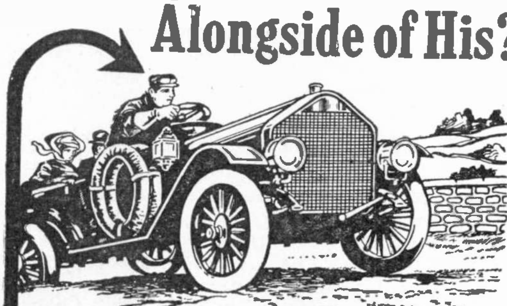

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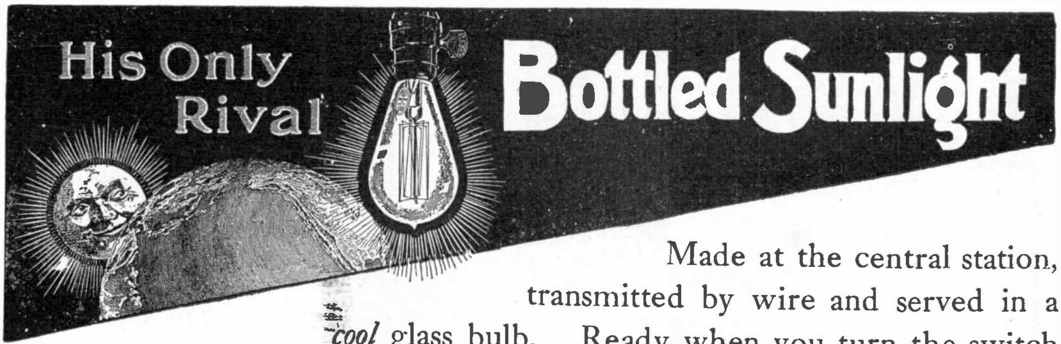

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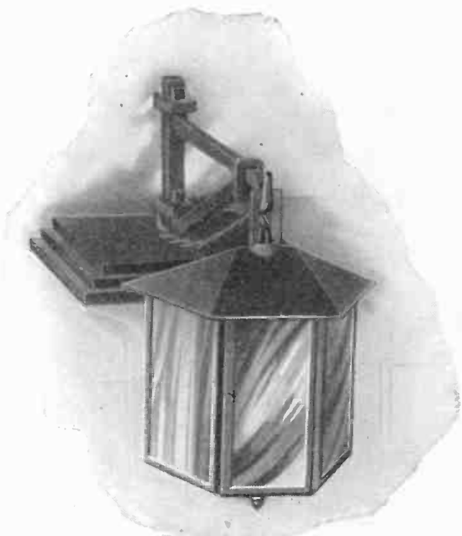

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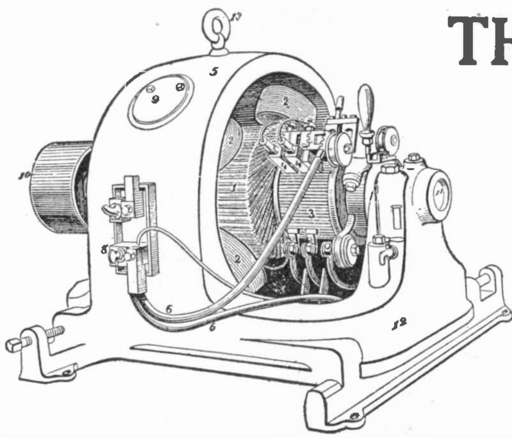

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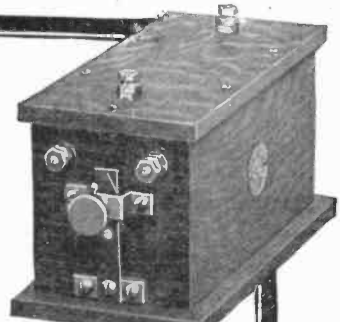

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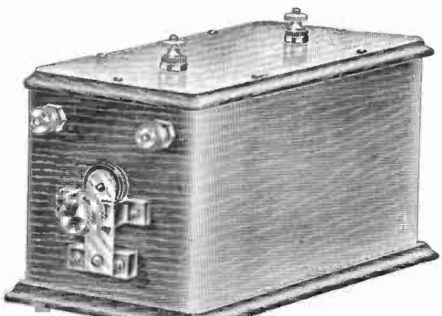

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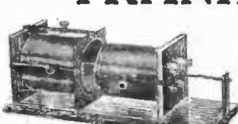

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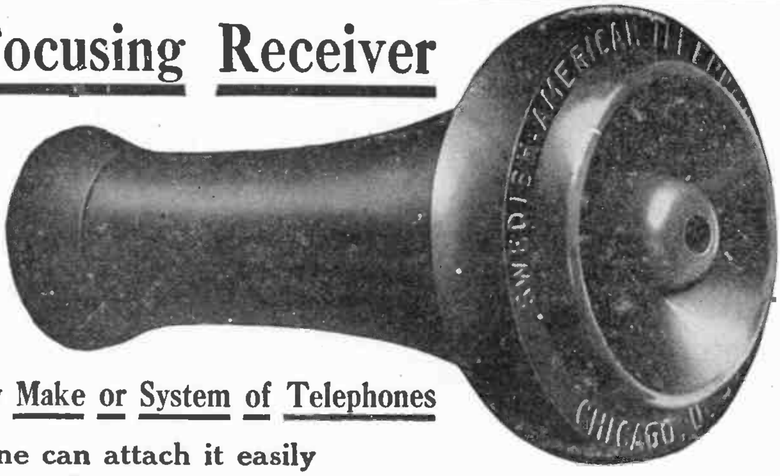

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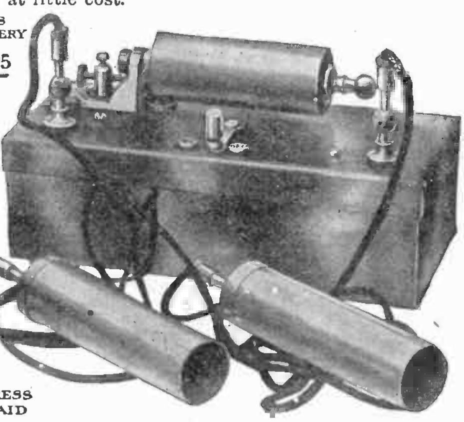

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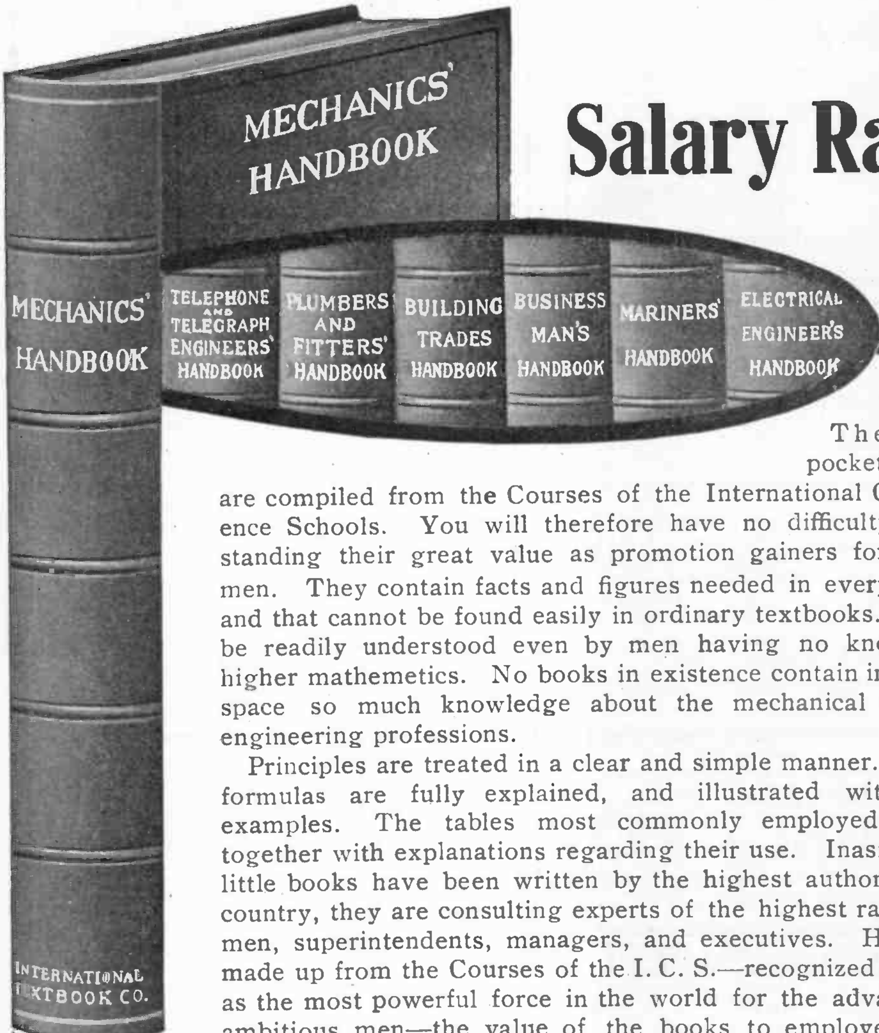

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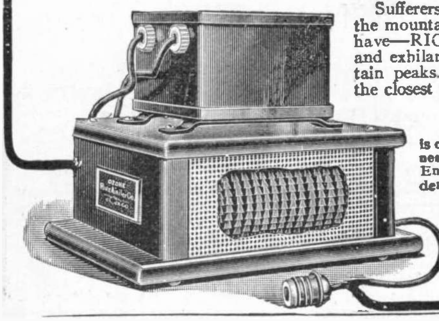

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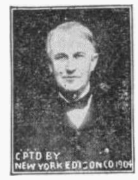

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