Popular Electricity In Plain English

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Electro-Chemical Wonders

An Interview With Sir William Ramsay

By FRANK PARKER STOCKBRIDGE

"What is going to be the next great development in electro-chemical science? I do not know. I am not a prophet. Science has nothing to do with prophecy. Predictions are for commercial men and engineers. Science concerns itself only with facts actually ascertained, and the two most important facts bearing on electrical chemistry that have been ascertained in the last few years are that it is possible to extract the nitrogen from the air by means of an electrical furnace and convert it into nitrates for use in manufacturing fertilizers, explosives, dyestuffs and for other commercial purposes; and that we can actually make rubber—and I know of nothing more important to the development of the use of electricity than an unlimited supply of cheap rubber."

The speaker, a slender, wiry, grey bearded, pleasant faced, genial gentleman of fifty-five, with whom I was conversing in the big lounging room of the Hotel Belmont the other day, was Sir William Ramsay. And if you don't know who Sir William Ramsay is, here is a list of his titles and degrees:

In the first place, he is a Knight Commander of the Bath, which is nearly the highest order of Knighthood of the British Empire. Then, he can write after his name the initials L. Ld., D. Sc., M. D., Ph. D., F. R. S. and F. C. S.; he is a Commander of the Crown of Italy, an officer of the Legion of Honor of France, honorary member of the Institute of France, honorary member of the Royal Academies of Ireland, Berlin, Bohemia, Holland, Rome, St. Petersburg, Turin, Roumania, Vienna, Norway and Sweden, as well as of the Academies of Geneva, Frankfort and Mexico. He is an honorary member of the German Chemical Society, of the Royal Medical and Chirurgical Society, the Pharmaceutical Society and the Philosophical Societies of Manchester, Philadelphia and Rotterdam. Besides all of these he is Professor of Chemistry at the University College, London.

None of Sir William's titles and honors has gone to his head. He is as affable and democratic as he was when he was just plain Willie Ramsay, studying chemistry in his native city of Glasgow. But wherever chemists foregather the name of Sir William Ramsay is the one name of a living man that is honored above all the rest. For this wiry, pleasant spoken Scotsman, with the twinkling blue eye, has made more important discoveries in chemistry himself, and has pointed the way to more important discoveries in chemistry for others, than any other individual since the days when

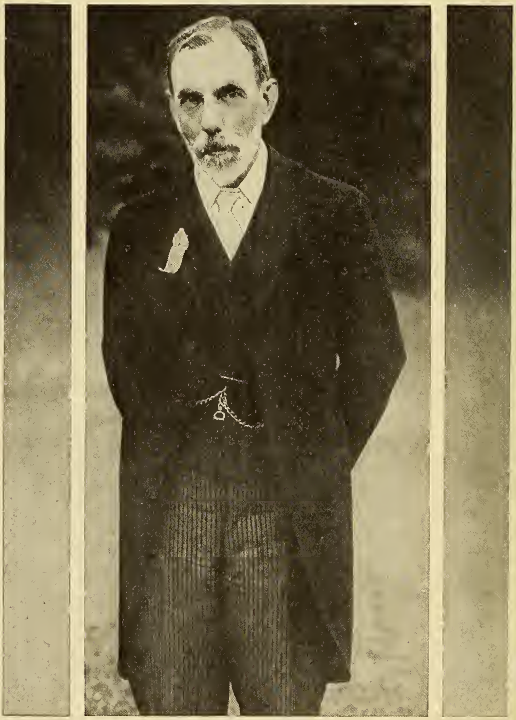

Photo from Underwood & Underwood *Copyright by G. V. Buck*

SIR WILLIAM RAMSAY, WHOSE NAME IS HONORED ABOVE ALL OTHERS WHEREVER CHEMISTS FOREGATHER. HE MAY RIGHTLY BE TERMED THE GREATEST LIVING SCIENTIST

POPULAR ELECTRICITY MAGAZINE
In Plain English
HENRY WALTER YOUNG, Editor

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chemistry was allied to magic, and the search for the philosopher's stone was the aim and object of those who were trying to penetrate the secrets of Nature.

If Sir William Ramsay had never done anything else but discover that the air, which all scientists had accepted as being composed of a mixture of oxygen and nitrogen, actually contains a number of gases and elements new to science, his name would live in scientific literature as that of a great discoverer. It is sixteen years since he found the element argon as a constant constituent of the air, and it was after that that he discovered three other atmospheric gases —neon, krypton and xenon. The element helium was also first discovered by him, and when he discovered that radium may be transmuted into helium, he found something that chemists and alchemists had sought in vain since the beginning of time—the actual transformation of one substance into another, which the "philosopher's stone" of the ancients was to accomplish. And since he was the first to tell the world just what the air is composed of, it was quite natural that when, during his visit to America to attend the International Congress of Applied Chemistry, I finally persuaded him to talk of present-day and future wonders in electro-chemistry for the readers of Popular Electricity, the first subject he referred to was the wonderful utilization of the air as a source of nitrogen supply.

"If you have never given the subject careful study, you cannot realize how important to the world the insurance of a continuous supply of nitrogen in some commercial form is and always will be," he said. "England would be depopulated in a short time if the supply of nitrates were to be cut off. Not only is the agriculture of Great Britain dependent upon nitrogen fertilizers, but the explosives for use in the guns of her army and navy must also be made from nitrogen compounds. .

"Until Dr. Samuel Eyre of Norway and his colleague, Dr. Birkeland, discovered an economical way to extract the nitrogen from the air by means of the electric arc, the whole world of science and economics had been wondering what would happen when the only known large deposits of nitrogen—the Chilean nitrate beds—should become exhausted. Now Dr. Eyre has just told us how sufficient nitrogen to supply all the needs of the civilized world is actually being made from the air and sold in competition with the Chilean product.

"The Birkeland-Eyre process, as practiced in Norway is a very simple one. They are using some 200,000 electrical horsepower, generated by water power, and a $30,000,000 company is manufacturing the various nitrates—80,000 tons a year of nitrate of lime for fertilizer, 10,000 tons of nitrate of ammonia for explosives and 10,000 tons of nitrate of soda for use in dyeing, as well as many other products. The process is a development of possibilities which I personally had the honor of pointing out some years ago. Air under pressure is admitted to fireproof furnaces in which an electric arc of high intensity is maintained. The passing of the free air over the arc forms nitrogen oxide, the addition of oxygen converts it into nitrogen dioxide, and the addition of water into nitric acid. I am told that the process is extremely economical, the electrodes lasting three or four weeks, and the fire clay furnaces some five to six months. Certainly the product is being sold at a very low rate. But that may not continue after the Chilean deposits have been exhausted and abandoned. We may find some such condition as that which obtains with regard to alizarin.

"Alizarin is the red dyestuff from which the color Turkey red is produced. It formerly was obtained exclusively from the roots of the madder plant, and all France was covered with madder farms and gardens. Now you cannot find a madder plant in France outside of the botanical gardens. The discovery of a method of producing alizarin synthetically, from inorganic substances, was taken up by German color manufacturers, and the market was flooded with artificial dyestuff at a price so low that there was no longer any profit in the growing of the madder plants. As soon, however, as the madder had been rendered practically extinct, the price of alizarin began to go up. I am not criticizing the manufacturers. That is commerce, and commerce is war.

"Just at present we are facing a situation that may be similar, with regard to indigo. Indigo dye can be produced artificially, and it is being made in Germany and sold at a price calculated to discourage the growing of the indigo plant. It will not surprise me if in the course of a short time the indigo growers of India are compelled to abandon their plantations. Nor would it surprise me to learn that at the present price at which artificial indigo is sold, there is a net loss that is borne by the more profitable divisions of the manufacturing business, and that as soon as the supply of natural indigo is cut off, the price of the artificial product will rise.

"That may be the way it will work out with artificial rubber. The synthetic rubber is here—not something 'practically the same' as rubber, but actual rubber, manufactured out of vegetable products, and exactly the same in all respects as rubber produced from the caoutchouc gum. Dr. Perkin has told us about it and Dr. Carl Duisberg of Elberfeld, Germany, has shown us two automobile tires made from the artificial product which have run several thousand miles.

"Nobody knows what it costs to make artificial rubber today except Dr. Duisberg, and he is not telling, beyond indicating that these tires cost a round thousand dollars each. Now nobody is going to buy much rubber at such prices, but the time will undoubtedly come when improved manufacturing processes and possible governmental aid will enable someone to make rubber at a loss so small that an institution with large resources could afford to put it on the market in competition with the natural product, in the hope of driving the rubber planters out of business.

"That will be a more difficult process than in the case of alizarin and indigo, however. The natural rubber can stand a great deal of competition before its producers have to throw up their hands and quit. Rubber is now selling at around $1.25 a pound for the crude, I believe. I have friends engaged in the production of rubber in Ceylon, who tell me that it actually costs only about 25 cents a pound to produce, and shares in producing companies are paying as high as 200 per cent a year dividends.

"If artificial rubber is produced in the next ten years at a cost that will enable it to be sold at 50 cents a pound, it still will not drive the natural rubber out of the market. But these are problems for the engineer and the business man, and not for the scientist. We have produced artificial rubber—now the man of science must turn his attention to something else, and let commerce take care of the purely commercial questions."

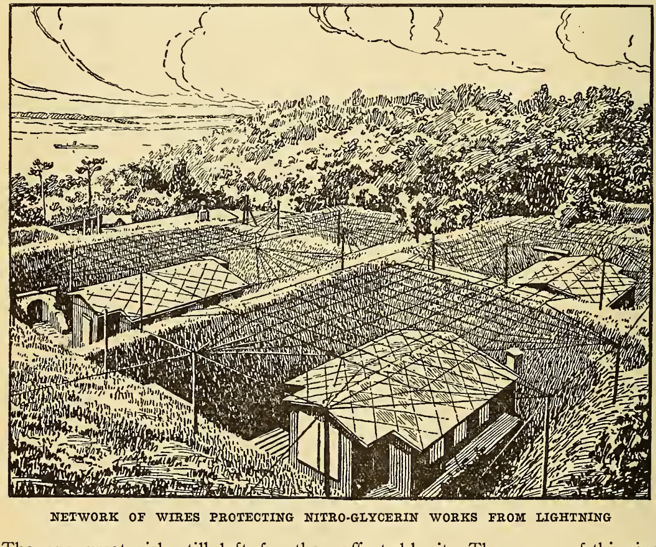
Lighting as an Art

The view has been advanced that the illuminating engineer can treat a cathedral very much as a painter does, by emphasizing the lights and shadows. Confidence has been expressed in the results to be obtained by a solution of the problem of luminous paint. There is a ceiling 125 feet square, covering a concert room in Pittsburgh which has been illuminated by a great variety of electric lights modified by screens, so as to produce the effect of a vast glowing, but harmoniously colored, Oriental rug.

It is believed that in time chandeliers will be made in the form of twisted luminous tubes and that means will be found to cause light to stream from cornices, and to make the atmosphere of a large room glow without visible means of illumination.

Protecting Nitro-Glycerin Works From Lightning

One of the great problems in the making of high explosives is that of safeguarding both the workmen and the contents of the buildings in which they are employed. Of course, the use of gas for lighting is entirely prohibited, and in some cases the electric lights themselves have been placed outside of the buildings, so that no wires whatever would enter the latter. However, the modern methods of electric wiring have made the same so safe that they are no longer a source of danger, when properly installed.



NETWORK OF WIRES PROTECTING NITRO-GLYCERIN WORKS FROM LIGHTNING

The one great risk still left for the explosive factories is that of being struck by lightning. This is minimized by dividing the works into scattered and low buildings, each of which has a network of bare wires strung above it, as shown in the sketch of a German plant reproduced herewith. These wire grids are all connected to each other and to metal plates buried deep in the moist ground, so as to form ready conductors for dissipating any difference in potential between the ground and the air above the buildings.

Strange Electric Battery Plant

Scientists tell us that there has been discovered in the forests of India a strange plant which possesses in a very high degree astonishing electric and magnetic power. The hand that breaks a leaf from it receives instantly a shock equal to that which is produced by the conductor of an inductive coil. At a distance of six meters a magnetic needle is affected by it. The energy of this singular force varies, but it is most powerful when the sun is hottest, and at times of storms its intensity increases in striking proportion. One never by any chance sees a bird or an insect light on the electric plant; nature seems to warn them that they would find their death.—*Christian Herald.*

Harper Memorial Library, University of Chicago

The Harper Memorial Library of the University of Chicago, which was recently opened, is one of the very best equipped library buildings in the world, especially with reference to its mechanical devices. The structure cost $800,000 and the income on an additional $200,000 has been set aside for upkeep. Its two lofty towers, set respectively at the east and west ends, rise 135 feet above the ground, and there are five miles of book shelves within its walls. In the magnificent reading room are 26 reading tables, at each of which fourteen readers may be seated. Besides the reading, stack, and auxiliary rooms, there are lecture halls, etc. Thus it may be seen that the equipment for all this must needs be on no inconsiderable scale.

HARPER MEMORIAL LIBRARY

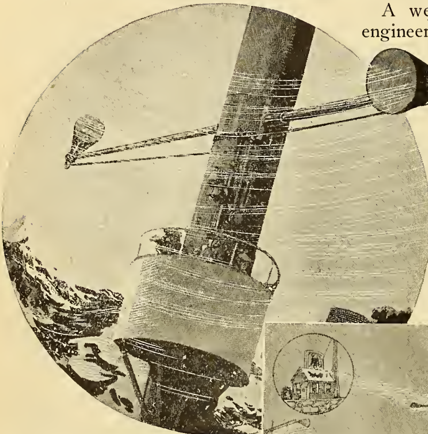
Beginning with the reading room, two large chandeliers, suspended far above the floor, are fitted with 72, 40 watt tungsten lamps each. At the present time for lighting the reading tables the experiment is being tried of setting a reflector a little distance above the table for its whole length. This reflector is a bronze trough, inverted and lined with milk glass. Tungsten lamps are distributed along this trough.

For heating and ventilating purposes, a number of electrically driven blowers have been installed. For the upper floors, the apparatus for this purpose is on the topmost floor; for the lower floors, in the basement. Exhaust fans draw off the vitiated air. The reading room has its own equipment for this purpose, for there are times, at night, for instance, when this is the only room in the big building that is open.

All the elevators are operated by electricity. There are three automatic elevators for the use of patrons, a non-automatic elevator for general passenger service, and a freight elevator. Books are sent from the stacks in small electrically operated automatic carriers. There are five of these. All the water that may be required for general or drinking purposes is pumped by a special equipment, electrically driven. There are telephones to communicate between those working at the delivery desk and those in the stack rooms. For transmitting orders, etc., there is also a pneumatic tube system, operated by electricity.

Sounds Signals by the Ries System

A well known New York electrical engineer, Elias E. Ries, who has already won fame as the inventor of the regulating socket for controlling the candle-power of incandescent electric lamps, and also of the "converter" electric railroad system, to say nothing of about 150 other pioneer inventions, has just come forward with a device by which he hopes to render collisions at sea with



SCOUTING WITH THE RIES SOUND DETECTORS

By courtesy of the New York World

BATTLESHIP FEELING ITS WAY INTO HARBOR IN THE FOG—SENDING AND RECEIVING VIBRATIONS WITH THE RIES APPARATUS

either icebergs, derelicts, or other ships practically impossible. Briefly stated, the device consists of a long range electrically operated pneumatic siren for projecting sound or atmospheric waves of any selected pitch in any desired direction, combined with a pair of widely separated and exceeding sensitive sound detecting, receiving and intensifying appliances pivotally mounted at the extremities of a yardarm, so arranged as to be automatically focused upon the point from which any transmitted or reflected sound originates. These operate on the principle of the microphone with special telephone receiver attachments.

For large liners and warships the equipment consists of a "finding apparatus," comprising a centrally pivoted yardarm located preferably on the foremast of the vessel just above the lookout's nest. This arm is mounted upon ball bearings, contains a central pointer moving over a fixed scale and forms a movable acoustic base line by which the direction and distance (through knowing the angle of divergence) of the source or point of origin of the sounds can be ascertained.

Suppose a liner is steaming through a thick fog, or in waters strewn with icebergs, or in a latitude from whence a derelict has been reported. The siren would sound at intervals of from three to five seconds each minute. The echo from the siren would be reflected back from the sails and other exposed surfaces of smaller craft, unprovided with sound producing means of their own. Icebergs or derelicts would also produce an echo. The yardarm or finder is then swung into a position where the sound from both receivers is in unison and of equal strength, and the index needle fixed to the center of the yardarm will point directly toward the source of sound, no matter how distant, and the distance in miles and fractions may be read off from the scale. By turning the finder first in one direction and then in another, just as one would employ a searchlight, and noting the corresponding scale subdivisions caused by the sounds of sirens, fog horns, or bells, any number of vessels can be accurately located, one after another.

Mr. Ries has also devised a portable apparatus for military use on land, and for explorers, surveyors, prospectors, engineers, scouting and hunting, etc., in determining the direction and distance of sounds. This type of apparatus is an admirable substitute for wireless telegraphy, and can be made of any desired range within the limits of atmospheric transmission on land. The signaling range is usually from three to five miles, but when in conjunction with a stationary apparatus of somewhat greater receiving capacity, this range is increased to from ten to fifteen miles.

Fireboat Electric Searchlight

Strong searchlights upon boats and vessels have been adjudged not only a convenience but an absolute necessity. The accompanying picture shows a Carlisle & Finch electric searchlight upon the fireboat David Scannel, belonging to the city of San Francisco. The searchlight, which is located just above the pilot house, is a fourteen inch marine projector. Besides its service at fires, it is used to pick out buoys, other vessels, wharves, etc., at night.

A SAN FRANCISCO FIREBOAT

Dignity of the Electric Sign

No business has ever felt itself too dignified to use an electric sign. No church has ever hesitated to hang out an electric sign when it wanted a larger congregation. No moralist has ever found in the electric sign any hindering element, but has embraced the opportunity to use the brightly illuminated sign, recognizing the fact that there is a certain subtle influence about it, and that there is a certain dignified connection between light and truth.

The Power Behind the Phone

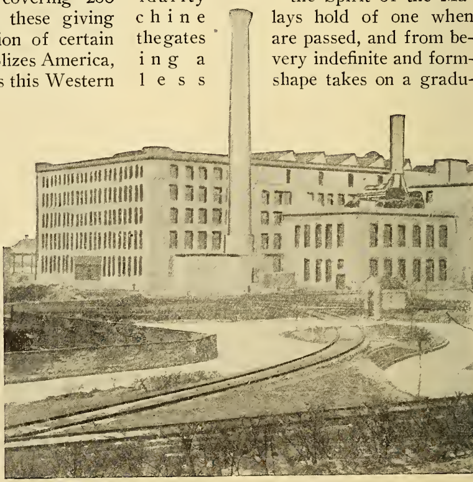
By H. Bedford-Jones

THE GATES OPEN UPON A BROAD STREET

Twelve thousand men, two and a half million square feet of floor space, an engine room of nearly 10,000 kilowatt power, forests of whirling belts and gyrating spindles, shops covering 200 acres of ground—and all these giving themselves to the production of certain electrical supplies! It symbolizes America, the paradox of history, does this Western Electric Company's plant at Hawthorne. Yesterday a host of infinitesimal energies would create a single tremendous product. Today a host of tremendous energies create a single infinitesimal product. Yesterday untold thousands of men worked for years on some very great thing such as the Pyramids. Today a host of giants works on some very little thing such as your desk telephone.

We seldom pause to realize the greatness of our little things, even though we know that the fragile moth will fret away our heaviest robes, that the delicate rust will consume our thickest armor. Pick up a strand of wire from your telephone; how long would it have required for the deftest workman of a century since to have wrapped this wire? And yet, in this wonder-palace of Hawthorne it is turned out in a few seconds. Machinery? No; something much greater than machinery, as you will see in time.

It is extremely imposing on first sight, is this central factory of the Western Electric Company, in which is built all apparatus for the Bell telephone system. The name of the concern is not spread over walls and roof in pompous display. But one's first impression is that of solidarity—the Spirit of the Machine lays hold of one when the gates are passed, and from being a very indefinite and formless shape takes on a gradu-

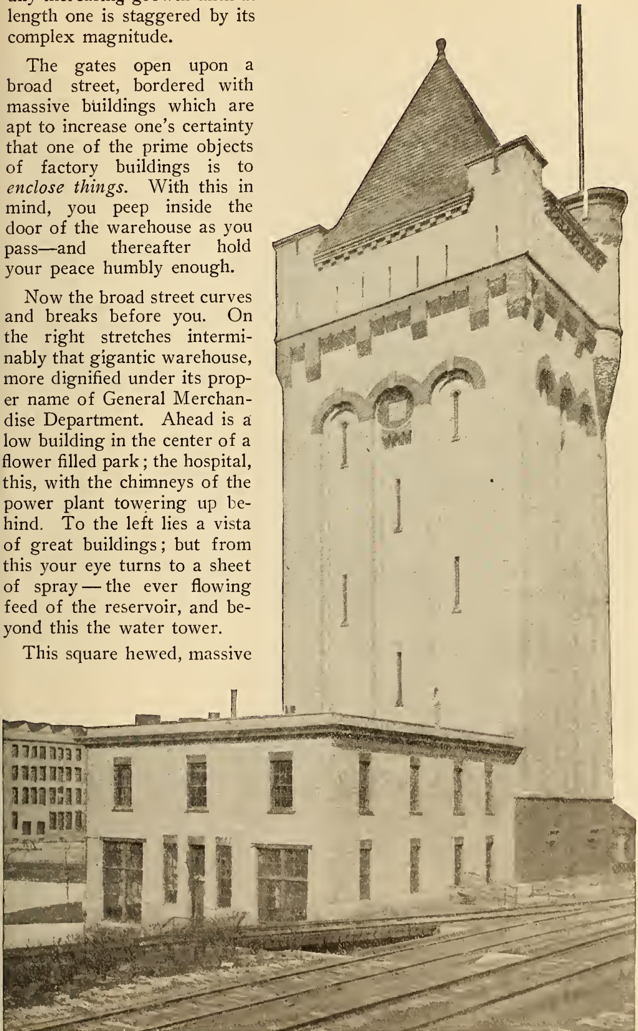


THE SQUARE HEWED, MASSIVE WATER TOWER IN THE CENTER ally increasing growth until at length one is staggered by its complex magnitude.

The gates open upon a broad street, bordered with massive buildings which are apt to increase one's certainty that one of the prime objects of factory buildings is to *enclose things*. With this in mind, you peep inside the door of the warehouse as you pass—and thereafter hold your peace humbly enough.

Now the broad street curves and breaks before you. On the right stretches interminably that gigantic warehouse, more dignified under its proper name of General Merchandise Department. Ahead is a low building in the center of a flower filled park; the hospital, this, with the chimneys of the power plant towering up behind. To the left lies a vista of great buildings; but from this your eye turns to a sheet of spray — the ever flowing feed of the reservoir, and beyond this the water tower.

This square hewed, massive



OF THE WORKS—THE GRIM BULLDOG EVER READY TO GRIP THE FIRE DEMON

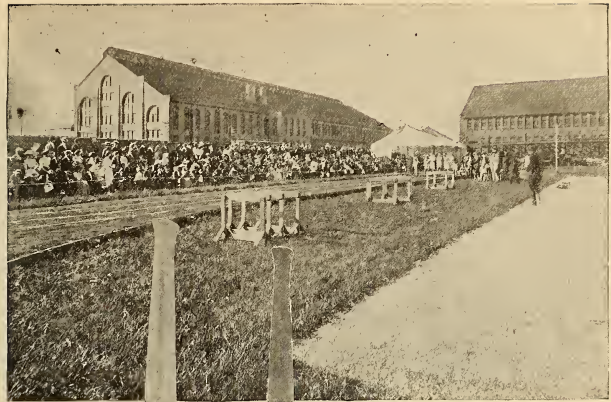
"THE VISITOR HAS BEFORE HIM STRAIGHT LINES OF AISLES SPOTLESSLY CLEAN." AT THE TOP IS SHOWN AN AISLE IN THE TELEPHONE AND SWITCHBOARD CORD BRAIDING DEPARTMENT; NEXT, ONE OF THE APPARATUS ASSEMBLY DEPARTMENTS; AT THE BOTTOM THE CORD FINISHING DEPARTMENT

tain all necessary material. At Hawthorne the fire hazard is eliminated, or reduced to a minimum. Even should the two large pumps fail, there is another reservoir and station at the hardwood lumber yard, half a mile away, and the two stations are interconnected.

The hospital, although small, is well able to handle the 60 to 80 cases a day it receives —and it is absolutely complete to the last detail. To one who knows much of hospital work, it is a joy to find such a perfect equipment in a factory; yet it has exactly the same relation to the company's dividends as have the baseball and athletic fields, the tennis courts and restaurants, the band and the library, the men's clubs and the cases of trophies.

What an industrial concern cares about is its employees' work. And through welfare lies good work. In the spending of money today lies the saving of money tomorrow. No matter how small a hurt, every injured workman goes to the hospital; although the majority of cases are very slight, the hospital is equipped to handle everything. This is more than philanthropy—it is good business. Athletics, a mammoth restaurant, the largest in Chicago, libraries, clubs—these are not only philanthropies, but methods of business. That this is true shows in the

tower is the center of the works — the grim bulldog ever ready to grip the fire demon. Notwithstanding that all the buildings are fireproof, fire walled into sections, and equipped with automatic sprinklers, a trained brigade of firemen is maintained, and around the plant are scattered 45 hydrant houses, which con-



ATHLETIC FIELD AT HAWTHORNE AND THE GREAT POWER HOUSE THAT SUPPLIES THE WORKS

things made and the men who make them. The products of Hawthorne are electric appliances—but its by-products are *men*.

A striking instance of this is shown in the engine room. Here are placed three 2000 kilowatt steam turbines. When they were to be installed it was decided to place them on stilts instead of on a solid foundation, in order to give increased room beneath.

"That is impossible," decided the outside engineers. "The foundation must be solid."

The Hawthorne engineers decided to attempt the impossible. Today you can stand beneath those great turbines, going at top speed, and placing your hand on one of the six stilts supporting each engine, feel hardly a tremor. The stilts are steel and concrete—and the men of Hawthorne achieved another trimuph.

There are two things which stand out pre-eminent above all others in the mind of the visitor and which send him away thoughtful. I visited that gigantic warehouse, through which pass some 13,000 freight cars per year; I saw the piles of crates and boxes, each pile in limits painted on the floor, while electrical trucks loaded or unloaded them. I went through the telephone apparatus shops, with their miles of lathes and punching machinery, through slate grinding and polishing works and lumber mills. I went through the foundry and then through the cable, rubber and insulating shops, from the engine rooms to the offices, and in no part of that whole vast plant did I have to "look out for the dirt." There was none.

Progressive business is taking psychology into consideration more and more every day. It used to be argued that to stop work and pick up filings or shavings was a rank waste of time, or to have anyone else whose special task that should be. But all that is changed now.

A littered-up floor is bound to have a bad effect upon a workman. If he can simply throw his waste matter on the floor and be rid of it, the principle of carelessness is taught him by his employer. A slovenly workshop means a slovenly workman—and there are a great many big shops and factories which have not discovered that fact. The concentration of energy and the psychology of dirt are about equally important in results. They both cost something to take into consideration, but the dividends are going to show the difference in the end.

Even the foundry at Hawthorne was spick and span—for a foundry. Throughout the shops, dirt was collected, shavings and filings and dust all gathered up and sorted for future use, as soon as made. There was a machine for covering cable with lead, and another for stripping the lead from defective cable—rejected by the testers—at the same rate of speed.

This amazing cleanliness was the first thing that struck me, and the second came about in this wise. I was lunching in the restaurant building. The prices were easily 50 per cent below those of an ordinary city restaurant, and the food was excellent. About me were college men and foreigners; a Japanese student, in training for special work at a Tokio factory, a Kansas collegian, a doctor, a Yale man—all sorts and conditions of men from indentured apprentices up. My guide turned my attention from my surroundings with a jerk.

"Our great principle here," he said, "is economy in handling material. The cable shop is, say, 400 feet across. The crude rubber and wire is unloaded from the cars at one end—goes straight forward—and at the other end is loaded as cable ready for the warehouse. It always goes straight forward, and that's the same with switchboards and all the rest."

"Do you mean to say," I asked, "that the raw material can go across approximately 400 feet and come out finished?"

"I can show you a cable made on one floor of the building," he smiled, at which I promptly challenged him to do so, after lunch.

Now this process of cable making is interesting in the extreme—together with most other things in Hawthorne. At the east side of the shops the copper wire comes in. Each separate wire is now wound with thin paper of varying colors, whole rows of machines whirling in unison with a particularly dizzy effect to an outsider. Then, in the next room, two of these wires are twisted together, forming pairs of like color.

From here the paired wires pass to the stranding machines, which twist them into the required cable size. The largest which I saw made contained 600 pairs, or 1200 separate wires, and as the complete number was obtained each cable received its twisted paper cover. The peculiar twist is given, no doubt, for some technical reason known to the engineers; the color of the "pairs" has a different explanation.

Should a lineman wish to reach a certain point of a laid cable, to repair an injury, he must find which wire to reach. In the outside color wrapping is inserted a key-wire of a different color, and by counting from this on down and around, the lineman can reach the required point and pick it up again a mile farther on if he wishes.

At this stage every single wire in the cable is tested, and it is then baked to remove all incidental dampness. From the ovens it goes directly to the wonderful lead presses, where the lead jacket is applied. The cable is now completed; but for submarine uses it goes through still another process where it receives coating after coating of hemp, wire and a tar preparation, which render it water and injury proof. As the cable receives its lead covering, and also as this stage is completed, it rolls upon immense spools. The traveling crane overhead carries these spools for a few feet, and the cable is aboard its car—at the western side of the shops. Thirty miles of cable a day follow this course.

In one room of the insulating department there are 600 girls at work wrapping the ends of switchboard cords by hand. This work demands intelligence, and these workers are of a very superior class to the ordinary factory employee. No machine has yet been invented that can do this work with complete satisfaction, but this room turns out 6,000,000 switchboard cords a year.

ONE OF THE COMPANY RESTAURANTS WHERE PRICES ARE 50 PER CENT BELOW THOSE OF THE ORDINARY CITY RESTAURANTS; ONE OF THE GENERAL OFFICES

This remarkable efficiency in handling all material is the second great feature of the Hawthorne plant. I suppose it is the same with the other factories of the Western Electric Company, and there are many others scattered about the world. Most of the European countries where telephone and telegraph lines are owned by the governments, demand that all material used be manufactured in the country itself; so that in each of the European countries the chief factory of the Western Electric has the same scope as this at Hawthorne. And the Hawthorne plant, by the way, is the largest telephone and cable producer in the world today.

Again I say that "tremendous trifles" are more impressive than mere big things. Not only this, but American business is largely built upon the skillful handling of complicated detail. And there are only two ways of winning the game of worldly success. You must either play it better than the other fellow, or you must use marked cards; and the latter method is rapidly going out of date in this country. This care and attention to the little things, this close watch over the infinitely small no less than over the infinitely big, has revolutionized Hawthorne within the past two years.

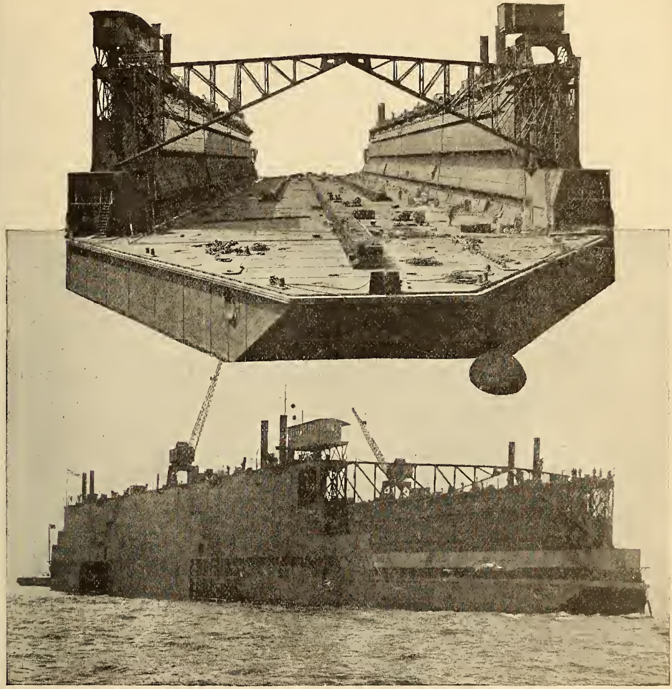
Many of the articles of telephone construction and use go through process after process, sometimes as many as 200, and all delicate in the extreme. The great slabs of slate must be bored for the switchboards without the deviation of a millimeter; each piece of wood or metal must be passed down from machine to machine for polishing, boring and fitting; each must pass the inspectors before going to the assembling room, while through it all run the tiny threads of neatness and watchfulness. Each building has its separate clerical force, and each department its foreman; but each department is like every other, in that the visitor has before him straight lines of aisles, spotlessly clean, straight lines of men at work, straight lines of material and machines. There is no lost energy in these shops. There is plenty of room for everyone, but there is none to be wasted.

There is a double training school here. One part is devoted to the training of college men in the ways of the plant, the other is an apprenticeship for boys, who are indentured for a certain length of time. The results of this system are remarkably good. Men are developed for every possible position. Whatever they show most aptitude for is emphasized, until in time they are turned out first class men. And there is always a chance waiting. One young fellow, not yet through his course, happened to think of a simple change in making a certain mold; this change increased the output of a certain product by a third, and that young fellow found a place waiting for him on the next rung up.

Besides the nine central factories in foreign countries, there are many distributing centers. Twenty-six of these are located at strategic points in this country alone. The Western Electric shops produce more telephone apparatus than any other concern, having made the 6,000,000 Bell telephones together with all telephone exchange and accessory equipment. The place is in fact a city within a city. Taking the usual average of five to one, there are 50,000 people dependent on this one factory—more than the population of the average American city!

Nor is this splendid industrial "city" a thing of chance, upgrown by the accident of time from small to large. The whole place was built upon a city plan of its own, definite and exact to the last detail, and centered about the frowning water tower.

And so we have seen Hawthorne—ah, but have we even glimpsed it? Have we had more than the tiniest of bird's-eye views? No. For behind the miles of desks and machines, behind this play of giant forces, behind this world-thing are the little heart beats of men pulsating to the ends of the world. And still farther behind these, controlling all, forcing all forward in its indomitable will, is this thing I have called the Spirit of the Machine. Perhaps it would be more rightly called the Spirit of Hawthorne; yet it is found in every such place, and the men who create it are molded by it, for better or for worse, according as they have wrought. Here at Hawthorne is realized the truth of that thunder-text, "Where there is no Vision the people perish"—for the vision of Hawthorne is the Spirit of the Machine, the power behind the 'phone, and its people shall not perish.

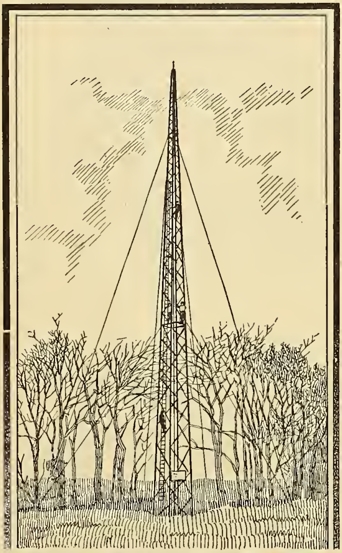


FLOATING DRY DOCK FOR BRITISH BATTLESHIPS

A floating dry dock is a huge structure of steel built with scores of compartments which may be flooded or pumped out at will, causing it to float high or low in the water. Partly submerged, the broad platform receives the ship to be docked. Then the compartments are pumped out and the resulting buoyancy causes the structure to rise, carrying a battleship on its back, clear out of water. England's greatest floating dock is shown above. It covers an area of 2¼ acres and will lift a battleship having a displacement of 32,000 tons. All power operations upon it are performed electrically. Electricity does all of the lighting, operates the capstans and traveling cranes, works the pumps, moves the massive valves to the bulkheads, drives the machine tools in the shops where repairs are made to the crippled Leviathan, etc. All of this electric power is developed by two steam driven power plants, one located in each of the two side walls.

"Paragrèle" to Prevent Hailstorms

Some French scientists have long believed that the formation of hailstones is due to atmospheric electricity, and have sought for a means to prevent the making of these destructive formations and consequent storms.



ODD TOWERS IN FRANCE TO PROTECT THE VINEYARDS

In the October, 1912, issue of POPULAR ELECTRICITY MAGAZINE, page 519, reference is made to a "paragrèle" which it is hoped will prove successful in protecting districts subject to hailstorms. Several lightning-rod-like structures similar to the one shown are to be built in the vine growing districts, and the result carefully studied. The paragrèle proper is a rod of copper supported in an upright position by surrounding framework to a height of 130 feet at least, terminating at the top in a crown of numerous blades or points. The lower end of the rod is well grounded. The setting of these conductors at intervals of six miles along the path usually followed by the storms, it is theorized, will so tend to neutralize the atmospheric electricity that the region will be immune from damage by hailstorms.

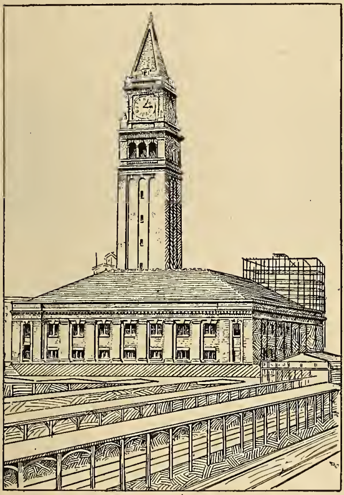
Natural Light for Mercury Lamp

All are familiar with the mercury vapor arc lamp, with its long glowing tube of luminous mercury vapor, and have noted the ghastly appearance of human beings and the great distortion of color values. This is because all the colors found in natural light (these are exhibited in the rainbow) are not present. In order for colored objects to appear natural, rays of all colors must be present in the light which falls upon these objects. The mercury vapor light is deficient in several colors. Especially are the red rays absent. This accounts for the greenish appearance of the human skin and the bluish appearance of the lips under that light.

Recently the inventor of the mercury vapor lamp, Dr. Peter Cooper-Hewitt, has improved the color value of the light by adding a fluorescent reflector. The commercial lamp is equipped with a white enameled parabolic reflector. After long research, the inventor has perfected a fluorescent reflector which, instead of reflecting all of the light incident upon it, absorbs some of the rays, and emits in return a red light. Many aniline dyes have the property of fluorescing under the action of light; that is, they absorb the rays of various colors and emit light of a different color. This new reflector appears to be made of a white fibrous material like paper, the outer coat of which is painted with an aniline dye called rhodamine. This reflector adds much red light to the deficient light direct from the lamp, with the result that colored objects are far less distorted. Human beings also appear quite normal in color. The equipment is therefore a decided improvement.

Labeling Seattle's Railway Station

A contract has been let and work has been commenced on the electrification of the famous tower of Seattle's King Street railway station. The electrical engineers will carry out designs made by Louis W. Hill, chairman of the executive board of the Great Northern. The tower of the King Street Station is a true copy of the famous tower of the Campanile,



THE KING STREET STATION, SEATTLE

which stood 1,000 years, and which was lately reconstructed. The King Street Station prototype is 250 feet high and 30 feet square.

The contract calls for installing electric signs on all four sides of the tower immediately beneath each of the four clock faces, and containing the words "King Street Station." The letters in this wording will be seven feet high, and immediately beneath each sign the initials "N. P., G. N." will appear. This wording will be visible for many miles in each direction at night. There will be five colors used, and the lights will work automatically on the sectional flash plan. The pyramidal top of the tower is already studded with small lights.

Electricity on Fujiyama

One of the latest indications of the progress of Japan in Occidental ideas is the project, which has been on foot for two or three years, to illuminate with a gigantic electric light the summit of the celebrated mountain, Fujiyama, which figures in almost all Japanese pictures, and which is one of the loftiest and most beautiful peaks in all the world.

Already the pilgrim stations on the way up the peak are heated and lighted with electricity. Since the Japanese are an artistic people, one wonders whether some of them may not oppose this startling innovation, as the people of Venice expressed their disapprobation of the scheme to light the Venetian canals with electric lamps. The scientific spirit was not strong enough in Venice to make the decision of the municipal authorities to light the canals with electricity popularly acceptable. A protest was circulated among the Venetians, in vigorous opposition to "the sacrilege." "The blinding light of the electric arcs," it said, "will destroy the beautiful effects of the moonlight and the enchantment of Venetian nights, celebrated all over the world."

Turning Down Electric Lights

Among the interesting problems for inventors is that of producing an electric light which can be turned up or down as freely as a gas jet or a kerosene light. Various devices have been employed for this purpose, such as inserting a resistance to cut off half the current, or using a lamp with a long filament run in series with a short filament; but while a reduction of the light is thus attained at will, the operation of the lamp is not economical, because the best efficiency is only obtained by running a filament at a high temperature.

How Much Will It Lift?

Probably the question most frequently asked concerning a lifting magnet is: "How much will it lift?" This depends upon the kind of material to be handled. If a solid mass of steel or iron affords a good surface for magnetic contact, a magnet like the one illustrated, having a diameter of 62 inches, will lift as much as 30 tons, or 60,000 pounds. The one shown is a Cutler-Hammer magnet, 43 inches in diameter, and is conveying a seven foot locomotive drive wheel aboard the flat car.

Mammoth Bouquet Advertises Electric

During the fall display upon "Automobile Row," Chicago, manufacturers vied with each other in making their windows points of attraction.

A view from the sidewalk is here shown of a window in the salesrooms of an electric car company. The center of attraction is the basket containing 144 gladioli. In the evening the beauty of this big bouquet was brought out by twelve four candlepower lamps in reflectors almost concealed by placing them on the floor close to the window.

The background is an Argo electric brougham, built somewhat similar to the well known Renault type of car, carrying 40 cells of battery, and capable of making 20 miles an hour.

LIFTING A LOCOMOTIVE DRIVE WHEEL

MAMMOTH BOUQUET IN AUTOMOBILE ADVERTISING

Electric Ice Making

It is estimated that there are now in operation in the United States about 300 electric stations provided with ice making apparatus. The unused power of the stations during the "light load" summer season is employed to run compression motors for liquefying ammonia in the process of freezing artificial ice. The plan has been especially successful with small plants supplying electric power and light for towns of less than 5,000 inhabitants. In some cases the earnings of the auxiliary ice making apparatus equal the annual return on the whole plant for other purposes, this condition pertaining, of course only in southern cities.

The Pullman Automobile Has Arrived

Luxury in motor travel, together with independence from hotels, has been achieved by U. H. Dandurand, of Montreal, in a Pullman Packard. On a three ton Packard truck chassis has been mounted a body whose interior arrangement is similar to that of a private railroad car. Twenty-five persons are easily carried on short trips, and for long journeys there are accommodations for the comfort of eleven, including chauffeur and cook.

AUTOMOBILE WITH SLEEPING COMPARTMENTS AND KITCHENETTE

The body is 20 feet three inches over all. The compartments consist of a stateroom for the driver in front, a ladies' stateroom with sleeping room for five, a men's stateroom with quarters for four. This section is also the dining and smoking room, with two extension tables and a folding desk.

In the rear is a kitchenette, compact and complete from stove to refrigerator.

The interior of the car is finished throughout with solid mahogany and the drapings are very luxurious. The carpet is of the Pullman type, also green to match the rest of the fittings. There are four telephones in the car to connect with the chauffeur, besides the electric car bells. Lighting arrangements are perfect, and consist of dynamo and two large accumulators with a capacity of 160 amperes. The front of the car has six lights—two electric, two gas and two oil. The rear has four lights, one ordinary red tail light, one electric dome light and two railway signal lamps with red, green and white lights.

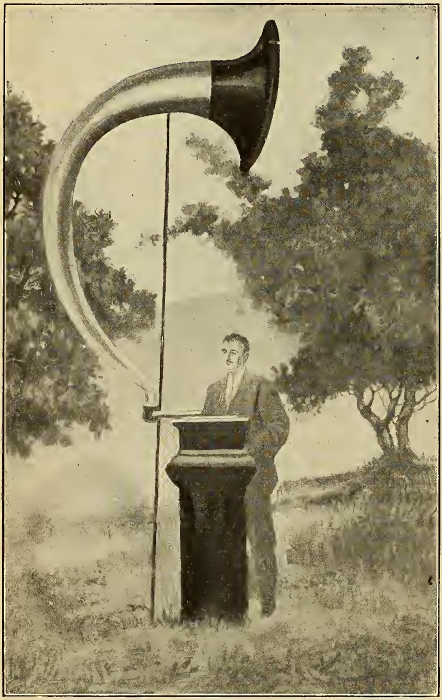
Under the body floor are five lockers containing planks to reinforce weak bridges, blocks and tackle, and an entire touring emergency outfit.

Electric Conquest of the Pyrenees

Owing to their great mean elevation, the Pyrenees form one of the most complete mountain walls in the world, capable of arresting the march of commerce as well as that of armies. Until within recent years no railways traversed the chain, communication between France and Spain being kept up around the ends. But now electricity enables engineers to attack this vast wall with success, since electric traction is possible on grades too steep for steam engines to overcome. For the Oloron-Jaca line a current of 21,000 horsepower is available, and for the Axles-Thermes-Ripoli line one of still greater capacity.

Giant Talking Machine

A description appeared recently in the London *Daily Mirror* of a talking machine which could be heard more than a mile, the invention of H. A. Gaydon. It is called the stentorphone, from Stentor, the Greek herald.



A GIANT TALKING MACHINE

An ordinary phonograph disk record is used, the sound being amplified to a great volume partly by using an immense horn and partly through the use of compressed air forced through the horn. A portable air compressor, driven by an electric motor, makes possible the giving of open air concerts and lectures.

Luminous Marble Walls

When Dr. E. P. Hyde, of the U. S. Bureau of Standards, was making a recent inspection of indoor lighting arrangements as used in Europe, he was surprised to find an old church in Italy in which the daylight was filtered through thin slabs of delicately tinted marble. The effect was a surprisingly beautiful one, and one not easily duplicated by our makers of ornamental glassware, as there is a peculiar charm about the natural coloring of some of the Italian marbles.

However, the marble has to be so thin for such a purpose that it could not form a commercial substitute for window panes or for use on electric light fixtures. Now a German, Dr. A. Pfaff, has found that such marble slabs can be used in much greater thickness if they are polished on both sides and then saturated with paraffin or shellac. By giving them such a treatment, he has been able to obtain beautiful effects in illuminating corridors by the light of tungsten lamps concealed behind the marble walls of the hallways. The loss of light is said to be only about 20 per cent (or no more than with most of the milky glassware used on fixtures), and as the whole plate of marble glows, the effect is surprisingly charming and unusual.

The electric still is exceedingly simple in construction and is therefore unlikely to break down or get out of order. By its use even the dirtiest water may be made pure and sparkling, free from germs and infectious matter which would be injurious to health.

The Motorcycle and the Trouble Shooters

The North Dakota Independent Telephone Company, whose toll lines cover nearly half the State of North Dakota, is confronted with the problem of great distances to be covered by its linemen and "trouble shooters." Naturally, it has

A TROUBLE SHOOTER AND HIS MOTORCYCLE

resorted to the motorcycle as a quick and convenient means of travel for the men. Six of these machines are owned by the company, and they are busy all the time scooting around at the rate of 40 miles an hour over the great stretches of famous wheat lands. One of the company's linemen, Mr. Jack Cooney, is shown in the picture on his favorite machine. The photographer in this case tried to make it appear that Jack uses the motorcycle in place of climbing irons, but as he didn't put his name on the photograph it is safe to call him a faker.

Coal Equivalent of Niagara Falls

It is estimated that Niagara Falls, if completely harnessed, would yield 5,000,000 electrical horsepower. About one-tenth of this available power is now serving man. It is interesting to calculate the saving in coal which would result if the falls were yielding in electrical horsepower all the energy which is now thundering over the great precipice.

Various types of steam engines require different amounts of coal in order to develop a horsepower for one hour. Assume an engine which requires one pound of coal to furnish it sufficient steam to develop one horsepower constantly for a period of one hour. In order to continue the work for a whole day 24 pounds of coal would be required. Niagara Falls could furnish 5,000,000 horsepower 24 hours per day, which in terms of coal is $24 \times 5{,}000{,}000 = 120{,}000{,}000$ pounds, or 60,000 tons. Assuming a value of four dollars per ton of coal, this would represent an equivalent of $240,000 per day. In other words, we are willing to sacrifice a quarter of a million dollars per day in order to preserve one of Nature's most wonderful spots.

Electricity in Research

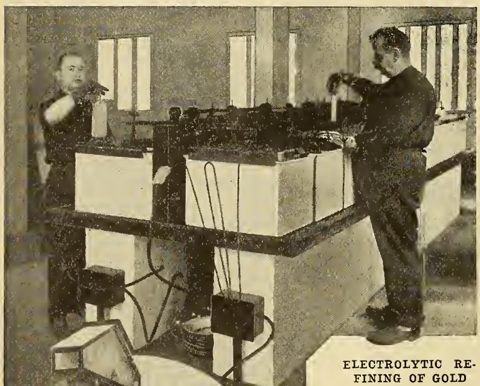
The great advantage of the electrical methods for the study of the properties of matter is due to the fact that whenever a particle is electrified it is very easily identified, whereas an uncharged molecule is elusive. The smallest quantity of unelectrified matter ever detected is probably that of the rare atmospheric gas, neon. The volume of neon in one-twentieth of a cubic centimeter of air is half a millionth of a cubic centimeter, and this quantity can be detected by the spectroscope. But this amount of neon contains 10,000,000,000,000 molecules, and by electrical methods the presence of only three or four charged molecules can be detected. Rutherford has even shown that a single "alpha particle," which is a charged atom of helium, can be detected.

The Purging of Raw Gold

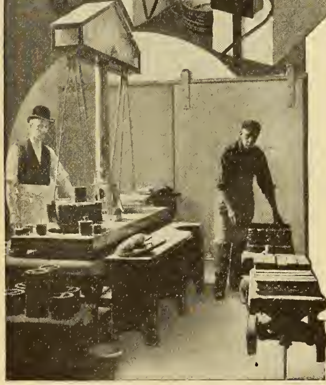
By ALAN R. WARD

Down on the lower end of Manhattan Island where the great sky-scrapers cast their shadows across the city, a little building sits huddled among them. It fronts narrow Pine Street where many brokers' offices are and its back is to Wall Street. All about it are the confusion and din of the financial district. Excitement is in the air. You can see it in the faces of the passers-by, in their quick footsteps, in their nervous mannerisms. Yet in the little building everything is calm. Day after day its work goes on—work conducted as quietly, you imagine, as the making by hand of fine laces.

If you didn't know you would never imagine the place to be one of the largest assay offices in the world. Behind its doors they talk of gold as other people would of salt. In its vaults lie millions of dollars. In its storerooms piles of gold bricks wait to be refined. On its floors the powdered dust when swept and examined yields thousands of dollars a year. And always to it is flowing a vast impure tide of the precious metal and always leaving it is the pure tide for which it is exchanged. And that step, the purging of raw gold, depends to a great extent upon electricity.



ELECTROLYTIC REFINING OF GOLD



WEIGHING THE GOLD

It's a tremendous task that they're handling down in Pine Street. This gold refinery recently established at the United States Assay Office is grinding out millions. Estimates place the amount of gold handled at from $9,000,000 to $10,000,000 a month. With such operations being carried on, you would suppose that conversation would be minimized. It is. If you go to Pine Street armed only with talk you'll feel that someone is staring over your head. If you go with a gold brick to sell or with the cash to buy one, you are made to feel very much at home.

But now let us see how it all worked out. A short time ago armed with some letters of introduction I went down to the new refinery. Not having any gold bricks the letters were necessary. At any rate they seemed to work, for I was shown through the place so that the different operations were made perfectly clear.

On the first floor I noticed, as I entered, a brass window. I wondered about it until I saw a man come in very quietly and approach this window much the same as one approaches the receiving teller in a bank.

I watched the newcomer. He was the kind of a man whose appearance you would forget five minutes later. There was nothing about him that impressed you. Without saying a word he lifted the two small bundles he had been carrying, and pushed them across the counter. On the other side of the window was a man who would have reminded you of a clerk in a fashionable hotel if he'd had on a hair-line striped suit. Also, without saying a word, he took the packages. Very carelessly he removed the covering disclosing two shining bars of gold. Then without the slightest trace of excitement in his voice he asked the stranger what they weighed.

I was near enough to hear just five words. They were, "What is the alleged weight?" Later I learned that everything is "alleged weight" there until the government scales have ascertained the official statistics. A person leaving gold at the refinery leaves it secure in the honesty of the government. The question of its value is left solely to the men on Pine Street. Three days after leaving, payment is made for the metal. For gold, cash is given; for any silver in the brick, the equivalent in silver bars is paid. All other metals such as platinum, palladium, etc., that may be found in the samples become the property of the government. From this source about $90,000 a year is made.

And with this necessary digression let us go back to the brass window. After the man had been given a receipt and was turning to go away, I tried to draw him into conversation. I wanted to know how he regarded his task of carrying about $35,000 worth of gold through the streets of a city where gun fighting is frequent. For he was a typical messenger—one whose daily task it is to carry bricks to the refinery. But all I could learn was that he regarded his responsible work as a "steady job." At the suggestion of notoriety he shied as an old fashioned college professor might have done.

Then H. J. Slaker, who was brought from Philadelphia to supervise the melting and refining happened along. Also, it was a most fortunate happening. For by him I was led to the different parts of the plant, listening the while to his lucid explanations.

"Now if you were to follow that man's gold to the melting room," he began, pointing to the brass window, "you would see it placed in a crucible with a flux, smelted and cast into ingot mold."

And then he took me to a bare walled room where men in blue shirts and leather aprons were standing about. Before them was an electric puddler in which the gold was cooked and stirred. The men in the leather aprons were watching the current; they were careful to see that it was just so strong, no stronger. One of them was constantly testing it with the stirrer. And finally when the gold was evidently "done" they began pouring it. Out through a tap it came—a thick, fluid, reddish yellow, worth many, many dollars by the pint.

In little receptacles it was cooled. And while it was cooling the current went humming through the wires again—and the furnace began heating another batch of the raw material. Just before we left the room Mr. Slaker explained that the gold bars cooked by the furnace ranged in value from $100 to $18,000.

"We won't accept any bar worth less than $100," he told me. "We pay at the rate of $20.67 an ounce. If a person wants to buy gold, though, he has to take more than $5,000 worth. The gold we buy sometimes goes into coin or trade. We refine it, however, before selling it to

THE DELICATE SCALES OF THE ASSAYER'S OFFICE
FURNACES FOR HEATING TINY CRUCIBLES

the trade. Dentists and jewelers must have an absolutely pure product. We provide it for them."

Then he took me upstairs to what he called the "deposit room." Here the gold, after cooling, is reweighed. Also, from each lot the assayer takes a small sample. By this, the quality is learned and the value calculated. Then the depositor is paid. The government knows the real value. You see there piled up thousands and thousands of dollars worth of the bright yellow metal. And when you feel like paraphrasing Samuel Coleridge and moaning—"Gold, gold, everywhere and not an ounce for me!"—you are led into another room.

And now you are about to look upon the electrolytic process of refining gold. Gold is almost always silver-bearing, and silver returns the compliment. At the refinery they don't care to leave these two metals in each other's company, so they separate them. First the gold is taken from the silver and after the operation the gold, boiled with nitric acid, attains the acme of purity. This is called "999 Gold."

After Mr. Slaker finished explaining the principle, he showed me a solution called an "electrolyte of water." It was composed of two per cent free nitric acid and three per cent silver nitrate. I tried to remember a college course I had in chemistry but I couldn't recall ever having heard of such an electrolyte before. Then he showed me the gold anodes. He pointed out that each anode was a slab of gold; that they had a hole in one end; that they were numbered and suspended in the electrolytes. He told me that the acid made the gold readily soluble.

Then began the electrolytic process. The bath was heated from 150° to 158°. If the pungent odor of chlorine arose the temperature was raised. More acid must be added, to promote the solubility of the gold. And with the current turned on, little bubbles began to gather on the anodes. More closely clustered they became until Mr. Slaker told me that each drop of water in the cells was worth ten cents. It was very pleasant to hear the word "cents" after being overcome with casual observations in the thousands of dollars. The next moment though, he had to go and spoil it by saying that in the cells were suspended half a million dollars worth of gold bars.

And then we left electricity doing its work in the nitric bath and went down to the room where the alloy was made. On the way he told me that the place we had just left was called the "gold room."

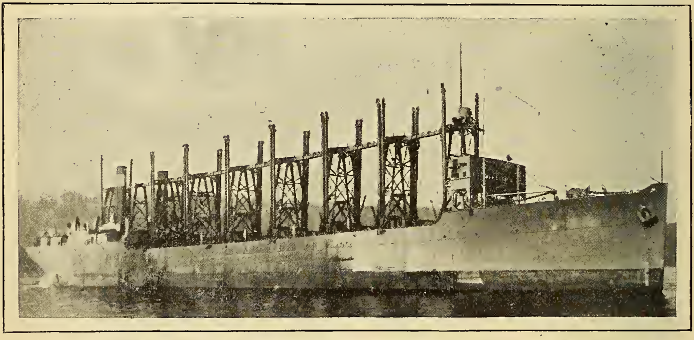
"There," he said, "we turn out pure gold. We wash it and after drying, send it down to the room where bars for the trade are made."

In the alloy room I found that the gold alloy was fused electrically with a quantity of lead, sometimes silver. The resulting alloy, which is known as the "lead button," is then fused. This is done on a very porous support called a cupel. The bones of sheep and horses, powdered as fine as flour, are used for the body of the cupel. This cupel absorbs melted oxide of lead without taking up any of the metallic globules. It is like blotting paper absorbing water, and leaving mercury behind.

If the lead is correctly proportioned, the button will consist of only silver and gold. Then these are separated by an operation called "parting." This is done by rolling the alloy into a thin plate and then boiling it electrically in a strong solution of acid. The silver dissolving, the gold is left as a coherent sponge. At first dense fumes rise from the melted metal. Then small luminous points begin to gleam on the surface. As the electric current becomes stronger and the solution hotter the points grow in size and in brilliancy. A moment later a tiny stream, reddish, is seen to trickle from the top of the metal globule. Round and round it flows—down, down until it is absorbed in the bone ash cupel. With it have been carried away the last traces of the lead and alloy. And now the gold-silver alloy shows itself in a glimmer of iridescent circling bands of yellow. It is the refined product—the finished work that the men in the leather aprons began.

Our First Electrically Driven Naval Vessel

Within the next few months there will go into commission the first electrically driven United States naval vessel ever constructed. This novelty is the collier Jupiter, and she is under construction at the Mare Island Navy Yard, Calif., being the largest ship of any description ever laid down on the Pacific Coast. In dimensions, carrying capacity, etc., the Jupiter is the exact duplicate of two other new fuel-carrying craft, the Neptune and the Cyclops. Indeed, in so far as outward appearance is concerned, she does not differ in the slightest detail from her sister ship, the Neptune, so that our readers may obtain an accurate idea of how the new electric ship will appear when completed by consulting the accompanying picture of the Neptune.



THE NEPTUNE—TYPE OF COLLIER TO BE DRIVEN BY ELECTRIC POWER

But the electrical "innards" of the Jupiter will put her in a class by herself and, if the expectations of the designers of her electrical machinery are justified, the vessel will mark a new epoch in the field of navigation.

The naval powers were at first more or less skeptical. They were willing to test electrical propulsion on a small vessel of any kind, but were unwilling to make the venture of installing the electrical equipment in a battleship costing millions of dollars. On the other hand the champions of electric power realized that a try-out in a small craft would be by no means conclusive. Finally, after the question had been argued back and forth for years, what amounted to a compromise was effected. The Jupiter was to be almost as big as a battleship so that she could afford adequate tests, but, on the other hand, she would not represent so formidable an investment on the part of the government.

Even at that, however, the electrical interests have had to assume every risk in the undertaking. The General Electric Company, it is understood, will receive something like $60,000 if its electrical installation in the Jupiter is a success, but if it is not it must not only stand the loss on its machinery but must also bear all the expense of removing the apparatus and preparing the machinery space to receive other equipment. And many of the naval officers in authority are decidedly in a "from Missouri" attitude. One of them has been heard to say that he favors pumping the rooms occupied by the power plant on the Jupiter full of sea water in order thoroughly to test the insulation which the Navy Department insisted, when the contract was let, must be such as to withstand the action of salt water.

The Jupiter, which has been chosen as the scene of this long step forward in the cause of electrical science, is 542 feet in length and 65 feet in breadth. As a source of energy the Jupiter has one turbo-generator and two motors. The generating unit consists of a six stage Curtis turbine connected to a bipolar alternator. Electricity is delivered by this generating unit to two motors, one mounted directly upon each propeller shaft. The speed of the motors will be changed by variations in the speed of the generating unit, the turbine being equipped with a governor so arranged that the speed may be automatically held at any point from five to fourteen knots. A feature of the Jupiter is the complete control of the movements of the ship by one man.

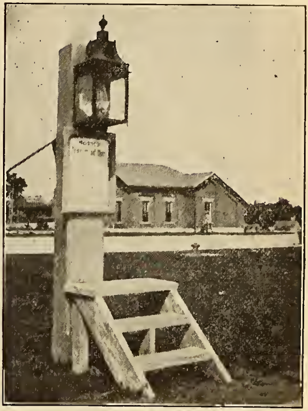
Steel Refining Furnace

One of the most important uses of electricity in German steel plants is in refining the steel. This is done in electric furnaces. The accompanying illustration shows one of these furnaces at the Stahlwerk-Becker plant in Willick, Germany, being tapped. Each of the electric furnaces will take care of 3,500 pounds of steel at a time. After the steel is properly refined it is run out into crucibles as shown and made into ingots for use in making armor plate and high class forgings.

ELECTRICALLY HEATED STEEL FURNACE

Is It Possible at This Age?

That oil lamps are in use and that the gates of a canal are opened and closed by human efforts when a 300 kilowatt power station is not 50 yards away—why is such a condition possible? However, such is the state of affairs at Morrisburg, Ont. Each day a dozen lamps have to be filled, trimmed and cleaned. One of these is shown in the illustration, the power house being in the background. Each pair of gates is opened and closed by strenuous efforts of four men. It requires about three minutes to open a pair of gates by this old time method, while electric motors on other canals do the work in less than 30 seconds, employing the services of only two men, one on each side of the canal, to control current to the motors.



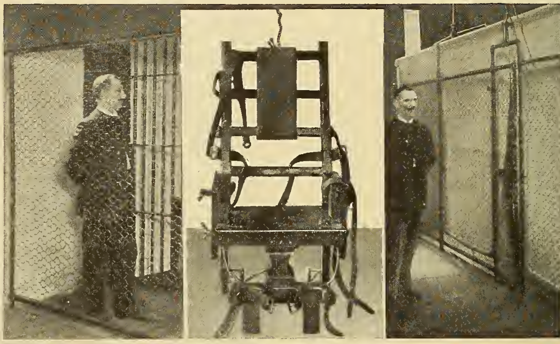
THIS WITHIN 50 YARDS OF A POWER STATION

The exports of electrical machinery and appliances from the United States during 1911 were worth, in round figures, about $19,329,000, as against $16,547,300 in 1910.

Electrocution

An Account of the Practice Common in New York. Does It Really Kill?

By HEREWARD CARRINGTON—Author of "Death: Its Causes and Phenomena," "Death Deferred," etc.



DEATH CELL FOR CONDEMNED PRISONERS — THE DEATH CHAIR — CURTAINS OF THE OTHER CELLS ARE DRAWN DURING THE DEATH MARCH

Photos Especially Posed

Does electrocution really kill? Or does it only render unconscious—the patient dying, in point of fact, upon the operating table, during the autopsy?

There are able physicians who contend that such *is* the case. Again, others say that it is not. Inasmuch as a human life is in the balance, this is a point worth considering—a question of some importance, from the ethical no less than the scientific point of view.

America is the only country in the world in which electrocution is the form of capital punishment employed. There are many who do not believe in capital punishment at all; but this is not the place to argue that point. Assuming that death has to be meted out to the prisoner, what is the safest, the speediest, and the most humane way of doing so? Is it electrocution?

The preliminaries must be trying to the strongest nerves! Blindfolded, strapped into a chair, having the adjustments made to the head, feet, etc.—there is nothing heroic or stirring in this, nothing that suggests anything beyond the dog whipped to its kennel, and breathing its last alone, uncared for, destitute! It is a miserable climax to a life which might have been full of promise and hope.

The chair itself is a forbidding looking thing, at best, and suggests the torture chair of the Spanish Inquisition. I once saw a chair of this latter description, in which the unfortunate prisoners were strapped and tortured; and it assuredly looked no more ominous than the chair of electrocution. Then the death cell, caged in, as though some wild beast were within, presents a curious paradox, in our modern civilization and culture. In front of each of these death cells (there are quite a row of them in Sing Sing) white blinds are drawn, so that when a prisoner is led between the line of cells, their inmates cannot see who it is thus led to his fate.

The prisoner once in the death chamber, the process of strapping commences, and in a few moments the prisoner is secure beyond all effort to release himself. He is blindfolded, and the service for the dead is read aloud. A physician stands in attendance, the electrician is at the switch waiting for the signal to throw it in and let forth the death dealing current. The signal is given; the lever is thrown home and this is what follows, in the words of an eye witness:

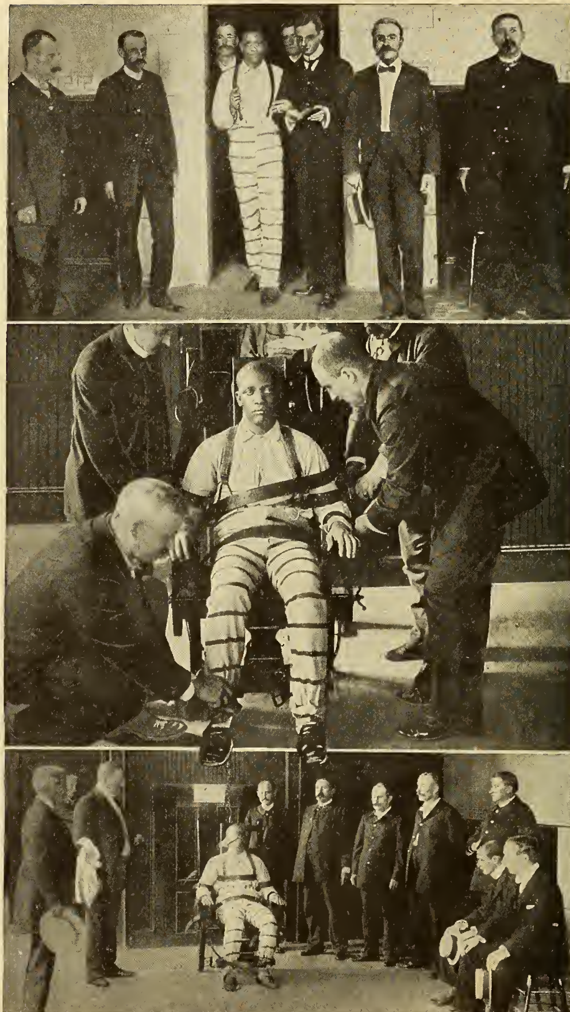
"There is not much to see. Those who would witness a killing by electricity from morbid curiosity surely would be disappointed. A deep whirring sound shoots into the air, and for a moment reminds you of the humming of a giant top. The face of the victim is hidden nearly completely by the headgear attached to the chair, so that the muscular writhing is kept from the view to a large extent. Only the mouth can be seen clearly, and the distortion is enough to make you feel glad the whole face is not exposed. As the current shoots into the body, the torso straightens out with a bound, and swells until you think the heavy straps are about to burst. The strain upon them is intense. The fearful voltage shot with lightning rapidity into the body, and circulating through every vein, makes the body quiver and vibrate so quickly that the movement is scarcely visible. The current is then lowered and the tension is taken off the body; but again the current is turned on and again the body stretches and bounds, pressing hard against the straps. Finally the lever is swung back again and what was once a man falls limp and lifeless, huddled in a heap in the bottom of the avenging chair. It is this suddenness of death that impresses: this realization that a moment before there stood before you a breathing human being, while now before you lies a lifeless corpse. The prisoner had solved the great secret."

All this might not be so bad if the electrocution really achieved the object sought. But does it? Dr. George F. Shrady, late Coroner of Manhattan, thinks that it does not, and in a letter written some time ago he said:

"There seems to be a great difference of opinion among eminent physicians and scientists as to whether the death of the criminal is actually produced by the electric current or by the doctors who perform the autopsy. It has even been hinted that the autopsy clause introduced in the law was added for the purpose of making certain of the death of the criminal.

"Prof. d'Arsonval, of the French Academy of Sciences, goes so far as to contend that the electric current merely produces suspended animation, and that the victim may be restored to consciousness and life by artificial respiration. Prof. d'Arsonval believes that the electric shock does not kill, and considers 'electrocution' objectionable and of questionable effect."

"My father," continues Dr. Shrady, "was one of the medical experts selected to witness the first electrocution in New York State—that of William Kemmler. He unhesitatingly characterized it as 'the most brutal and revolting exhibition he had ever seen,' and seemed inclined to believe that the old method of executing murderers by hanging was, after all, the most humane. Kemmler was subjected to two contacts of the electric current, lasting seventeen seconds, and 70 seconds, respectively. After the first contact the victim was pronounced dead by one or two of the physicians present, when my father called their attention to the fact that the man was still breathing, as a movement of the button on his vest plainly indicated. A few seconds later Kemmler gave unmistakable signs of life, much to the consternation and horror of those present. The current was quickly turned on again, and continued until a little column of smoke, accompanied by a sickening odor of burning flesh, ascended from



PREPARATIONS FOR AN ELECTROCUTION. AT THE DROP OF A HANDKERCHIEF ALL IS OVER *(Photos Especially Posed.)*

the body of the criminal to the ceiling of the execution chamber and passed out of a window opening to the external air. Kemmler's execution was afterwards pronounced 'a successful experiment' by the majority of those present."

Dr. Shrady is of the opinion that artificial respiration will, in a large number of cases, have the effect of restoring the patient to life, and contends that this is based on "exact scientific principles." Dr. W. G. Taylor gives a case in which the subject was completely revived, and 48 minutes after the electrocution "his pulse was 130, full and vigorous." The unfortunate man was again placed in the chair, however, and another contact of 40 seconds was made. As Dr. Taylor says: "It is certainly a grave question whether the post mortem examinations should not always be delayed until the matter of death be indisputably settled."

Dr. Gibbons gives a case in which life returned after the electrocution was performed; another physician quotes two cases. Still another says: "I am thoroughly convinced that many of the men who have been pronounced electrocuted in New York State have been placed upon the dissecting table conscious of what was going on and what was about to take place."

This hardly seems like capital punishment; it is more like human vivisection —yes, torture in its most refined form! Is this the best form of capital punishment we can devise?

It is true that other physicians do not share the views just expressed. D'Arsonval's "facts" are now questioned—even shown to be probably untrue. In the executions, as carried out today, there is no bungling, no burning of flesh, no tearing of straps. Consciousness is doubtless obliterated at once, even though *life* may not be. No sense of pain can be felt by the body when the current is turned on. It has been proved that it takes about a fifth of a second for the brain to appreciate a sensation, and one twenty-eighth of a second to telegraph that impression; and as nerve force travels only about 100 feet a second, while the velocity of electricity is millions of times greater than this, the brain has doubtless no time in which to appreciate the sense of pain.

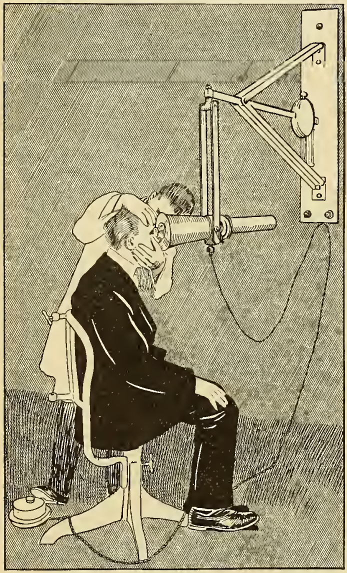
Again, Dr. R. T. Irvine, in writing on this subject, says:

"I have been present and have seen 64 persons put to death by electricity in this State (New York), and there is no doubt in my mind whatsoever but that all those men were absolutely killed by the electric shock and that death is instantaneous. The changes produced by the electric shock are such that resuscitation, in my opinion, is absolutely impossible. The amount of fresh blood found in the cranium in all these 64 cases I have seen in itself would preclude any possibility of saving a man. Then you have the patechial hemorrhages in the brain tissues. They change certain nerve cells in the brain. There is also a change in the structure of the blood after the electrical shock. Any one of these, in my opinion, would prove fatal, but when you have them all in each case and every case, as I have noticed in autopsies, death is unquestionable."

Thus, opinions differ, the weight of authority being seemingly on the side of those who say that, if electrocution is properly performed, the patient will not recover. But, as opposed to this, there are several undoubted cases on record in which a person has received even a greater voltage than that usually administered, and for a longer period of time, and yet recovered. As an example of this, I need only cite the famous case of John Branda, who received a current of 2,400 volts for nearly fifteen minutes, yet lived to tell the tale, and escaped with severe burns only. (He was, of course, completely unconscious during all this time.) Until such cases are disposed of, the question is certainly an open one and is not settled, as many seem to think. So we may ask again: Does electrocution kill?

Electro-Magnet for Treating the Eye

The application of the electro-magnet to removing particles of iron or other magnetic metal from the eye has been most successful, and physicians near metal works or in attendance upon workmen employed in such works include this apparatus in their office equipment.



NEW FORM OF EYE MAGNET

The illustration shows one of these magnets arranged for attachment to the wall and controlled by foot pressure, leaving both hands of the physician to handle the magnet and adjust the patient. This magnet is delicately balanced by a weight and can be swung about as required. Care must be used in applying it to the eye because the strength of its pull is such that it can draw a piece of metal out through an uninjured part of the eyeball.

Electricity to Attract American Tourists

Among the returned voyagers from across the Atlantic the first and most obvious comment is the greatly increased usage of electricity within the last few years, especially on the continent itself. In fact, it might be safely said that practically all institutions designed to attract American tourists advertise their electrical supply. This may be seen best, perhaps, in England. Take, for example, a provincial town of some 60,000 inhabitants, like Winchester, which boasts considerable historical importance. Leaving the hotels out of the question, there is a small inn, dating back to the sixteenth century, whose age darkened rafters particularly attract Americans in search of the picturesque. The brass knocker may antedate Shakespeare, but within are electric lights.

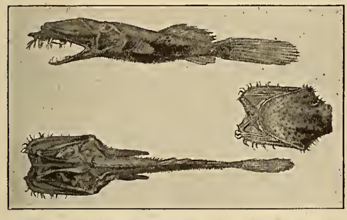
Nowhere is shown more strikingly this contrast between the mediæval and the modern than in the famous churches and cathedrals of Europe. At the time of the last coronation, electric lights were introduced in Westminster Abbey, and the great cathedrals at Winchester and Canterbury are similarly lighted.

An English Electro-Plating Process

There is an English electro-plating process whereby worn plated articles are replated by the simple plan of rubbing them with a powder of peculiar composition. The powder contains three essentials: the metal to be deposited, in pure or combined form; a salt, capable of producing an aqueous electrolyte when brought into contact with moisture and a metal that is electro-positive as regards the metal to be deposited. Silver, tin, nickel or cadmium can be deposited on any metal surface except aluminum by the English method, and the process promises to be of great value for use in homes generally.

Deep Sea Fish Carries a Searchlight

A fish which lies on the bottom of the sea, turns on a light which is fixed in the roof of its mouth to attract the prey, and, when the small fish congregate to see "what is doing," closes its terrible jaws and then sets the trap for another catch; this is the strange monster which was discovered by the recent expedition to the Philippine Islands of the United States Fisheries Steamer Albatross.



DEEP SEA FISH THAT CARRIES A SEARCHLIGHT

A part of the investigations involved a cruise around the island of Celebes, at which time numerous dredgings were made and specimens collected off the coast and in the bays of the island. A number of deep water stations were established on the east coast, and it was while members of the expedition were engaged in the locating of one of these stations in the gulf of Tomini that the remarkable fish was discovered which is the subject of the accompanying cut. It proved to be the representative of a species hitherto unknown to science, and it was therefore necessary to coin names for a new family, a new genus, and a new species of fish. After a consultation and the ransacking of several Greek lexicons, the name Thaumatichthys was chosen for the genus, which is derived from two Greek words meaning, "a wonder," and "a fish," respectively.

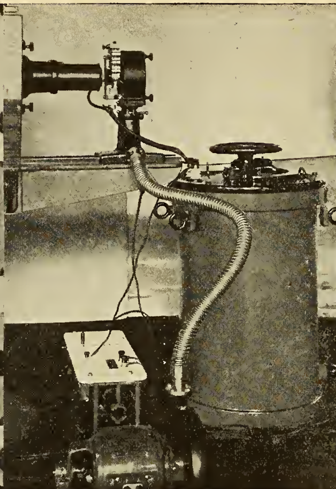
The power of attracting its prey by means of a phosphorescent bulb in the roof of the mouth is probably the most striking characteristic. The cavernous, elastic mouth is a trap into which the prey is lured and dispatched. Of the three views shown, the top one represents the side aspect of the fish, the bottom figure shows a view looking down on the same specimen, and the one in the middle is a view of the head from below. If the latter drawing is closely examined, the luminous bulb can be seen, resembling a collar button placed in the roof of the mouth, and showing in the cut just in front of the short lower jaw. The light from this bulb shines through the toothless space in the front of the upper jaw and attracts the prey which, having entered the mouth, is prevented from escaping, and brought within reach of the lateral teeth by the two pairs of large hinged, hooked teeth.

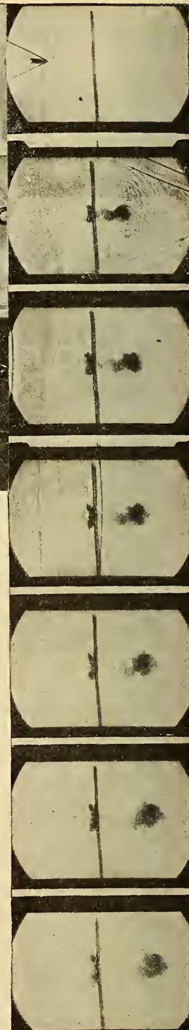
The specimen caught was brought up in a beam trawl at station 5607, near Benang Unang Island, Gulf of Tomini, Celebes, from a depth of 761 fathoms, or nearly a mile below the surface.

Dressmaker's Illuminated Sign

Many dressmakers and milliners use one room of their residence for a workshop and it is seldom that other than the conventional sign plate is used. One exception to this is a Chicago milliner who uses the front porch railing as a support for a large sign which is illuminated by four hooded incandescent lamps, the wires for which are brought up in conduit from the basement.

DIFFERENT FROM THE CONVENTIONAL SIGN PLATE





Moving Pictures of Bullets

By Dr. Alfred Gradenwitz

Many scientific applications have been made of the cinematograph, which in the popular moving picture show has found such universal favor. This apparatus, in fact, allows such phenomena as are too rapid or too slow to be followed by the human eye to be decomposed into their phases and viewed at a moderate speed.

The most wonderful use of the cinematograph principle has, however, been made by Professor Cranz of the Charlottenburg Military Academy, in the construction of an apparatus designed for the investigation of ballistic (shooting) phenomena, the flight of insects, and any other processes occurring in the animate or inanimate world. It in fact allows many thousands, and in its most recent form up to 100,000 pictures to be taken in a second's time.

An endless photographic film unwinds between two drums set rotating at a high speed by an electric motor. A photographic objective of proper focal distance projects on this film the image of a mirror or a lens. The phenomena occurring in front of this mirror thus appear in outline on the film, providing the mirror be lighted by a convenient source of light. Exposures are chosen short enough so that the displacement of the film during these intervals is practically nil. This is effected by means of electric sparks, each lasting perhaps the hundred-thousandth part of a second, which are produced as uniformly as possible. These sparks are so arranged with respect to the mirror as to project on the objective of the cinematograph camera a real image of themselves. This is why the mirror appears on the films here reproduced as a surface of uniform brilliancy.

An oil condenser charged periodically by means of a high frequency generator —through a resonance transformer discharging through a spark-gap—serves to produce the sparks. In order to start and stop the latter, the alternating current is made to pass through two attachments, one of which closes the circuit at the beginning of the process to be recorded, while the other at the end of this process automatically reopens the circuit. Owing to the enormous rate at which the sparks follow up one another and to their remarkable luminous intensity, this apparatus allows several thousands of pictures per second to be produced.

The film samples reproduced herewith give a striking idea of the results to be expected from this wonderful apparatus. The one at the left shows a Browning pistol being fired, and the one at the right the piercing of a caoutchouc plate by means of a German infantry rifle. These views have been taken at a rate of 6,000 per second.

In the second and third pictures of the pistol shot, note the spherical condensation of the air around the muzzle. It is easy to infer that these are sound waves just starting out in their ever widening circles. With the film run at the proper rate through the projecting lantern, you could thus actually *see* sound pass slowly out and away from the muzzle.

The top picture on the other film strip shows the rifle ball just entering the field. Some of the intermediate pictures are left out, and then in the next one it is seen that the bullet is gone, leaving its divergent trail of compressed air behind it. A little puff of smoke and gas has now reached the plate and passed through the bullet hole.

Effects of the Metallic Filament

At a discussion of the metallic filament lamp by electrical engineers at London lately attention was called to the "slump" which its introduction had caused in the demand for electricity for lighting purposes, resulting from greater economy of current. It had even been proposed to increase the price per unit for current used for that purpose, but a wiser plan was adopted, namely, the encouragement of a wider use of electric lighting. One result of the introduction of the metallic filament was said to have been that many who had gone back to gas now returned to electricity. The predicted end is a gain for both producer and consumer.

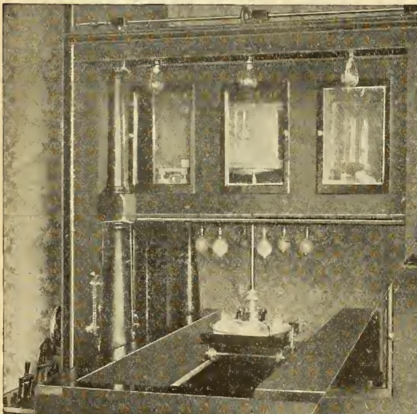
Stepping on Mat Signals Elevator

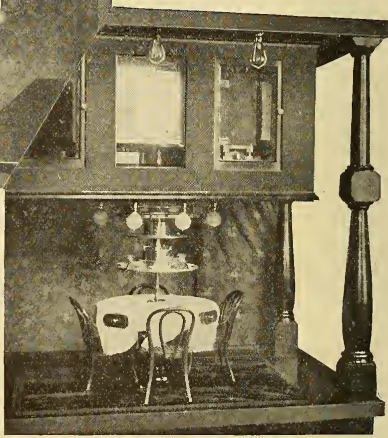
A decided novelty in the matter of signaling passenger elevators to stop at floors where passengers are waiting is to be tried out in one of Chicago's large stores. The "up" and "down" push button is to be discarded and instead an electrical contact mat will be laid in front of each elevator doorway on every floor. The matting, which can be purchased of electrical supply houses, is constructed so that when a person steps upon it at any point an electrical circuit is closed, just as when a push button is pressed.

An Automatic Table Waiter

An automatic serving system for restaurants and hotel dining rooms has been invented recently by James Doyle, of Pittsburgh, who is a colored man, and was formerly a waiter. In general the system involves electrically operated appliances for picking up a tray or several trays of food from the kitchen, carrying the same through overhead channels into the dining room and lowering to the proper table.

The illustrations show the inventor's working model which was demonstrated for the first time at the Pittsburgh Exposition, where it attracted a great deal of attention. Below is shown a dining room table with a tray descending to it from the channel, and in the picture above is the kitchen with a tray in position for being lifted to a car which automatically conveys the tray to the desired table. The motive power is furnished by a small motor not shown in the illustration; for a full sized car in a regular installation a one-fourth horse-power motor is sufficiently powerful, so that comparatively little current is consumed.





KITCHEN AND DINING ROOM TERMINALS OF THE AUTOMATIC TABLE WAITER

The actual operation of the system is like this. On entering a dining room equipped with the automatic serving system the patron checks off his order on the menu slip, encloses it in a hollow ball bearing the number of his table and places the ball in an opening below the table—the ball rolls through an inclined tube to the kitchen. The patron's order is then filled and placed on a tray having a projection from the center by means of which the tray is lifted by a rod to the car above and conveyed through the channel to above the proper table where the car is stopped and the tray lowered. The patron then simply turns a handle releasing the tray and the car returns. The system can serve a table in less than a minute on the average.

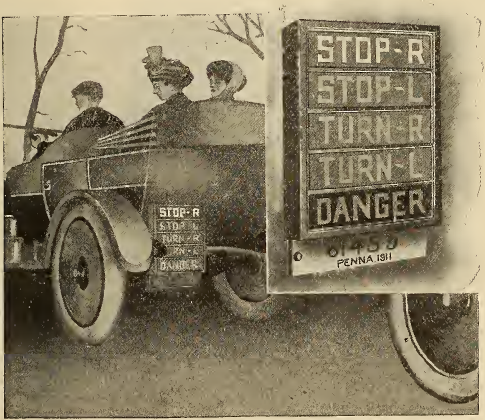
A system of any size can be operated

from a single switchboard and by one operator. The control is simple and the position of all the cars in service is indicated so that the operator always knows when the destination has been reached and when to lower.

The inventor claims that his invention will revolutionize dining room service by entirely doing away with human waiters and the tips incident to the present system.

Warns the Man Behind

With the growing mania for speed, and at the same time a desire on the part of the rapidly increasing number of automobilists for safety, various warning devices have been patented. The accompanying illustration shows one of these consisting of a metal cabinet containing upon its face panes of glass upon which are printed words indicating to the man behind what the autoist ahead desires to do. If, for example, the latter is going to turn to the right, he pushes a button which lights the electric lamp in the cabinet on the rear of his machine under the glass marked "Turn R" and the man in the rear acts accordingly.



REAR END SIGNAL BOARD FOR AUTOMOBILES

The Electrics of Taste

A distinguished scientist has suggested that wherever a distinctive flavor is formed in the cooking or eating of certain things together the reason why they seem to improve each other is that a certain amount of electrical action is set up between them.

Experiments have been made along this line, wherein there were used the two eatables as elements in a galvanic battery instead of the proverbial copper and zinc, the idea being to ascertain whether a current would be produced. Articles of diet generally eaten together, such as, for instance, raisins and almonds, pepper and salt, tea and sugar, were tried, and in every instance the experimenter, Edwin Smith, found electrical action occurring, a current being produced. He stated as a result of his experiments that "bitters and sweets, pungents and salts, bitters and acids," appear generally to furnish the elements for true voltaic couples.

Among the articles experimented on were the following, the first mentioned element of the couple taking the place, in each instance, of the attacked element, or zinc: Raw potato and lemon juice, tea and sugar, nutmeg and sugar, horseradish and table salt, onion and beet, vanilla and sugar, starch and iodine.

Temperature of the Arc

Recent determinations, by various methods, of the temperature of the electric arc, gives 3,500° C., or say, 6,300° F., as the most probable average value. This is the greatest temperature that has yet been artificially produced.

In the Copper Country

By GEO. F. WORTS

LOADED MAN-CAR READY FOR THE MILE PLUNGE INTO THE EARTH. IF THE CABLE SHOULD BREAK, THE CAR WOULD STRIKE THE BOTTOM TRAVELING AT THE RATE OF OVER FOUR MILES A MINUTE

The man-car, with its 30 odd occupants, slackened from a sickening, lightning like drop to a stand-still, and the miners, murkily illumined by the flickering oil flames, clambered out into the open tunnel and stumbled off into the enveloping darkness to their stations.

A mile above them—through the hole burrowed at a sharp angle into the rich metallic veins—was daylight.

Under the pine clad hills of the northern peninsula of Michigan, which juts out into the sparkling waters of Lake Superior, lies the metal which gives to this locality its picturesque name—The Copper Country.

Here the highest priced copper in the world is mined and melted into ingots.

From rumbling depths, thousands of feet below the openings in the hills, tons upon tons of broken rock, bearing the metal so precious to all things electrical, comes in a never ending stream to the black maws of crushers at the surface.

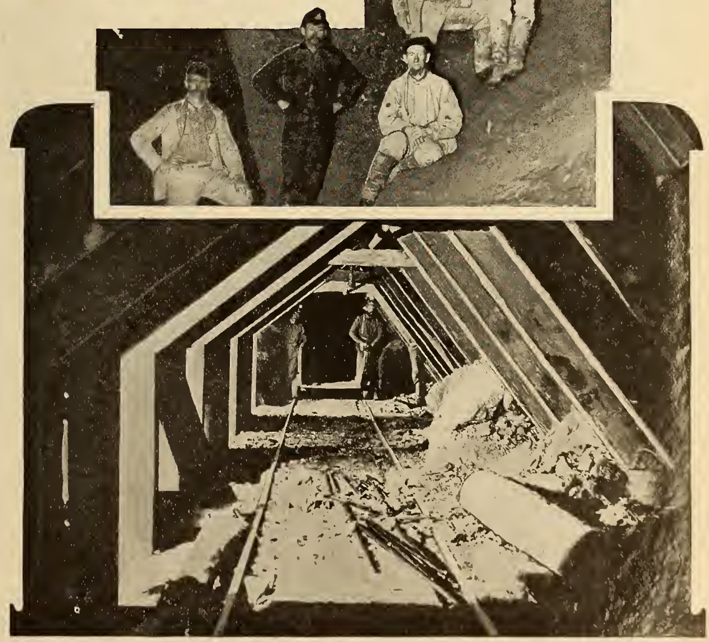
Experienced miners—true denizens of the underworld—drill and blast and tear at the wealth bearing veins, extending their labyrinth of tunnels in all directions in their effort to meet the enormous demand for the "electrical metal," as copper can truthfully be called.

Electric power is utilized in the mines to a large extent, although archaic methods, firmly established by time worn use, are proving difficult to displace. Hence, oil lighting is still in vogue—as it has been for past centuries—in deep mining. Electric lights make them nervous, so the old miners say.

Electric fire signaling systems, thoroughly comprehensive in their scope, add greatly to the safety of the miners.

Electro-pneumatic drills are slowly superseding the straight compressed air type, although, it is claimed, the latter afford a simple means of ventilating the tunnels, bringing the air as they do from a greater distance. In this connection, it is of interest to know that even during the cold winter months when the temperature of the outside air sinks to many degrees below zero, half naked "trammers" at the mine bottom, toil and sweat

A GROUP OF MINING CAPTAINS OR SUPERVISORS



THE ELEMENT OF DANGER—MANY OF THE TUNNELS MUST BE HEAVILY TIMBERED in an atmosphere which is often over 100° F.

One of the most important electric motor applications in the mines is that of pumping out the drainage water, which everlastingly seeps from the rock and may, at any time, reach dangerous proportions. Pulsing with life like insistency in their tremendous task of ridding the tunnels of water, thousands of feet below the surface, the electric pumps work untiringly that the grimy toilers may drill and blast without interruption in their work.

Electric locomotives, for hauling the broken rock on the various levels, are in extensive use; thereby dispensing with the most irksome of mining tasks—hand tramming. Electric hoists, for lifting the copper rock to the surface, are constantly replacing steam apparatus.

In the words of the electrical superintendent: "All hoisting will be done eventually by electricity. In fact, the possible uses for electricity in deep mining practice are just beginning to become known. In the near future, all mining apparatus will be electrically driven."

A matter of unusual interest in connection with the hoisting apparatus is the heavy steel cable used—thousands of feet in length—to raise and lower the cars. This cable costs approximately one dollar a foot and, in some instances, lengths as great as 16,000 feet are used. When one stops to consider that this cable, from wear, may be discarded in six or seven months, a slight idea may be gained of the enormous upkeep expense of a deep mine.

Arriving at the top of the ground in small cars, or "skips," the rock containing masses of native copper, passes through crushers and thence by rail is transported to the stamping mills.

Here iron and steel mortars and pestles of gigantic size, mounted upon concrete beds of countless tons, and actuated at a high steam pressure, receive through wooden chutes emanating from deep bins, the lumps of copper rock and pound them into fine particles.

So tremendous are the blows of these mighty hammers that conversation is entirely out of the question, and the building, regardless of its especially rigid construction, shakes from foundation to roof; to such an extent, in fact, that special incandescent lamps of low voltage, and having unusually thick filaments, are required successfully to withstand the vibration.

Leaving the three-story-high steam stamps, the intermingled copper and rock is separated by a series of electrically operated machines, embodying an elaboration of the pan principle utilized by the pioneer gold miner—a simple matter of gravitation—the metal settling and the fine sand washing away.

The final and most interesting step in the process involves a slanting, rectangular table with wooden strips, or riffles, over half the surface. The sand washes over these irregularities and the copper, due to a left-to-right vibration of the table, is shaken to the lower end and into tanks.

Another application of a well known physical law in the separation of copper from rock, occurs in a large, whirling bowl, known as the sand wheel. The finely ground particles are loaded into the sand wheel, and it is revolved at a rapid speed. Due to centrifugal force, the copper is thrown towards the circumference and the sand, being lighter, remains near the axis.

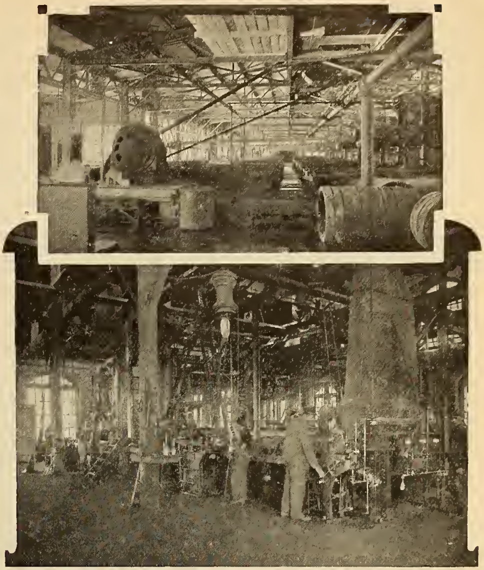
And now we come to the vital process in the purifying of a metal surpassed only by one other in world wide utility, a metal which was known and mined and used thousands of years before the beginning of history and a metal whose own history is more fascinating and thrilling than the most exciting romance.

The scene in the furnace room of a copper smelter is one of confusion, well ordered. The roar and hiss of compressed air; the clank and clatter of steel upon steel and the softer ringing thud of bright red copper bars; the hurrying, sure footed flight of half naked men holding blazing ladles aloft from furnace to mold, illumined by the blinding glare of the molten metal. All this combining of the forces of Nature and Man was bewildering.

Above the din, the foreman explained:

"The copper, 45,000 pounds to a charge, is placed in a large furnace and the temperature maintained at a white heat for half a day or longer. During this time the remaining sand, which has still clung to the metal, melts and floats to the surface and is drawn off as a slag.

"Most chemical impurities are removed by oxidation, forcing compressed air upwards through the molten mass."



PANNING COPPER ON A LARGE SCALE
DULLED DRILLS ARE HERE SHARPENED AT THE RATE OF ONE EVERY TWELVE SECONDS

Above the voice of our guide, and completely overwhelming all other sounds, comes a penetrating explosion, followed by a fiery shower of sparks throughout one portion of the large room.

"Some one poured metal into a wet mold," he explained, and continued:

"The average electrical worker would be greatly surprised to know the effects of impurities upon the electrical conductivity of copper. One per cent of sulphur or carbon lowers the current carrying ability over one per cent. The same amount of phosphorous has an effect just 50 times as great. One part of arsenic in 1000 of copper; that is, one one-thousandth of a per cent, lowers the value of copper for electrical uses over one per cent.

"Refined copper attains—it *must* attain—a purity of at least 99.89 per cent. If silver or arsenic is present the metal is cast into thick sheets and the silver and copper recovered separately by electrolysis."

A large, low lying machine, having odd semblance to a gigantic spider, receives molten copper from a furnace and turns out ingots at the amazing rate of 100,000 pounds an hour—a fact which is causing the entire copper smelting industry of this country to revolutionize and concentrate.

Not only does this queer machine resemble in appearance a mammoth spider of many legs, but it also performs an analogous function, weaving, as it does, the first strands of a mighty copper web which enwraps and holds the entire world for a captive.

One man seated at the center amidst an imposing array of levers and controllers operates the mechanism. An electric fan perched a foot from his head continually blows full strength upon him, for his job is a hot one.

A livid, scintillating stream of liquid copper gushes from a vent in the furnace wall and flows through iron channels into the molds arranged on the circumference of the great wheel. Square bars, later to be rolled and drawn into wire, are being cast.

In the above ground workings of the Michigan copper mines electricity enters as a prime factor. The first commercial arc lighting system in the United States was here installed in 1878. It comprised an imported generator and 20 lamps. The only prior arc lighting on this side of the water consisted of a similar set shown at the Philadelphia Exposition in 1876 and one installed at Cornell University in the same year.

THIS ODD MACHINE RESEMBLES A MAMMOTH SPIDER. LIVID STREAMS OF COPPER FLOW FROM THE LADLE TO THE MOLDS, AS IT SLOWLY REVOLVES

When the wheel has made a half revolution the molds are suddenly tilted and the red-hot copper ingots plunged into cold water.

The relative speed of the Walker automatic casting machine—the invention of Professor Walker of Columbia University—and the traditional hand ladle method is conclusively shown by the following figures:

By hand, 5 men, 6 hours.... 25,000 lbs.
Machine, 1 man, 1 hour.....100,000 lbs.

The color of molten copper defies description. From a beautiful sea green in the cauldron, it flows into the ladle wavering between green and a pale, opalescent pink. It reaches the molds in a glorious golden stream and cools to a ruddy hue when thrust under water.

Huge generators of the latest design spin quietly in their work of supplying current to hundreds of motors by day and a myriad of twinkling lamps by night.

One of the most noteworthy applications of the electric current in the mining industry of this section, occurs in the Calumet and Hecla drill shop—the largest project of its nature ever attempted.

Several massive machines receive the hexagonal drill blanks, heat and reheat them, mold and hammer and fashion their heads into peculiarly shaped cutting edges, performing the work of many hands in an inconceivably short time.

In the same manner dulled drills, red

from their grinding contact with the copper, are re-sharpened. Five drills a minute, or approximately 3,000 a day, is the capacity of one machine.

Arriving from the mines in little cars, the dull drills are unloaded by an electric crane and reach the sharpener by means of an endless transmission belt.

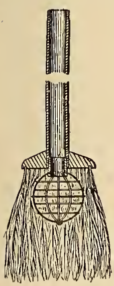
As the hexagon rods approach the machine, they are ingeniously lifted from the belt by steel "hands" and placed crosswise upon a slowly moving chain. First, they pass under a terrific blast flame of vaporized oil; thence, through a succession of pneumatic hammers, back upon the lower or returning part of the transmission belt, and to the mines.

Besides the electrical operation of mines and mills, current is also supplied to the various machine shops and foundries, as practically all of the machinery in them is electrically driven.

A novel addition to the electrical equipment of twelve of the mining shafts was the recent installation of searchlights on the dashboards of the man-cars. The white beam is invaluable in detecting flaws in roof and rail, and proves a source of considerable entertainment to the visitor to whom the violent downward plunge formerly held such terrifying thrills.

Duster for Vacuum Cleaners

A combination of the old fashioned feather duster and the most modern device, the vacuum cleaner tool, is shown in the illustration. The duster is intended for attachment to a vacuum cleaner and for use especially in dusting fragile china or similar articles. The feathers together with the suction will more thoroughly dust the articles to which it is applied than the ordinary tool, is the idea of the inventor, Charles L. Eichele, Pittsburgh, Pennsylvania.



DUSTER FOR VACUUM CLEANERS

The Speaking Automaton

The new Forcade speaking automaton is a French invention and is quite an improvement over what is already used. It is intended for advertising purposes and the like, so as to attract the attention of the public. It is of life size and the base contains an electric mechanism

IT HAS A MOST LIFELIKE APPEARANCE

working together with a phonograph. What is novel about the device is that it has a most lifelike appearance, and there are no less than fourteen animated parts, including the eyelids, eyes, mouth, head, forearm and arm, hands and fingers. By combining the different positions which all these parts can take, the figure has no less than 5,600 attitudes given by the mechanism. A double phonograph in the base can give both spoken parts and singing in turn. When placed in front of a store or just inside, it can be dressed as a "runner-in" to proclaim the merits of the wares, or as a bill distributer. Using a table in front, carrying food products or any kind of goods, the figure can be dressed as a cook, chocolate girl, and the like, and is sure to attract a large crowd. Political candidates can also multiply themselves, and the phonograph faithfully gives their ideas in a loud voice without any fatigue. At night the figure can be brilliantly lighted by electric light and can be mounted along with suitable electric flash signs.

The First Carborundum Furnace

Long ago man found it possible to produce crystals of great hardness by the application of terrific heat. This high temperature is only available for practical purposes in the electric arc. However, without the cheap production of electricity the use of the electric arc furnace

THE FIRST CARBORUNDUM FURNACE

in the industries is prohibitive from the economic standpoint. With the harnessing of Niagara Falls the manufacture of carborundum on a large scale was born. By mixing coke, salt, silica and sawdust in proper proportions, and placing the mixture into a long pile with a huge electrode at each end the application of electricity in the form of a huge electric arc produces wonderfully hard crystals called carborundum.

These crystals, which are excelled in hardness only by the diamond, are reduced to various degrees of fineness, and from these are produced all grades of grinding wheels, carborundum paper and cloth.

The first carborundum furnace built by the great company at Niagara Falls is shown in the illustration. This is preserved and stands among the many modern buildings which shelter this great industry. The electric furnace as used today contains huge water cooled electrodes weighing hundreds of pounds, and consume as high as 2,700 electrical horsepower. The voltage used varies from 100 to 200 volts, making a current capacity for these furnaces of 10,000 to 20,000 amperes. More than a score of these furnaces are in operation today, and the first furnace shown in the illustration stands near-by a silent testimonial of the growth of this industry.

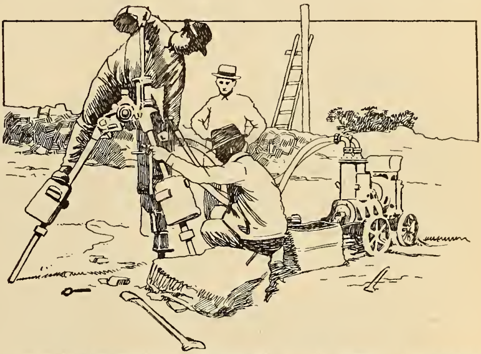
Moving Pictures for the Blind

There is a device, invented by Doctor Dussaud, of Paris, whereby blind persons may experience the illusion of moving objects as people with sight do an illuminated screen. The apparatus consists of a machine operated by electricity which causes a series of reliefs, representing trees, birds, or other objects, to pass rapidly under the fingers. The reliefs are so graduated that the delicate sense of touch possessed by the blind translates their variations into apparent movements of the objects which are represented.

Doctor Dussaud employs the apparatus mainly for educational purposes. He has also devised a system of electric vibrations for conveying to the deaf an impression of musical rhythm.

Motors in the Quarrying of Sandstone

An exceptionally fine grade of sandstone for paving and building blocks, having a fine gritty surface free from the slippery ingredients, mica and feldspar, has been located at Stevens Point, Wis. In quarrying this standstone a scraper and shovel gang strip off the loose, disintegrated stone and clay which covers the standstone to a depth of ten feet or more, drilling holes and loosening with charges of dynamite. Next below this is found a loose layer of seamy rock which is pried off with a crowbar and is used in rubble building stone work. This exposes the sandstone proper, into which fourteen foot holes, two inches in diameter and ten feet apart are sunk into the ledge, about seven feet back from the face, by means of an electric air drill.



A DUPLEX AIR PULSATOR DRIVEN BY A FIVE HORSEPOWER MOTOR OPERATES THE DRILL

THE PLUG DRILL WILL MAKE A HOLE FOUR INCHES DEEP AND ONE INCH IN DIAMETER IN ABOUT THREE MINUTES

This drill is mounted on a tripod and driven by the pulsations of compressed air, created by a duplex air pulsator, which in turn is operated by a five horsepower motor.

The pulsator has an unique feature, namely that it has no intake or discharge valves—the air in it is never exhausted but is used over and over again, playing back and forth in a closed circuit. Two short lengths of hose connect pulsator and drill, each of which run from a pulsator cylinder to one end of the drill cylinder—one serving as an admission while the other serves as a return. The air simply acts as a transmitting agent; an unwearing, unbreakable spring or cushion between the pulsator and drill, transmitting the energy of the motor to the point of impact with the stone.

These fourteen foot holes are loaded with a charge of black powder, just enough in fact to loosen and throw the stone over in large chunks but not enough to break it into fine pieces. Blocks weighing several tons are thus loosened and the next operation is to drill them across the center with a plug drill operated by an electric motor. This drill is held in the hand of the workman and will plug a hole four inches deep and one inch in diameter in about three minutes. A line of these holes is made across the block generally at right angles to the grain of the stone, a single-bit drill point being used for this purpose. Into these holes are inserted "plugs and feathers," or adjustable wedges; a few blows with a sledge hammer on the plugs cause the stone to break squarely in a straight line, thus dividing it. This process of division goes on until chunks approximately two feet square are obtained; these are drawn by a horse to the different block cutters located in various parts of the quarry, who split and resplit the blocks down to the proper sizes by means of 24 pound mells or sledges, with a sharp edge.

Sandstone from the Stevens Point quarry has been found by actual test to have a crushing strength as great as that of granite, running as high as 23,000 pounds per square inch and in composition is practically pure quartz.

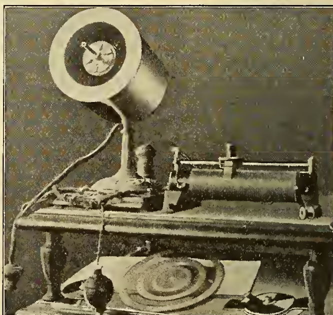
An Artificial Aurora

In a lecture delivered not long ago before the Royal Society, Sir William Ramsey showed an experimental proof of the electrical nature of the northern lights. Between poles of a powerful electro-magnet he suspended an exhausted glass globe, containing at the top a metallic ring. An alternating current discharged through the ring in the globe produced an annular glow, and when a current was sent through the coils of the electro-magnet the glow was deflected downward in streamers resembling those of the Aurora Borealis.

The spectrum of the natural aurora shows the presence of krypton, and in this Ramsey's experiment krypton was produced in the discharge through the rarefied air within the globe.

A Color Blending Top

An electric color top designed by P. Dosne and made by Poulenc Brothers, Paris, France, is designed to aid in the blending and matching of colors. It is well known that almost any shade or tint may be obtained by properly mixing the three primary colors, red, yellow and blue. The top is provided with three color disks, each representing a primary color. These disks are mounted upon the shaft



COLOR BLENDING TOP

so that their segments form a circle. They are also adjustable so that any proportionate area of the various segments is obtainable. When rotated very rapidly by the motor which operates the top, the colors of the segments blend so as to give the disk a certain definite shade or tint—this is a simple and easily performed experiment in physics.

Suppose a printer, for instance, wishes to mix his inks so as to match the color proof of a cut or sample of printing. Instead of dabbling with the inks to get the right effect he would adjust the disks of the top until when whirled rapidly they would present the same shade as the sample—this could be accomplished after a few trials. Then, stopping the top, he would note from a scale, the proportions of the three primary colors shown by the exposed segments of their respective disks, and mix his inks accordingly.

Electric Gondola

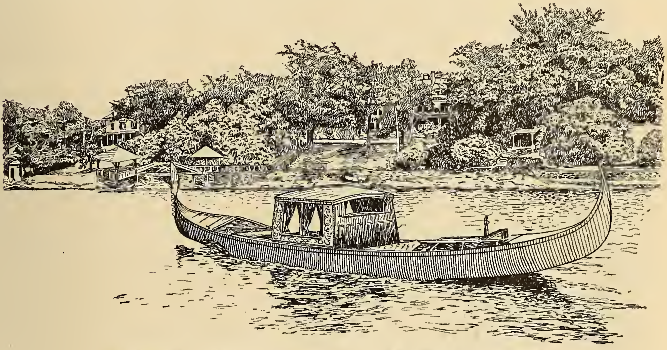
At his beautiful home in the Thousand Islands an artistic 40-foot electric gondola has been utilized for pleasure service by Commodore F. G. Bourne, of the New York Yacht Club, and the electric boat has been greatly admired. This Venetian gondola was built at Bayonne, N. J., and is equipped with an electric motor and storage batteries, giving a normal speed of 7½ miles an hour, with a maximum speed of nine miles an hour.

Constructed of Indian teak and African mahogany, the entire exterior of the felsi, or cabin, is hand carved, while the interior is luxuriously upholstered, even the ceiling being paneled handsomely in leather.

It is understood that Commodore Bourne had intended to have this boat built in Venice, but on the assurance it could be constructed in this country to his satisfaction, he directed that it be built here.

In order that the gondola should be built in strict accordance with all the technical traditions, which have been handed down from the time of the Doges, some dating back to the Eighth Century, an exhaustive research was made of all that has been written pertaining to these ancient craft, an examination of old prints being made in order not to offend any of these traditions.

For instance, the ferri, or irons, which decorate the bow and stern, are exact reproductions of those from a boat built in the Eleventh Century and are of polished nickel steel. The highly ornamented rowlocks or forcoles, represent sea horses and are bronze castings on carved teak bases.



AN ELECTRIC VENETIAN GONDOLA AT THE THOUSAND ISLANDS

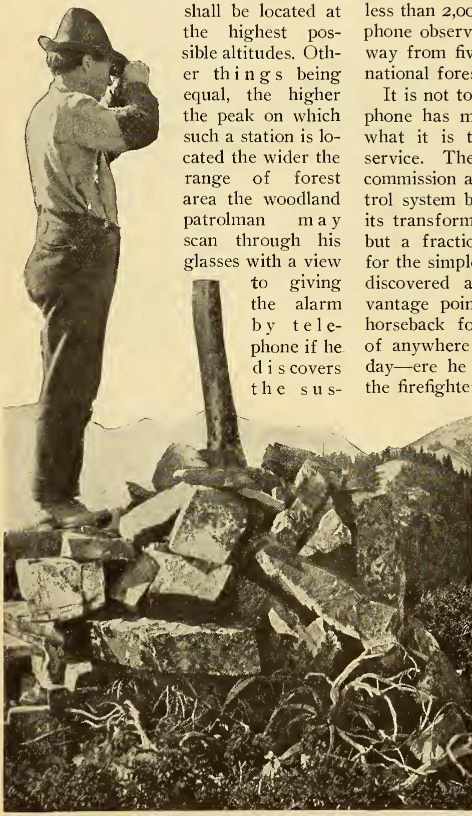
The source of electric motive power has been skillfully concealed so that the boat glides silently along as though propelled by some ghostly gondolier.

Lamp Filaments

Tungsten filaments for electric lamps, the price of which has been reduced within the past year or so by reason of improvements in methods of manufacture, now vary, it is said, from .001 to .013 of an inch in diameter, but filaments as small as .0008 of an inch in diameter can be made commercially. Comparison with threads of glass drawn down to approximately the same diameter shows that the glass has almost three times the ultimate strength of the tungsten filaments, but the filaments are much more flexible than the glass, which gives about 60 per cent less deflection under the same load.

Telephone Stations of the U. S. Forest Service

The primary purpose of the Federal forestry bureau in maintaining telephone stations is to give warnings and summon assistance in case of forest fires. This will indicate why it is important that the telephone stations that keep the forest scouts in touch with the outside world shall be located at the highest possible altitudes. Other things being equal, the higher the peak on which such a station is located the wider the range of forest area the woodland patrolman may scan through his glasses with a view to giving the alarm by telephone if he discovers the suspicious smoke rising among the trees at any point. It is not meant to convey, however, the impression that all of these observatories are located at extreme altitudes. Thus we have these mountain-top telephone stations ranging down in altitude from 11,000 or 12,000 feet to less than 2,000 feet. The number of telephone observatory stations varies all the way from five to 20 in each of our 150 national forests.



UNITED STATES FOREST RANGER MAKING OBSERVATIONS PRELIMINARY TO TELEPHONING A REPORT

It is not too much to say that the telephone has made the forest observatory what it is today in our governmental service. There were lookout stations in commission as adjuncts of the forest patrol system before the telephone worked its transformation, but they represented but a fraction of the present efficiency for the simple reason that when a ranger discovered a forest fire from such a vantage point he had to walk or ride horseback for miles—involving a delay of anywhere from an hour to a whole day—ere he could sound the alarm for the firefighters that he now gives literaally at a moment's notice by telephone. Heliograph signaling, the only other form of communication which has ever even suggested itself in this connection, has been tried by the Forest Service with varying degrees of success, but the fact that sunlight is required and that smoke, which is inevitable throughout the entire region where a forest fire is raging, puts a ban on heliographing has served to give the telephone a monopoly of the field in these latter days. Now the officials in charge of our great national forests are eagerly awaiting the higher development of wireless telephony to the point of general commercial practicability.

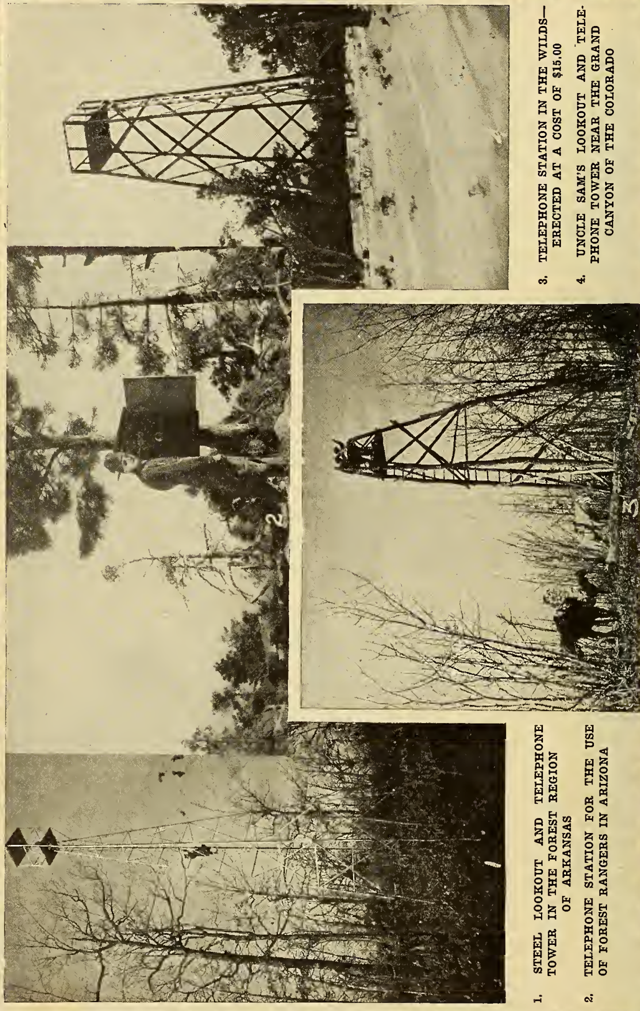
In many sections of Uncle Sam's forest domains the climatic and natural conditions are such that no effort is made to keep the telephone lines to the lookout stations in commission during the winter. However, with the approach of the forest fire season (which may be said to extend from spring until late autumn) linemen are sent out and the wire system is put in condition for business. Thereafter tests are made at frequent intervals to ascertain that the line is in working condition and in some localities where the menaces are many, and where any interruption to communication might be especially serious, regularly organized patrols are constantly traversing the phone routes in order to keep the wires in perfect condition.

An interesting development of the government's telephonic supervision of our public forests and national parks is found in the erection at strategic points of lookout towers—elevated platforms equipped with maps and range finding apparatus for locating distant forest fires and with one or more telephone instruments for sending broadcast news of the discovery of the fire.

Many of these lookout towers for fire watching are of wooden construction, some of them having been erected at a cost as low as $15, but lately Uncle Sam has taken an important advance step and has constructed several iron or steel telephone towers. Some of these lately completed towers in the Ozark National Forest are each 64 feet in height and have a twelve-foot spread at the ground. They are constructed of galvanized iron and each post has a fourteen-inch anchor set five feet in the ground. The tower platform at the top is five feet square and is capable of sustaining a weight of 2,500 pounds. Here, duly protected against the weather, is the all important telephone instrument and, as a precaution against damage by trespassers, a padlock is attached to the trap door opening to the platform.

Such precaution is necessary, of course, only where a tower or other lookout station is simply visited by a patrolling ranger several times a day as he reaches the point on his regular rounds. In the case of many stations, particularly those located on lofty peaks, the ranger on duty occupies a camp or cabin at the observatory site and, being constantly on duty, is enabled to telephone at frequent intervals. In the case of all telephone stations it is required that rangers shall report by telephone at stated intervals as evidence that they are on the job, no matter whether or not they have news of forest conditions. The telephone is yielding yet another important service to the Federal forestry institution in affording a means of calling in rangers and other employees for work at points other than their regular stations, and from the regular stations during rainy periods, when there is no danger of fire.

While the watcher for forest fires has, of course, not the benefit of anything approximating a telephone "central," he has, in most instances, two chances instead of one of sounding a warning at any hour of the day or night. His tower or mountain top terminal is connected not only with the office of the forestry official in charge of the particular district in which his station is located, but also with the office of the supervisor who has jurisdiction over a large forest area. If one cannot be reached it is probable that the other can. Most of the forest telephone lines are of the overhead variety, trees being used as supports for the wire, but in some instances, particularly in emergencies, wire is laid on the ground and for this class of work the preference is for about a No. 20 B. & S. gauge copper wire with a light insulation, similar to that used by the U. S. Signal Corps and weighing not over 25 pounds to the mile. Resistance is low enough to render it serviceable up to 75 to 80 miles, either



1. STEEL LOOKOUT AND TELEPHONE TOWER IN THE FOREST REGION OF ARKANSAS

2. TELEPHONE STATION FOR THE USE OF FOREST RANGERS IN ARIZONA

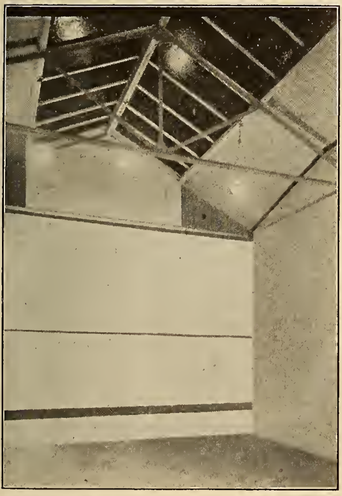
3. TELEPHONE STATION IN THE WILDS—ERECTED AT A COST OF $15.00

4. UNCLE SAM'S LOOKOUT AND TELEPHONE TOWER NEAR THE GRAND CANYON OF THE COLORADO

as a separate grounded system or when attached to a galvanized iron pole line. Such equipment can be used during actual fire fighting as well as in reporting conditions in an emergency.

Special Illumination of Rackets Courts

In England the use of artificial light in order to enable games to be played at night time is becoming quite a feature. Perhaps the most simple case of artificial



AN ENGLISH RACKETS COURT AND METHOD OF ILLUMINATION

lighting for athletics is the racket courts which are springing up in London. They can be built and lighted quite cheaply. The illustration shows a court of this kind illuminated by a series of Holophane reflector bowls and tungsten lamps. The game is played within white walls and with a small black ball. A very even illumination is necessary and it is stated that in this case the artificial arrangements were better than daylight. The court is 30 feet long, 21 feet broad and 15 feet high. The consumption of electricity is only about one-third of a unit per hour, costing a little more than one penny.

Electrifying the Railroads of a Whole Country

Switzerland has set for itself the task of electrifying every railroad within its borders. A commission recently appointed for the purpose has brought in a report recommending a 1,500 volt, single phase system. After a thorough investigation, experiments made to determine the mileage and cost show that the entire Swiss system can be converted at a cost of something like $14,000,000. There are some 1,700 miles of road, and the work will be started at once on the St. Gotthard tunnel route. Here are found the steepest grades and longest tunnels. One of the latter undercuts the mountains for nine miles. The commission has reported that the cost of operating a railroad by electricity, even at its worst, will be over ten per cent lower than if run by steam power. Coal in Switzerland is a most serious problem, since the country produces none. Power, however, is available everywhere from the numerous mountain streams and cascades, all owned by the government.

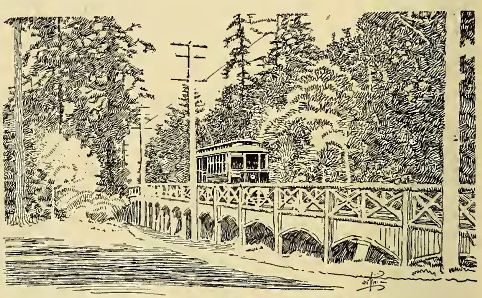
Electrical Music

An interesting experiment may be made, with the aid of electricity, in a vacuum tube. When a continuous current is sent through such a tube, matters being adjusted so that the current is only just able to pass, the current becomes periodic, and the cathode, being set into vibration, gives forth a musical note. The vibrations are ascribed to the periodical attractions exercised by the electric charges on the walls of the tube.

Style in Trolley Construction

Seattle is fast acquiring a reputation as a city of beautiful parks and boulevards. She has more parks and bigger parks than any other city of her size and age in the United States. Seattle might be said to be park crazy, and the electric railway people, too, naturally fell in line with the movement, with rustic bridges, rustic stations, rustic rails, rustic employees, and everything else rustic that goes with a rustically finished park.

Woodland Park is Seattle's biggest and best. It is not a man made park. It is mostly just as Nature made it, and the section of land it contains right in the city's midst is covered with a heavy forest in which giant trees of every description stand. There are lawn plots by the acre scattered everywhere for tennis courts, ball games, drives and promenades, and there is a zoo well worth going miles to see. But the Seattle electric company made itself solid with the park management when it built its pretty rustic bridge and trestle through the park, thereby making the line a thing of beauty instead of a badge of man's handiwork with a maul and railroad spikes.



A RUSTIC TROLLEY BRIDGE IN SEATTLE

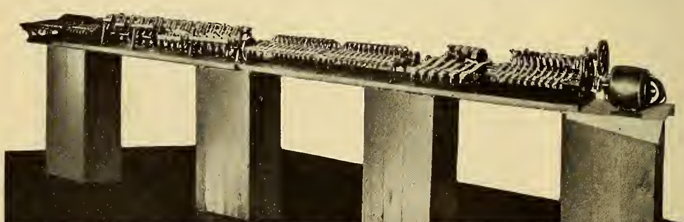
The Largest Sign Flasher

The largest sign flasher ever constructed is shown in the accompanying illustration, the photograph for which was taken just before shipment to New York City, where it will be used to operate a large sign on Broadway.

The flasher is run by a ¼ horsepower, 110 volt, alternating current, slow speed motor, operating on the same circuit as the lights which it controls.

The cycle of the sign is 50 seconds, the motor is belted to the flasher from a small to a large pulley, and further reduction in speed is obtained by reduction gears.

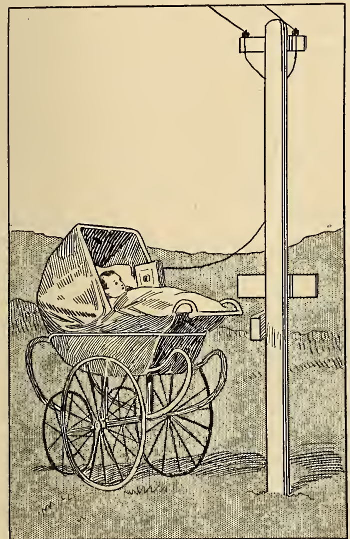
The flasher controls 74 circuits; that is, there are 74 changes in the cycle of the sign; of course, on some of these circuits there is a large number of lights which flash on at the same time.



FLASHER FOR A BROADWAY SIGN

Tending Baby by Telephone

In the October issue of POPULAR ELECTRICITY MAGAZINE, page 547, is a picture of the Platte Fougere Lighthouse, Guernsey, and some of its electrical equipment, but not all. The accompanying illustration shows the unique arrangement used at the station to aid the keeper's wife in caring for the baby while it takes a nap in its carriage out in the open air.



TENDING BABY BY TELEPHONE

A cigar box containing a telephone transmitter and a clock are placed in the carriage close to the baby's head. Wires run from the transmitter to a telephone receiver in the house. Now and then as the mother goes about her work she picks up the receiver and listens to hear if the youngster is entering any audible protests. The ticking of the clock can always be heard and is an assurance that the line is in working order.

Profuse Light Pays the Jeweler

By rearranging his electric lights and using white paraffin shades for show window and interior display, Hugo Block, a Chicago jeweler, has increased his business fifteen per cent in four months. He handles a large quantity of imitation diamonds, and was worried because of the fact that by his old arrangement of lights the stones showed yellow instead of the desired white, and prospective customers became dubious.

The store has a 12½ foot front and 25 foot depth. Because of the brilliancy of the stones the casual pedestrian could hardly pass without being attracted by the unique window. There are twelve 60 watt tungsten drop lights with paraffin shades in the show window. Suspended from the top of the window over the glass is a white curtain like cloth, and the twelve lights are concealed behind this. Each imitation diamond is invested with the same white luster that characterizes the genuine, and the only intimation the gazer would have that the stone is not genuine is the price tab attached. The lights are so arranged that their full power is concentrated on the stones that it is desired to give the most prominence.

Arranged about the show cases inside the store are 24, 25 watt tungsten lights with paraffin shades, sixteen of these being drop lights. There are also two chandeliers suspended from the ceiling near the entrance, each holding four 60 watt tungsten lights. So profuse is the lighting, in fact, that the interior of the tiny store has almost the appearance of an electric bath cabinet.

"I had been displeased for a long time with my window display, because the lights caused the imitation diamonds to look yellow instead of white," said Mr. Block. "This situation caused sales to be slow, and I decided that I must remedy conditions. I consulted with the electric light people, and they suggested that I use paraffin shades and also have the lights arranged behind a curtain so that the full force could be focused on any part of the display I might wish to give prominence. Within one week after the imitation jewelry commenced to show the white luster of the real diamond business began to increase until today it is fifteen per cent better."

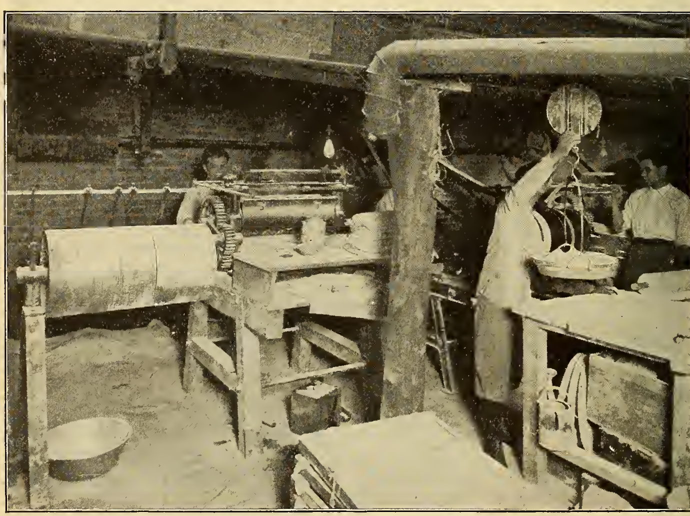
The Chinese Noodle Makers

The industry of noodle making is quite a flourishing one in the Chinese colony bounded by Mott and Pell streets and the Bowery, on the lower East Side of New York. Tons of the stringy delicacy so much relished by Germans and German-Americans are manufactured daily by these sons of the Orient in the dingy basements of Chinatown.

Moreover, these noodle makers are exceptional, as Chinese go. They are progressive to the extent of attempting to manufacture the noodles with the aid of electricity, and the result is that now the output of each tiny basement factory has been trebled. The absence of fire and odor appealed to the cautious Celestials, and immediately after the first factory was equipped other factories arranged for electric service. The result is that now, with few exceptions, the noodle factories on the East Side are operated by electric power.

But in spite of the fact that the Chinamen of New York have been familiar with electricity, electric lights and electrically operated machinery for some time, they are still wary about provoking the Evil God of the Wire to wrath. In several of the noodle factories of Chinatown it has been noted that some one of the more superstitious employees takes particular pains each night to cover up the motor and the switchboard with gaudy blankets so that "they will not catch cold." The employees are very much afraid to take any chances with the erratic temper of the enigma called electricity.

In fact, some of the men refuse to



THESE CHINESE NOODLE MAKERS ARE PROGRESSIVE touch the switch handles at all and those who do, often poke them over with a stick or broomhandle, so that they can be at a safe distance if the Monster should take it in his head to hiss and sputter at them.

One of the first of the noodle manufacturing concerns to use electricity for the operations of their machines was the Mon Chong Tai Company on Mott Street. The factory is in the basement under the salesroom of the company, and although in very cramped quarters the Mongolian workmen manage to turn out nearly three tons of noodles each day.

The Mon Chong Tai factory is as large as the average Chinatown noodle factory, being equipped with two heavy rolling mills and one cutting machine, besides an automatic dough mixer. The foreman of the factory is a well educated Chinaman and consequently he has very little superstition about electric power, but the employes under him hold various and weird opinions as to the damage that the God of the Wire might do were he to be offended.

The Chinese noodle manufacturer finds very little trouble in disposing of his output. The only thing he has to be careful about is to see that his clerks do not mix up the labels. When a shipment is made to a German-American grocer the cases are carefully labeled "Noodles," and when a Chinese restaurant proprietor is the purchaser the package bears the Chinese characters which translated would mean "Yakaman," for the two are identical.

The process of noodle making is very simple. The dough is composed of nothing more than flour, water, eggs and salt. It is cooked for a very short time in a huge boiler and then dumped into the mixing machines to be properly kneaded.

Before machines were introduced the noodle makers kneaded the dough in a huge wooden tub and very often if the quantity was large the kneaders were not adverse to getting into the tub with bared feet. That helped matters considerably and seemed to be a time saving method. But with the advent of the mechanical dough mixer and the subsequent enlightenment of the Chinese that method was abandoned.

In the olden days the dough, after it had been kneaded, was rolled with huge rolling pins into strips as thin as waxed paper and ten or fifteen feet long. But now the rolling machine does that work. The dough is fed through it and comes out into a strip so thin as to be translucent and varying in length from 100 feet to the average length of a city block. As it comes out of the machine it is dusted with powder and rolled onto polished hickory sticks.

As it is kneaded it is unrolled into four or five-foot strips and folded neatly. At that stage is looks very much like a thin felt blanket and far from relishing to the appetite. These folds are fed on a canvas belt through a cutting machine and chopped into strips scarcely an eighth of an inch wide. Then it is piled on huge trays to await the coming of a customer, or an order. It is never packed until the order is forthcoming for some reason or other.

Magnetism and Petroleum

It has been observed that the great Appalachian oil field is the area of the greatest variation of magnetic declination in the United States, and in glancing over a map of the magnetic declination for the whole country, one finds that the irregularities of the compass needle are strongly marked in the principal oil regions. Similar magnetic conditions have been observed in the oil region of the Caucasus. The facts go to bear out the assumption that the great oil deposits are generated from iron carbides. But besides oils thus due to inorganic processes, there are stated to be others which are undoubtedly of organic origin, derived from carbonaceous matter of vegetable or animal origin.

Something Really New—The Magnaphone

Although school has just "let out" and the afternoon is fine, a dozen boys of baseball age are gathered in a library in an upper Broadway apartment house. They are ranged in a circle, facing a corner of the room, straining eager ears and eyes toward a small horn about the size and appearance of those used by the deaf. From the horn comes a voice, proclaiming:

"Ty Cobb fanned out, leaving two men on bases, and two out. Southpaw Binks to the bat."

The boys set up a babel of heated comment, which instantly subsides into tense quiet when the voice in the horn continues:

"Binks hits a bounder to the pitcher. The ball flies home and then gets to first ahead of Binks. New York to the bat."

The strange instrument about which the boys are grouped is called a magnaphone. It is the latest development of telephone principles, put to the fullest use in news and music distribution.

When the baseball bulletins cease a voice announces:

"Barbieri will sing Shubert's 'Serenade,' by special request."

So it varies—music and baseball scores, weather reports and the latest news. At three minute intervals, from noon till midnight, the horn in the corner of the library keeps up a continual chatter.

At present there are nearly 100 such instruments in New York apartments, and the number is increasing. The wires from these various machines lead to a central office. This office can send news service and music to 1,000 subscribers with its present equipment.

In Wilmington, Delaware, a central office for this service has actually over 1,000 subscribers getting this new kind of wire service.

In the New York office the wires all lead to a table on which there are ten disks for graphophone records, and to a single voice transmitter, through which the news bulletins and announcements are sent. In connection with each disk there is a novel kind of transmitter, fitted with a graphophone needle, which operates over the record as usual.

But it is not a sound box, as in the graphophone, which receives the vibrations of the needle as it travels over the record. The sound boxes are all at the other end of the line, perhaps blocks away, possibly miles away. While the record is turning no sound is heard at the machine. In order that the operator may know that the record is playing, he must have one of the receiving horns in the room with him, or he must depend upon the lamps which are cut into the same circuit with the transmitter to tell him that the machine is working.

The little transmitter works a modern miracle in the way of music. The vibrations of the needle are transformed first, not into sound waves, but into electrical waves, which are sent over the wire. At the receiving end they are transformed back into sound waves. The result, maybe years after the human voice threw its melody into the graphophone horn, and certainly miles away from the instrument which is reproducing the song—the result, after all this interval of time and place, is music. This music is capable of constant magnification. It can be so repeated that ten people can hear it. And it can be repeated so that a thousand instruments in as many different places will pour out melody.

One graphophone record, however, is not depended upon for 1,000 wires, if all are listening. The transmitting table having ten disks turned by a single motor and controlled by a single switch, ten records can be played at once in absolute synchronization. It is customary to use an additional record for each 100 subscribers using that particular line.

By jacketing the transmitter with a flow of cold water on the same principle that the steam engine is jacketed, the inventor is enabled to pass through each transmitter, without burning it out, sufficient current to permit connecting in excess of that necessary for 100 wires.

The music is not limited to the graphophone, although that is the principal reliance at present and will probably remain so. But as the service is extended, high class soloists and singers can perform directly before the voice transmitter.

In the meantime many other extensions of the serviceableness of this instrument have come. In the first place, it has been installed in the Grand Central Terminal in New York, and with receiving horns at all parts of the station, one announcer is enabled to call out the trains in a voice uniformly distributed. Last summer at the close of the season these instruments were installed in one of the Hudson River boats to Albany for announcing features of the scenery. The United States Navy appreciated the pos-

TEN DISKS PLAYING THE SAME SELECTION CAN SERVE 1,000 SUBSCRIBERS SIMULTANEOUSLY

The service is not expensive, the present rate being eight dollars a month to each subscriber.

In spite of the value of the music to the sick and the lonely, the news is proving to be the most attractive feature of the service offered by the magnaphone company. It is always ahead of the newspapers on local news. The regular news is bulletined once an hour, but special features have precedence over the announced music schedule.

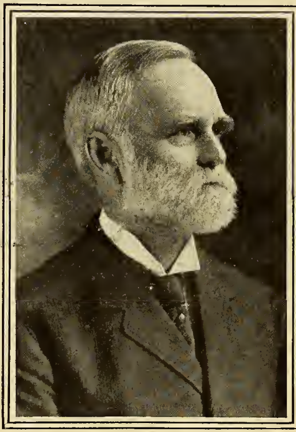
sibility of these instruments on ships. The battleship Utah is now equipped with the magnaphone, and eventually all of the vessels of the navy will be.

The inventor of the magnaphone, George R. Webb, is constantly extending the use of the instrument. When he first produced it, over five years ago, he was heavily interested in various electric light companies, traction companies and telephone lines. At one time he was president of the United Railways of Baltimore, of the electric light company and of the telephone company of that city. He was also head of the Pittsburgh, the Allegheny, the Duquesne and the Wilmington light companies. The magnaphone was simply his relaxation, but now he has given up all other interests to push this one invention. So quiet had been Mr. Webb's work in New York that no notice was taken in the newspapers of the franchise, and of the wonderful field it was opening up. None of them heralded the entrance into their field of an agency certain greatly to influence them, and possibly to prove in some ways an all powerful rival.

The Practical Engineer

By ONWARD BATES, C.E.

Extracts from "Addresses to Engineering Students," edited by Waddell and Harrington, consulting engineers. This is the sixth of a series of similar articles by prominent educators and business men, which will be especially interesting to boys and young men who contemplate following the engineering profession.—Editorial Note.



If I give you a lecture on words, it is not wholly inappropriate under the title of The Practical Engineer. We are not dummies; words are as necessary to us as to others, and in our profession more necessary than in some others. I will not ask if each of you knows his letters, accepting that much without question; but I do question if each of you knows how to spell. If you do, it is more than some practical engineers do. Correct spelling is an accomplishment; a man is frequently underrated just because he has made some mistakes in spelling. It is also a matter of importance, for sometimes the idea one wishes to convey is changed by a mistake in spelling. It is important to know the meaning of words, in order that you may say or write what you mean. How can one expect to write specifications, or draw up contracts, if he does not know what words to use, and what construction can be put upon them when they have been used? In addition to spelling correctly, and using words whose meaning you understand, it is still more essential that you should know how to string them together. Our profession is exact in its nature, and should be precise in its expressions of fact or opinion, written or spoken. There is no occupation in which it is more important to say precisely what is meant to be said. The engineer's opinions should be expressed with the same regard for accuracy as is used in his mathematical computations.

Can you write a letter? Some engineers cannot. They may write what purports to be a letter, and can perhaps make their correspondent understand the ideas they wish to convey. I do not ask if you can write legibly; that seems to be a lost art, and is not, in these days of typewriters, to be expected. I mean, can you write a letter, stating in clear, distinct, concise and correct language the facts and opinions which you wish to make known to your correspondent? If you cannot, then your education as an engineer is incomplete.

Do you know how to talk? To talk well is a great art. You can please, you can plead, you can instruct, you can command, or you can rebuke, in each case with the right use of words, and the right degree of emphasis, if you can correctly use the English language. Talk, like every other commodity, is valuable not for its quantity, but for its quality.

The command of the English language is a necessity as well as an accomplishment. It is the language of the profession, and it is fast becoming the language of the civilized world.

I have personally felt myself handicapped by fixed ideas, narrow views, and a stubborn purpose of proving myself to be in the right. Is narrowness of mind an inherent quality which leads one to select engineering as his vocation? I reject this query with scorn, and only mention it to dispose of it at once and altogether. It must then be due to his education, and I think the trouble is located in the university. The professors may demolish me for this statement, but I have a right to make it, for I am a member of the National Society for the Promotion of Engineering Education. I am also a member of a National Committee to Consider the Status of Engineering Education.

In the first instance, professors of engineering are usually specialists, and they generally teach their specialties. In a teacher's effort to impart the knowledge of his specialty to the student, the latter forms his opinion of the specialty and is much influenced by the personality of the teacher. If the subject is one for which the student has an aptitude, or liking, it obtains a preference in his mind over other subjects. He becomes more proficient in it and he attaches more importance to it. It is an old saying that it takes nine tailors to make a man, and I suppose it takes at least that many professors to make an engineer.

The young engineer does not, as a rule, grasp the opportunities which are ahead of him. He may have a remote idea that some day he will be a chief engineer, that great works will be under his charge, that important questions will be submitted to him for decision, that he will be called upon to plan great structures and to solve large problems; but just how these honors will come to him he does not know. There are certain qualities of mind which young engineers do not possess, because they have not learned them. One of these is the quality of discrimination; the ability to determine between right and wrong, good and bad; what should be rejected, what is acceptable; and what is to be desired and striven for. In other words, an engineer is not fitted for high position unless he is judicious.

There is no quality so much appreciated by those who have need of your services, and who are in a position to promote your advancement, which is as much valued as the quality of reliability. In past times men have attained distinction as engineers who had no college education, and very little school education of any kind. These same men, however, could not start over and succeed under existing conditions. At the present day it is useless for any one, who has a proper ambition to be among the first in his vocation, to attempt the engineering profession without a university education.

There is one more specification in the charge against the engineers of a narrowness of vision, and it is this, that those of us who are zealous over-estimate the value of the profession. There is no good reason why an engineer should not cultivate and enjoy the society of his fellow men. The setting of one's profession on a pinnacle, to be worshiped as the only real object in life, is unwholesome, and it defeats its own ends. Engineers should be seen at other places than at a desk, or leaning over a drawing board, or squinting through an instrument. They ought to be found where their fellow citizens congregate for any purpose affecting the common good, and they should take their part in such meetings.

A German Electric Candle

Everybody knows the defect of the ordinary arc light wherein the carbons are placed vertically, one over the other, with a consequent shading of the space directly beneath. Messrs. Timar and Von Dreger, in Germany, have invented a form of electric candle in which this objection is eliminated. The carbons are placed horizontally, one beneath the other, and parallel. The arc is formed by separating the tips, and experience shows that it does not travel along the carbons, as might have been expected, because of the existence of an electric field between them. The electric field tends, on the contrary, to keep the arc at the tips, and even acts as an automatic regulator, for when the current becomes too strong the arc is forced farther out and becomes longer, thereby increasing the resistance. The light is thrown downward, and by using two sets of carbons facing in opposite directions, a good field of illumination is produced below. This candle is intended especially for indoors.

COALING A WARSHIP BY SEARCHLIGHT

This photograph was taken at the Charlestown Navy Yard and shows how a warship is coaled at night in the almost daylight glare of great searchlights.

Cable Incline in the Tyrol

A new aerial cableway is now running in the Tyrol region of Austria. Starting from the station of Eisack, the passengers enter the comfortable hanging car and then are drawn aloft while suspended from the seemingly frail cable. The car slowly ascends and when at a great height in the air the tourists have a magnificent panorama of the valley with the lofty mountains in the background, finally reaching the top of the Kehlererberg, where the cable incline ends. This point lies at a height of 2,800 feet above the surrounding country, and the length of the incline is about 5,200 feet. The trip to the top of the mountain is made in thirteen minutes.

TOURISTS HAVE A MAGNIFICENT PANORAMA OF THE VALLEY

A double steel cable is hung upon a series of iron towers and a roller carriage runs along this cable, from which is suspended the car. At the end stations there is a cable running over drums driven by electric motors so as to draw the traveling carriage up the slope. The car will hold sixteen passengers. The drawing cable is endless, so that one car goes up while the second is running down, as is usual in cable inclines. The present line is built by Adolf Bleichert and Company, of Leipzig and Vienna, who favored us with the present information.

Tesla's Plan of Electrically Treating School Children

By E. Leslie Gilliams

Nikola Tesla believes he has found an electrical way of lessening the burdens of school life and the difficulties of acquiring education. A few months ago Mr. Tesla laid before the superintendent of the schools of New York, William H. Maxwell, a plan for making dull pupils bright by saturating them unconsciously with electricity.

Mr. Maxwell, an eminently progressive and practical man, after a careful investigation of Mr. Tesla's plan, arrived at the conclusion that the experiment could not possibly do the pupils any harm, seemed feasible, and to promise the accomplishment of great good.

Therefore he endorsed it for a six months' trial.

News of the new electrical project has leaked out in the school world, and the eyes of progressive schoolmasters all over the United States are now turned towards New York, and many inquiries have been received by Mr. Maxwell, requesting particulars regarding this novel electrical educational experiment.

Nothing in detail, however, will be furnished for awhile, as after the test has been made, careful calculations must be undertaken and conclusions and deductions drawn therefrom. It has been announced that the experiment is first to be conducted on a class of mentally defective children, the most difficult of all pupils to handle, and the bane and trial of every school teacher's life.

Mr. Tesla's plan for the arrangement of the experimental electrical school room, which has received Mr. Maxwell's approval, calls for the installation in this room of a number of insulated cable wires through the walls. These wires will be so carefully concealed as not to be noticeable to the pupils. Every effort will be made to keep the knowledge of the experiment from them. In general appearance the room will not differ from the ordinary bright, sunny, cheerful school room with its desks and other useful fixtures.

A high frequency current of millions of volts will be generated in an apartment properly arranged for the purpose outside of the school room. When school begins, by simply turning a switch, the high frequency current will be turned on, by one of the instructors, and shortly afterwards the school room will become completely saturated with infinitesimal electrical waves vibrating at high frequency. The whole room will thus, Mr. Tesla claims, be converted into a health giving and stimulating electro-magnetic field, or "bath."

When the inventor's plan was first brought to the attention of the Board of Education in New York, a lively controversy over the benefits of the proposition ensued. A fear existed on the part of some of the members of the board that the stimulation of the defective children, during the experimental period of six months, might be followed by a more or less prolonged or permanent reaction. These educators based their view upon the position taken by Professor W. C. Bagley of the Department of Physiology of the University of Illinois, who has made the statement that it would be years before it could be determined whether bad effects followed such an electrical experiment. Mr. Tesla and other noted electrical experts, who have had great experience with high frequency currents, claim that Professor Bagley is at fault in his presumption.

As proof they point to the fact that Mr. Tesla's project is more than a plan as, in Stockholm, it has already been carried out by Professor Savante Arrhenius with school children and proved most successful. No after effects except those of a beneficial nature have been observed, although they have been carefully looked for.

According to Tesla the high frequency current sets up in the body what he describes as a sort of molecular massage or tissue gymnastics. The tiny particles of which the body is composed are constantly in motion, and the high frequency current causes them to move about in a livelier fashion and increase in number. This unusual activity of the molecules of the human body brings about increased oxidation—the burning up of the waste product of the body by oxygen.

He acknowledges that his plan of stimulating dull pupils by saturating them with electricity is based on the well known theory of stimulating plant growth by electricity—a theory which has been successfully carried out in England by Sir Oliver Lodge, and has also been tried with favorable results by scientists in Denmark and Belgium.

The up to date home of the near future, Mr. Tesla believes, will not only be a place of rest, ease and comfort, but a health resort and a sanitarium as well, making seaside vacations unnecessary.

It will be equipped with high frequency electrical apparatus which will without the knowledge of the inmates keep them constantly charged with electricity, thereby warding off many ills and aches now common, and making the workers always fit for the battle of life. By means of the high frequency currents, he says, all the benefits of the seashore may be obtained right in the crowded city. Instead of spending a few weeks by the sad sea waves every summer, a man and his family may derive all the benefits of the seaside in his own home all the year around.

Upon the authority of George E. Williamson, illuminating engineer of Denver, Colo., that city bears the distinction of being the best lighted city in the country. Denver uses three candlepower per capita and the next best lighted city, classic Boston, one candlepower per capita.

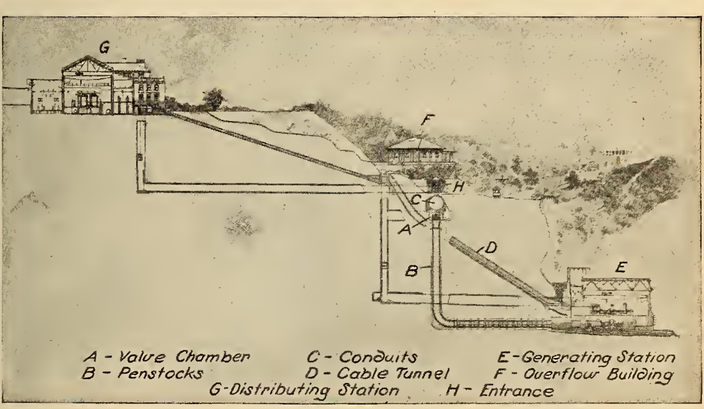
The Ontario Power Plant at Niagara Falls

Of all the great power plants clustered near the brink of Niagara Falls, the largest and one of the most recently built is that of the Ontario Power Company. The general plan of development is as follows: Water is taken from the river on the Canadian shore about a mile above the crest of the Horseshoe Fall, and just above the rim of the first cascade of the upper rapids. After being thoroughly freed from floating ice and debris, it is conveyed through steel and concrete conduits laid underground and steel penstocks tunneled through the solid rock to the generating station situated at the base of the cliff below the Horseshoe Fall.

The electrical energy here generated by means of turbines and generators is transmitted by underground cables to the distributing station located high on the bluff above. From this station radiate the transmission lines which convey the power to the manifold enterprises depending upon it.

The potentiality of the falls is explained by the fact that the Niagara River falls 300 feet in five miles, 50 feet in the upper rapids, 165 feet at the falls, and 85 feet in the lower river. In its entire length of 36 miles the river falls 326 feet. The average flow of the river is 222,400 cubic feet per second. The flow of water over the falls is about 25,000,000 tons an hour, or one cubic mile per week.

In the winter and spring, large quantities of ice come down the river, floating on the surface for the most part, but with enough suspended in the water to impede the successful operation of the plant, were it not removed at the headworks. For this purpose a long intake dam stretches out into the river in a down stream direction, almost parallel to the current, admitting to the forebay only the water at the bottom of the river, while ice and floating debris are carried to the rapids by the swift current that sweeps along its outer face. In the comparative quiet of the outer forebay more ice rises to the surface, to be similarly skimmed off at the screen house, where the water is further cleansed by heavy iron screens. At the gate house the water is again skimmed and finally admitted to the main conduits through large electric-



SECTION THROUGH THE GENERATING AND DISTRIBUTING STATIONS OF THE ONTARIO POWER COMPANY, NIAGARA FALLS ally operated gates. During the entire 24 hours three men are in attendance at the gate house, each man being on duty eight hours, and he is never out of hearing distance of the telephone.

The gate house is 120 feet long, and divided into six bays, two for each main conduit. The entrances to the conduits are guarded by large gates, 18 foot and 20 foot, weighing about 40 tons each, including the counterbalances. The gates are operated by electric motors. The screen house is 320 feet long, built of reinforced concrete faced with Roman stone. Broad ornamental stairways at either end lead to the roof, where a spacious promenade, open to the public at all times, commands a magnificent view of the upper rapids.

The inner forebay is a quiet pool of two acres area and 20 to 30 feet in depth. Here the water has a final opportunity for being cleared before entering the conduits, and it is this cleared, purified water which, by virtue of its potentiality, actually does the work down below the Horseshoe Fall. From the conduits the water enters steel penstocks nine feet in diameter, through electrically operated valves. The penstocks lead vertically downward to a level slightly below that of the generating station floor, then, turning at right angles, lead horizontally to the turbines.

The entrance to this remarkable power plant is modest and unobtrusive, so that the visitor is but little prepared for the marvelous skill and ingenuity displayed in the construction. One passes through double doors, enters an underground elevator and descends to the valve chambers; these are built beneath the lower ends of the main conduits, and they are approximately 300 feet long, ten feet high and sixteen feet wide, with arched concrete roofs to support the conduits above.

After leaving the valve chamber, one enters the elevator again, descends 120 feet and passes through a 250 foot tunnel to the generating station, the walls of which are of concrete, the rear wall being twelve feet thick and the river wall nine feet thick. Here are installed the enormous horizontal turbines, made in Germany, and the ten huge generators, seven of which were built in this country and three in Canada.

Cable tunnels and conduit systems lead from the generating station to the distributing station on the hill. The electrical power is thus conducted in lead covered cables to the bus-bars. From the bus-bars the power is distributed through cables to the transformers, where the voltage is stepped up from 12,000 to 60,000 volts. At this voltage it is sent out on the lines, some of it going as far as Syracuse, N. Y., 160 miles away.

Odd Effects of Electric Currents

In a Brussels street traversed by an electric tramway it has been noticed that the trees on one side of the way begin to lose their foliage early in August, the leaves turning brown and dropping off. But in October the same trees begin to bud again, and sometimes even blossom. Meanwhile the trees on the opposite side of the street are unaffected, losing their foliage late in the autumn and budding only in the spring. The cause of the anomaly is supposed to be leaking electric currents, which stimulate the growth of the trees affected.

Transmission Voltage 150,000

The voltage at which transmission lines are operated creeps steadily upward from year to year. So far 125,000 volts has been practically the limit of operation. It is now planned, however, to transmit current from the new Big Creek plant of the Pacific Light and Power Company at a pressure between 150,000 and 175,000 volts; the line will be 275 miles long. Some Pacific Coast engineers assert that the climatic conditions in California are so favorable that 200,000 to 250,000 volts may be employed in future power transmission projects.

Opportunities of the Electrical Store Window

Objects of spectacular interest and of artistic design make up the greater part of the regular stock of every electrical supply store, and there is really little excuse for the tradesman in this line who does not make his window the most attractive of any in his block. There are

EXCELLENT EXAMPLE OF AN ELECTRICAL WINDOW DISPLAY

ample opportunities for displaying working devices driven by motors, artistic lighting fixtures and table lamps, and the adroit use of those miniature lamp letter signs that tingle one's optic nerves like letters bent from white hot rods of steel. In addition, there are remarkable and mystifying stunts which can be performed with the invisible forces of electricity and magnetism, everything, of course, to be overtopped by an elaborate electric sign distinctive from any in the vicinity and in keeping with the nature of the goods to be sold. In other words, if you are selling electrical goods make your store the real electrical center of the locality, and be absolutely lavish in the use of lights.

The picture presented herewith is an excellent example of the attention drawing qualities that may be secured in the relatively small space of a single window and entrance. It is the Federal display room in Monroe Street, Chicago. The electric sign draws you, and once there the window holds you like the pages of an illustrated book, there are so many things to be studied over, marveled at and surmised about.

Search for Particle of Lost Radium

Tedious but exciting the search for a tiny particle of lost radium, now being made by a Birmingham firm of chemists, says the London *Daily Mirror*.

This precious particle, worth about $486 and one-thirteenth of a grain in weight, it is hoped to recover from a quantity of ashes taken out of a bedroom fire grate.

The firm hires out radium, and this particular portion, contained in a little holder known as the applicator, to which it was attached by strong varnish, was let to a local doctor. After applying the radium to the body of a patient, the doctor removed the applicator and the surgical dressings at the same time, and inadvertently threw both onto the bedroom fire. As the bandages flared up, the doctor realized his mistake, but it was too late to rescue the radium, for the varnish had perished and the precious particle had mingled with the cinders.

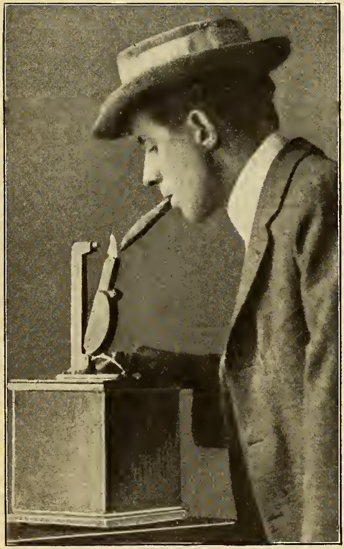
Collecting all the ashes in the fireplace, the doctor placed them in a cardboard box and sent them to the owners of the radium. Tests were applied, and these showed the ashes to be radio-active and to contain 4.5 out of the five milligrams (one-thirteenth of a grain) of radium originally contained in the applicator.

It is proposed to reduce the ashes to powder by slow ignition in oxygen—in fact, to heat the concentrated ashes by the same method as that used for the extraction of barium. The process is difficult and will take a considerable time.

Electric Current at Work

Battery Cigar Lighter

The illustration shows a compact cigar lighter in use at many cigar stands. Within the box are three dry cells and a spark coil. Upon the end of the scissors-like arm is an asbestos wick kept automatically saturated with gasoline. As the movable arm is pressed outward against a spring, an electrical contact is made and broken by a point on the upright, and a spark ignites the wick. When released, the wick is thrown back against the upright and extinguished.

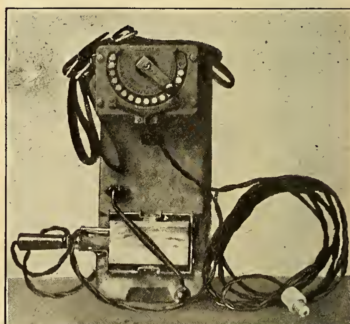


BATTERY CIGAR LIGHTER

Tire Economy

The initial cost of automobile tires compels the owner to take every precaution to keep them in good condition for as long a period as possible. Unless properly attended to when first discovered, a hole in the shoe grows rapidly and soon tears out.

Repairs can be made with a vulcanizer, like the one shown, quickly and satisfactorily at home. The heating element consists of a metal ribbon imbedded in mica and hermetically sealed in the vulcanizer casing. In from fifteen to 45 minutes, depending on the cut, a patch can be placed on the tire and thoroughly vulcanized.

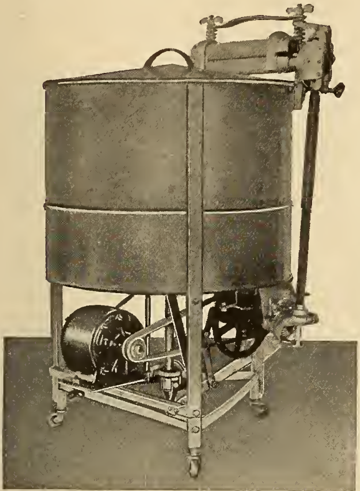


ELECTRIC TIRE VULCANIZER

The temperature of the vulcanizer is held at 275 degrees. The heat is controlled through the regulation of the current by the rheostat. The device operates on any lighting circuit of the usual 100 to 125 volts.

The "Easy" Washing Machine

The principle of washing consists in forcing the soap suds through the clothes, and was accomplished, before the advent



A NEW TYPE OF WASHING MACHINE

of the washing machine, by rubbing the clothes against a board.

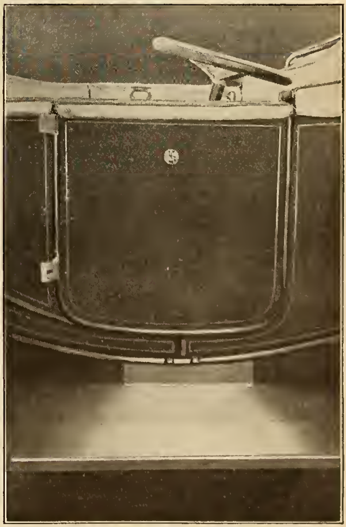
The Easy motor washer here shown utilizes the above principle by means of an electric motor which raises and lowers rust proof metal funnels or basins through the soapy water. These basins are attached to a yoke which is in turn fastened to a center bar. The electric motor is mounted on the frame under the wash pan in an accessible place.

The machine is equipped with a wringer, which is also operated by the motor through a set of silent, enclosed bevel gears, the power being transferred from the washer basins by a clutch lever conveniently located near the bottom of the tub. This lever can be operated to transfer the power from wringer to washer and vice versa without stopping the motor. The wringer can be reversed by a small lever located near the upper roll.

The entire machine is mounted on channel steel legs and roller bearing casters, weighs about 130 pounds and can be conveniently wheeled about the floor.

Automobile Step Light

Builders of electric cars are ever on the lookout for features that add to the convenience and desirability of their cars. One of these little innovations is presented in the illustration. A few inches above the step, close up to the body of the car and out of the way, is a small electric lamp and an elongated reflector so placed that the light is thrown directly upon the step. In the evening, when entering or leaving this car, the Argo electric, it is only necessary to press a push button just inside the door, and the danger of making a misstep is eliminated by a flood of light in the right place.



AUTOMOBILE STEP LIGHT

Measures Cost of Operation

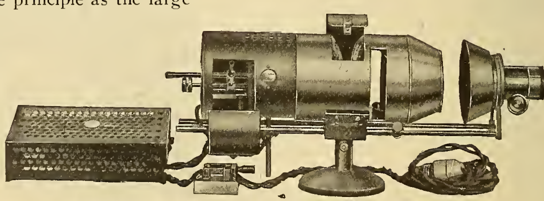
THE ENERGY-COST METER

One of the important questions asked by the buyer of an electrical device is: How much does it cost to operate?

The accompanying illustration shows a new device, the Energy-cost meter for use where things electrical are sold. When any energy consuming device is connected to the meter the hand points at once to the number of cents per hour that it costs to operate. With the meter the customer is able to see for himself and is a satisfied patron.

A Compact, Portable Stereopticon

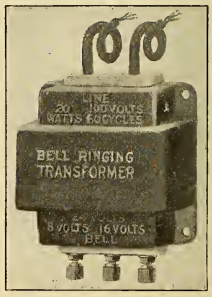
While experiments have been made with high candlepower incandescent lamps as the source of light for projecting lanterns, these were not strong enough to give sharp, clear pictures. The use of the carbon arc gave proper results. The lamp shown uses 5/16-inch carbons adjusted by hand feed apparatus, smaller but upon the same principle as the large lanterns. The carbons last for four hours without renewal. At 60 feet from the screen a twelve-foot picture is produced. A rheostat and switch with cord and plug for attaching to a lamp socket are part of this Miopticon outfit as it is called. The lamp sets on a 5½-inch base, and the whole equipment is carried in a case 20 by 6¼ by 10½ inches. In fact, the entertainer or educator may start out with his lantern in one hand and his slides in the other.



STEREOPTICON THAT CAN BE PACKED IN A SUITCASE

Bell Ringing Transformer

The use of transformers for reducing the voltage of the lighting circuit so that it may serve to ring bells and operate electric toys has become common. The light, compact transformer shown in the illustration will give eight to sixteen volts fully loaded and 24 on light load when operated from a 110 volt circuit. Binding posts are provided and the transformer is mounted by lugs cast on the case.



TRANSFORMER

An Adaptable Small Motor

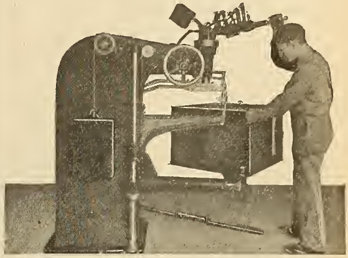
Some one has said "Human labor is the most expensive form of energy. Any machine that is in even occasional use should be run by an electric motor where current is to be had."

The illustration of a one-eighth horse-power Westinghouse motor driving a hand power washing machine strikingly exemplifies the quotation, and is equally forceful in showing an arrangement that may be used to operate the wringer, the ice cream freezer, or the shop lathe. All the running parts of the motor except the driving end of the shaft are fully protected by a metal framework.

ADAPTING A SMALL MOTOR TO A HAND DRIVE WASHING MACHINE

Electric Stove Welder

In stove factories extensive use is now made of spot welders, electric welders which do work every bit as good as riveting and in much less time. The two parts which are to be welded are placed together and upon the terminal at the end of the horizontal arm of the machine shown in the picture, one side of the electric circuit being connected to this peg-like terminal. Pulling down the lever brings the upper terminal, shaped like a punch, down upon the work. A very heavy current then flows from one terminal to the other through the metal of the two parts to be welded. Almost instantly this metal, at a little spot no bigger than a rivet, begins to glow—first red then white hot. At this temperature the pressure welds the two sheets together in less time than it takes to read this, and they are as firmly united as if a rivet had been put through.



WELDING A STOVE PLATE

While it may perhaps be supposed that the utilization of water for the development of power interferes with if it does not prohibit log driving, the statement is made that as a matter of fact the two industries in Maine have worked together satisfactorily. Of course this co-operation has involved a more economical use of the water, for it is stated that wherever a dam has been built to develop power the conditions have, in general, been improved for log driving.

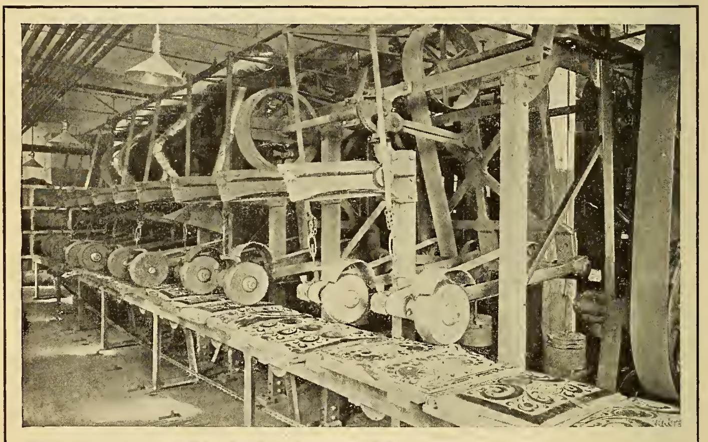
The Grinding of Stove Plates

Not only does one observe in a modern stove factory the innumerable small applications of short cuts in intricate manufacturing processes, but he also comes in contact with great, nearly human machines which cut time and cost into negligible fractions. Such an example is the automatic stoveplate polishing machine.

Previous to the advent of this time saver, stove tops and sides were ground, polished and trimmed by hand—an expensive process considering that skilled labor of the highest class was required. Now, one electrically operated machine does the work of a dozen men at a fraction of the former cost.

The plates which go to make the top and sides of a stove and to which it is desired to impart a polished surface, are placed upon a slowly moving belt geared down so low that it moves almost imperceptibly. A coarse grained abrasive wheel at the end of a long, pivoted arm swings out back and forth across the slowly moving plate, bearing down with sufficient pressure—obtained by adjustable weights—so that the rough surface is partially removed. As the plate is carried beyond the scope of the first wheel it comes within range of another of slightly finer grit, secured, as the other, at the extreme end of a long, swinging arm, which, sweeping back and forth over the plate, grinds it to a still finer surface.

In this manner, the iron lids pass under a series of ten wheels, each one of finer grit than the one preceding; the last ones being leather, faced with emery cloth for polishing, and the very last an oiled cloth wheel. The result is a smooth, satiny surface, and the oil prevents the accumulation of rust.



THE IRON LIDS PASS UNDER A SERIES OF TEN WHEELS

Powerful suction pumps, actuated by electric fans, are located behind the wheels to remove the powdered iron, and the grinding rooms are surprisingly free from floating dust.

The first telephones were used both as transmitters and receivers and there was usually posted up a rule that read: "Don't talk with your ear or listen with your mouth."

Electric Truck in Twine Factory

The electric truck which has been found most efficient in handling baggage, mail and express matter is finding a place in manufacturing plants.

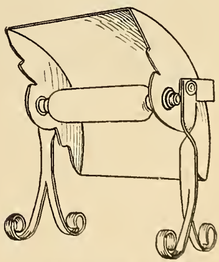
ELECTRIC TRUCK IN A TWINE FACTORY

The illustration shows one of these trucks in a thread and twine plant handling a load of flax bundles. The superintendent of the factory states that this truck performs the work formerly done with a two horse team and five men. The storage battery is located at the front end of the truck and will operate it for ten hours at a cost of from twelve to eighteen cents.

A Reflecting Heater

A new reflecting heater brought out by an English firm is the result of considerable experience in electric heating. With the usual radiators, the warm air rises to the top of the room, and even after such a heater has been turned on for some time the portion of the air near the floor is often found to be cold, as the warm air needs to rise at first and then be forced downwards. In the Murray reflecting heater this drawback is overcome, since the heat rays are sent directly onto the floor by using a movable parabolic mirror placed behind the lamp. In heating a large area, a suitable number of these single lamp devices can be employed.

A pattern without legs is also made for screwing to the legs of a table or in the knee-hole of a desk so that the lower part of the body may be warmed better than is done by the other electric or steam heaters that may be in the room, especially in large offices.



A REFLECTING HEATER

Electrical Men of the Times

PHILIP STEPHENS DODD

To make good nowadays one must have the faculty of acquiring friends and of keeping these friends always loyally inclined. Philip Stephens Dodd, though young in years, possesses this particular faculty. Four years in the insurance field, two years as sales manager and two in the journalistic field brought him well towards the work in which he is now achieving an enviable success.

In 1912 Mr. Dodd became connected with the *Electrical Review* and when this magazine moved its headquarters to Chicago he became acting manager. Brought in contact with prominent electrical men of the day, they recognized his ability and offered him the position of Director of Publicity for the National Electric Lamp Association. Since the dissolution of that association, a few months ago, and the formation of the National Quality Lamp Division, he has been actively engaged in the work of co-operative electrical advertising throughout the United States in connection with the latter organization. Briefly stated, "Phil" Dodd is now, in effect, the good fellow and human pacifier of the electrical industry.

In his early youth and while at school he was an all-around athlete, a champion tennis player, a boxer of great skill and hardihood, and a wrestler of considerable prowess. This athletic ability, coupled with a splendid constitution and a most optimistic disposition, has stood him in good stead upon many occasions when he has had to stand the gaff of responsibility, of heavy duty for long periods without a chance for rest and recuperation. He has a most cheerful disposition and a queer blending of courage and fatalistic philosophy. He is, in fact, the man to lead a forlorn hope, or if the conditions are insuperable to accept the fate gracefully and make friends with the enemy.

In a recent statement regarding his work he said: "I am at the present time working for the development of publicity of any character which will serve to give prominence to things electrical and assist in the education of the public to the further use of electric current and current consuming devices."

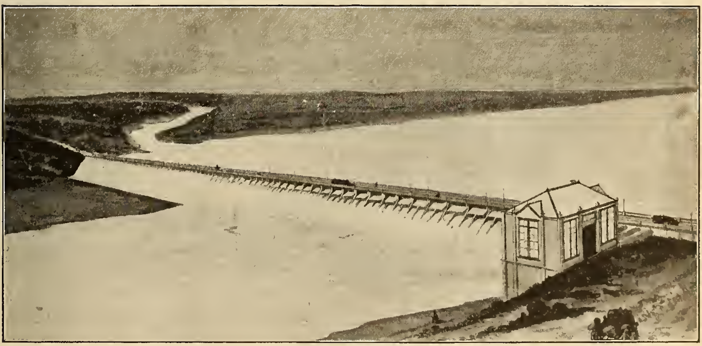
One plan which Mr. Dodd has most successfully carried out is the formation of co-operative luncheon clubs of electrical men in the larger cities, and 40 of these are now organized.

Another far sighted and valuable effort initiated by Mr. Dodd for bringing before the public the use of things electrical is the "Co-operative Electrical Page" running in but two newspapers a year ago. At the present time twenty-five or thirty newspapers throughout the country run such a page representing a co-operative investment on the part of the electric lighting companies, manufacturers, jobbers, contractors, and local distributing agents everywhere of something like $265,000.00 yearly.

As secretary of the Commercial Section of the National Electric Light Association to which he was elected last year Mr. Dodd is seeking through committees to bring out books upon subjects especially valuable to the commercial side of electricity. Two of these books, "Data on Electric Signs" and "The Electrical Equipment of the Home" are already published while others are in preparation.

Hydro-Electric Dam Surmounted by a Roadway

The accompanying engraving, reproduced from an architect's wash drawing, shows the hydro-electric dam at Austin, Tex., as it will appear when completed. An unusual feature of this structure is the roadway which runs along the top, for vehicular and street car traffic; thus the dam will serve a double purpose.



THE DAM AT AUSTIN, TEX., WHICH WILL ALSO FORM A BRIDGE

The structure is being built across the Colorado River and will afford initial energy for generating 7,400 horsepower. Part of this electric current will be transmitted to the municipal waterworks plant, a distance of three miles, and there used for operating the pumps. The excess power will be used for other purposes. The cost of the construction of the dam, the installation of the hydro-electric plant and the building of a 10,000,000 gallon underground auxiliary storage réservoir on a hill north of the city is to be $1,720,000.

The dam will be 1,091 feet long and 65 feet high, and will form an artificial lake having a length of about 29 miles and a width of 400 to 800 yards. About 35,000 barrels of cement and 400 to 500 tons of reinforced steel will be required. This new dam is to replace the original structure that was washed away by a flood in the river more than twelve years ago.

Ingenious Advertisement

Taking advantage of the collision between a large motor truck and a lamp post, which bent the latter in half, so that the glass enclosed osram incandescent lamp was bowed completely down to the pavement, the manufacturers of the particular form tungsten lamp had the doubled up post photographed and are using it as an advertisement. The intact incandescent continued to burn despite the accident, so the firm have an advertisement running thus:

Down
but
not
Out!

Electrical Interests of Women

EDITED BY GRACE T. HADLEY

Mr. Flannerty Goes Hunting

"I think I will go hunting," announced Mr. Flannerty at the dinner table. It was late in November, and preparations were in evidence everywhere for Thanksgiving.

"You never bag anything but your trousers," said Mrs. Flannerty. "I was planning a nice Thanksgiving dinner, and I thought we would ask Mr. and Mrs. McGinnis."

"Well, I'm sorry, but I've got to get away for a few days. I have been so tied up in the office lately, and then my friend, Mr. Roosevelt Withrow, will be in town soon, and we both need the outing."

Mrs. Flannerty did not reply for a full minute. She was deeply disappointed, but the "best laid plans of wives and widows gang aft aglee."

Finally she said: "I wish I had an electric broiler!"

"Your remark is scarcely apropos," said Mr. Flannerty. "I do not catch the connection."

"The connection isn't made yet," said Mrs. Flannerty. "The circuit is not complete."

"I think I will go upstairs and look up my hunting togs," announced Mr. Flannerty, briskly. Five minutes later he was back in the library, immersed in the evening paper. Mrs. Flannerty strolled in and, picking up a magazine, began to turn the pages idly, stopping now and then to study the photograph of some favorite stage beauty.

"Oh, by the way, dear," said Mr. Flannerty, "I couldn't find my shooting jacket or my leggins, or, in fact, any of my togs. I wish you would look them up—will you, dear?"

"Perhaps, to-morrow," said Mrs. Flannerty. "I'm busy now." And she continued to turn the pages of the magazine.

The next morning when Mrs. McGinnis called her up, she casually mentioned the fact that Mr. Flannerty was going hunting over Thanksgiving, and Mrs. McGinnis promptly invited her to dine with them on the national Bird Day. When she hung up the receiver at the end of ten minutes she had regained her usual cheerfulness. She spent the balance of the morning looking up Mr. Flannerty's hunting clothes and mending the rents in them.

On the following Wednesday evening Mr. Flannerty brought home with him his friend, Mr. Roosevelt Withrow, and the two men behaved like a couple of boys let loose from school.

"Good-bye, good-bye," shouted Mr. Flannerty to his wife in the doorway. "When we come back you shall have quail on toast."

"I prefer eagles on ten dollar gold pieces!" was Mrs. Flannerty's parting shot.

That night the weather changed. It turned bitterly cold and a light snow fell. The two hunters were bound for the Ozarks—that gentle uplift of wild woodland extending over central and southern Missouri. They arrived at the village of C—— at the interesting hour of 3 a. m. After a rest and a hearty breakfast at the home of a friend, they drove six miles further into the heart of the hills and put up their horses in the barn of a native Ozarkian. The family consisted of the native himself, his wife and three grown-up children. They all lived in a one room cabin, but they had a fine barn for the stock.

"We're goin' to build a house afore long," remarked the head of the family; "not that we need it, but we hev' allowed mebbe we better build in the spring."

The sixteen year old son of the household was engaged to act as guide. He was as sharp sighted as a Canadian trapper.

"See that rabbit?" he would say to the city "fellers" who were trailing him through the brush.

"No—where?" they cried, excitedly.

"Right there! Don't you see his eye?" Before they could even glimpse the rabbit, bang! went the boy's gun, and the rabbit was dead.

They tramped miles and miles, and Mr. Flannerty sprained his ankle jumping a fence. Then they had to tramp back again to the cabin. The Ozarks abound with game. Wild turkeys are plentiful, but on this particular day they had business elsewhere. So did the quail. In July the quail will stand out in the middle of the road and look at you fearlessly or whistle to you from a rail fence, but they know when the hunting season opens. The two hunters harnessed their horses and drove back to the village in the bitter cold of the early dusk. A good hot dinner revived them, however, and Mr. Flannerty rubbed his ankle with horse liniment. Their train was due at 9 p. m., but on account of the blizzard it did not arrive until 1:15 a. m. The two hunters huddled together in the wretched little waiting room at the station. During the early part of the evening the natives grouped themselves about the redhot stove and discussed the city "fellers" in an audible undertone.

MR. FLANNERTY SPRAINED HIS ANKLE JUMPING A FENCE

"Who be they?" inquired Hi Stimson, as he bit off an extra chew of Battle Axe.

"They be two hunters from the city. One of 'em is named Roosevelt," announced Mart Hoover, who made it his business to acquire all information pos-

THAT MAKES A TOTAL OF $15.00 FOR TEN RABBITS

sible regarding all newcomers in the village. Old Hi pricked up his ears and edged about so as to get a squint at Mr. Roosevelt Withrow.

"Be he related to Teddy?"

"Sure!" said Mart. "He must be. They's both hunters."

"Bag anything?" inquired Hi.

"Rabbits!" remarked Mart, with the laconic brevity of the Ozark native.

There was a burst of laughter from the vicinity of the stove, which caused the two gentlemen from the city to find a sudden interest in the landscape outside the window. They strained their eyes trying to see the headlight of the past due train.

One by one the little group about the stove drifted away towards home, and each one going out let in a blast of wintry wind so that the temperature was considerably lowered. Then the fire died out, so that when the two hunters climbed onto the belated train they were half frozen, and they had to take an upper berth.

It seemed to Mr. Flannerty he had not been asleep two hours when he was awakened by a confused murmur which gradually increased to a chatter. He thought he was still in the Ozark woods and had just run upon a tree party of squirrels. He was getting ready to fire when a sudden peal of laughter startled the squirrels and put them to flight. Then he sat up suddenly and realized that he was in the upper berth of a Pullman sleeper. His watch informed him that it was time to be up and dressing, so he threw his stockinged feet over the side of the berth and pushed back the curtains. Eight pairs of eyes were immediately fastened upon him. Directly opposite were four pretty girls, chattering and eating oranges. There was a sudden silence as their eyes fell upon the figure in pajamas perched away up on the edge of the berth. Girl-like, they giggled. Mr. Flannerty clutched the curtains and fell back in the berth in a sudden panic. How was he ever to get out with a lame ankle and four pairs of saucy eyes fixed upon him? Fortunately, something sent the four girls trooping to the other end of the car, and Mr. Flannerty managed to slip into his trousers and get to the lavatory before they returned.

Home looked good to Mr. Flannerty, and Mrs. Flannerty was most agreeable. She had had a beautiful time at Mrs. McGinnis'. The baron and several other chosen friends had dined with them, and then they played bridge all afternoon, and Mrs. Flannerty had won the ladies' prize—an electric curling iron!

Mr. Flannerty took ten rabbits out of his hunting case and proudly presented them to his wife.

"Well," said Mrs. Flannerty, "I can buy these at the market any day—two for a quarter! I thought you were going to bring home some quail!" This proves how unappreciative wives can be.

"How much was your railroad fare?" she inquired.

"About eight dollars," said Mr. Flannerty, a trifle uneasily. He wondered what on earth she was driving at.

"And your sleeper, I presume, was two?"

"Yes."

"That makes ten dollars. And your incidental expenses?"

"About five dollars."

"That makes a total of fifteen dollars for ten rabbits, or a dollar and a half apiece," announced Mrs. Flannerty, with mathematical exactness.

"But you forgot to count in the fun —the sport," protested Mr. Flannerty.

"Well," said Mrs. Flannerty, with fine irony, "I could not think of cooking such expensive game on my old broiler—besides, it's broken." So she went at once to the telephone, ordered an electric broiler, which she had wanted for some time, and had it charged to Mr. Flannerty.

Broiling by Electricity

The new "American" broiler is not to be compared with the ordinary electric broiler. This new broiler holds the meats vertically and the heating is done by means of red hot heating elements attached to the side walls of the broiler. These elements heat instantly, no time being lost in waiting for the broiler to heat up. A small steak may be broiled in six minutes from the time the current is turned on. The thing to be broiled is not brought into contact with the heating element and the cooking operation is done under ideal conditions, as there is no flame or combustion, hence no odor, fire or danger.

The time required to perform various operations, starting everything cold, varies. Steaks, from four to fifteen minutes; chops, from four to eight minutes; squab, quail, chicken or other fowl, from five to ten minutes; toast, from one to two minutes; baked potatoes, about 30 minutes.

THE NEW BROILER HOLDS THE MEATS VERTICALLY

These broilers are so arranged that the grease will drip and drain into a pan at the bottom.

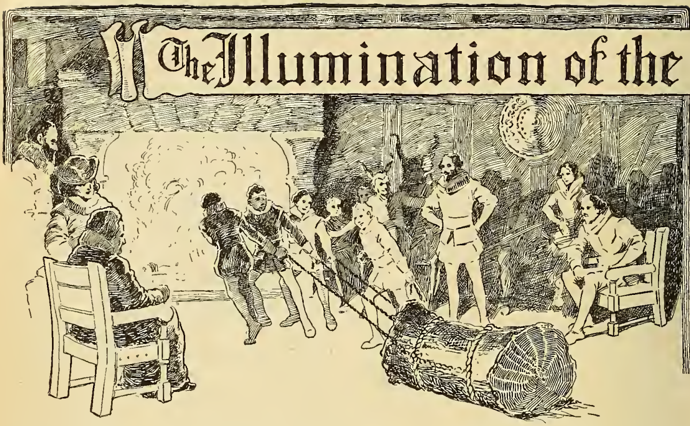
Toast Stove Hints

ENTIRE WHEAT GRIDDLE CAKES

Mix and sift ½ cup flour, ¼ cup entire wheat or graham flour, 1½ teaspoonfuls baking powder, 1½ teaspoonfuls sugar, and ¼ teaspoonful salt. Add ½ cup milk, 1 egg, slightly beaten, and ½ teaspoonful butter, melted.

Use the griddle of the toaster. Turn on the current, allow the toaster stove to stand until the griddle gets hot.

Drop the batter on to the griddle from the tip of a spoon. Cook on one side until delicately brown, then turn and cook on the other side.



Christmas means the festival of the Nativity of Christ, and the scene of the Nativity has been placed in a cave; over this cave has been erected the Church of the Nativity, and there is a stone slab with a star cut in it to mark the spot where the Saviour was born. The appearance of the miraculous Star of Bethlehem may be regarded as an important feature of the first celebration of the Nativity, and the angels' song has been called the first Christmas carol.

The birth of Christ was fixed at the time of the winter solstice; thus Christmas came at the time of the year when the most celebrated festivals of the ancients were held in honor of the return of the sun, which at the winter solstice begins gradually and apparently to ascend in the horizon. Northern nations kept a festival at this time, called Yule, which was a mingling of much feasting, dancing and religious rites. The Romans had festivals with apparently the same object as the Yuletide and other nations had something similar.

The Christmas entertainments of King Arthur were princely pageants, and Christmas at York was kept with great joy and festivity. The round table was filled with jocund guests, minstrels, harpers, jugglers and dancers. Enormous log fires furnished not only the necessary warmth, but afforded the principal means of illumination. William the Conqueror kept the Christmas festival with unusual splendor, and Richard the First, that king of great strength and courage, made magnificent festivals abroad with other potentates.

One of the earliest illuminants was the torch, a stick of resinous wood. The torch gave but a fitful and wavering light, but it was a standard method of illumination for some time. Sir Walter Scott gives a vivid pen picture of a banquet hall where "behind every seat stood a gigantic Highlander, . . . holding in his right hand his drawn sword with the point turned downwards and in his left a blazing torch made of bog pine."

An English writer states that if you go into the Duomo late on Christmas Eve, you find the time stained alabaster and dark aisles lit up with hundreds of wax candles over seven feet high. The massive silver lamps suspended across the choir are all ablaze, as is also the graceful chandelier in the center of the nave that glitters like a cluster of stars from dozens of tiny glass cups with wick and oil within. In the solemn and

Christmas Festival

mysterious gloom you pass figures of men and women kneeling in devotion before the many shrines. There is no music, but a deep quiet pervades the dim golden domes overhead and the faintly lighted transepts. Stray rays of light catch the smooth surface of the mosaics, which throw off sparkles of brightness and cast deeper shadows beyond the uncertain radiance.

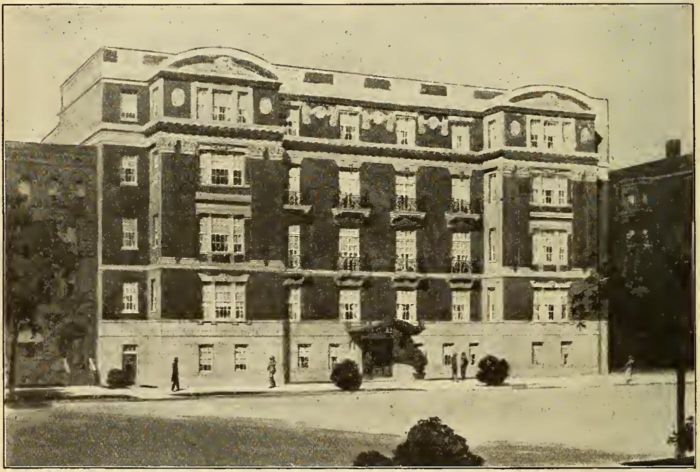
Christmas in Naples is celebrated by fairs, bonfires, and fireworks. The shops on the most famous street, flaming in color, are filled with all sorts of tempting wares. Throughout Christmas Eve a great crowd of men, women and children throng this street, which is nearly a mile in length. The vendors shriek at the top of their voices, praising their wares and themselves, and then with merry peals of laughter exhibit their tricks of trade. As night comes on the mirth grows uproarious, fireworks are let off at every street corner, flaming torches carried in processions illuminate the streets, rockets rise in the air, colored lamps are hung over doorways, and in the midst of the blaze of light the church bells announce the midnight mass. Then the crowds leave the fair and the streets and on bended knee begin to worship.

In America, the modern home is brilliantly illuminated with electric lights and decorated with holly and mistletoe. The chief feature of the festivity, the Christmas tree, is decked with tiny incandescent lamps that are entirely safe and free from the dangerous risk that characterized the old time candle. The little electric lamps are now made in fantastic forms, sometimes in the shape of fruits or animals, even the figure of good St. Nick himself being utilized. The children gather about the great tree laden with pretty and ingenious toys and examine the sparkling treasures with outbursts of joy and childish glee. Then the mother seats herself at the piano and plays a soft prelude, and after the breathless hush of a moment, the childish voices ring triumphantly in the exquisite Christmas carol:

"It came upon the midnight clear,
That glorious song of old,
From angels bending near the earth,
To touch their harps of gold."

An Ideal Realized

To construct an apartment with all the conveniences of a house, to make everything of the very best, to make housekeeping as easy as possible and at the same time to produce a building of beauty that perfectly fulfills these purposes was a problem which has been brought to a successful solution and an ideal apartment house is the result.



THE BUCKINGHAM CHANDLER APARTMENTS

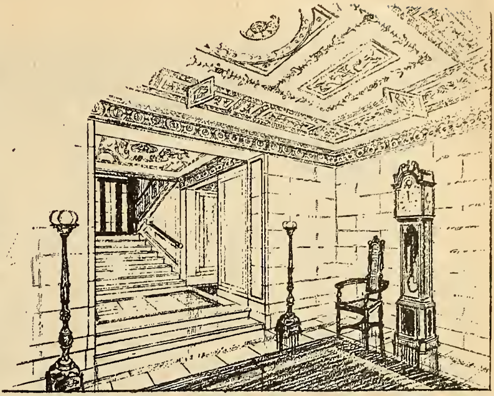
In style, this new apartment is English Renaissance of the time of Charles II. Good taste has been exercised in designing the building and a definite attempt has been made to produce a structure that will grow old gracefully.

Electricity plays a most important part in this modern apartment building, 600 amperes of current being used and five electric motors do the drudgery and the hard work; one motor operates the electric elevators; a slow speed motor runs the ammonia compressor of the refrigerating apparatus in the basement, the vacuum cleaner is motor driven and the brine pump, while the house pump is a triplex installation.

Four large apartments and an English basement are built around a fountain court ornamented with flower beds, terrace, vases, backed by a garden wall covered with vines. The solid bronze entrance door admits one to a harmonious hall with delicate French gray marble walls and ornamental plaster ceiling. Very handsome electric floor standards afford adequate illumination and the electric elevator lifts one to any of the main floors by the simple pressure of a button.

The rooms show that special care and attention have been given to an arrangement that is most convenient for entertaining; four large openings with wide sliding doors make four rooms practically open into one. The lavishness in electric light outlets for electric lamps, floor standards and all electrical devices, is noticeable, as such outlets are found on nearly every baseboard. "I have noticed," said Mr. Buckingham Chandler, who planned these up-to-date apartments, "that if there are only two electric light outlets in a room, they are never where you want them, so I decided to have plenty of them everywhere."

Just outside the dining room is a safety vault for holding table silver, tea and coffee sets. It is built into the wall and protected by a paneled door to which is attached an electric burglar alarm. Opening one of the mirrored doors at the end of the foyer hall a wide corridor leads to the master's bedrooms. The first door leads into a room that is oval in shape with large triple mullioned windows facing the fountain court. On each side of the bed are doors, one to a large closet with shelves, drawers and hangers, in one end of which, built into the wall, is a jewel safe with combination lock. The door to the closet is connected with a burglar system controlled by a concealed switch, which also controls the vault for the table silverware, and special connections have been made so that when the occupant of the apartment is away for the summer, the burglar alarm can be made to ring in the janitor's apartment if protecting doors are molested. On the side of the bed is an outlet for an extension of the public telephone.

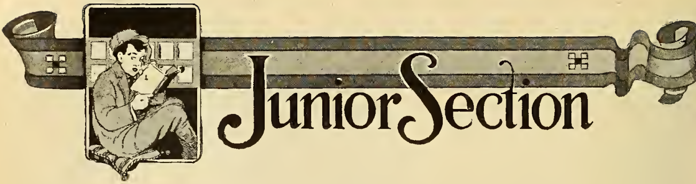


A HARMONIOUS HALL OF DELICATE FRENCH GREY MARBLE

The door to the bathroom has a full length mirror on its inner side. The solid porcelain tub is recessed and the walls are of milky white glass. The bathroom also has its telephone from which the master may telephone to any of the four stations in his apartment, to the garage, the laundry, the boiler room, the janitor and the entrance hall downstairs. There is an outlet for the attachment of an electric heater or luminous radiator.

The kitchen with tile floor is of good size and shows careful planning of sinks and stoves, including an outlet for an electric cooker. In the butler's pantry there is a special radiator for warming plates, also a connection so that in summer, with the heat off, the plates can be warmed by electricity. The entire service quarters can be shut off from the balance of the apartment by closing the dining room pantry door and the door from the rear corridor to the service dining room. The laundries are on the upper floor so that no odor of washday can penetrate to the apartments below. There are seven large individual laundries each with its laundry tubs, clothes' dryer ventilated to roof, and a number of electric outlets for the attachment of electric washing machines and irons.

In every possible way the electric current has been utilized in this ideal apartment building, not only for artistic illumination, but for cooking, sweeping, cleaning, washing, ironing and all the homely housekeeping tasks. As woman becomes emancipated more and more from the drudgery of housekeeping, she becomes more and more an artistic homemaker through the practical applications of the electric current.



Training Youth for the Electrical Age

Board a Van Buren street car in Chicago's "Loop District" some morning about eight o'clock and ride west. If the car is not hindered by traffic, you will reach Oakley Boulevard in time to see scores of boys and young men with school paraphernalia entering an imposing four story building upon the northeast corner—the R. T. Crane Technical High School.

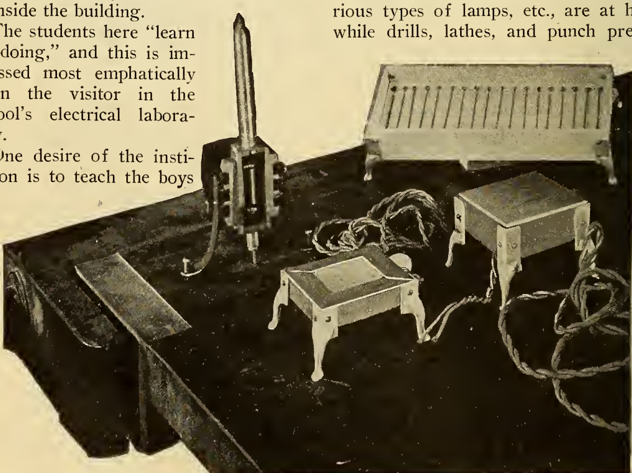
There is a spirit of eagerness and pleasure about these young fellows often found lacking in the student of the ordinary high school, and the reason for this contrast is readily found once the visitor is inside the building.

The students here "learn by doing," and this is impressed most emphatically upon the visitor in the school's electrical laboratory.

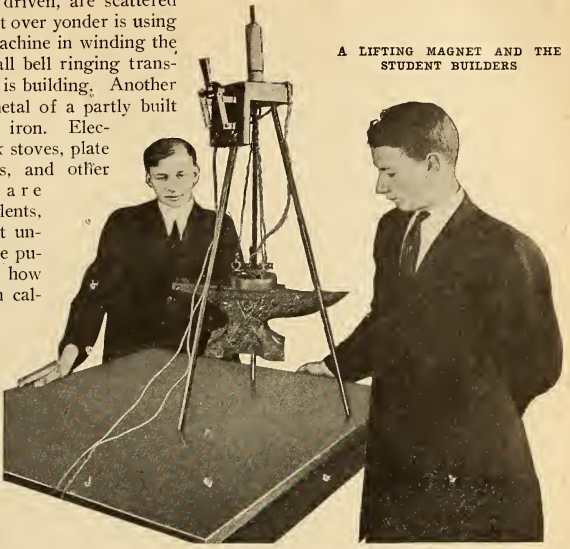
One desire of the institution is to teach the boys to use their hands as well as their heads, but as one instructor puts it, "We endeavor to keep the head a long way in advance of the hand."

One's first impression of the electrical laboratory, which is located on the third floor, is formed at the doorway—a place for the hands to work. At the benches around two sides of the big room 30 students may work at one time. Both alternating and direct current are at the service of each pupil, who controls his supply by switches independently of other students.

Voltmeters, ammeters, lampboards, various types of lamps, etc., are at hand, while drills, lathes, and punch presses,

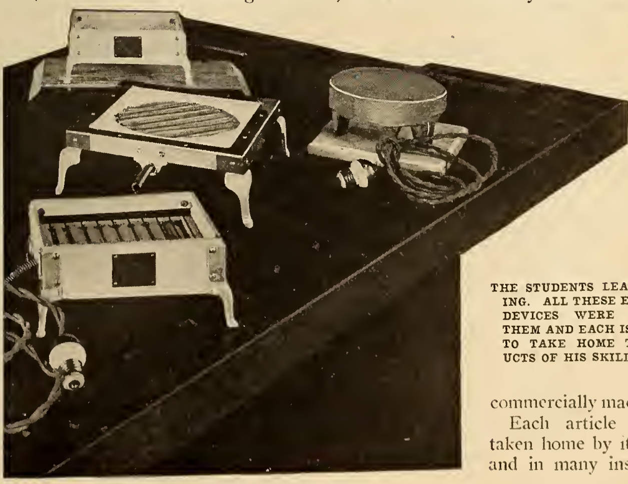


each electrically driven, are scattered about. A student over yonder is using a coil winding machine in winding the wire upon a small bell ringing transformer which he is building. Another is drilling the metal of a partly built electric pressing iron. Electric toasters, disk stoves, plate warmers, curlers, and other home devices are made by the students, but these are not undertaken until the pupil understands how to make his own calculations.



A LIFTING MAGNET AND THE STUDENT BUILDERS

The body of the toasters is constructed of asbestos board, while the metal legs and framework are made by the students in the foundry and machine shop. Nichrome wire is used for the heating elements, and a finished toaster may readily rank as to efficiency and finish with its commercially made cousin.



THE STUDENTS LEARN BY DOING. ALL THESE ELECTRICAL DEVICES WERE MADE BY THEM AND EACH IS ALLOWED TO TAKE HOME THE PRODUCTS OF HIS SKILL

Each article made is taken home by its builder and in many instances it is, with the students' knowledge of electricity, a direct cause of the adoption of electricity in the home. In fact, students' homes have been wired for electricity that before knew only oil or gas illumination.

Hand in hand, but always a little ahead of the construction work, is the theoretical. For each semester of a year in the laboratory, there are arranged 20 subjects for investigation, so that at the close of the year's work the student has come in touch with the electrical field at 40 points.

One of the aims of the school is to assist the apprentice learning a trade to obtain theory as he works out his apprenticeship on the outside. While the apprentice electrician, for example, may be getting along well with the manual work, a certain amount of practical theory scattered along enables him to come through a better master of his trade. In this regard the school is extending its efforts to the apprentices of labor bodies with excellent results.

With the students from this and other similar schools going out with an intelligent knowledge of the service that electricity may render, the more extended use of this energy will surely follow.

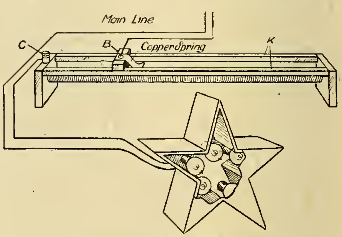
Electric Star of Bethlehem

For Christmas entertainments it is sometimes desired to make use of a large star, the light from which can be regulated so that it can be increased or diminished at pleasure.

The star here illustrated is made of sheet metal or asbestos board, is 24 inches from tip to tip, eight inches in diameter at the inner points and five inches deep inside. Five lamp sockets may be fitted into holes through the back of the star, the sockets holding them in place when screwed on. A better construction is to use a Federal clamp socket to hold the lamps.

The sockets are connected in multiple. One lead connects to one side of the lighting circuit and the other goes to a binding post (C) on the dimmer. The open face of the star is covered with tracing cloth or other similar white material and the inside of the star is painted a glossy white to light up the tips of the rays.

The dimmer consists of about 800 feet of very fine copper wire, not larger than No. 36, and uninsulated, wound closely together on an asbestos rod two inches in diameter. This rod is mounted on a frame and one end of the fine wire con-



STAR OF BETHLEHEM

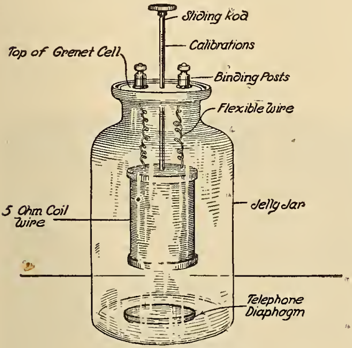
nects to the binding post (C). The other end of the fine wire is fastened to the rod with a tack. The frame of the dimmer has two slide bars (K) nailed on top, and the sliding block (B) moves along these bars. This block has a strip of spring copper fastened to it that is bent down so it touches the wire on the stick, lightly but positively. The other wire from the main circuit is connected to this copper spring.

Set the block at the end of the dimmer away from the binding post. Turn on the current. Then move the block slowly along toward the other end, making sure that the spring touches the wire all the time. Do not bear on so hard as to move the coils of wire. As the block is moved along the slides, the resistance in the circuit is lessened by cutting out the coils of fine wire and the lamps will begin to glow faintly. The closer to the binding post the block is moved the stronger the lights will become.

If this apparatus is used in a darkened auditorium while a solo centering around the Star of Bethlehem is sung the effect will be striking.

Unique Ammeter

The ammeter I am about to describe is, as far as I am able to ascertain, entirely original. Although the diagram is sufficiently explanatory, I trust a few words of elucidation will not be amiss. The one I constructed consists of a jelly jar,



UNIQUE AMMETER

the top of a Grenet (bichromate of potash) battery cell, a five ohm coil of wire and a telephone diaphragm. To the sliding rod, screw on the five ohm coil, which, if obtained from a telegraph sounder, will have a hole in it tapped for an 8/32 screw. Lead out the terminals of the coil through the medium of two flexible wires, to the two binding posts on the battery top in the neck of the jar. Place the diaphragm in the jar.

Now calibrate the ammeter by comparing to a standard ammeter in the following manner: Pass a current of say one ampere through the coil, and by sliding the rod on which the coil is mounted up or down, as the occasion may require, a position will be found where the solenoid just attracts the iron diaphragm. Mark the position on the rod by filing a notch in it. Repeat the operation using two, three, etc., amperes up to ten. You will now have an ammeter that is cheap and measures up to ten amperes with a fair degree of accuracy.

Of course any departure from my method which the ingenuity of the experimenter may suggest is permissible, providing the fundamental principle is adhered to.—Maurice Rubin.

Another Explanation of the Static Trick

In the October issue of this magazine appeared an article entitled "An Interesting Trick With Static." This was contributed by Charles Ollson, and gives his theory of a phenomenon of the repulsion of particles of dust floating on water by the finger previously rubbed through the hair. This repulsion he attributed to static electricity. Another explanation is, however, presented by S. L. Nash, of Chesley, Ontario, Canada.

"The true cause of this effect is the change of the surface tension of the water, caused by a very small quantity of natural oil from the hair, the same oil that soils hat and cap bands. To prove this theory, use a smooth, round metal rod in place of the finger; the effect is just the same, although the rod will not retain a charge of static if held in the hand, as it acts as a ground unless a person is insulated from the floor by some means.

"Next obtain a small round stick of sealing wax, about six or eight inches long, then try the effect on the dust and water before and after charging the wax with electricity. The wax can be charged when dry by rubbing with a piece of silk. It is very interesting to try the effect on the dust and water when the finger is moistened with ether, alcohol, coal oil or gasoline, etc."

New York Telephone Directories

It will take a force of more than 400 men to deliver the fall edition of the New York telephone directory, which consists of 1,385,000 copies. Each subscriber will receive two books, the city and suburban directories. About one million of these directories will be delivered by hand.

Down Rue de l'Etoile to the City of Toys

By EDWARD LYELL FOX

Turn off the pebbled boulevards of Paris and go down Rue de l'Etoile. Past a block of low tin roofed houses you will walk; past a canopied street market where stout *dames* bend over bins of vegetables; past a little dark walled church whose tiny translucent windows give out no brilliance to the sun; past a dreary length of frame houses—and then you come to the City of Toys.

Here in little shops they are being created, dolls waiting for the brush that will give their faces the color of flesh, soldiers waiting for uniforms to be painted on, houses unroofed, locomotives needing wheels—many types of toys made in this quaint section of Paris. And as you pass from window to window, and peering in see parents and children bent over their tasks, you know for the first time that toys are made only with extreme trouble. And if you walk on a little further and come to an old brick building on the corner and stopping there look within, you will also realize that electricity has entered another province—become a mighty force in the City of Toys.

DOLL HEADS THAT HAVE BEEN THROUGH THE ELECTRIC FURNACE

A GLIMPSE OF WHERE THE DOLLS ARE MADE

When I tried to enter this building a white haired man rose from a chair and barred my way. In just such a way, it occurred to me, the Ancient Mariner must have stayed the Wedding Guests.

"You cannot go in there," he said in French, his voice cracking.

We asked him why. But he only shook his head with all the stubborness of old men. Then our guide said something to him. They began jabbering, gesticulating. For a moment I was afraid the old man would be taken with a stroke, so agitated did he become. Then as suddenly he calmed, and drawing himself up to his pitiful four-score-year-old height he said, as a Marshal might have said:

"You may come in. I, Jacques Voisin, say so. For years, almost after I left the school, I have been the guardian of the secrets of this workshop. Without my word no one could enter. It was necessary because the Germans (he made a grimace) were stealing our methods and copying our toys. You, though, are not German. You may enter."

Within we saw a place of confusion—a low ceilinged room whose windows at the other end bore the stains and dirt of a generation. Later we learned that the frames were nailed down, that the only air freshening the place came through the little square paned windows of the street. So we stood watching and no-one seemed to notice us. They were all too busy. Black eyed, black haired, smiling little children of the Paris slums they were—children for whom the illusion of Christmas had long been broken by the very nature of their work; older children, too, sad faced, white haired and wan, some of them 60 years old, but just as young in thought as that unhappy day when they had been taken from the kindergarten.

The foreman, a short, pudgy man with a pointed beard, came to meet us. Our guide explained our visit and the foreman smiled a welcome.

"Oh, you want to see how we make the toys, do you?" he exclaimed. "You want to write something about them? Very well. *Allez!*"

Saying, he took us up a flight of stairs, explaining as we felt the boards creaking beneath our feet that the room we had just left was the finishing room.

"There," he said, "is where the painting is done."

Finally he stopped before a door—a heavy oaken door, as thick and as slow swinging as the door of a safe. Moving back noiselessly, it permitted us to enter a long narrow room. Instantly the clatter of machines smote the ear. A motor was moaning in a corner. A cobwebbing of black wires hung from the ceiling, falling in strands to each bench. And beside them stood men, aproned in black leather—stolid faced men unlike the Frenchmen you see in cartoons, pipe smoking automatons who ever so often fed a shining piece of metal to the machines, and watched it cut along the outlines of a pattern.

So were the sides of electric cars, tops, stations, fire houses and a score of other toys made. So did a square of bright tin become the engineer's cab, pierced for windows. So was another sheet cut and rolled into the shape of a boiler. So did the electric top obtain its disk-like surface. So were trolley poles made from sticks of bare alloy.

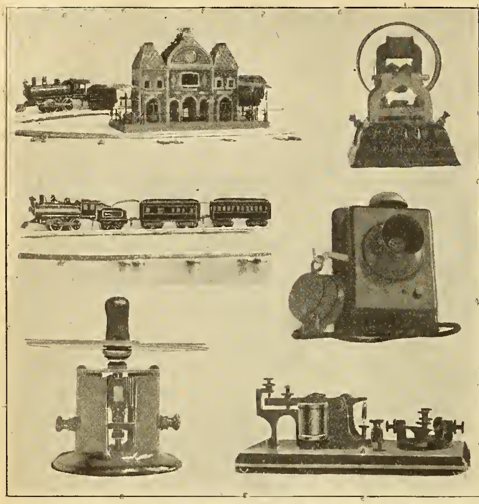
"That is the most important room in our factory," explained the foreman. "That is where the toys are shaped. Upstairs is another room where they are joined, put together. Downstairs they are painted and shipped."

Then we asked him if they made many electrical toys, and he said:

"That's all those men are doing, cutting out the pieces for electrical toys. They are very popular this year. They are cutting into the business of the Germans (at which he made a grimace the same, I swear, as old Voisin's). We are making electric toys much better than the factories at Nuremberg. Yes, that is what we call our electric room—electric machines to make electric toys. Odd coincidence, isn't it?"

"But the dolls? Do you make them, too?" I asked.

By way of reply he beckoned. I followed him up another flight of stairs. There were two doors. He opened the one that was closed. Through the other we saw all stacked up on racks electric locomotives, tops, telephones, telegraph instruments, all pieced together and only waiting the painter's brush. And like



THE ELECTRIC TOYS ARE BECOMING MORE AND MORE POPULAR

the other it was a very dirty, dusty odorous room.

Then we caught a glimpse of where the dolls were made—a glimpse sharpened by contrast. For through the just-opened door we saw a little room, its walls and ceiling painted white, its windows fresh and clean, its floors free from dust—a room, it seemed, like some quaint inn of the chateau country. And there the dolls were being joined together and dressed. On the shelves were large pasteboard boxes, filled with different articles of apparel—French apparel, dainty and new. In one box we saw tiny shoes, in another hats, in another dresses.

And such is the factory on the Rue de l'Etoile, the place whence come many of the electric toys—the place where electricity is able to bring Christmas to the children.

This year it is estimated that $5,000,000 worth of toys were imported from France alone. And it is safe to say that the biggest bill will be against those run by electricity. For, not only are they excessively popular, but their prices bring them within the reach of all.

I happened to be walking on Fifth Avenue the other day and a fashionable toy store attracted my attention. I stopped and looked in the window. I saw a train of electric cars, and looking closer I tried to assure myself that they were of the identical pattern that I had seen being manufactured on the Rue de l'Etoile. Later the manager took me around the store, explained the different types of electric toys and showed the wonderful detail with which they were made. He showed me locomotives like the steam cabs in shape, but run by current. He showed me an electric cab, an exact imitation of those used on the New York Central's suburban service. He told me that they could be run with dry batteries or from a house current (direct or alternating). When the house current is used, though, the reducer has to be employed. For 110 volts a reducer costs $6, for 220 volts $1.50 more.

He gave me his price list. Glancing through it I saw that an electric train can be bought for as low as $8.50. A locomotive, a tender and two cars with an oval track can be obtained. I saw, too, that a $65 train was equipped with an electric cab that had three pairs of driving wheels. Not only that, one could buy third rail "pay-as-you-enter" cars and overhead trolleys with control switches and batteries.

He showed me a special room in which an electric train was exhibited. It was a sort of reception hall for customers who bought on a big scale. On a huge table in the center lay a perfect railroad system—a tunnel, a terminal, grade crossings, bridges, semaphores, block signals, switches, round houses—I forget what all. I noticed the little third rail, the storage batteries hidden behind a tin landscape. I saw the current turned on and the train go whirling through its toy world. I saw it stop to take on passengers, to take on water—which appeared rather incongruous, since the power was electricity rather than steam. I imagined children clapping their hands at the sight of it. But they would have to be children of very well-to-do fathers, for the whole system, I was told, cost $175.

But there were other electrical toys within the reach of almost all. I saw the electric top—a small motor upon whose vertical axle colored disks were placed. Then the motor began to run, and whirling around, the disks produced the constant colored confusion of a great pinwheel. Also, I was told, that with the battery the price of this top was only a dollar. Near it lay an electric telegraph outfit, a sender and a receiver on the same block of wood. And that with a battery cost only $2.50. There was a thing called an "electric thriller." This cost a dollar and the current was generated by the turning of a crank.

There was a wonderful contrivance that was called the "Electric Questioner." When the key on the left part of the board was placed on a question a pointer on the right side was run along a series of pins. When the pointer came in contact with the pin of the right answer a connection was made and a bell rang.

And so are they in all the big toy stores —electric toys attracting the most attention, inciting the most curiosity. New York is the distributing center. From Europe come the different playthings, from Paris, from Nuremberg. Salesmen begin to put them on the market with New Year's Day—almost a year before Christmas. Toy jobbers tell me that concerns of the Pacific coast are the first to order. They have their goods shipped early in spring, going by the all sea route so as to save railroad tolls. Other concerns begin to buy late in spring. By July most of them have their stock of Christmas toys—the toys electrically made and electric themselves such as we saw the tired people working upon in the Rue de l'Etoile.

Electric Light for Birds

It has been found by the authorities of many zoölogical parks that one of the difficulties in maintaining their aviaries is the providing of a proper environment for birds brought from the tropics.

To warm the air to a tropical temperature is not enough. The birds demand light as well as heat. Many of them in their native homes are accustomed to feed at sunrise and again just before sunset, and their habits in this respect are seriously disturbed by the shortness of the winter days in Northern climes.

It has been found beneficial to keep aviaries containing tropical birds brilliantly illuminated in the daytime with electric light from six o'clock in the morning to six in the evening, thus closely imitating the duration of daylight to which they are accustomed in their natural habitat. The result is that they feed in the normal way, live longer and remain in better condition.

Why Thunder Is So Loud

Experiments by Professor Trowbridge, of Harvard, have shown that the astounding noise of a lightning discharge is largely due to the dissociation of water vapor, through the explosion of the hydrogen and oxygen gases produced by such dissociation. In his mimic lightning experiments Trowbridge has produced a torrent of huge electric sparks. The noise of the discharge was so great that the operator was obliged to stop his ears with cotton and then wrap a heavy cloth around them.

Popular Electricity Wireless Club

60,000 Meter Wave Now Possible

M. Bethenod is the chief engineer of the new Radio Electric Wireless Company, which works his patent. As an inventor he was unwilling to write about it, but as a director of the company he said the invention was not an improvement on the apparatus system of communication, but the discovery of a new principle of wireless. All scientists, he said, had been searching for a long time for a sparkless wireless. Some had succeeded, notably the American, Alexander Anderson, but the machines thus made are high frequency alternators, with which, contrary to the statement in the press, the Bethenod system has absolutely nothing to do.

M. Bethenod's apparatus is in two parts, the machine and the antennae both being special. The spark is suppressed and the oscillation produced by special machinery. An important point, which was the inventor's real object, is the production of very long waves. The difficulty with the present wireless is the short wave, with whose progress all other short waves in the atmosphere interfere. Long waves are not troubled by the short ones. The longer a wave is, the less it deteriorates. The very long waves emitted by Bethenod's apparatus are said to be completely independent of the phenomena of Nature.

Furthermore, the short waves cannot be measured mathematically. One can be measured, perhaps, but the next one cannot, owing to the depressions. Bethenod's waves are all measured mathematically. Before launching a wave he knows its mathematical measure, for he is a mathematician before everything.

Between Paris and Brussels he used the existing supports of masts and then, after testing the antennae, sent an experimental 2,000 meter wave. He next used an apparatus which allowed a 20,000 meter wave. He measured the waves and found them to be exactly what he had expected. He found communication by the long wave better than by the short one, and it is important to note that the long wave was obtained with the same antennae and supports; that is to say, at the same expense, as the short one. He was so satisfied with the results that he ordered machinery of high power, and hopes to be able to communicate from Paris to America, using 60,000 meter waves.

Can M. Bethenod's wireless messages be intercepted?

Other stations will not interfere because of their length, but if a post wishes to intercept a message that can easily be effected. Secrecy of transmission is a separate problem.

The Wireless Season

The best season of all the year for the wireless man is here—the season of clear, crisp nights, when the faint signals from far away are clearly heard in the wireless 'phones, and when the operator's mind is not confused by the unpleasant rasping noise of static.

During the last two or three months probably every one of the thousands of wireless enthusiasts in our country has been improving his outfit, or adding to it, having in mind the coming months which are especially suited for long distance work. Remembering the wonderful work of many stations last winter, it is safe to say there is not an amateur on the Pacific coast who will be satisfied with any record short of Colon, Panama, while every eastern amateur is probably looking forward to copying the wonderful new station at the Mare Island Navy Yard, near San Francisco, Calif.

But the amateur is not alone in his expectations. In a few weeks the great 100 kilowatt installation at Washington, D. C., will be completed. Great results are also expected from the new army station at San Antonio, Texas. Regular communication between Honolulu and the Atlantic Coast is expected, via Mare Island, Calif., and Key West, Fla.

The Marconi Company's chain of stations around the world will be well under way during the coming winter.

Surely there are great pleasures, and perhaps surprises in store for the wireless enthusiast during the coming months. Here is hoping that our fondest expectations, and more, will be fully realized.

BRITISH SOLDIERS USING WIRELESS

WIRELESS IN THE MANŒUVRES OF THE BRITISH ARMY NEAR WINDSOR ON THE THAMES

It will not be the fault of training and preparation should wireless telegraphy fail to play its part in modern warfare, for every nation of accountable fighting strength is making use of it in the "practice wars" of its army. An illustration of the attention given it is shown in the accompanying picture taken at the manœuvers of the British army near Windsor on the Thames. The equipment here shown and similar ones were used to keep the infantry detachments in touch with each other as they met the onslaughts of the enemy, British cavalry. The collapsible mast is nearly ready to be shot up into the air, the soldier on the left giving his attention to the antenna and the lead-in.

Detector for Portable Set

The following is a description of a detector stand for use with portable sets. Hard rubber or fiber is preferably used for the base, which measures 2 by 3 by ½ inches, all holes being drilled as in Fig. 1. The upright (A) and the arm (B) are of ¼ inch square brass rod 1½ and 2½ inches, respectively. The top of the upright (A) is cut in a 180° arc or semicircle, while one end of the arm (B) is milled in the same way. A hole is drilled and tapped one-half inch from the top of the standard to take the elevating screw (C), while the bottom is drilled for a base screw. A small hole is drilled in the relative position shown in Figs. 1 and 2 and designated by (F), to take a small pin. A slot as shown in Fig. 2 is now cut in the top of the upright to take the arm (B). One-quarter inch from the outer end of (B) a hole is drilled to take the tension screw (D). A small hole is drilled crosswise in the opposite end, of sufficient size to allow the pin to pass through easily. This is not the case, however, in the upright, for the pin should fit tightly.

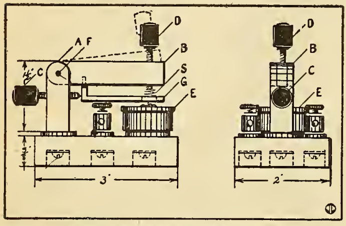


FIG. 1. SIDE AND REAR ELEVATIONS OF COMPLETE DETECTOR

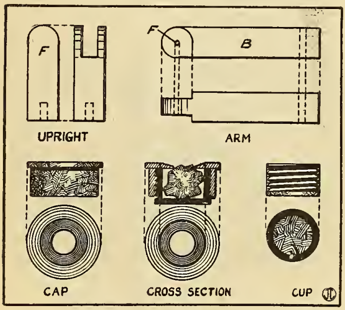


FIG. 2. DETAILS OF MINERAL CUP, UPRIGHT AND ARM

The end of the arm through which the pin passes is milled as shown in Fig. 2, so that it fits loosely in the slot cut in the upright. The pin forms a joint which allows (B) to revolve around (A). The cup (E) is turned from one inch brass and is composed of two parts, Fig. 2, the cup which contains the crystal, and the cap which holds the crystal in place. The cup is turned to ¾ inch outside diameter and ½ inch inside diameter and is ½ inch high. It is threaded to within ⅛ inch of the bottom. The cap measures 1 inch (outside diameter) and is turned to the proper size for threading on the inside to fit the cup. A rim is turned on the top of the cap as shown, Fig. 2. A hole is drilled and tapped slightly off center in the base so that the spring shown in Fig. 2 (S) will cover more of the surface of the crystal than it would if the cup were fastened through the center. The coiled spring should be of No. 40 copper wire if galena is used, for the lightest possible contact is necessary with this mineral. The spring is soldered to the tension screws. (G) is a piece of ⅛ inch brass ½ inch wide, bent at one end as in Fig. 1. Before being bent, however, this piece is turned down until it forms a ⅛ inch threaded rod for a distance of a little over ⅛ inch. A small hole is drilled in the arm to receive this piece, which is screwed down until it is in the position shown in Fig. 1. A hole of sufficient size to allow the free passage of the coiled spring is drilled through the opposite end. All holes with the exception of the above mentioned are drilled with a No. 23 drill and tapped with an 8-32 tap. Two binding posts are put in place and the detector assembled. —JESSE JAY.

An Efficient Wireless Set

The following is a description of a practical and efficient wireless set: The aerial of this set is composed of six guy wires. The six wire aerial is of the "straightaway" type, connections being shown in Fig. 1. The sending set consists of a closed core 2-kw. transformer, an oil immersed glass plate condenser, an

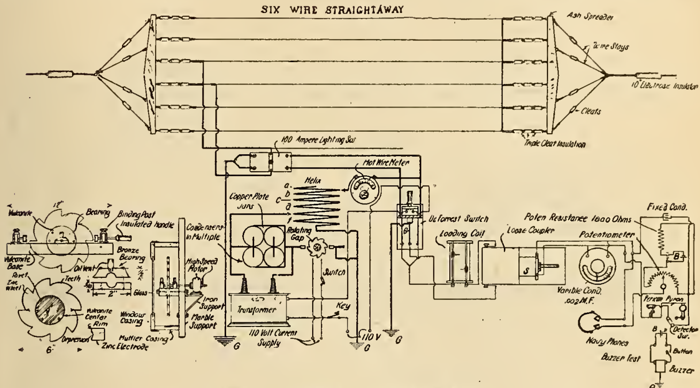


FIG. 1. DIAGRAM OF COMPLETE SET

strands of No. 12 aluminum wire of as near 150 feet in length as conditions will allow. Eight-foot spreaders are used, preferably of ash or bamboo, for the six wires, and are insulated by a double row of glazed porcelain cleats between each spreader and the aerial wires. The suspension ropes are insulated with two ten-inch Electrose insulators, as shown in Fig. 1. The aerial is supported by a 44-foot pole consisting of a sixteen-foot 2 by 4, a sixteen-foot 2½ by 2½, and a twelve-foot 2 by 2 bolted together with a two-foot overlap, the whole being braced by eight No. 12 galvanized iron inductive helix, a hot wire meter, a rotary spark gap, and a heavy contact key. The rotary spark gap used in connection with this set is shown in Fig. 2, and is used with any high speed motor operating on 110 volts a. c. or d. c. An efficient receiving set, which gives excellent results in long distance work, is the one described in the June issue, page 190, and

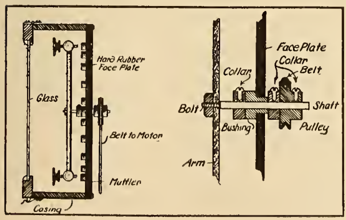


FIG. 2. ROTARY SPARK GAP

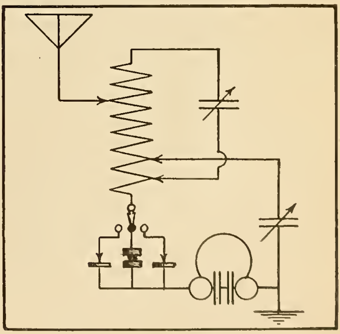


FIG. 3. RECEIVING HOOK-UP

shown in Fig. 3. This set consists of a triple slide bare wire tuner, two galena and a silicon detector, navy type phones, a fixed condenser in steps, and two rotary variable condensers. A compact way of mounting a complete set using a receiving set as shown in Fig. 3 is illustrated in a front elevation view, Fig. 4.

The aerial switch used in this set is of the De Forrest type with the disconnecting ground. An emergency gap and muffler are shown in the helix in Fig. 4, and are used in case of a breakdown of the rotary. For general efficiency this set has a proven value.—JESSE JAY.

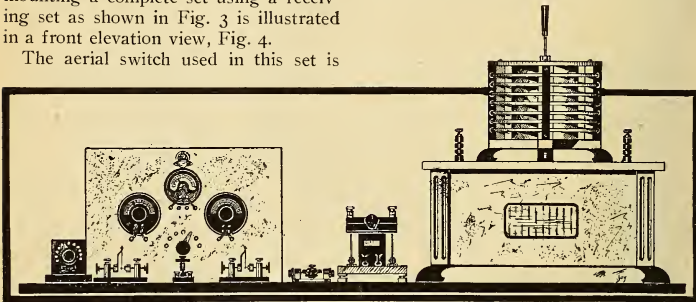


FIG. 4. FRONT ELEVATION OF COMPLETE SET

Effect of Ionization on Wave Propagation

Does the velocity of electric waves through the air increase with ionization? Dr. W. H. Eccles of the British Royal Society answers this question in the affirmative. The natural electric wave train which radiates from a lightning discharge produces a disturbance in the apparatus for reception of wireless telegraph messages. Normally these disturbances form a steady stream of faint or loud clicks in the receiving telephones. The rate at which they are received at a station varies from hour to hour during the 24 hours, and also with the season. As a general rule, however, the disturbances—or "strays" as they are often called—heard at night are stronger and more frequent than those heard in the day. The change from day to night and from night to day conditions is very striking just at sunset and sunrise.

It is chiefly this period of transition that is investigated by Dr. Eccles. He found that very often there is an absence of the gradual transition that might be expected, but instead there is a passage through a sharply marked minimum.

In order to explain these phenomena, Dr. Eccles develops a hypothesis which is based on the proposition to the effect that the velocity of electric waves through ionized air increases with increasing ionization. Now the ionization produced by solar radiation increases within limits, with the increase of the height in the atmosphere.

From this it follows that a system of waves with vertical wave fronts must suffer a forward tilting of the wave fronts as it traverses the heterogeneous medium, and the rays will follow curved trajectories which have their concavity downwards. This alone explains many of the hitherto unexplained phenomena of wireless telegraphy.

To explain, however, the stray minima found at sunset and sunrise, it is necessary to suppose that the process of ionization of the atmosphere at sunrise, and the process of de-ionization at sunset, form a turbulence in the medium that leads to difficulty of propagation.— DR. L. K. HIRSHBERG.

How to Comply With the New Wireless Law

Standard Experimental Equipment in Accordance with Regulations

By PHILIP E. EDELMAN

Part II.—Transmitting Condenser

In order to standardize experimental apparatus, the author considers that the parallel plate type of condenser immersed in an insulator to prevent surface leakage is the best to adopt because the capacity can be readily calculated. The formula is,

$$C = \frac{KA}{4\pi D} \text{ C. G. S. electrostatic units,}$$

in which C represents the capacity, K the dielectric constant (see table), A the area of one of the plates overlapped by the other plate, and D the distance apart of the plates, in centimeters. The formula is only applicable to ordinary condensers in which the distance between the plates is relatively small in comparison with the length and breadth of the plates. This will be simplified by stages as with the wave length formula.

To express the capacity direct in microfarads, the formula is

$$C = \frac{KA}{4\pi D \times 9 \times 10^5} \text{ or } KA = C4\pi D \times 9 \times 10^5$$

In order to find the desired area, this may be arranged,

$$A = \frac{36\pi DC \times 10^5}{K}$$

Now the quantity $36\pi \times 10^5$ is the same in every case, so that the formula may be simplified to

$$\text{Formula, } A = \frac{DC \times 11309760}{K}$$

and when glass is used for the dielectric, which has a constant of eight, this may be further simplified to

$$A = DC \times 1413720 \text{ because } \frac{11309760}{8} = 1413720.$$

DIELECTRIC TABLE FOR CONSTANTS K

(Air, empty space, or gases at atmospheric pressure, 1.)

Glass	6 to 10
Light flint glass	6.5
Dense flint glass	6.5 to 10
Hard crown glass	7
Mica	6.6 to 7.5
Hard rubber	2.7
Kerosene oil	2
Castor oil	4.78
Shellac	2.7 to 3.5
Ebonite	2.5 to 3
Manilla paper	1.5
Paraffin	1.75 to 2.3
Resin	1.77 to 2.5
Porcelain	4.38
Water	80

Note.—An average result is best to use in the formula. Glass should be taken as 7½ or 8 when ordinary glass or old photographic plates are to be used. The emulsion should be cleaned off before using the latter.

The calculation is thus very simple. The figures are in the metric system and to change to inches after the area has been found in square centimeters, change the ratio.

One inch is equal to 2.54 centimeters. One centimeter is equal to .3937 inch.

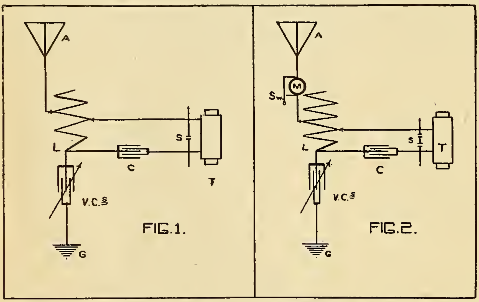
One square inch equals 6.45 sq. cm. One sq. cm. equals .1550 sq. in.

To illustrate the use of the formula. Find the necessary area for the tinfoil to make up a condenser of .002 microfarad capacity, using glass 0.1 centimeter thick. Ordinary glass plates are approximately .125 centimeter thick. Using the simplified, we get,

$$A = .1 \times .002 \times 1413720 = 282.74 \text{ sq. cm.}$$

Now this surface can be apportioned in almost any desired manner. For instance, three plates of glass of this size and 12x14 centimeters with tinfoil on each side, 9x10½ centimeters would be approximately right. Almost any desired capacity can be worked out to a fairly close degree of accuracy in this manner. If either of the three factors, A, D or K, is desired, the other two must be known.

In designing a condenser for transmission purposes the thickness of the dielectric used must be sufficient to withstand the impressed voltage as well as an overload without puncturing. For this reason a thickness of one centimeter for every 40,000 volts should be allowed. Thus for 10,000 volts the dielectric should be .25 centimeter thick, and so on. If glass can not be had which is large enough, two or more capacities of the same size can be connected in series or series multiple to care for the voltage without breaking down. This method cuts down the capacity, however, so that larger units must be used. Thus if two condensers are used in series to secure a capacity of .2 microfarad, each must have a capacity of .4 microfarad, and so on. When parallel connections are used the capacity increases directly, but the puncture voltage must be considered for the weakest unit. Thus two condensers of .4 microfarad capacity each connected in parallel will give a capacity of .8 microfarad. It is of the greatest importance that the condenser be constructed with care, and that the coatings should have sufficient capacity, leakage be avoided, connections of large capacity, and so on. Thin sheets of copper or aluminum are preferred to tinfoil, though the latter may be used if of large size. Transformer or boiled linseed oil should be used to cool the condenser and to prevent brush discharges. The glass used should be very clean and free from lead. It should also be of uniform size throughout.



A—AERIAL. L—INDUCTANCE. C—CONDENSER. S—SPARK GAP. T—TRANSFORMER. G—GROUND. V.C.s—VARIABLE CONDENSER. M—HOT WIRE AMMETER. Sw—SHORT CIRCUITING SWITCH

It was stated that the wave length could be lowered by a series capacity in the aerial. The method is illustrated in Fig. 1, and a variable or variable step condenser is preferable for the purpose. The method is only of value, however, when a wave meter may be had for measuring the transmitting wave length. It is interesting to note, however, that it can be made to serve with aerials already installed and in use. The transmitting range will be cut down by this arrangement, and it is valuable more as an experiment than anything else. When the primary circuit is calculated a hot wire ammeter can be used, as will be seen later.

CALCULATION OF INDUCTANCE.

Like wave length and capacity, it is easy to calculate inductance, when the simple formulas which follow are used.

The formula for cylindrical coils of one layer, as helices or choke coils, taking variable factors into consideration, is

$$\frac{(5\times D\times T)^2}{M+\frac{1}{3}D}=\text{inductance in centimeters}$$

D is the diameter of the coil in *inches.*
T is the total number of turns of wire.
M is the length of the coil in inches.

While the result is expressed in centimeters, it may be changed to microhenrys by dividing by 1,000.

As an illustration: Suppose we wish to find the inductance of a helix or choke coil which is nine inches in diameter, ten inches long and is composed of a total of ten turns of wire. By using the above formula for inductance we would substitute these values as follows:

$$\frac{(5\times9\times10)^2}{10+3}=\frac{450^2}{13}$$

or 15.580 cm. approximately, or 15.580 microhenrys.

The formula for the inductance for a flat or pancake coil or helix (the kind with several layers wound over each other), is

$$\frac{(5\times D\times T)^2}{\frac{1}{3}D+\frac{3}{2}M+\frac{5}{4}N}= \text{Inductance in centimeters.}$$

D is the average diameter of the coil in inches.

M is the length of the coil in inches.

N is the depth of the coil in inches.

T is the total number of turns of the coil.

For example: Find the inductance of a flat type of helix of the dimensions: six turns of copper strip one inch apart, the strip being one inch wide, depth of winding six inches, and average diameter twelve inches. (Inside six inches, outside eighteen inches.)

$$\frac{(5\times12\times6)^2}{4+1\frac{1}{2}+7\frac{1}{2}}=\frac{(360)^2}{13}=\frac{129,600}{13}$$

or 9970 centimeters or 9.970 microhenrys.

Now from the foregoing it should be possible to calculate the inductance of any helix or oscillation transformer which you may have, so that you will know where you are at. In the case of an oscillation transformer the primary and secondary are calculated separately, though the primary is all that it is essential to know, since the actual tuning is best carried out by the use of a hot wire ammeter. That is, the object is to calculate the primary or condenser circuit for a wave length of 200 meters, using an efficient capacity of the proper size for the given coil or transformer, and then to bring the secondary or antenna circuit to resonance by using a hot wire ammeter or other indicator. In calculating the inductance, the separate turns must be considered independently for accuracy, particularly when a pancake type of coil is used. Thus starting with the outer turns, calculate the inductance for the first two turns as if they formed the coil alone, then the first three, the first four, and so on, or vice versa, starting from the inner turns.

The law requires that the transmitted wave be *pure* and *sharp*. This means that both the primary and secondary circuits must be brought to resonance, that the connections between the apparatus must be good, that heavy wire be used for the connections, and that the helix or oscillation transformer used be of a construction which allows easy and accurate variation. Now small stations will find the close coupling resulting from a helix an advantage because of the increased intensity of signals, but as the double wave which results from an ordinary spark system is not sharp or in compliance with the law unless the circuits are nicely adjusted, this item is of great importance. The use of an oscillation transformer is therefore to be preferred, as the variable coupling allows of sharper tuning. *Untuned or poorly tuned stations do not comply with the law.*

Without considering the details on account of the lack of space, the following standards are suggested for a helix and oscillation transformer.

STANDARD HELIX.

Seven complete turns of No. 4 B. & S. brass or aluminum wire are wound on a form ten inches in diameter and spaced three-fourths of an inch apart. About 19½ feet are necessary. This standard helix has a maximum inductance of 30.28 microhenrys, which is even more than is ever needed for an average station with a 200 meter wave length. The inductance of a single turn is approximately .618 microhenry, that of three turns 9x.618, that of 3½ turns, 12¼x.618, and so on, since the inductance increases as the square of the number of turns.

STANDARD OSCILLATION TRANSFORMER.

Pancake type. Recommended when over 100 watts of energy are used. Use

½ inch brass ribbon about 1-16 inch thick. The primary and secondary are wound as a spiral, the primary having five complete turns and the secondary nine complete turns. The turns for both the primary and secondary coils are spaced exactly ½ inch apart and begin ¼ inch in from the outside edge of the support arms. The secondary coil will thus end nearer the center than the primary. The support strips are 14½ inches long and ¾x½ inch, with slots for the ribbon. The two coils are mounted so that they are adjustable with respect to each other. Clips should be provided for both coils. The maximum inductance of the primary coil is approximately 13½ microhenrys when all the turns are used. Beginning with the outside turn the values are approximately: First turn, .868 microhenry; first two turns, 3.97 microhenrys; first three turns, 5.7 microhenrys; first four turns, 10.25 microhenrys. (Formula 2).

SPARK GAP.

While a minor item as far as wave length and tuning is concerned, the spark gap should not be overlooked as it determines the efficiency and damping of the set to a large extent. The use of a series gap with perforated faces, or a rotary series gap is recommended. While a simple non-cooled gap can be used, it is less efficient and satisfactory and should not be adopted when other and better types are to be had. A quenched gap is also very desirable, as the best waves are avoided by its use. Any of the three types when well constructed with regard to efficiency and durability will serve as a satisfactory standard.

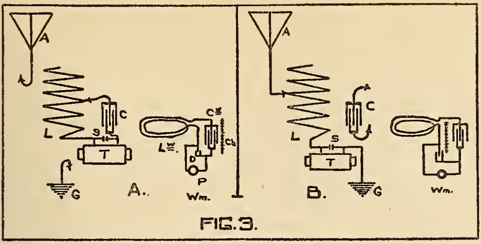
OPERATING.

The minor instruments have not been mentioned, but the key, switches, wiring, kickback prevention, lightning protection switches, and so on should not be neglected and should be installed in approved form.

The hot wire ammeter is essential if the tuning idea suggested in this article is to be efficiently carried out. This instrument is quite simple and can either be purchased or constructed, but can hardly be omitted. With the apparatus connected up, the tuning is carried out by adjusting the spark length so that the spark is neither mushy or stringy, (with leakage transformers, the adjustment of the primary circuit by the use of more or less leakage is used to cooperate with the adjustment at this point), the helix or oscillation transformer is then included in the primary or condenser circuit, using a number of turns which will give the inductance necessary in connection with the condenser to produce the desired wave length of 200 meters, as per the foregoing calculations, and then the secondary or antenna circuit is adjusted by using the hot wire ammeter as an indicator. More or less turns are included in the secondary circuit until the hot wire ammeter indicates a maximum radiation for the given wave length of 200 meters. The spark gap should then be further adjusted, leaving the rest of the connections alone, until a maximum radiation is indicated. If these operations are carried out carefully, the station will be adjusted to its maximum efficiency for the given 200 meter wave length. If the condenser is altered, the whole operation must be repeated with the new value for the capacity.

Figure 2 shows how a large aerial can be used for experimental purposes to produce a 200 meter wave length. The primary circuit is adjusted as before, but the secondary circuit is adjusted by increasing or decreasing the series capacity until the maximum radiation is indicated for both the series capacity and secondary inductance adjustments. Many experimenters will very likely be able to use this method without erecting a smaller aerial. If the aerial is very large, this method will probably be of little use.

In either case, the tuning can then be further carried out in the case when a transformer is used instead of a helix, by



A—AERIAL. L—INDUCTANCE. G—GROUND. S—SPARK GAP. C—CONDENSER. T—TRANSFORMER. Wm—WAVE METER. Lw—INDUCTANCE . Cw—CONDENSER WITH SCALE Cb. D—DETECTOR. P—TELEPHONE

varying the coupling between the primary and secondary circuits. While a small degree of coupling means very sharp tuning, this should not be carried too far, as the intensity of the transmitted impulses is less with a small coupling. This may also be carried out in a small way with a helix provided with adjustable clips for the terminals of both condenser and aerial circuits. The circuits are not properly tuned until the maximum radiation is indicated and since the primary circuit is fixed at 200 meters, the secondary circuit is very nearly at this same value when in resonance with it.

A wave meter is nothing but a simple condenser and inductance of known value connected in series. While the construction is very simple, the instrument is of little or no value unless calibrated, and since this is best accomplished by comparison with a calibrated instrument, the readers are not advised to construct one unless a calibrated wave meter may be had for comparison. A calibrated rotary plate variable condenser in series with two to four turns of No. 18 bell wire wound on a form nine inches in diameter may be used. When the wave meter is available the calculations for the circuits are hardly necessary, and, at any rate, they may be checked up. The method of using a wave meter is indicated in Fig. 3. A telephone receiver and detector can be made to serve as an indicator for experimental purposes. The inductance of the wave meter is placed in a parallel plane with the helix as shown, but not too near, and the wave length of the primary measured with the aerial and ground disconnected as shown. The adjustment which gives a 200 meter wave length should be noted. Now disconnect the condenser and connect in the aerial and ground as shown at B of the figure, and adjust the inductance or the antenna circuit until the wave meter responds most efficiently when fixed at 200 meters.

This idea can be nicely carried out with the arrangement of Fig. 1, and will show whether or not the aerial can be used with a series capacity to give a 200 meter wave length. The connections are then made with the amount of inductance for both circuits which was indicated as the proper amount. The transmitted waves will then be very nearly 200 meters on each of the two wave peaks.

A less reliable method of calibrating the wave meter is to calculate the primary circuit for a 200 meter wave length and to mark the adjustment of the wave meter's condenser which gives a maximum indication for the given circuit. The secondary circuit can then be adjusted to give a maximum indication in the wave meter with the capacity left at the previous adjustment.

RECEIVING.

The receiving station needs no special comment. A loose coupling will be practically essential for tuning purposes for the reasons already set forth. Both long and short distance receiving may be carried on as before except that the secrecy of messages must be preserved and that a license is necessary in order to receive interstate messages; that is, those coming from another state.

Eclipse of the Sun Affects Wireless Signals

In *L'Electrician* of May 31, M. Schederman gives an account of the intensity of the signals received at the wireless station at Copenhagen, Denmark, which was in constant communication with the station at Blaavands Huk, on the North Sea, situated at a distance of about 180 miles, during the eclipse of the sun on April 17 of this year.

The variations in the intensity of the sounds heard at Copenhagen were very considerable, and while they could easily be made imperceptible by placing a small resistance between the binding screws of the receiver, and by loosening any of the connections as long as the eclipse was not far advanced, they became gradually stronger, and at the time of maximum eclipse they were so strong that even putting the receiver in short circuit and loosening the connections did not sensibly diminish them. After that the intensity became gradually normal, in proportion as the disk of the sun reappeared. Seeing that the other station, 180 miles away, was sending waves of constant power at regular intervals during the whole duration of the eclipse, it follows that the variations in the strength of the signals received must have been entirely due to modifications in the ether conductivity.

In a communication to the Academy of Sciences (France), M. Rothe says that it is well known that the intensity of the reception of radio-telegrams is greater it is frequently doubled between noon and midnight. This difference is attributed to the effects of the rays of the sun; disturbances are observed also at sunrise and at sunset. In attempting to explain these phenomena by a study of the action of the radio-telegraph during the eclipse, it was found that there was a relation between the eclipse, the lowering of the air temperature, the movement of the wind resulting from this, and the intensity of the wireless signals, which were found to be augmented during the eclipse.

Directory of Wireless Clubs

This directory of amateur wireless clubs and associations will be published each month. When a new club is formed the names of the officers, also the street address of the secretary, should be forwarded to us at once. Any changes that should be made in the directory, when designated by an official of a club, will be made in the next issue after receipt of such advice.

Aerogram Club.—J. Stedman, President; A. Hayward Carr, Chairman Board of Directors; Albert S. Hayward, Treasurer; Donald P. Thurston, Secretary; Walter B. Clarke, 17 May St., Newport, R. I., Corresponding Secretary.

Aerograph Club of Richmond, Ind.—H. J. Trueblood, President; Richard Gatzek, Vice President; James Pardieck, 320 South 8th St., Richmond, Ind., Secretary.

Aero Wireless Club.—A. Garland, President; W. Ladley, Vice President; D. Beard, Napa, Calif., Secretary and Treasurer.

Allegheny County (Pa.) Wireless Association.—Arthur O. Davis, President; Theodore D. Richards, Vice President; James Seaman, Leetsdale, Pa., Secretary and Treasurer.

Alpha Wireless Association.—L. L. Martin, President; F. A. Schaeffer, Vice President; G. F. Girton, Box 57, Valparaiso, Ind., Secretary and Treasurer.

Amateur Wireless Association of Schenectady, N. Y.—D. F. Crawford, President; L. Beebe, Vice President; C. Wright, Treasurer; L. S. Uphoff, 122 Ave. "B," Schenectady, N. Y., Secretary.

Amateur Wireless Club of Geneva (N. Y.).—H. B. Graves, Jr., President; C. Hartman, Vice President; L. Reid, Treasurer; Benj. Merry, 148 William St., Geneva, N. Y., Secretary.

Arkansas Wireless Association.—G. A. Rauch, President; Edward Vaughn, 2622 State St., Little Rock, Ark., Secretary and Treasurer.

Berkshire Wireless Club.—Warren A. Ford, President; William Yarkee, Vice President; Charles Hodecker, Treasurer; Jas. H. Ferguson, 18 Dean St., Adams, Mass., Secretary.

Canadian Central Wireless Club.—Alexander Polson, President; Stuart Scorer, Vice President; Benj. Lazarus, P. O. Box 1115, Winnipeg, Manitoba, Can., Secretary and Treasurer.

Cardinal Wireless Club.—K. Walthers, President; F. Dannenfelser, Vice President; Miss A. Peterson, South Division High School, Milwaukee, Wis., Secretary.

Chester Hill Wireless Club.—Waller Morgan, President; Richard D. Zucker, 46 Clinton Place, Mt. Vernon, N. Y., Secretary and Treasurer.

Chicago Wireless Association.—F. V. W. ReQua, President; S. W. Wooster, Vice President; C. Stone, Treasurer; F. D. Northland, Secretary; R. P. Bradley, 4418 South Wabash Ave., Chicago, Ill., Corresponding Secretary.

Colorado Wireless Association.—William Cawley, President; Thomas Ekren, Vice President; W. F. Lapham, 1545 Milwaukee St., Denver, Colo., Secretary-Treasurer.

Custer Wireless Club—Franklin Webber, President; Fred Cross, Vice President; Oakley Ashton, Treasurer; Walter Maynes, 438 Custer Ave., Los Angeles, Cal., Secretary.

De Kalb Radio-Transmission Association.—Bruce Lundberg, President; Walter Bergendorf, Vice-President; De Estin Snow, Treasurer; Bayard Clark, 205 Augusta Ave., De Kalb, Ill., Secretary.

Fargo Wireless Association.—Kenneth Hance, President; John Bathrick, Vice President; Earl C. Reineke, 518 9th St., Fargo, N. D., Secretary.

Forest Park School Wireless Club.—W. S. Robinson, Jr., President; William Crawford, R. F. D. No. 1, Springfield, Mass., Secretary.

Frontier Wireless Club.—Franklin J. Kidd, Jr., President; A. Donald Allerbury, 1034 Elmwood Ave., Buffalo, N. Y., Secretary-Treasurer.

Geneva Wireless Club.—Charles B. Hartman, President; Charles Smith, Vice-President; Benjamin Merry, Treasurer; Henry B. Graves, Jr., 448 Castle St., Geneva, N. Y., Secretary.

Gramercy Wireless Club.—James Platt, President; John Gebhard, Vice President; John Diehl, Treasurer; John Jordan, 219 East 23d St., New York, N. Y., Secretary.

Granby High School Electricity Club.—Harold Taylor, President; Stuart Bliss, Vice President; Eastman Smith, Granby, Mass., Secretary-Treasurer.

Greenfield Wireless Association.—Edward M. Wolfe, President and Corresponding Secretary, 4125 Haldane St., Pittsburgh, Pa.

Hannibal (Mo.) Amateur Wireless Club.—Charles A. Cruickshank, President; J. C. Rowland, Vice President; William Youse, treasurer; G. G. Owens, 1306 Hill St., Hannibal, Mo., Secretary.

Harriman Wireless Association.—Oswald L. Fillmore, President; Everett R. Parish, 801 Clinton St., Harriman, Tenn., Secretary.

Haverhill (Mass.) Wireless Association.—Riedel G. Sprague, President; Charles Farrington, Vice President; Leon R. Westbrook, Haverhill, Mass., Secretary and Treasurer.

Hobart Wireless Association.—Asa Bullock, President; Charles Clifford, Hobart, Ind., Secretary.

Independence Wireless Association.—Boyce Miller, President; Ralph Elliott, Secretary; Joseph Mahan, 214 South Sixth St., Independence, Kan., Vice President.

Independent Wireless Transmission Co.—Harlan A. Eveleth, 72 Gray St., Arlington, Mass., Secretary.

Jonesville Wireless Association.—Frederic Wetmore, President; Webb Virmylia, Vice President; Richard Hawkins, Treasurer; Merritt Greeu, Lock Box 82, Jonesville, Mich., Secretary.

Lake View Wireless Club.—E. M. Fickett, President; R. Ludwig, Treasurer; R. F. Becker, 1439 Winona Ave., Chicago, Ill., Secretary.

Lane Technical High School Club.—B. C. Lizenby, President; C. I. Gringrich, Vice President; C. H. Stone, Treasurer; J. Simon, Secretary; R. R. Traub, Lane Technical High School, Chicago, Ill., Corresponding Secretary.

Lexington Aerogram Company.—Roger H. Preston, President; Francis Dean, Vice President; Charles Young, 5 Warren St., Lexington, Mass., Secretary.

Long Beach Radio Research Club.—Bernard Williams, 555 E. Seaside Bvd., Long Beach., Calif., Secretary.

Manchester (N. H.) Radio Club.—Homer B. Lincoln, President; Clarence Campbell, Vice President; Elmer Cutts, Treasurer; Earle Freeman, 759 Pine St., Manchester, N. H., Secretary.

New Haven Wireless Association.—Roy E. Wilmot, President; Arthur P. Seeley, Vice President; Russell O'Connor, 27 Vernon St., New Haven, Conn., Secretary and Treasurer.

New Thomson Wireless Club.—T. Frank Edwards, President; C. D. Fitzgerald, Vice President; Edward M. Fleming, care the New Thomson, Kane, Pa., Secretary.

Northwestern Wireless Association of Chicago.—Rolf Rolfson, President; H. Kunde, Treasurer; Edw. G. Egloff, 2729 Noble Ave., Chicago, Ill., Recording Secretary.

Oakland Wireless Club.—H. Montag, President; W. L. Walker, Treasurer; W. R. Sibbert, 916 Chester St., Oakland, Calif., Secretary.

Oklahoma State Wireless Association.—T. E. Reid, President; G. O. Sutton, Vice President; Ralph Jones, Box 1448, Muskogee, Okla., Secretary and Treasurer.

Oregon State Wireless Association.—Charles Austin, President; Joyce Kelly, Recording Secretary; Edward Murray, Sergeant-at-Arms; Clarence Bischoff, Lents, Ore., Treasurer and Corresponding Secretary.

Peterboro Wireless Club.—G. B. Powell, President; C. V. Miller, Vice President; E. W. Oke, 263 Engleburn Ave., Peterboro, Ontario, Can., Secretary and Treasurer.

Plaza Wireless Club.—Paul Elliott, President; Myron Hanover, 156 E. 66th St., New York, N. Y., Secretary and Treasurer.

Pueblo Wireless Club.—L. R. Finke, President; B. C. Howe, Treasurer; K. G. Hermann, 100 Board of Trade, Pueblo, Colo., Secretary.

Radio-Signal Club of Chicago.—W. E. White, President; G. C. Schade, Vice President; F. H. McCarthy, 2113 Washington Bvd., Chicago, Ill., secretary and treasurer.

Rockland County Radio Wireless Association.—M. V. Bryant, President; H. I. Sprott, Treasurer; P. Haeselbarth, Nyak, N. Y., Secretary.

Roslindale (Mass.) Wireless Association.—O. Gilus, President; E. T. McKay, Treasurer; Fred C. Fruth, 962 South St., Roslindale, Mass., Secretary.

Sacramento Wireless Signal Club.—E. Rackliff, President; J. Murray, Vice President; G. Banvard, Treasurer; W. E. Totten, 1524 "M" St., Sacramento, Calif., Secretary.

Santa Cruz Wireless Association—Orville Johnson, President; Harold E. Sentor, 184 Walnut Ave., Santa Cruz, Calif., Secretary and Treasurer.

Seneca Electrical Club.—Neil A. Stillman, President; Maurice P. Whitney, Vice President; Harold Server, Treasurer; Howard Donnelly, R. F. D. 1, Geneva, N. Y., Secretary.

Southeastern Indiana Wireless Association.—R. F. Vanter, President; D. C. Cox, Vice President and Treasurer; H. Hitz, Fairmont, Madison, Ind., Corresponding secretary.

Southern Wireless Association.—B. Oppenheim, President; P. Gernsbacher, 1435 Henry Clay Ave., New Orleans, La., Secretary and Treasurer.

Springfield (Mass.) Wireless Association.—A. C. Gravel, President; C. K. Seely, Vice President and Treasurer; D. W. Martenson, Secretary; Club Rooms, 323 King St., Springfield, Mass.

Spring Hill Amateur Wireless Association.—R. D. Thiery, President; H. P. Hood, 2nd, 2 Benton Road, Somerville, Mass., Secretary and Treasurer.

St. Paul Wireless Club.—E. C. Estes, President; W. P. Husby, Vice President; T. J. Taylor, Treasurer; L. R. Moore, 1911 Ashland Ave., St. Paul, Minn., Secretary.

Tri-State Wireless Association.—C. B. DeLaHunt, President; O. F. Lyons, Vice President; T. J. M. Daly, Treasurer; C. J. Cowan, Memphis, Tenn., Secretary.

Waterbury Wireless Association.—Arthur E. Hapeman, President; Walter Lowell, Treasurer; H. M. Rogers, Jr., 65 Elizabeth St., Waterbury, Conn., Secretary.

Wireless Association of British Columbia.—Clifford C. Watson, President; J. Arnott, Vice President; E. Kelly, Treasurer; H. J. Bothel, 300 Fourteenth Ave. E., Vancouver, B. C., Corresponding Secretary.

Wireless Association of Canada.—W. Fowler, President; E. G. Lunn, Vice President; W. C. Schuur, Secretary and Treasurer.

Wireless Association of Fort Wayne.—Adolph Rose, 1326 E. Wayne St., Fort Wayne, Ind., President and Secretary.

Wireless Association of Montana.—Roy Tysel, President; Elliot Gillie, Vice President; Harold Satter, 309 South Ohio St., Butte, Mont., Secretary.

Wireless Association of Savannah.—P. C. Bangs, President; A. A. Funk, Vice President; H. Jenkins, Treasurer; L. H. Cole, Cor. Liberty and Price Sts., Savanuah, Ga., Secretary.

Wireless Club of Baltimore.—Harry Richards, President; William Pules, Vice President; Curtis Garret, Treasurer; Winters Jones, 728 North Monroe St., Baltimore, Md., Secretary.

Wireless Club of the Shortridge High School.—Robert C. Schimmel, 2220 N. Penn St., Indianapolis, Ind., President; George R. Popp, Vice President; Bayard Brill, Treasurer; Oliver Hamilton, Secretary.

Y. M. C. A. Wireless Club of Williamsport, Pa.—Lewis Holtzinger, President; Christian Cupp, Vice President; Robert Tempieman, Treasurer; Lester Lighton, 211 W. 4th St., Williamsport, Pa., Secretary.

Zanesville Wireless Association.—Charles S. Shryock, President; Rudolph C. Kamphausen, 105 South Seventh St., Zanesville, Ohio, Secretary-Treasurer.

Construction of a 50 Watt Dynamo

By CHAS. F. FRAASA

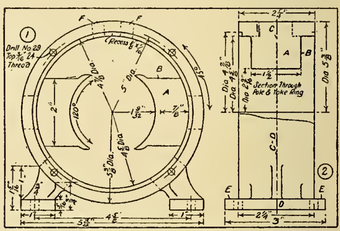
PART I.—FIELD MAGNETS, ENDPLATES, PATTERN MAKING AND MACHINING

The following design is for a dynamo of 50 watts output at 2400 revolutions per minute. Data is given for winding for either shunt or series excitation at 25 volts and two amperes, or ten volts and five amperes. The machine will run well as a motor, but at a lower speed at the above voltages. To secure 2400 r.p.m., the voltage would have to be raised.

There are so many foundries producing excellent castings at reasonable cost that the use of castings should cause the builder no difficulty.

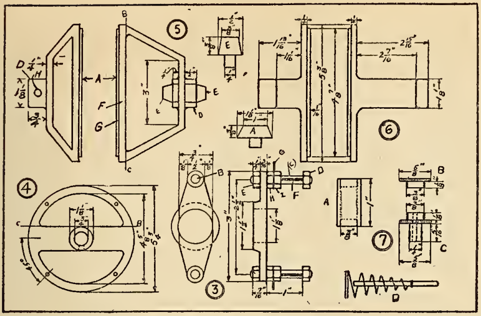
Pattern making. The patterns are constructed of ¼ inch white pine glued together to the proper thickness with pattern maker's glue. Patterns to be turned are glued to a piece of one inch plank fastened to the lathe faceplate, after first gluing a piece of thick paper between the pattern and the piece of wood on the faceplate. All patterns should taper slightly from the parting line, making sections thicker at the parting so that the pattern may be removed without tearing the mould. The castings are most too small to make any practical allowance for shrinkage but about ⅛ inch or more must be allowed all finished surfaces for machining. All sharp corners should be carefully rounded out with fillet. Remember that the dimensions given are finished dimensions.

The field magnet is dimensioned in Figs. 1 and 2. The top half of Fig. 2 is a section through the field showing the shape of the poles and the yoke ring. The poles (A) should be rounded off on the four edges (B). The pattern divides along the line (CD). The two parts are fastened together by 3/16-inch dowel pins located by inscribing a five inch diameter circle on each half of the pattern. With the two parts connected in this way, the field ring or yoke may be turned and bored. Remove the



ring from the faceplate, and locate the pole pieces (A) Figs. 1 and 2. The pole pieces and the base lugs (E) are built up from quarter inch pine. Each part is fastened with glue by a projection as indicated by the dotted lines in the field ring in slots cut in the ring. Be sure to allow ⅛ inch all around the face of the pole pieces for boring.

The brush holder pattern is made in one piece as illustrated in Fig. 3. Drill a hole in the center of the round portion



be filed and ground to shape. Drill the two 3/8 inch holes (F), Fig. 1, in the top of the field magnet casting for the terminal connection binding posts.

Probably the best method of machining the end plates is to chuck the end plate, and bore the hole for the bearing bushing 3/4 inch in diameter and then mount the end plate on a mandrel for finishing. The ends

of the brush holder to receive the dowel of the core print (A), which should be fastened with glue.

The patterns for the bearing and end plates, Figs. 4, 5 and 6, are made in one piece, since the parting line is the inside of the pattern and the edge (A), Fig. 5. The main portion is built up and turned, inside and out. Then saw away the portion on both sides of the bearing, by sawing along the lines (BC), Figs. 4 and 5. Then turn up the hub (D) and the core prints (E) and glue them in place. The bearings are cored 1/2 inch in diameter. In making these patterns, make the part (F) 7/16 inch thick, allowing 1/8 inch for machining and 1/16 inch for the bearing bracket ring (G), which is not turned in the pattern but in the casting when finished.

Machine work. When you receive your castings from the foundry, carefully clean them with a file and emery cloth or a grind wheel. Strap the field magnet to the faceplate and bore the armature tunnel to 2 9/16 inches in diameter. Face the end of the field magnet yoke and turn the recess for the ring on the end plates. To center the field casting when turning the other end of the yoke, turn up a supplementary faceplate having an elevated portion to snugly fit the recess in the end of the yoke. Then strap the casting on this and face the other side of the yoke and turn the recess. The base should then

of the hub should be faced and the ring (A), Fig. 5, faced and turned. The bushings should be made of hard brass or phosphor bronze, preferably the latter. Bore out the center first and then mount the bushing on a mandrel and turn the outside to shape. The bushing should fit tightly in the end plate. When the bushing is driven into place, tool oil grooves in it, if they are desired, and ream with a 3/8 inch reamer.

The grease cups for the bearing lubrication are dimensioned in Fig. 7. A piece of brass tube (A) is threaded internally on both ends to receive the caps (B) and (C). The piece (C) has a 1/8 inch hole drilled through it for a 1/8 inch wick which feeds the grease to the bearing. This is shown at (D). A piece of brass spring wire is coiled up and bound to the wick near one end to force the wick against the shaft.

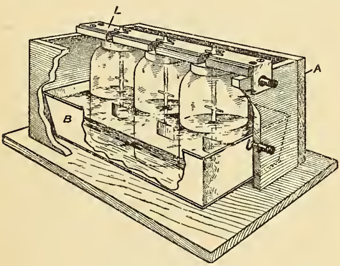
The grease cup is mounted on the under side of the bearing in a hole (H), Fig. 5, which is drilled and tapped to receive it. Only a 1/8 inch hole need be drilled through the bushing.

To insure alignment of the four holes through which bolts pass for securing the end plates on the field magnet, put the end plates in place and strap down on the drill press. Drill through the end plate into the field magnet with a 3/16 inch drill, and continue with a No. 29 drill. Then tap with a 3/16 inch 24 thread tap.

Bore the center hole in the brush holder, and drill the holes (B) for the brush studs.

A Liquid Condenser

In the condenser described below, instead of using tinfoil for coating the dielectric, a conducting liquid covered with ½ inch of boiled linseed oil is employed, a practice which obviates all brush discharge. It also has the additional advantage of insuring perfect contact between dielectric and coating, thus obviating all uneven distribution of strain and decreasing the liability of a breakdown.



LIQUID CONDENSER

A box (A) of proper dimensions is constructed of paraffined oak. The strip top (L) should have deep notches sawed in it to correspond with the mouths of the jars. A bread pan (B), long enough to hold three jars side by side, is placed in the box and in it three Mason pint jars.

The conducting liquid is then poured to within ¾ inch of the upper edge of bread pan and over it is placed ½ inch of boiled linseed oil. The jars are filled in the same manner. The conducting liquid may be either dilute sulphuric acid (fifteen parts water and one part acid), a strong solution of sal ammoniac, or a salt water solution.

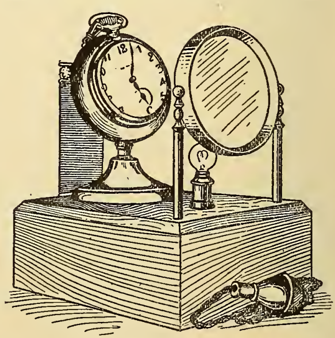
Three connectors are constructed by soldering a short length of No. 8 copper wire to a copper plate. Two supports of No. 12 copper wire are soldered at right angles to the large wire and are so spaced that when the upper one rests on the connecting strip the plate is immersed in the conducting liquid, and when the lower one rests on the connecting strip the plate clears the liquid by ½ inch or more.

The top is then put in place and over it the connecting strip. The three connectors are then slipped in place and the top and connecting strip are screwed to the box. A binding post is mounted on the bent end of the connecting strip. Another binding post is mounted on the same end of the box and fastened to it is a No. 12 wire which makes contact with the bread pan.

The capacity of one of these units of three jars is .00234 microfarads when all the jars are connected, .00156 when two are connected, and .00078 microfarads when one jar is connected, for it is a well known principle that when a number of condensers are connected in parallel the total capacity is equal to the sum of the individual capacities of the several condensers.

Watch Face Lighter and Magnifier

A useful little device for the bedroom during the winter months is a watch stand like the one illustrated. This stand



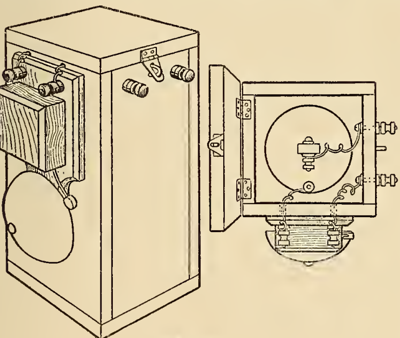
WATCH FACE LIGHTER

is manufactured large enough to contain a battery in the base to which is connected the lamp, cord and an ordinary push button.

After the watch is placed in the holder the lens may be set so that at any time during the night a push of the button will illuminate the watch face and the magnified hands and figures may be seen and the time ascertained without getting out of bed.

A Test Bell

A great many electricians are content with an electric bell bound to a dry cell with tape as a testing apparatus. Such an instrument may serve its purpose well for a while, but it really pays to have something better. A portable outfit consisting of a wooden box just large enough



TEST BELL

to hold a dry cell and upon the side of which is fastened an electric bell, has been found very practical by the writer. Binding posts are placed on the other side, to which is fastened a few feet of flexible lamp cord. A cover is fixed to the box with small brass hinges and a suitable catch.

No definite size can be given for the construction of the box as dry cells vary in size. The sketches will make the other details clear and explain the wiring of the apparatus.—H. Carl Cramer.

Curious Features of Lightning

One scientist had the unusual fortune to see a bolt of lightning strike an isolated cottonwood tree about a quarter of a mile away. The flash appeared as a superb column or shaft of light about 400 or 500 feet high, and eight to twelve inches in diameter, perfectly straight, vertical and steady. The shaft was white, but its base was tinged with red. This column seemed to stand between two diverging trunks of the tree and lasted about two seconds. Afterward the observer found that one of the two trunks of the double tree had its bark stripped off in the shape of a ribbon six inches wide and two yards long. The other trunk showed two furrows beginning ten feet above the ground. They looked as if they had been plowed by a piece of steel. There was no sign of fire.

Perhaps the most curious accompaniment of a lightning shock is the stripping off of the clothes of the person struck. This appears to be very common. There has been reported a case in which a man was struck by lightning while standing by a willow tree. Immediately afterward his shoes were found at the foot of the tree and the man was lying on his back two yards off absolutely naked except for part of the left arm of his flannel vest.

He was conscious, but much burned, and his left leg was broken. The field around was strewn with fragments of the clothes, torn from top to bottom. The shoes were partly torn.

It is supposed that the stripping of the clothes is caused by the rapid formation of steam. When trees are struck the bark is frequently torn off, probably by the electricity passing between it and the wood. It is not unreasonable to imagine that the same explanation applies to the removal of clothes.

Almost as remarkable is the shaving

effect that is sometimes seen. Two men in a windmill were struck by lightning. Both were rendered deaf, and the hair, beard and eyebrows of one were burned. A woman who was struck had the hair of her head completely removed. Sometimes the hair returns, and sometimes the part is rendered permanently bald.

When an electric current is passed through a number of persons holding hands it is generally felt most by those at the end of the chain. Several cases have been recorded in which only those which may be called the terminals of a series of animals are damaged. Five horses in a line received a stroke of lightning; only the first and the last were killed. On another occasion five horses in a stable were struck; the only animal to escape death was the horse in the center.

Several remarkable accounts have been recorded wherein alternate animals of a series have been killed. During a storm in 1901 lightning entered a stable where there were 20 cows and it killed ten of them. The first, the third, and so on, were killed, while the second, the fourth, and so on, survived. Men of science are at a loss to account for such cases as these.

Many cases of complete incineration are recorded. More remarkable are the instances in which the body of a man killed by lightning has appeared to be unaltered, but when touched has crumbled to dust. It is said that three soldiers took shelter under a tree, were killed by lightning, but remained standing. Even their clothes appeared to be intact; but when touched the bodies fell into a heap of ashes.

The lower animals appear to be more liable to be struck than human beings. A whole herd of cattle or sheep may be destroyed by lightning.

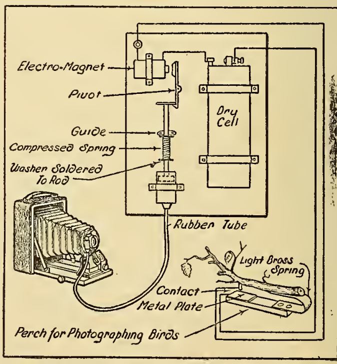
Representatives of surrounding objects are sometimes said to have been imprinted on the victims' skins by a lightning discharge. Nearly always the picture is that of a tree, and may be merely a branching mark made by the electricity.

Fireballs of globular lightning are the most mysterious of all the freakish manifestations thereof. For a long time men of science even doubted that there were such manifestations, but it seems that their reality has been demonstrated beyond all question. Ball or meteoric lightning is sometimes seen proceeding from cloud to cloud, sometimes rolling, bouncing and skipping along the ground. In 1885, in Constantinople, a globe of fire about the size of an orange is declared to have come spinning along, to have proceeded through an open window, and to have played about a gas jet.

Photographing Birds

In taking snap shot photographs of animals and birds, it is especially desirable to operate the camera shutter from a distance. By means of the arrangement shown in the illustration a bird alighting on the little perch brings the contact point down against the metal plate, completing the electrical circuit and actuating the shutter. The perch, of course, is connected in the electrical circuit, and the camera is focused with the shutter set.

The device consists of a piston forced into a cylinder by means of a spring. A strong electro-magnet, consisting of a

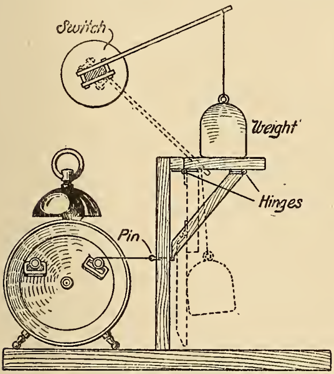


ARRANGEMENT FOR PHOTOGRAPHING BIRDS

couple of hundred turns of No. 20 wire, pulls over the lever, releasing the piston, which in descending, compresses the air in the cylinder, communicating with the camera shutter by a piece of rubber tubing.—W. G. PAULSON.

Clock Operated Time Switch

The snap switch being already connected to the circuit and fastened on the wall, an arm of wood about eight inches long is fastened at one end to the button



TWIN SWITCH

on the switch by a small cleat, and to the free end of this arm is fastened a suitable weight by a chain or cord. This weight stands on a hinged shelf so that when the alarm on an ordinary alarm clock goes off it pulls a string which operates a small brass pin, which in turn releases the shelf, allowing the weight to drop to a fixed platform below. This is shown by the illustration. The alarm clock has its alarm wind key soldered so that the hinged portion stands out rigidly. Over this key is fastened a small wooden spool, slotted to fit over it. The release string is wound a couple of turns around this spool so that when the alarm goes off the key turns and the spool winds up pulling the brass release pin out. Needless to say the clock should set so that it will not pull over. Also the "set" position of the snap switch shall be such that a downward pull on the lever arm will snap the switch.—HENRI PICCARD.

An Industrial University

An original idea in the line of industrial training is to be promoted at Lomax, Ill., if present plans materialize. It is proposed to establish there an industrial university with a view to furnish not only the manufacturing interests at Lomax, but to small industries generally a highly trained class of employees, including electricians, mechanics, chemists and advertising and business managers. The large manufacturing companies, even, which can afford to maintain training and apprenticeship courses, find difficulty in securing enough such men and the smaller industrial concerns are at a still greater disadvantage.

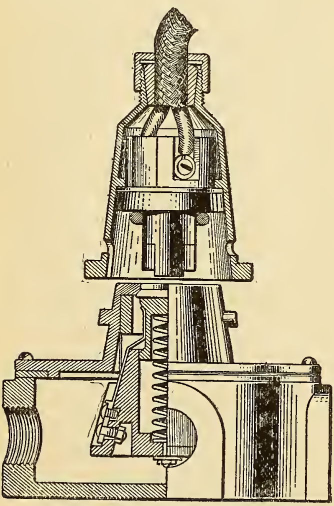
In addition to this higher training for craftsmen and industrial business men, the Lomax Town Company proposes to institute an inventor's department; to give to any inventor free of charge, if he so desires, such advice as will enable him to make such experiments as will demonstrate the value of the idea, together with an opportunity to work out such idea and the use free of charge of exclusive and private apartments, equipped with all facilities for the development of such invention.

With the development of the invention to a point which will demonstrate its value, and, if such value is considered sufficient to justify its manufacture, such assistance will be given to the inventor as will enable him to secure binding patents, under the direction of the legal department of the university.

If the inventor is in a position financially to go into the manufacturing of his invention, a small or large unit of space in the "nursery" building would be placed at his disposal at a very small rental. In the event of the inability of the inventor to undertake the manufacture of his invention through lack of necessary capital, the board of experts would make such recommendation and report on the probable value of the invention and give such assistance as would enable the inventor to secure such financial backing as might be necessary to carry on its manufacture under the most favorable conditions.

Water-Tight Receptacle and Plug

A receptacle that will last when installed in a damp place and permit an extension cord to be plugged upon it is a rare electrical fitting, as most electricians are aware.

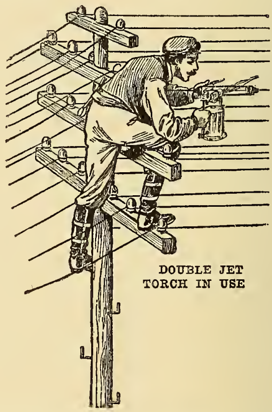


WATER-TIGHT RECEPTACLE AND PLUG

The Conlan receptacle is built to meet this need. The cable terminals are in the upper water-tight part of the plug. Crowding the plug into the receptacle and giving it a turn holds it in place by side pins. When the plug is removed a valve and gasket, forced outward by a spring, operate to fill the hole and keep out water.

Double Jet Gasoline Torch

On a windy day in winter brazing telephone or telegraph wires is not an easy task, though one that has to be done. This work, however, is more eas-



DOUBLE JET TORCH IN USE

ily accomplished with a double jet gasoline torch, for two hot jets are better than one in cold weather. To further aid in the application of a large amount of heat to a restricted area, this torch is equipped with a wind-shield, which adds to its efficiency on a windy day.

Making Glass Threads

The delicate needles of fine galvanometers and other extremely sensitive laboratory instruments used to be suspended by threads of silk or by spider webbing. But both of these materials absorb moisture and therefore move with changes in the humidity of the room in which they are used. Indeed, the breath of a person working close to the instrument may moisten the air sufficiently to spoil the adjustment. A thread of glass, i. e., a glass tube drawn down to a very small diameter, will not do this, but the puzzle has been to make the same fine enough to have the required flexibility.

Recently Mr. H. S. Souttar, of London, has succeeded by employing a little electric furnace which enables him to draw glass tubes fairly uniform in size and having an outside diameter of about 1/25,000 inch, the bore of the tubes being approximately four-fifths of this diameter. To produce such exceedingly fine glass threads, Mr. Souttar starts with a small glass tube placed within a spiral of platinum wire in a mica box. When current is sent through the wire, this will become red hot, but the heat will only soften the lower end of the glass tube, as a brass tube shields all but the lower tip of the glass.

Before turning on the current, a metal rod is welded to the lower end of the glass and this rod projects through the bottom of the mica oven into a tube filled with a mixture of water and glycerin. When the heat softens the glass, the weight of this metal rod draws the glass into a tube scarcely visible to the naked eye, but so strong that the 1/25,000 inch tube will support a weight of five grams (about one-sixth ounce).

If the nature of the apparatus for which the delicate thread is to be used requires the suspension to be a conductor, the fine tube can either be filled with mercury or plated with a thin film of silver.

Electric Osmose in the Drying of Peat

The technical application of the principle of electric osmose or, as it is frequently and erroneously termed, "electric endosmosis," is exceedingly promising. To define we will use an illustration. In Fig. 1 the electric current is passing through a water solution of lithium sulphate though similar compounds would serve as well. Like all acids, bases and salts each molecule of this salt breaks up in water solution into two kinds of oppositely charged particles called ions—too small to be visible individually.

In fact, electricity is carried through solutions only when some ions are present, for they carry the current. In the illustration the positively charged lithium ions are attracted to the negative pole and reaching it, are discharged. Had copper sulphate been used copper plating would

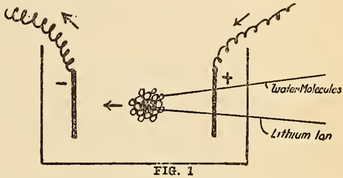


FIG. 1

have resulted. It seems well established by recent research work that all ions are hydrated—that is, have loosely attached to them some molecules of water which they carry along.

Lithium ions carry more water than any other known ion, sodium nearly as

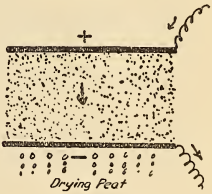


FIG. 2

much, potassium much less and hydrogen almost none. The sulphate ion carries very little. Naturally as the lithium ions proceed to the negative pole—by attraction—they carry a very appreciable quantity of water, while the negative sulphate ions, attracted in the opposite direction by the positive pole, carry very little water.

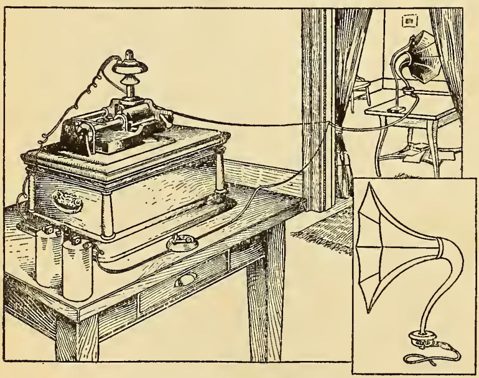
It is interesting to note that the heavily hydrated lithium ions are the slowest known and the least hydrated ions, hydrogen (derived from all acids) are the swiftest. Probably the dragging effect of the water molecules hanging on to the ions accounts for the difference in velocity.

The commercial application is easily shown by Fig. 2, which illustrates a new method of drying peat. The mass of wet peat is pressed between two metallic plates which serve as electrodes, the lower plate being perforated. Of course, the peat water contains some dissolved salts and consequently some positive ions. As these move down to the lower negative plate under a pressure of 100 volts or more they carry with them their little crowd of clinging water molecules. When the ions are discharged on this negative electrode the water lets go and drains off through the perforations in the plate. In Germany peat is dried as cheaply by this means as by the oven process. The enormous use of peat as a fuel makes the process important.—Harry N. Holmes.

Transmitting Phonograph Music

The illustration shows the arrangement I have used at home to entertain friends, and at the same time it enables me to have the phonograph in a room away from the crowd.

Procure a long distance transmitter, including the mouthpiece, and set this on the reproducer stem. Fasten a watch-case receiver to a phonograph horn in the room where the music is to be delivered.



DISTANT PHONOGRAPH TRANSMITTER

Connect as shown, using dry cells, and a two point switch to control the current. A small choke coil placed in the circuit will sometimes improve the sound at the horn.—E. H. Winkler.

Care of Commutator and Brushes

The commutator of a direct current machine being built up of comparatively small bars or segments of copper which are insulated from each other by strips of mica is sometimes troublesome and hard to make run smoothly. Some of the common troubles are here noted, with remedies.

High mica is occasioned by the copper segments wearing away faster, due to frictional contact with the brushes, than the mica, thus causing the brushes to jump, resulting in a blackened commutator surface, caused by the consequent arcing. The remedy is to undercut the mica, or groove it out between the bars to about 1/16 inch in depth and about 1/32 inch in width. This may be done with one of the many devices on the market, or with a hacksaw blade, by replacing the frame with a "stiffener" fitted to the blade. When the mica has been removed, all the slots should be carefully cleaned out and kept clean. After the whole surface has been thoroughly sandpapered, the machine may be placed in operation.

Sparking caused by dirty brush holders preventing the brushes from following any slightly irregular parts on the surface of the commutator may be remedied by using a piece of fine grained grindstone, shaped to the commutator surface and held in contact therewith by hand, with the machine slowly revolving until the surface assumes a clean appearance. It may then be finished, using finer grades of sandpaper, and a high polish may be given by using ordinary lubricating oil in combination with the paper.

In case of dirty and gummed brush holders, they should be thoroughly wiped or scraped if necessary by using kerosene as a remover of the gummy accumulation. When this is done, the brushes, if of the proper size, should then be free to hug the surface.

Chattering and squeaking brushes, being usually more annoying to the attendant than harmful to the machine, may be remedied by readjusting the brushes' angular contact with the commutator. One way to relieve the squeaking is to remove one brush out of each arm, in a spiral path around the whole commutator, and boil in a heavy engine of cylinder oil. Allow them to drain before being replaced. Thus the whole width of the commutator will be lubricated. A little kerosene sparingly applied with a piece of heavy canvas may be used while the machine is running, to remove any gummed oils, etc. Following this by a slight application of engine oil will, as a rule, give good results.—H. G. Wilson.

New Use for Conduit

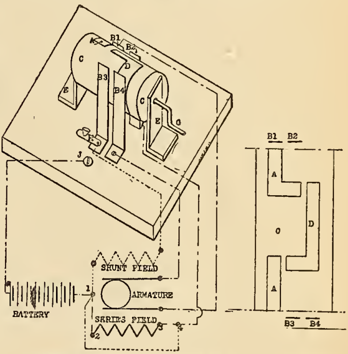
A novel use for clay conduit is reported in the *Western Electric News*.

A wealthy wool merchant, who is a lover of good living, has decided to build a wine cellar in his house. He has bought 600 twelve-inch lengths of vitrified clay conduit and will build the tile ducts into the walls, using them as receptacles for wine bottles. Each piece of conduit, being about a foot long and four inches in diameter, is just the right size to hold a quart bottle comfortably.

This illustrates very clearly the fact that more than one kind of "juice" can be run through a conduit. This may also serve as a hint to architects.

Reversing Switch for Small Motor

An easily made and simple contrivance for reversing a small motor is shown in the sketch. The cylinder (C) can be made from a cork or an old spool with the hole through its center plugged and a piece of No. 14 iron wire (G) wedged in firmly and bent, as shown, to form an axle and handle. The supports (E) may be made from light strip brass or iron



REVERSING SWITCH FOR SMALL MOTOR

or, lacking anything better, a small wooden box with holes in its opposite sides may be used for the supporting framework.

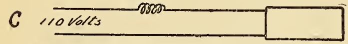
The brushes (B1, B2, B3, B4)—pieces of an old alarm clock spring, or light strips of spring brass or tin—should be bent as shown and fastened with screws so they will bear against (C); (B2) and (B3) must be directly opposite each other and half way from each end of (C); (B1) must be to the left of (B2) and on the same side of (C); (B4) must be to the right of (B3). The two strips (A) and (D) are made of thin sheet copper and are exactly the same size and shape. The surface of (C) rolled out flat shows the position in which these strips must be fastened on it.

Two hook-ups are shown, the series field being the best adapted to most small battery motors. To connect the motor if series wound, use the dash dot wires and the solid heavy "series field." Pay no attention to the dotted wires or to the dotted "shunt field." With this connection the switch (HJ) may be eliminated as whenever the reverser is turned into a position that stops the motor the battery circuit must of necessity be open. Connect wire (J) to (B3).

To connect the motor shunt wound, disregard the solid heavy "series field" and wire (1, 2, 3, 4) using the dotted "shunt field" and the dotted wires. Use all the dash dot wires also, except wire (1, 2, 3, 4). Switch (HJ) must be used with this hook up, as otherwise there would always be a battery circuit closed through the field.—H. S. Worrell.

Illuminated House Numbers

When one is required to find a strange address after dark, he is impressed with the desirability of illuminated house numbers. This, of course, can easily be done by placing an incandescent lamp behind a translucent glass on which the



THREE WAYS OF CONNECTING ILLUMINATED HOUSE NUMBERS

number has been painted. The smallest 110 volt incandescent lamp available is of higher candlepower than necessary for this purpose, so that it is desirable to adopt other means. Here are given three methods of obtaining the desired result. These methods are applicable to any case where it is desired to burn low voltage lamps on a commercial alternating current lighting circuit.

Obviously it is possible to use a transformer as shown in (A). This might be built after some of the methods outlined in this magazine in previous numbers.

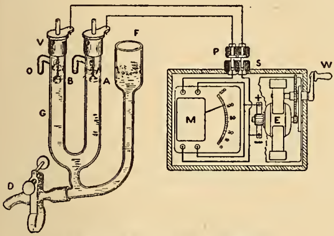
The scheme shown at (B) utilizes telephone condensers and their property of allowing an alternating current to flow through them. The smaller the current required by the lamp, the less capacity is necessary in the condenser. With a small lamp taking 0.25 amperes the capacity required is from two to four microfarads, if the frequency of the alternating current is 60 cycles per second, as is usually the case. In this case there is no loss in the condenser, as would be experienced if a resistance was employed to reduce the voltage at the lamp.

The scheme shown at (C) employs an inductance which consists of a coil of wire wound upon an iron core consisting of a bundle of iron wires. Make an iron core by winding soft iron wire on a wooden cylinder about four inches in diameter. The core should be of one square inch cross-section or over and the wires should be well bound. Wind No. 18 double cotton covered wire on this ring, adding shellac to each layer. Do not have the winding too thick in order that the coil may not overheat. The number of turns required depends upon the amperage of the lamp to be used. About 800 turns on an iron core is sufficient to place in series with a ten volt, ten candlepower tungsten sign lamp on a 115 volt alternating current circuit. One thousand turns is sufficient for a four volt, four candlepower lamp. A continuous iron core is desirable, although a cylindrical coil with a bundle of wires in the middle can be used, but more turns must be provided. This latter method has an advantage of adjusting the position of the core and size of it to fit the lamp used.

The advantage of these methods in reducing the lamp voltage and permitting the use of miniature lamps on commercial circuits is that they entail very little loss of energy in the apparatus. This would not be true, of course, if resistance was used for the same purpose.

Electric Testing of Water Supply

Pure water is practically a nonconductor of electricity, while water containing in solution such substances as acids, bases and salts conducts the current very well. To measure the conductivity—the reciprocal of the specific resistance—of



THE DIONIC WATER TESTER

water, chemists have long used delicate apparatus devised by Kohlrausch for determining specific resistance. Its application heretofore has been wholly limited to water of a high degree of purity and the conductivity was considered directly proportional to the amount of impurity.

Recently a simple device called the Dionic water tester has been put on the market in England and America to use the above principle for measuring approximately and quickly the hardness of water, sewage contamination in rivers, minute traces of impurity in distilled water, priming of steam boilers, etc.

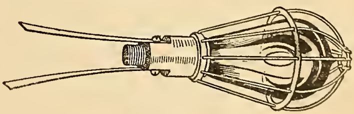
This simple and portable apparatus consists of a U tube of glass containing two platinum electrodes and in addition a hand dynamo and a direct reading conductivity meter. The U tube is washed out and filled with the water to be tested. By the use of a constant speed clutch current at a pressure of 100 volts is maintained and, passing through the water column and the meter, gives a direct reading on the scale of the resistance of the water. In making this scale due allowance was made for all disturbing factors. To be exact this scale is written to read in conductivity—the reciprocal of resistance.

The next step is to have a chemical analysis of the water made and compared with the conductivity reading of the Dionic water tester. From day to day new conductivity readings may be taken in two minutes by unskilled workmen. If these readings are practically the same it is reasonable to suppose there is little or no change in the chemical content of the water. In proportion to any variation in the conductivity one infers a corresponding variation in the chemical content. Thus the expense of more than one chemical analysis is done away with and frequent control tests are made with ease.

Of course conductivity measurements do not discriminate between one kind of impurity and another—analysis alone can do that; but in most instances of water testing for engineering purposes the nature of the impurities present is known, having been learned once for all by a chemist. Further tests then are needed only to show increase or decrease in the percentage of impurity and the new electric device performs these tests with a simplicity and speed impossible in chemistry.

A Convenient Battery Tester

The battery tester here described is excellent in ignition, signaling, bell and battery work. Take an ordinary candelabra or metal socket and solder two strips



BATTERY TESTER

of thin brass, each about six by ¼ inch, one to each contact part of the socket, so placed that the strips will be flat sides together. With this, use a 1½ volt tungsten lamp, which can be protected by a wire guard fastened around it. This simple outfit will indicate by the relative brightness of the lamp when applied to a battery, just what condition the battery is in. In testing, the strips are held apart with the finger sufficiently to touch the binding posts or other contacts.—Henri Piccard.

Testing the Permanence of Colors

It is well known that besides the visible rays in sunlight, the invisible chemical rays, the ultra-violet rays, tend to produce chemical effects, apparently because they lead to resonance of the electrons within the atom. It is these rays which cause snow blindness, sunburn and even, it is thought, the marking of small pox. They are also largely responsible for the deterioration in color of dyed materials. In a recent number of *Science Progress* Mr. J. S. Dow mentions this fact, and alludes to the new quartz tube mercury vapour lamp, which is very strong in these rays. So well is this effect recognized that the carpet manufacturers of North Germany are said to use the new quartz lamp as a means of testing the permanence of their dyes. Formerly they used to send the goods to the sunny south, where there was abundant bright daylight, to which the materials were exposed for weeks at a time. But now it is possible to do by artificial light in a few days what it formerly took weeks to accomplish. And there is also the advantage that this can be done irrespective of climatic conditions.

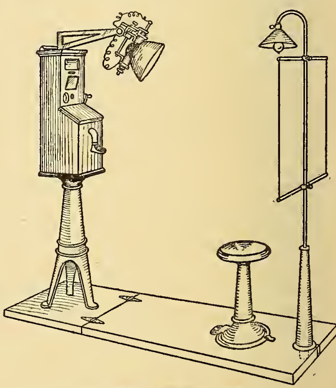
Powerful Incandescent Lamps

An incandescent lamp giving as much light as an arc lamp would be preferable to the arc lamp on account of the superior quality of its light, and its slighter demand for supervision. But for a long time it was found impossible to give to an incandescent lamp a power exceeding about 250 candles, because of the extreme fragility of the filaments required for high intensities of light. This difficulty has been, at least to a large degree, overcome in the Fixfar incandescent lamp, manufactured in Paris. High tension current is avoided by means of a special transformer of the Weissman type, which is placed in the lamp itself, and lowers the tension of an alternating current to 40 volts. The filaments are larger than in the ordinary high tension lamp, and the temperature higher, so that a luminosity of from 100 to 1,200 candles may be obtained.

Take Your Own Picture

Telling yourself to "look pleasant, please," while you take your own picture is the end in view by John Herricht, New York City, who has a patent upon an automatic photographing machine.

The apparatus consists of an arc lamp, a cabinet containing mechanism for actu-



PICTURE TAKING OUTFIT

ating the arc, and also for holding photographic material. A stool, a screen for a background, and an incandescent lamp complete the equipment, which is mounted on a common base. The incandescent lamp is used so that no strong shadows may be present. Pulling a lever on the cabinet imparts enough power to the mechanism to bring the lamp carbons together for a sufficient time to take your picture when seated on the stool.

Should Inventing Be Taught?

By ALBERT SCHEIBLE, M.E.

If there is any one term that has become more prominent than any other during the industrial and commercial developments of the last few years, it is the word "efficiency." Old as the term is, we had been in the habit of applying it almost wholly to machinery or mechanical and electrical equipment. Then it suddenly dawned upon some that if a motor driven shovel is to be judged by its effectiveness, the same standard should hold also for men wielding shovels. And if variations in the design of operative parts and in their rate of motion can make a great difference in the output of a power driven mechanism, might not the same sort of carefully studied changes work a corresponding improvement in the human machine when employed at a given operation?

Thus a consideration of human efficiency took its place with the study of machine efficiencies and the past decade has marked decided improvements all along the line.

All around us there is now a concerted striving for higher efficiency, often extending even into the work of churches and other religious organizations. Yet in the midst of it all there is one line of human endeavor in which the average efficiency is admitted to be very low and in which no determined effort has been made toward improvement. It is the field of independent inventing. Where investigations and experiments leading to inventions are conducted in manufacturing establishments of any size, these are generally carefully planned and highly effective in their results. Particularly is this true of some of the large electrical manufacturing concerns which owe their continued prominence partly to crews of highly trained men paid both for their experimental and for their inventive ability.

But when we leave these inventive groups and look about us among the scattered inventors of the country, we immediately strike almost the opposite extreme. Instead of men expert at the particular lines in which they are working either in the laboratory or on the drafting board, we find men, women and boys dabbling in lines of which they know very little. Instead of men consulting with others who have had valuable experience, we find suspicious and secretive natures which ask no counsel and profit by none. In place of a careful analysis of the commercial outlook for a new device, to determine whether or not the prospects would warrant the cost of patenting it, we find a rash assumption that whatever is novel must be of commercial value. Instead of a basic understanding of our patent system as a protection for new articles having sufficient merit to make them profitably salable, we find the curious conception that the patenting in itself will give a value to a new idea.

Thus in a dozen different ways the point of view of the corporation hired designer is radically different from that of the average isolated inventor. The latter may be just as ingenious, as persistent and as versatile as the former, but what does it avail him? Perhaps he could ably defend his own point of view. But of this you may be sure: the experienced business man knows both the laws and the trade customs, and when he pays good salaries to men of ingenuity he sees to it that they work in harmony with our existing patent system and with commercial practice. Right here is where the isolated inventor usually falls down and that is why the average patentee gets no returns from his invention. He assumes that he knows our patent system from having read some advertising literature, assuming also that he is qualified to enter the ranks of successful patentees and that his own knowledge and judgment are ample.

And why not? Does not Uncle Sam say that a patent may be obtained by "any person who has invented or discovered?" What the inventor overlooks is the fact that our patent system was chiefly designed to protect those who would not only evolve the new idea but who also would introduce it upon the market. To do the latter means a business acumen, a knowledge of market conditions, an ability to develop a crude idea into a commercial article and a keen understanding of the elements of novelty in a new device—all of which are rarely found in the isolated inventor. Moreover, if his patent is really to protect him, he should know how to judge the strength or weakness of a patent, for shoddy in patents wears even less well than in clothes. He must know how to predetermine the extent to which he can monopolize a certain field, for all that the patent does is to give him a basis for a certain seventeen year monopoly. He must know how to tell whether or not the money spent for the patenting should be classed as a promising investment or as a rash speculation. All of this—and more too—is presupposed in the applicant to whom a United States patent really offers returns for his time and money.

But what if the man of ingenuity does not have all of these qualifications and is not connected with a concern that will supply the deficiencies for him? Is he merely to blunder along and take the long chances, with the odds tremendously in favor of those who are otherwise situated? Not when he wakes up, though it is exactly what so many thousands have done in the past. To believe that he will continue doing so when he once understands their situation, would be to malign the prudence of the American inventor.

No, what the inventor of tomorrow will do is to post himself on the implied requirements for a successful patentee and then try to measure up to them. If he has been handicapped by scattering his efforts over a large variety of lines, he will learn to concentrate on some one or two that look promising and in which he can thoroughly ground himself. If his conceptions of inventions and patents are vague and somewhat erroneous (as they are in the case of most inventors) he will be meek enough to admit it, shrewd enough to seek and pay for competent advice, and persistent enough to buckle down to instruction in this line just as he would in any other subject worthy of his time and energy.

"But," you may ask, "can inventing be taught?" Yes, and no. If a man has no ingenuity, no one can funnel it into him. The inventive instinct must be present—the ability to see things not only in their ordinary relations but in uncommon ones also. If this germ of ingenuity is present, why should it not be trained like any other faculty? To do so will require patience and persistence, but without these how can one expect to excel in any line? Of couse, much of this training, as also of the related advice and guidance regarding the commercializing of inventions and the really protective patenting of them, must come from men of experience, men who have actually been "through the mill" as successful inventors and patentees. Perhaps that fact has been most largely responsible for delaying such instruction heretofore, as successful inventors are usually absorbed in their own lines and often jealous of the progress of others. Besides, not every one has that ability to teach and guide others which must also be a prime requisite in the successful instructor of inventors.

But there are such, and when the demand for them arises, when the thousands of patentees who do not even know why their patents have brought no returns realize that they have rushed rashly into a field in which proper training is a requisite for success; when men in all lines learn that remunerative inventing cannot be learnt over night, but is a subject requiring careful study under competent guidance, and when the holding of a patent comes to mean an honor only when the same brings returns for the patentee —then inventing will be recognized as a legitimate and much needed topic of either oral or correspondence instruction. And who will pay for such instruction? Apparently the inventor will bear the burden, but in reality much of it will fall upon the government and the patent attorneys, for the immediate result will be a great reduction in numbers of the kind of patent applications which now are so unproductive of returns. Indeed, a small part of what the average patentee now spends for procuring a single unremunerative patent ought to pay for sufficient guidance to give him a real opportunity when he again approaches the patent office with an application. But first of all, he must admit that he still has much to learn—and when will the average American inventor be ready to make that admission?

Turning Point in Pupin's Life

Michael I. Pupin, to whom we owe the Pupin loading coil, which, installed at intervals in a telephone circuit has added so much to the possibilities of long distance telephony, was turned from his study of Latin and Greek at Columbia University to physics by witnessing Joseph Henry's experiment showing the presence and effect of electro-magnetic induction. Before the American Institute of Electrical Engineers recently he told of the incident.

"It is thirty years to a day since I first saw Henry's discovery. I was a student at Columbia at that time, very fond of Greek and Latin, in fact, so fond of it that I devoted most of my time to the study of Greek and Latin and classical literature. At the same time I was fond of mathematics and of physics, and of chemistry, and there was a doubt in my mind whether, when I graduated, I should take up as my life work classical studies or physics. One day I saw an experiment in the lecture room performed by the late Professor Rood, of Columbia. He had a coil of wire, the terminals of which were connected to a galvanoscope, which was attached to the side of the wall so that the class could see the movement of the magnetic needle. The coil was in his left hand, and he had a magnet in his right hand. He moved the magnet a little bit, and off went the needle to one side, and then he moved the coil back, and the needle moved in the opposite direction. They say that the magnetic needle moves because it is acted upon by the passage of electricity through the coil. Be that as it may, that needle, I am sure, was never as much thrilled as I was thrilled with that experiment, and I said, 'Good-by, Latin; good-by, Greek; I am going to study physics.'"

Making Sugar by Electricity

Whether the time will ever come when it will be possible to manufacture sugar on a commercial scale by the action of a silent electric discharge upon carbon dioxide and water may be doubted, but at any rate sugar has been formed in that way, and, it is understood, patents have been taken out for the synthetic production of sugar by this method. The transformations thus effected appear to be brought about under conditions approximating those that exist in plants.

Ice Insulated Conduits

As electricians know, ice is an almost perfect non-conductor of electricity. It has been suggested that there be used for an electric conductor a pipe of metal. It is to be immersed in a subway kept filled with water and through the pipe cold brine from a freezing machine is to circulate. This would freeze the water in contact with the pipe, thereby insulating it. The brine could be used in supplying artificial cold to refrigerators in stores, markets, or even in private houses. The simplicity of the project and the complete dispensing with ordinary insulation are very striking.

Electrical Securities

By "CONTANGO"

The Prosperity of the Country in the Rural Districts as It Relates to Electrical Development—The Great Extension of Electric Lighting, Power and Telephone Systems the Past Year—How the Farmer Now Possessing an Automobile Insists on Having Electric Light and Every Other Electrical Convenience—The Result as It Affects the Digestion of Electrical Securities—A Growing Investment Opportunity Is the Outlook for the Present and for the Immediate Future.

It has been said that this is the electrical age at high tension. The phenomenal expansion in all branches of electrical science during the last few years has surprised even those most enthusiastically interested in électricity. It is a fact that the public has come at last to realize, if slowly, that the age of steam has passed, and since the beginning of this year stocks of electrical manufacturing companies, hydro-electric, electric traction and all manner of electric light and power companies have been in constant demand. Indeed all such securities—using the term in its widest sense—have shown a generally rising tendency with many a big upward movement in particular favorites.

It will be quite in order then at this time, the close of the year, to examine a little closely as to the reasons for all this and indicate at the threshold of the new year something of what the future is likely to hold in store for those interested in the shares and bonds of electrical companies.

The great prominent fact that must always be kept in mind is the determination of the American people at large, not necessarily to live in extreme luxury, but to have every convenience they can—every practical convenience that may be obtained.

Edison, before the recent political campaign closed, on being asked as to his opinions, was quoted as saying that he considered one of the main causes of the higher cost of living and high prices generally would be found in the higher standard set and demanded by the American people, from year to year, as to what should constitute a decent and live existence.

The real gist of the matter lies in the fact that men of affairs, of positive genius in observing opportunities, have gone ahead to utilize this or that inventor's discovery or dream and make it practicable, and then bit by bit the public in general has been converted and convinced, and each unit jealous or combative, struggling or aggressive, has followed the natural course and trend of human nature that only really lives by being abreast of the flood. So now it comes about, as our Sunday paper comic supplements have oftentimes pointed out, the farmer in remotest places is not in the least content without his "machine," his "phone," and his "'lectric light," and the more light the better.

You have been told of the bumper crops of the United States and Canada this eventful year just closing. They mean of themselves additional railway construction, the carrying out of improved facilities for connection between point and point. They mean increased spending power all round and they mean that those who have been projecting power development, electric lines of traction, transmission lines for current and the like enterprises have merely discounted to a very small degree an era which, if not spoiled by mismanagement, wrongful exploitation or insincerity of purpose, will, as time goes on, only reach its climax when modern convenience is available to all and in every place.

You have been told over and over again that concentration, good management and honest reputation are the safeguards and security of these electrical enterprises. You have been warned over and over again against wild-cat propositions, be it in local water power schemes or local trolley lines. You cannot go it alone, for the part is never greater than the whole and this entire scheme of things electrical is working itself down to the final point of economy and efficiency derived in the main from consolidation and centralization.

You in the country districts, in the smaller towns, dependent on these districts, have done, are doing, and will do more than any others to contribute to this spread in the use of modern conveniences. Then the best thing to do is to participate as far as possible in their practical development. This you can best achieve by placing your money as you may have it to spare, in the best public utility company stocks and securities—such for example as the Public Service Company of Northern Illinois, which exactly illustrates the points just brought out, serving as it does an enormous territory in the central and northern parts of Illinois with an ever growing and ever prospering population to support it. The success of such companies depends on your support, both ways, and of course on good management. The more you are interested the better the service.

As to the management, this does not only mean the mere operation of plants, lines or systems: it means management of finance whereby the capitalization and bonded indebtedness march together in reasonable relations; whereby the former is kept fairly down to actual physical assets and properties. You must remember in this connection that those who do things and project and carry out enterprises must have a reasonable interest for their ability. And as to bonded indebtedness: this must never attain the size of a stupendous load or unwieldly mortgage. Bonded indebtedness must go hand in hand absolutely with the physical development of the property and no further. These things have already been carefully explained to you in detail.

An expansion or boom in one section of the country, whether it be derived from exceptionally good crops, exceptionally heavy settling up by immigration or by some internal movement, or from railway construction, inevitably means corresponding activity in electrical progress. For the very simple reason that trade—commercial activity—always follows the electrical star—the electric light first and with it the trolley line, then the use of electric power and electric domestic conveniences and accommodations.

Having made these points, a few instances, only a very few, for many figures but confuse the mind and spoil the definite aim, will be given as to the success achieved by some electrical companies taken at random from different points, and related not at all except in the particular of good management, and, in some cases, as parts of a chain, in wisely governed and financed systems. For example it may be stated that work on the big hydro-electric plant of the Ozark Power & Water Company, on the White River at Branson, Mo., keeps 400 men busy on the completion of the concrete dam and power house, and it is expected that the dam will be ready to impound water by February 1, 1913, and that the entire plant will be in operation by April 1 next. There is every reason to believe that shareholders of this company will be well satisfied with its operations. The market for the power is at hand. The distance from the Ozark dam to the Springfield sub-station is just short of 50 miles, the transmission line from Joplin to Springfield having now been completed. This gives one an idea in regard to construction. Or, again, from results accomplished, take the American Gas & Electric Company, which was expected at the time this article was written to increase its dividend rate from seven per cent to eight per cent. This company increased its dividend last June from six to seven per cent. All the subsidiary companies of the corporation have shown gains over 1911. Thus for the twelve months ended August 31 the Atlantic City Electric Company showed betterment of gross to the extent of ten per cent, an increase in net of 22 per cent. The Canton Electric Company, Muncie Electric Company, Rockford Electric Company and Scranton Electric Company have all shown as good an advance, the Muncie Electric Company even showing a betterment of 36 per cent in net earnings and an increase of exactly 50 per cent in the surplus after all charges.

Again a few words as to a recent bond issue of a company mentioned in this series. There is more behind the latest financing of the Pacific Gas & Electric Company, which not long since issued $5,000,000 new five per cent bonds, than appeared in the mere announcement of the offering. The Pacific Gas & Electric Company, through an old agreement with its competitor, the Western Power Company, buys something like 25,000 horsepower from the latter company every year. The proceeds of the new issue of bonds, however, are to be used to make various additions and improvements, including a new hydroelectric development which will have an initial capacity of 53,000 horsepower. This development will make the company independent of outside sources of power supply, otherwise the Western Power Company. Within a year the Pacific Gas & Electric Company will be enabled to go it alone, and thereafter there will be no contract relations whatever between the big company and its smaller rival. It is estimated that the savings thereby will be double the amount of the interest on the new bonds.

One may note, too, that there has been a decided boom in the Northwest for some time past and therefore the earnings of properties in the best known cities of Minnesota and Wisconsin must be feeling the favorable condition of affairs. Thus the Northern States Power Company, which company not long ago took over the Minneapolis General Electric Company, is doing well, with the result that the preferred and common stocks are again in better demand. Another company, the recently formed holding company known as the American Public Utilities Company, financed by the Kelsey-Brewer interests of Grand Rapids, Mich., has in the first months of its existence been making a most excellent showing. The management makes an estimate of the probable results for the year ended June 30, 1913, placing gross earnings at $1,134,583, with net earnings of $535,599, which after interest on the underlying securities shall have been taken care of and regular payment on the preferred shares made, means net earnings at the rate of 7.37 on the $2,150,000 common stock outstanding. Reports of operations of all the companies forming the holding company have shown good increases all this year.

In conclusion let it be said that in addition to the varied uses of electricity in the power field of agriculture, it is certain that the general introduction of electric lighting, both along roads and in dwellings, will do much to transform the countryside and diminish the danger from fire. When to this is added the possibilities of the employment of electric traction for passengers and farm products, it will be seen that the whole future prospect is one of national importance. It has been said that much of the idle land in the United States is unused because of the distance from railways, and that it does not require a very great distance from transportation to render a good piece of land unprofitable. When, however, a few miles of electric railway running alongside of a country road, may be made to act as a feeder to the trunk line of a steam railway, there will be opened up for productiveness and profit many thousands of acres of land at present unprofitable.

SCIENCE EXTRACTS FROM FOREIGN JOURNALS

Ozone Purifying System a Success in St. Petersburg.—The electric method of purifying the city water for St. Petersburg is meeting with so much success that the municipality intends to make a large increase in the present plant. The ozone system is used here, and it is very effective in destroying the disease germs which the water of the Neva contains in large numbers, so that a very good drinking water is the result. At present the city is planning to build a new purifying works at a cost of $5,000,000, so as to serve for the whole water supply of St. Petersburg, this being no less than 60,000,000 gallons per day. Among other large companies which have sent in proposals for the new plant is the English Ozonair firm, and as they made the best offer, it is thought that they will secure the contract. Their process is an interesting one, and consists in atomizing the water in the presence of a stream of ozone given by the electric discharge apparatus, and the minute particles of liquid are allowed to fall on a pile of glass spheres, through whose gaps is sent an uprush of ozone. In this way the water and ozone are well brought in contact, so that the purifying action can take place.—*The Electrician, London.*

Making a Motor Dust Proof.—A somewhat novel method of running an electric motor so as to make it dust proof is found in a cement works at Fyansford, in Australia, and the electric plant is specially designed so as to work in dusty air such as is caused by handling the cement. The motor is of the 500 volt, three phase type, and is all enclosed by a steel casing, but there is a good inrush of air through the revolving part by means of openings. An air fan is placed on the shaft of the motor and is also enclosed, and the piping connects with the casing of the electric motor and also with the outside air in such a way that the clean air is taken in from the outside of the building, goes through the motor and cools it, and is then expelled to the outside. In this way the air circulation has no connection with the dusty air within the building, so that the motor always works in clean and cool air and thus works under the best conditions.—*The Electrician, London.*

Electric Motors Dry Themselves.—In a German works which were using a number of electric motors to drive the machinery, it was found that the motors became so damp during the idle periods that it was unsafe to work them without first drying out the windings. An idea occurred to one of the engineers to send a current through the wires of the motors while they were not running, so as to heat them up and thus give them an electric drying by a slow and safe heat. Accordingly he connected the motors to the low tension side of a transformer so as to obtain 260 volts, and after leaving this current on the motors for a time, it was found that they were very well dried out. The current was not strong enough to run the motors, as it was quite below the standard current. As the air in the room was always very damp, it was decided to put this low tension current on the motors at all times when they were out of use, and although this is not very economical, it allows of keeping the motors always in good shape and ready to run, as no moisture can collect upon the inside.—*The Electrician, London.*

The Great Crane of Hamburg.—What is probably the largest electric crane in the world is being built at Hamburg by one of the well known German construction firms, and it is to be used in handling material in the shipbuilding docks. The crane can lift a weight of 275 tons, and is mounted as a pivoting crane, being turned about its center by an electric motor mechanism. It has a reach of nearly 250 feet for handling the load, so that it covers a circle of 500 feet diameter in which it can work. Loads can be raised from any point within this circle to a height of 300 feet. It is expected to have the crane completed before the end of the year, and it is to cost $200,000.—*Genie Civil, Paris.*

Wireless in the Antarctic.—Wireless telegraphy can sometimes be carried out in the Antarctic regions at much greater distances than are usually covered, owing to the state of the air which prevails there at times. A case of this kind is noticed in a wireless plant erected on Macquarie Island, in the Southern Ocean, and when using an ordinary ship's set, the station is able to pick up messages from Freemantle and then repeat them to Fiji, this being due to the favorable conditions which prevail there. Ships as a rule can only receive messages coming from 200 or 300 miles distance, but when in these regions in the long stretch of ocean and absence of bad atmospheric influences they are able to cover much greater distances. The present wireless post is also used as a repeating station to New Zealand.—*Australian Mining Standard.*

Desert Earth Conducts Wireless Waves.—According to the researches made by Dr. Löwy and Göttingen University, the rocks which make up the principal part of the earth's mass can be traversed by the electric waves such as are used in wireless telegraphy, but the bodies of water as well as water-soaked layers of the earth and metals or minerals which conduct the current will not give passage to the waves. As the earth is almost entirely covered by damp earth or bodies of water, the waves are not able to penetrate into the earth when they are sent out from a point on the surface, except when the wireless post is placed in a region which is quite dry—for instance, in the desert. Such posts can also detect underground bodies of water, seeing that the waves will not pass through, but are reflected. To prove his ideas, he took an apparatus into a mine which had over it 6.000 feet of dry rock, with a body of water above this. He found that the waves easily passed through the rock, but went no further, as the water cut them off and reflected them.—*Elektechnischer Anzeiger, Berlin.*

Curious Electrical Effects in the Lake Tchad Region.—Some curious electrical effects were observed in Africa, in the Lake Tchad region, by Dr. Gaillard, a medical officer of the French colonial troops, when on an expedition in the districts of the Niger and Tchad. On one occasion at about 5:30 p. m. he was leaving camp with a party, when he noticed that the horse which preceded him, and was led by a groom, gave rise to electric sparks when brushing the sides with his tail. In fact, the air of these regions seems to be favorable to electric spark effects, for he noticed quite strong sparks given off by his mosquito net. He was lying on a camp bed and stroked the bar with the fingers, and was thus able to draw off sparks which made quite a crackling sound and gave out some light as well. The longest sparks were given by rubbing with the head instead of the fingers, as it is known that the hair will give good electrical effects. Such action was better noticed inside of the straw or earth huts than in the open air.—*Cosmos, Paris.*

The St. Gotthard Electrification.—The commission which was appointed in Switzerland to examine the question of using electricity on the St. Gotthard Railroad has now made a favorable report. The main conclusions are that, allowing double the amount of traffic as shown for 1904, the cost of the enterprise would be $13,000,000, most of which is needed for the electric outfit proper. Against this, the cost of transportation would be lowered at the rate of 72 against 94. On the other hand, Dr. Kummel has been making some calculations on the subject, and shows that a hydraulic plant of 20,000 to 27,000 horsepower would be needed at the north side of the tunnel, working in connection with a similar station of 37,000 horsepower on the south side.

The two regions should be operated separately, however. Water power can be had which will easily cover this amount. —*Elektr. und Masch., Berlin.*

Suspended in Mid-Air.—A trip on an aerial cable line is greatly enjoyed by tourists, as it is quite a sensation to be suspended in a small car which hangs down from an overhead cable and runs high across the surrounding country, and in this way a far-reaching view is to be had. The first aerial line to be constructed in Austria runs from Lana up to the top of the elevated point of Vigiljoch, and it was opened up during the summer season. The length and height are about the same, or 3,500 feet, so that the cableway is a steep one. Cables are run over towers of 100 feet height, and from these a car is hung down from a rolling carriage. Drawing cables are attached to the carriage so as to propel it by means of electric motor driven drums in the top station, and in this way the carriage with its suspended car mounts up the slope to the summit. The car holds sixteen persons and weighs about four tons. A 50 horsepower electric motor drives the cable drum, and it receives current from a mountain hydraulic station.—*Electrical Review, London.*

Leave the Electric Wiring Alone

Why is it that a man who would call in a carpenter to hang a door, who would summon a plumber to put a new valve in a faucet, will not hesitate to repair the electric wiring?

It is a fact that most of the accidents resulting from electric wiring would never have occurred had the wiring remained just as it was installed by the electrician.

Houses are wired by competent electricians, who take every precaution to guard against any leakage of current, any places where the electricity can leave the wires and cause trouble. This wiring is always finally inspected by the insurance authorities, and if it is left just as it is installed there is not the slightest danger of accidental "shocks," "shorts" or fires from crossed wires.—*Electrical Advertiser.*

Bakelite

This is the name, derived from that of its inventor, Doctor Bakeland, of that substitute for gutta percha, ebonite, celluloid, amber and other insulators. It is produced through the condensation of formaldehyde and phenol. It is held to be an electric insulator of the first rank, insoluble in all ordinary dissolvents, and not melting at high temperatures. In chemical constitution it closely resembles Japanese lacquer, the composition of which has always been more or less of a mystery.

NEW BOOKS

Care and Operation of Automobiles. By Morris A. Hall. Chicago: American School of Correspondence. 1912. 134 pages with 118 illustrations. Price, $1.00.

This book aims to give the automobile owner who possesses some mechanical instinct and the proper equipment of appliances and tools such instruction as will allow most of the aggravating simple repairs to be made at home with the least expense and delay.

The Gasoline Automobile. By Victor Lougheed and Morris A. Hall. Chicago: American School of Correspondence. 1912. 298 pages with 276 illustrations. Price, $2.00.

A treatise designed to meet a need for an authoritative and readable presentation of the essential elements of the gasoline motor and its attachments, a discussion of the newer features of the modern car and helpful suggestions regarding road and home repairs.

Wireless Telegraphy and Wireless Telephony. By Charles G. Ashley and Charles B. Hayward. Chicago: American School of Correspondence. 134 pages with 93 illustrations. Price, $1.00.

A practical and understandable presentation of the subjects noted in the title of the book, beginning with the earliest development and concluding with the present apparatus.

POPULAR ELECTRICITY MAGAZINE'S SWORN STATEMENT

Statement of ownership, management, etc., of Popular Electricity Magazine, published monthly at Chicago, Ill., required by act of August 24, 1912.

Note—This statement is to be made in duplicate, both copies to be delivered by the publisher to the postmaster, who will send one copy to the Third Assistant Postmaster General (Division of Classification), Washington, D. C., and retain the other in the files of the post office.

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(Signed) F. W. Harvey, Jr., Business Manager.

Sworn and subscribed before me this 30th day of September, 1912.

(Seal.) Richard Mueller, Notary Public.

(My commission expires May 25, 1915.)

Thomas A. Edison Honored

The formal opening of the New York Electrical Exposition and Automobile Show on October 9th was marked by a function of unusual interest and significance.

Thirty years ago there occurred an event the far-reaching importance of which to the world may well be considered as the beginning of a new epoch in the history of human progress and civilization. This event was the starting of the first central station in New York by the Edison Company on September 4, 1882, thereby commencing the demonstration of the practical and commercial central station system of generating, regulating, distributing and measuring electric current to be used for light, heat and power. It was to celebrate the thirtieth anniversary of this momentous event, and to do honor to Thomas A. Edison, whose work and inventions were embodied in this pioneer station and have since proved to be the foundation and cornerstone of the stupendous electric development that has taken place, that the New York Edison Company tendered to him a formal luncheon on the opening day of the exposition.

The function took place upon the balcony floor of the Grand Central Palace, and was attended by about 400 of the leading electrical, financial and mercantile men of the industry, and numerous distinguished guests.

A large space of the balcony floor of the exposition building had been fenced around with a trellis which was beautifully decorated with autumn foliage. Within this enclosure were four long tables, each seating 100 guests. The decorations on the tables were also of beautiful autumnal flowers and foliage.

At the center of Table A sat Mr. J. W. Lieb, Jr., vice president of the New York Edison Company. At his right sat Mr. Thomas A. Edison, and on his left Mr. Edward H. Johnson; at Mr. Edison's right sat Mr. Samuel Insull of Chicago, and at Mr. Johnson's left Mr. Arthur Williams of the New York Edison Company. The Edison veterans were seated at both sides of the table in the immediate proximity of those already mentioned. At the back of the guest of honor was the word "Edison" in electric lights.

There were among the guests not less than 20 of the men who were associated with Mr. Edison when he started the First Central Station in 1882. Of these, six are still in the New York Edison Company's employ, and were especially named in Mr. Lieb's speech.

Among the other pioneers present, but not now connected with the New York Company, were: W. S. Andrews, Charles S. Bradley, H. M. Byllesby, W. I. Donshea, Charles L. Edgar, F. S. Hastings, William J. Hammer, John W. Howell, Wilson S. Howell, Robert T. Lozier, T. Commerford Martin, William H. Meadowcroft, Frank J. Sprague, Robert M. Searle and Dr. Schuyler S. Wheeler.

Thirty years ago all of them were humble beginners in the industry, pinning their faith to a possibly great future, and drawing but small salaries or wages when the little station on Pearl street, New York, was started.

When the guests were seated and before the lunch was served, the exercises of the afternoon were opened with an original poem by W. J. Lampton, which was read by the well known actor, Robert Lorraine, and was greeted with much applause.

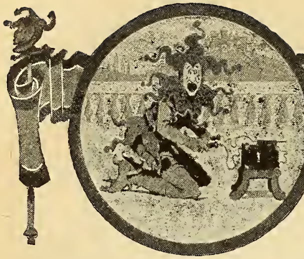
After luncheon the story of the old and the new was given in an interesting speech by Mr. Lieb, after which Mr. Insull made a short address in behalf of Mr. Edison.

Signs Needed in Mexico City

One of the readers of this magazine, writing from Mexico City, announces the need of enterprising electric sign dealers there. He says:

"In Mexico City, a modern commercial and industrial center, with a population of over 500,000 inhabitants, where mercantile operations of every nature are pursued, and competition is a notable feature, it is surprising to notice the lack of electric illuminating advertising signs and novelties, notwithstanding there are several concerns who have an annual expenditure of something like $100,000 for advertising alone. The fact of the matter is, no manufacturers of electric signs have made any worthy effort to extend their trade in this section. The people are enterprising and ever alert for trade novelties and advertising contrivances, and there is a competitive rivalry among manufacturers of beer, cigarettes, mineral waters, etc., which is a condition that offers excellent opportunities for advertising propaganda.

"At least 20 per cent of the population of Mexico City are foreigners, representing every nation of the globe, which causes an amicable national emulation for supremacy with regard to the representation of their native products, a condition which affords a grand occasion for the introduction of novelty electric advertising illuminating signs."



Short Circuits

A subscriber had called a number several times and each time received the busy signal. After a short time he again called and said: ''Say, operator, for goodness sakes, ain't dot line empty yet?''

* * *

A prospective buyer of copper stock went to visit the mining camp and on approaching the hotel was amazed to read the sign as follows:

''Fifth Avenoo Hotel. Rooms Singles or En-soot. Private Wash Pan, Soap and Towel for Bawth Two Dollars a Day Extry. Mannycuring and Massaging Done in Kitchen if the Cook has Time. Silk Nightgowns to Let. Guests Kindly Report any Inattention and Some One will be Shot.''

* * *

''How does it happen that you are five minutes late at school this morning?'' the teacher asked, severely.

''Please, ma'am,'' said William. ''I must have overwashed myself.''

* * *

Two suffragettes were met together, and the one had a grievance against the other.

''I am told,'' she said, severely, ''that you allow your husband to carry a latchkey. Is it possible?''

''Yes,'' answered the other, with an indulgent smile. ''I do let the poor boy carry a latchkey, I must admit. But it doesn't fit the door. I just let him carry it to humor him. He likes to show it to his friends, you know, and make them think he's independent.''

* * *

''Aye vant a ticket to Gothenburg.''

''When do you want to go?'' asked the clerk in an impatient tone.''

''Aye vant,'' she said with simple directness, ''to go van the boat starts.''

* * *

Woman Passenger—''Conductor, why is the train standing here so long? A hot-box? It's funny you never discover these things before the train starts!''

* * *

A foreigner calling Lincoln 7508 gave the order in very broken English as ''Lincoln 75, nothing in the middle, then 8.''

A small boy who was enjoying his first trip to the country stood for several minutes watching a large windmill in the vicinity of the barn. Finally he ventured. ''Gee, mister, you've got a fine electric fan for your pigs.''

* * *

Once upon a time an Irishman was walking through a lonely cemetery and stopped before an imposing looking monument bearing the following inscription: ''I Still Live.''

Pat reflected soberly for a moment and then said, ''Well, if Oi was dead, begorra, Oi'd own up to it!''

* * *

''So you want to marry my daughter?'' ''Yes, sir.'' ''Got any money saved up?'' ''Yes, sir.'' ''Could you let me have $5,000 on my unsecured note?'' ''I could, but I wouldn't.'' ''I guess you can take care of her all right. She's yours, my boy, and here's a five cent cigar.''

* * *

''Susannah,'' asked the preacher, when it came her turn to answer the usual question in such cases, ''do you take this man to be your wedded husband, for better or for worse—''

''Jes' as he is, pahson,'' she interrupted, ''jes' as he is. Ef he gets any better Ah'll know de good Lawd's gwine take him, an' if he gets any wusser, w'y, Ah'll ten' to him myself.''

* * *

Two little children, being awakened one morning and told that they had a new little brother, were keen, as children are, to know whence and how he had come.

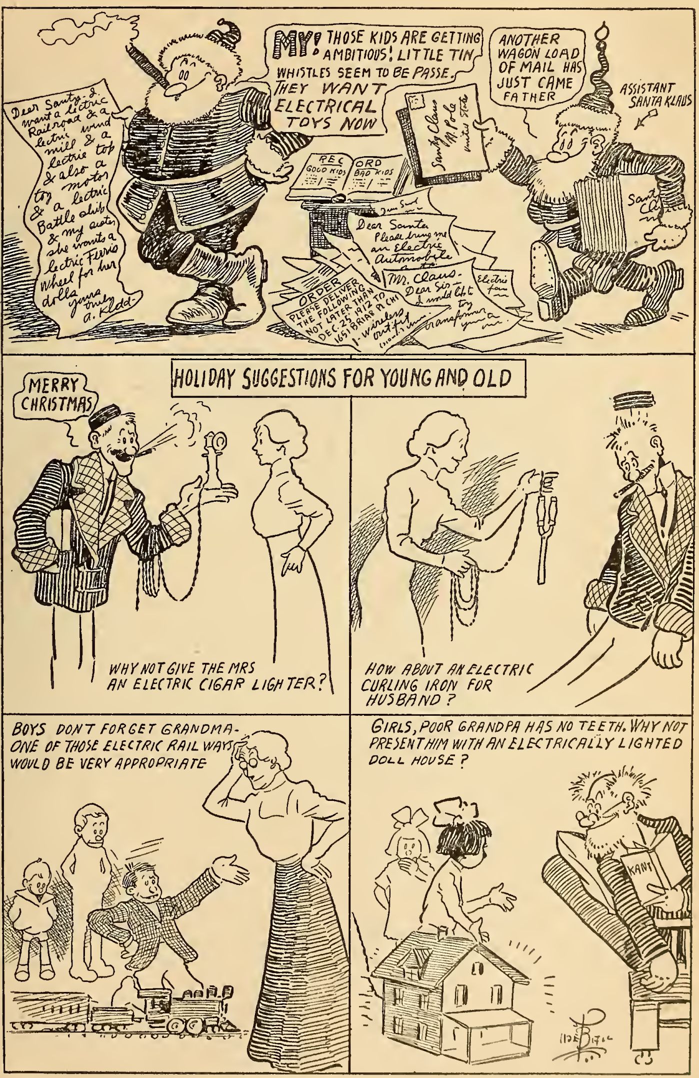
''It must have been the milkman,'' said the girl.

''Why the milkman?'' asked her little brother.

''Because,'' replied the sister, ''it says on his cart, 'Families supplied.' ''

* * *

A psychologist came upon a hard working Irishman toiling, bareheaded, in the street. ''Don't you know,'' said the psychologist, ''that to work in the hot sun without a hat is bad for your brains?'' ''D'ye think,'' asked the Irishman, ''that Oi'd be on this job if Oi had any brains?''


Dear Santy-I want a lectric Railroad & a lectric wind mill & a lectric top & also a toy motor & a lectric Battle ship & my sister she wants a lectric Ferris Wheel for her dolls yours truly A. Kidd.
MY! THOSE KIDS ARE GETTING AMBITIOUS! LITTLE TIN WHISTLES SEEM TO BE PASSE. THEY WANT ELECTRICAL TOYS NOW
REC ORD
GOOD KIDS
BAD KIDS
ANOTHER WAGON LOAD OF MAIL HAS JUST CAME FATHER
ASSISTANT SANTA KLAUS
Santa Claus N. Pole
Dear Santa Please bring me an Electric Automobile
ORDER PLEASE DELIVER THE FOLLOWING NOT LATER THAN DEC. 25 1912 TO 1651 BRIAR PL CHI
1- wireless outfit
Mr. Claus- Dear Sir- I would like toy transformer
Electric fan
HOLIDAY SUGGESTIONS FOR YOUNG AND OLD
MERRY CHRISTMAS
WHY NOT GIVE THE MRS AN ELECTRIC CIGAR LIGHTER?
HOW ABOUT AN ELECTRIC CURLING IRON FOR HUSBAND?
BOYS DONT FORGET GRANDMA- ONE OF THOSE ELECTRIC RAIL WAYS WOULD BE VERY APPROPRIATE
GIRLS, POOR GRANDPA HAS NO TEETH. WHY NOT PRESENT HIM WITH AN ELECTRICALLY LIGHTED DOLL HOUSE?
KANT

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.

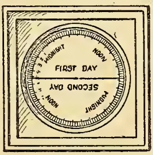
WALL BRACKET.—A bracket used in attaching electric wires to the wall of a building into which they are to run.

WATCH CASE RECEIVER.—A type of telephone receiver much used with wireless telegraph receiving sets. It is sometimes called a "pony" receiver. Being small and compact, it is readily attachable to the head band which holds it to the ear of the operator. (See cut.)

WATCH CASE RECEIVER

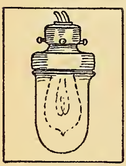
WATER AND WIND LINE.—A place on telegraph poles close to the ground at which decay generally begins to take place.

WATCHMAN'S CLOCK.—In some watchman's clocks a paper dial is caused to revolve slowly over a number of electro-magnetically operated punches. Each electro-magnet is connected to a station in some part of the grounds or place that the watchman visits periodically. At each visit the watchman uses a key to close an electric circuit, or in some systems turns a magneto located at the place, this causing the proper electro-magnet at the paper dial to punch a hole. This hole indicates the station turned in and the time of the watchman's visit. (See cut.)



WATCHMAN'S CLOCK

WATERPROOF GLOBE.—An outer globe for incandescent lamps to protect them from water. (See cut.)



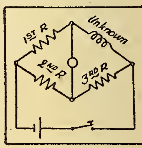
WATERPROOF GLOBE

WATER LEVEL ALARM.—An alarm having its circuit closed by a change in the level of the water in a tank or boiler. A float is used to accomplish the operation of bringing the contacts together.

WEDGE CUTOUT.—See Spring Jack.

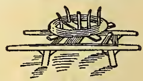
WELDING TRANSFORMER.—The induction coil or transformer used in electric welding. The primary of such a transformer consists of a great number of turns of relatively small wire while the secondary may be only one turn of a large copper bar.

WHEATSTONE'S BRIDGE.—A system of three known resistances connected in such a manner that a third unknown resistance may be connected in on the fourth side (see cut), and its resistance found by adjusting the three known resistances until no current flows through the galvanometer on closing the key. Then by proportion the first resistance is to the second as the unknown resistance is to the third resistance.



WHEATSTONE'S BRIDGE

WIRE BARROW.—A hand barrow upon which a reel of wire may be placed and moved about when stringing pole lines. (See cut.)



WIRE BARROW

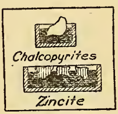
WIRE GAUGE.—A steel disk having at intervals around its circumference slots corresponding to the different sizes of wires. The wire to be measured is tried in the slots until one is found into which it fits snugly. The size is then read under the slot on the gauge.

WIRE FINDER.—A galvanometer used to identify the end of a given wire in a cable.

YOKE.—In an electro-magnet it is the piece of iron which connects the ends farthest from the poles of the two portions of the core on which the wire is wound.

ZERO POTENTIAL.—The electrical condition of the earth is considered as zero; that is, a voltmeter connected to a known source of electric pressure and with the other terminal to ground would show a deflection of its needle equal to the full voltage of the source.

ZINC.—A metal much used in electrical work. Its principal uses are to serve as the positive plate of voltaic batteries and as the spark gap terminals of wireless sending sets. Its specific gravity is 6.8 to 7.2. Its resistance is 3.7 times that of silver, which is one.



DETECTOR CRYSTALS

ZINCITE.—A mineral zinc oxide, used in the form of a crystal to make wireless detectors. The crystals are set in a cup and upon one of these is brought down lightly a crystal of chalcopyrites, making a delicate contact. (See cut.)

ZIRCONIUM.—A mineral crystal used in wireless telegraph detectors.