"LIVE BATTERIES"—THE NATURE AND HABITS OF ELECTRIC EELS

POPULAR ELECTRICITY MAGAZINE

IN PLAIN ENGLISH

(NON TECHNICAL)

FROM BARON VON HUMBOLDT'S DESCRIPTION OF THE ELECTRIC EEL

See "Live Batteries," page 876

Vol. III FEBRUARY, 1911 No. 10

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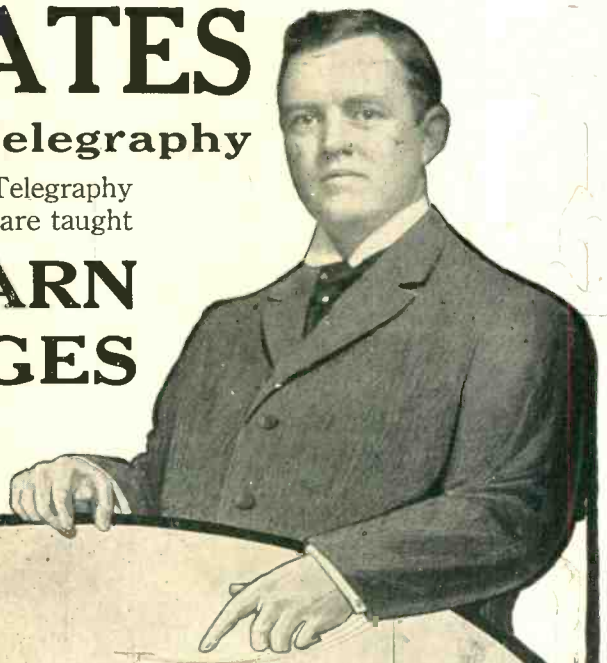

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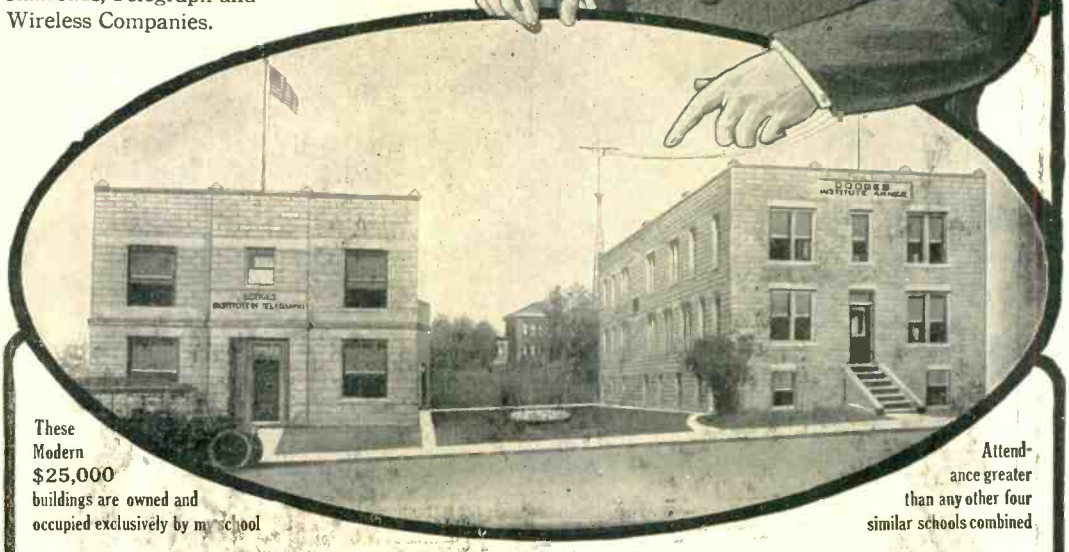

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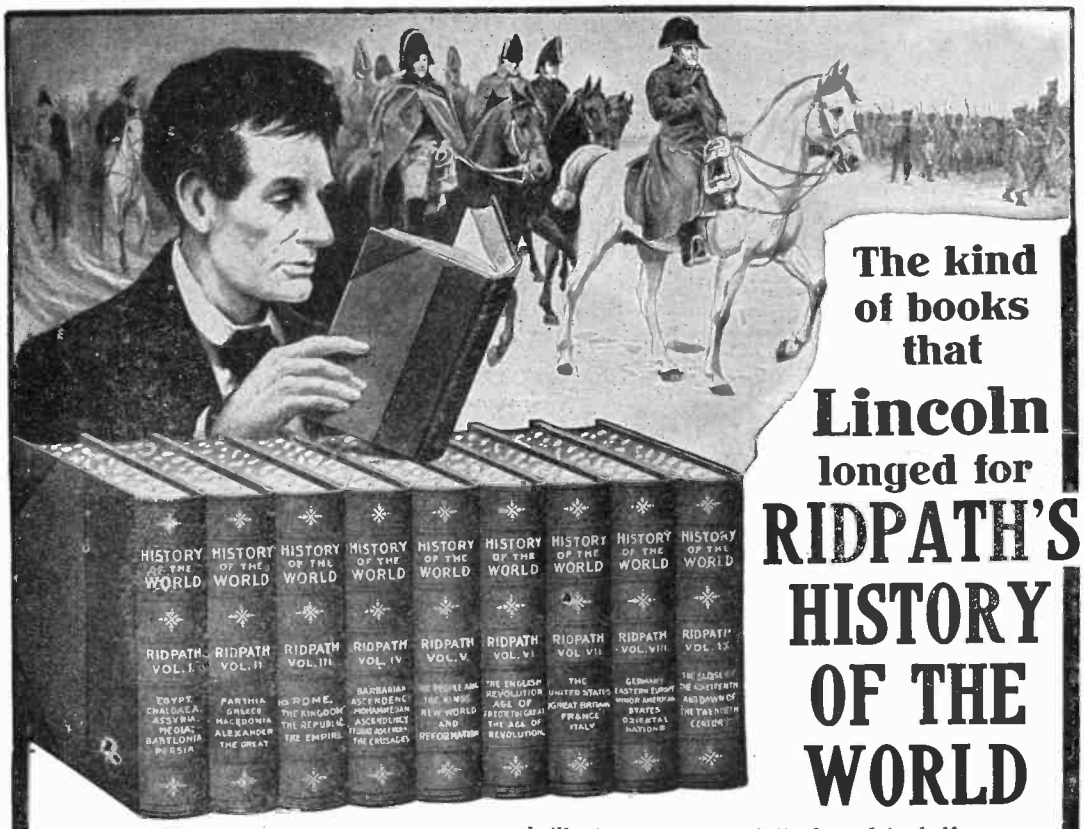

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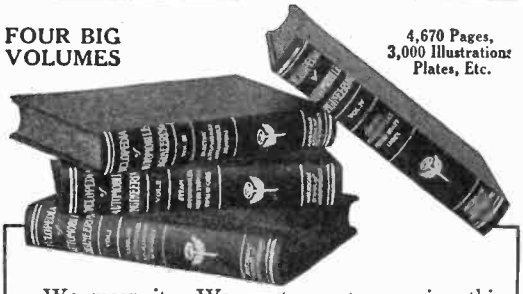

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Electrical Talks—Flash No. 8

THE salesman who wilts and quits at the first "turn down," is not likely to make a success of selling goods. The advertiser who is disheartened because his first advertisement doesn't "pan out," fails to understand the game.

A short time ago a certain firm, hearing of the wonderful success which an advertiser had obtained through our publication, decided to use our medium—tried one issue, was dissatisfied with results and quit—becoming, possibly, a member of the "Advertising-doesn't-pay" club.

The successful advertiser had used large copy for over a year and had quoted prices which could not be equaled by any retailer. The one-time-adventurer quoted prices that any retailer could better—used small copy—and still expected a rush of patronage as soon as he put up his sign.

Is that common sense?

The successful advertiser impresses his name upon the reader's mind, as that of a reliable concern, through consecutive and repeated advertising. The newcomer must win the prestige of stability and reliability in the same way—by consistent and continuous advertising.

"Repetition is reputation"—the great advertising successes in the electrical field prove it. The General Electric did not make a success of their Mazda lamp with a one-time splurge; the Westinghouse Co. knew it would take time to solidify the reputation of their Utility Motor. These and other successful advertisers were prepared for discouraging results at the outset.

There is room for all in the electrical advertising field—except the quitter. The advice which a great sales manager gave to a prospective advertiser—not to start unless he could keep everlastingly at it—overlooks the conditions of some advertisers, no doubt, but it hits the nail on the head. Better a quarter-page twelve times than three pages one time—and out! When making an appropriation, divide the amount by twelve and use that amount of space.

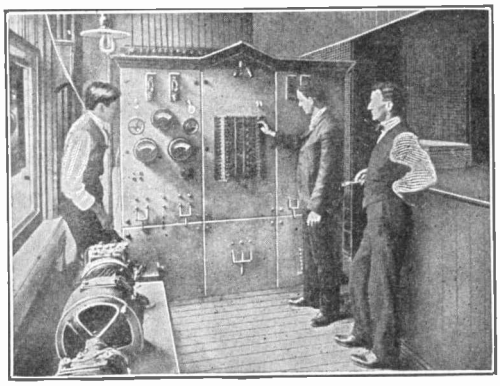
Keep at it continuously—if only with a quarter-page.

POPULAR ELECTRICITY.

What Electricity Offers as a Life Work

By EDMUND SEARLES

The question of life-work is probably the most important which has to be solved. If the right kind of work is chosen and a thorough training secured in that line a capital is created which can never be taken away and which will yield large dividends both in money and satisfaction. Statistics compiled in California show the labor value of the people living in that state to be greater than the value of all other property in the state.



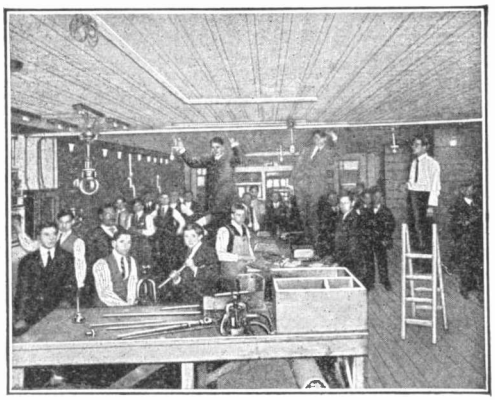
MOTOR-GENERATOR AND SWITCHBOARD IN TELEPHONE AND TELEGRAPH DEPARTMENT

In these days of fierce competition and changing conditions which make the average work simply an employment by a large trust, a person is particularly fortunate who can secure a complete knowledge of a line of work which will make him independent of combinations as well as to earn a satisfactory income. Electricity offers the greatest opportunity to do this.

It is said that electricity is still in its infancy in spite of the tremendous development that has already taken place. While electricity is used in a great many ways, yet the opportunity for extending the use of current is almost boundless. In the use for lighting purposes it can still be developed so as to cover every community where a few hundred people can be reached. For use in factories for power and light, electricity can be extended so that before many years it is probable that almost all machinery will be driven by electric current. Its use by the telephone and telegraph systems is steadily being extended. The general development for business use looks larger than the prospect in any other line.

In addition to the many present uses, electricity will be developed to include many others. For instance, it will not be long before electric heat will be used in many homes. Electricity will soon be the motive power on the majority of the transportation lines, and in many ways not now known electricity will be found useful.

One of the greatest tributes to the commercial value of electricity was given when the new Pennsylvania service was opened into the heart of New York City. This was made possible by electricity. Electric engines are now attached to Pennsylvania trains at Harrison, N. J., twelve miles from New York City, which draw the trains through the tunnels under the Hudson River into the wonderful new station at 33rd Street, New York. Thousands of men have been given employment in connection with the electrical work on this new system.



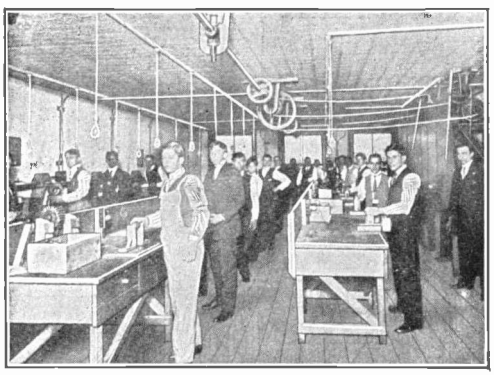
STUDENTS INSTALLING METERS, INCANDESCENT AND ARC LIGHTS

An Electrical show was recently held in New York City, at which were exhibited many new electrical devices to be used in the home, in the factory and for public utilities. A visit to this Show demonstrated the progress made by the manufacturers of electrical devices and indicated that in a brief time most of the results now obtained by the use

of coal and gas would be secured by electric current.

Electricity is taught in theory in many of the educational institutions of the country. In some few educational institutions a limited amount of practice is added to the theoretical instructions.

A review of the many institutions teaching electricity shows one institution which



STUDENTS PERFORMING PRACTICAL WORK IN ARMATURE WINDING AND PATTERN MAKING

stands out pre-eminently for the complete manner in which both the theory and practice of electricity is taught. This is the New York Electrical School, located in the heart of New York City and occupying a building especially fitted for teaching electricity.

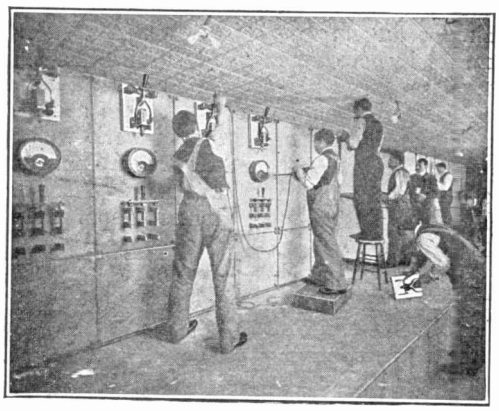
The student before enrolling in the New York Electrical School is taken through the school and shown the method by which electricity is taught. He is told of the theoretical instruction and sees for himself the students engaged in the actual work of carrying out the practice. He is given an opportunity to examine all departments of the school and to be sure that he will receive a thorough training before he is allowed to enroll as a student.

Upon entering the New York Electrical School the student is given a brief outline of the theory of electrical work. The lecturer assumes that the student has no knowledge of electricity and in the most easily understood language tells the electrical story. Many points are illustrated by picture and by the use of the blackboard, so as to bring out strongly each detail.

The wonderful electrical story is spread out for him and he grasps the fundamental points necessary for him to understand before he enters upon the practical work. The instructors are Electrical Engineers and practical electricians, and have been carefully chosen for their ability to explain to the uninformed student the vital points about electricity, without asking him to go through any tedious course of study.

After the first day, the student dons working clothes and begins actual practice. He is expected to apply the theory which is given to him in all of its details. In order that the theory may be kept before him, lectures are interspersed with the practical work, thus keeping alive the essential of the theory while at the same time applying them in practice.

The student does each part of electrical work. For instance, he learns the construction of a small battery and to connect it to a wire with a bell at one end and a push-button at the other so as to make the bell ring. From this small beginning he is carried along until he is proficient in his



GENERAL VIEW OF MAIN SWITCH BOARD SHOWING STUDENTS EQUIPPING BOARD FOR HANDLING ALTERNATING AND DIRECT CURRENT

work. Towards the close of the course the student is assigned work to do which comes under the "trouble" head. That is, he is told to do a certain piece of electrical work with an instrument that is purposely put out of order and no student is graduated from the School until he can detect and remedy the trouble, no matter where it is located.

No time limit is placed upon the work of a student. After entering the New York Electrical School, he is advanced as rapidly as he is able to acquire the necessary knowledge. Some students are able to graduate

in record time while others, being slower to grasp the information, take a longer period. But no student is expected to leave the School until his course is completed, irrespective of the time it takes.

Classes are held in both daytime and evenings. If the student is able to come in the daytime he may devote as much time as he likes to his work. But, if he is employed during the daytime he may take the evening course which is identical with the day course.

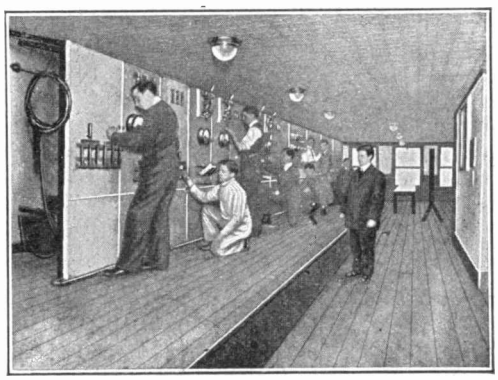
Some interesting developments have arisen from the work of students. For instance, a student recently came from England to take the course. He is the son of a multi-millionaire. His father expects him to take charge of a large business in England. As part of his preliminary training he took the course in the New York Electrical School, so that he would be fully prepared to meet every emergency in his immense factories along electrical lines.

On the other hand, most of the students who enter the School expect to make electricity their life-work and to engage in the various recognized lines. Some continue as journeymen workers after graduation. A considerable number of the students put in several years in working at the electrical trade and then develop into the various higher branches of the electrical business. Some of them become electrical contractors or open stores for the sale and installation of electrical devices for the home. Still others find their training has fitted them to enter large business concerns as electrical advisors and many patents have been taken out by graduates of this school.

A number of students have enrolled for the purpose of learning the fundamentals of electricity in order to apply them to the every-day use of electrical current in the household. If a bell is out of order, they want to repair it themselves rather than to send for an electrician; if any trouble develops with the electric stove or electric lights they want to be in a position to handle it themselves. In view of the importance that electricity is assuming in the household the taking of a course for such a purpose is valuable and proves to be very economical.

Looking over the men who have started as electricians, we find that the growth of electricity has opened many positions which pay large salaries. The electrician working at his trade makes, according to United States statistics, a larger average wage than journeymen workers in other industrial lines. Electricians who have proven themselves proficient have found for themselves splendid positions with the Public Service corporations and large companies that want trained men of quality to take charge of their electrical departments.

To the man with an electrical training who is also a good business man the opportunities in electrical work are practically unlimited. The extension of electricity into



STUDENTS ENGAGED IN OPERATING A. C. AND D. C. SWITCHBOARD INSTALLATION

the country generally, is going on rapidly and a knowledge of electricity backed by good business qualifications, enable a man to grasp these opportunities.

The New York Electrical School has prepared some interesting booklets telling of the possibilities of the electrical business, and giving details of the course of instruction offered, and will be pleased to send these booklets to anyone, on request. The young man just about to decide on his life-work, the man with a good business education who would like to enter the electrical business, and the man who wants to apply a knowledge of electricity to his every-day home-life, should write for copies of this literature.

Opportunity knocks but few times. There are thousands of men who regret their failure to grasp their opportunity. Many of these look back upon their wasted youth when they failed to learn some practical line of work. Perhaps this is your opportunity. Write for this literature.

NEW YORK ELECTRICAL SCHOOL,
40 West 17th Street,
New York, N. Y.

POPULAR ELECTRICITY
IN PLAIN ENGLISH

HENRY WALTER YOUNG, Editor

Vol. III | February, 1911 | No. 10

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ISSUED MONTHLY BY POPULAR ELECTRICITY PUBLISHING CO., Commercial Bldg., Chicago, Ill.
YEARLY SUBSCRIPTION, $1.00: CANADIAN, $1.35; FOREIGN, $1.50; SINGLE COPY, 10 CENTS

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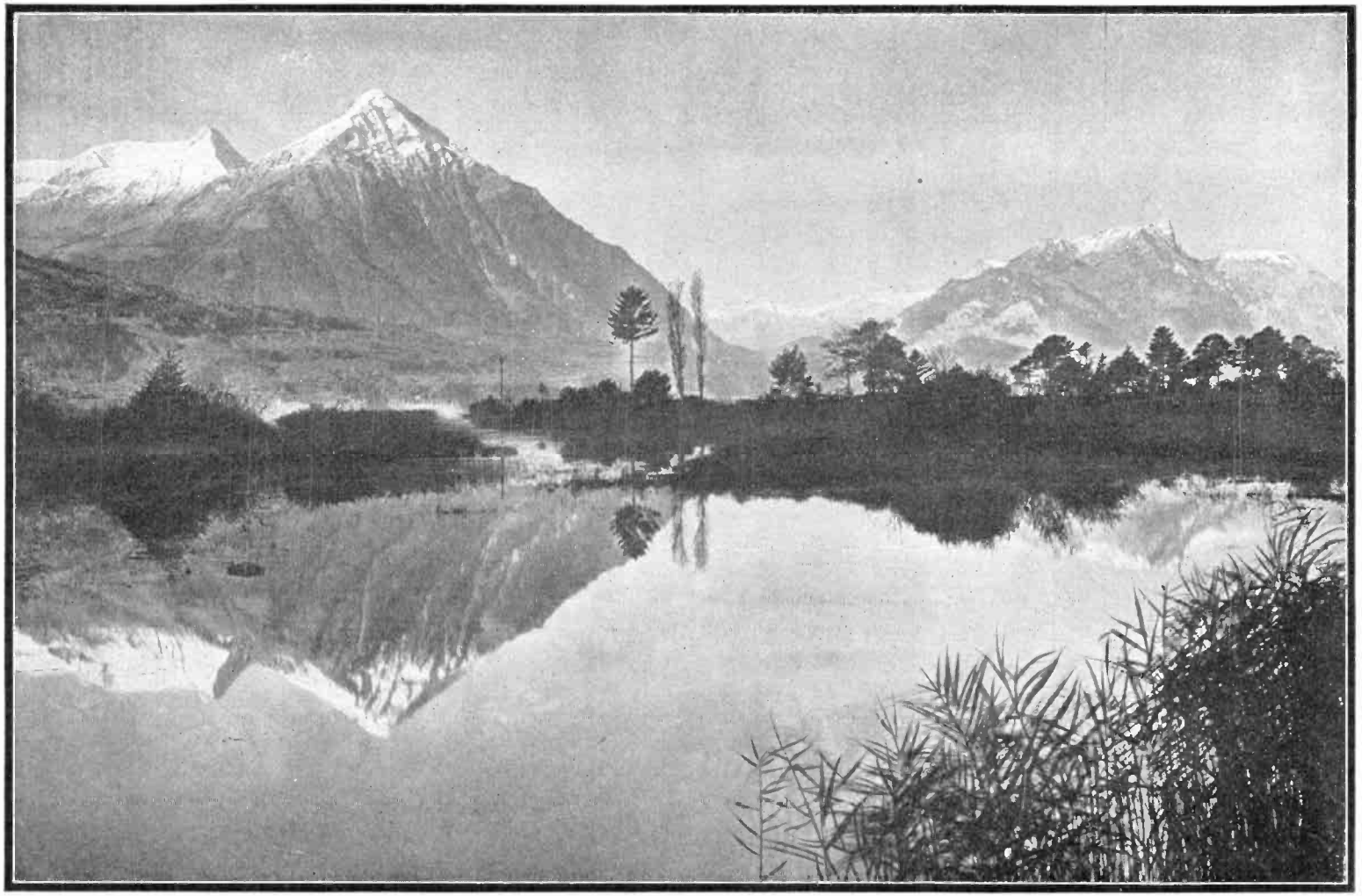
Entered as Second Class Matter April 14, 1908, at the Post Office at Chicago. Under Act of March 3, 1879.



MT. NIESEN, AS SEEN FROM THE LAKE OF THUN

Popular Electricity
In Plain English

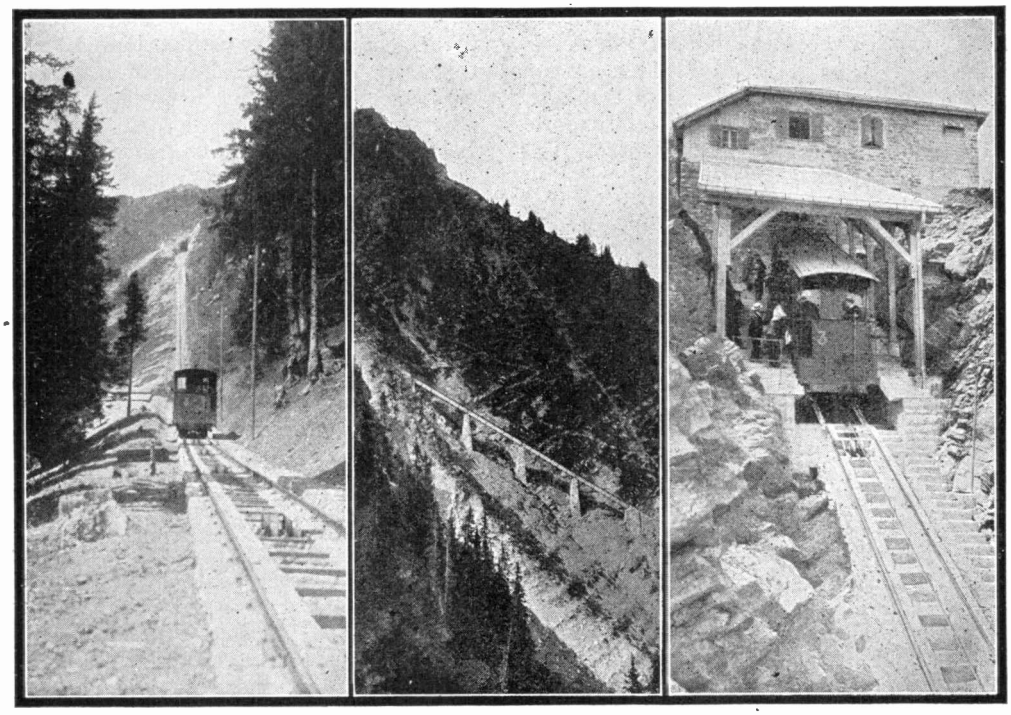
VOL. III FEBRUARY 1911 No. 10

A New Alpine Railway

By DR. ALFRED GRADENWITZ

The latest addition to the network of mountain railways traversing the various cantons of Switzerland is the electrical cable-way up Mt. Niesen, the imposing peak, which by the regularity of its profile, favorably impresses all tourists visiting the Bernese Oberland. The panorama embraced from this summit—as the extreme link in a mountain chain encompassing the left bank of the Lake of Thun—is of surpassing beauty and comprises the whole of the Bernese as well as some peaks of the Valasian Alps, encircling to the north the shining expanse of the lake with the many villages that dot its banks. The valleys of the north lead up to the High Alps, and the lowlands, in a western direction, stretch as far as the blue ribbon of the Jura River.

The very difficult ascent of Mt. Niesen is now made extremely easy by the cable-way



BEGINNING THE ASCENT OF MT. NIESEN

SCHLICTENWALD VIADUCT, WELL UP MT. NIESEN

THE TERMINAL STATION

above referred to, the starting point of which is situated at Mülenen-on-the-Kander, 2,300 feet above sea level, in the immediate neighborhood of the electric section of the Bernese Alpine Railway. It is reached in ten minutes from Spiez Station, the crossing point of the Berne-Thun, Montreux-Zweisimmen, and Interlaken lines and stopping place of the boats plying the Lake of Thun.

On account of technical reasons and in order to make the traffic more lively, the electric cable-way, 2¼ miles in length, was divided into two sections. The lower section leads in 30 minutes through shady pine woods to the intermediary station of Schwandegg (at 5,500 feet above sea level) whence an incomparable view is enjoyed on the lake and the surrounding valleys. After a journey full of variety of another 20 minutes there is reached the terminal station Niesen-Kulm, distant only two minutes from the summit of the mountain.

The ascent of this line is so steep that of course the ordinary kind of electric railway would be of no avail, so it is necessary to draw the cars up the incline by means of steel cables 1.4 inches in diameter. The cable is operated by immense drums which in turn receive their power from motors of 85 and 65 horsepower, respectively. Each car seats 40 people and its equipment includes hand and automatic brakes as well as telephones and alarms connecting with the power station.

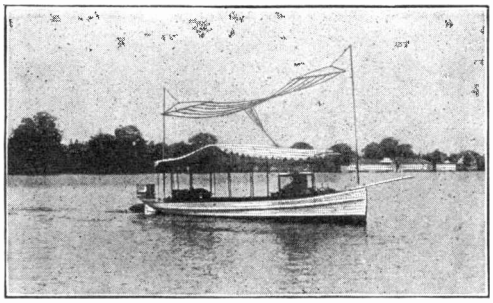
The road bed comprises a sort of masonry dam having on its right a stairway of 10,572 steps for anyone who has lung and heart power sufficient to make the long climb. There are seven important viaducts and two tunnels in the line.

Controlling Boats by Wireless

By ALBERT SCHEIBLE

Any craft that flies into the face of the enemy's fire must expect to go down with its crew. The only way to reduce the loss of life in such a move would consist in steering the vessel from a distance. This has long been one of the favorite dreams of naval experts and its coming true is foreshadowed by tests which the German firm of Beck, Wirth and Knauss have made on a lagoon at Nuremberg, known as the Dutzend Teich.

There, on a recent fine afternoon, a little cutter without a single man aboard was drifting aimlessly on the water when suddenly swinging to port, the crewless motorboat started its propellor and headed for the opposite shore. Tacking back and forth, sounding its gong as a warning signal when approaching other boats and even firing shots, the "Prince Ludwig" executed a series of maneuvres that not only surprised but dumbfounded all spectators. The mesh of wires high above its canopy implied a wireless equipment, but those watching it looked in vain for an operator on board the vessel. Then the more shrewd among them turned to the lighthouse tower with the long antennae that marked it as a wireless station. There, with one hand holding a spyglass and the other manipulating some levers or handles, stood an officer whose every move brought a response from the boat. Was he only experimenting? Or did he fancy that the approaching boats were an enemy's fleet? See! The motorboat heads for them; it puffs out a shot that might mean the firing of a torpedo if the battle were on a larger scale; it bumps into a buoy that might discharge submerged mines several minutes after the boat has beaten a hasty retreat, or just in time to damage the enemy's fleet; it swings close enough to the opposite shore to fire a bomb into the hostile camp—all in obedience to the wireless operator. The vessel itself might be dangerously exposed at all times,



MOTOR BOAT CONTROLLED BY WIRELESS

but even if it were sunk there would be no lives lost with it, for it carries no human crew.

But what if the enemy confronted by the wirelessly operated craft should have a similarly tuned and more intense wireless equipment with which to turn it back upon its own mines, or make it fire upon its own port?

Will the naval battles of the future depend for their outcome on a superiority of wireless equipment?

These conjectures are but a slight forecast of the many interesting problems opened up by the ingenious Christopher Wirth with his successful wireless boat directing, which in itself is probably the most epoch-making of all the experiments of recent years affecting naval progress.

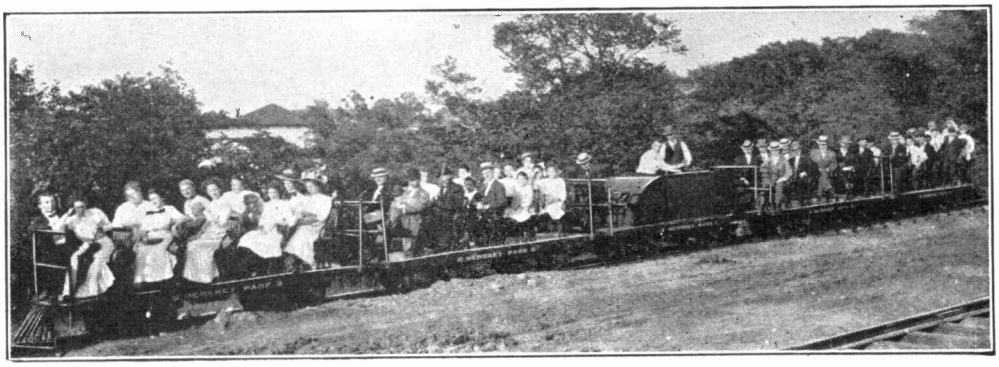
BOAT-CONTROLLING WIRELESS STATION

Miniature Trolley Train

Electricity's inroads on the domain of the steam train do not stop with the trolley lines. As further testifying to the preference of the general public for the electric locomotive a miniature electric railway constructed at Hersey Park, N. Y., entertains a larger crowd than any other of the numerous attractions.

This miniature railway, which is probably the only one of its kind in the United States, runs on a narrow gauge track around the grounds and collects its power from a regular third rail, involving the same shoe arrangement as is seen on the standard type of passenger cars. The electric locomotive is set on miniature trucks made to order after the pattern of the larger ones and is run by two motors. The control consists of a regular motorman's controller and the whole train of four cars and the locomotive is run by a single individual.

The train will average from eighteen to 20 miles an hour carrying a crowd of 50 people. The current carrying third rail is protected and it will be noticed that the locomotive is run in the center of the train, as by this method some operating advantages are obtained.



MINIATURE THIRD RAIL ELECTRIC RAILWAY

The Beginnings of the Telephone

"In that somewhat distant year 1875, when the telegraph and the Atlantic cable were the most wonderful things in the world, a tall young professor of elocution was desperately busy in a noisy machine shop that stood in one of the narrow streets of Boston, not far from Scollay Square. It was a very hot afternoon in June, but the young professor had forgotten the heat and the grime of the workshop. He was wholly absorbed in the making of a nondescript machine, a sort of crude harmonica with a clock-spring reed, a magnet, and a wire. It was a most absurd toy in appearance. It was unlike any other thing that had ever been made in any country. The young professor had been toiling over it for three years and it had constantly baffled him, until, on this hot afternoon in June, 1875, he heard an almost inaudible sound—a faint twang—come from the machine itself.

"For an instant he was stunned. He had been expecting just such a sound for several months, but it came so suddenly as to give him the sensation of surprise. His eyes blazed with delight, and he sprang in a passion of eagerness to an adjoining room in which stood a young mechanic who was assisting him.

"'Snap that reed again, Watson,' cried the apparently irrational young professor. There was one of the odd-looking machines in each room, so it appears, and the two were connected by an electric wire. Watson had snapped the reed on one of the machines and the professor had heard from the other machine exactly the same sound. It was no more than the gentle twang of a clock spring; but it was the first time in the history of the world that a complete sound had been carried along a wire, reproduced perfectly at the other end, and heard by an expert in acoustics.

"That twang of the clock-spring was the first tiny cry of the newborn telephone, uttered in the clanging din of a machine-shop and happily heard by a man whose ear had been trained to recognize the strange voice of the little new-comer. There, amidst flying belts and jarring wheels, the baby telephone was born, as feeble and helpless as any other baby, and 'with no language but a cry.'"

So opens the first chapter of a new and wonderfully interesting book which has just been published by A. C. McClurg & Co., of Chicago. The title of the book is "The History of the Telephone" and its author Herbert N. Casson. Mr. Casson has once again demonstrated his ability to take the historical facts connected with a more or less abstruse mechanical subject and weave them into a story of absorbing interest.

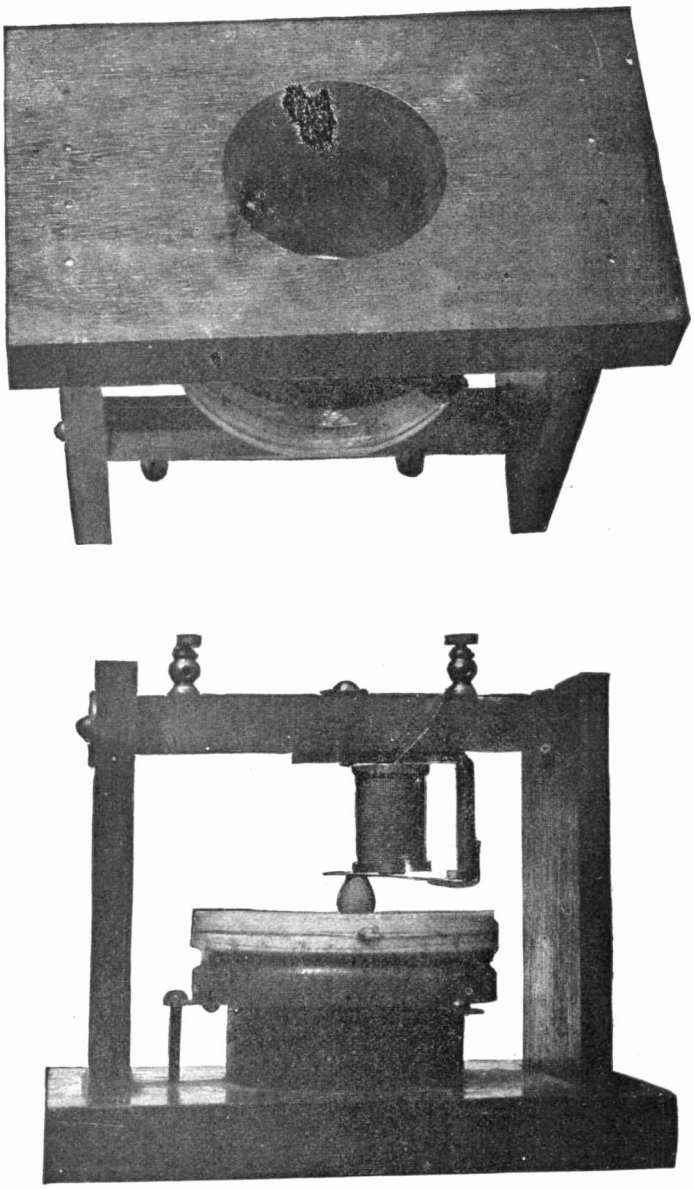
The history of the telephone, which was invented by Alexander Graham Bell at a time well within the memory of many of the readers of this magazine, embodies a series of events, many of them spectacular, many of them romantic, which go into the making of a book which, to use a common expression "reads like a novel."

To quote again from the book:

"In the early summer of 1874, while he [Bell] was puzzling over his harp apparatus, [first suggested to him by Helmholtz's experiments with tuning forks vibrated by electro-magnets] the dim outline of a new path suddenly glinted in front of him. He had not been forgetful of 'visible speech' all this while, but had been making experiments with two remarkable machines—the phonautograph and the manometric capsule, by means of which the vibrations of sound were made plainly visible. If these could be improved, he thought, then the deaf might be taught to speak by sight—by learning an alphabet of vibrations. He mentioned these experiments to a Boston friend, Dr. Clarence J. Blake, and he, being a surgeon and an aurist, naturally said, 'Why don't you use a real ear?'

"Such an idea never had, and probably never could have, occurred to Bell; but he accepted it with eagerness. Dr. Blake cut an ear from a dead man's head, together with the ear drum and the associated bones. Bell took this fragment of a skull and arranged it so that a straw touched the ear drum at one end and a piece of moving smoked glass at the other. Thus, when Bell spoke loudly into the ear, the vibration of the drum made tiny markings upon the glass.

"It was one of the most extraordinary incidents in the whole history of the telephone. To an uninitiated onlooker, nothing could have been more ghastly or absurd



ALEXANDER GRAHAM BELL'S FIRST TELEPHONE

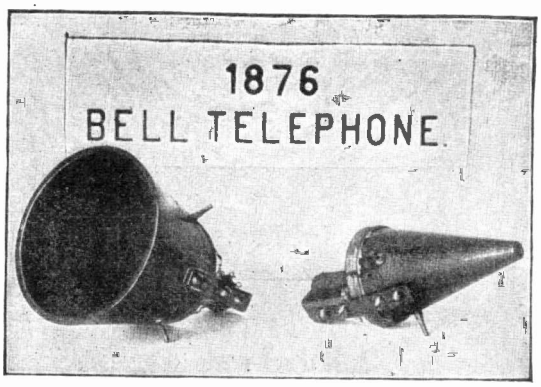
By Courtesy of A. C. McClurg & Co.

How could any one have interpreted the gruesome joy of this young professor with the pale face and the black eyes, who stood earnestly singing, whispering and shouting into a dead man's ear? What sort of a wizard must he be, or ghoul, or madman? And in Salem, too, the home of the witchcraft superstition! Certainly it would not have gone well with Bell had he lived two centuries earlier and been caught at such black magic.

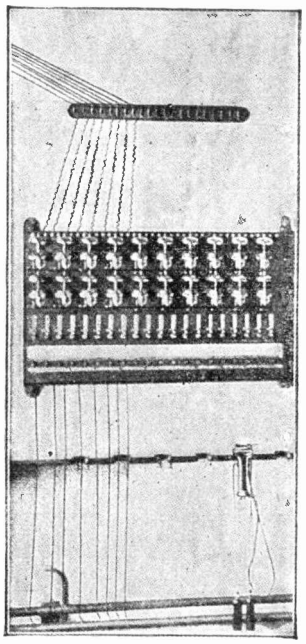
"What had this dead man's ear to do with the invention of the telephone? Much. Bell noticed how small and thin was the ear-drum, and yet how effectively it could send thrills and vibrations through heavy bones. 'If this tiny disk can vibrate a bone,' he thought, 'then an iron disk might vibrate an iron rod, or at least, an iron wire.' In a flash the conception of a membrane telephone was pictured in his mind. He saw in imagination two iron disks, or ear-drums, far apart and connected by an electrified wire, catching the vibrations of sound at one end, and reproducing them at the other. At last he was on the right path, and had a theoretical knowledge of what a speaking telephone ought to be. What remained to be done was to construct such a machine and find out how the electric current could best be brought into harness."

Having arrived at this stage, as if Fortune felt that he was winning success too easily, Bell met with a serious setback. Two men, Gardiner Hubbard and Thomas Sanders, who had been backing him financially said they would pay no more unless he confined his experiments to the musical telegraph and stop wasting his time on ear toys. Bell wished to marry the daughter of Hubbard, and his prospective father-in-law even withdrew his consent to the marriage unless Bell abandoned the "foolish telephone."

Bell was poor, very poor, for he had given up his lucrative position of professor in Boston University. While stumbling through this Slough of Despond he was called to Washington by his patent attorney and finally reached there by borrowing the price of a return ticket

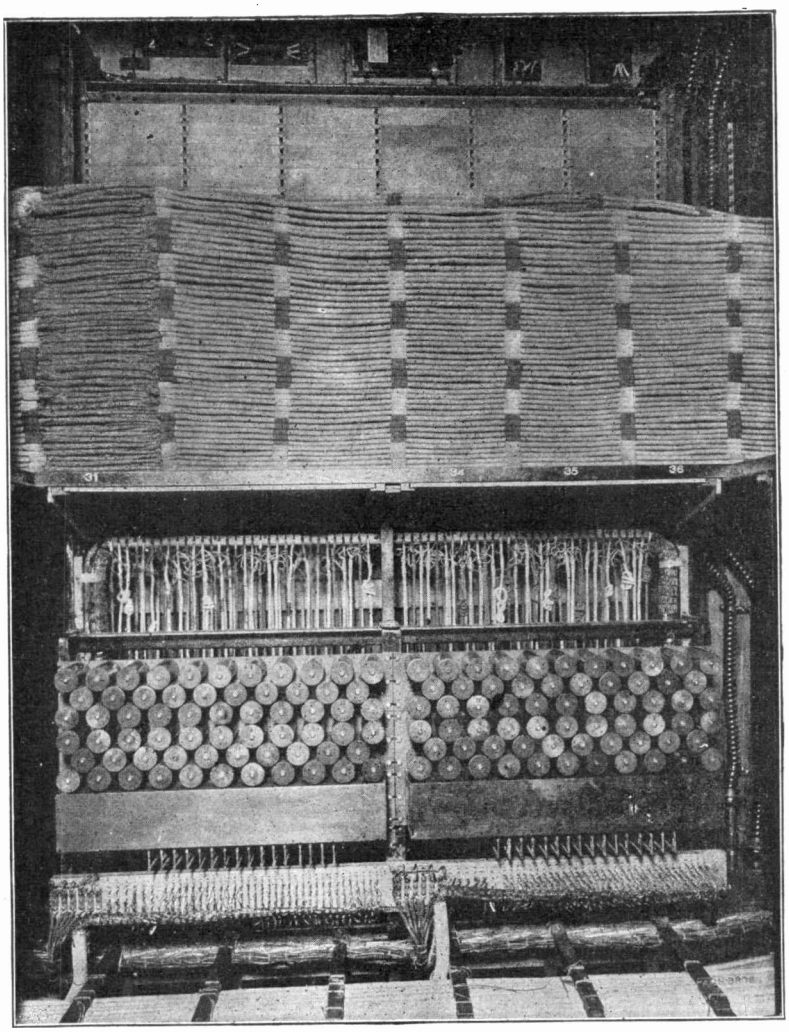


FIRST BELL TELEPHONES, PHOTOGRAPHED FROM THE ORIGINAL INSTRUMENTS IN THE PATENT OFFICE AT WASHINGTON



FIRST EXCHANGE SWITCH BOARD WITH TWENTY CIRCUITS EQUIPPED IN 1878

By Courtesy of A. C. McClurg & Co.



BACK SECTION OF MODERN SWITCHBOARD

By Courtesy of A. C. McClurg & Co.

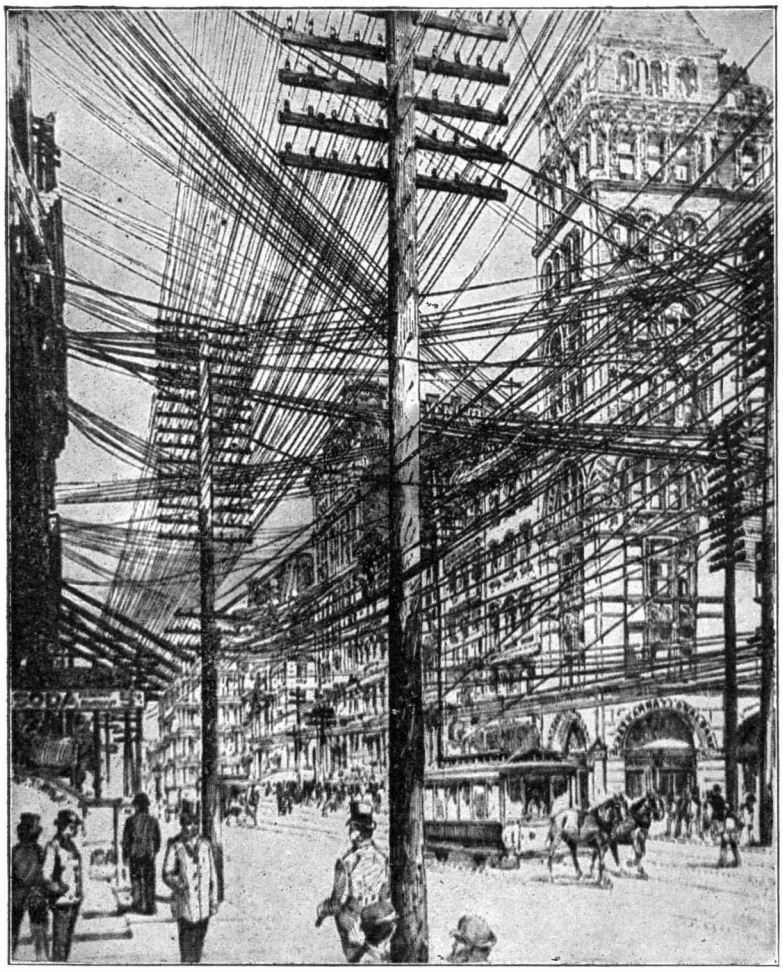
from Hubbard. At Washington Bell went to Professor Joseph Henry, who then knew the theory of electrical science better than any other American and showed him his apparatus. The great scientist said :

"You are in possession of the germ of a great invention and I would advise you to work at it until you have made it complete."

"But," replied Bell, "I have not the electrical knowledge that is necessary."

"Get it," responded the aged scientist.

These few words encouraged Bell wonderfully and again he went to work. To continue again in the words of the book: "For forty weeks—long exasperating weeks —the telephone could do no more than gasp and make strange inarticulate noises. Its educators had not learned how to manage it. Then, on March 10, 1876, it talked. It said distinctly, 'Mr. Watson, come here, I want you.' Watson who was at the lower end of the wire, in the basement, dropped the receiver and rushed with wild joy up three flights of stairs to tell the glad tidings to Bell. 'I can hear you!' Watson shouted breathlessly. 'I can hear the words.'



FROM A PHOTOGRAPH

BROADWAY AND JOHN STREET, NEW YORK, IN 1890, SHOWING THE DENSITY OF OVERHEAD WIRES

By Courtesy of A. C. McClurg & Co.

"It was not easy, of course, for the weak young telephone to make itself heard in that noisy workshop. No one, not even Bell and Watson, were familiar with its odd little voice. Usually Watson, who had a remarkably keen sense of hearing, did the listening; and Bell, who was a professional elocutionist, did the talking. And day by day the tone of the baby instrument grew clearer—a new note in the orchestra of civilization.

"On his twenty-ninth birthday, Bell received his patent, No. 174,465—'the most valuable single patent ever issued' in any country. He had created something so entirely new that there was no name for it in any of the world's languages. In describing it to the officials of the Patent Office, he was obliged to call it 'an improvement in telegraphy,' when in truth, it was nothing of the kind. It was as different from the telegraph as the eloquence of a great orator is from the sign-language of a deaf-mute."

As though the very stars in their courses were working for this young wizard with the talking wire, the Centennial Exposition in Philadelphia opened its doors exactly two

BROADWAY AND JOHN STREET, NEW YORK, AS IT APPEARS WITHOUT OVERHEAD WIRES

By Courtesy of A. C. McClurg & Co.

months after the telephone had learned to talk. Bell felt that he could not afford to go. But one Friday afternoon, toward the end of June his sweetheart, Mabel Hubbard, was taking the train for the Centennial, and he went to the depot to say good-bye. Upon finding out for the first time that he could not go she coaxed and pleaded with him. Finally like a true Sir Galahad, he dashed after the moving train and sprang aboard without ticket or baggage.

"As it happened, this impromptu trip to the Centennial proved to be one of the most timely acts of his life. On the following Sunday afternoon the judges were to make a special tour of inspection and Mr. Hubbard, after much trouble had obtained a promise that they would spend a few minutes examining Bell's telephone. By this time it had been on exhibition for more than six weeks, without attracting the serious attention of anybody.

"When Sunday afternoon arrived, Bell was at his little table, nervous, yet confident. But hour after hour went by and the judges did not arrive. The day was intensely hot,

and they had many wonders to examine. There was the first grain-binder, the musical telegraph of Elisha Gray, and the marvellous exhibit of printing telegraphs shown by the Western Union Company. By the time they came to Bell's table, through a litter of school desks and blackboards, the hour was seven o'clock, and every man in the party was hot, tired and hungry. Several announced their intention of returning to their hotels. One took up a telephone receiver, looked at it blankly, and put it down again. He did not even place it to his ear. Another judge made a slighting remark which raised a laugh at Bell's expense. Then a most marvellous thing happened—such an incident would make a chapter in 'The Arabian Nights Entertainments'.

"Accompanied by his wife, the Empress Theresa, and by a bevy of courtiers, the Emperor of Brazil, Dom Pedro de Alcantara, walked into the room, advanced with both hands outstretched to the bewildered Bell, and exclaimed: 'Professor Bell, I am delighted to see you again.' The judges at once forgot the heat and fatigue and the hunger. Who was this young inventor with the pale complexion and black eyes, that he should be the friend of Emperors? They did not know and for the moment even Bell himself had forgotten, that Dom Pedro had once visited Bell's class of deaf mutes at Boston University. He was especially interested in such humanitarian work and had recently helped to organize the first Brazilian school for deaf mutes at Rio de Janeiro. And so, with the tall, blond-bearded Dom Pedro in the centre, the assembled judges and scientists—there were fully 50 in all—entered with unusual zest into the proceedings of this first telephone exhibition..

"A wire had been strung from one end of the room to the other, and while Bell went to the transmitter, Dom Pedro took up the receiver and placed it to his ear. It was a moment of tense expectancy. No one knew clearly what was about to happen, when the Emperor, with a dramatic gesture raised his head from the receiver and exclaimed with a look of utter amazement: "*My God—it talks!*"

"Next came to the receiver the oldest scientist in the group, the venerable Joseph Henry, whose encouragement to Bell had been so timely. He stopped to listen, and, as one of the bystanders afterwards said, no one could forget the look of awe that came into his face as he heard that iron disk talking with a human voice. 'This,' said he, 'comes nearer to overthrowing the doctrine of the conservation of energy than anything I ever saw.'

"Then came Sir William Thomson, latterly known as Lord Kelvin. It was fitting that he should be there, for he was the foremost electrical scientist at that time in the world, and had been the engineer of the first Atlantic cable. He listened and learned what even he had not known before, that a solid metallic body could take up from the air all the countless varieties of vibrations produced by speech, and that these vibrations could be carried along a wire and reproduced exactly by a second metallic body. He nodded his head solemnly as he rose from the receiver. 'It does speak,' he said emphatically. 'It is the most wonderful thing I have seen in America.'

"So one after another, this notable company of men listened to the voice of the first telephone, and the more they knew of science, the less they were inclined to believe their ears. The wiser they were the more they wondered. To Henry and Thomson, the masters of electrical magic, this instrument was as surprising as it was to the man in the street. And both were noble enough to admit frankly their astonishment in the reports which they made as judges, when they gave Bell a Certificate of Award. 'Mr. Bell has achieved a result of transcendent scientific interest,' wrote Sir William Thomson. 'I heard it speak distinctly several sentences . . . I was astonished and delighted . . It is the greatest marvel hitherto achieved by the electric telegraph.' "

These few brief extracts show the kind of reading in the new book. It goes on to recount the early difficulties in making the telephone a commercial proposition; tells of the brilliant men who took up its cause, perfected it, financed it, and added the business brains; the beginnings of long-distance telephony; the development of the art down to the present time. All along, the story is told in the same simple, entertaining style which characterizes the opening paragraphs.

The Flying Scarab and the Seventh Heaven

By RENE MANSFIELD

I.

Fletcher Kent, inventor among other things of Kent's Aeromotor Muffler and Kent's system of aero-telephony, as well as a successful sustainer; champion aviator of a continent or two and unwilling idol of several more—Fletcher Kent, in pale blue pajamas was treading the greensward with pink, dew-drenched feet, in the early dawn of a June day. In his left hand he held a spray of wild roses which he frequently sniffed; with his right he steadied the pail of spring water that rested upon his shoulder.

Click—click! The enterprising eye of the *Daily Sun*, concealed behind a bush near by, winked impudently at Fletcher Kent. The world and his wife at breakfast next morning would gaze delighted at a picture of the famous flyer in his robe de nuit, feet au naturel, and presenting the appearance of a bifurcated Rebecca at the well.

Splash—and again splash!

"Oh, that's all right, Mr. Kent," spluttered Dawson of the *Sun*, as he emerged from behind the bush, pouring the spring water from the gulleys of his soft hat, and sopping it up with a couple of handkerchiefs from his coat. "Don't mention it. It didn't hurt the camera in the least."

"Now you get out of here," roared Kent. "Is a man never to have a blamed minute's privacy, without some of you fellows on his trail? I tell you it's outrageous!"

"Sorry you feel that way about it, Mr. Kent," said Dawson serenely, tucking his camera under his arm and starting for the cowpath that led to the main road. "Orders is orders, you know."

Horrid visions of the fantastic film that reposed in the reporter's camera cooled Kent's ire for a moment.

"See here, Dawson," he began, setting his pail down with determination and absently sticking the spray of roses in the pocket of his garment, "see here, now, you can't use a picture like that, you know—really you can't. Absurd! Ridiculous!—But of course, you're not seriously intending to?" Kent summoned a feeble, wheedling laugh.

Dawson lifted his water-soaked hat with difficulty, but with elegance.

"Good morning, Mr. Kent," he responded pleasantly as he struck off down the road.

"But I won't have it—I tell you I won't have it," cried Kent to Dawson's retreating back. Dawson gave every indication of considering the conversation closed. "Oh, well," flung Kent, picking up the empty pail with violence. "Print it and be damned!"

"Thank you for your kind permission," acknowledged Dawson sweetly from over his shoulder.

Kent strode into the sleeping-tent with choler in his bosom that wilted the flower in his breast pocket. Butler, his wireless telegraph operator, sat on the edge of the air mattress pulling on his shoes with early morning languor.

"I tell you, Butler, I won't stand it!" Kent sat down on the top of a trunk with emphasis.

"Well, wha'smatter now?" inquired Butler sleepily.

"Matter? Do you think you'd get any keen pleasure in having your picture scattered over the country in *these*? Heroic garb for a man who calls himself a scientist, is it not? 'Kent taking the Kneipp cure,' I suppose they'll label it, or 'the aviator at off moments,' or——"

"Good Lord!" broke in Butler, sitting up, "did they get you that way?—'With a rose in his buttonhole'—" he sang.

Kent snatched the wilted blossom from his pocket. "You may be able to find some humor in the affair, Butler, but I swear I don't. Came out to this forlorn old prairie to escape the press and experiment in peace. Very first morning when I arise with the birds—how could you sleep through their clatter, Butler?—and saunter out to the spring with a yearning to get near to nature, and without the formality of dressing, behind the bushes at 5 a. m. lurks one of those rascally reporters——"

"Good heavens, Kent, you're as fussy as the old lady Godiva. Didst pluck out the eyes of the varmint?"

Kent grinned. "No, but I dashed cold water on any hopes he may have entertained—nice, clear, cold water from the spring.

But, I say, Butler, I'm going to outwit those chaps somehow, I don't propose to be dogged to death about this thing we're working on now. I won't give up a word about that till I'm good-and-ready, if they line up four deep around here." Kent's jaw took on the expression that had inspired the *Sun* to speak of "the fighting face of the man who had flown from ocean to ocean, waging constant battle with the crafty elements."

"By George, Butler," he exclaimed after a minute's thought, "let's disappear!"

"I'm on," said Butler, succinctly.

And so they did. Two mornings after the *Daily Sun* made extended mention of it.

"Fletcher Kent, with Albert Butler, wireless expert, has suddenly left Plainville where he had gone to conduct experiments along an entirely new line, the nature of which have not as yet been disclosed. There is some mystery about their disappearance, as, although their camping outfit is gone, as well as the famous Flying Scarab, inquiry of the Plainville station agent established the fact that no shipment had been made from the village for several days. Friends of the aviator know nothing of his whereabouts and some concern is felt," etc., etc.

II.

"Gad, if I were a poet!" breathed Fletcher Kent. Above him, a cloudless, fathomless blue; below him a swift flowing sea of verdure, the fields like golden crests on the emerald waves of the luxurious country. Now and again a farmhouse appeared for a moment like a bit of bark riding the undulating hills; here and there a river gleamed like a silver-moted moonbeam. The Flying Scarab was the only aerial craft navigating the pathless waste for miles around.

Although he spent most of his waking hours in the air, Kent never failed to experience an exhilarating sense of power, mingled with awe, when he realized that he was coursing through long-forbidden and unexplored areas, where only the birds might question his right of way. The day was perfect. The upper currents of air were steady, the lower just breathed on the tree tops, stirring them gently.

Being unfamiliar with that section of the country, Kent dipped his elevating plane slightly and dropped several hundred feet to sight the land marks he had noted. Presently what seemed a black snake, emitting a vapory breath, and winding through the green, he knew to be a long train of cars, and soon the cliff-fringed eye of Polar Lake was beneath him. Across its placid surface he skimmed, headed for the cliff whose steep sides reared their wooded crests high above the surrounding shore line.

While still above the lake Kent shut off his power and glided easily to the plateau-like clearing at the summit of the cliff. So well had he gauged his descent that the wheels beneath the machine scarcely made a single revolution after touching the ground. Kent leaped from his seat. Then he clutched a lever and leaned against a sustainer for support. Before him stood an angel, or a dream, or a dryad priestess, or some such divinity. Angels, he reflected, were not in the habit of displaying round, brown ankles beneath snug fitting tailored skirts, and above trim brown shoes. Dreams, as he recalled them, were pale and pasty affairs, showing none of the tanned detail of the plump arms, and hands clasped in wonderment before him, like a child's. A dryad priestess would scarcely wear her hair in a red-brown braid swung over a bosom that rose and fell excitedly beneath a soft shirt with a turn-down collar.

By this process of elimination it would seem that it might be a real girl standing before him here on a cliff of Polar Lake, miles, as he had supposed, from any habitation. Then the brown of her little feet, and the gold glint of her wind-blown hair, against the fluttering foliage, made him think of autumn leaves and the elusive swaying of slim branches.

"Might you be Miss Daphne?" he asked finally, not at all certain of his mythology.

"Might *you* be Mr. Mercury?" she inquired in return.

"This *might* be Mount Olympus," he affirmed decisively, including in his admiring glance the lake like a sapphire far beneath, the woods behind like a huge velvet throne against a curtain of turquoise—and the girl like a wood nymph startled by a faun.

"It is the Seventh Heaven," the girl stated simply.

"It is," Kent agreed devoutly.

"Have you a passport, Mr. Mercury?" she demanded demurely.

Kent racked his scientific brain for a poetic response. Mythology and poesy failed him. But strategy came to his aid.

"MIGHT YOU BE MISS DAPHNE?" HE ASKED

"I have not, Miss Daphne, I'll go back at once to get one." He made as if to resume his seat in the Flying Scarab. "Careless of Jove to send me off like that. I beg your pardon for my intrusion——" he was manipulating a couple of levers industriously.

The girl laughed, and put a tanned little hand on the white stretch of the elevator.

"Please, Mr. Mercury—would you mind not being a divinity for a little while? You see, I've never seen an aeroplane. I know that's queer, in this day and age—but I haven't been out of the village for a year, since I came back from school. I'd—I'd like to ask a few questions if—if——"

Kent interrupted her with a magnificent wave of his hand toward the passenger's seat of the Flying Scarab.

"If the high priestess of the Seventh Heaven will deign to seat herself on Mercury's winged steed—or was it his feet that were winged?—oh, hang the ancients, I'm getting all balled up. If you'll allow me, my name is——"

"Mr. Mercury will do very well," put in the girl coolly, as she smilingly seated herself in the seat he had pointed out, and began to examine with interest the levers and instruments.

Kent was grateful that he had not been permitted impulsively to divulge his name. "Perhaps it will be better, Miss Daphne," he acquiesced. The girl turned to look at him a bit sharply. "And I'm going to ask you if you will please not mention in the village the fact that a strange bird lit in your Seventh Heaven. You see, my assistant and myself have grave reasons for wishing to remain undiscovered as long as possible. It's not an easy thing to do with a white flyer like this on one's hands. We've pitched camp down the side of the bluff a ways—I had the deuce of a time getting up in the air this morning, too. I may depend upon you not to betray us, Miss Daphne?"

"But you might be flying from justice or jail or something," she objected.

"As a matter of fact, we are flying from the pen," he punned back recklessly. "The pitiless pen of the press. It's this way, Miss Daphne," he went on for the sole purpose of keeping a pair of laughing eyes upturned to his, "I'm working out a very delicate experiment, which may mean something tremendous—or may fail absolutely," he added with modesty, but with a total lack of conviction. "My assistant and I thought we'd try disappearing, so we could conduct our final tests in peace, without being pestered into premature statements by zealous reporters. This place being about five miles from the village—isn't it—," the girl nodded, "and the village being without a railroad seemed to furnish as safe a retreat as any."

"But even in this out-of-the-way place you can't expect to remain very long undiscovered," the girl suggested.

"No. But it's only a matter of a few days before I'll be ready to give out a statement, I think. I've a good notion to make 'em tramp from the village up here to the heights—those pesky newspaper men—with your permission, Miss Daphne." The girl seemed highly amused at the picture of a reportorial squad kicking up five miles of desert dust and clambering up to the Seventh Heaven.

Kent looked at her suddenly with curiosity. "But you—how do you——" he began.

The girl pointed to a narrow trail scarcely discernible in the thick woods behind her. "At the end of that path down near the road," she replied, "is tethered my prehistoric steed. It's got pedals and rubber tires and a handle bar."

"A bicycle, by Jove!" cried Kent as though she had spoken of riding a pterodactyl.

"Have you seen the village yet?" she asked abruptly.

"No."

"If you ever do, you'll understand why I call this the Seventh Heaven. I'd die if I couldn't pedal out here every day, that's all."

"That's almost too good to be true," said Kent, beaming. The girl raised her eyebrows in haughty inquiry. Kent sensed the delicacy of the situation. "Won't you let me drop in on you occasionally up here in your Seventh Heaven?" he pleaded tactfully.

She ignored the question. "And when you want to go up you turn the planes this way?" she inquired, having discovered that a light push on the lever operated the planes.

Kent explained in detail the workings of the machine and of the wireless telegraph and telephone. He was amazed at the quick comprehension of the girl and the intelligence with which she questioned him. He sighed for more theories to expound.

Presently she glanced up at the sun with speculating eye. "O, I must be getting back. Thank you so much for your kindness in explaining things to me," she said simply, as she turned toward the little trail that led through the woods.

"But—but you will come tomorrow?" stammered the eminent scientist and aviator, not daring to follow her, but in a panic for fear he might not see her again.

"It is *my* Seventh Heaven," she reminded him.

"Which I'm going to construe as a promise," he replied. "And, Miss Daphne, you won't let fall a word, you know—you can't ever tell about those reporters—they're liable—"

"You needn't worry, Mr. Mercury. I'll do my best to keep them away from you," she called over her shoulder as she pushed back a low hanging bough across her path, which swung back in place again, hiding her from the eager eyes of Fletcher Kent.

III.

"Good afternoon, Miss Daphne."

"Good afternoon, Mr. Mercury." The girl raised her eyes for a moment from the book she was reading; then settled herself more comfortably in the low tree crotch that formed a natural seat, and turned a page with strict attention to the performance thereof.

Kent fussed with his engine; clicked out a few wireless messages; sternly inspected the propellers and the planes and then sat down in the seat of the Scarab and ruefully inspected the silent young sphinx in the tree crotch.

After a time, when the pink in her cheeks had mounted to the roots of her red-brown hair, she glanced down at Kent as though quite unconscious of his manuevers and inquired, "Would you please tell me if you can use the smallest stop with bulb exposures? I've just been given a camera and I'm reading up on how to use it."

Kent bounded from the Scarab, unstrapped his own camera from its position in front of the swinging seat beneath the machine, flung himself on the grass beside the tree in which she was sitting, and launched forthwith into the rules and rudiments of plain and fancy photography.

The girl's austere formality vanished by degrees. Eventually she slipped down from her leaf shaded seat and sat beside him on the grass.

"I don't happen to have any films to load this up," he was saying, "but you see you set this for the exposure, and have the shutter so—and now you are all ready to take a picture—if it is properly loaded, of course."

"Seems simple, doesn't it?" said the girl, peering into the finder. "Oh, dear, Mr. Mercury, there goes my handkerchief—it's dreadfully windy today, isn't it—there, over there by that ash——oh, it has blown down the cliff? Don't bother—please."

But Kent, having started in pursuit of the elusive, dainty square, plunged down the side of the cliff and was some little time recovering it. When he appeared again the girl was still diligently gazing into the finder with the camera focused on the Scarab.

"Thank you very much. Now, if I wanted to snap the aeroplane—see, but I can't get it all in. And of course the seat shouldn't be in the exact center, 'cording to art, should it? Do please sit in it and wave your handkerchief so I can tell where the center is, anyway." Kent did solemnly as he was directed. "I can see that all right," she laughed. "Now, I should set this, press the bulb so"—click!—"and what a pity it isn't loaded!" she finished, as he arose.

Kent grinned grimly. "I'm afraid I shouldn't have been quite so docile if it had been," he said.

The girl tripped about, trying to focus the camera on the picturesque views disclosed on every side, Kent offering profound suggestions at her elbow.

"What a magnificent view it would be from down there on that little point, looking up toward the cliff," she cried excitedly. "You see I'm turning into a camera fiend."

"So long as it isn't a laurel bush, it's all right, Miss Daphne," returned Kent, fatuously, as they plunged down the cliff to the spot she had indicated. "You can just see our camp from here," Kent pointed out, "down there in that clearing. If you would care to walk down, I'd like to show you our telephone station and some other apparatus——" he began tentatively.

"Oh, I should so like to see them," the girl agreed enthusiastically.

So they clambered down the rugged cliff, catching at sturdy shoots and bits of rock

to keep from slipping on the treacherous sand. Very often Kent leaped ahead of her and extended a steady hand in lieu of the swaying shoots, which she grasped occasionally with strict impartiality.

Before the tent which they came upon soon, sat Butler. He was unable to conceal his surprise at the sudden appearance of the two. He stared at the girl as though she were a sprite whom Kent in his aerial wanderings had plucked from another world.

"Miss Daphne," said Kent, "let me present Mr. Butler—my wizard of the wireless," he added laughingly.

"Miss Daffney," acknowledged Butler stupidly.

The girl smiled at him winningly. "You've no idea how picturesque you looked just now, Mr. Butler, sitting there with the tent and the wood there and all. Mr. Mercury"—with a mischievous little giggle—"Mr. Mercury has been letting me use his camera for a sort of dress rehearsal, you see, because I just got one and I don't know the first thing about using it." She reached for the camera tucked under Kent's arm. "Do let me see what a stunning picture that would make," she begged, stepping back a few steps to focus on the tent. "Oh, I could almost get both of you in. Do stand just a little bit nearer." She cast imploring eyes at Kent. Butler looked at Kent oddly.

"It isn't loaded," Kent reassured him, smiling, as he complied amiably.

"No, isn't it a pity?" she babbled on. "I'd just have to push this and poke this and squeeze this, and there you'd be!"

"I told Miss Daphne I'd show her the workings of some of our instruments," Kent explained presently. "The wireless is right back of the tent here."—"Lives in the village—doesn't know an induction coil from a hairpin. What's the matter with you?" he found a chance to whisper into the ear of Butler who had made no attempt to conceal his surliness. He stood by impatiently while Kent answered the girl's flood of questions as he sparked off messages for her on the little wireless instrument. After a time Butler sauntered over to a rough table near by that was littered with various experimental apparatus—Leyden jars—intricate tracings of copper wire on wooden framework—metal wheels that revolved at every degree of speed—dynamometers and a series of peculiar indicators, which he examined closely.

The girl, happening to glance up as Butler was scowlingly scrutinizing the last of these, saw him suddenly bend close, stare intently at the indicator, then raise his head with a wonderful light in his eyes.

"Kent!" he called, "Kent, come here!" His voice was not quite steady. Kent was beside him at one bound, examining the indicator with suppressed excitement. In a moment he turned to Butler, and putting a hand that trembled upon his shoulder he said hoarsely, "We've got it, old boy—we've got it!"

(To be Concluded.)

Sleet on Aluminum Lines

In many of the northern states severe sleet storms load down telegraph, telephone and electric transmission lines to the breaking point, with ice which freezes around the wires as it falls. Because aluminum wire must have twice the cross-section of an equivalent copper wire has been one of the arguments against its use on transmission lines, the assumption being that its greater surface area would collect heavy loads of ice. However, an engineer who has made a comparison of copper and aluminum wire lines observes that the aluminum lines withstand heavy storms much better than those of copper. He explains this by stating that the surface coat of aluminum hydroxide gives the metal an oily feeling and drops of water striking the wire are not able to stay long enough to be frozen.

Dredging on the Yukon

At Dawson, the wonderful camp on the Yukon, up in Yukon Territory, one of the largest dredges in the world has been placed in commission. It belongs to the Canadian Klondike Company, and is one of its fleet, now in the big river of the north, engaged in digging gravel and sifting the golden treasure from the deposits of ages. The construction was begun in August and the boat completed in November. The machinery is from an American dredge and steam-shovel works. The boat has been named the *Canadian* and is 130 feet long by 91 feet wide.

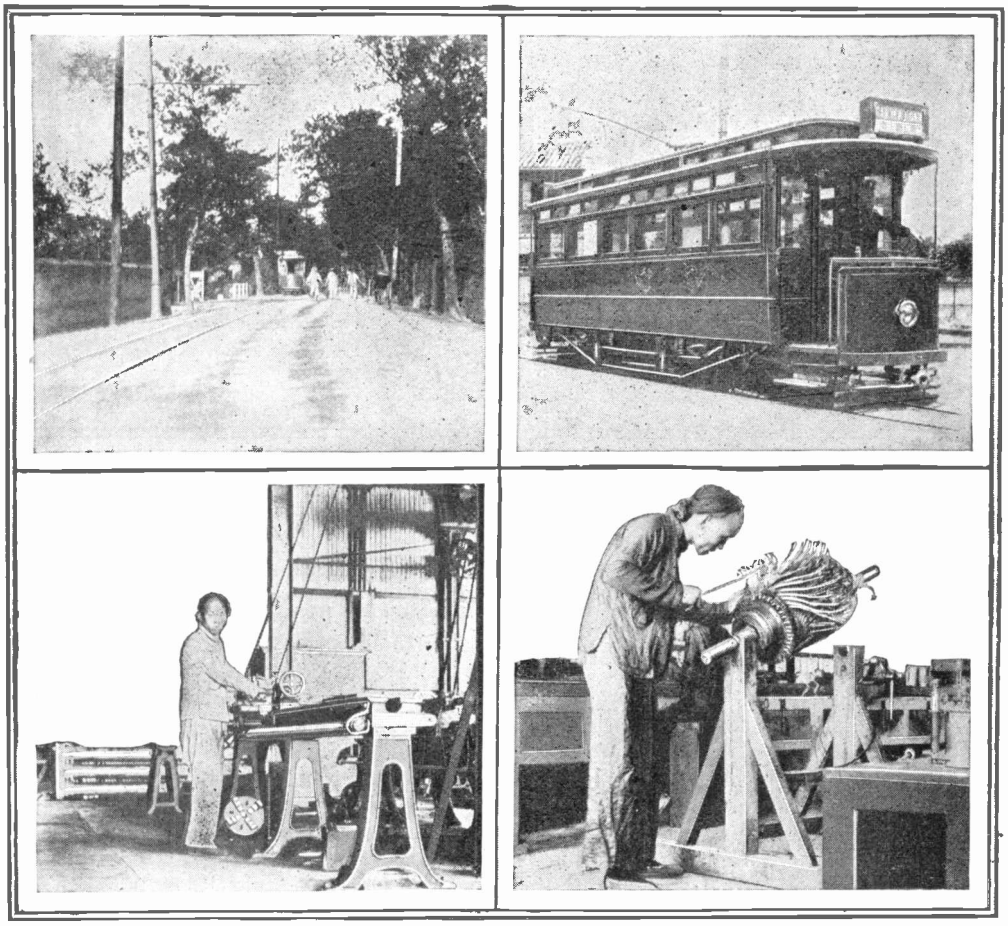
It is operated by electrical power and has a capacity of 10,000 cubic yards a day. It is now located in one of the richest dredging tracts in the world and is expected to recover a vast amount of gold.

Teaching Chinese Electric Railroading

By C. B. EDWARDS

Connecting the thickly populated outskirts of Shanghai, China, through its ancient gateways with the narrow little streets of one of China's greatest seaports, the tramway system of Shanghai may be acclaimed the most modern electric railway in this eastern empire.

went rattling up a narrow Shanghai thoroughfare before a wondering throng of native population, the road ramifies throughout the most populous districts of Shanghai and includes 26 miles of track, and a rolling stock of 65 electric cars. In the founding of such a system, among a people whose customs



Street Scene in Shanghai
Chinese Machinist

Typical Motor Car
Armature Worker

GLIMPSES OF CHINESE ELECTRIC RAILROADING

After successfully meeting the exacting conditions of the Chinese government in the foundation of this electric road the foreign promoters have gradually increased the importance of the Shanghai Tramway till at the present time, two years after the first car

have remained unchanged for untold centuries, a wonderful task was carried out. On account of China's backwardness in carrying through a project such as an electric railway the initiative is all thrown on the shoulders of foreign nations anxious to

THE CHINESE RAILWAY MEN MUST BE PHYSICALLY FIT

handle China's trade and for this reason it fell to the British interests to put through the Shanghai road.

In almost all foreign concessions with regard to the building of railroads, the Chinese government not only reserves for itself the ultimate reversion of the railway lines and their equipment, with no compensation, but also the larger share of the profits. Provision for Chinese control is also made in all cases, for the fear of foreign interference is strong among the Mongolians and the foreign syndicate obtaining a railway concession is permitted only to construct and operate the road. The government also assures itself of the ultimate native control of the road by requiring each foreign syndicate to maintain a school for the instruction of young Chinese in the railway business. The foreign syndicate receives five per cent on the capital invested and one-fifth of the net profits, the remaining four-fifths being divided equally between the native syndicate and the Chinese government. Through this procedure the government secures 40 per cent of the net profits and the final reversion of the road, in addition to the privilege of transporting troops and ammunition at half rates.

It can be safely said, that no electric railway in the United States could be either built or operated under such government rulings and native conditions existing in China when the Shanghai Tramways were first put in commission. The really wonderful part of it all is that the road is not only flourishing but is adding to its mileage each year new trackage opening up new territory.

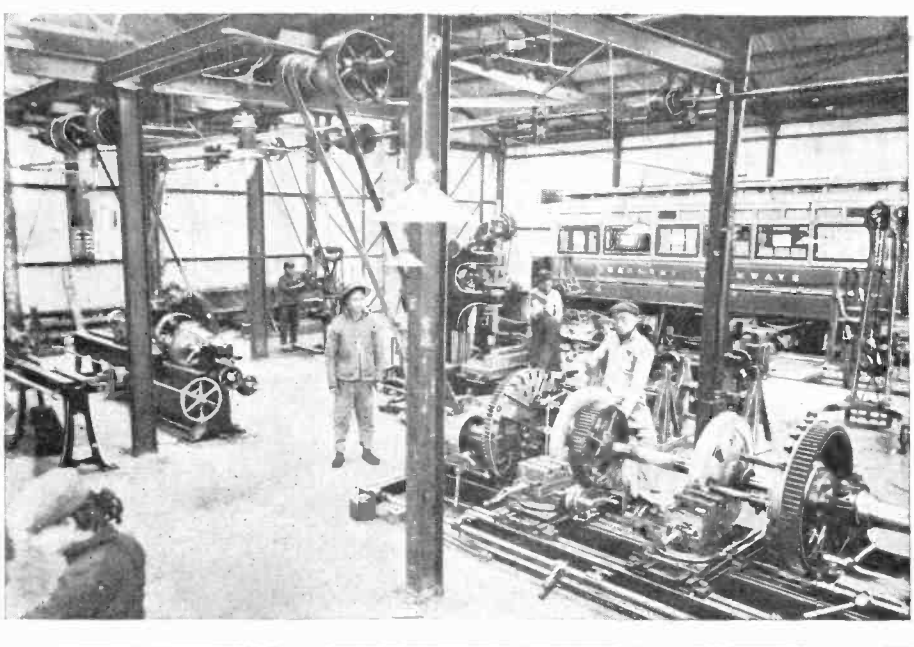
The government provision requiring the hiring of Chinese employees by the Shanghai Tramway Company made the project assume a dubious turn but with the instruction of the native Chinese the operators of the road have found that the Mongolian is easy to teach and possesses a wonderful memory for detail unequalled by railway employees in the United States. No doubt the outlook was discouraging when an English engineer took up the running of the road and saw before him as prospective motormen and conductors a long line of uncleanly China-

men who not only knew absolutely nothing about an electric car but were even slightly awed by the car which moved at the command of an invisible force. The temperament of the Chinese proved them to be admirable employees, however, from the start. With a silent and reserved temperament and polite demeanor the natives have made a marked success as public service employees. They rarely become ruffled and their wonderful memory, lacking, it is true, in corresponding good judgment and originality, make them a marvel of exactness in the routine duties necessary in the running of a street railway. In the picking of employees special care is taken to secure only the healthy young Mongolians of the better educated classes. Owing to the large number of natives anxious to be connected with the new electric road the five hundred odd employees are the pick of a great number of applicants. After passing through mental examinations the recruits are taken before a Chinese doctor, of English training, and thoroughly examined; especially with regard to sight and hearing. The applicants are next drilled in the training room of the company located in the Hart Road car house. The training room is replete with maps of the tracks of the company, street names encountered in the different runs and a platform on which are mounted several motorman's controllers and brakes. The new men are taught to manipulate the dummy apparatus at signals given by the instructor and, the instructor always being the older and more experienced of the Mongolian motormen, and advice is freely given by the teacher in Chinese to his pupils.

After the training with the dummy apparatus, applicants commence their real apprenticeship under the experienced men who run the cars. When they are deemed sufficiently educated in the practical side of the business a final examination is given and if a new man receives a passing grade in the examination he is given a certificate and put to work. The antiquated coinage still in use in China makes the conductor's job far from enviable. There are two classes of tickets to handle with four divisions in each class besides monthly and coupon season tickets and the coins with which cash fares are paid are what are called ten cash pieces, of which it takes approximately three to equal the value of our cent. For this reason it is

LEARNING TO OPERATE THE CONTROLLERS AND BRAKES

TURNING IN THE DAY'S RECEIPTS



IN THE MACHINE SHOP OF THE SHANGHAI ELECTRIC RAILWAY

necessary for the conductors of the Shanghai system to collect several times the number of coins a railway employee in this country would have to handle. This is true notwithstanding the much lower passenger rates in force, and the weight in coinage which a Shanghai conductor carries on his last trip would floor many of our American railway employees.

The fare is governed by what is commonly known as the "zone system" and signs giving the fares in both English and Chinese are placed at the zone intersections. The cars are likewise labelled with signs giving the destination in the two languages by reason of the large number of foreigners living in the vicinity of Shanghai. A unique system of giving advice to the motorman is employed, each pole having painted on it in Chinese instructions regarding the use of current, same being based on the distance of the next stop and the grades encountered. A telephone system also allows for the prompt transmission of orders to all parts of the line, it being utilized as a dispatching medium for the regulation of traffic.

Perhaps in no single detail of the service as many difficulties have been successfully dealt with as in the matter of fare regulation. Complications of every kind, with which no other railway in existence has ever had to contend, made fare rates a matter requiring the utmost skill and patience to give adequate returns to the company. The competition of the native vehicle of China, a two-wheeled affair termed a "jinrikisha" made the fares low enough but in addition to this the depreciation of the subsidiary coinage in which fares are paid caused a still greater reduction in receipts which was not counterbalanced by the money paid out as expenses. Other forms of public service in China have not had to cope with this problem as their income was in the form of Mexican dollars, which are not subject to the depreciation that exists with the smaller currency.

Both the rolling stock and electrical equipment are of English manufacture, the standard car being a single truck, 9½ ton vehicle propelled by two 25-horse motors and the overhead trolley is used throughout the system. The company maintains a large repair shop, all of the work being performed by native employees, which turns out construction equipment and keeps the cars in running order. It is indeed a strange sight to witness Chinese workmen bending over fine machine work or a broken armature, skilfully making the needed alterations. There is something almost unbelievable, in this inconsistent linking of work requiring such a high degree of perfection and the slant-eyed oriental who slides around the shops in loose shoes and still looser garments. To the American who has never been able to associate the Chinese with other than an ironing board a trip through the Hart Road shops at Shanghai will be a source of great surprise and interest, resulting in greatly enhanced respect for the brain behind the yellow skin of the average native of China.

How Does a Cell "Recuperate"?

After your flashlight battery had run down and you had laid it aside you were no doubt surprised on trying it to find the lamp quite bright again. The battery had "come back"—but what had really happened? The cause of the rapid running down of some primary cells may be summed up in the word "polarization."

As the cell sends out current little bubbles of hydrogen gas collect on the surface of the positive electrode and hinder the contact of this plate with the liquid and also, like air, offer a resistance to the passage of current. By placing in the cell, some liquid or substance termed a "depolarizer" which will combine with the free hydrogen and take it up, polarization is much reduced. Sometimes, however, the cell is worked so hard that the hydrogen bubbles collect faster than the depolarizer can combine with them. Then it is that a short period of rest will make the cell come back if the chemicals themselves are not all used up. Black oxide of manganese and powdered carbon is the depolarizer in dry cells and nitric acid, copper sulphate, bichromate of potash, etc., is used in various wet cells. One cell, the Smee, removes the bubbles by mechanical means, a platinum-plated silver plate offering a roughened platinum surface from which the hydrogen bubbles easily free themselves and pass off.

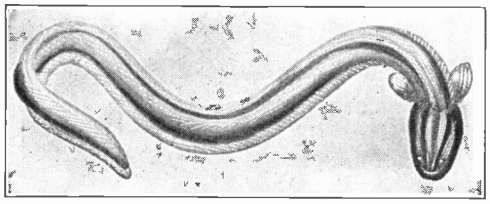
The temporary tomb of Mary Baker Eddy, founder of Christian Science, is lighted with electricity, and is equipped with a telephone. A guard is stationed at the tomb, and watch is kept day and night. A large mausoleum is being built, in which Mrs. Eddy's body will be permanently placed.

"Live Batteries"

By WARREN H. MILLER

A study of the electric fishes goes far to convince one that all our nervous system is essentially electric, and this is true throughout the animal kingdom. No other medium is instantaneous enough to transmit the will of the mind to the muscles. By the electric current alone can you deprive anyone of the control of his own nerves, as witness the total disability of a person, holding the electrodes of a powerful Rhumkorff coil, to let go of them.

The electric pressure in the nerves is otherwise entirely under the control of the mind, and conversely the smallest irritation on the most outlying nerve is instantly telegraphed, not through the general body but along the particular nerve to its branch and down the branch to the main nerve leading to the brain.



THE GYMNOTUS ELECTRICUS OR SURINAM EEL

The electric batteries of the gymnotus,—the famous electric eel; of the numerous species of torpedo rays; of the electric catfish of the Nile; and of the queer elephant-nosed fishes of the Congo are all built on the same plan—the motor plate which terminates all nerve-ends in ordinary animals is enormously developed; thousands of these motor plates are assembled, all feeding by branches into a few large nerves; and the plates are insulated in series of thousands of cells, filled with a jelly-like fluid and formed out of ordinary muscle tissues into hexagonal or flat or longitudinal cells. Each plate has a ramification of nerve tissues on the back of it, and each is provided with a minute artery and a vein for maintenance.

The action of the mind, if it so may be termed, of any of these fishes can induce a state of static pressure on the face of these plates, and can alter the strength of the electricity drawn from the battery at will. He can give you no shock at all, or a little one, or one so violent that you will be more than four hours getting back possession of your faculties in the stunned part. If you take a torpedo ray, used from long captivity in an aquarium to the presence of man, and stroke the fish lightly, he will pay no attention whatever. But draw your finger sharply down his back so as to irritate him and you at once invite a powerful shock; do it again, still more roughly his eyes will depress sharply and you will get such a stunning shock as to paralyze your arm for a day.

All of the electric fish are exceedingly pugnacious. Two Nile catfish, placed in the same tank will invariably fight until one is shocked to death. Reaumur, the celebrated French physicist, placed a duck in a tank in which he had a torpedo, and the fish killed it in a short time. The electric eels of the Orinoco, Surinam, and the Amazon tributaries are to this day a veritable pest to travellers who are obliged to ford some of these streams on horseback, as the eels instantly attack the horses and mules, which are lucky to get across alive. Baron von Humboldt's account of the methods of capture of the gymnotus by the Indians of the Orinoco, by exhausting their electric powers upon wild horses before attempting their capture, gives a vivid picture of their methods of attack. Says the great naturalist:

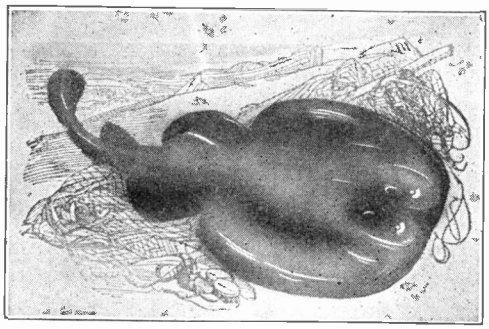
"I shall but imperfectly depict the intensely interesting spectacle presented to our view by the combat of eels against horses. The Indians, provided with long reeds and harpoons, placed themselves around the pool. They all prevented by their cries and the length of their rods the horses from attaining the shore. The eels, frightened and confused by the noise of the horses, defended themselves with their electric batteries. For a long time they seemed likely to gain a victory over the horses and mules: these were seen in every direction, stunned by the frequency and force of the electric shocks, to disappear under the waters. Some horses, however, in spite of the active vigilance of the Indians, gained the shore exhausted with fatigue, and, their limbs being benumbed by

the electric commotions, they stretched themselves at full length on the ground. I could have wished that a skillful painter had had the opportunity of seizing the moment when the scene was most animated. The group of Indians surrounding the basin; the yellow and livid eels, which, like huge aquatic serpents are swimming on the surface of the water and pursuing their enemy; all these objects presented without doubt the most picturesque assemblage imaginable. In less than five minutes two horses were already drowned. The eel, more than five feet long, glides under the belly of the horse or mule; it then makes a discharge from the entire extent of its electric organ. It attacks at once the heart, the viscera and particularly the plexus and the gastric nerves. It is not therefore, surprising that the effect it produces upon a large quadruped should exceed that produced in a man, whom it touches at only one of his extremities. I have my doubts, however, whether the gymnotus kills the horses immediately. I rather believe that the latter, stunned by the reiteration of the electric shocks, fall into a profound lethargy. Deprived of all sensibility they disappear under the water, the other horses and mules pass over the bodies, and they perish after a few minutes.

"After this commencement I was afraid that the sport might terminate very tragically: I did not doubt but that by degrees the greater part of the mules would be drowned. But the Indians assured me that the fishing would soon be over and that nothing is to be dreaded but the first assault of the gymnotus. In fact, whether the galvanic electricity is accumulated in repose, or the electric organ ceases to perform its functions when fatigued by long use, the eels after a certain time resemble discharged batteries. The muscular action is still equally active but they no longer have the power of giving energetic shocks. When the combat had lasted a quarter of an hour the mules and horses appeared less frightened; they no longer bristled at the mane, and the eye was less expressive of suffering and fear. They no longer seemed to fall backwards; and the eels, swimming with the body half out of water and now flying from the horses instead of attacking them, began themselves in their turn to approach the shore."

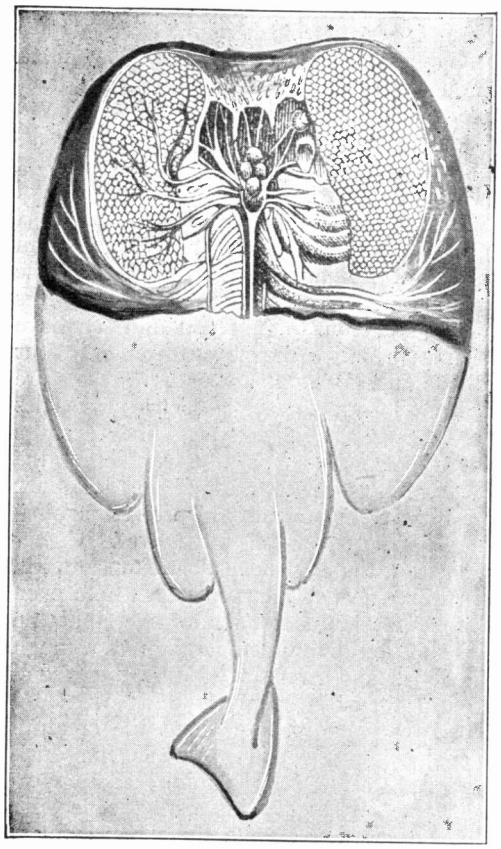
All the electric fishes require rest and food after giving repeated shocks when their batteries become exhausted—another proof of the action being a mental and nervous phenomenon. A dead or nearly dead one will give no shock, and the feebler and in poorer health the animal is, the weaker shock it can give. In a strong, live animal, if the nerve leading to the cells is cut, it can give no shock, but, if the stump of the nerve on the battery end be irritated, the full force of the battery will be discharged. This fact seems to point out that the battery is not galvanic, as the early naturalists of the Eighteenth Century were inclined to think, but rather, static, as the most powerful charge it could produce was *lodged* on all the motor plates in the battery during the anguish of cutting the nerve, (with insulated scissors, of course) and this discharge took place at once on further irritating the nerve. There is nothing like this mental formation of a powerful destructive force in the whole animal kingdom, unless it might be the spontaneous formation of venom in ordinary saliva under mental stress of intense anger. The venom of snakes is simply a modified form of saliva, secreted in the same way, and the facilities of producing and storing it have probably developed in the venomous snakes through centuries of evolution. It is their sole means of defense against large and predatory animals. Dr. Shufeldt, the well-known authority on snake venoms, says: "I would rather be bitten by any number of Gila 'Monsters' than by one person in a raging, mad state of anger." The venom formed of ordinary saliva under such terrific mental and nervous stress is at all times highly dangerous to the blood, and may have been a primitive means of defense in our remote ancestors. In the same way Nature has developed the feeble electric properties of the ordinary nerve system into a static battery of force enough to enable all the electric fish species to attack and kill their prey, and to defend themselves against enemies larger than themselves. Cuvier states that the electric eels can stun and kill fish fifteen feet off, and, you will note from Baron von Humboldt's narrative, that the eels shocked the unfortunate horses through the lungs and heart by gliding under and around them. Reaumur's duck was also killed by the torpedo without the creature ever leaving the bottom, while the duck floated paralyzed above him. These facts are food for highly interesting reflection. There is no doubt as to the shock being a high tension static discharge, as Hunter ob-

tained sparks by insulating a metal gap in a circuit shocked by a powerful electric eel; and Galvani, Walsh, Pringle and Magellan all obtained sparks from the gymnotus,

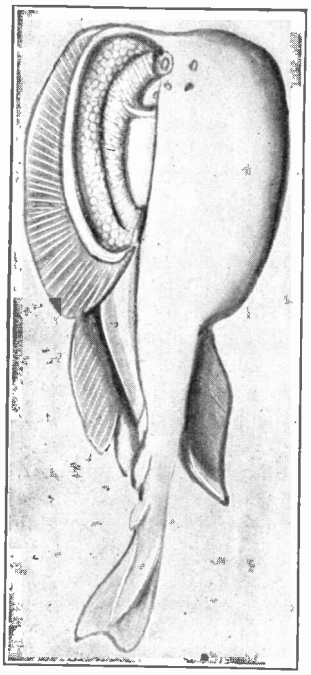


THE TORPEDO FISH OF THE MEDITERRANEAN

torpedo and Nile cat. No galvanic current has sufficient tension to bridge such an air gap, as it takes a pressure of 10,000 volts to jump one-fourth inch with ordinary direct-current form of dynamo. Yet to store any appreciable charge of static electricity at high tension requires the driest of apparatus and clear, dry weather for the static machine to operate. Notwithstanding this, the gymnotus attacks its prey from considerable distances and has been known to stun and drown swimming Indians, frequently at distances from four to six feet. How does he raise this high tension in the midst of a good conductor like water, when we can hardly do it in dry air? And how



ELECTRIC APPARATUS OF THE TORPEDO



TOP VIEW OF THE TORPEDO FISH

can he direct it at his victim through the surrounding water, when we know that electricity always takes the shortest path through a conductor from positive to negative?

How he generates it is evidently by nervous action. The battery of the gymnotus consists of four long bundles of plates occupying about one-third of the bulk of the fish. These plates are long, thin nerve motor-plates, separated about 1-20th of an inch apart, running parallel down the body from head to tail, and set vertically on edge. Cross plates divide it into numerous cells, filled with a clear jelly-like fluid. Ramifications of nerves spread over the entire surfaces of the plates. About 240 plates

make up a battery for a full-grown six-foot eel, giving a surface of 123 square feet of plate. The head end of the eel is positive and tail negative. His thick, olive green body is covered with minute pores, which continually exude a gluey, viscous fluid in such quantities that the water of the troughs in which specimens are kept for exhibit by the Surinam Indians, has to be changed every day.

The battery of the torpedo ray consists of perpendicular hexagonal prisms, extending from the top to the underside of the ray, being longer or shorter according to their position in the body. The plates are placed one above the other, 150 to the inch in the prisms, and are very vascular, having each a vein and an artery besides its own particular nerve.

The total surface of plates in a large torpedo is 58 square feet. When we realize what a very powerful shock a Leyden jar of only a few square feet capacity can give, it is easy to understand the terrific force of these live batteries. Baron von Humboldt's experiment of placing both his feet upon a gymnotus resulted in a shock infinitely more severe than the heaviest he had ever felt from the most powerful Leyden jar. He was laid up with violent pains in his knees and more or less distress throughout his entire body, for the rest of the day. Indians struck by the shock are deprived of the use of their limbs for not less than 20 minutes, and hence are drowned if attacked by the eels, while swimming.

The ability to strike through any space of water is not at all clear, with our present knowledge of static electricity. It may be classed with the phenomenon that 27 persons joining hands are all struck with equal severity under a static electric shock or by an eel or torpedo, whereas, with ordinary low-tension dynamic electricity, the greater the resistance the feebler the effects. The electric shock itself owes its disagreeable commotion in our nerves principally to the highly oscillatory nature of the discharge, whence the passage of such a current will affect all equally. A similar action is probably felt when these fishes loosen their static charge in the water. Everything in the water within range of the disturbance feels it equally. The torpedo is positive on his upper surface and negative on his lower, so that the whole bottom of the sea is "ground" to him, and his shock must traverse everything around him in arriving at ground. The eel is positive at his head and negative at his tail, whence his habit of bowing himself around the victim if possible in order to make his shock the more effective. The Nile cat is positive on one flank and negative on the other, wherefore his best method of attack would be above or below his enemy.

In all cases, equilibrium is restored by the oscillatory static discharge through the water to the other pole, and the amount of water actually affected depends upon the severity of the shock. If one happens to be in the zone, the shock is felt without requiring to be in an insulated circuit, as with dynamic electricity. On land a similar effect is noticed as it is not necessary for a chain of people to be insulated from the ground to feel a shock imparted to the first and last member. With a flowing dynamic current the circuit would only be felt at the finger tips of the first and last person, as the ground offers a better conductor than the chain of persons.

As to the method of loosing the shock, it is quite probable that the gymnotus closes his skin-pores, thus insulating himself in his viscous covering, just previously to awakening the electric pressure in his batteries. Opening the pores would then at once open an outlet to restore the static equilibrium through the water. As for the torpedo, no such provision is made, and the only physical movement observable is a depression of the eyes just previous to the delivery of a shock. This may indicate a sudden awakening of the static pressure through nervous action or possibly some internal method, so far not discoverable by dissection, by which the static discharge is loosed after the desired pressure has been produced.

In conclusion it may be stated that these phenomena are all the effects of releasing a static charge induced by the animal's nerves on the plates of the battery. While dynamic and static electricity are one and the same thing, the first is a flowing current and hence must follow the laws of conductors, and would be much harder to handle in such a wild environment as the weapon of a carnivorous fish. The static charge, however, simply requires means for its production, release, and discharge, and is undoubtedly the method that Nature has taken to make a weapon out of that mysterious animal electricity by which we all "live, move, and have our being."

Electric Block Signaling

By SIMON DEUTSCH, E. E

PART III.

On Aug. 20, 1872, the United States Government issued to William Robinson, Patent No. 130661, covering a means of energizing or controlling, through the medium of the two track rails of a railroad, an electro-magnet, located at a considerable distance from a feeble source of power.

This simple invention, technically termed a "closed track circuit," in itself merely involves a practical and economical method of transmitting current, from a proper battery, through the two running rails, of such strength as properly to energize an electro-magnet also electrically connected to the two rails, and the entire arrangement forming a continuous circuit.

To any system of automatic block signaling, where the signal indications are controlled by the position of a train on the track rails, condition of the track, switches, derails, etc., this simple invention of a closed track circuit is basic and indispensable.

The term "track circuit" as used in signal work, designates an electric circuit using the rails, on which trains operate, as electrical conductors to carry the current from a battery or other source of power, to an electrical instrument, usually a form of electro-magnet carrying contacts controlling other circuits, as shown by Fig. 6. The presence of the wheels of a train or car on this track is indicated by its effect, electrically, on the conductor-rails and the electro-magnet, which in turn communicates itself to the signal or signals controlled by contacts on the electro-magnet.

A form of electro-magnet described above and properly termed a "relay" is shown by Fig. 7. The track circuit most commonly used, as shown in Fig. 6, consists of (A) the "insulating joints," shown by Fig. 8, used

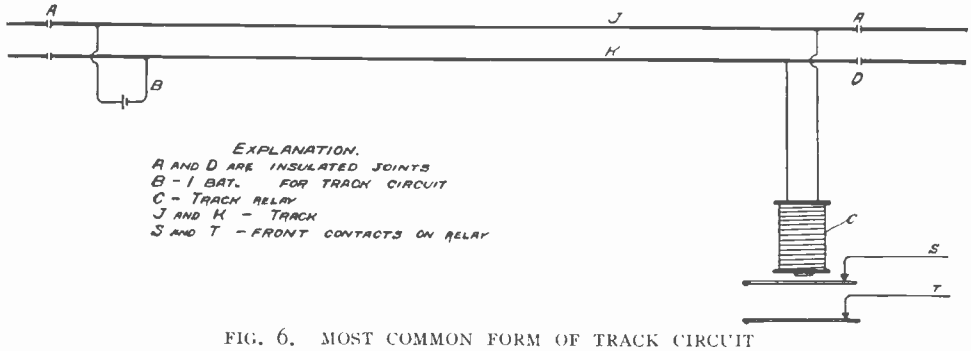


FIG. 6. MOST COMMON FORM OF TRACK CIRCUIT

for electrically separating one section of track from another; (B) the track batteries in a battery chute, shown by Fig. 9, generally placed at the extreme end of the circuit, and (C) the relay, placed at the extreme other end of the circuit. To insure a continuous circuit of low resistance, heavy iron wire is used to bond around the rail joints within the circuit, shown by Fig. 10.

With a system of this kind, it is apparent that any disturbances in the circuit, due to failure of battery, short circuit, broken rail, open switch or derail, is immediately evidenced by the position of the signal blade, which is arranged to assume the "stop" position upon failure of current supply.

Up to the year of 1884, practically nothing had been done in the way of automatic block signaling. Some trial block signal and interlocking installations were made in this country between 1873 and 1880 which were examined with much interest and appreciation by many railroad officials. Partly as a result of this interest in signaling devices, a group of capitalists organized a company in 1882, for the purpose of exploiting the Robinson and other signal inventions.

In 1884, this company made the first large installation of automatic block signals controlled by track circuits. However, in view

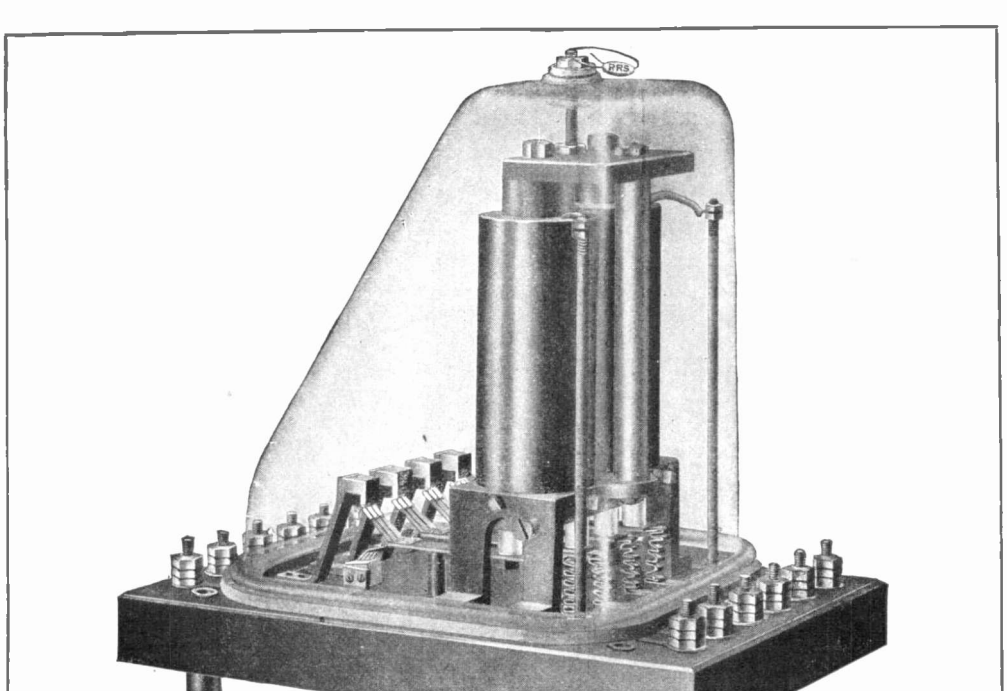


FIG. 7. COMMON FORM OF "RELAY" USED IN ELECTRIC BLOCK SIGNALING

of the fact that this company owned and controlled the Robinson patent which was basic and necessary to any practical system of automatic signaling, competition was lacking, with the result that up to the expiration of this patent, Aug. 20, 1889, only a total of 920 automatic signals had been installed.

Although during the seventeen years of life of this patent it had been so little used, most of the important principles now employed in automatic signaling, were known years before the expiration of this patent, and a great many valuable contingent ideas were developed and patented, such as the "overlap," "polarized track circuit," etc., of which mention will be made later.

It was therefore not until about 1892 that more popular interest was directed to this art, and under the stimulus of competition, improvements were made in all details which heretofore had been more theoretical than practical. Everything from the signal mechanism down to the bonding wires received careful study and attention with the view of improving them, and, in general, underwent a change for the better. The railways, quick to appreciate this advancement to a practical stage, began to install these systems on their busiest lines, and by the end of 1899, there were about 6,500 automatic signals in use, of clock-work disk,

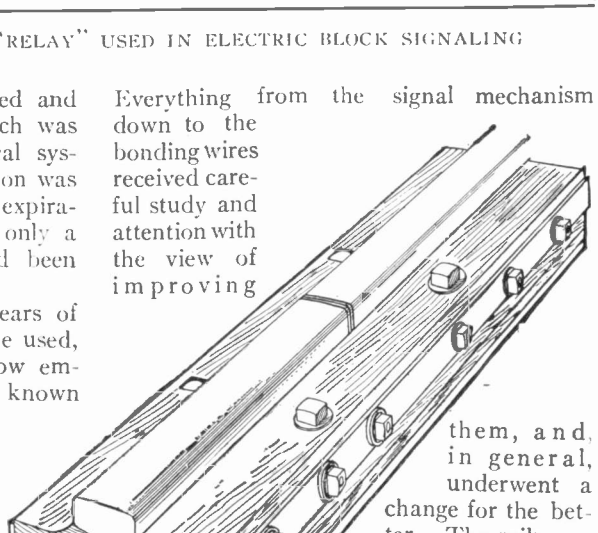


FIG. 8. SHOWING HOW TRACK JOINTS ARE INSULATED

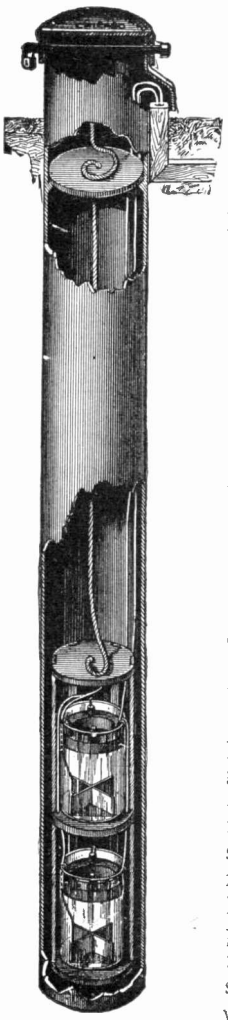


FIG. 9. BATTERY CHUTE

enclosed disk, electro-pneumatic semaphore and electric semaphore types. Five years later there were over 20,000 automatic signals in service.

This brings us to 1905, and it is practically between this year and the present that the most rapid strides have been made, both as regards the development of the apparatus and number of installations made.

In installations there has been a decided decrease in the number of clock-work disk-signals used, but few enclosed disk signals, electro-pneumatic and electro-gas signals, and enormous increases in the number of electric semaphore signals. In fact this latter type has almost entirely supplanted all other types, more having been installed in the last five years than were installed of all other kinds in the past thirty years.

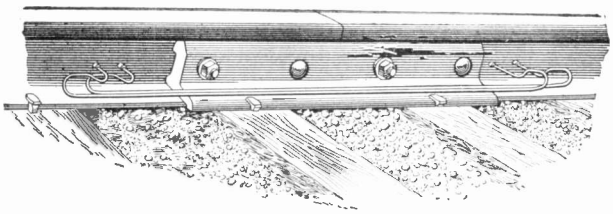


FIG. 10. BONDED RAIL JOINT

All of the types of signals mentioned above, with the exception of the enclosed disk and electric semaphore, are signals using one kind of power for their operation, and another kind of power for their control, as their names indicate. Experience has proven the "all electric" or "one power" type of signal to be the most efficient, flexible, and economical in operation, and engineers for signal companies and railroads have directed their energies during the past few years towards the simplification of these types.

(To be Continued.)

Same Story Over There

In reporting a fire at a Wellingborough (England) music hall, a provincial paper concludes thus: "Though it cannot actually be stated as a fact, it is believed the outbreak was due to the fusion of an electric wire." Of course it is—what else *could* be the cause? As, to the reporter's mind, all brides are charming, all bridegrooms handsome, so all fires are electrical—when there is no evidence as to the real cause.

We do not question for a moment that all gas explosions are "alarming," for really they do give you a shock, you know. A Glasgow paper, however, says that one of these "alarming" events that occurred in that city last Friday, "*is believed* to have been caused through a defective electric light fitting. . . . melting a gas supply pipe."

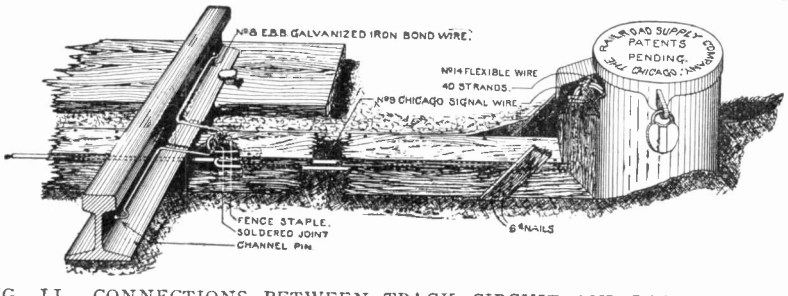


FIG. 11. CONNECTIONS BETWEEN TRACK CIRCUIT AND BATTERY CHUTE

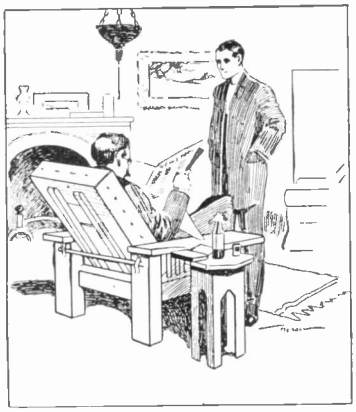
The daily press has a remarkable ability for *believing*—some things.

—*London Electrical Review.*

Talks With the Judge

THE MAKING OF LIGHT

"Those things which are apparently most simple are sometimes hard to explain in every-day English," said the Judge, "I am generally there with an explanation of some kind whenever a question is asked me, and, by long practice in the art of conversational gymnastics, I can almost always get away with it by talking fast and mumbling a word here and there. Now just yesterday a fellow came to me with the question: 'How does electricity make an incandescent lamp burn?' When he sprung it, I stooped for a moment to tie my shoe and when I straightened up I said: 'It is caused by the intermolecular resistance of the carbon particles under the stress of voltaic forces actuated by the dynamic power of the dynamo.' I got it off without batting an eye and he said, 'Oh yes, to be sure I remember now, it was in Carhart's physics, wasn't it?' Then I steered him around onto the subject of the different books we studied when we used to go to school."



How does electricity make a lamp burn?

"Well, Judge, what more do you want? You told him, didn't you?"

"Yes, I know, but perhaps it was not a very clear explanation. I would like you to tell me so I understand it myself."

"All right, then," I replied, "for a simple explanation imagine this: A broad, deep, placid stream of water flowing leisurely along between its banks; that corresponds to the heavy feed wire from the power station carrying a large amount of current but carrying it easily, for the wire is plenty large enough and the current from the dynamo flows over it easily.

"Now all of a sudden this stream comes to a narrow gorge with a very small cross section. The high banks all along the stream demand that all the water shall go through the gorge. The only way the result can be accomplished is for the water to travel faster, and consequently it goes raging and tearing through, spending a vast amount of energy in straining and lashing at the rocky walls.

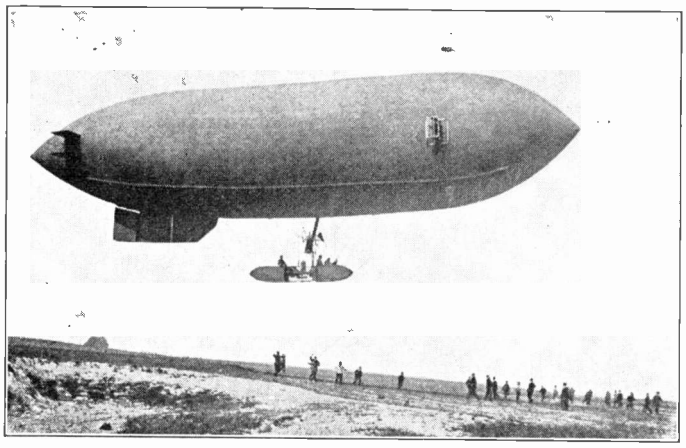
"In the circuit of the electric current you have an analogous case when you insert the fine, hair-like filament of an incandescent lamp as you do when you turn on the lamp. The filament then becomes the narrow gorge in the electric circuit and places a restriction on the flow of current. But there is a big pressure back of it and the current is forced through the high resistance of the filament at a tremendous rate and we have a phenomenon similar to friction; that is, energy is dissipated at the point of resistance in the form of heat and as a consequence the filament is brought to a very high temperature, causing it to glow.

"This brings up an interesting point in connection with the comparatively new tungsten lamp which is so rapidly displacing the old carbon filament type. In the latter type of lamp the filament is composed of specially treated carbon. This carbon could be heated up to a clear white heat, if desired, and consequently give much more light. But it has been found that the carbon will vaporize or disintegrate rapidly above a certain temperature and soon coat the interior of the globe with a dark deposit, quickly making the lamp useless. Therefore, carbon filament lamps are designed to operate at a temperature which gives the light a distinctly yellowish tinge.

"In casting about for better filament material, after years of experiment, the metal tungsten was hit upon. Tungsten will not vaporize to an appreciable extent even up to its melting point. Consequently tungsten lamps may be operated at a temperature many hundreds of degrees above that of carbon lamps and the terrific temperature raises the filament to a perfectly white heat and the light for a given consumption of current is much more powerful.

Does Lightning Endanger Dirigible Balloons?

Ever since Benjamin Franklin made his historic kite experiment it has been generally acknowledged that a metallic connection with an object high above the earth would facilitate the discharge of any potential gathered in the clouds. If the lower terminus of the wire or cable were insulated from the earth, as in the case of the captive balloons used by those who have experimented with the electrical stimulation of plant growth, there would be a discharge from the same to the earth through the air. Ordinarily this would be at a very moderate rate, but if the charge reached a high value it might lead to that sudden breaking down of the air gap which we call lightning. However, if the lower end of the metal cable which leads to the flying kite or balloon is itself grounded any differences in the electrostatic charges of earth and clouds will continually neutralize themselves through this cable. Hence in a balloon dragging a metallic cable which dips into the water as was the case with Wellman's America, this cable constitutes an effective lightning rod, and as it was connected metallically to various parts of the balloon's covering, Wellman had nothing to fear from atmospheric electricity.



DIRIGIBLE BALLOON "CLOUTH" WITH WIRE-SUSPENDED BASKET

But how about the dirigibles which strike out boldly above the earth, those which are not, as it were, tied to earth's apron strings? Take for instance a modern German dirigible such as the "Clouth" which is 135 feet long, with a maximum diameter of 27 feet and which has stabilizing fins and rudders made out of aluminum tubes covered with cotton, thus offering additional metallic points projecting into the charged air. In this case the car which carries two passengers besides the pilot and the engineer, has a frame work of steel, thus again introducing the metal elements with the danger to the passengers as well as the balloon modified according as steel or hemp ropes are used for suspending the car.

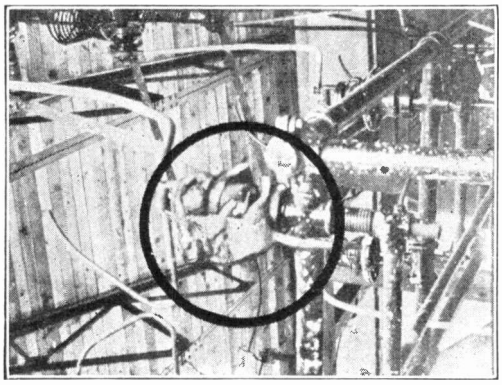
Even greater is this danger with the much larger dirigibles operated by the Zeppelin Company, in which the inner aluminum frame work allows of a surface charge amounting to over a thousand volts per yard of length, so that a balloon fully a hundred yards long may accumulate a difference of over 100,000 volts between its extreme ends. Should this tend to neutralize itself by puncturing the enclosure at any point, it might easily set fire to the gas filling and explode the balloon. To avoid such a mishap it was at first suggested that all metallic parts be carefully rounded so as not to present points from which a discharge could take place. This has not been practical, so the alternative has been that of providing the exterior with a protective network of metallic conductors connected to the interior metal frame work at places where the discharge cannot set fire to the gas.

Some Uses of Hydrogen

A generation ago hydrogen was little more than a curiosity found in the chemist's laboratory. One of its earliest uses—being the lightest substance yet known—was for filling balloons. It now takes part in the preparation of tungsten electric lamp filaments. In the last mentioned industry the metal is combined with carbon, and then to remove the carbon the unfinished filament is immersed in a hydrogen bath. The gas gradually unites with the carbon and so leaves the tungsten pure.

Two Interesting Electrocutions

Any animal which scampers about among the high tension conductors in a power plant gambles with death. Sooner or later its life is snuffed out and likely as not at the same time a generator of several thousand



THIS RAT HAD BEEN STUDYING ELECTRICITY

horsepower may be temporarily shut down as a result of its innocent amusements.

The first picture shows the remains of a mountain rat which was studying electricity in the plant of the Telluride Power Company. While pursuing its investigations it accidentally "shorted" the high tension side of a lightning arrester onto the supporting frame. This caused a large arc to start making it necessary to pull one of the generators off the line. After it was all over the rat was so near the color of the surrounding objects that it didn't even take a good photograph. Puzzle—Who can find the rat inside the black circle?

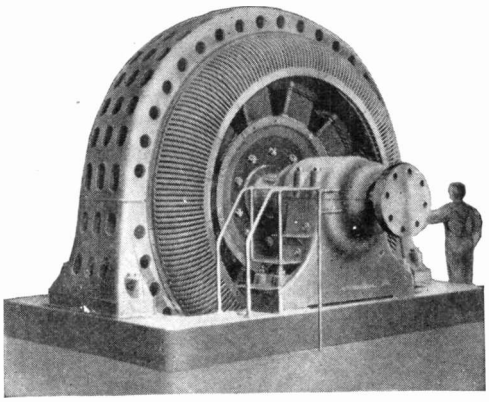
The second picture shows some cat fragments after the animal had received a charge of 12,700 volts to ground, in the central station lighting plant in Toronto, Ontario. The cat had thought to find mice among the bus bars at the back of the switchboard. Can anyone maintain after this example that electric cooking is not practicable?

REMAINS OF AN ELECTROCUTED CAT

A Mighty Generator for Niagara Falls

Comparing this great dynamo with the man who stands beside it will give the reader an idea of the size of a machine capable of developing 6,500 K. W. or approximately 8,700 horsepower.

This is one of six Allis-Chalmers alternators which will go in the plant of the Cliff



GENERATOR OF 8,700 HORSEPOWER

Electrical Distribtuing Company of Niagara Falls, N. Y. These dynamos are operated by hydraulic turbines and develop current at 12,000 volts. They are designed to run at 300 revolutions per minute but the governor went wrong on one of them and it stood up under a speed of 525 revolutions, which shows that a high factor of safety was allowed in the design of the machines.

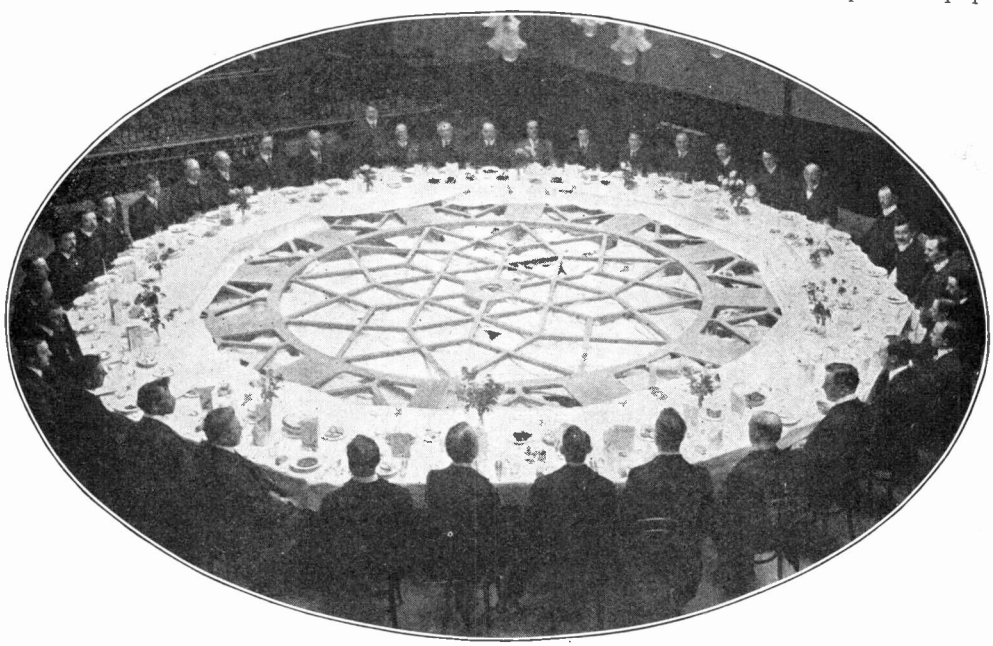
A Remarkable Clock

One of the largest electrical clocks in the world is located in the tower of the Liverpool Royal Society Building, England. Four dials each 25 feet in diameter mark the time with huge hands, the minute hands being fourteen feet long and three feet at the point of greatest width. Owing to their exposed position the hands and clock face were built to stand a heavy wind pressure.

The dials of this enormous clock are electrically lighted and by automatic apparatus the electric current is switched on the lighting circuits at dusk and disconnected at dawn, the time of lighting up changing with the seasons, being from 4:20 P. M. in the winter to 10 P. M. in the summer, with proper variations from time to time.

The electric transmitter of the clock is connected with Greenwich, thus assuring correct time. One feature which few people detect is the absence trom the dial of the Roman letters, their places being occupied by plain black rectangles. In building the clock the dial was constructed and put in place in twelve sections, each section being that portion marked off for five minutes of time and weighing 550 pounds.

The accompanying illustration shows a unique banquet table at a luncheon held in the Free Trades Hall at Leicester in celebration of the completion of this remarkable time piece. At this feast a company of 50 people sat down around the reproduction of the face of this clock declaring it to be something new in the way of "time" tables.



SOMETHING NEW IN THE WAY OF TIME TABLES

Telephoning from An Automobile

By Frank C. Perkins

Manager C. Durr Forrest of the Independent telephone system at Pomeroy, Ohio, has devised an ingenious telephone equipment for the use of automobilists. By means of this novel outfit the owner of an automobile can have telephone communication from any point in the rural districts where there are overhead telephone wires available. He can make connection with a telephone exchange within two minutes without leaving his seat in the automobile and talk with his home, business place or any city over a local or long-distance line.

It is stated that the conversation can be transmitted with the same degree of efficiency as any regular long-distance telephone and the many advantages of having the auto-phone available on a motor car are obvious. Every one who drives a motor car has seen the time when a telephone would have been a convenient article to

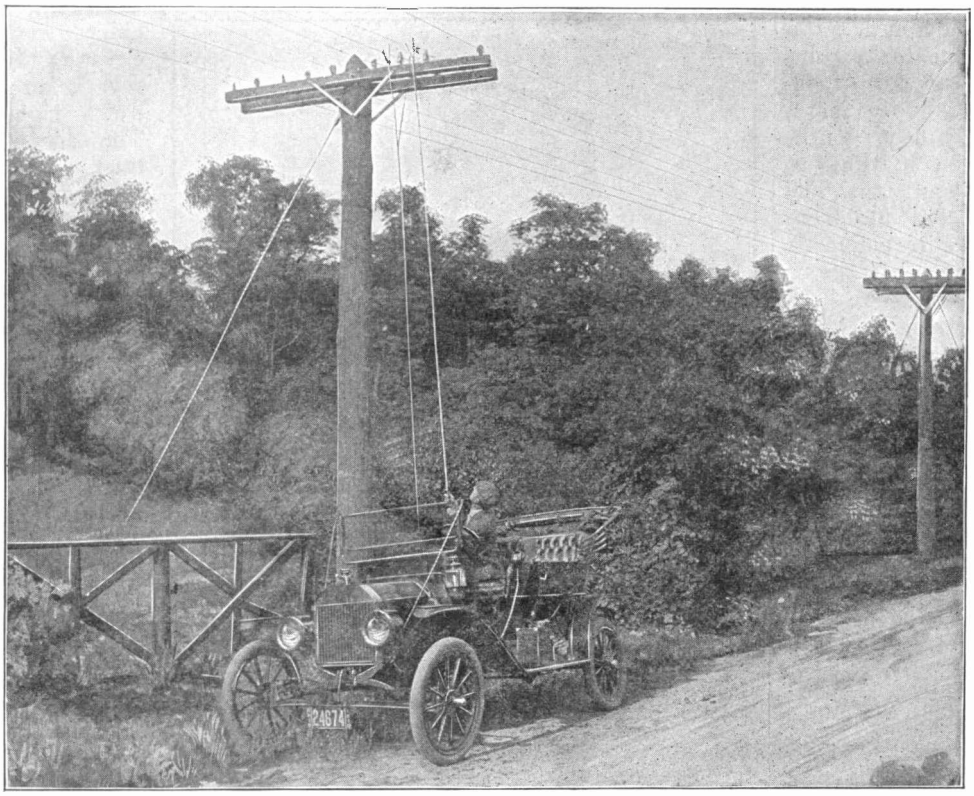
have in the car, as in case of accident a garage, physician's office or other stations may be called up without even leaving the machine.

In addition to the telephone instrument, a pair of connecting wires are provided for conducting the current from the overhead wires, a jointed aluminum rod being employed for attaching the conductors without leaving the motor car. When the auto phone is ready for operation the rod is taken down and stored away as it is not required in detaching the wire. The detachable contact clip is so arranged mechanically that it will make a positive contact even with rusty wires and at the same time will not damage the finest copper wire and can be detached without any strain on the connecting cord.

It is stated that connections can be made in the dark if necessary as provision is made for finding the wire without having even to look up for it.

The Interurban Brings Country to City

This is essentially the age of electricity—the electric age—golden with its possibilities for men. The possibility of human happiness and development is given its exemplification in the "trolley car." Wherever the interurban goes it revolutionizes things. It has opened up a new life to man. It has placed the man in the business office in close communion with nature. It has broadened the areas of our great cities, relieved congestion in our centers of population by extending the residence sections, making it possible for both rich and poor to live in close communion with Nature the year round. In God's great out-of-doors, always under the dome of heaven, in the arena of the unconfined horizon, has man been able to work and play at his best, and the trolley car has served a great purpose in assisting man to get back to his natural environments.

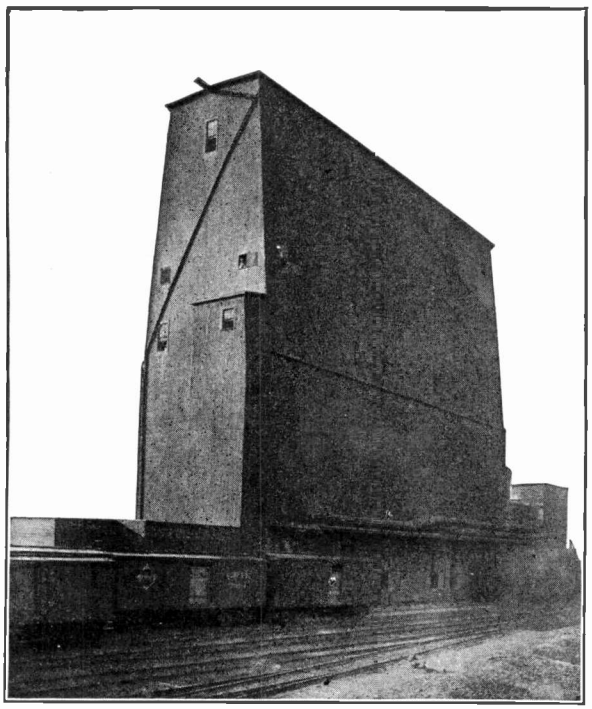


TELEPHONING FROM AN AUTOMOBILE

Electricity in the World's Granaries

The first step in the preparation of a loaf of bread after the wheat leaves the immense grain fields of the West and Northwest takes place in the grain elevators where the wheat is cleaned, dried, graded and stored, or loaded on boats or cars for shipment to distant climes and ports.

The millions of bushels of grain raised every year require hundreds of elevators, large and small, located at convenient shipping points and equipped with modern machinery for handling the grain without touching it with human hands. The need for more or less automatic machinery is better realized when we know the capacity of some of these immense granaries. The largest one in the world is located at Fort William at the head of the Great Lakes and has a storage capacity of 4,000,000 bushels of grain. Some idea of the size of the Fort William elevator may be had by comparison with the one in the accompanying picture which latter has a capacity of 100,000 bushels or one-fortieth that of the former.



ELEVATOR WITH A CAPACITY OF 100,000 BUSHELS

Those who have lived on the farm and have followed the threshing machine about the neighborhood know how much dust is raised as the grain is threshed. The grain elevator, too, is a dusty place and great care has to be taken as to fire. Oil lanterns are used to some extent for lighting, but the more modern elevators are equipped with incandescent lamps in double glass or vapor-tight globes, while the extension cord and wire guarded lamp replace the lantern.

With dust constantly settling on everything, the direct-current open motor is an unsatisfactory means of power, for it produces more or less sparks at the commutator, but the entrance of the brushless, alternating current, induction type of motor makes electricity the safest, most convenient and economical of motive powers.

The elevator here shown is run entirely by electric power, and the large metal pipes which you see above the roof of the unloading platform draw the dust by suction out of the cleaning machines in the elevator and convey it to the dust house. The cars on the track contain grain which is to be taken into the elevator. At this end of the building is located the motor-driven "car-puller". A rope running over pulleys is drawn down the track, hooked to the cars, the motor thus pulling them up alongside the elevator. Another motor operates a long "shovel-shaft" to which are attached ropes, pulleys and big wooden shovels for unloading the waiting cars.

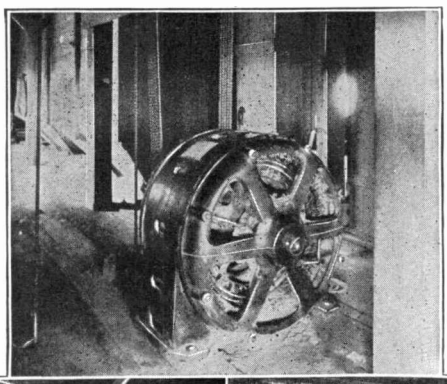
After the grain is unloaded heavy belts carrying metal buckets and running in wooden shafts or "legs", lift it to the top of the elevator by motor power to there begin its preparation for storage or shipment.

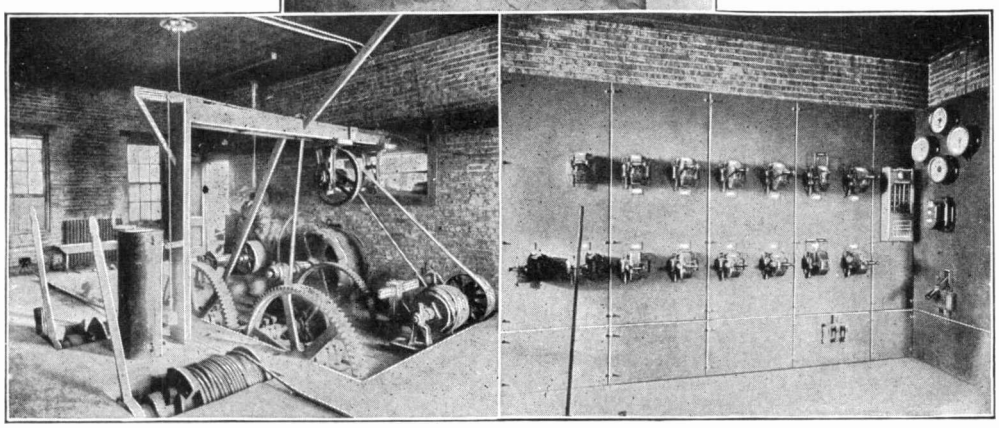
The switchboard is in a room cut off from the elevator. Pushing a button at any motor throws the annunciator on the switchboard, indicating to the attendant which motor is wanted in service. A return push button rings a bell at the motor showing that the attendant at the board is about to start the motor signaled for. Pushing a second button at the motor stops it.

Welsbach Electric Lights

If there is any name by which those interested in gas lighting can conjure, it is that of Dr. Carl Auer von Welsbach, the Austrian chemist who has reflected so much credit on his former teacher at Heidelberg, Professor Bunsen. For it was Welsbach more than any one else who raised gas lighting out of its old ruts over 20 years ago and enabled it to survive the competition of electric lighting in so many places. When the perfection of the incandescent lamp made it possible to use electric lights in residences the gas companies knew that they were face to face with their first real competition, and while they would not openly admit it, the fall in the price of gas stocks spoke louder than words. Many of the larger stockholders themselves were shrewd enough to invest also in the stock of electric light companies, while others counted on getting their returns while the economical distribution and use of electric lights was passing through the inevitable experimental years. By the time these years were about over, some of the gas interests had good reason for feeling uneasy, as the incandescent lights offered too many advantages to be offset even by a reduction in the rate for gas which would shave the profit to a questionable margin.

At this critical point Welsbach saved the day by his invention of a successful incandescent gas mantle which would enable the gas companies to compete with incandescent lighting while still charging a good rate for the gas. After years of careful experimenting Dr. Welsbach (who in Europe is always referred to as Dr. Auer) had found just the combination of rare earths that was needed to afford light-giving properties to a mantle when heated by a non-luminous gas flame. As this meant a more efficient use of the gas the producers only needed to make part of their proposed price reduction to stay in the race, and thanks to the thorough work of Welsbach and his business associates they were able to continue the struggle. For with all the disadvantages of the gas lamps which blacken walls and ceilings, consume the oxygen and vitiate the air of the rooms, the fact remains that they might have a price advantage over the old carbon filament incandescent lamps and there are always those who judge more by the cost than by the results obtained.





CAR PULLER

MOTOR DRIVE AT THE TOP OF AN ELEVATOR "LEG".

SIGNALING DEVICES AND SWITCHES

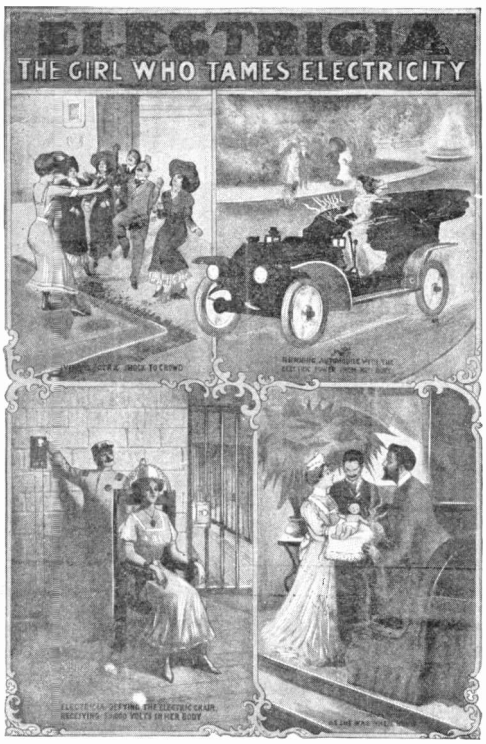
However the same helpful turn which came to gas lighting in 1891 through Wels-

bach's invention, came to the incandescent lamp a few years ago when tungsten was proven to be a practical successor to the carbon of the old filaments at nearly thrice its efficiency. This robbed the gas mantle lamps of their only real advantage, leaving their disadvantages to stand out all the more strongly and speeding the rate at which the gas lamps are being displaced by electric lights. How rapidly this change is going on, most of our readers will know from observation. But the far-sighted may ask: What of gas? Can there be another revolution to put it back into the race? Those familiar with gas lighting and with the perfection already obtained in mantle lamps (in so far as the term perfection is allowable for any device having such serious drawbacks),, agree in answering: "No." And if any striking confirmation is needed, it can be found in the attitude of the genius who brought gas lighting as far as it could be brought, Dr. von Welsbach. For instead of skirmishing after the unattainable in the way of a still more efficient gas lamp, he has for years been working on new ways of making filaments for incandescent lamps. It is he who produced the practical incandescent lamp having a filament made of osmium, since which time he has also been using some of the same rare elements which made his gas mantles a success. Here in America those interested in the sale of the Welsbach gas mantles have been studiously quiet about this recent work of their famous leader, but abroad their colleagues have made no secret of it. There they frankly admit that they have read the handwriting on the wall and that to stay profitably in the lighting supply business they must be ready with tungsten lamps or their equals so as to have something to offer to their old customers as fast as these discard their gas service. Already British and Australian journals are carrying large advertisements of Welsbach incandescent lamps, openly offered on the market by the same companies which thrived heretofore on the making of gas mantles. Of course their old patrons have not been slow to draw the logical inference from these advertisements, for this is a case where even he who runs may read.

Nearly a quarter of a million dollars worth of electrical apparatus was shipped from the United States to the Philippines last year.

"Electric Girl" Shows

P. T. Barnum's celebrated dictum that the public likes to be humbugged, seems to be just as true today as it was in the years when the great showman accumulated his fortune partly by playing upon this trait of the American people. To provide many present day vaudeville acts, therefore, embodies the making of commonplace actors appear as if they possessed unusual talent. For instance, here is a promotor who points with pride to the "Electric Girl" Shows, which proved such a



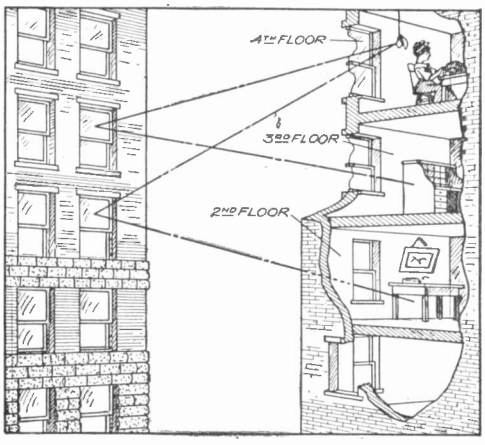
fine money maker at a popular seashore resort last summer. The posters billed her as "Electricia: The Girl Who Tames Electricity" and the barker at the entrance to the show proclaimed her as the only woman in the world strongly possessed of this magic power. These unusual powers were impressively shown by glaring posters, one of which pictured her as an infant sending out sparks that nearly stunned the attending physician; another showed her lighting gas jets with the sparks which freely flow from her finger tips and still another as driving an electric automobile at high speed with the

electricity furnished by her own body. Surely we would expect to search the country for decades to find even a single manifestation of such rare powers. But no, the promoter who offers to furnish this "act" for $175.00 assures you that "the audience thinks it is all in the powers of the girl, but any girl can do the act as she has no speaking part."

Of course an induction coil with impressively large dimensions forms part of the outfit. Its crackling sparks terrify the audience and seem to be truly tamed by the girl wonder who, according to the posters, has 50,000 volts sent through her while strapped in an electric chair said to be a duplicate of the ones used for electrocuting murderers in New York state. The stage manager vividly describes the enormity of this voltage and the marvelous power which the young woman must have to outlive the same, but the provider of the apparatus assures us that "the chair is secretly wired so that the girl scarcely feels the electricity."

Using Windows as Reflectors

One of the older buildings opposite the new and magnificent LaSalle Hotel in Chicago is occupied partly by a group of lawyers and

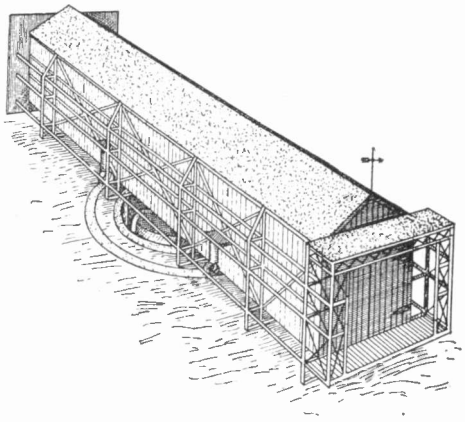


THE SCHEME OF THE CLEVER STENOGRAPHER

real estate men who have their letters and briefs transcribed by a public stenographer on the top floor. As she goes to some of the offices for her dictation, others were frequently puzzled to find her at her own room. When the new hotel building was erected, they were agreeably surprised to find that its windows acted as reflectors so as to reveal her at her post when in her own office. Then the question still remained as to whether or not she was busy with other work. To save her patrons from puzzling about this, the clever stenographer has arranged her electric lamp where it can be seen in the window reflections. Ordinarily the reflector which shields her eyes from the light throws it on her work, but when at leisure she turns the reflector to throw the beam towards the opposite windows. This simple and most inexpensive method of signalling is said to work like a charm and implies that most of us in our endeavors to utilize everything about us may have overlooked the reflecting power of the windows across the street.

Housing Dirigible Balloons

When an automobile approaches its garage it can easily swing around so as to enter the doorway squarely, no matter in



REVOLVING BALLOON SHED

what direction the latter faces. In the case of aeroplanes the turns are more difficult to negotiate with exactness in other than calm weather, and with a dirigible balloon a side wind may make it impossible for the craft to enter its garage safely. Nor can the dirigible leave the garage without the risk of scraping its sides if the wind comes from one side, even though the breeze may not be severe enough otherwise to interfere with the aerial trips.

A German structural steel builder, August Kloenne, has designed a garage for dirigible balloons which can readily be rotated to match the prevailing wind. For dirigibles

of the Zeppelin type this means a building 480 feet long, with folding doors giving a clear opening 63 feet wide and 63 feet high. The whole building is supported by trusses from a disk floating in a basin of water under the center of the garage, although ordinarily the weight rests on trucks running on a circular track. When the garage is to be turned, pressure from a motor driven air compressor raises the level of the water until the floating disk takes most of the weight off the trucks, allowing a 50 horsepower electric motor to rotate the building quickly to any desired direction. The doors are also opened and closed by means of electric motors, either operation requiring only two minutes.

Ice Skating All the Year Round

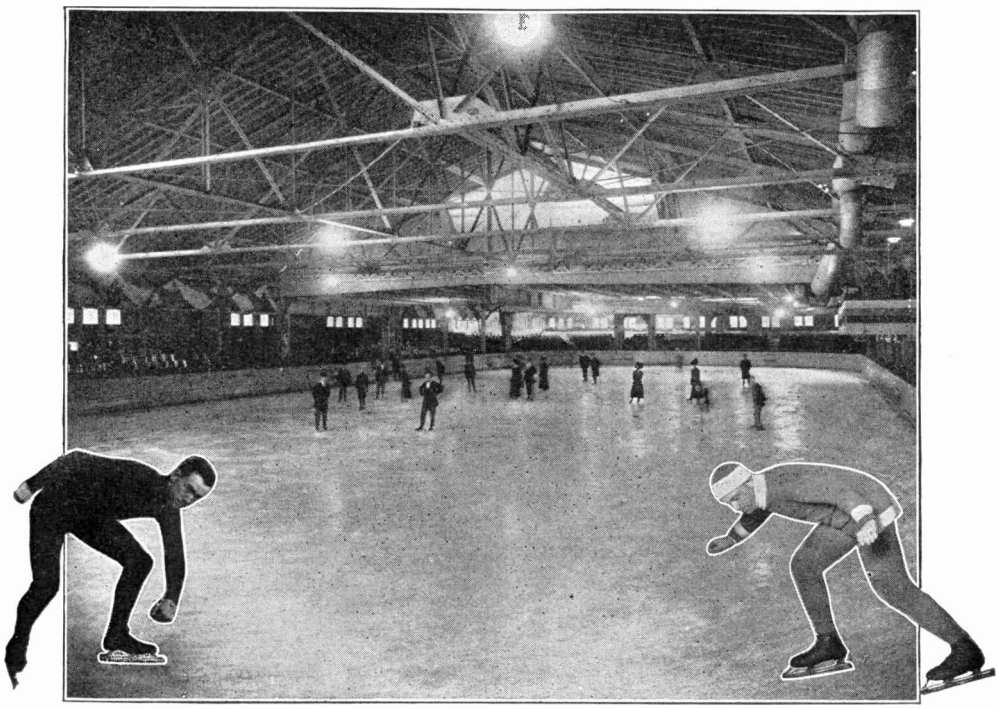
You will remember that old rule in your school physics "Rolling friction is less than sliding friction." Primitive man who lived where ice and snow ruled the earth for part of the year ignored this law. He had not reached that stage where he could readily fasten wheels upon his feet, but he did accomplish results by making for himself a pair of skates out of the shin or rib bones of an animal. He tied one of them to each foot and so worked out a way of going over ice and crusted snow from one place to another with speed and little effort. In Guild Hall, London, is a collection of these skates of bone.

Some 560 years ago came the wooden skate shod with iron, then the all-metal skate, and finally the Norwegian skate fastened permanently to the shoe.

We are not told whether the first ice "bone skater" used his devices for work or pleasure, but we must thank him for the hint, which, transformed into an improved art is a national pastime in at least one country of Europe, and a pleasure in others where the season permits.

And now, thanks to electricity, which, as a cheap, flexible source of power and an illuminant for great halls and interiors we are even permitted to have ice skating all the year round. By means of electrical refrigeration the story of the snow ball in the hot place has been revised.

Within Chicago's "Ice Palace" the cold of winter prevails at all seasons. Some idea of the interior is here shown—a pond of ice one-ninth of a mile around; seats for 2,000



Morris Wood INTERIOR OF CHICAGO'S ICE PALACE Herman Leweck

people; the whole interior brilliantly lighted by arcs. Winter or summer you may here put on your skates, don a sweater and with the band playing "Alice, My Ice Palace Queen" have all the fun and pleasure of real ice skating.

Two big electrically driven compressors by means of ammonia, chill a brine solution which electric pumps then force in its frigid condition through fifteen miles of pipe lying on sand under about four inches of ice. By flooding the surface of the ice with a thin layer of water and starting the motors a fresh glary surface is formed in a few minutes and grandfather's rule "Cracks she bears, bends she breaks" for judging safe ice is all upset, for electrically made ice-rink ice is always safe.

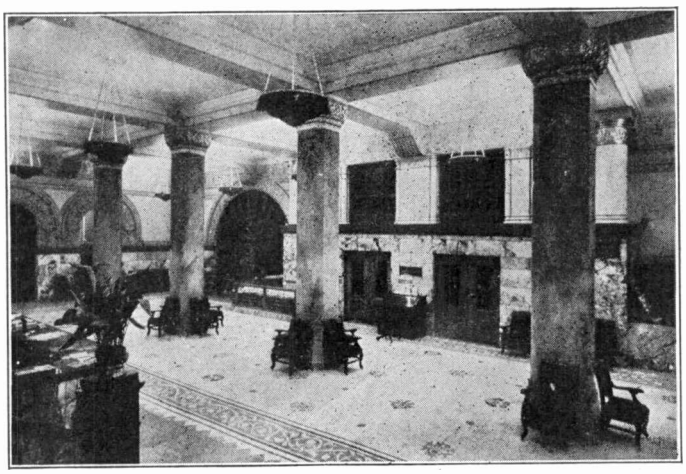
On the right of the picture is Herman Leweck, champion backward skater and jumper; on the left Morris Wood, champion professional speed skater of the world as posed on the ice in the rink. Hockey, racing and other ice sports are put on to entertain patrons and instructors are provided to teach beginners.

London has three rinks of this kind, Paris two, and Berlin the only one approaching the Ice Palace in ice surface. Besides Chicago there are rinks in Boston, New York, Philadelphia and Cleveland.

LIGHTING THE LOBBY OF A FAMOUS HOTEL

Not only are the modern new hotels installing every modern appliance for the comfort and convenience of guests, but the old established hostelries are rearranging their lobbies in the most artistic, attractive and homelike manner.

The reasons are obvious. With the number of new hotels starting in almost every city, it is necessary for the older hotels in order to retain their patrons, to follow suit.



INDIRECT ILLUMINATION OF THE AUDITORIUM LOBBY

The interior shown here, that of the lobby of the Auditorium Hotel on Michigan avenue, Chicago, is familiar to thousands, from coast to coast. Previously lighted with large numbers of exposed direct incandescent lamps, a cluster being in the center of each of the 16 by 24 foot bays, as well as the arches being outlined with them, presented a glare and blaze of light. Very efficient, but trying. The beautiful architecture was shown to poor advantage.

All these glaring lights have been discarded and it would hardly be recognized on account of the radical change made in the method of illumination. The charm and comfort of the present indirect lighting arrangement may be partially realized from the accompanying illustration which was made from a photograph taken by the light of the system.

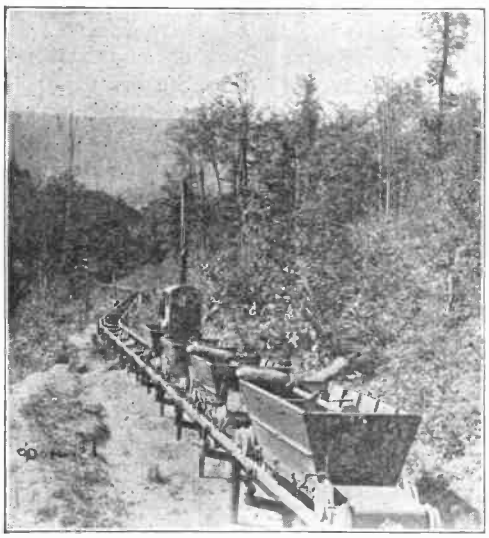
Suspended by chains from the center of each bay are artistic bowl fixtures, classic in design, each containing five powerful reflectors of scientific design with a 100-watt Mazda lamp. These indirect lighting units are hung five feet from the ceiling which is 24 feet high. The light thrown to the ceiling (finished in ivory and white) is reflected back again to the working plane, and diffused throughout the room in a flood of comfortable even illumination.

The lighting of a ceiling has the effect as architects say, of raising the ceiling, and the beautiful architecture of this Auditorium lobby is now shown off to the best possible advantage.

Automatic Transportation

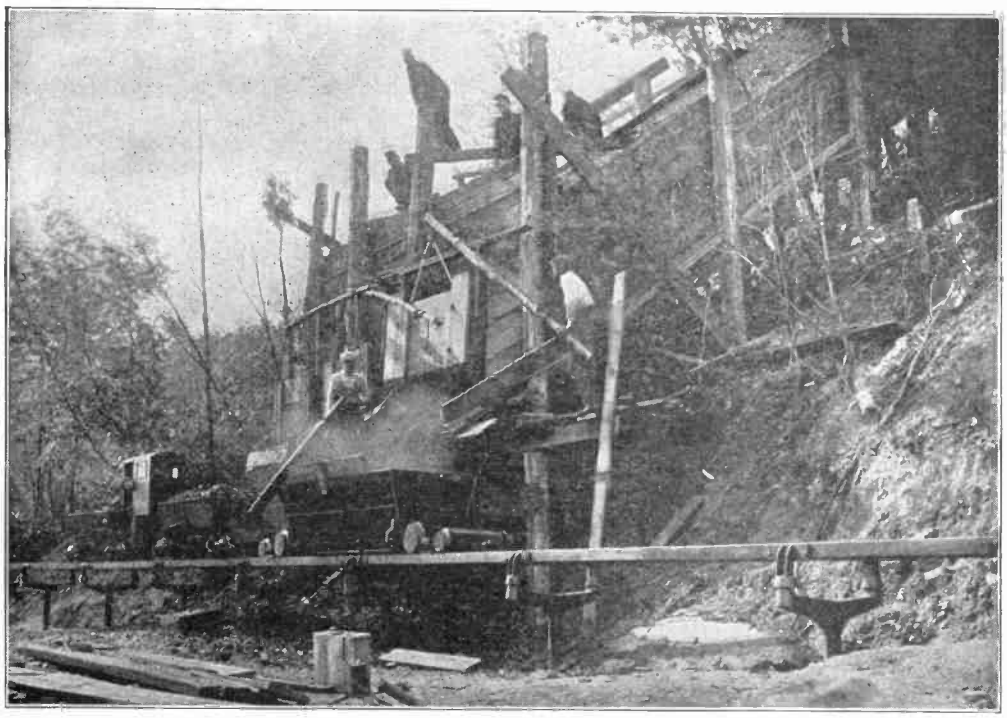
As far back as the October, 1908, issue of POPULAR ELECTRICITY a brief description was given of the unique system of automatic transportation devised by William C. Carr. Since that time some improvements have been made and the system has actually been put to practical use in and about coal mines. No doubt our new readers will be interested in a description of the unusual features of the automatic cars and their operation.

In the first place it is designed to give better transportation facilities over relatively short distances—as a feeder, so to speak, to systems of a greater scope, such as electric railways and steam roads. It comprises a series of concrete or metal posts capped by malleable iron Y's, which support a double steel track of 30-inch gauge elevated above the ground. The carriers or motor cars are intended to travel automatically on these parallel rails at any desired rate of speed up to 40 or 50 miles an hour.



AUTOMATIC COAL RAILWAY AT BLOSSBURG

The designs of the company building the cars and tracks are quite comprehensive in their scope and include cars for a variety of purposes. All these uses have

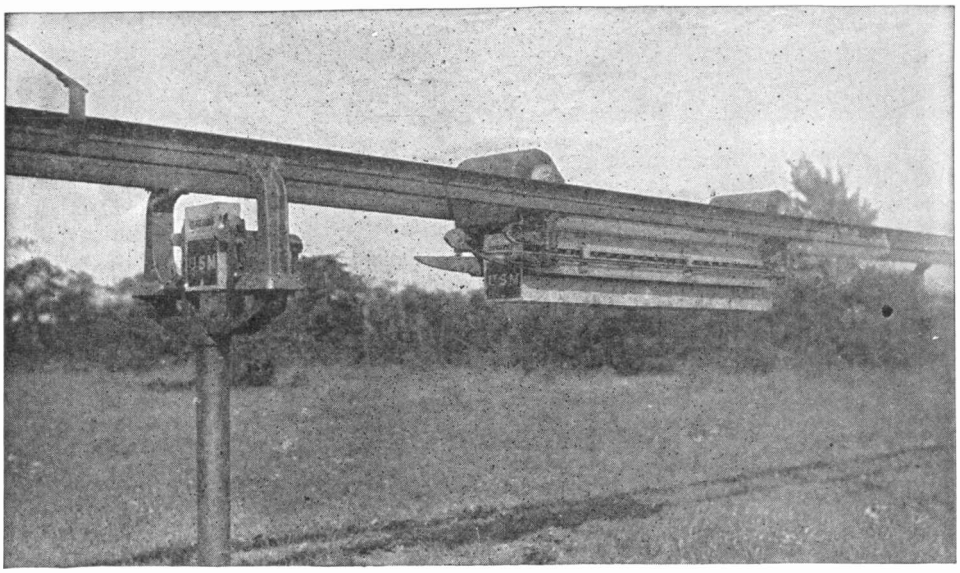


LOADING THE AUTOMATIC CARS AT THE BLOSSBURG MINE

not been demonstrated by practical commercial operation but the pictures show the development to which the promoters hope to arrive in time.

Following are the uses planned for the system: Ore carriers capable of conveying large quantities of ore, sand, coal, lumber, etc.; specially constructed passenger cars equipped to operate on automatic transportation tracks; mail and package carriers designed especially to serve rural communities; concrete tube systems for use underground in congested centers of population; flexible tracks with electric truck scales for moving freight in railroad terminals and manufacturing plants; electric truck scales, that runs. A train of two motor cars and four trailers will carry 16,000 pounds of coal at a trip. The carriers may be automatically operated, dumping the coal and returning empty to the loading chute at the mine. Horses were formerly used, but the railway performs the service more quickly and economically.

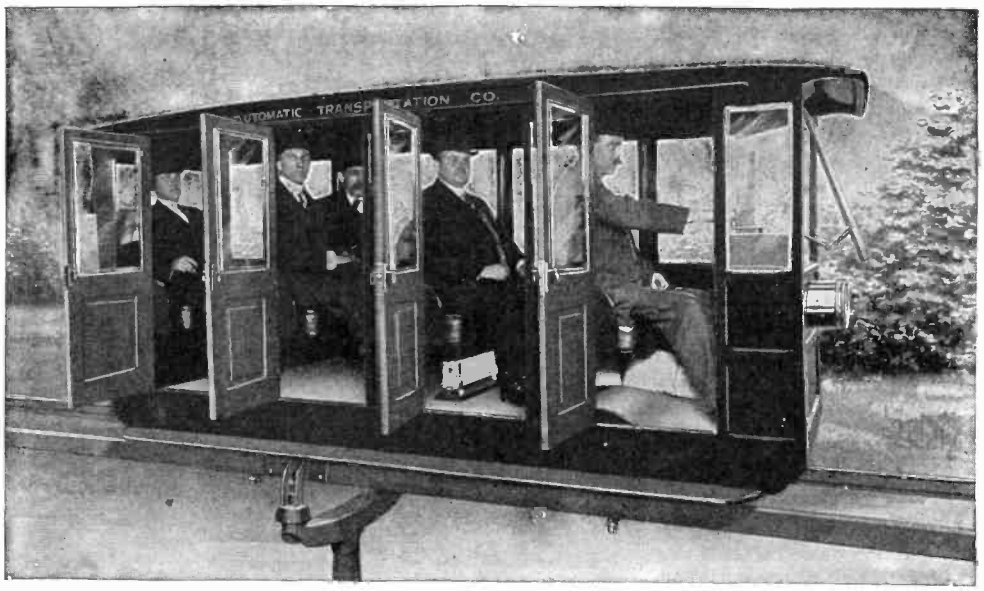
In all cases except the storage battery truck, it is intended to have a central generating plant to furnish the power, or else buy the power from a central station or railway company. In the case of the passenger cars it is of course unnecessary to have the automatic feature, as a motorman could ride in the car to operate it, as shown



AUTOMATIC RAILWAY AS PLANNED FOR PACKAGE AND MAIL DELIVERY

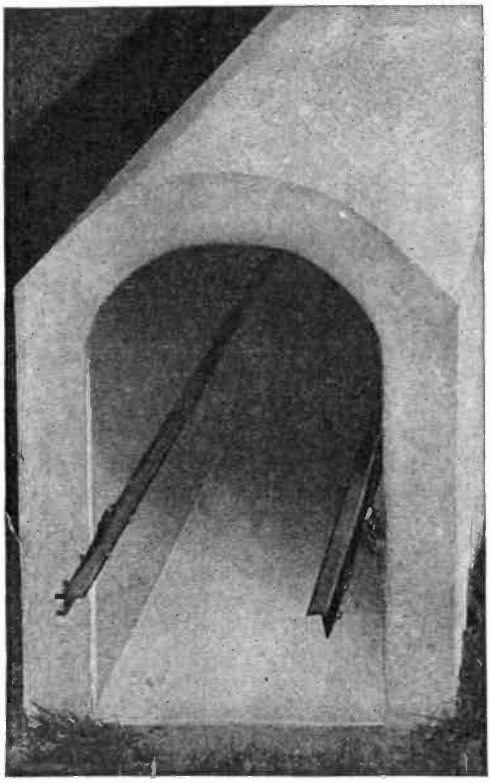
require no tracks, equipped with storage batteries and provided with special weighing attachments that record the individual weight of each package as well as the combined weight of a truck load, also specially designed for use at railroad terminals.

One practical application which has been made at one of the coal mines in Blossburg, Pa. The track is a mile in length and is built by placing the rails on insulators supported on Y-shaped iron posts resting in concrete. One side of the track serves as a trolley, the other as a return. To prevent sleet and ice from interfering with the operation of the line the "trolley rail" is V-shaped on the under side and in this groove the trolley in one of the pictures, which illustrates an experimental equipment. It is in the automatic package delivery, however, that the most interesting features are exhibited. It is intended to send these little cars out over a system something after the manner of a cash carrier in a department store only the cars are self-propelled, by little motors, and will travel up hill and down dale. In delivering mail for instance, in rural communities, it is planned to direct these cars from a central operator. The car will slow down automatically, leave a mail box containing the farmer's mail locked in a station in front of his house, ring an electric bell in the house, pick up a box containing



AUTOMATIC RAILWAY AS PLANNED FOR PASSENGER SERVICE

outgoing mail and proceed on its way to the next station, going at the rate of 20 to 30 miles an hour. The same method would be employed in delivering and collecting packages of merchandise.



AUTOMATIC RAILWAY THROUGH TUNNEL

Whether or not such systems will be put into practical operation to any considerable extent throughout the country is, at present, a matter for conjecture. It takes a long time to convince the public of the merits of a new departure such as this. It is conceivable, however, that in communities too sparsely settled to support an electric railway, that such a system might be employed to advantage as the cost of installation would be far below that of an ordinary railway.

On the whole these pictures give rise to interesting conjectures. Is it not possible that some day great power generating centers will be created at the coal mines and the water power sites; that this power created cheaply, in bulk, will be transmitted to points along the railroad trunk lines, and these lines be all operated electrically by large electric locomotives drawing trains; that the trunk lines will be fed by electric trolley and third rail lines, as is now quite largely the case; that then, in turn, these full size electric railways may be the collectors for tributary monorail lines of a type similar to the one described—the whole spreading out in one intricate net work of trunks, feeders and subfeeders, all operated by electric power?

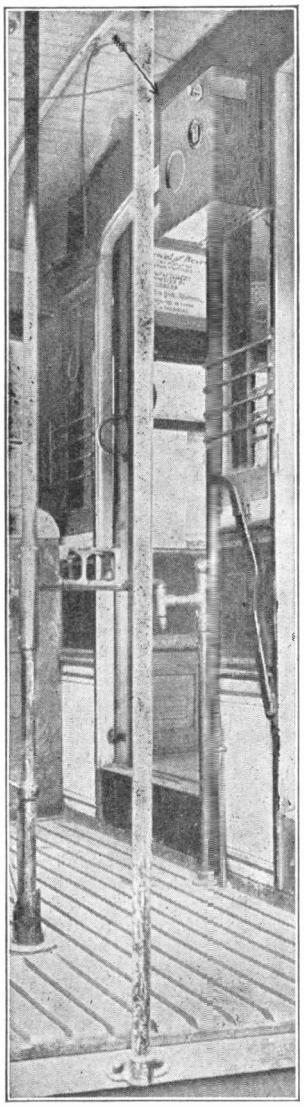
Recording the "Coasting" of Cars

Few recent inventions are as unerring in figuring out the errors of the individual man and enabling an indiscriminate judgment to be made of the capabilities of railway employees as the new device just put into use on the lines of the Interborough Rapid Transit Company of New York City.

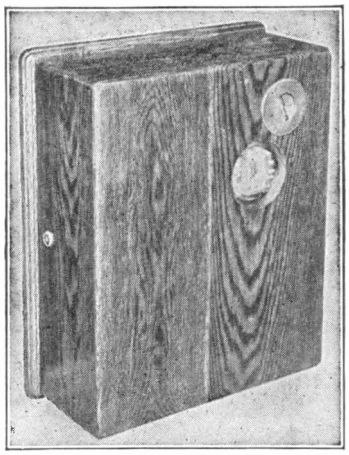
This appliance takes the place of the inspector or "spotter" of the railway who, riding about in different cars unbeknown to the crew, takes notes on the way the motorman runs his car, whether he uses more or less power than he ought to and coasts as far as the stored up energy of a car will allow him. Its name, "the coasting time recorder," gives a good idea exactly what the device is intended to do and, being the product of the ingenuity of officials of the largest of New York's electric railways, it does it. At the same time the motorman feels an interest in having his record show up as good as possible, instead of being incensed at knowing "spotters" are watching his movements.

The object of the coasting time recorder is to secure a comparative and certain record of the efficiency of the motormen in running cars. It had been demonstrated by tests on the Manhattan Elevated with wattmeters that the difference in kilowatt hours used by different motormen on the same stretches of track, with the same car and exactly similar conditions of power, varied from slight amounts to as much as 30 per cent. Carelessness in running a car and not coasting as far as practicable accounted for the latter high figures.

Investigation proved that a permanent record of the time spent in coasting possesses certain advantages over a record of the time that the source of power was drawn on. It not only makes the motorman careful to go as far on as little power as possible but it also indicates to the officials the braking

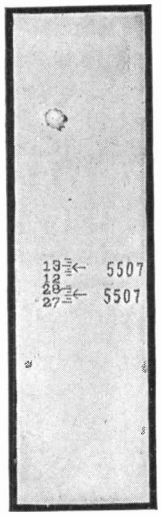


COASTING RECORDER MOUNTED IN THE VESTIBULE OF A CAR



COASTING RECORDER

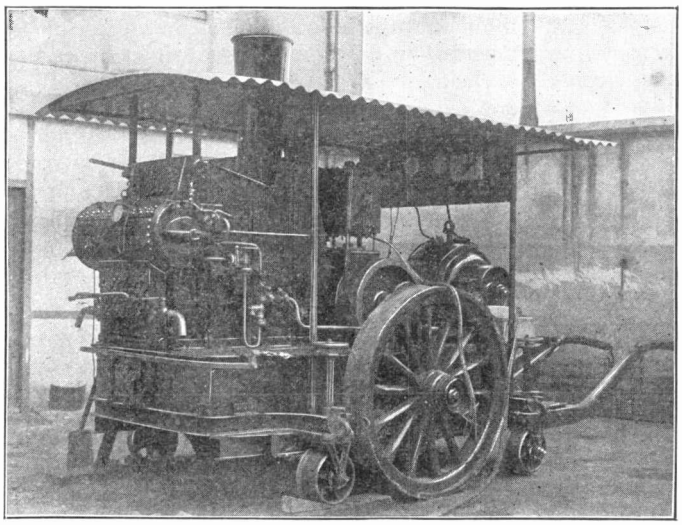
THE MOTORMAN'S KEY



A SECTION OF THE RECORD TAPE

efficiency or quickness of stopping when occasion demands it.

Essentially the device consists of a clock movement which engages a type wheel. The type wheel indicates the time in raised figures and a paper tape is fed under the type wheel upon which is printed the coasting time each time the motorman inserts his key and turns it. The clock is stopped and started by a magnetic brake which is actuated by magnets, the brake being withheld as long as the power is shut off and applied when the brake of the car is thrown on.



A PORTABLE ELECTRIC PLANT

Each motorman is given a numbered key which he inserts and turns on starting on his run. This records his number and records the initial reading of the clock. The motorman then goes on his run and when at the end of the trip he again inserts his key and turns it a printed record of the elapsed coasting time is delivered from the box in which the machine is mounted. This record is delivered at the superintendent's office and filed. This enables the motorman to correct his abuse of the company's power and gives the company an idea of the comparative efficiency of the motormen.

A record ribbon photographed as delivered after the run shows that motorman 5507, during his total run, coasted from 13 minutes to nearly 28 minutes, making a total of about 15 minutes' coasting time for the entire run.

A Portable Electric Plant

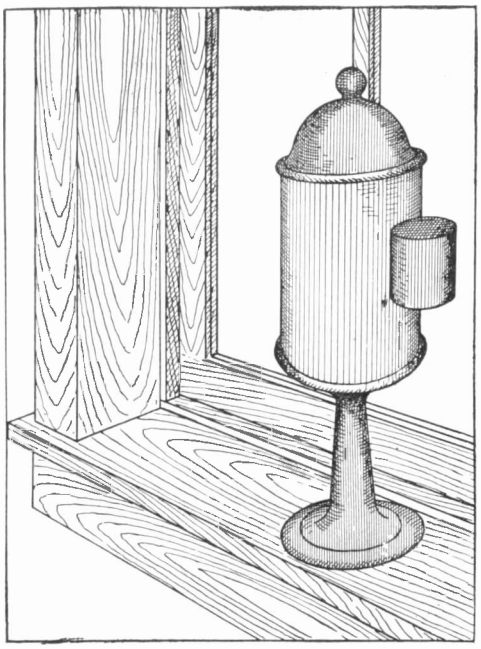
Foreign engineers are highly skilled in the design of compact, portable outfits for generating electricity. One of the latest ideas in this line is French portable electric light plant embodying a steam engine and boiler on wheels, dynamo, switchboard and all accessories.

The steam engine is mounted in the center of the portable plant as noted in the illustration, directly back of the boiler, and develops 40 horsepower. The dynamo is driven from the engine by belt transmission, an idler pulley being used on account of the short belt. The total weight of this portable steam-electric plant is about five tons, and not being self-propelling is drawn about by horses.

A Window Advertising Novelty

Some two years ago the former general manager of Marshall Field & Co., Mr. H. G. Selfridge of Chicago, surprised the mercantile world by establishing a department store modeled on American lines right in the heart of London. Among the characteristic features which shocked the old London shopkeepers were the huge show windows which were brightly lighted every evening, while theirs were carefully concealed by iron shutters pulled down at dusk. The evident success of these window displays in attracting trade has had its effect on Mr. Selfridge's competitors who are gradually improving their store fronts and catering to the spectators even after their closing hours.

Indeed, some of them have lately been skirmishing around for new effects to catch the eyes of the thousands who pass by their stores at all hours. One of these, which has been successfully holding the attention of the crowds, is a display of canned goods (or as the English call them "goods in tins") consisting of a series of columns with the labelled cans rolling around them without visible means of support. Some of the columns had only one can slowly rolling



WINDOW ADVERTISING NOVELTY

around each while others had several that apparently were chasing each other around the advertising pillar. Of course, the secret involves magnetism as each column contains an electro-magnet slowly rotated by a small motor. The cans are empty and where they are made of brass (as in the case of mushroom cans) an iron tube rolling inside each can keeps it close to the column opposite the slowly revolving pole of the concealed magnet. The effect of these magically suspended and slowly gyrating objects is said to be all the more weird as the moving cans look exactly like the regular stock article as stacked high in the same windows.

Is it Alternating or Direct Current

"How can I tell whether the current I am using is alternating or direct?" is a question frequently asked by our readers.

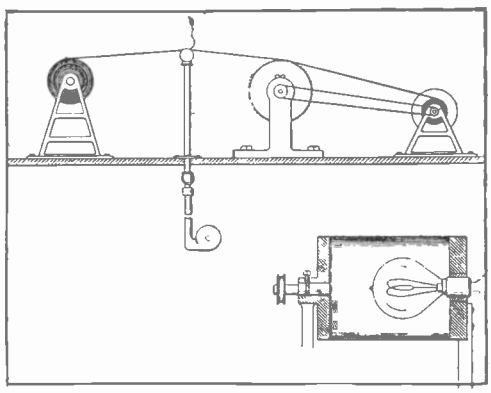
Take a simple bar magnet and hold it near a lighted incandescent lamp. If the current is alternating the filament will vibrate, if direct, the filament will be attracted or repelled according to the sign of the magnet pole held near the lamp.

Preparing Moving Picture Films

The picture thrown upon the screen at a moving picture show is many times larger than the picture on the film in front of the lamp. Great care must be taken, therefore, in preparing films to have the surface free from all dust or other foreign particles, as these magnified when thrown upon the screen would spoil the picture.

A device for cleaning the film and for placing identifying marks on it by photography is the subject of a patent issued to Gustav E. Hoglund of Chicago, Ill.

In preparing the film a delivery reel of it is placed in position as in the upper illustration. The end of the film is then passed between two cylindrically shaped sucker heads. Each cylinder has a small



PREPARING MOVING PICTURE FILMS

opening in it next to the film, and by piping and an electric fan or other means of producing suction, dust particles are removed. The film then passes over a drum equipped with sprocket teeth arranged to engage with the holes along the edge of the film. Just outside of these teeth on either side is a ring of holes opening into the drum which is hollow and contains an electric lamp. Over each of these holes a stencil letter may be placed, and as the film passes over the openings with the drum revolving, letters, words, or trade marks may be photographed on each outside edge.

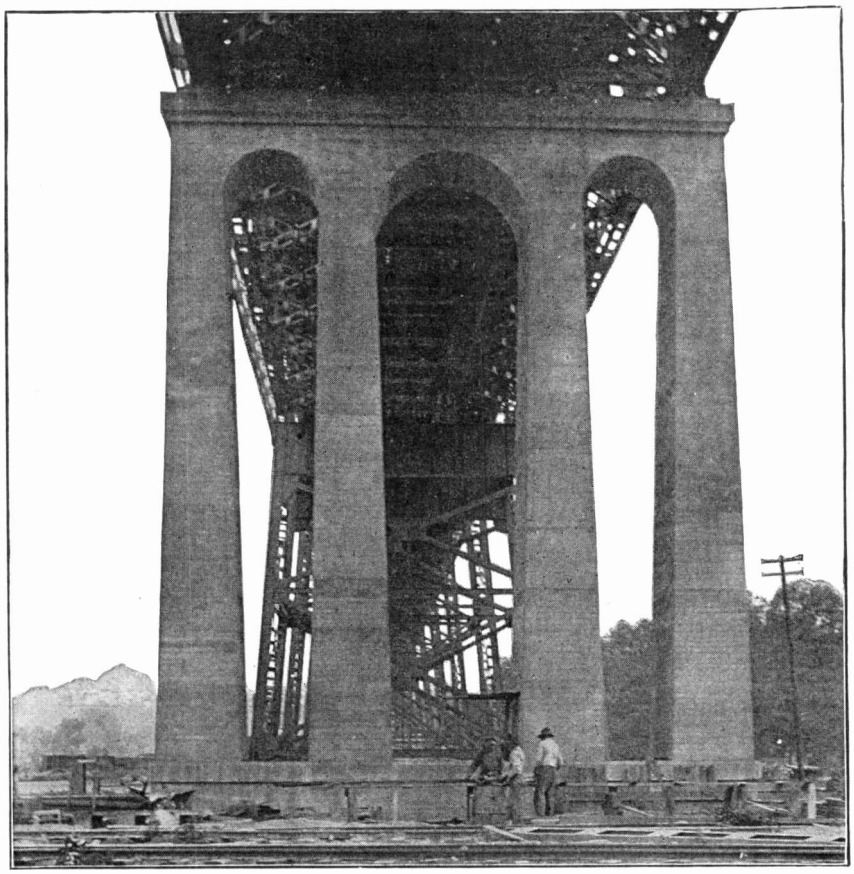
There are at present sixteen cables across the Altantic. Two of these are owned by the Western Union company, four by the Anglo-American, one by the Direct United States, five by the Commercial, two by French and two by German companies.

Garbage Made into Electricity

Hamburg, Germany, not only disposes of its garbage most satisfactorily but realizes a revenue from it. Four-wheeled water-tight iron carts are used to convey the garbage to an incinerating plant where it is reduced to ashes. The cart bodies are lifted from the wheels by electric traveling cranes and the contents discharged directly into the furnace. One electric cart is now in use and more will be purchased until no horses are in service. The slag from the furnaces is broken up during which operation an electro-magnet removes all small pieces of iron. The scrap iron is sold at auction and the slag brings 24 cents per ton being used for roadways, paving blocks and for manufacturing slag bricks. From the garbage furnaces sufficient power is obtained to operate the cranes, slag breakers and lighting plant, besides furnishing current for the storage battery of an electric launch and an automobile.

A Half-million Dollar Viaduct

At a cost of half a million dollars the Dennison-Harvard viaduct will soon be completed across the river in Cleveland, Ohio.



THE GREAT CLEVELAND VIADUCT FOR CARRYING ELECTRIC RAILWAYS, LIGHT, POWER AND TELEPHONE WIRES

This great piece of engineering is three-quarters of a mile long and provision has been made not only for car tracks but also for carrying over all light, power and telephone wires. Some idea of the immensity of the structure is conveyed by the picture of one of the concrete piers supporting the roadway. From the surface of the water to the sidewalk on the viaduct is 103 feet high.

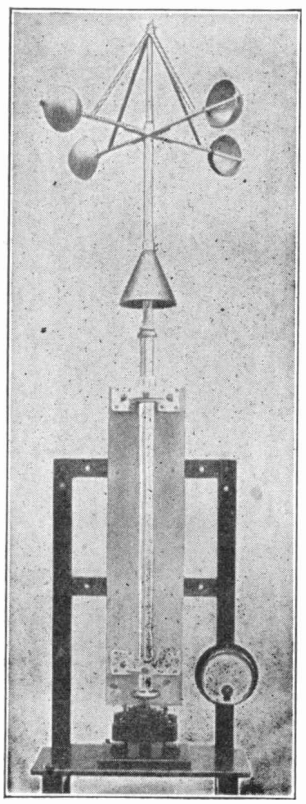
Leg-power Electricity

A curious form of exercising apparatus has been brought out by a Virginian who had been impressed with the fact that the static electricity generated in walking over rugs is often powerful enough to give one a surprising shock when touching radiators or fixtures. If such an effect can be developed incidental to walking, it ought to be much greater if produced by deliberate and continued action. Then if the resulting gentle currents of electricity were passed through the body, they might give the same sort of a helpful stimulus that is often secured from medical batteries. Carrying out this theory, Mr. Hitt has mounted a number of brushes on a board so that the user can rest his foot on one of the brushes while swinging his other foot or ankle between another pair. If this is done in stocking feet, the resulting combination of leg exercise and electrical action is said to stimulate the system.

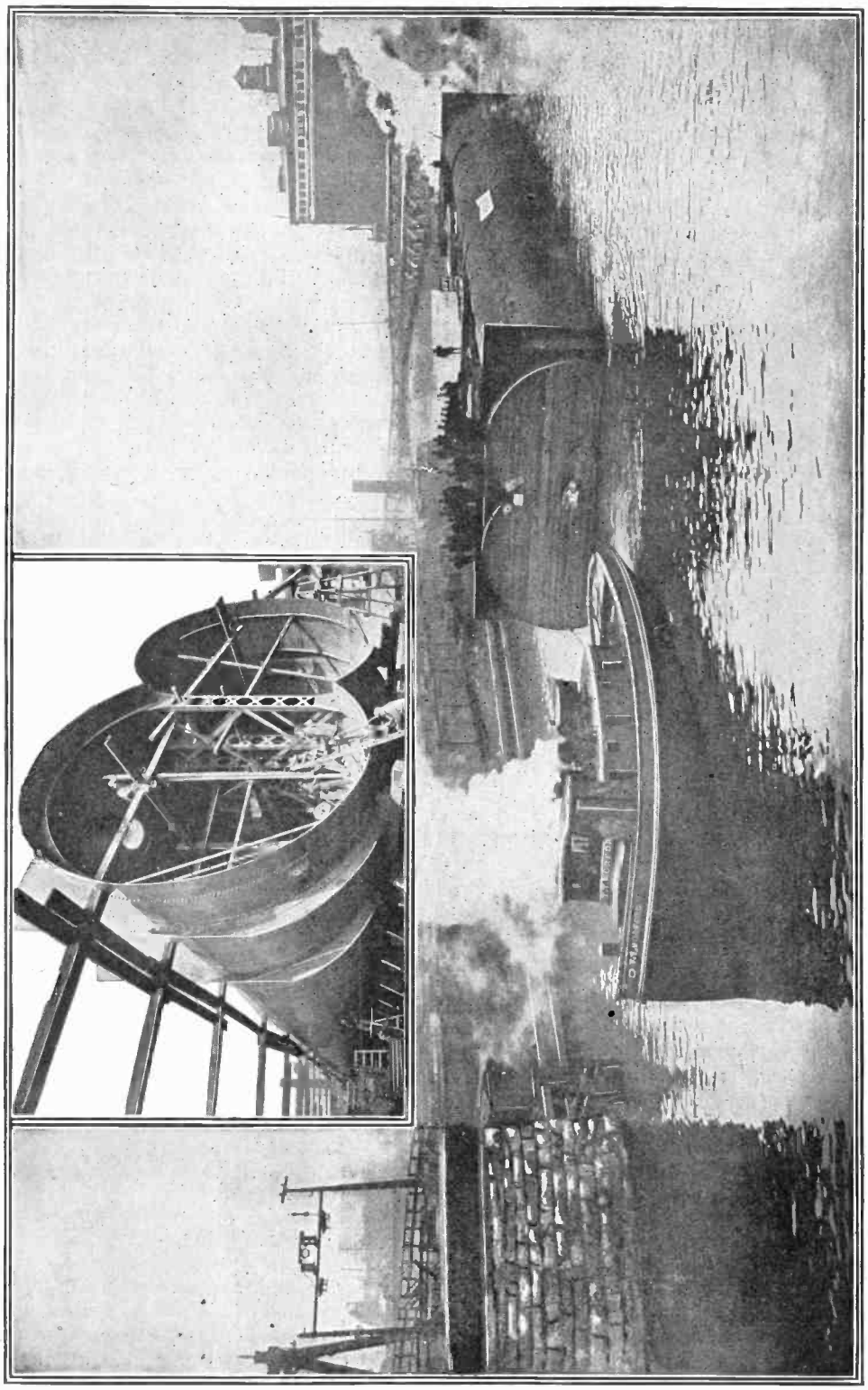
LEG POWER ELECTRIC EXERCISER

Electrical Wind Measuring

In addition to a recorder for counting the total number of miles at which the wind has passed a given point during an hour, every weather bureau and rifle range needs to have some instrument for indicating the breeze blowing at any moment. This is easily done because of the simple electrical law that the voltage of a dynamo varies with its speed, so that if we drive a small dynamo by wind power and measure the voltage, this will always be proportional to the speed. For that purpose a cross carrying hemispherical cup is mounted at the top of a vertical shaft, there being four of the cups so as to catch the wind from any direction, and the lower end of the shaft carries the armature of a miniature dynamo. From this the wires run to a voltmeter located in any convenient place, with the scale marked to indicate the wind speed to which the voltage of the current corresponds. Then if there is any movement of the air over the roof or tower on which the rotating brackets are placed, the needle on the distant indicator will tell the speed of the wind at any moment and by arranging contacts in the path of the needle, this can be made to ring alarm bells when the wind exceeds a certain rate or when it slackens again to a less dangerous speed. The device as thus pictured by us is made by Max Kohl of Chemnitz, Germany.



ELECTRICAL WIND MEASURING INSTRUMENT



GIANT TUBES FOR ELECTRIC RAILWAY TUNNELS UNDER THE CHICAGO RIVER, AND HOW THEY WERE FLOATED INTO POSITION

Through Giant Tubes Under River

A gigantic piece of engineering, costing more than $3,000,000 is going on in the heart of Chicago so rapidly but quietly that the casual observer will not know it until he finds himself some morning plunged from the light of day into a world of electric light, with concrete floor, walls and ceiling all about him and only a small circle of daylight ahead. With the time for completion of three under-the-river tunnels not far away, thousands of workers for the North and West sides who ride on surface cars to and from their places of business will, it is hoped, forget the meaning of the word "blockade," for it is to help do away with congestion in Chicago's "loop district" that these tunnels are built.

The illustration shows one of the steel tubes on its way down the river to be put in place. This double tube, weighing 8,000 tons, is 289 feet long, 30 feet wide and 20 feet high. A street-car track will occupy each half of the tube, which with the steel trusses that stud the middle, make the end view resemble the figure eight. The tube was built in a dry dock, sealed up at the ends, and in this condition towed down the river, where it will be swung into position and sunk into the bed of the river, which has been prepared by excavating with marine dredges to such a depth that the top of the tube will not interfere with the passage of lake boats, as was the case with the old tunnels. The approaches to the tunnels are of concrete and the tubes will be lined with the same material.

Trial of the Edison Battery Car

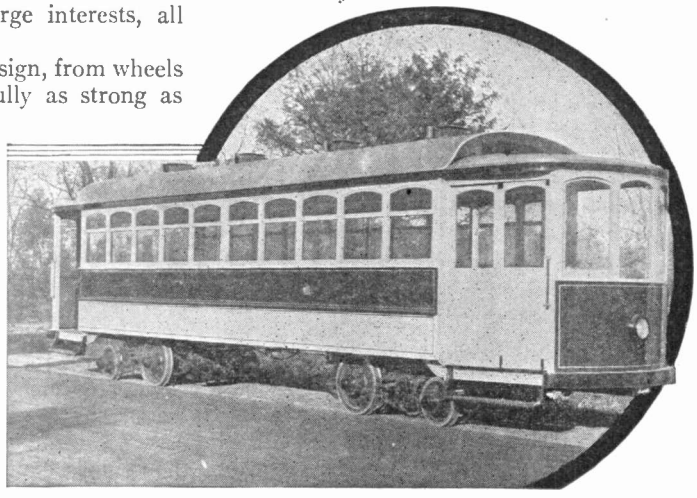
The unusual spectacle of an electric car of urban street railway pattern going at 25 miles an hour on a standard gauge steam railroad track was witnessed recently on the line of the Erie railroad, from West Orange to Forest Hills, New Jersey.

Thomas A. Edison was a member of the party watching the car, for the motive power was the storage battery invented by him, the first of its class to prove practical in its application to the railway passenger traffic problem. With Mr. Edison were President Underwood of the Erie and a number of other representatives of large interests, all concerned in the trial.

The car used is of new design, from wheels to roof. It is light, yet fully as strong as if it weighed ten times as much, as far as practical demands are concerned.

The unnecessary consumption of power on cars obtaining with the solid axle car, is eliminated. Naturally, when two wheels are joined together rigidly on the same axle, and the car is forced around a curve, the outside wheel travels a great deal further than the inside wheel. Therefore, the inside wheel must slip and grind against the inside rail with consequent enormous consumption of power and wear of wheel and rail. With this car each wheel is as independent as are the wheels of automobiles, turning independently on the same axle, and each wheel is driven by its own motor. These wheels are mounted on roller bearings, thereby diminishing bearing friction.

Silent chains are used to transmit the power from the motors to the wheels, with consequent quiet running and the absence of all gear noises so common with trolley cars. The battery cells—180 in all,—are under



THE EDISON BATTERY CAR

the seats. A separate set of batteries supplies current for lights.

The car travels 85 miles per charge on the basis of stopping ten times per mile, letting off and taking on passengers. If allowed to run without stops, it would probably run 125 miles. The scheduled speed is eighteen miles per hour, but the car has reached a speed of 35 miles per hour on a long, straight level track.

In place of the ordinary compressed air signal an electric signal, called the Klaxon, is used. One of these signals is mounted on the roof at each end of the car, though not showing in the picture. The Klaxon produces a loud and peculiar sound by the rubbing of a toothed wheel over a vibrating metal reed. The wheel is operated by a little electric motor which is thrown into and out of circuit by a plunger-operated switch, which the motorman actuates with his foot.

The Telephone in an Emergency

An impressive illustration of the service rendered by the telephone in time of emergency was given during the big stockyards fire the week preceding Christmas in which Fire Chief Horan and 24 of his men lost their lives and as many more were injured.

As the rumor of fatalities spread the calls over the telephone increased until, between ten and eleven o'clock, 200,000 fire-information calls an hour were being handled.

Lists of the telephone numbers of engine houses in the vicinity of the stockyards were given to the information operators throughout the city, so that callers insistent upon having news about particular members of the department could be switched to these points for extra calls.

Low Wireless Rates

The South Eastern Railway Company, which operates steamers across the British Channel has announced a new schedule of rates for messages sent from its vessels by wireless. The rate per word is to be six cents to England; nine cents to Germany, Belgium or France; ten cents to Switzerland, Italy and Austria; and eleven cents to Denmark, Sweden and Norway. These surprisingly low rates for aerograms are based on a minimum charge of 62 cents for messages to England and of 75 cents for all messages to the European continent.

ABOVE THE CLOUDS

Above the Clouds in an Electric Auto

The practicability of the electric both as a car for city and suburban use and for hill-climbing as well, was demonstrated by the successful completion of a series of remarkable tests made in New England last fall.

In one of the tests a Detroit Electric left New York September 17, arriving at Waterbury, Connecticut, that evening. From there is proceeded to Boston, thence along the Massachusetts and Maine coasts and later to Glen, which is at the base of Mount Washington and from there the actual start of climbing the mountain was made.

A blinding rain and windstorm was encountered after a climb of 6,000 feet was made. Returning to Bretton Woods, the prescribed route was again taken up and the electric continued without mishap.

The actual distance covered was 1,007.73 miles in 89 hours and 25 minutes.

Locating a Shot in the Eyeball

How to locate, with mathematical accuracy, the exact position of a foreign body imbedded in the eyeball is a problem which has been successfully solved by an ingenious application of the X-ray. This is known as the Sweet method, after its inventor, Dr. Sweet. Manifestly, taking one photograph of the eye by X-rays would show the body, but we would not know how far in. To locate it exactly a second picture must be taken at a different angle. To do this and locate the spots takes a device of some ingenuity, as shown in the pictures.

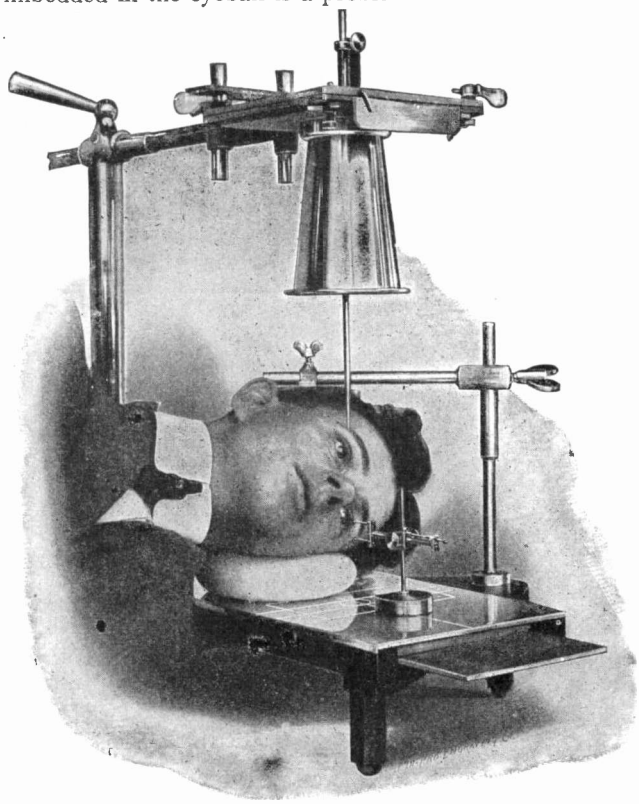


FIG. 1. FIRST EXPOSURE

In Fig. 1 we see the stand on which the patient's head rests, on a pneumatic cushion. In the lower part of the stand is a sort of drawer holding the photographic plates. The upper surface of the stand is made of aluminum, which allows the X-rays to pass through. On it is marked a diagram, with a little circle, directly over which the eye is to be placed. Above the head is a sort of funnel which directs the rays from the X-ray tube downward along the line of the needle pointer.

In front of the patient's eye is what is known as the localizer. On the projecting bracket arm of the localizer are carried two small prongs with metallic knobs on the ends, one round and the other slightly pointed. The two arms carrying these knobs are at a known distance apart.

The little base carrying the localizer is moved up to the front line marked on the aluminum surface. The patient's head is then moved up until the little knobs press on his closed eyelid. Then his eye is directly over the proper place on the diagram. By an ingenious trigger arrangement the knobs are released and fly back exactly 10 millimeters, so the patient can open his eye. Next the funnel is swung over until the needle points down in a plane just touching the front of the eyeball and we are ready to take the first picture, which is as shown in Fig. 2. Here, the heavy black dot at the right is made by the two knobs of the

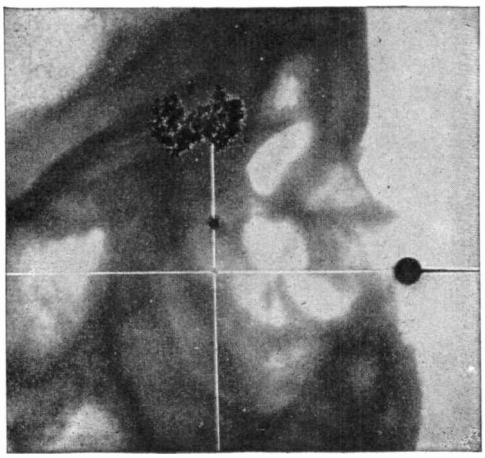


FIG. 2. FIRST NEGATIVE

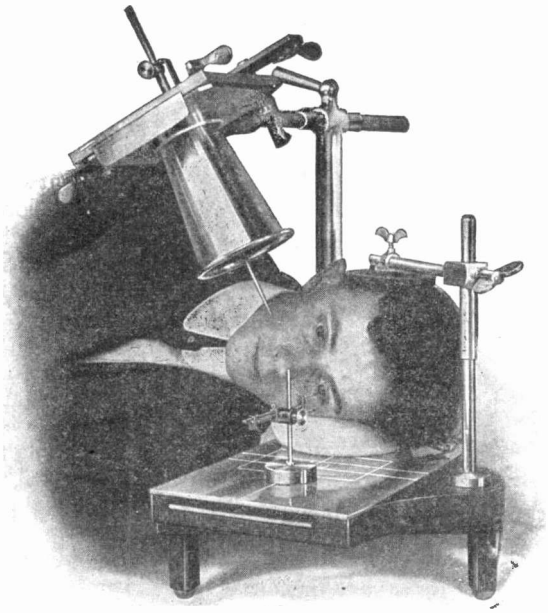


FIG. 3. SECOND EXPOSURE

localizer, for the X-rays were shining vertically down upon them in this first picture, and they show as one. The small black dot is the foreign body, in this instance a shot.

So much for the first picture; it shows how far back in the shot is, but no more. So we proceed to take the second picture, as shown in Fig. 3, moving the plate down in the plate holder so as to expose its second half. In Fig. 3 the funnel is tilted over so as to cause the light to be directed in an oblique direction, everything else remaining as before. In this case we have the negative Fig. 4. Here the upper and the lower knobs of the localizer show and eventually will give us an angle to work upon to make an exact determination of the position of the shot.

In making the determination horizontal and vertical lines are drawn on the two negatives as shown, and then a chart is laid out as in Fig. 5. Referring to this chart (B) represents the two knobs of the localizer in the first negative. On a horizontal line through (B) lay off with dividers the distances (BR) and (RF^1) in the same relation to each other as the lines joining the two dots in Fig. 2.

Now imagine the localizer as shown at (B) to be brought up

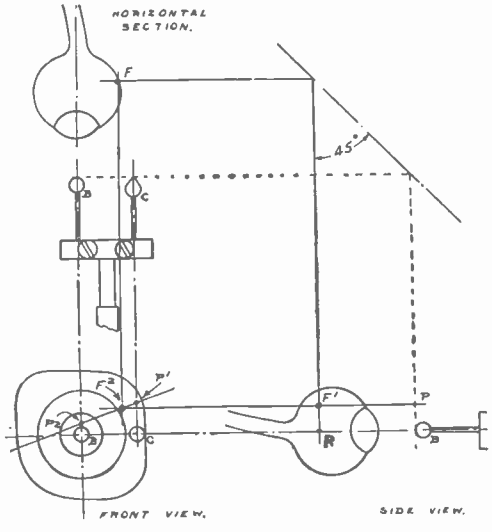


FIG. 5. PLOTTING THE RESULTS

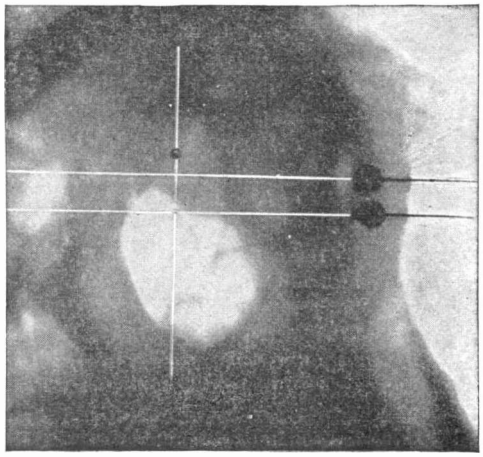


FIG. 4. SECOND NEGATIVE

and over in the arc of a vertical circle until the two knobs (B) and (C) are projected down in a horizontal plane (Front view). We then have two points (B) and (C) located as they would be on the eyeball if we were looking straight into the eye along the line of the localizer arms. Draw vertical lines (BB) and (CC) through these points. Then lay off the distance (BP^2) equal to the distance from the upper horizontal line to the shot, in Fig.

4, and (CP^1) equal to the distance from the lower horizontal line in Fig. 4, to the shot. Connecting (P^2) and (P^1) we have the line which shows the angle at which the oblique ray passes through the eye in taking the second picture. A horizontal line through (F^1 P) will intersect (P^2 P^1) at a point (F^2) which shows the location of the shot in the eyeball if we were looking straight into the latter. The distance (F^1 P), minus 10 millimeters, shows how far in the body is, and the exact position is thus deterimned.

Of course, when the two pictures are taken the patient must look at some object directly in line with the localizer arms, so that the eye will be in the same position during the two exposures.

FROM OUT THE LEYDEN JAR

All the alleyways and dark corners in the city of Washington are to be lighted at night for the suppression of crime.

* * *

In the manufacture of cable for telephone uses Chicago leads the world. It is possible to purchase an entire telephone equipment of any capacity—power, poles, wire, instruments, switchboards, etc., from stocks carried in Chicago.

* * *

The United States Steel Corporation has taken over the exclusive rights to all of the Heroult patents for electric steel furnaces for America and the manufacture of and refining of steel by electric furnaces will be made a special feature of the corporation's operations in the future.

* * *

Wireless telegraphy is to be put to another practical use. The United States weather bureau proposes to warn whalers of the Arctic fleet and merchant vessels of impending storms and the movement of ice packs if weather stations are established in Alaska and the Aleutian islands.

* * *

A new idea has been worked out in the use of the wireless telegraph on the ships of the navy, according to the annual report of the chief of the equipment bureau. A portable apparatus has been devised that will enable the long distance aerial wires to be taken down in battle and replaced by a short wire running up to the yard arm and connected to a set of instruments carried by the operator behind the armor inside the upper deck.

A feature of the voyage of the steamship Zelandia, which arrived at Victoria, British Columbia, recently, from Australia, was a chess match by wireless, between Captain Phillips and four passengers of the Zelandia and Mr. Frick and four passengers from the Makuria. The game which was won by the Zelandia in six moves, began when the steamers were in sight of each other, and the last move took place when they were 400 miles apart.

* * *

Experiments to produce iron and steel from Norwegian ores by the electric process have been made during the last three or four years, partly by aid from the government, in response to a petition sent to the Department of Commerce and Industries by the Christiania Polytechnical Society. Private interest has in this manner been awakened, and the industry now promises to become one of considerable importance. The Norwegian iron ore is often so poor that smelting by the old process was found profitless.

* * *

The Pere Marquette is soon to join the already long list of railroads using the telephone to dispatch trains, supplanting the telegraph, which was considered the standard for handling train movements for a great many years. Instruments, selectors and line material have been ordered to equip a line from Saginaw, Michigan, to Toledo, Ohio, approximately 135 miles in length, with the telephone for train dispatching. This is understood to be the beginning of the adoption of the telephone system over the entire road, extensions to follow the completion of the first circuits.

MAIN STREET, SALT LAKE CITY—PHOTOGRAPH TAKEN BY LIGHT OF MAGNETITE ARCS

Luminous (Magnetite) Arc Lamps

For a long time hard-working inventors tried to change the electric spark into a continuous glow. It was finally done but with batteries and the cost was too great. Not until Faraday in 1831 discovered that electric current can be induced in a copper wire by moving it across a magnetic field, was the way made clear to produce economically a steady light between two carbon tips by current from a dynamo. Even then, it was not until 1878 that Paul Jablochkoff lighted the streets of Paris by the "Jablochkoff candle," the beginning of the arc lamp, supplying current from a Gramme dynamo. This same year Brush brought out his arc light system in this country, and for 30 years the carbon arc lamp has held sway without any serious competition because of its efficiency in certain fields.

Recent years have produced high efficiency incandescent lamps but even this still leaves the arc lamp best for large interiors such as

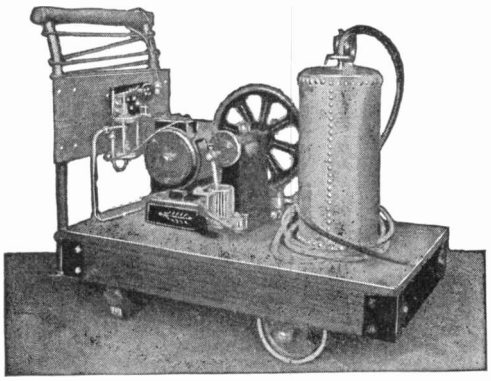
TWENTY-FOURTH ST., MINNEAPOLIS—ILLUMINATED BY MAGNETITE ARCS

mills and factories, and superior to all other illumination for street service, parks, wharves, or places where fog or smoke make a penetrating light necessary. The improvements in filament lamps have led to experimenting with the arc lamp to find a slow burning material for electrodes and thus do away with frequent trimming, and at the same time to produce an electrode using less current and giving more light. These improvements are realized in the luminous arc (magnetite) lamp.

The electrodes in this lamp differ from the ordinary carbon lamp electrodes, the upper being composed of a solid copper rod sheathed by a thin iron tube. This electrode lasts from 4,000 to 6,000 hours. The lower or negative electrode is composed largely of magnetite or oxide of iron encased in an iron tube ⅝ by eight inches, and burns from 175 to 200 hours as against fourteen hours for the open carbon arc and 24 hours for the enclosed flaming arc. Moreover the magnetite arc produces a white light, the kind most people prefer. The lower carbon feeds up as it burns away, which is just the opposite of the operation in the ordinary carbon arc. The lamp consumes one-third less energy than the ordinary carbon lamp and gives one-third more illumination.

Keeping Pumped Up

It's easy enough to be pleasant when your automobile is in trim; but the man worth while is the man who can smile, when he has to go home on the rim.

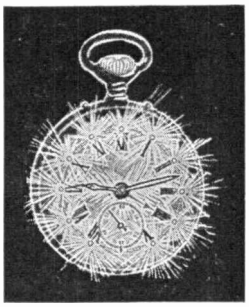


PUMP FOR INFLATING TIRES

Especially designed to remedy this most trying physical and mental condition is the Eureka electric tire inflater outfit, consisting of an air tank, electrically driven pump, and a switch controlled by the air pressure. The compressed air in the tank may be kept at 100 pounds or less as desired, the only attention required being an occasional oiling of the pump and motor bearings. This equipment reduces the labor of inflating automobile tires to making the necessary connection of the hose, and gets rid of the "Let it go this time" idea, the motor driven pump replenishing the air supply when the tank pressure drops below a predetermined point.

A Luminous Watch

German periodicals have been printing advertisements of a novel watch which looks in the picture as if it were studded with electric lamps of the size of pin heads and which is claimed to be luminous at night. It is variously offered as having an electric or a radium dial, but really turns out to be only a cheap watch with a coating of luminous paint (probably containing calcium sulphide) on the dial. The only real connection with electricity lies in the maker's advice to purchasers that they recharge the activity of the luminous dial as often as possible by exposing it to the rays of an electric desk lamp.



LUMINOUS WATCH

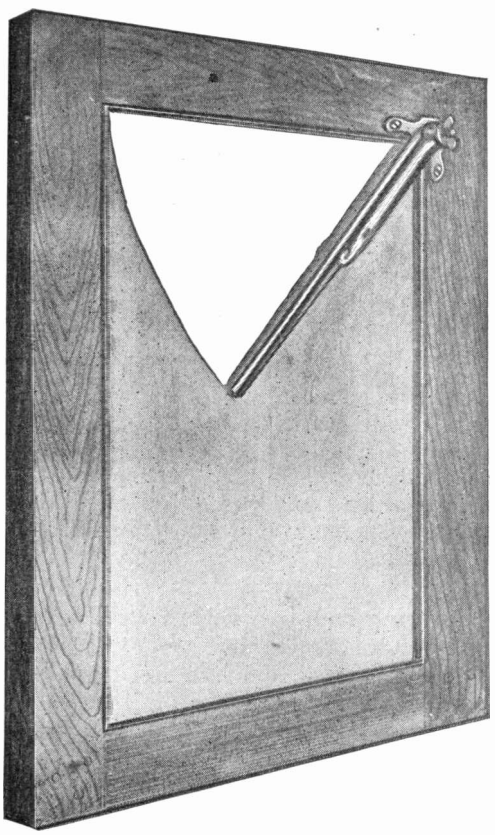
Lightning-rod Inspectors in Prussia

According to the provisions of the decree of the Prussian Minister of the Interior, of Dec. 24, 1843, before lightning-rods can be erected in Prussia permission must be obtained from the local police authorities and the work inspected and passed. Anyone who wishes to engage in the lightning-rod business must first obtain a government certificate of efficiency. This document can only be procured after having successfully passed an examination held by the police officials. The form and scope of the examinations are determined by the Ministry of the Interior.

By the terms of a general order dated Dec. 25, 1897, all lightning-rods placed upon government buildings must be inspected by an expert electrician at least once a year, to determine whether or not the rods have sufficient conductivity to carry off lightning, and once every five years the electrical resistance of the conductors must be accurately measured.

Motorman's Window Cleaner

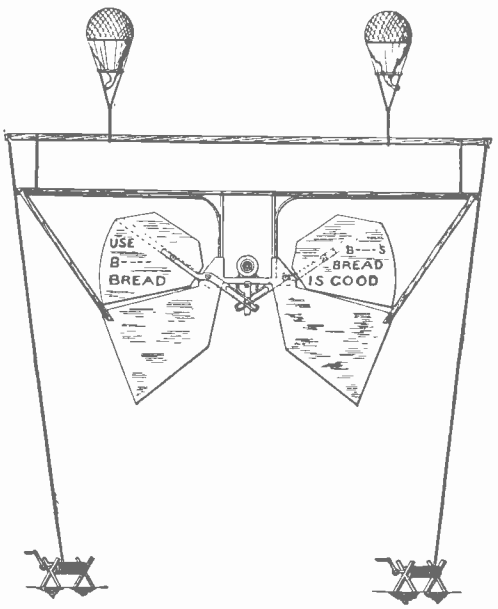
On days when the air is full of rain and sleet the motorman's window might as well be a piece of ground glass as far as its usefulness to him is concerned. Recognizing the liability of accidents under such conditions, an ingenious appliance has been devised by a Dayton, Ohio, concern, whereby the motorman is enabled to clear a section of his vestibule window with one sweep of the hinged arm which is shown in the drawing. This swinging arm, which is double and bears on both sides of the pane, carries a set of wipers similar to those used by a window cleaner.



MOTORMAN'S CAR WINDOW CLEANER

An Aerial Electric Sign

In keeping with the spirit of the day a patent has been granted to Edward Jocher, Philadelphia, for an aerial advertising sign. Two captive balloons attached to the framework supporting the sign pull the equipment up into the air as far as the windlasses and anchor ropes allow. Upon a platform of the sign is an electric motor which by levers will cause the wings to move as though the machine were in flight. Current will be conveyed to the motor and to lights with which it is proposed to illuminate the sign by electric wires within the anchor ropes. It is at least an odd looking affair, though its practicability like that of many patented devices, is a long way from being proved.



AERIAL ELECTRIC SIGN

The proposed wireless time-signal service from the Eiffel tower was inaugurated on November 21, and mariners can now receive signals at midnight and 11:00 a. m., except on Sundays and holidays.

A Life-saving Telegraph Pole

An interesting episode in which a former amateur telegraph operator showed good presence of mind, is reported from Algeria in northern Africa, where goods are still frequently transported on the backs of mules.

A French trader who was using a line of telegraph poles as his guide through a lonely district in which the roadway could hardly be distinguished, was surprised by two Arabs who promptly seized the mule and its cargo. Badly frightened, the trader ran to the nearest pole and climbed to its top, where he braced himself against the wire while the Arabs flourished their daggers at him. Then, recalling the days when he and a schoolmate had enjoyed a private telegraph line, he took out his knife and began tapping Morse code signals on the wire. According to all canons of modern fiction, his message should have been heard by distant rescuers who would entrap the bandits. In reality, no one heard his tapping except the two Arabs to whom it sounded like the mysterious message sending about which they had heard such wonderful tales in the city.

Scared by the thought that the trader might be summoning help, they fled in haste, leaving the merchant to make the astonishing report that he had saved his wares by playing again at telegraphy.

A Sure Remedy

Telephone men, when traveling on inspection trips, come in contact with a great deal of trouble caused in various ways, and when they have not a thorough understanding as to the remedy to be applied, frequently write in for information to the proper department. Recently, a manager wrote a letter to the effect "that on recent trips over —— route, south, I noticed there was considerable damage being done to cedar poles by holes being pecked in same by birds and woodpeckers." What would you suggest as a preventative?"

The man at the head of that particular department in the district replied:

"Answering your letter of recent date containing information that the woodpeckers are pecking holes in our poles beg to state that we have several remedies to offer and you can select and put any one of them in force at once, if you believe it will prove satisfactory. First—File the bird's bill off and he cannot peck these holes in the poles. Second—By first getting the size of the bird, you can easily tack sandpaper in the hole and the bird would soon wear its wings off and would not be able to fly up to the top of the pole. Third—A very simple thing is to tack a piece of tin on the spot that you think the birds are going to peck on next time.

After applying all the mentioned remedies, if they persist in destroying our property, I would suggest a remedy that would prove more effective than any one mentioned above, but would only suggest that we put it into effect as a last resort. We will get the necessary papers in order to secure an injunction from the nearest court against them to prevent them from pecking holes in our cedar poles. You will please advise the writer the result of your efforts in putting any of the remedies into effect."

—*Cumberland Telephone Journal.*

A Remedy for Party Line Telephone Troubles

By WILLIAM J. MISKELLA

Referring back a few years in the history of the telephone, we who live in cities remember the long ugly looking wall telephone with its bells and generator crank attached to a box at the top, the transmitter inclosed in a small unsanitary wooden box in the middle and the batteries inclosed in a larger box at the bottom. In the next few years, we find this type of telephone replaced by the so-called common-battery telephone from which the generator crank has been omitted and the wooden transmitter replaced by an improved one made of metal, while the lower box has either been eliminated altogether or replaced by a box similar to the one that was originally at the top. Coming still closer to the present time, we find the mounting board equipped with an extra box known as the coin collector and at the present time a few of the telephones are equipped with another mysterious-looking box or attachment, which as time goes on, we are bound to see used more and more.

This little box is like a physician's medicine cabinet. It comes to us containing the remedies for the well-known troubles that so many of us have experienced in using the common party line telephone. These troubles are perfectly evident, but for the purpose of discussion a few of them may be mentioned as follows:

(a). Code ringing.
(b). Unwelcome and unknown parties listening to your private conversation.
(c). Annoyance to the talking parties by a third party in trying to find out when a conversation has been concluded.
(d). Aggravation of the third party in his persistent efforts to find out when he can secure the line.

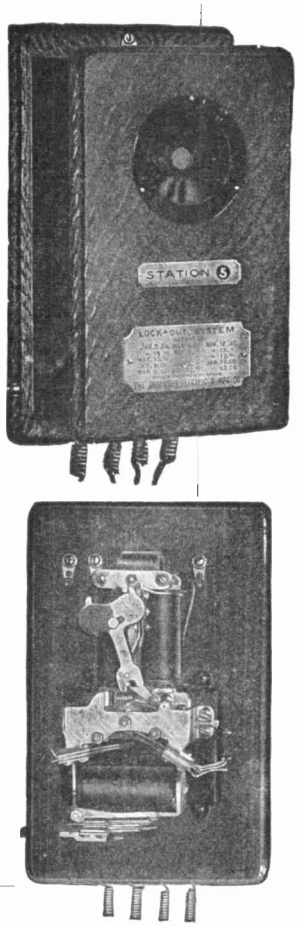
In the matter of code-ringing, assuming that there are ten parties on the line and that each party gets on an average, one call per day, the fact that each party on the line is interrupted unnecessarily by the ringing of his telephone bell when some one else is desired, nine times out of the ten, should be of some concern to him. How many times have you been interrupted by another's ring even after you have retired for the night? How many times have you answered your own telephone only to be told that you were the wrong party?

There is nothing more disagreeable and certainly nothing more annoying than to have a third party hear your private conversation. This obnoxious third party cannot see the facial expressions of the persons who are carrying on a conversation and is more than likely, therefore, to cause trouble by taking statements seriously and repeating some part of an overheard conversation. It may have been that the talking parties were joking. It may have been that the "listener" erred in his judgment in regard to the identity of the talking parties.

How often have we desired to use the 'phone in a hurry and as often found someone else using the line? Regardless of how we disliked to interrupt the conversation, we were forced to test the line every few minutes to find out when it was clear for our use. Incidentally, we may or may not have heard some unpleasant remarks passed about ourselves.

However much we have been inconvenienced by these objections to a common party line, we may now repose in peace and await the day when our telephone company will come to the rescue and introduce this other mysterious little box just above our telephone. If central is supplied with a selecting key and all the parties on your line have these little boxes attached to their telephones, then it is within the power of central to transform your party line into a private line, during the interval that you are talking, and thereby lock out all the other parties on the line so

they cannot hear your conversation and cannot interfere with your conversation in any way. It is likewise in central's power to ring only the bell of the telephone that is wanted and thereby refrain from interfering with any of the other parties. Should a third party desire the use of the line, in case of an emergency, provision is made so that he can signal central to that effect and central



THE "LOCK-OUT" ATTACHMENT FOR PARTY LINE TELEPHONES

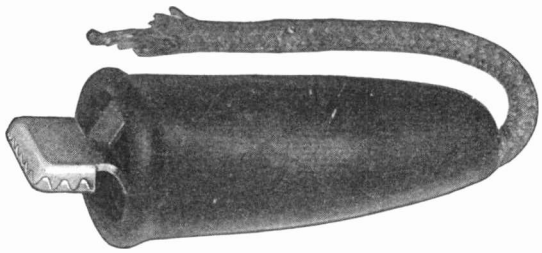
can get permission from those who are using the line, for the temporary use of it.

Referring to the upper one of the two illustrations we see a view of the attachment which, by the way, is known to the telephone people as a lock-out attachment. When the line is being used that fact is indicated by the color of the little red disk at the centre of the black dial in the upper part of the figure. When the line is clear, the little disk will always be white and when the line is in use the little disk will always be red, temporarily replacing the white one.

If we refer to the lower picture, the principle of operation can be seen. In the centre of this device is a little ratchet wheel which has eighteen teeth on it, one tooth for each party on the line. Just above this we see a magnet consisting of two coils and pivoted above and between these two coils, we note a long finger (back of the busy signal) which causes the ratchet wheel to revolve. If, now, we assume that party number five on this line is desired and remember that something must cause the finger to move the ratchet wheel around five steps, we can see that it will be necessary for the magnet to attract its armature, which is rigidly attached to the long finger, five times. When this is done, the proper contacts are made in the springs which are seen until finally an impulse is sent through the coil in the lower part of the figure which connects station number five in line, leaving all the other parties locked out. The selector key, which is located in front of the central operator is merely a small mechanical counting device which sends the required number of impulses over the line, depending upon which particular party is desired.

An Insulated Test Clip

"Get a better contact down there, you rummy!" This is not an unknown expression, to those who have ever assisted in



testing out the fire or signal-alarm wiring of a large building, as it comes down the elevator shaft.

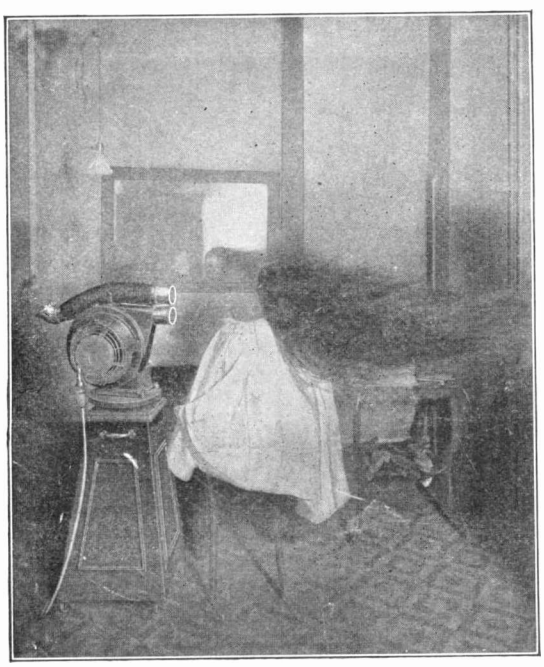
The accompanying illustration shows the Universal test-clip designed to eliminate testing-contact troubles and do away with

the necessity of a large vocabulary. Fitted with a steel spring and made with teeth on both end and sides, it grips either fine or coarse wire or almost any-shaped line terminals and will appeal to electricians, linemen and troublemen who use the magneto and microphone test-sets. Lighting companies may use them for making voltage and wattmeter tests, while electric railway signal inspectors will find service for them on portable instruments. A rubber cover for all but the nose of the clip enables it to be connected without getting a "shock."

Electric Hair Drier

The two illustrations on this page represent the application of the Halliwell electric hair drier. The machine, which is for use in hair-dressing establishments, consists of a motor-driven, centrifugal fan, which delivers a powerful blast of air through the nozzle. The air is heated by electricity through the agency of an ingeniously contrived electric heating unit inside of the machine. The cost of operation of the device is not over a few cents an hour, even with the electric heating attachment. It will dry the heaviest head of hair in five minutes.

REACHES ANY PART OF THE HEAD



WHEN YOU WANT A BREEZE YOU CAN GET IT

A Great Power Development

About 20 miles east of Tacoma, Wash., there is to be a hydro-electric power development which will be one of the most extensive on the Pacific Coast. It will be built by the Pacific Coast Power Company, and will utilize the waters of the White River. This is fed by the glaciers of Mt. Ranier and receives its name from the milky silt which it carries and which gives it a whitish color. The water will be diverted by a small dam to an earthen ditch five miles long through which it will flow to the main storage reservoir and allowed to settle. This will hold enough water to operate the plant three or four months, should no additional water be received. From this reservoir the water will be carried 3,000 feet through a tunnel to the head basin of the power-plant. From there, a separate pipe-line will be built down to each turbine in the power-house. Here the largest water turbines ever built will be installed, each of 20,400 horsepower and each connected direct to an electric generator.

FOR PRACTICAL ELECTRICAL WORKERS
HOW TO MAKE AND OPERATE ELECTRICAL DEVICES

The Romance of Power

By WARREN H. MILLER

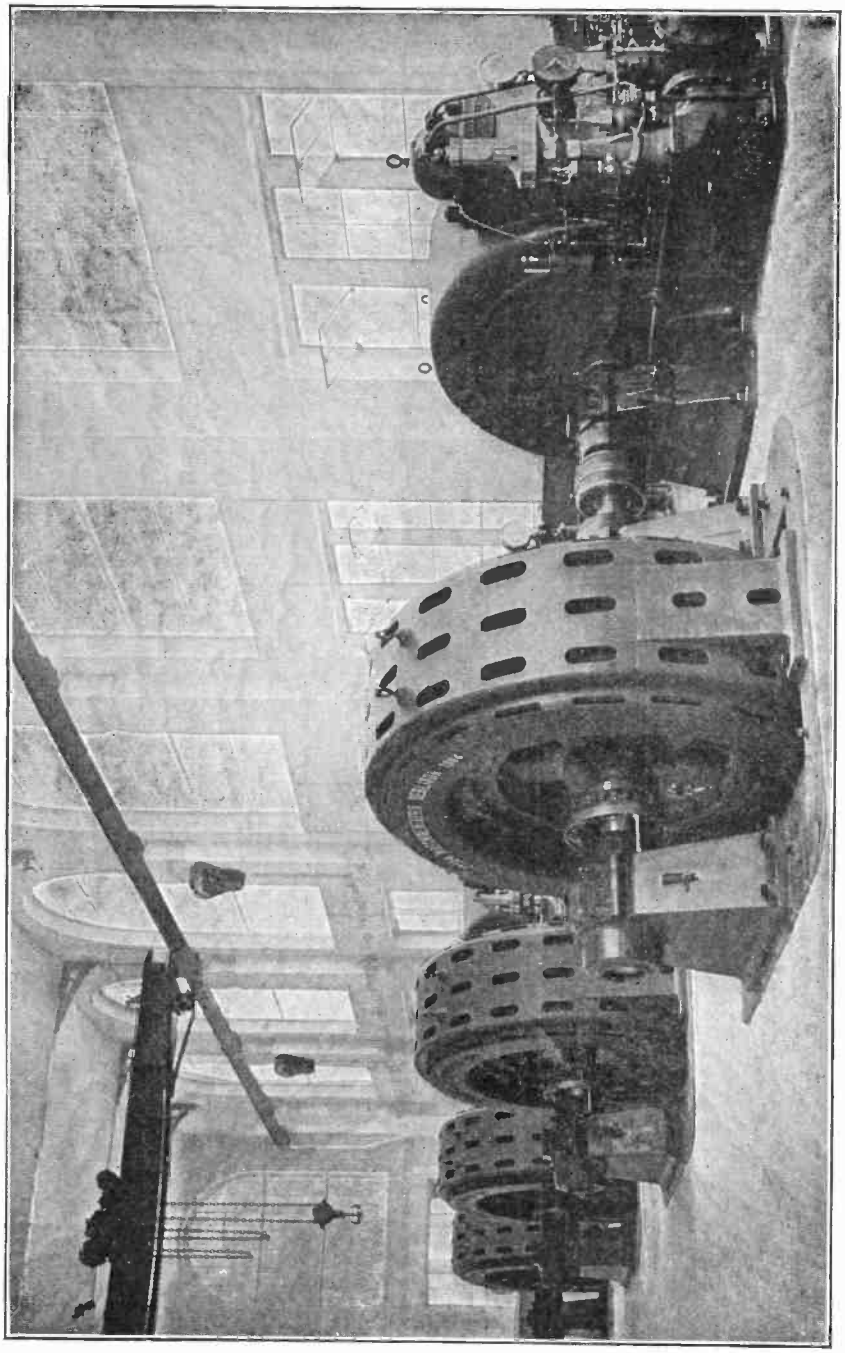
III.—HIGH TENSION TRANSMISSION

One does not realize what a wonderfully supple and obedient servant electricity is until after a study of modern long distance high-tension transmission. To think that, under the stress of the field magnets in the alternating dynamo, the electric current will rise from zero to 6,000 volts, transform to 135,000, rush out over 140 miles of wire, dash through hundreds of motors representing thousands of horsepower, fly back again to pass through zero and rise to 135,000 volts in the opposite direction; and do all this 60 *times a second*,—it makes the "wonders" of the ancients pale into insignificance! Tesla once ran a motor on alternating current with only *one* wire. He put a large condenser beyond the motor, and the currents flowing into and out of this electrical lake, so to speak, ran the motor, which was on the single line precisely like a water-wheel on a mill race.

This problem of capacity or electric reservoirage for the volume of an alternating electric current hardly enters into direct current calculations at all, as a direct current line is only charged once. About the only exception is the submarine cable. Here we have a worm 3,000 miles long,—"some" copper. You feed it full of electricity and then empty it again, and in doing so it makes a signal. That is rather different than ordinary telegraphing.

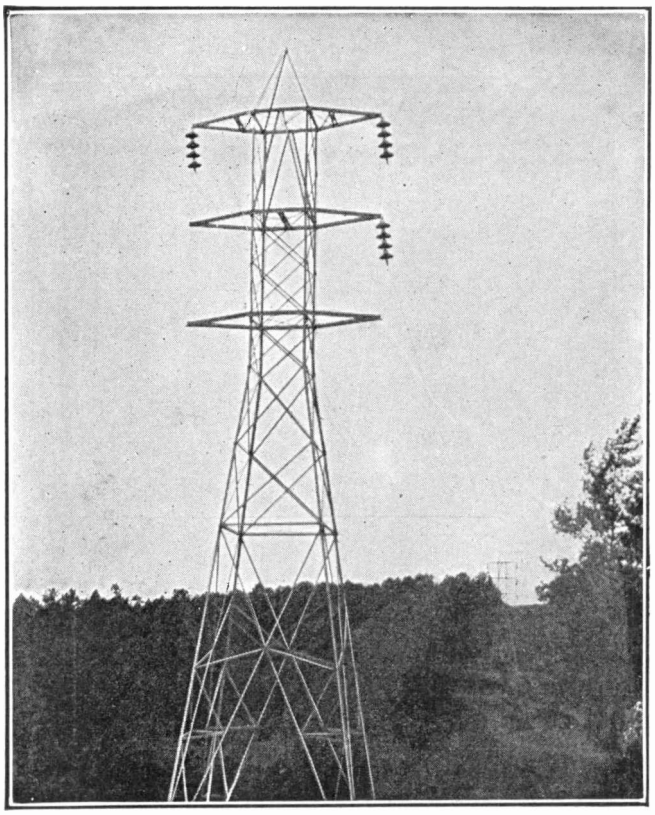
But with the 100,000 volt alternating transmission line 140 miles long from Great Falls, South Carolina, to Guilford the charging current needed to fill the line 60 times a second is 40 amperes, so that the line carries a steady charging and discharging account of 6,400 kilovolt-amperes. When this line is put on without a single motor at the other end the voltage of the generators *rises* from 1,300 to 1,800, because of the reaction of the "capacity" of the line on the alternator coils. It causes a "leading" voltage in the dynamo —the voltage rises faster than the current because the line has to be charged before the current begins to flow. However, this charging account has but little real energy loss, as none of the current is turned into work until it goes through the motors. It is a *wattless* current, and the only real loss is the heating of line and generator due to the passage of the current into and out of them all the time. The real current in kilowatts flows through the motors after the line is charged, and, as it both charges and flows through the motors in two directions 60 times a second, it becomes almost inconceivable for our intellects to comprehend how very fast a wave of electricity *does* travel.

We said in a previous article that the case of "power *vs* the potato" proved that in an agricultural country water power was worth far more, used in irrigation than in making electric energy. But in mountainous countries, where forestry reigns supreme and agriculture is out of the question, are found hundreds and hundreds of rapids and waterfalls whose value can alone be realized by electricity and its high tension transmission. These sites can never be given over to agriculture, because the forests themselves are worth far more than the potato if properly managed, and are besides necessary for national existence. Switzerland, our own country, Italy, Norway, South America, and South Africa are full of such sites. During the last few years the growth of high-tension transmissions in the first three of these countries has been phenomenal. By



POWERHOUSE OF THE LUCERNE-ENGLEBERG TRANSMISSION LINE AT OBERMATT, SWITZERLAND

1900 there were numerous lines at from 20,000 to 30,000 volts; in 1904 there were literally hundreds at 30,000 and a few at 50,000 volts; and by 1909 in our own country alone there were five lines at 100,000 volts and even one at 135,000 volts, run from Au Sable river into Flint and Battle Creek, Michigan. In this we have considerably outstripped Europe, as the 88,000 volt line developing the Pescara river in Italy is their highest present voltage. Our own advances have been largely due to the courage and ability of our western and southern engineers, backed by the progressiveness of our great electric manufacturing concerns.

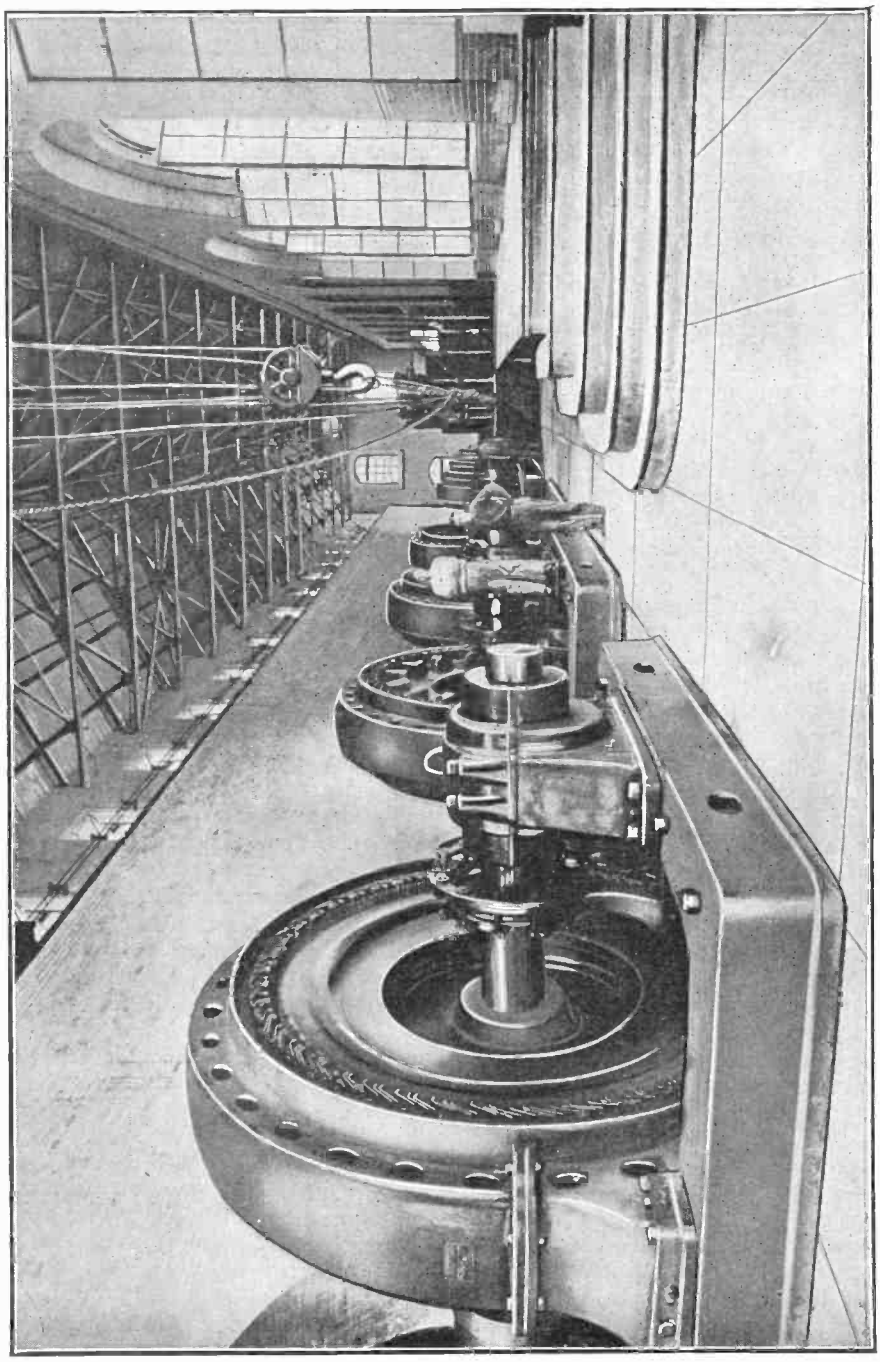


100,000-VOLT TRANSMISSION LINE TOWER

As to the national good high-tension transmission has done, let me cite just one instance. In 1904, the Southern Power Company started generating electricity on the Catawba river in South Carolina, within transmission distance of a hostile and indifferent cotton mill district. The electricity could hardly be given away, and it took lots of missionary work to get the mills to introduce electric motors in place of the old engine and shafting drive, in spite of the proved waste of 42 per cent of the engine's power by the shafting. Today, just six years later, that same company generates 98,000 kilowatts of energy, distributes it over a network of 900 miles of high-tension 50,000 and 100,000 volt lines to over 140 cotton mills, and the electric power is considered indispensable in that district which has boomed, to become the leading cotton manufacturing section of the South.

Perhaps the one thing that has done more than any other to make high tension transmission possible is the suspension insulator. No matter how large you make a pin insulator one half of it will always be wet in stormy weather and you cannot get enough air gap without an unwieldy construction. But if you construct an ordinary fourteen-inch insulator of, say, 80,000 volts' breakdown limit in wet weather and then hang another under it, you will have 160,000 volts insulation. Five of them, hung one below the other, will make a suspension insulator about four feet long and will have an ultimate breakdown of 400,000 volts which is a factor of safety of four on a 100,000 volt line.

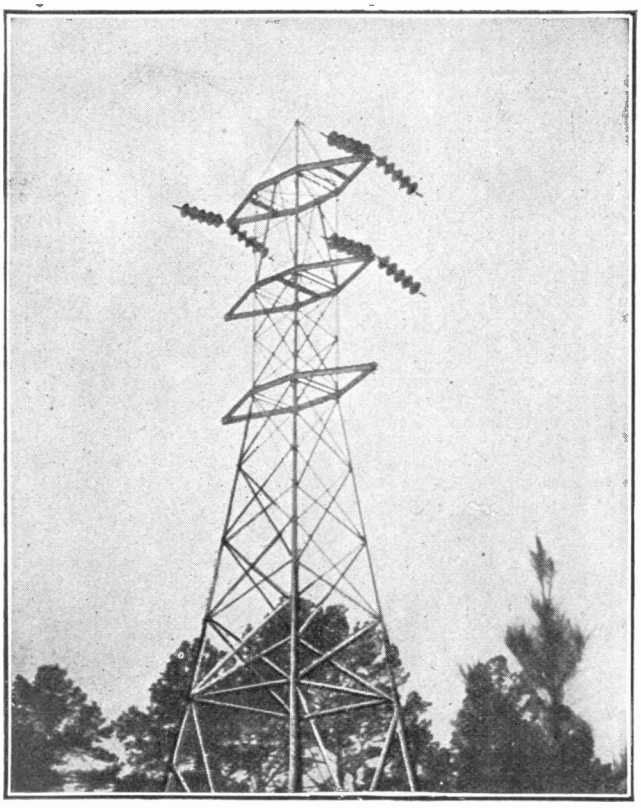
Another advantage—if you have a pin insulator line and a big tree falls across the line and breaks it, the whole strain of the lines will come on the pins of the adjacent poles. But if it is a suspension insulator line these will immediately fly out horizontally when the line breaks, and thus slack off the sag between poles of the adjacent spans. As the insulator is from four to four and one-half feet long, this slacking the line back about four feet takes out nearly all the strain in it, as anyone who has ever tightened up wire spans will easily realize. In suspension insulator lines every tenth pole is what is called a strain tower, to which the wires are anchored, the rest of the poles merely holding up the line. Here the insulators must necessarily stand out horizontally as they take the pull of the wire. There



INTERIOR OF THE GREAT HYDRO-ELECTRIC PLANT, GREAT FALLS, S. C.

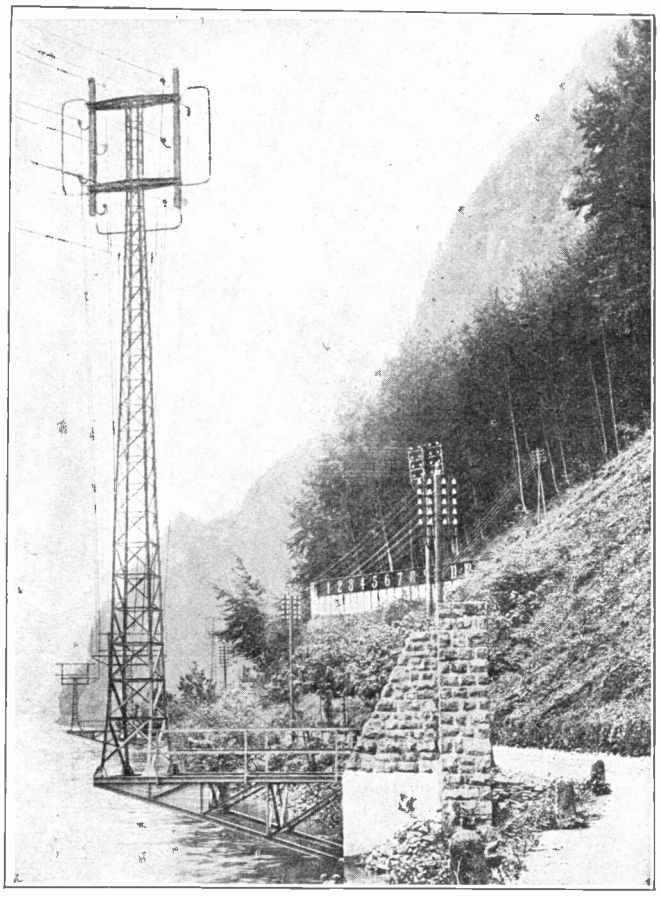
are therefore *ten* insulators in series instead of four or five, because the weather will wet at least half of them, no matter which way the wind blows.

The poles for these high tension lines are almost invariably high structural steel towers carrying the lowest wire 45 to 50 feet from the ground. Our illustrations show various types of them. The horizontal distance between conductors is fifteen feet and vertical distance about eight feet, which will give some idea of how great is the span of the 100,000 volt arc. As an instance of the various pole problems that come up, the high-tension line of the Lucerne-Engleberg transmission has a very interesting section passing along the base of the Loppergrat, an outlying spur of Mt. Pilatus. This spur is practically a sheer precipice 1,000 feet high with sharp terminal slopes of rock detritus at its base, with just room for a state road between it and Lake Lucerne. This steep slope continues down under the lake giving no location for piers out in the lake for the poles, and the only available right of way along the road is already usurped by a telegraph and telephone line. Standing on top of the Loppergrat you can peer down, it would seem, vertically upon the wagons a thousand feet below, but in reality there is considerable slope—enough to form large almost perpendicular fields of snow in winter. The avalanches in the spring off the Loppergrat are very frequent, and also an occasional boulder will start down the slope for no particular reason and arrive in the road with all the energy and velocity of a 13-inch shell. This cheerful combination of adverse conditions was met by the Swiss engineers by putting the poles out over the lake on cantilever struts, as will be seen on the next page. These are anchored into massive stone and concrete piers which not only resist the turning movement of the cantilever but also protect the pole from flying boulders and avalanches.



100,000 VOLT TRANSMISSION LINE STRAIN TOWER

In our own country the high-tension lines go over hill and valley, for the most part forested, and the slopes of the mountains are by no means the even grades one would imagine, being full of ravines and ridges. The spans run from 400 to 600 feet with occasional long spans of as much as 1,400 feet. Working over this rough country introduces many a line construction problem. It is important to distribute the static load, *i. e.*, the weight of the wire, equally on all the towers, and to do this the sag should be uniform between them. Now suppose when the wire is pulled up to its proper sag, you find the pole down in a ravine four feet below the wire. You cannot alter the sag as that would throw uneven loads on the other towers, nor can you tie the line down onto the pin because it is a suspension insulator and the wire must hang from *it*. Therefore the pole must be moved, and to avoid doing this frequently in mountainous country the lines have to be carefully surveyed and profiled and the sags accurately calculated.



CANTILEVER TOWERS ALONG LAKE LUCERNE UNDER THE LOPPERGRAT

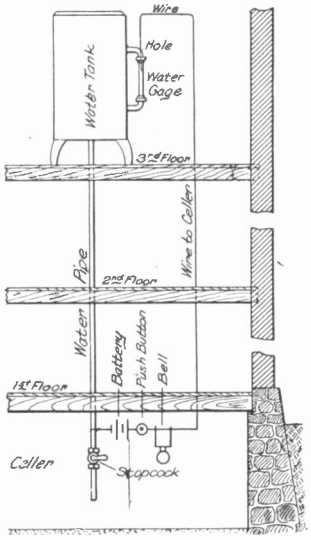
In getting up to 135,000 volts on the Cook-Flint line another problem, that of the corona or atmospheric leakage of this high tension line, had to be studied for probable line losses. Based upon the experience of this company with the 110,000 volt transmission line to Grand Rapids this corona loss would not exceed one kilowatt a mile for No. 0 wires at 135,000 volts. The computation data were gotten by raising the Grand Rapids line temporarily to 125,000 volts and noting the brush display and corona loss for the No. 2 wire of that line. This 135,000 volt line feeds Flint, Saginaw, Bay City and all the towns in that part of Michigan with their large manufacturing interests. It is a curious fact that the lightning and thunder strokes, which give so much trouble with the lower voltage lines of 30,000 to 50,000 volts, have been less difficult to manage during severe thunder storms on the 100,000 to 135,000 volt lines. The electrostatic conditions, up hill and down dale, vary all along transmission lines with the passage of heavily charged clouds, etc., and every static disturbance gives rise to abnormal potentials and frequencies. The lower voltage lines have less insulation to ground, so that a lightning stroke can break through somewhere and establish a destructive arc, instead of going to ground through the line or station lightning arresters. With the high-tension lines the better insulation forces the lightning charge to stay on the wire and depart by the proper arresters, which are designed to take care of the violence of the discharge without disaster. "Lightning" means much more than the visible flash seen during electrical storms. It includes also surges of current due to static charging during a storm and the existence of varying conditions of temperature and weather over the entire system, which may stretch 150 miles across valleys and mountain ranges. Although some of these high-tension 100,000 volt lines have been run without any protection except that at central station and sub-stations, lightning arresters are essential features at frequent points along the line for lower voltages.

As to the future of high tension transmission, the distance that power can be sent is simply a matter of wire and insulation. The suspension insulator seems to be as capable of use on 200,000 volts as on 135,000. The limit will probably be set by the atmospheric corona loss over the whole line, but it is impossible to predict *anything* in electricity. Actual trial of a 200,000 volt line may develop new scientific discoveries that will prove the 200,000 volt line as much superior in practice to the 100,000 volt as the latter is to the 30,000 volt transmission.

(The end)

"Enough Water" Signal

This drawing shows how I have saved myself many steps in taking care of a hot water system. To fill the water tank the stop-cock in the basement is used. As soon as the water in the gauge glass rises high enough to touch the end of the wire running into the glass at the top, the bell in the basement will ring whenever the circuit is closed by the push button near the stop-cock. The small hole for the wire through the gauge glass pipe I closed up with sealing wax.



WATER TANK ALARM

—Wm. J. Holmes.

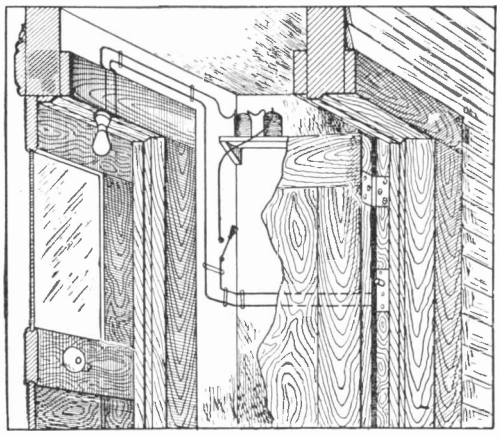
Hints on Caring for Gravity Cells

The following hint regarding the care of the gravity cell has enabled me to get better service out of it and to keep it cleaner: Allow at least one inch from the surface of the liquid to the top of the jar and pour over this surface plenty of paraffine. If enough of this is not obtainable, use common clear machine oil over the liquid, dipping only the top of the jar into paraffine. This plan prevents evaporation and stops the creeping of sulphate over the top of the jar.

—Joe N. Banker.

Lighting the Way In

It is most convenient to be able to find the door-bell push-button, the keyhole or the door-knob on a dark night. An arrangement for doing this is here illustrated. In the casing of the storm-door or outer door to the hall an automatic door-switch may be installed and connected as shown. When the outer door is opened, the switch closes the circuit and lights a small, low-voltage lamp placed at any desired location about the inner door. Closing the outer door causes the door-switch to turn off the light. The switch may be purchased of any electrical supply house or made in the form of



VESTIBULE LIGHT

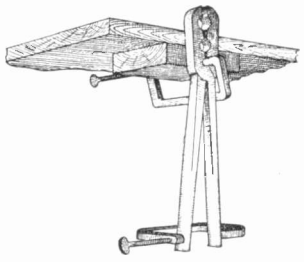
a push-button and set in the casing. Two dry cells connected in series will light a one-candlepower, three-volt, tungsten, battery-lamp which will do very satisfactory service.

—Miss R. E. Matthews.

Making a Vise

A handy substitute for a vise to hold metal conduit may be made as shown in the accompanying sketch.

Under the edge of the bench securely nail a block of wood 2 by 1 by 3 inches. By



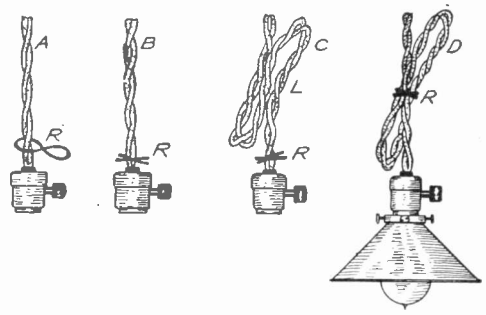
SIMPLE VISE FOR METAL CONDUIT

means of a screw clamp fasten a plumber's wrench to this block. The jaws of the wrench can be made to close tightly by applying a screw clamp near the ends of the handle.

—Francis B. Coyle.

Cord Adjuster from a Rubber Band

An ordinary rubber band such as is used to hold a bundle of folded papers together makes a very handy cord adjuster to vary



SIMPLE WAY TO ADJUST LAMP CORDS

the height of a drop light. The illustration explains how to put on the band, which, being soft and pliant, does not wear the insulation of the cord.

—CLYDE MERTZ.

Changing Small Battery Motor to Induction Type

Any one who has been operating his small battery motor on low voltage alternating current can easily convert it into a perfect induction motor. The motor I have found

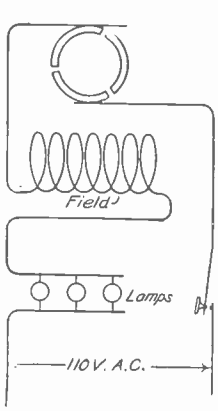


FIG. 1

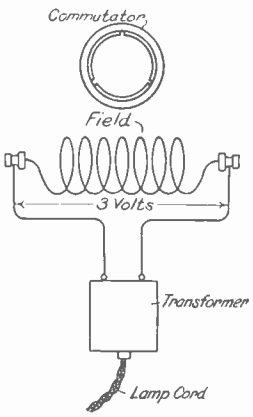


FIG. 2

most suitable for the purpose is the small three-pole armature type. Fig. 1 shows the connections of such a series wound motor for operating in series with three sixteen candle-power lamps in multiple.

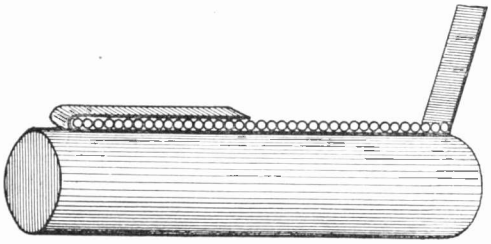
To change the motor to the induction type take the brushes and brush holders off. Connect up the field so that current will flow through the field only, as clearly indicated in Fig. 2.

Now carefully wrap a few turns of small copper wire around the commutator, apply the current, give the motor a turn and it will climb up to speed. It will run in either direction depending upon the direction in which it is started. A very neat trick is turned by stuffing small bits of tinfoil in the segments of the commutator and using no wire.

—C. V. V. TURNER.

Magnet Coils Without End Disks

If the space available lengthwise of the core in a magnet is limited, a magnet coil may be made without the usual spool or even the fibre end disks by using tape to hold the wires in place. To do this, the first layer of wire is wound over three or four narrow pieces of tape laid lengthwise of the



METHOD OF WINDING MAGNET COIL

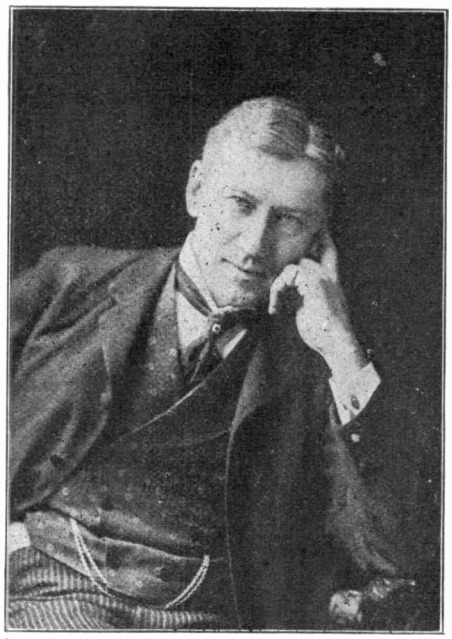
core, each piece being of such width that together they cover the upper surface of the core.

When the first layer of wire has been wound over the strips of tape (each of which should be twice as long as the intended coil) the two ends of the tape are doubled back over the winding and fastened in place by the stickiness of the tape itself. Or if an unsaturated tape is used, a coat of shellac over the wire before the tape is doubled over will hold the latter in place. Then another series of tapes of the same length but slightly wider, so as to allow for the increasing circumference of the center, is started over the other. By building up in this manner it will be found that the successive layers of the coil will be bound together firmly.

Electrical Men of the Times

CHARLES S. BRADLEY

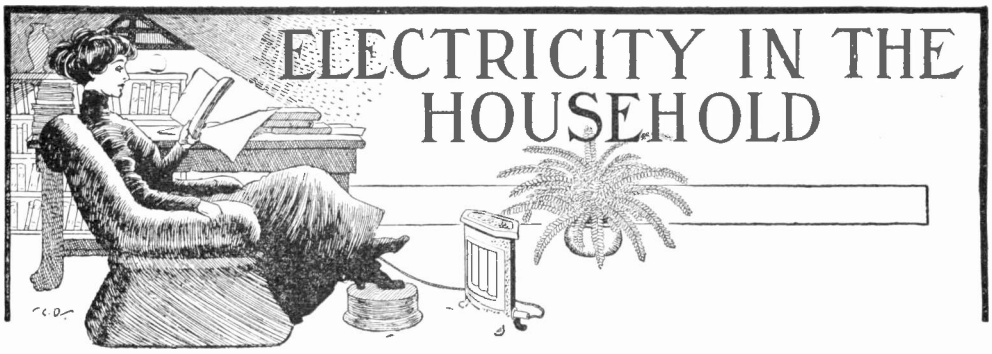
A man who has made a deep impress on many electrical arts is Charles Schenck Bradley, who was born at Victor, New York, on April 12, 1853, of old English and Dutch stock. After receiving a grammar school and collegiate education, Mr. Bradley became associated with Thomas A. Edison in 1880, and for three strenuous years aided in the early development of the Edison system. Being very fertile, however, in ideas and inventions of his own, he created a personal laboratory, from which came in rapid succession a long series of valuable patents and apparatus. Foremost among these, perhaps, were ones relating to the polyphase alternating current, now in such universal use; while one of the patents embodies the basic principle of the modern rotary converter by means of which alternating current is changed at will for use as direct; or vice versa. Very early, Mr. Bradley, turned his attention to electro-chemistry and electro-metallurgy and this brought him to the production of aluminum by processes which gave the world cheap and abundant supplies of the new metal. Next in line came his brilliant work in electrically "fixing" nitrogen from the atmosphere, to take the place of the nitrate deposits of Chili and of the phosphate beds of the southern states. His plant at Niagara attracted world wide attention at the beginning of the century. More latterly, Mr. Bradley has been engaged in the chemical extraction of copper, by methods corresponding to the cyanide process of gold extraction. In this field, where enormous economies can be effected, Mr. Bradley has done a wonderful amount of ingenious and successful work.



All this, however, does not fully detail his results, nor has it exhausted his energies. For example, over 20 years ago he invented and patented automobiles in which the current to drive the motor is generated by a small gasoline engine plant on the car itself, as now seen in practice with prospects of large development. Another patent covers the first continuous electric furnace for the production of calcium carbide, yielding acetylene gas, the process being used in the largest plants for carbide production. Other inventions relate to transformers, telegraphs, electrical condensers, measuring instruments, power transmission, liquid air, reduction of iron, etc.

Mr. Bradley is a man of unbounded originality, and touches nothing he does not improve, while, as will be seen from the above he has done highly creative work in many arts.

It might also be added that during his life, he has necessarily been connected with various companies, by some of which he has been substantially aided in his work; but he is essentially one to push his own way forward into the new domains of discovery, and he has ever been ready to exploit a new art with the reward won in developing an earlier one. An interesting fact is that of late years he has enjoyed the active assistance and co-operation of two sons, to whom he confides details of finance and engineering, thus leaving himself free for purely inventive work.



Where Art and Science Meet

By T. VERNETTE MORSE

In the old colonial days when the capable housewife was not only mistress of the home, but, from the raw material, produced nearly everything required in that home, she did not make much of a stir in the scientific world. As a matter of course she mixed the proper ingredients for those delicious breads and cakes, she managed in some way to dye the cottons and wools which she spun, wove and afterwards manufactured into garments for her family to wear. She had a way of preserving fruits and vegetables when they were plenty, that they might form part of the family menu during the long, cold winters. Her spare moments—we wonder where they came from—were devoted to embroidery, painting and the thousand-and-one little things that express so clearly the æsthetic nature of woman.

Day after day those noble women planned and executed that their families might enjoy the comforts and luxuries of life. But no one ever suggested that they were scientific or artistic.

The kitchen was the laboratory and central force of their activities. Each member of the family was an essential element in that small, manufacturing home world.

To follow the history of the kitchen from those early colonial days is to follow the evolution of all great American industries.

Our grandmothers said, "Give me a well-supplied kitchen, and I will produce everything needed in the home." But the whirl of machinery and combined manufacturing interests have changed those conditions, until we of the present demand a kitchen so revolutionized by scientific invention that it is only necessary to "touch the button" in order to supply the modern home with everything needful.

When the great universities and colleges first opened their doors to admit women, they took from the home those who were most progressive, women who had a desire to express intelligently and professionally the great scientific problems of life. Years were consumed in the study of technique, the diploma was earned, and the brilliant scholar returned to the home, but was no longer a part of it.

Her knowledge of technique had, for the time being, carried her beyond the problems which she had so clearly and sensibly solved before technique and analysis became the all-absorbing topics of her life. She had returned a specialist, instead of a general.

In the meantime the machine-made world had not been idle, and the homely occupations of the home were slowly but surely giving away to methods and processes developed by factory-made utensils.

The home-producers became the consumers and women were emancipated from the drudgery of housework.

Then it was that woman's true nature asserted itself. The college woman with her oft-derided "isms" came loyally to the rescue; again she became a general but in what a different manner. With her enlarged outlook, she understood her true worth and her importance as a companion to her husband and family.

She immediately marshaled her new forces, and applied their principles again to the every-day problems of housekeeping, meeting the new conditions with a better knowledge of the situation, but with the same gracious assurance that her grandmother had met those of her time.

The modern woman has learned to select as her burden-bearers those inventions that will best lighten the labor of each day.

You may say if you will that it is the men who have designed, experimented with and developed electric cooking-utensils as they are used today. But the burden of selection of the things which are essential and practical has fallen on the women, and to them should be given the credit of separating the wheat from the chaff. The product of great inventors must eventually pass the test of her judgment. Those things which she has finally accepted have been made her servants, all helping to make the home a center of culture and refinement. She returns to the "simple life" by the direct route of advanced science.

Electricity may not be as sentimental or as picturesque as some of the "pictures that hang on memory's walls," but it is far more cleanly, economical and labor-saving. It gives greater returns for the time and labor expended.

The small space required for the electric range, its absolute cleanliness, and perfect results, makes it especially adaptable to the cottage home. The different kinds of heat required in cooking may be obtained at a moment's notice. It is always ready, there is no dust, no smoke, nothing disagreeable. The writer has in mind an electrical kitchen, a small room just off from the dining-room. It is so planned with closed cabinets and convenient shelves that a butler's pantry is as unnecessary as the butler. In this cosy home the housewife reigns supreme, yet has leisure for her social life.

There is little else to do aside from preparing the foods, which is done on a long, white table under the window. As soon as the foods are prepared the meat is placed in the broiler or oven, as the case may be, the vegetables are cooking on the different disks, the soup and dessert are in the fireless cooker, and the coffee sends forth an appetizing aroma from the electric percolator. If you have never used an electric percolator, you have missed one of the great treats of modern life.

The electric fireless cooker may be the cultured cousin of the old-time "hay-stove," for it is a combined stove and fireless cooker.

The foods are prepared and placed in the cooker, the current turned on long enough to partly cook them, then, without disturbing them in the least the current is turned off and the stove becomes a practical fireless cooker.

In this new kitchen the ventilation may be controlled by electric fans or blowers and not the slightest odor of cooking penetrates beyond the range.

Possibly the one convenience which appeals most forcibly to housekeepers is the electric dishwasher, for it does its work perfectly with never a growl nor grumble.

The dishes are placed in position in the cabinet, the current turned on, the hot water thus loosened leaps and sparkles with joyous motion, until those "horrid dishes" are once more bright and clean.

The electric kitchen in white enamel, furnished with modern electrical appliances, has solved the servant-problem, and given to housekeeping a new and enlightened interest.

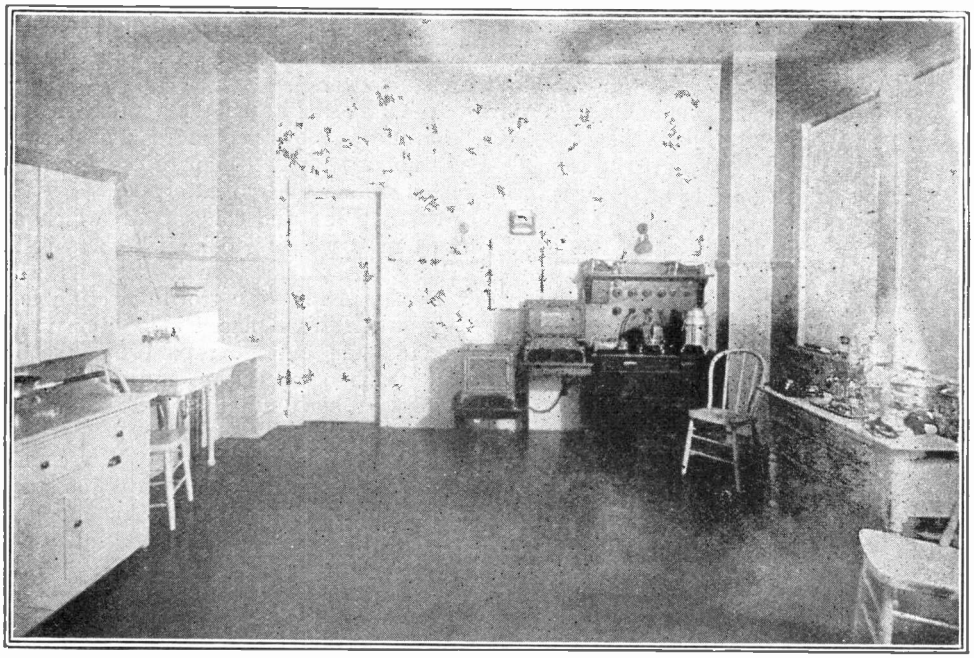
There are few women who do not like housekeeping. What they dislike is its complications, and incessant repetition. Electricity has entered the field as first assistant to all demands and will, if properly guided, open the doorway of a new and attractive home life wherein the ideal woman may reign supreme without detracting from her intellectual and artistic development

The kitchen will again become the unit of activities, but this time it will be based upon the combined forces of art and science and will give to the creative mind a wide field for individual development.

The House Without a Chimney

By VARNEY V. SHUMAKER

An unusual exhibit was opened to the public on Thursday evening, October 27, by the Seattle Electric Company. It consists of a four room cottage with bath, equipped throughout for lighting, heating and cooking by electricity. The exhibit has very appropriately been called by its designer, Manager W. J. Grambs, "The House Without a Chimney."



MODEL KITCHEN IN THE HOUSE WITHOUT A CHIMNEY

The company has recently completed a large office building at the corner of Seventh Avenue and Olive Street, Seattle, and a depth of twelve feet, extending the whole width of the building is occupied by this model house interior.

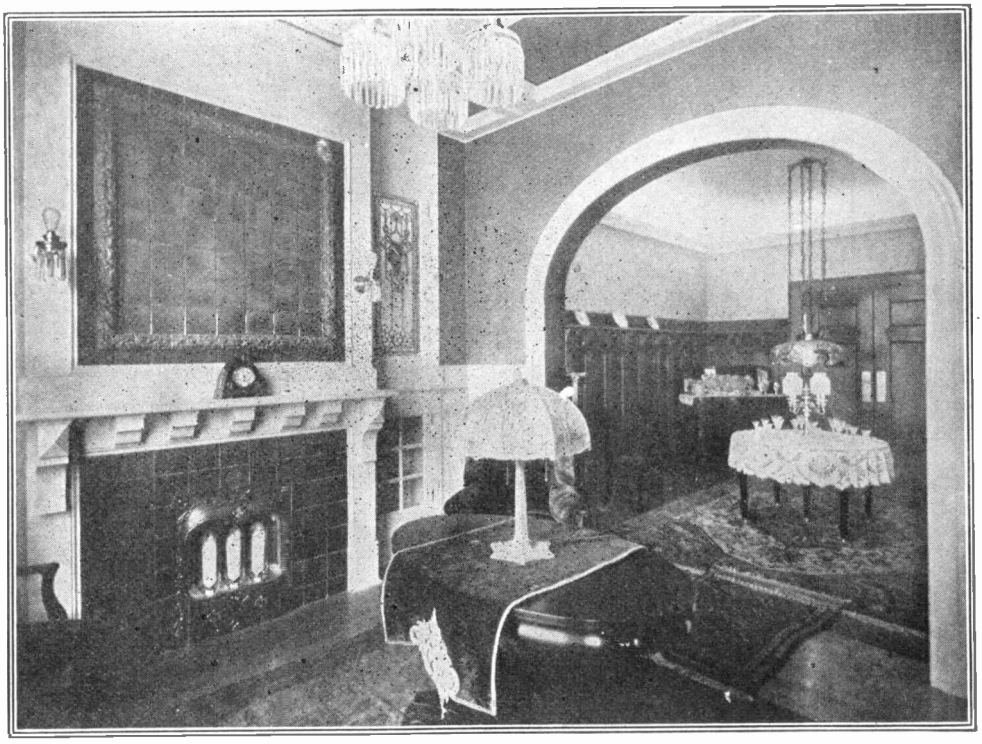
Previous to the opening many thousands of invitations had been sent out to the friends and patrons of the company and a cordial invitation extended through the papers to the public in general as well, to attend a reception in the model home. As variously estimated, from five to seven thousand attended the reception. The entrance to the building was attractively decorated for the occasion, the doors being flanked by huge laurels in tubs, and suspended above the entrance the triskelion, the emblem of the company, was displayed in electric lights. Inside the hall there were other potted palms, Japanese spruce, and huge unnamable plants from park greenhouses. In the various rooms ferns and cut flowers were tastefully arranged. Across the hall in the contract department an orchestra was stationed and here refreshments were served. All of the dainty dishes which delighted the guests were served direct from the model kitchen where they had been prepared upon its electric range.

During the evening the greatest interest was manifested in the model house which may possibly mark the beginning of a new epoch in the building of dwellings—the age of the chimneyless home free from smoke, ashes and their attending dust. No pains nor expense were spared in the appointment of this little flat.

The drawing room is finished in ivory

enamel with a wall decoration in flat gold while the upholstering, hangings, and a beautiful Boccaro rug blend harmoniously in a soft brown. The fireplace is equipped with an electric radiator of three 250-watt lamps having their heating elements arranged so as to give three different degrees of heat, low, medium and high. This radiator will very comfortably heat this room in the coldest weather and lends a "comfy" appearance by giving forth the cheerful glow of an open fireplace. The lighting is by a "shower" leaded glass dome. An electric heater warms the room and for keeping side dishes warm or for preparing light lunches electric chafing dishes may be found on the sideboard nearby.

But the equipment most fitted for making housekeeping a pleasure and for freeing it from all inconveniences is to be found in the model kitchen. Here every auxiliary to domestic economy may be found. The kitchen cabinet, table, chair, and kitchen itself are all finished in white enamel. At



DRAWING ROOM AND DINING ROOM IN THE HOUSE WITHOUT A CHIMNEY

chandelier and by brackets on the fireplace decorated with prisms. On the centertable is also a large portable lamp with an elegant leaded glass shade.

The dining room is finished in beautiful Philippine mahogany, to the height of six feet, surmounted by a plate rail. The floor is of hard wood and in the center is a royal Khiva rug. The lighting here is by the direct-indirect method, a row of 40-watt lamps being placed around the border of the ceiling concealed from view but reflecting the light from the plaster of Paris ceiling. Over the table is suspended a beautiful

one side is a porcelain sink with hot and cold water connections—the water being heated by an electric heater. Among the cooking utensils may be found every device for the convenience of this department foremost among which is a large electric range suitable for every kind of baking. The range is equipped with switches for regulating the heat to any desired temperature, low, medium or extremely high. There are also a tea-kettle, toasters, a grid for broiling, waffle irons, frying pans, coffee percolators, double boilers for cereals, all electrically equipped for fast or slow heating.

The bath is connected with both kitchen and bedroom. It is finished in white enamel, and furnished with a specially lighted shaving mirror, a small water heater for use in shaving, a foot warmer, and a tiny radiator. The water for the bath is heated by a large electric heater.

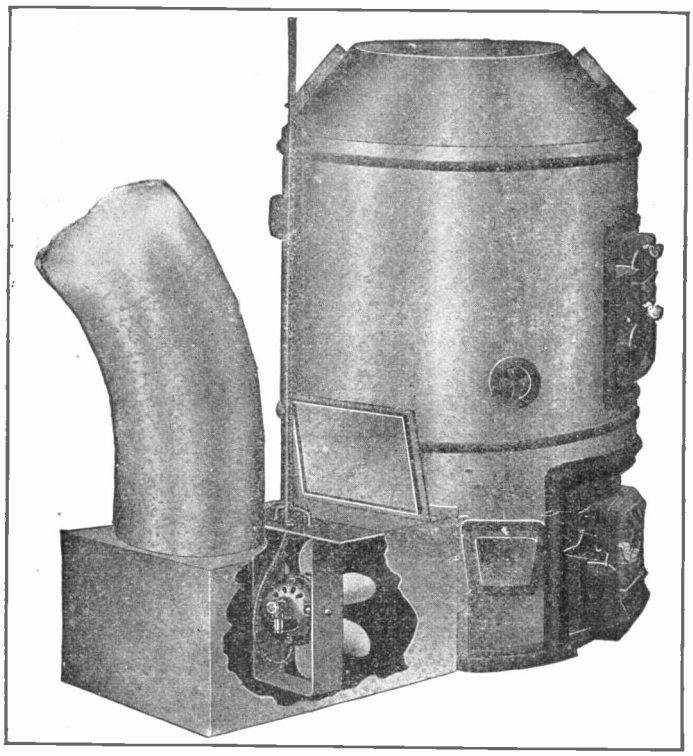
The bedroom is quite in keeping in its elaborateness with the rest of the cottage. It is furnished with a heavy brass bedstead with a handsome bedroll and covering of embroidered lace. A princess dresser, chairs stand and table are in white enamel, the room in pearl grey with a slight touch of rose. From the ceiling hangs a beautiful lamp with brown silk shade, while near the bed is a reading lamp adjustable to different heights and to any position. Every appliance for the toilet is provided, electric curling irons, electric vibrators, hair dryers with hot and cold blast, warming pad, water heater and the indispensable electric radiator.

In the general display room, which it is necessary to cross after leaving "The House Without a Chimney," have been arranged many other devices which would not harmonize with the idea of the model cottage, all of which have their place in lightening the burdens of housekeeping.

Fan Motor to Reduce Fuel Bills

The usefulness of the fan motor is by no means confined to the hot days of summer, and that, paradoxical as it may seem, the electric fan blows hot and cold; and incidentally while it is blowing hot it cuts the fuel bill.

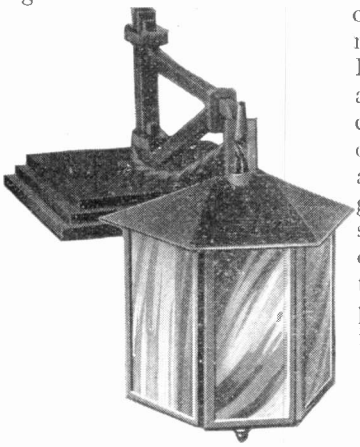
The efficiency of the hot-air heating-system may be greatly increased by placing a fan motor in the cold-air box to force the air through the registers to all parts of the house. On particularly cold days when the wind is so strong that it forces the air through the furnace into the rooms without having become heated, a fan motor placed in the cold-air box, after having closed the slide which permits air to come in from the outside, and opening the slide which lets the air in from the cellar, will cause an appreciable rise in the temperature of the room, without making any increase in fuel consumption.



MAKING THE FAN MOTOR WORK IN WINTER

Artistic Piano Lamp

In this age of bungalows, dens and home conveniences, interior decoration is receiving more consideration. Something out of the ordinary is the Federal piano lamp constructed of metal and art glass in the style of an old lantern, the metal portions being finished in dull black. For lighting the music, screening the eyes and at the same time adding to the attractiveness of the piano corner it deserves consideration.



ARTISTIC PIANO LAMP

A New Portable Vacuum Cleaner

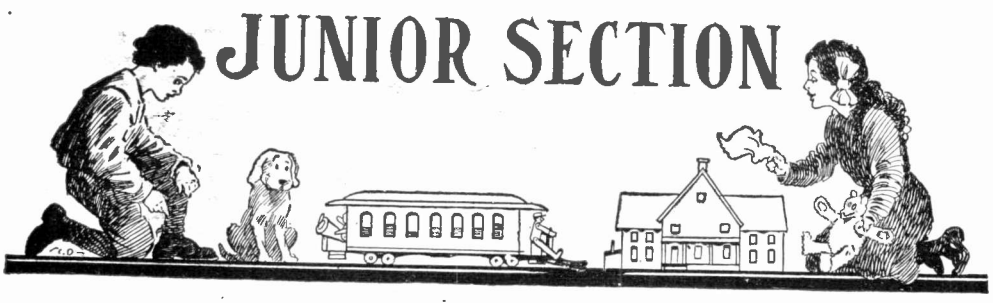
The advantages of vacuum cleaning have been pointed out a great many times in this department. Not all the different types of electric vacuum cleaners have yet been shown, however, among the newcomers in the field being that of the Birtman Electric Company. A few words about this "truly portable" type, will not be out of place:

The machine, complete, weighs only 20 pounds. It operates upon either direct or alternating current circuits, and at a cost within two cents an hour. There are a number of different "tools" or nozzles to be connected to the flexible hose, which are adapted to cleaning curtains, carpets, upholstery, radiators, tufted furniture moldings, bedding, etc., in fact, any place where dust can accumulate. It is arranged to blow air out through the nozzle as well as draw it in by suction, thereby acting as a compact compressed-air system.

A new feature is the adjustable handle which is shown in one of the illustrations. This is made in two parts, with a special flexible joint between. This adapts the nozzle for working over pictures, moldings, door frames, under beds and in otherwise inaccessible places.

ATTACHMENT FOR CLEANING MOULDINGS

DUSTLESS "SWEEPING"



Construction of Small Motors and Dynamos

By CHAS. F. FRAASA, JR.

CHAPTER II.—FIELD MAGNETS

Having described the construction of the boring machine and drill press in the preceding chapter, we will now take up in detail the construction of a small direct current dynamo or motor, of given capacity. A dynamo or motor consists of the following essential parts: The field magnet, armature, commutator or collector, brushes and brush holders, and the windings and connections. The functions of each part may be learned from any book on this subject and will not be given here, for this article will deal only with the construction. It should be said, however, that the whole is so dependent upon each part for good operation that careful attention must be paid both to construction and assembling

FIELD MAGNET

The field magnet is one of the most important parts of the dynamo or motor, and one of the hardest to construct properly. For convenience, we will designate the parts of the field magnet referring to Fig. 8: The pole pieces (H); the magnet cores (I); and the yoke (J). The pole pieces (H) partly surround a cylindrical air-space which is between them, known as the polar bore, in which the armature rotates. Between the armature and pole pieces there is a slight clearance known as the air-gap. This air-gap is equal roughly to one-half of the difference between the diameters of the armature and the polar bore.

It might be well here to enumerate certain features of construction which are desired in nearly all small machines. The shape and type of field magnet depend upon the conditions under which the machine must operate, and the facilities for constructing it. The number of poles or pole-faces depends upon the number of commutator segments, and the voltage under which the machine must operate. The number of poles must not be too great, for with ordinary armature windings the number of brushes and brush holders must then be unnecessarily increased, cutting down the number of intervening insulations between the commutator segments per pair of poles, and consequently the number between brushes, leaving them so few, that poor commutation and disastrous sparking results. The permissible number of poles may be determined by

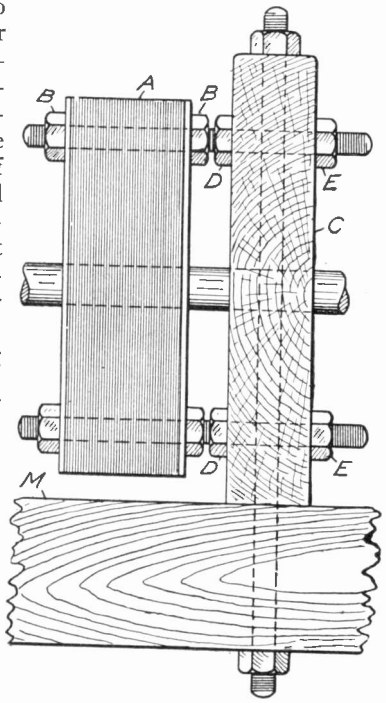


FIG. 7. BEARING BLOCK AND WORK HOLDER

dividing the voltage of the machine by ten, which gives the number of necessary insulations between brushes, and by dividing the number of insulations in the commutator by the result. This is based upon an allowance of ten volts per insulation on the commutator.

In order to maintain the efficiency, the air-gap must be short, as a large magnetizing force is necessary to push magnetic lines through even a comparatively short air-gap. The length of the air-gap should be somewhere between 1/16 and 1/32 inch.

There also exists a general ratio between the length and diameter of the field bore of standard models based upon this same ratio in dimensions of the armature. For field-magnets of dynamos and motors having a toothed armature core, the diameter should be equal to the length for two-pole fields; for four-pole fields, the diameter should be twice the length; and for six-pole fields, three times the length.

The percentage of the armature bore covered by the pole pieces varies from 50 to 75 or 80 per cent but can be considerably less. The greater the per cent of armature covered, the greater will be the output which a given machine will generate, provided the field core sectional area is correspondingly increased.

Another factor in the design of field magnets is the magnetic circuit. Field magnets are usually made of cast iron, wrought iron, steel, or sheet iron. Of these, the first three are capable of retaining magnetism after the field magnetizing current ceases to flow. This retained magnetism is known as residual magnetism. In a motor, the fields are magnetized by the line current, therefore any one of the four may be used in the construction of its field magnets. But in the case of the dynamo is it different, unless the field is excited separately (magnetized by a current external to its armature circuit), the self-excited dynamo depending upon the residual magnetism for its start in generating. Upon rotating the armature, this magnetism causes a current to be generated in the armature, and this current in turn passing through the field coils increases the magnetism until it has been built up to a certain density or to saturation depending on the ampere-turns in the field coils. From this it will be clear that of the four designs, the first three may be used in the construction of a direct current field magnet, sheet iron being useless for this purpose. However, by bolting cast iron, wrought iron or steel plates on the sides of the sheet-iron fields these may be made to retain a certain amount of magnetism. An example of this will be given in the construction of the following designs, all of which have sheet iron field magnets. For motors, for reasons previously stated, the field magnet may be constructed entirely of sheet iron; but if a dynamo field is to be so built, it should have cast or wrought iron plates bolted to it.

The wrought iron plates for this purpose may be obtained by cutting open a piece of iron pipe of such a size as will give a sheet of the required dimensions, when flattened out. Flatten while red hot. I have successfully made many plates in this way, by cutting a piece of pipe into two parts with a hack saw, and heating the resulting parts in a cook stove; then by holding them in a monkey wrench upon the head of an ax for an anvil, have beaten them flat with an ordinary hammer.

The cheapest form of sheet iron for use in the field magnet may be obtained by melting the solder off of tin cans, cutting them open and then beating them flat into sheets. They may be cleaned with sand paper if desired, but I have never found this necessary This tin-can iron will give very good results. I have had it give as good results as sheet iron I have purchased. But to be sure of good results and neat work a good grade of sheet iron should be used. Stove pipe iron, which is very satisfactory, may be obtained from the hardware store, but the blue iron of which the tinner makes pipe is cheaper and just as good.

These machines are designed for four given capacities, which we will designate by the four letters (A), (B), (C), and (D). Machine (A) will generate an output of 50 watts; (B), 100 watts; (C), 300 watts; and (D), 800 watts. These ratings are at 1,500 revolutions per minute. When run as motors (A) will have an output of about 1-16 horsepower; (B), 1/8 horsepower; (C), 1/2 horsepower, and (D), one horsepower.

Though the standard speed of these machines is 1,500 revolutions per minute, by driving at a speed of 2,500 revolutions per minute, the outputs will be: (A), 100 watts; (B), 225 watts; (C), 500 watts, when wound for this.

These models when built to operate as alternating current generators, double-

current generators, or as rotary converters, should be run at a speed of 1,800 revolutions per minute, to get the standard frequency of 60 cycles, and to get the full rated output. The field for the alternating current dynamo will require four poles as in Fig. 9, and must be excited by direct current led from a commutator provided for this purpose.

The fields of these models are of two general types, the two-pole, and the four-pole. The two-pole field, for reasons given

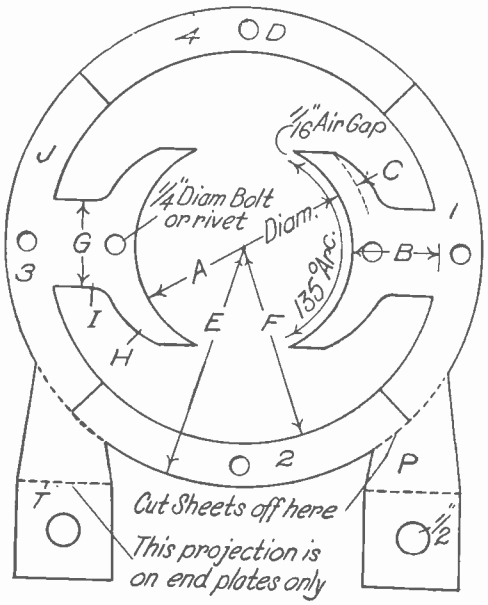


FIG. 8. FRAME OF TWO-POLE DYNAMO OR MOTOR

above is to be preferred, since the sparking will be less than with the four-pole field, but the four-pole field must be used for the alternating current generators. The two-pole field covers 75 per cent of the armature, or each pole covers an arc of 135°; the four-pole, 80 per cent, or an arc of 72° per pole.

Upon reading the dimensions of the field bore, next page, the reader will notice that those for the four-pole field do not comply with the data given above. It is necessary in these designs to keep the dimensions diameter equal to length, in the polar bore, in order to keep the diameter of boring within the limits of the boring machine.

For the alternating current machines there will be a few changes in the dimensions, as follows:

Dimension (G) in (A), will be 7/10 inch; in (B), 8/10 inch; in (C), 1 inch, in (D), $1\frac{3}{8}$ inches. The yoke or rim thickness for (A) will be $\frac{1}{2}$ inch; for (B), $\frac{1}{2}$ inch; for (C), $\frac{3}{4}$ inch; for (D) $\frac{3}{4}$ inch. The thickness of the stack of sheets for both the alternating and direct current machines should be: (A), $3\frac{1}{4}$ inches; (B), $3\frac{1}{2}$ inches; (C), $4\frac{1}{4}$ inches; (D), 5 inches.

To better explain the construction of these models, we will from here on take up the construction of the 50-watt size in particular, as the building of this is as difficult as any to design because of having to build a very small machine for a high voltage. For the dynamo field magnet four wrought iron plates will be required, two on each side of the stack of sheet iron, though twice this number would be preferable. The wrought iron and the sheet iron should be cut to $8\frac{1}{2}$ by 10 inches. Cut V-notches in the two ends of one of the sheets, and using this sheet as a pattern, cut notches in the ends of all the sheets. Then drill holes in the ends of the plates corresponding to the notches in the sheets, and after placing half of the wrought iron plates upon either side of the sheets, pass one-fourth inch bolts through the holes in the plates and the notches in the sheets, and clamp the whole tightly by tightening up the nuts. This serves to clamp the whole and hold it so that it can be handled as one solid mass, and will not allow the sheets to slip or turn.

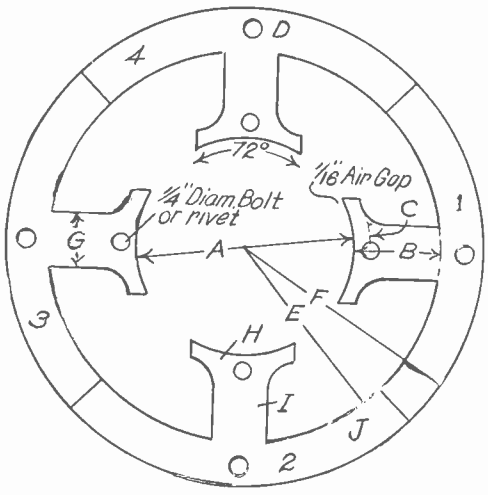


FIG. 9. FRAME OF FOUR-POLE DYNAMO OR MOTOR

Now describe a circle of 3 7/16 inches radius, divide this into four parts by two lines perpendicular to each other passing through

the center of the circle. Drill ¼-inch holes at the intersection of these lines with the circle. These holes are for the bolts which hold the field together, support it while boring, and later hold the bearings.

Next take the bolts from the iron and trace the pattern on one of the sheets. Cut out along the lines and use as a pattern to cut the rest. Two of these patterns will have to be made, each being cut into two segments. Pattern No. 1 will be composed of two segments; segment 1 being (1) and (2) in Fig. 9, and segment 2 being (3) and (4). In pattern No. 2, segment 1 is composed of (1) and (4); segment 2, of (2) and (3). When these segments are stacked in this way, the joints will be staggered and there will be a good magnetic circuit. It is necessary to cut the field in this way in order to cut out the pole-pieces. Now put four bolts through the four holes in one of the end plates, and lay the plate with the bolts up; on this place one of the sheets with the bolts through the holes in it, and on this the pattern, and trace around and remove. Then cut out the field along the lines with the tin shears. Continue this until all are cut.

The patterns should be traced around the plates in the same way (they should not be cut in segments) and cut out with a file, hack saw and a cold chisel.

When all the sheets and plates are cut, they should be assembled in such a manner that all the joints are staggered, and the field bolts passed through the four holes. This may be done by assembling the sheets on the bolts passed through the holes in the end plates. When assembled the stack should be 3⅜ inches thick, and half the end-plates should be on either side. The field is now ready for boring. All preparations for boring should be made carefully to get good results. Set the boring tool in the tool holder of the boring machine at a point such that it will cut a circle of 3 7/16 inches radius, and inscribe a light circle upon the bearing block (C), shown in Fig. 1, Chapter I. Divide this circle into four equal parts, and then drill four equally spaced holes, ¼ inch in diameter at these points. The bolts (a) Fig. 7 (the field magnet bolts) should be threaded as shown in the figure, and be secured by the nuts (B), the nuts (D) screwed on, and then put through the holes in the block (C). Then screw on the remaining nuts, and tighten all until the field is securely fastened to the boring machine block (C).

Now set the boring tool upon rotating the shaft so that it will cut a circle 3⅜ inches in diameter. The tool for this purpose is the side cutting tool shown in Fig. 4. Now feed up the device by turning up the nuts (H), until the tool touches the field in at least one place. Then adjust the nuts at each bolt till the tool touches at all points when revolved. This will make the bore perpendicular to the face of the field magnet. Then very slowly feed the tool and bore the field. When the field is bored, remove it from the boring machine. By cutting the projections (P), Fig. 8, on the end-plates, and bending along the line (T) perpendicular to the plate, good strong base lugs for bolting the machine to a base may be made. Holes about ½ inch in diameter should be drilled in the lugs for this purpose.

If the outside surface of the field magnet is not smooth or neat enough to suit the builder, it may be benefited somewhat by grinding it smooth on an emery-wheel if one is at hand. The whole should then receive several coats of japalac, or bicycle paint. Do not paint the pole faces, as this is not necessary. This completes the field magnet for the 50-watt dynamo or motor. These instructions apply practically to all the machines.

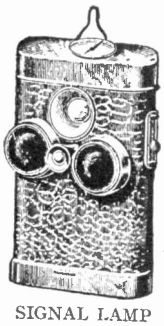
DATA FOR D. C. MACHINE, TWO-POLES, REFERRED TO FIG. 8

Machine	A dia.	B	C	D dia.	E rad.	F	G
	in.	in.	in.	in.	in.	in.	in.
A	3⅜	1½	¼	¼	3 3-16	3 11-16	1 1-4
B	3⅜	1¾	¼	¼	3 9-16	4 5-16	4-10
C	4⅜	1¾	⅜	⅜	4 1-16	4 7-8	1 4-5
D	5½	2⅜	½	½	5 1-16	5 5-16	2 1-3

(To be continued.)

A Boy Scout Signal Lamp

Few organizations have ever had as rapid and as healthy a growth as the "Boy Scout Movement" developed by the British hero of the Boer war, General Baden-Powell, out of ideas advanced by Ernest Thompson Seton and Dan Beard. Unlike the usual military movements, with which the title would class it, this organization aims at peace scouting, putting the emphasis partly on manly outdoor sports. Thus the requirements for advancing from a "tenderfoot" to a second-class and later to a first-class scout include the ability to send messages by signaling at the rate of at least 16 letters per minute.



SIGNAL LAMP

In this signaling, the boy scouts have been free to select thornughly modern equipment. Thus instead of using oil lamps for their signaling they have procured electric flash lamps which can be more easily carried in any position. One British concern has even brought out a special type called-the "Baden-Powell-Scout Lamp," consisting of two cells of battery with a miniature search-light mounted between them. A revolving arm carrying red and green lenses allows the color of the light to be changed instantly for signaling purposes, a compass in the top of the case helps the scout to keep his bearings correctly, and the whole outfit can either be carried on a belt or hung on a tree by a loop which folds out of the way when the outfit is slipped into a pocket.

The Magnetic Puzzle

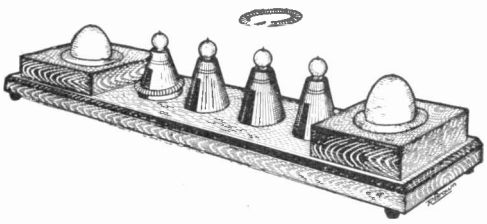
In the December issue there was a brief description in the Junior Section, of a magnetic puzzle. Therein it was stated that the north and south poles of the circular magnet were located in either side and next to the cut in the ring, the neutral point being on the opposite side of the ring. For the sake of accuracy it should be pointed out that this statement is in error. One pole is at the cut and the other pole on the opposite side of the ring, the two neutral points being half way between. This method of construction the manufacturer finds most economical.

Tell Others of Your Experiences

Readers of the Junior Section are invited to write letters concerning experiences they have had in the construction of electrical devices, interesting experiments they have made, electrical phenomena which they have noticed, etc., for publication in the department. It is probable that we will not find the space each month to publish all the letters, but will select those which contain the most of general interest. These letters should be carefully written on one side of the sheet and addressed to "The Junior Section, Popular Electricity Magazine." We can devote one or two pages a month to this interchange of experiences, which should work up into a valuable feature of the Junior Section.

Luminous Quoits

Patrons of the various shooting and ball-throwing booths that line the "Pikes" of summer parks and that nestle around circus tents know that the fascination is all the greater when a bell proclaims the accurate marksmanship. The same is true in many other games of skill, whether for children or for adults, many of which have had an added charm lent to them by the attaching of one or more bells. In the case of the old game of quoits a French firm of toymakers has gone still further by using electric lights instead of bells to announce the correct aim



LUMINOUS QUOITS

of the player. For this purpose each of the four pegs has a pair of metal contacts running down its sloping sides while the quoits themselves are braided out of a soft cord intertwined with bare brass wires so as to offer the lightness of a corded ring while much too soft to injure the globes over the incandescent lamps at each end of the base. A small dry cell under each lamp supplies the current which lights one of the lamps when the ring drops down on the contact.

POPULAR ELECTRICITY WIRELESS CLUB

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

A High-Power Wireless Equipment

By ALFRED P. MORGAN

PART X.—DETECTORS.

In discussing the construction of the receiving apparatus I am going to follow as far as possible the plan used in the preceding chapters, namely that of making each article complete in itself so that it will be of interest and value to the general reader.

Many experimenters have certain ideas of their own regarding the construction and operation of the receiving instruments. Each piece of apparatus under description therefore has been so designed that it may be used in connection with any receiving set. For the benefit of those who contemplate constructing the complete outfit without any departure from the plans given here I have described a case for mounting the instruments so that the set is compact and complete in itself.

Given a good pair of telephone receivers, the detector will largely determine the receiving range of a station.

During the past three years the crystal type detectors have come into extensive use principally because they are readily and easily adjusted. They can be used for portable work or on shipboard where jolts and jars would quickly throw an electrolytic detector out of adjustment. However, in spite of numerous new sensitive minerals and compounds, the electrolytic has held its own and stands at the top of the list in the order of sensitiveness. Its only drawback is that it requires more frequent adjustment than a mineral detector of the silicon type. For the amateur operator who is striving to do long distance work it is ideal.

There are two types of electrolytic detector, known as the "barepoint" due to Reginald A. Fessenden, and the "sealed point" of John S. Stone. The former is the most sensitive and the only one which will be discussed here.

Fig. 113 illustrates the principle and construction of an electrolytic barepoint detector. A thumbscrew carrying at its lower end an extremely fine piece of platinum wire is mounted over a small non-metallic cup which contains a 20 per cent solution of either chemically pure nitric or sulphuric acid, preferably the latter.

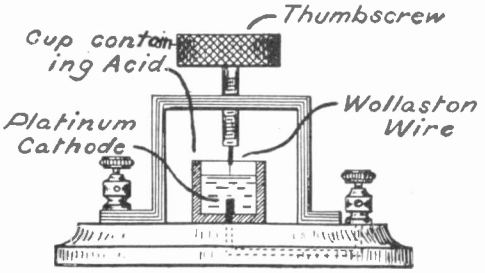


FIG. 113. SIMPLE ELECTROLYTIC DETECTOR

By turning the thumbscrew, the fine "Wollaston" platinum wire may be raised or lowered into the liquid. If the cup is made of some insulating material such as glass or hard rubber, a piece of platinum wire or foil is sealed in the bottom. The size is immaterial since its purpose is simply to establish an electrical connection with the liquid. This in turn is connected to a binding post mounted on the base. A second binding post connects with the standard supporting the thumbscrew and its fine Wollaston wire point. A battery and a

pair of telephone receivers are then connected to the binding posts so that the current flows through the telephones to the fine platinum point, into the electrolyte through that and back to the battery, that is, the *positive* pole of the battery is connected to the *fine platinum wire.* Otherwise, the detector will be inoperative.

The thumbscrew is connected to the aerial and the electrolyte in the cup to an earthed plate. The illustration, Fig. 114, also shows an instrument called a potentiometer, but for the moment we will disregard its existence and purpose.

The sensitiveness of the detector, outside of its adjustment, will depend upon the size

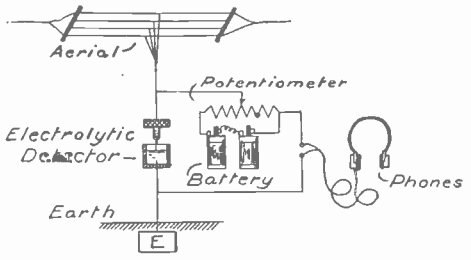


FIG. 114. CONNECTIONS FOR ELECTROLYTIC DETECTOR

of the extremely fine platinum Wollaston wire and will be greater as the diameter of the latter is smaller. To the naked eye, Wollaston wire appears like an ordinary piece of platinum wire about .003 inch in diameter, but in reality it is a piece of silver having a platinum core from .0005 to .00002 of an inch in diameter. This extraordinary small diameter is obtained by plating a piece of fine platinum wire with silver until its diameter is increased several times. The whole wire is then drawn through a small die about .003 of an inch in diameter and the platinum core thus stretched out until it is microscopic.

The thumbscrew carrying the Wollaston wire at its lower end is lowered until the wire comes into contact with the electrolyte in the cup. The acid will dissolve the silver on the lower end of the wire and expose the fine platinum core. It is very important that too much wire should not be exposed or the point will be unable to pass below the surface of the liquid, as the surface tension will cause it to curl over and present a large, flat surface instead of a fine point.

The action of the detector depends upon the electrolysis of water. The acid is merely added to form an electrolyte and reduce the resistance of the water. As stated above the *positive* pole of the battery is connected to the *fine platinum point* and the negative to the electrolyte. When the current passes through the liquid it decomposes a portion of the water into its constituent gases.

$$\underset{\text{Water}}{H_2O} = \underset{\text{Hydrogen}}{H_2} + \underset{\text{Oxygen}}{O}$$

The gases appear as minute bubbles, the oxygen on the positive pole where the current enters the liquid and the hydrogen upon the large platinum electrode sealed in the bottom of the cup. The oxygen collects upon the fine platinum point and soon completely shields or insulates it from the liquid so that the current can no longer flow. The voltage of the battery of itself is insufficient to break down this film of gas. But when the detector is connected to the aerial and the earth it comes under the influence of the oscillatory currents set up in the aerial by the transmitter. These currents are alternating at an extremely high frequency. When the fine wire point of the detector is connected to the aerial and the positive half of the wave is passing, the added voltage is sufficient to break down the film of gas and permit the battery current to flow and register a sound in the telephone receivers. As soon as the wave ceases to pass, the film of gas is immediately reestablished.

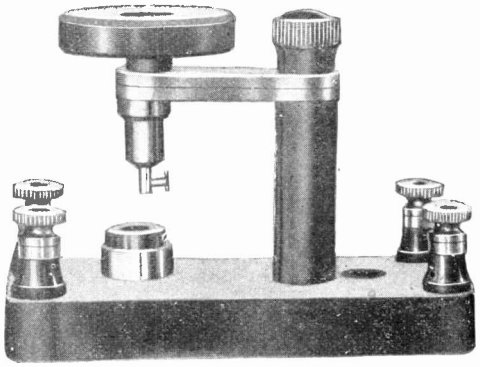


FIG. 115. ELECTROLYTIC DETECTOR

Fig. 115 is from a photograph of a novel electrolytic detector designed and used with excellent results by the author.

In order to place an electrolytic detector in the most sensitive condition, the fine platinum point should not revolve or have any other motion save a perpendicular one, when the adjusting screw is turned.

The base, Fig. 116, is an oblong piece of hard rubber $4\frac{1}{2}$ by $2\frac{1}{4}$ by 9-16 inches, having the corners rounded and the faces polished so as to present a good appearance. Four holes which will just pass an 8-32 machine-screw are bored in the positions indicated in the illustration.

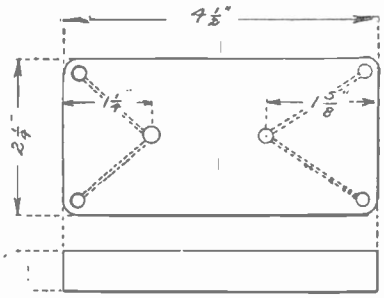


FIG. 116. HARD RUBBER BASE

The holes are countersunk in the under side of the base so that the heads of the screws will come below the surface. The dotted lines indicate the grooves through which the connecting wires pass.

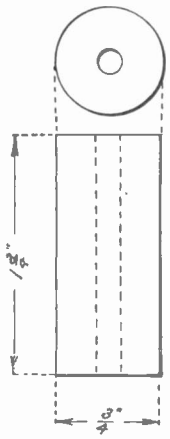


FIG. 117. HARD-RUBBER STANDARD

The hard-rubber standard, Fig. 117, is a piece of hard rubber rod $1\frac{3}{4}$ inches long and $\frac{3}{4}$ inch in diameter. The head of the adjusting-screw, Fig. 118, is a circular piece of hard rubber $1\frac{1}{2}$ inches in diameter and $\frac{1}{2}$ inch thick. Its exact shape and construction are most easily understood from the illustration. The purpose of the brass bushing shown in the sectional drawing, Fig. 119, is to avoid friction and wear, and make it possible to turn the adjusting-screw more easily. The bushing is formed of a piece of 5-16 brass rod $\frac{1}{2}$ inch long having a hole bored through its longitudinal axis and threaded with a 10-32 tap. It should fit snugly into the hard-rubber head, where it is secured by a small brass pin.

A brass arm, Fig. 120, $2\frac{1}{4}$ inches long and $\frac{3}{8}$ inch thick supports the moving parts of the detector. It is $\frac{5}{8}$ inch wide at one end and tapers down to $\frac{1}{2}$ inch at the other. The ends are rounded to coincide with the semi-circumference of a circle having a diameter equal to the width at that point. A 3-16-inch hole is bored in the larger end and a $\frac{3}{8}$-inch hole in the other to receive the upper end of the "barrel."

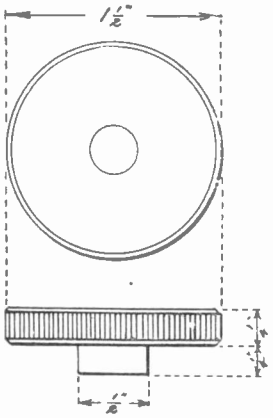


FIG. 118. ADJUSTING SCREW HEAD

This part of the detector, Fig. 121 is formed out of a piece of 7-16-inch round brass rod, 13-16 inch long. A hole 13-64 inch in diameter is bored through the axis of the barrel. This hole is enlarged for part of the distance to 9-32 of an inch. One end of the "barrel" is tapered as in the illustration in order to present a finished appearance. The other end is turned down

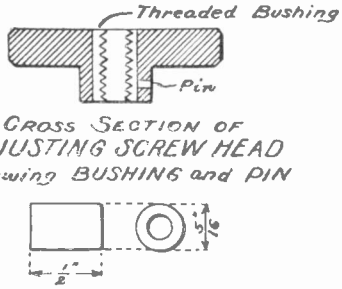


FIG. 119. DETAILS OF SCREW HEAD AND BUSHING

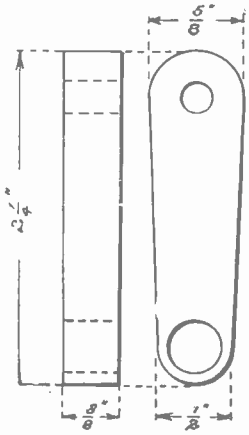


FIG. 120. BRASS ARM, SIDE VIEW AND PLAN

to a diameter of $\frac{3}{8}$ inch to fit the hole in the brass arm.

The shaft, Fig. 122, is a piece of brass rod 13-64 inch in diameter and $2\frac{1}{4}$ inches long. The lower end is bored with a 1-16 inch drill so that the Wollaston wire may be set in. A small knurled set-screw clamps the wire tightly in place. This part of the detector will be the most difficult to make

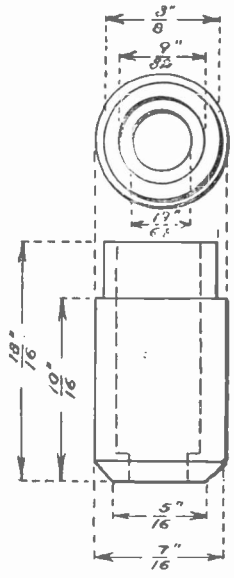


FIG. 121. BRASS ARM

since most experimenters do not possess a small screw-plate set for threading the screw and tapping the hole. This operation should therefore be performed by a jeweler. Or instead, the pivot end of an old drawing compass or pair of dividers may be cut off and soldered onto the end of the shaft.

The upper end of the shaft is threaded with a 10-32 die for a distance of 1½ inches. A small piece of brass wire is bent

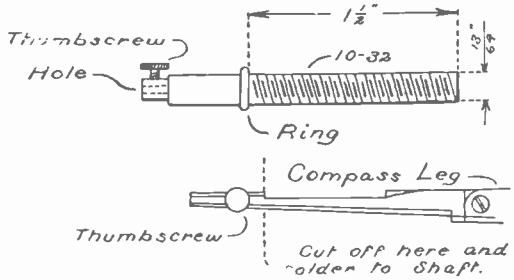


FIG. 122. SHAFT FOR HOLDING WIRE

into a ring which will just fit around the shaft and soldered at the base of the thread.

(To be Continued.)

First Woman Ready to Send "C. Q. D."

In times of peril the "code of the sea" requires the captain to be the last to leave the ship, and just preceding him may go the wireless operator who must forget self and stick to his key calling for aid as long as possible.

The first woman to assume this responsibility is Miss Graynella Packer of Jacksonville, Florida, who recently took charge of the wireless equipment on board the steamship Mohawk of the Clyde line plying between New York and Jacksonville. Miss Packer is 22 years old, with two years experience as a telegraph operator.

Wireless Outwits the Censors

That all civilized nations will have to reckon with the wireless operators when endeavoring to censor news in time of war, was clearly proven during the recent disturbances in Portugal even though no long distance wireless station has yet been installed there. On the night following the third of October the steamer "Cap Blanco" stopped at Lisbon on its way from South America to Hamburg, being just in time to witness the beginning of the revolution. The operator promptly signalled the captain's observations to the sister ship of the same line, the "Ypiranga" which was then at Santander in northern Spain, separated from Lisbon by high mountains and a distance of about 420 miles.

Later the foreign correspondents of several newspapers boarded the "Cap Blanco," eager to forward messages which could not be sent by telegraph because of the strict censorship. Knowing that neither Spain nor Portugal has yet erected a public wireless station, the operator had to choose between the one at Algiers in northern Africa and that at St. Marie de la Mer, near Marseilles in France. Selecting the latter, he soon got into communication with it and forwarded the series of messages which gave authentic news of the situation at Lisbon to the outside world. The distance in this instance was about 800 miles, also with mountainous country intervening.

While the sending of these particular messages probably had no influence on the political or military situation, it is easy to surmise how such unauthorized communication with distant points might betray secret plans and seriously affect the game of war at critical times.

Wireless Thunderstorm Announcers

By suitably tuning the receiving apparatus, a wireless telegraph outfit can be made to respond to waves sent out by distant strokes of lightning. If the thunderstorm is approaching, these waves will increase in intensity and thus indicate the direction in which the storm is moving. A Spanish weather observer, de Garcia, is now trying to perfect an apparatus which will record these waves and their intensity, believing that such records may enable him to predict the coming of thunderstorms.

Fessenden Equipment of the U. S. S. Connecticut

By WILLIAM E. SMITH

In 1909, the United States Navy Department issued proposals for bids on a high-power transmitting and long distance receiving set capable of communicating a distance of 1,000 miles during either day or night. It is a well known fact that wireless will reach a longer distance at night, possibly as much as three or four times the distance it will in daylight, due to the supposed effect of the sun's rays on electromagnetic waves. The National Electric Signal Company, builders of the Fessenden apparatus, secured this contract, and in August, 1909, installed a 25 kilowatt high frequency set on the U. S. S. Connecticut below the protected deck. The following is a general description of the apparatus:

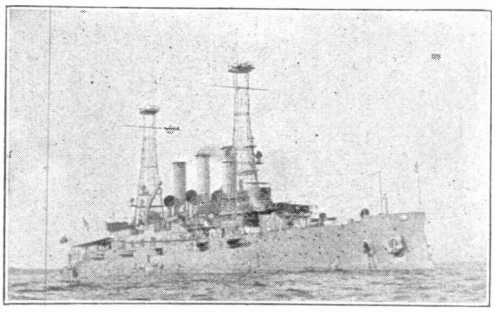


FIG. 1. U. S. S. CONNECTICUT

The motor-generator set consists of a 25 kilowatt General Electric, 500-cycle, 110-volt, single phase alternator driven by, and directly connected to, a 35 horsepower, 120-volt, direct current motor at a speed of 2,000 revolutions per minute. Also directly connected on the alternator and motor shaft is a synchronous rotating spark gap consisting of an electrose disk three feet in diameter and one inch in thickness, on the edge of which is a copper band upon which are set at a uniform distance from each other, 30 copper electrodes, there being an electrode for each field coil in the alternator. These electrodes are four inches in length, and terminate in spade-shaped heads. The spark gap is completed by two stationary electrodes placed at equal distances on the opposite sides of the rotating disk. These electrodes are highly insulated by the use of electrose and porcelain bushings contained in a cast iron case, which also encloses the rotating disk. By means of a worm-gear these electrodes can be turned through a small arc so as to get the proper adjustment of these electrodes in relation to the revolving electrodes on the disk, when so adjusted, that an electrode comes opposite both of the stationary electrodes at the exact instant of maximum potential, obtained in the condenser, it produces a discharge across the gap for every alternation, thereby giving 1,000 discharges per second.

The distance between the stationary and rotating electrodes are from $\frac{1}{4}$ inch to $\frac{3}{8}$ inch on either side, making a total gap of from $\frac{1}{2}$ inch to $\frac{3}{4}$ inch, but which in fact amounts to more than one inch on account of the spark

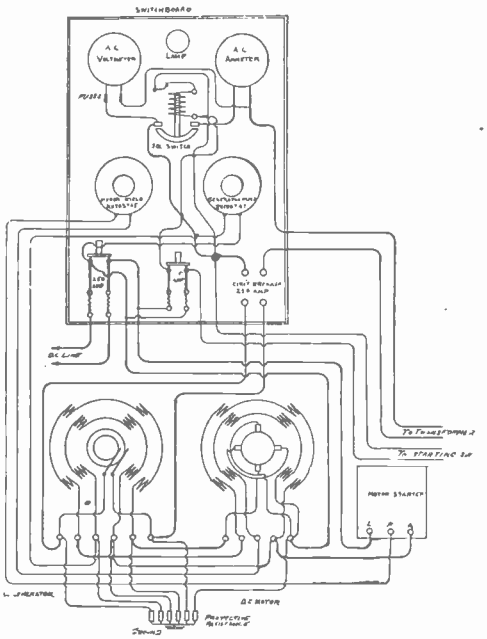


FIG. 2. SWITCHBOARD AND WIRING

jumping a little before and hanging on after the electrodes have passed.

Fig. 2 shows the switchboard and system of wiring for the primary circuits. The switchboard is of highly polished slate and consists of an alternating current voltmeter, 150 volt range; an alternating current ammeter, 300 ampere range, both instruments are of the Thomson inclined coil type; a solenoid switch for closing the alternating current circuit, controlled from the operating room; a motor field rheostat for varying the speed of the motor to bring the alternator up to the proper frequency; a generator field rheostat for varying the voltage of the alternator; one double pole single throw switch capable of carrying 250 amperes; a small fifteen-ampere, double pole, single throw switch on the relay key circuit, and two single pole, 250-ampere Westinghouse circuit breakers.

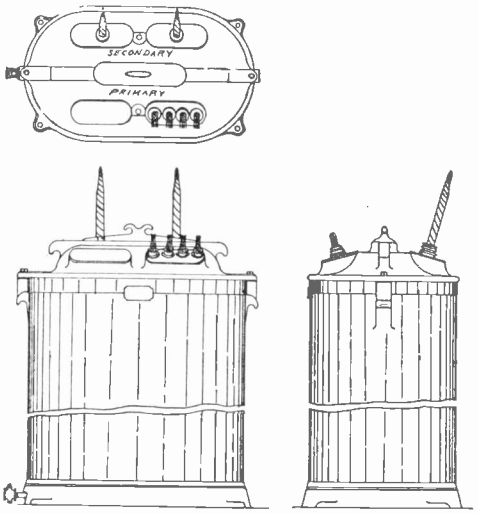


FIG. 3. TRANSFORMER

Fig. 3 shows the type of transformer used. The transformer is a 25 kilowatt and has oil insulation. The primary voltage is the same as that of the alternator—110 volts. From the secondary a voltage of 12,500 or 25,000 can be had. There are choke coils at each secondary terminal to prevent kick backs. It is also protected by an adjustable safety spark gap. The current through the primary is generally of constant value, but when necessary the current is regulated by varying the field strength of the alternator. The secondary is connected directly across the terminals of the rotary gap, across which is also connected the condenser in series with a variable inductance.

This condenser is of small size, having only a total capacity of .025 microfarad. It is made in two sections, each section being contained in a steel cylindrical tank about 1½ feet in diameter and four feet in height mounted upon insulating legs. Fig. 4 shows this condenser in the interior and exterior.

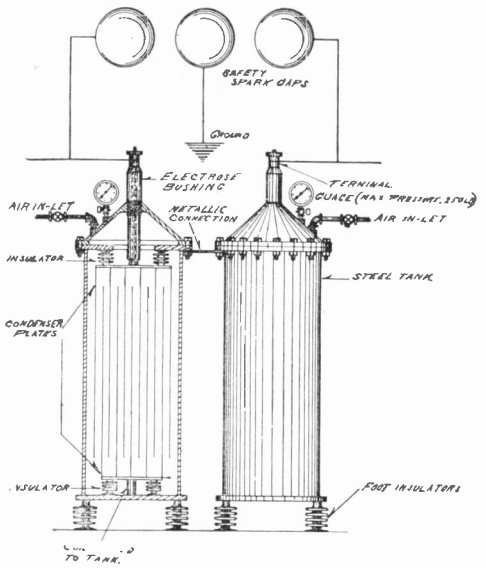


FIG. 4. SIDE VIEW AND CROSS SECTION OF CONDENSER

The condenser plates consist of steel plates 1-16 inch thick. The tanks are subjected to an air pressure of 250 pounds to the square inch, which forms the dielectric for the condenser plates. The series of plates in each tank are connected in multiple and the two groups are connected in series, the series connection being made by grounding a terminal of each condenser to the bottom of the tank, and the tanks being metallically connected together. The other terminal is taken through heavily insulated electrose bushings in the top of the tanks. From the two terminals leads are taken to three copper balls one foot in diameter, which are adjustable and form a safety valve for the condenser against excessive charging, the central ball being connected to ground.

The closed circuit inductance which is connected in series with the condenser consists of 40 turns of 1-16 by ½ inch phosphor bronze ribbon wound on its edge on an insulated cylindrical frame eighteen inches in

diameter and suspended from an insulated axle. Suspended on the same axle is the aerial or open circuit inductance, movable to or from the closed circuit inductance, the coupling of the two circuits thereby being varied as to their mutual and self induction, the coupling in all cases being purely inductive. There is still another inductance made the same as the others and placed in series with the aerial and used as a loading coil by means of which, and the inductive coupling, the wave radiated is made extremely "loose," there being but one wave. The inductances can be revolved upon the axle, and by means of a wheel spring contact, turns or part of a turn can be had.

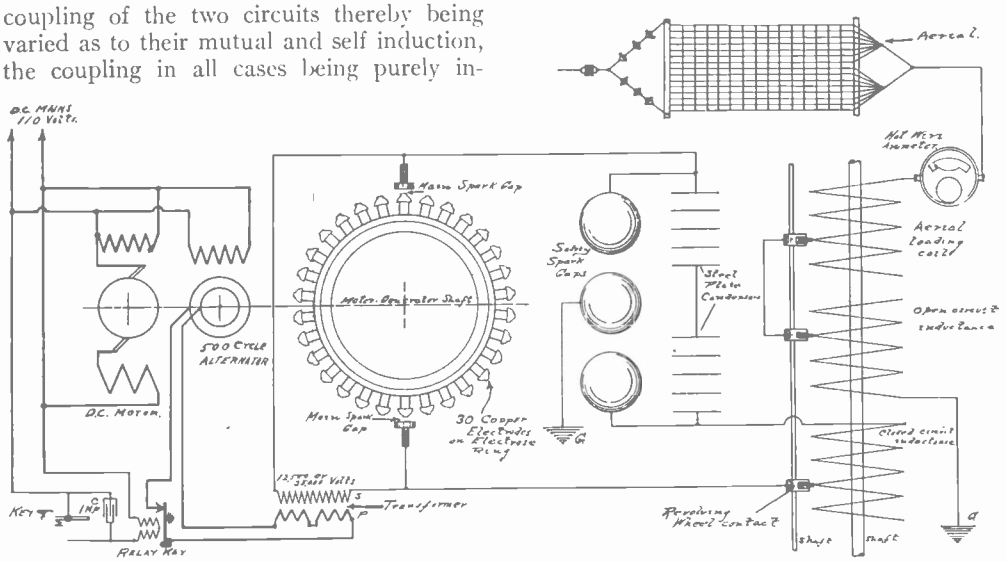


FIG. 5. DIAGRAM OF SECONDARY CONNECTIONS

All of the secondary connections are made with $2\frac{1}{2}$-inch copper strip, so as to keep down the induction. Fig. 5 is a complete diagram of the connections. The transmitting key is of the relay series break type and is placed in the primary of the transformer. It consists of a standard Western Union key shunted by lamps or a condenser, placed in series with an electromagnet which operates the main key in the primary circuit.

The receiver used with this set is the Fessenden interference preventer. It is capable of tuning very sharply. It has, however, one objectionable feature, that is, the somewhat lengthy time it requires to get the proper adjustments. Fig. 6 shows the receiver connections. The aerial is led in singly to a variable inductance after passing through which it is divided into two branches. In each leg is a variable condenser and a variable inductance in series with the primary of an oscillation transformer, and then to a common ground. The detector circuit is inductively coupled by means of the secondaries of the oscillation transformers which are variable as to mutual and self induction. The detector is the well-known Fessenden electrolytic type, having the usual phones and potentiometer connected in multiple around it, a variable condenser is shunted around the detector which neutralizes the effect of static induction, and a sharper coupling is thereby obtained.

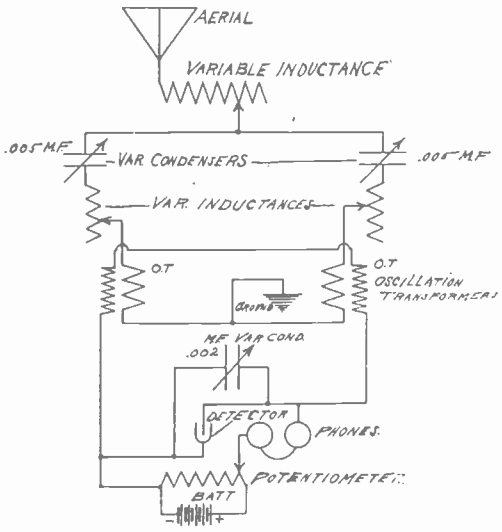


FIG. 6. RECEIVER CONNECTIONS

In conjunction with the above type of receiver is used the United States Navy Standard type I P 76 set, which the writer has found to be very simple and easily adjusted and capable of working over a great distance. The I P 76 is a complete receiving set of maximum efficiency, and contains every element necessary for the highest sensitivities and selectivity. It contains a transformer tuner with variable primary and secondary windings, and the secondary circuit is sharply tuned by means of a variable condenser, and an extra inductance coil is added to the primary circuit, enabling the operator to tune in very long wave lengths. The well-known perikon and pyron detectors are used, with a special potentiometer associated in order that the maximum sensitiveness of the detector can be obtained. This set also contains a special telephone condenser, special test buzzer and protective spark gap. The receiver connections are shown in Fig. 7. The aerial is led in singly to the variable inductance, after which it passes through the primary of an oscillation transformer and then to ground. The detector circuit is inductively coupled by means of the secondary of the oscillation transformer which is variable as to self and mutual induction, and is shunted by a variable condenser, the detector having a pair of adjustable phones and potentiometer connected in multiple around it. A variable condenser is also shunted around the detector.

The aerial on the U. S. S. Connecticut is a radical departure in aerial construction. It is made of No. 7–22 phosphor-bronze aerial wire, and consists of fifteen wires running lengthwise and at equal distance cross-connected by fourteen other wires. The lengthwise wires are spaced 2¾ feet apart, and are suspended on spreaders 40 feet long by 2½ inches in diameter, and are of such construction that the aerial can be easily changed from straight away to loop type. This type of construction gives the aerial a large capacity and its natural period large, the wave length used being about 1,200 meters. The aerial is insulated by means of eighteen-inch electrose insulators connected in series so as to form a creeping surface of 54 inches, which is connected to the ends of the spreaders and guyed back to the masts and made fast. When the Connecticut was in the southern drill grounds off Cuba, this station was heard and copied in Chicago, San Francisco and Brant Rock, Mass. The writer has just received word that the world's record for long distance wireless communication, "not signals" has been broken by the U. S. S. Tennessee, a distance of 4,580 knots.

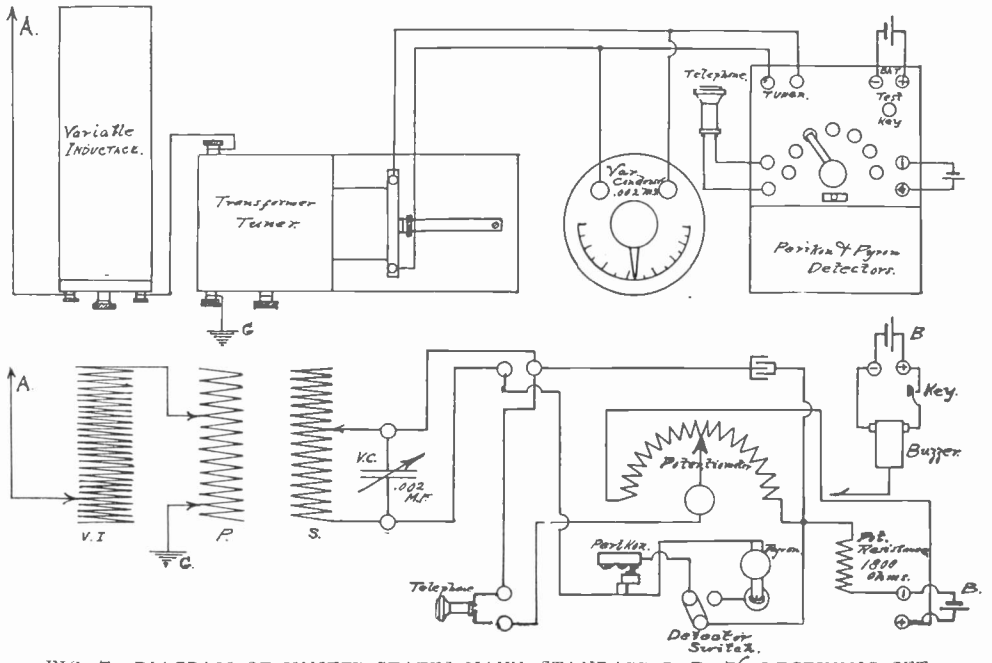


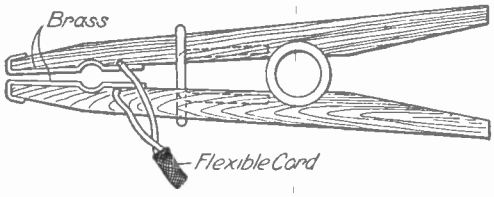
FIG. 7. DIAGRAM OF UNITED STATES NAVY STANDARD I. P. 76 RECEIVING SET

Sacramento (Cal.) Wireless Club

The following officers were elected by the Sacramento Wireless Club: Elwood Rackliffe, president; William Archibald, vice-president; Louis Huber, secretary; Elwood Miller, chief operator; John Murry, assistant operator; Fred Strader, sentinel. The object of the Club is to study wireless telegraphy and to aid in promoting non-interference between Government, commercial and amateur stations.

Convenient Helix Clip

A very satisfactory helix clip may be made of a spring clothes pin after the manner shown in the illustration. Fit the inside of the clips with brass straps. These will stay in place but may be held more secure by making



HELIX CLIP

a small dent through the brass into the wood with a nail-set. The flexible cord is soldered under both clips. Rubber tape may be wound about the handles if additional insulation is desired.

—FRED S. WALKER.

Wireless Problems

Wireless telegraphy of tomorrow will no doubt have solved the two problems which today make this means of communication not as positive as it should be.

The first problem, the means of preventing interference whether malicious or otherwise will no doubt yield to some method of close tuning which will make two stations responsive to each other's waves over a very small variation in wave length.

The other problem received emphasis in the flight of the Wellman balloon when efforts were made to signal the steamer Trent. No way has yet been devised for calling an operator to his instrument when another station desires to communicate with him. Notwithstanding the clicking of frantic appeals by the operator on the dirigible when within easy range, the operator on the Trent was all unconscious of this until his own needs directed him to his outfit.

Strangely enough the coherer first used by Marconi gave a signal when actuated by ether waves, but with the entrance of more delicate and long range instruments this valuable asset was lost.

WIRELESS QUERIES

Answered by B. B. Cole

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

Energy for Two-Inch Coil

Question.—How many volts and amperes will I need to operate a two-inch spark coil satisfactorily?—A. W. F., Chester, Pa.

Answer.—About twelve volts and four amperes.

Voltage for One-Inch Spark Coil

Question.—Is 27 volts too much to apply to a one-inch spark coil?—L. E. F., Madison, Maine.

Answer.—From four to six volts is enough.

Construction and Operation of a Ten Inch Coil

Questions.—(A) What voltage and amperage are required by the 10-inch coil whose dimensions are given on page 163 of the June, 1910, issue? (B) Can the above coil be run on 110 volts direct current in series with an electrolytic interrupter? What would be the amperage? (C) Should the secondary sections be boiled in paraffin or painted with shellac when enameled wire is used? (D) Would it better the insulation if the coil were permanently placed in linseed oil? (E) What is the kilowatt rating when the coil is on 110 volts? (F) What is the secondary voltage when used as in question (B)?—R. N., New York, N. Y.

Answers.—(A) About seven amperes and 24 volts.

(B) Yes, but if to be used this way great care should be taken in winding to secure the best of insulation between sections of the secondary. Most low-priced electrolytic interrupters require at least 20 amperes to make them operate properly.

(C) The former method will be better.

(D) Yes, far better,

(E) According to answer of (B), about two kilowatts.

(F) On no load, and with the spark terminals set at ten inches, about 150,000.

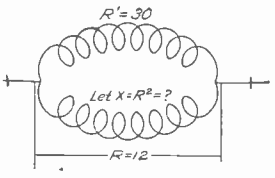
QUESTIONS AND ANSWERS

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

Resistance in Divided Circuits

Question.—If the combined resistance of two coils of wire in parallel is known and also the resistance of one of the coils, how can the resistance of the other coil be found?—N. G. B., Marlboro, Mass.

Answer.—The term conductivity is sometimes used to express the inverse of the resistance of one or several circuits in parallel. Thus, if R is the resistance of a divided circuit, 1-R represents the conductivity. We may use this to form an equation:



$$\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2}$$

where

R = resistance of two circuits in parallel.

R_1 = resistance of one of the circuits.

R_2 = resistance of the other circuit.

$$R = \frac{R_2 \times R_1}{R_1 + R_2}$$

Substituting from the diagram using X for the unknown resistance and solving

$$12 = \frac{X \times 20}{20 + X}$$

$$20X = 240 + 12X$$

$$8X = 240$$

$$X = R_2 = 30 \text{ ohms.}$$

Stranded Wire for High Frequency Currents

Question.—Why is a stranded wire better to use with high frequency currents than a solid wire?—C. V. V. T., Helena, Ark.

Answer.—High frequency currents permeate copper wire according to theory only about one three hundredth of an inch, so in order to increase the surface and decrease the resistance stranded wire is used.

What is Electricity? Radiometer

Questions.—(A) How may we define electricity? (B) What is a radiometer?—G. R. D., Kingston, Ont.

Answers.—(A) Our definition of electricity is limited to telling what it is in terms of energy into which it can be transformed, and in stating what that energy does. Electricity, magnetism, light, heat and motion are names of related energies. A study of one leads into the realm of the other. Through allied energies we shall probably some day find out just what electricity is.

(B) Crookes discovered that light or heat brought near a radiometer produce motion in its disks. A radiometer consists of a bulb of glass within which upon an axis are supported four mica disks on aluminum wire arms. One side of each disk is coated with lamp black and the other left with a clean surface. Ordinarily the bulb is partially exhausted of air. When light or heat rays fall upon the disk the lampblack absorbs them and becomes hotter than the other side. The molecules of confined gas striking the hotter side rebound and if the black surface is movable drive it backward. Moonlight produces no effect. An ordinary candle rotates a sensitive radiometer slowly and bright sunlight rapidly.

Rectifier Solution

Question.—What is the solution used in the cell of a rectifier consisting of an aluminum plate and a conducting plate such as carbon, lead or iron?—J. W. B., Clemson College, S. C.

Answer.—Acidulated sodium phosphate.

Bichromate Solution

Question.—Kindly give solution for bichromate battery.—H. G., Orange, N. J.

Answer.—The electrolyte is a solution of potassium bichromate, one part; sulphuric acid, three parts; water, nine parts.

Compensation for Patent Infringement
Profits Recoverable

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

PROFITS—RECOVERABLE IN EQUITY.—The rule in equity is that the amount recoverable for an infringement is the amount of profits realized by the infringer by reason of his unlawful use of the patent. A suit in equity cannot be maintained solely to recover profits because more favorable than the rule of damages at law, but the jurisdiction must first be founded upon some independent equity, such as the right to an injunction, whereupon profits will be awarded as an incident of complete relief.

PRINCIPLE ON WHICH AWARDED.—It is said that the infringer is converted into a trustee as regards the profits made, or rather that a court of equity will award as a substitute for legal damages a compensation measured by the rule that courts of equity apply in the case of a trustee who has wrongfully used trust property to his own advantage.

ESTIMATION OF PROFITS—*In General.*—The adjustment of the profits recoverable is subject to all the equitable considerations which are necessary to do complete justice between the parties.

Actual Profits or Advantage Gained.—Profits are the gains upon any business when both receipts and payments are taken into account, and in suits for infringement are confined to the worth of the actual advantage gained by the infringer by using the infringed invention over other available modes for accomplishing the same end. They are the saving or benefit arising directly from the use of the patented invention, and are recoverable although the particular business resulted in a loss, where the loss was less than it would have been except for the infringement. It is the profit actually made or which ought to have been made, and not the profit which might have been made, that is recoverable. The question of reasonable diligence does not enter into the calculation. Remote, contingent, or speculative profits are not recoverable. The burden of proof is upon the plaintiff to show the worth of the advantage gained, and in the absence of satisfactory proof only nominal damages will be allowed. The ordinary rules of evidence are applicable to this subject.

Where Complainant's Device is Used with Other Devices or is Merely Improvement.—If any portion of the profits arose from an improvement made by the defendant, or if the patent covers only some features of the device, and not the entire device, or if the patent is merely for an improvement on an old machine, the profits realized by the defendant must be apportioned, and the complainant is entitled to recover only so much thereof as arose from the use of his invention, and not the entire profit. The burden of proof is upon the plaintiff to show how much of the profit was due to the use of his device, and in the absence of such proof only nominal damages may be recovered; though the view has been taken that the defendant must show affirmatively the amount of credit to which he is entitled.

Exception.—Where the invention, though an improvement, adapts the machine or article to a particular use, and there is no way open to the public to supply that use, the patentee is entitled to the entire profits. So where the defendant's device derives its entire commercial value from the use of the plaintiff's invention, or where the infringing device is an independent marketable article though designed and actually used in connection with other devices, the entire profit made by the defendant may be recovered.

Profits From Construction of Patented Device.—Where the profit is derived from the construction of the thing patented, the infringer must account for the whole profit arising from the construction.

License Fees as Measure of Profits.—License fees, in the absence of other evidence, may be taken as the measure of profits, but an established license fee does not deprive the patentee of the right to recover profits.

Time to be Included in Accounting.—The account should extend over the time of the infringement only, and down to the time of the hearing before the master, if the infringement has continued so long. But by a

recent statute the profits recoverable are limited to those arising from acts of infringement committed within six years before the bringing of suit.

Deductions Allowed to Infringer.—In estimating the profits for which an infringer is liable, it is proper to make an allowance for the cost of conducting the business. Various items have been allowed or disallowed under this head in particular cases.

Apportionment of Expenses.—If the defendant is engaged in other business besides that involving the patented invention, the general expenses must be fairly apportioned.

Interest on Profits.—Profits are to be regarded in the light of unliquidated damages, which usually do not draw interest without order of the court before the final decree, or at least not before the filing of the master's report.

DAMAGES IN SUIT IN EQUITY UNDER STATUTE.—Under Rev. Stat. U. S., No. 4921, damages of a compensatory character may also be allowed to a complainant suing in equity where the gains and profits are clearly not enough to compensate him for the injury sustained by the infringement, and the court has the same power to increase such damages in its discretion as it has in actions at law.

NEW BOOKS

WIRELESS TELEPHONES. By James Esrkine-Murray, D. Sc. New York: The Norman Henley Publishing Co (London: Crosby Lockwood and Son). 1910. 68 pages with 17 illustrations. Price $1.00.

Telling how sound is converted into electric waves and describing how high frequency waves are radiated and how absorbed by wireless telephone detectors.

MODEL BALLOONS AND FLYING MACHINES. By J. H. Alexander. New York: The Norman Henley Publishing Company (London: Crosby Lockwood and Son). 1910. 127 pages with 45 illustrations. Price $1.50.

Teaching the theory and construction of balloons and lighter-than-air machines and showing by models the principles of their operation.

THE TESLA HIGH FREQUENCY COIL. By George F. Haller and Elmer Tiling Cunningham. New York: D. Van Nostrand Co. 1910. 179 pages with 56 illustrations. Price $1.50

Describing the construction of a twelve-inch Tesla coil, with its transformer and all other accessories and introducing interesting information concerning the uses of the coil.

CONSTRUCTION OF INDUCTION COILS AND TRANSFORMERS. By H. Winfield Secor. New York: Modern Electrics Publication. 1910. 92 pages with 56 illustrations. Price, paper, 25 cents.

A book designed to place in ready form the latest data and tables desired by the average experimenter and builder of induction coils and transformers. A section is devoted to the Tesla coil, and instructions are given for building a large coil of this type for use on stage and lecture platforms. The construction of open and closed core transformers up to three kilowatts is given in detail.

An appendix contains practical tables covering coil and transformer dimensions, spark distances and wire values.

HOW TO READ TELEPHONE CIRCUIT DIAGRAMS. By David S. Hulfish. Chicago: Electricity Magazine Corporation. 1910. 257 pages with 570 illustrations and diagrams. Price, $1.50.

The title of this book states its intention. The numerous simple diagrams it contains with their explanations should render easy the more complex ones of switchboards and other apparatus and enable one to "read the blue prints" without trouble.

Electrical Trades Directory

The Electrical Trades Directory and Hand Book is published soon after the end of January each year by the Electrician Printing and Publishing Company (Limited), Salisbury Court, Fleet St., London, England. It contains the names and addresses of electrical manufacturing concerns and allied industries in England and her colonies, Europe, United States, South American republics, Africa, Japan and the Far East. The "Big Blue Book," as it is called, is as near complete as a work of such scope can well be. The subscription price for the 1911 edition, if ordered before January 31, is $2.04 plus postage, which is 84 cents to the United States. Copies ordered after that date will be $3.60.

ON POLYPHASE SUBJECTS

"Live Batteries"

That strange and almost uncanny inhabitant of tropical waters, the electric eel, together with his equally mysterious brethren, the torpedo fish and the electric ray are frequently the subject of conversation. Many are the stories brought back by travelers of the wonderful powers of these animals, though most people are inclined to think the stories rather "fishy." That the reports which we hear are not exaggerated is, however, borne out by the investigations of men of reputed scientific accuracy, and the mysterious reptiles or fish do carry an electrical generating apparatus and means of discharging the current, of sufficient power to stun a horse or man. Some real facts concerning the physical nature of these pests of the Amazon and of the Mediterranean and the extent of their powers are contained in the article, "Live Batteries," which appears in another part of this issue. The author of this interesting discussion, Mr. Warren H. Miller, is well fitted to handle the subject, inasmuch as he is not only well trained in matters pertaining to electricity but must also have ability as a naturalist, or he would not be holding down the editor's chair on *"Field and Stream,"* which position he has recently accepted.

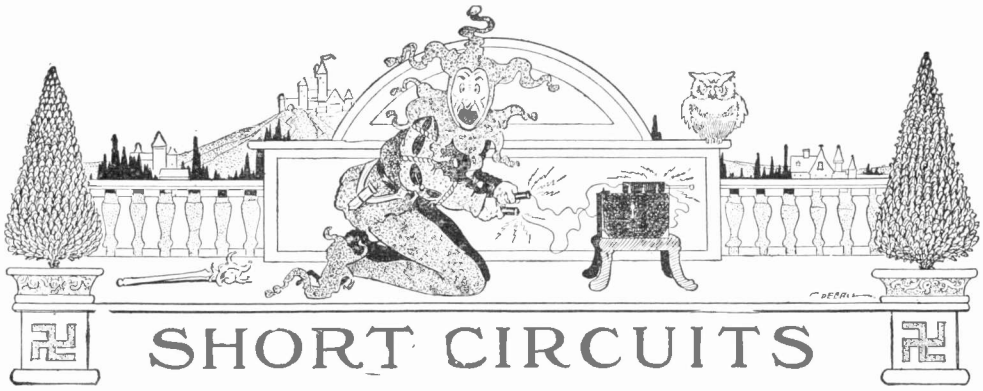
Snow-melting Trolley Cars

Every street railway outside of the tropics has its snow-plows, but these only sweep or shove the snow off the space between the rails, leaving it heaped up along both sides of the street until carted off. This carting is expensive for the city, while merchants and manufacturers suffer from the delay in team traffic while waiting for the snow to be shoveled into wagons and hauled away. Nature's own way of removing the snow consists in melting it when the weather gets mild enough. A London engineer, A. V. Emerson, has invented a snow-melting trolley car for use when the cold weather continues, instead of waiting for this change in temperature. According to his plan, a trolley car is equipped with rotary brushes which sweep the snow into the back of the car where stones and rubbish are separated from it by screens, after which the snow is passed over hot plates so as to melt it. The plates could be heated by coal or, if plenty of current is available, by electricity from the trolley circuit. In practice this would mean the curious sight of a car plowing its way into deep banks of snow, with the latter disappearing almost miraculously as the car moves along.

We Wonder Why

"Why can a small copper wire carry so much energy?" is a question that often arises when we see an electric motor running dozens of machines in a factory or shop, with only two or three little wires as the roadway for the current to the motor. Many scientists have attempted to give a reason or plausible theory for this, and all have to agree with Mr. Edison, who says we are only gropers today as compared to what will be known about this wonderful form of energy in the future.

Reasons like the following, have been advanced. The power of a moving object depends not only upon its mass or weight but also upon its velocity. Small bodies thrown with a high velocity have energy equal to that of a much heavier body going at a slow gait. This is why radium possesses such enormous energy. The particles which it shoots out are very small but travel with the quickness of light. Rankin once said that a spider web running over pulleys with the velocity of light would be capable of running all the machinery in England. In placer mining, a small stream of water at high velocity tears away great quantities of rock. With all these things in mind it is not so far to go in order to partially explain, at least, how thousands of horsepower of electrical energy, moving with lightning velocity under some form which we have not yet fathomed, travel over an insignificant wire,



SHORT CIRCUITS

Little Davy was forever asking questions. "You'd better keep still or something will happen to you," his tired mother finally told him one night, "curiosity once killed a cat, you know."

Davy was so impressed with this that he kept silent for three minutes. "Then: Say mother, what was it the cat wanted to know?"

* * *

"Does this car go to 24th Street?"

"No ma'am; but I have something just as good," replied the conductor, who was formerly a drug store clerk, "I can let you off twice at 12th Street."

* * *

A colored man complained to the storekeeper that a ham which he had purchased there was not good.

"The ham is all right, Zeph," insisted the storekeeper.

"No, it isn't, boss, indeed," insisted the negro. "Dat ham's shore bad!"

"How can that be," continued the storekeeper, "when it was cured only last week?"

The colored man scratched his head reflectively, and finally suggested:

"Well, sah, then it must have had a relapse."

* * *

"Every time I sees a Boss what's got a sign tacked to his desk about "DO IT NOW." "DON'T WATCH DE CLOCK," or some such gimcracks, I puts him down fer a pin-hed sise. I had one oncet. He never went fishin' ner saw no bawl game nor knowed the diffnishun of the word "fun". He handed me back flips of advice in castor oil doses. He'd tell me ter work hard'n urn my pay'n the raise'd come later. So will Annie Domminy 1954. He'd watch de payroll's close 's a cat watchus a mice hole 'n den tell me not ter watch de clock. If dat Boss is on to his job a watchin' de clock when I comes in in de mornin', I'se gotter rite to take my turn about quittin' time. Sass for de guse is sass fer de gander. If my pay cud be jacked up sumwat, the ginger I waste tryin' to make my two ends meat could be used workin' for de Boss. Con ider de vegitables 'n beaf stake, how dey grow in price. Dey toil not neider do dey spin, but de "cush" to buy grub wid duz a "walse-me-around again Willie" tell yer feels most frantic. I tackled dat Boss fer a boost in my envelope. I got it but not in de envelope.—*Trumbull Cheer.*

* * *

Bishop Charles W. Smith, at a harvest dinner in Portland, said of the harvest spirit: "The harvest spirit is one of thankfulness, but there are some crabbed old farmers who couldn't be thankful if they tried. I said to such an old fellow as he conducted me over his farm on a golden autumn afternoon and showed me a record harvest: 'Well, sir, this year, at least, you've got nothing to complain of.' 'I don't know, about that Bishop,' he answered, with a shake of the head. 'I'm afraid there'll be no spoilt hay for the young calves.'"

* * *

"Paw, what's a pretzel?"

"A cracker with the cramps, my son. Now go to bed."

The schoolmaster was calling on an indignant mother.

"For my part," gabbled the good woman, "I can't deceive what on earth eddification is comin' to! When I was young, if a gal only understood the elimens of distraction, provision, replenishing, an' the common dominator, an' knew all about the rivers an' their obituaries, the currents, an' the dormitories, the provinces an' umpires, they had eddification enough!"

* * *

One day a big city bank received the following message from one of its country correspondents: "Pay twenty-five dollars to John Smith who will call today." The cashier's curiosity became suspicious when a cabman assisted into the bank a drunken "fare" who shouted that he was John Smith and wanted some money. Two clerks pushed, pulled and piloted the boisterous individual into a private room away from the sight and hearing of regular depositors. The cashiers wired the country bank:

"Man claiming to be John Smith is here. Highly intoxicated. Shall we await identification?"

The answer read: "Identification complete. Pay the money."

* * *

A little boy was entertaining the minister the other day until his mother could complete her toilet. The minister, to make congenial conversation, inquired:

"Have you a dog?"

"Yes, sir; a dachshund," responded the lad.

"Where is he?" questioned the dominie, knowing the way to a boy's heart.

"Father sends him away for the winter. He says it takes him so long to go in and out the door, he cools the whole house off."

* * *

Mother: "But what did you do with the penny I gave you yesterday?"

Tommy: "I spent it, mother. A feller has to hold up his end with the rest of the boys."

* * *

When charged with being drunk and disorderly and asked what he had to say for himself the prisoner gazed pensively at the magistrate, smoothed down a remnant of gray hair, and said:

"Your honor, man's inhumanity to man makes countless thousands mourn. I'm not as debased as Swift, as profligate as Byron, as dissipated as Poe, as debauched as—"

"That will do!" thundered the magistrate. "Ten days! And, officer, take a list of those names and run 'em in. They're as bad a lot as he is!"

* * *

The story is told of a professing church member who, while regular in his attendance, was a scant contributor. When a new fence was needed around the graveyard, he was approached by the vestry for a donation. "I don't think a fence is necessary," said he. "Them as is in there can't get out, and them as is outside don't want to get in, so I guess I'll not subscribe."


BABY SEE PITTY 'LECTRIC LIGHTS?
GORM!
THAT SETTLES IT. HE WILL BE AN ELECTRILIAN!
AT THE AGE OF 6 MONTHS HE TOOK GREAT INTEREST IN THE ELECTRIC LIGHTS
HENRY! YOU'LL GET A FINGER TOUN OFF!
JUST CANT MAKE HIM LEAVE IT ALONE
WHEN ABOUT 3 YEARS OLD HE WAS ALWHYS FOOLING WITH THE ELECTRIC FAN
YES THAT'S MY SON HENRY - HE'S READING THE LIFE OF EDISON THAT BOY WILL DO WONDERS WHEN HE GROWS UP
LIFE OF EDISON
BEFORE HE WAS 7 YEARS OLD HE HAD READ THE LIFE OF EDISON
AT ABOUT THE AGE OF 12 HE WAS MAKING ALL SORTS OF ELECTRICAL DINGBATS
WHAT DO YOU MEAN BY BLOCKIN' UP THE TRAFFIC THAT WAY - GIT THAT COAL WAGON OFF THE TRACK YOU BLANK, ITY BLANK — !!!
HERE HE IS
WHEN HE WAS 15 YEARS OLD HE INVENTED AN ELECTRIC DOFUNNY —
— WHEN HE GREW UP
C DEMILL

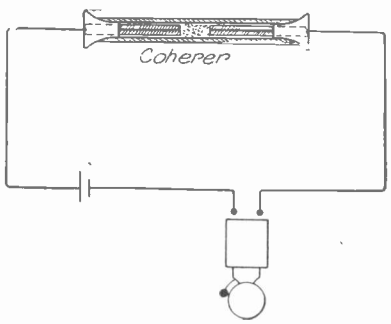
COMMON ELECTRICAL TERMS DEFINED

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.

CODE, CONTINENTAL.—The telegraph code used in Europe and other countries outside of the United States and Canada. Sometimes called also the European or Universal code. Quite generally used by wireless companies except in America.

CODE, MORSE.—A system of dots, dashes and spaces devised by Morse to signify letters in the transmission of messages by telegraph. Used exclusively on land in the United States and Canada.

COHERER.—A device used by Marconi in his experiments in 1894, consisting of a glass containing



metal filings between the ends of brass rods just fitting the tube. The filings and rods are connected in series with a battery and bell. Wireless waves will cause the filings to "cohere" thus reducing the resistance of the circuit and operating the bell, the hammer of which taps the tube and places the filings in a disturbed state again. (See cut.)

COLLECTING BRUSH.—See Brush.

COLLECTING RING.—A ring of insulated conducting metal placed on the shaft of any revolving portion of machinery to which current is conveyed by a brush contact on the circumference of the ring, a second ring and brush being used as a return circuit. Such rings are provided on alternating current generators.

COLLECTOR.—A term applied to the brushes on the commutator of a generator, or on the collecting rings of an alternator. Also applied to the points of the comb facing the revolving glass plate or cylinder of an influence machine and collecting the static charge.

COMB. A bar having projecting teeth like a comb. Used to gather up the electricity on an influence machine.

COMBINATION FIXTURE.—A lighting fixture so arranged as to furnish either gas or electric light.

COMMERCIAL EFFICIENCY.—The useful energy which a machine produces divided by the total energy put into it. In a dynamo for example, it is the total horsepower sent out over the external circuit divided by the horsepower applied. Some of the latter is used up in friction of bearings, eddy currents, windage, etc.

COMMUTATOR.—That part of a direct current dynamo or motor upon which brushes rest and collect or distribute current. The commutator is so designed as to cause the alternating currents produced in the armature to flow from the brushes as direct current.

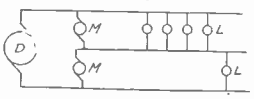
COMMUTATOR BARS.—The copper bars running lengthwise on the commutator of a dynamo or motor. These bars are connected to the armature coils and insulated from each other.

COMMUTATOR SEGMENTS.—See Commutator Bars.

COMPASS.—A magnetized steel bar or needle, pivoted so as to respond to the directive action of the earth's magnetism.

COMPENSATING COIL.—An adjustable resistance connected in shunt with the series winding of a compound wound machine so that the effect of this winding may be varied.

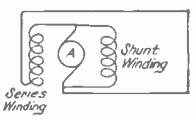
COMPENSATOR.—(1) Applied to two machines. (See cut.) (M) and (N) coupled together on a three-wire system each generating one-half as much pressure as the dynamo (D). The one on the more lightly loaded side runs as a motor driving the other as a dynamo. When the system is perfectly balanced both machines run as motors without load. These machines are also called equalizers. (2) An arrangement whereby a voltmeter at the dynamo will read correctly the voltage at the outer end of the feeder without running special pressure wires to the point where the reading is desired. Such a voltmeter is called a compensated voltmeter. (3) A device for starting induction motors by cutting down the voltage with an auto-transformer until the motor comes up to speed on the reduced voltage, when by throwing a switch the full line voltage is applied to the motor.



COMPENSATING MAGNET.—A magnet placed near the compass on an iron or steel ship to counteract the effect of the metal of the ship on the compass needle.

COMPENSATING POLES.—Small bar electro-magnets placed between the poles of a dynamo or motor to compensate for cross magnetization in the armature due to the lead of the brushes. (See Brushes, Lead and Lag.)

COMPOUND DYNAMO.—A dynamo having two windings on the field poles. One winding is in series with the armature and external circuit while the other winding is connected across the brushes of the machine or in shunt or parallel with the armature. (See cut.)



COMPOUND MAGNET.—A magnet built up of a number of magnets. Small magnets may be more strongly magnetized than large ones, so that a compound magnet may be made more powerful with the same amount of energy than a large one.

Telephone Etiquette

Co-operation is the keynote of telephone success.

For good service there must be perfect co-operation between the party calling, the party called, and the trained operator who connects these two.

Suggestions for the use of the telephone may be found in the directory and are worthy of study, but the principles of telephone etiquette are found in everyday life.

One who is courteous face to face should also be courteous when he bridges distance by means of the telephone wire.

He will not knock at the telephone door and run away, but will hold himself in readiness to speak as soon as the door is opened.

The 100,000 employees of the Bell system and the 25,000,000 telephone users constitute the great telephone democracy.

The success of the telephone democracy depends upon the ability and willingness of each individual to do his part.

AMERICAN TELEPHONE AND TELEGRAPH COMPANY AND ASSOCIATED COMPANIES

One Policy ***One System*** ***Universal Service***

ENLIST AS A LOCAL AGENT

for the Fast-Working, Fast-Selling

Oliver Typewriter!

The battle lines of the Oliver Typewriter forces are forming for another campaign of conquest. The triumphs of 1910—the most brilliant ever achieved by a great sales organization—have served to inspire to more mighty deeds in the coming year.

The roll-call of the Oliver Sales Organization shows over 15,000 men **under arms**—the most magnificent body of trained salesmen in the world.

This Sales Force, great as it is, cannot cope with the tremendous increase in business which the popularity of the Oliver Typewriter has created.

Resident Agents Wanted in Every Town and Village

This advertisement is a call for reinforcements—to enable the Oliver Sales Force to extend its skirmish lines to all sections of the country.

The central idea of our selling system is to have—**everywhere**—a vigilant agent of the Oliver Typewriter constantly **on the ground.** Whether that agent devotes part or all of his time to the sale of the Oliver Typewriter is left to his own discretion.

Teachers, tradesmen, doctors, ministers, lawyers, stenographers, telegraph operators, printers, mechanics—men and women in a multitude of different occupations—can succeed as Local Agents for the Oliver Typewriter. If you have the **will** to take up this work, **we will point out the way.**

The OLIVER Typewriter

The Standard Visible Writer

The Oliver Typewriter has been breaking records since the day it was placed on the market. **Efficiency** records, **speed** records, **endurance** records—it has won them in quick succession. It sets the swiftest pace in sales by giving unparalleled **service.**

With **several hundred less parts** than other standard typewriters, its **simplicity, strength, ease of operation, versatility and convenience** are correspondingly **increased.**

"17-Cents-a-Day" Plan a Wonderful Aid to Agents

This machine, with all of its advantages, all of its time and labor-saving devices, the Local Agent can buy—**and sell**—for Seventeen-Cents-a-Day.

The Oliver Typewriter No. 5—the newest model—the $100 machine—equipped with a brilliant array of new devices and conveniences, actually offered for **pennies!**

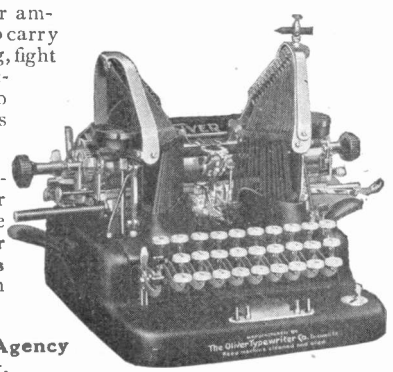
This irresistible offer enables the Local Agent to succeed **right from the word "go"!**

Write for Inspiring Book, "The Rise of the Local Agent"

Read the life stories of men who rose from the Local Agency ranks to positions of great importance in the Oliver Organization—How one Local Agent is today the Typewriter King of Mexico. (Mexican Government reports show that more Oliver Typewriters are imported than all other typewriters combined.)

These inspiring stories will open your eyes to the **big opportunities still open** for ambitious men to carry the Oliver flag, fight for new records and reap the rewards of success.

Send a personal letter today while the **Call for Volunteers** is ringing in your ears.



Address Agency Department.

THE OLIVER TYPEWRITER CO., 226 Oliver Typewriter Bldg., Chicago

The following is a list of the Member Companies of the

National Electric Lamp Association

CLEVELAND

Call upon any of them for your lamp supplies.

THE BANNER ELECTRIC CO., Youngstown, O.

THE BRILLIANT ELECTRIC CO., Cleveland, O.

BRYAN-MARSH COMPANY, Central Falls, R. I.—Chicago, Ill.

THE BUCKEYE ELECTRIC CO. Cleveland, O.

THE BUCKEYE ELECTRIC LAMP CO., City of Mexico

THE CLEVELAND MINIA. LAMP CO., Cleveland, O.

THE COLONIAL ELECTRIC CO., Warren, O.

THE COLUMBIA INC. LAMP CO. St. Louis, Mo.

ECONOMICAL ELECTRIC LAMP CO., New York City

THE FOSTORIA INC. LAMP CO., Fostoria, O.

THE GENERAL INC. LAMP CO., Cleveland, O.

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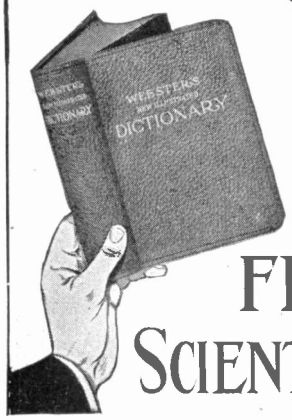

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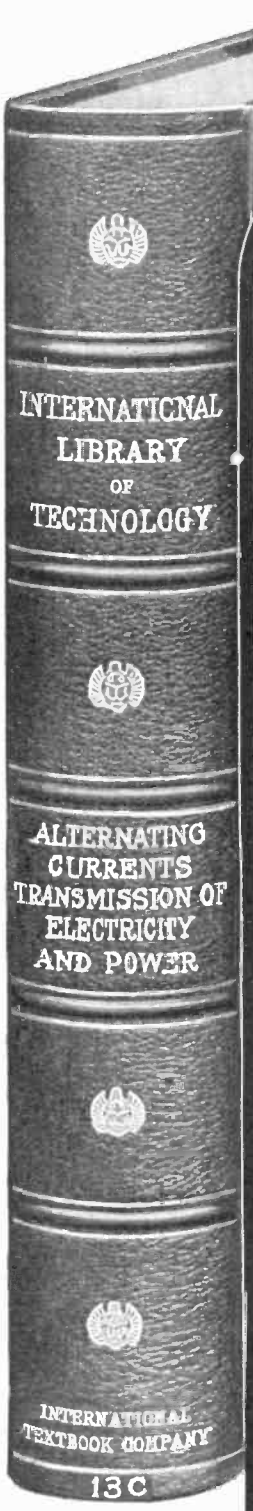

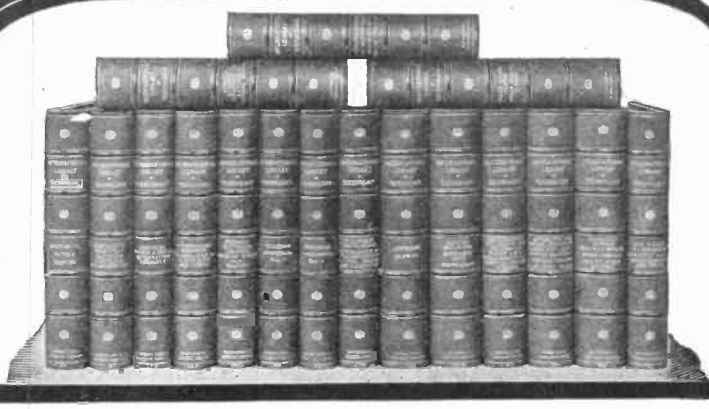

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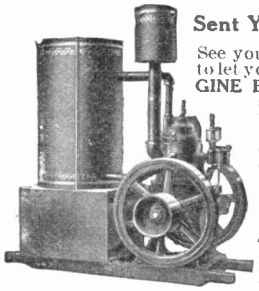

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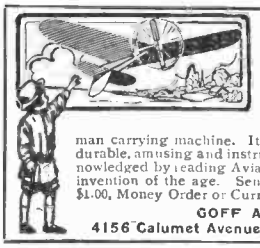

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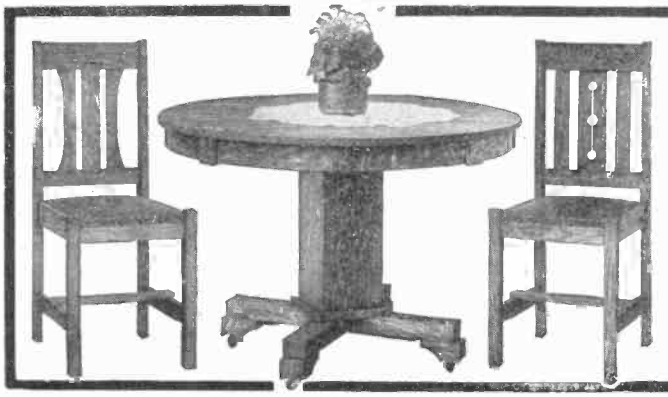

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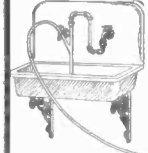

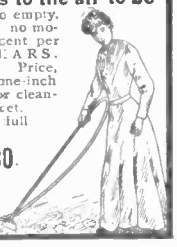

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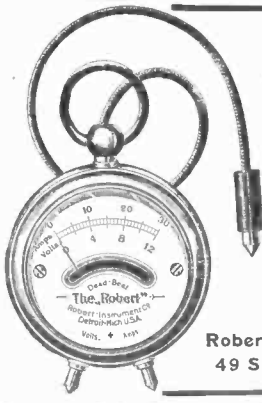

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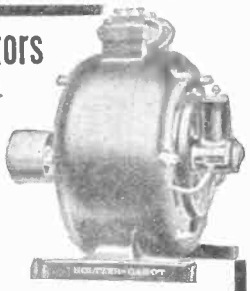

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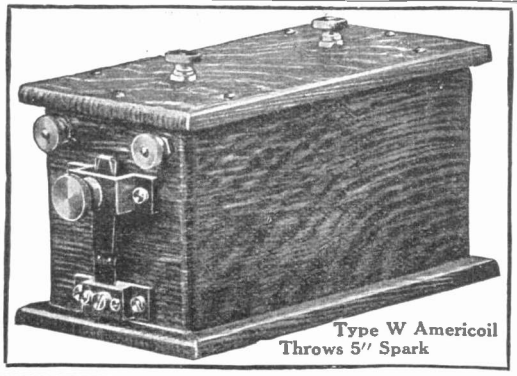

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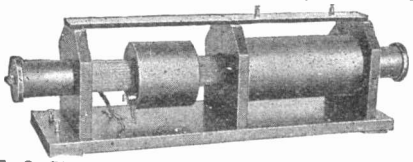

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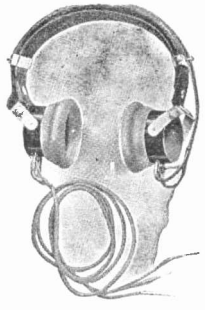

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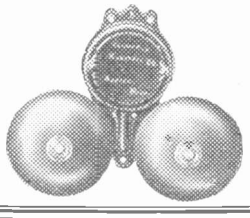

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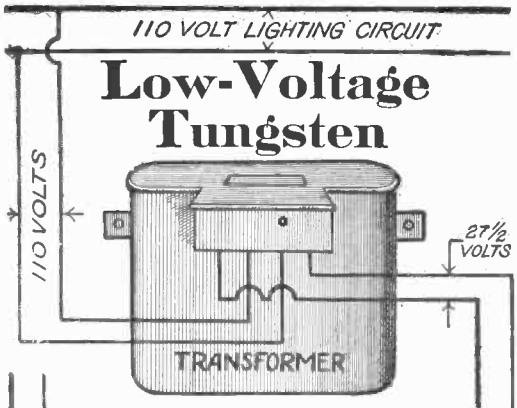

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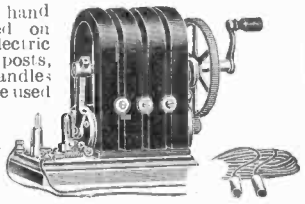

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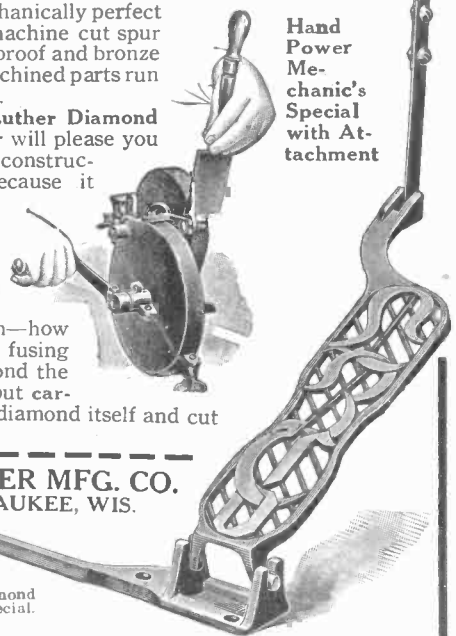

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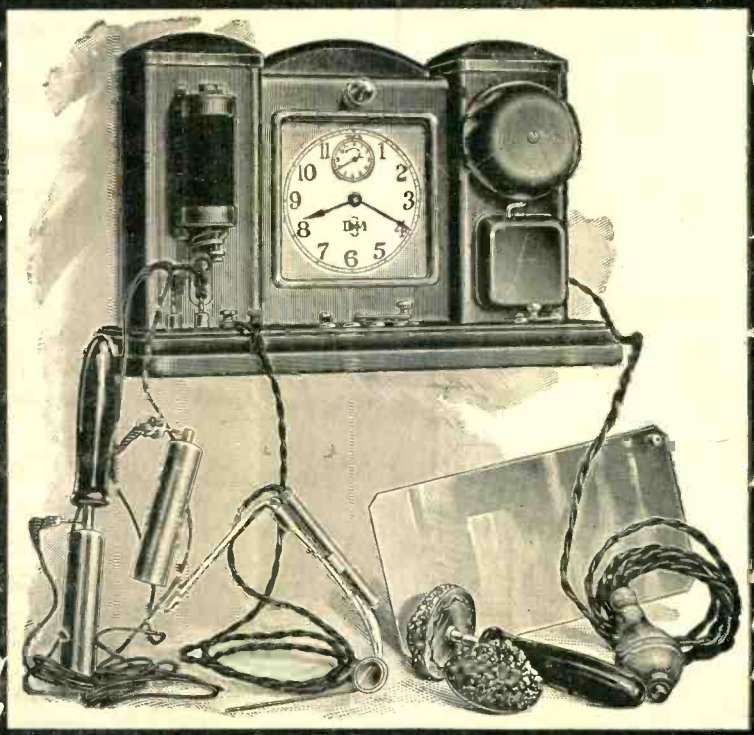

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