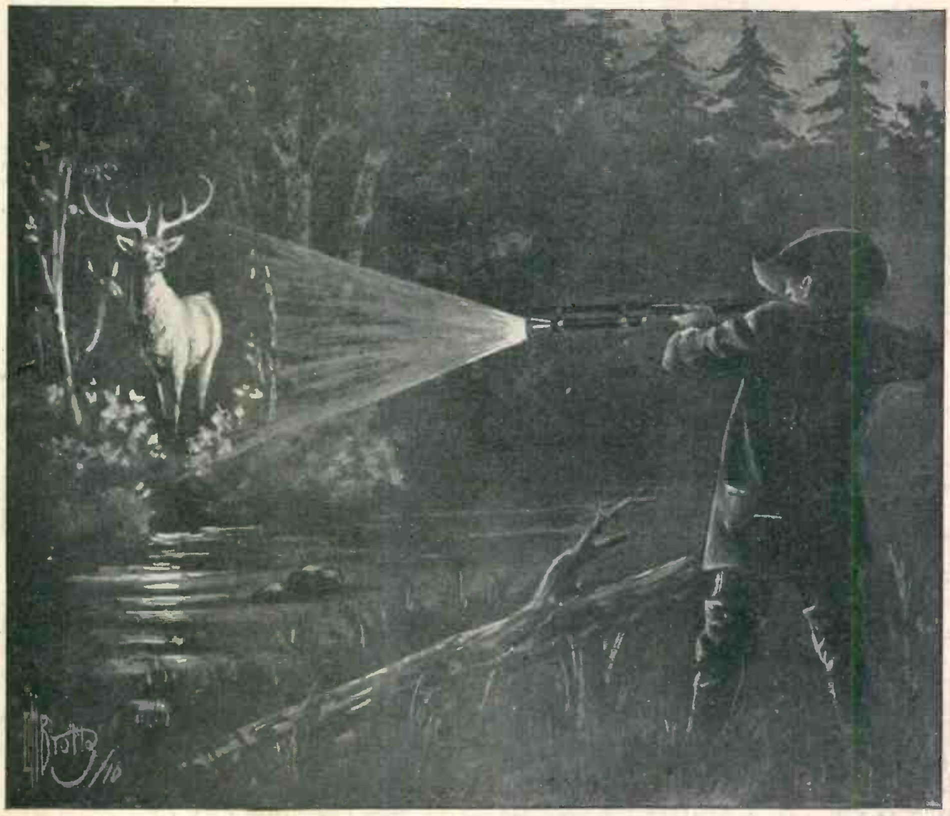
TALKING BETWEEN CHICAGO AND NEW YORK

POPULAR ELECTRICITY MAGAZINE

IN PLAIN ENGLISH

(NON TECHNICAL)



SEARCHLIGHTS FOR HUNTERS

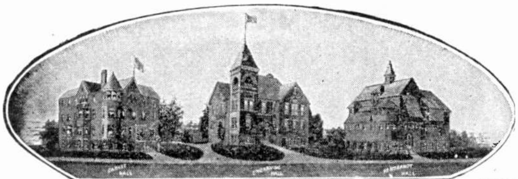
See Page 773

Vol. III JANUARY, 1911 No. 9

A MAGAZINE FOR EVERYBODY

10 Cents


P.S.&W.
MECHANICS' HANDY LIST
P. S. & W.
TRADE MARK
TOOLS GUARANTEED
The MARK of the MAKER
THE PECK, STOW & WILCOX CO
MANUFACTURERS
P. S. & W. Guaranteed Pliers
include pliers for every use, box-joint or lap-joint—large or small.
Our Lap-joint Pliers are perfect in quality and construction—as perfect as a lap-joint plier can be made.
But our Box-joint Pliers are still better; for the P. S. & W. Box-Joint is the best possible type of plier-construction.
It can't work loose; it always works smoothly; the cutting *edges always meet with accuracy,* no matter how long used.
A Handy Book for the Handy Workman
Our "Mechanics' Handy List" shown above, not only lists the best pliers made, but has many pages of valuable shop-information and a catalog of over 200 Hand Tools for Electricians, Machinists, Carpenters and Tinsmiths. Every one of our Guaranteed Tools is branded with The MARK of the MAKER.
The Peck, Stow & Wilcox Co.
MANUF'RS of the Largest Line of Mechanics' Hand Tools Offered by Any Maker
Established 1819
Five Large Factories
Address Correspondence to 30 Murray St.
NEW YORK CITY



Learn Photography, Photo-Engraving or 3-Color Work

Engravers and 3 Color Operators Earn $20 to $50 Per Week. Only College in the world where these paying professions are taught successfully. *Established 17 years.* Endorsed by International Association of Photo-Engravers and Photographers' Association of Illinois. Terms easy; living inexpensive. **Graduates assisted in securing good positions.** Write for catalog, and *specify course in which you are interested.*

Illinois College of Photography or } **939 Wabash Av.**
Bissell College of Photo-Engraving } **Effingham, Ill.**
L. H. BISSELL, Pres.

LEARN TO BE A WATCHMAKER

Bradley Polytechnic Institute
Horological Department
Peoria, Illinois

Largest and Best Watch School in America

We teach Watch Work, Jewelry, Engraving, Clock Work, Optics. Tuition reasonable. Board and rooms near school at moderate rates. Send for Catalog of Information.

BRADLEY, H. - Peoria, Ill.

LEARN AUTOMOBILE BUSINESS

Ours is the only Automobile Engineering School in United States, which acts as preparatory training school for auto factories and employs its students while studying. We teach by mail. Part of tuition payable after we place you in a good position. Course covers eight different branches of the automobile business. Write for plan V. It is free.

The Automobile College of Washington, Inc.
Washington, D. C.
References: Fourteenth St. Savings Bank

CAN YOU DRAW?

Our Graduates Are Filling High Salaried Positions

EARN $25 TO $100 PER WEEK

in easy, fascinating work. Practical, Individual Home Instruction. Expert Instructors. Superior equipment. Founded 1899. Twelve years' successful teaching.

Financial Returns Guaranteed.

Complete Courses in Commercial, Fashion, Magazine, Book and Advt. Illustrating; Newspaper, Cartooning, Lettering, Designing, Show Card, Architectural Perspective, Photo Retouching, Normal, Color, General Drawing, etc.

FREE ARTIST'S OUTFIT of fine instruments and supplies to each student.

Write for particulars and **Handsome Art Book.**

SCHOOL of APPLIED ART
E 70 FINE ARTS BLDG.
Battle Creek, Mich.

New York Electrical School

Offers to men and boys a theoretical and practical course in applied electricity without limit as to time.

Instruction individual, day and night school, equipment complete and up-to-date. Student learns by doing, and by practical application are fitted to enter all fields of electrical industry fully qualified. School open all year. Write for free prospectus.

40 West Seventeenth Street NEW YORK

Mount Birds and Animals.

SPORTSMEN! Fishermen! Hunters! Naturalists!

The wonderful profession of Taxidermy, so long kept secret, can now be easily learned right in your own home

We Teach by Mail how to mount Birds, Animals, Game Heads, tan skins, make rugs, and preserve all trophies. A delightful and fascinating art for men and women. Easily and quickly learned during spare time. **Decorate home and den with fine trophies**, or command big income selling mounted specimens and mounting for others. Skilled Taxidermists in great demand. *Success guaranteed or no tuition fee.* Endorsed by thousands of satisfied graduates. **Write today** for our Great Free Book **"How to Learn to Mount Birds and Animals."** Also our beautiful Taxidermy Magazine. **BOTH FREE.** Write today—do it now.

The N. W. SCHOOL OF TAXIDERMY, Inc.
1401 Elwood Bldg.. Omaha, Neb.

MEN WANTED

for **Chauffeurs** and **Repair Men.** Our complete **HOME STUDY** course prepares you in six weeks right in your own home. Big demand for trained men, work is pleasant, pay good. Our school is directed by **Experienced Mechanics** and **Instructors.** Write today for free illustrated book.

KANSAS CITY AUTOMOBILE SCHOOL
Dept. B. Kansas City, Mo.

RAILROAD MEN WANTED $80 TO $185 A MONTH

Doesn't this beat following a plow! Write for our legal binding bond to place graduates in a position sure if 20 to 35 years of age, and mentally and physically O. K. Learn in your spare time from practical Railroad men. Costs almost nothing. Positions waiting everywhere. Write now for information.

Official Ry. School, Gen'l Office,
452 Freeport, Ill.

I Can Increase Your Earnings

If you want an independent business of your own requiring no capital, mail your name and address and let me send you our **Big Free 62-Page Book** showing how you may earn $3,000 to $10,000 a year in the

Real Estate, Brokerage and Insurance Business

Our system is a positive success. It equips you to conduct these money making branches, and gives you a valuable Commercial Law Course Free. Clerks, Book Keepers, Salesmen, Agents, Solicitors and others should investigate this. Send no money, simply your name and address and I will mail you our **Big 62-Page Book, absolutely free.** Write today.

International Realty Corp., 806 Manhattan Bldg., Chicago
Successors to The Cross Co. and H. W. Cross & Co.

PRACTICAL ELECTRICAL EDUCATION

¶ We teach by practical work and scientific methods under practical working conditions. All branches of Electrical Science and Engineering.

¶ Students can enter at any time for the full or special courses.

¶ No matter what your education, we start you at the very point you are competent to begin. By our system of Individual Instruction you can complete our course as quick as your ability warrants.

¶ We guarantee positions. Many of our students have started to earning from $1500 a year and up immediately upon completion of the course.

¶ Full particulars, handsome illustrated catalog and terms free upon request.

SCHOOL OF ENGINEERING
1025 Winnebago Street MILWAUKEE, WIS.

Electrical Talks—Flash No. 7

EVERY once in a while you will hear a manufacturer say: "I don't care for inquiries, even sales, on individual pieces of apparatus. They are more trouble than they are worth. I want to do business with the jobber who buys in quantities."

A remark of this nature signifies one or both of two things;—either that manufacturer has not built up the lines of distribution for his product as they should be or else he is overlooking the one best bet to make himself solid with the jobbing fraternity.

When a sales manager finds on his desk, as the result of advertising, fifty or a hundred letters from individuals asking for information concerning items of his line, and he says: "Oh pshaw! Now we have got to correspond and fool with all these Toms, Dicks and Harrys," it shows up that sales manager. It indicates that he falls short of his job by not having the requisite number of good dealers to whom these inquiries may be distributed with profit to both himself and them.

On the other hand, suppose his distributing agencies cover all the land and he thinks to sit back and graciously accept the business which they send him. Now a jobber is human and there are pretty nearly always not one, but many manufacturers playing at the same game. Leave it to the jobber then to push the goods of the manufacturer who is trying to reduce the selling resistance for him.

Put yourself in the jobber's place, Mr. Manufacturer. If you were looking around for a good line to handle and push to a fare-you-well, whose would you take? Would you take the line of the concern advertising only in the trade journals with the customary "Agents Wanted" or would you take that of the manufacturer who not only advertises in the legitimate trade journals of his field, but also reaches out in the big class publications, and with strong, forceful copy, brings the consumer with his money to your door.

There is no argument.

The day has come when the manufacturer must do his share in educating the consumer and no stronger proof is needed than an examination of these advertising pages wherein the largest and most far-sighted manufacturers in the electrical field, month in and month out, are turning the legitimate jobbing business away from Mr. Non-Advertiser to Mr. Wise Advertiser.

POPULAR ELECTRICITY.

Special Salary Raisers, 50c

No books in existence contain in so small space as much information about the trades and professions of which they treat as do the I. C. S. Handbooks. The information they contain is so set forth as to be easily understood, even by men of little education. As they have been written by the best authorities in the country they are consulting experts of the highest rank for laborers, foremen, superintendents, managers, and executives. As they are compiled from the Courses of the International Correspondence Schools, of Scranton, Pa., everywhere famous as the most powerful force in the world for the promotion of ambitious men, their value to employes in subordinate positions will be quickly realized. They are an indispensable help to quicker work that will command advancement. Every important item is indexed with all the initial letters under which it is likely to be sought. They are printed on high-grade book paper in clear type, and durably and handsomely bound in cloth with gilt titles. They contain on an average 364 pages and 175 illustrations and are regularly sold for $1.25.

Special Offer: To better introduce the value of I. C. S. Textbooks and I. C. S. Training we will sell these books for a limited time to those sending to us this coupon and 50 cents.

International Textbook Co.

Box 1102-P, SCRANTON, PA.

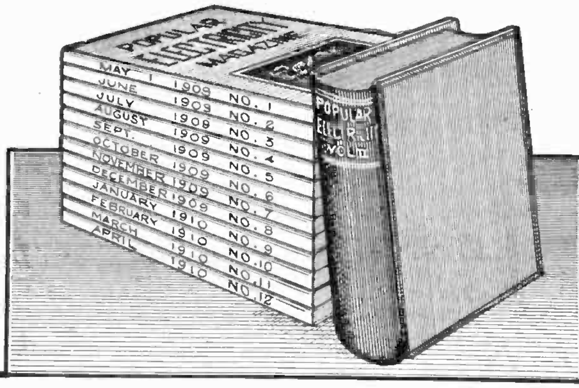
I enclose $______ for which please send me the books before which I have marked **X**.

__**Mechanics' Handbook**	__**Advertiser's Handbook**
__**Elect. Eng. Handbook**	__**Business Handbook**
__**Bldg. Trades Handbook**	__**Bookk'per's Handbook**
__**Plumb. & Fit. Handbook**	__**Sten. & Corr. Handbook**
__**Tel. & Tel. Handbook**	__**Mariners' Handbook**

Name ________________

St. and No. ________________

City __________ *State* __________



A Great Reference Book

Last Twelve Issues of

Popular Electricity

Bound Volume II. (May '09 to April '10 inclusive)

A summary of the year's progress in electrical science, containing authentic, interesting information on a thousand and one electrical subjects.

Also complete detailed directions for doing Electroplating, Electric Welding, Charging Batteries, Bell Wiring; Constructing Motors, Electric Heaters, Spark Coils, Burglar Alarms, Rheostats, Speaking Arc, Battery Motor Controller, "Pericon" Detector, Electric Alarm Clock, Transformers, Direct Current Ammeter, Electric Static Machine, Hot Wire Ammeter, Wireless Transformers, Direct Current Dynamo, Shocking Coil, Simple Wireless Telephone Set, Instantaneous Water Heater, Electrolytic Detector, Variable Coupling Tuning Coil, and numerous other electrical apparatus.

A complete index serves to locate any desired subject instantly.

Complete serials in this volume are:—

Electric Light and Power for Country Homes. By Louis A. Pratt.
A series of articles describing the uses and convenience of electricity in country homes or farms.

Construction and Operation of Spark Coils. By Victor H. Laughter.
Detailed directions for the construction of different sized coils and their uses.

How to Do Electroplating. By J. R. Wilson.
Contains full directions for electroplating with nickel, copper, silver and other alloys, showing how to prepare the work, tools to be used, etc.

Also:—Elementary Electricity, Chapters 13-24. By Prof. E. J. Houston.
Explains in a simple way with illustrations the basic principles necessary for every one to know who is taking up the study of Electricity.

Where Electricity Stands in the Practice of Medicine—Parts 1-4. By Dr. Noble M. Eberhart. Showing just where electricity is used in the practice of medicine told in a manner that is interesting to all.

An Electrical Laboratory for Twenty five Dollars—Parts 1-4. By David P. Morrison.
To anyone desiring an electrical laboratory for experimental use this series is invaluable as it gives directions for the construction of inexpensive instruments which can be made with ordinary tools.

In the Department of Questions and Answers, are solved a great many problems that arise in electrical work.

Numerous Electrical stories furnish both interesting and instructive reading.
900 Pages with over 1000 illustrations, well bound in handsome blue silk covers.
Price postpaid, $2.25.
A complete description of this book will be sent on request. Also an illustrated catalog.

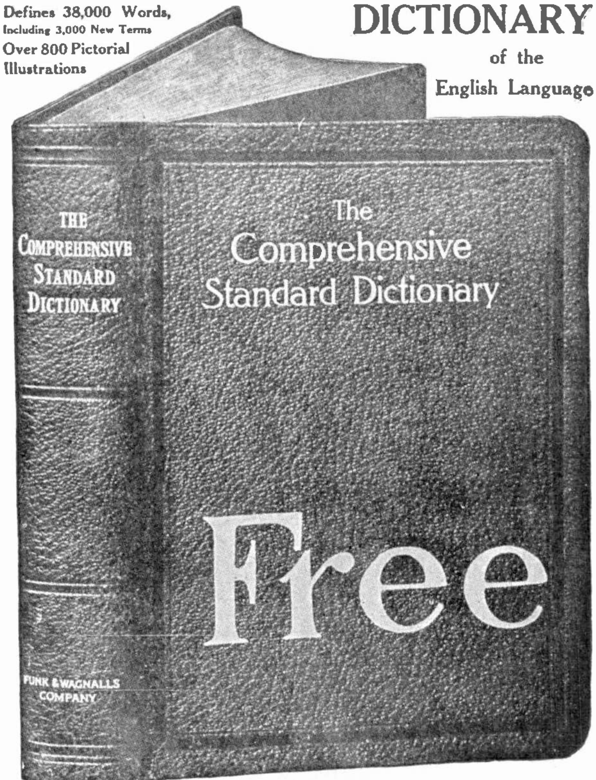
POPULAR ELECTRICITY
Book Department

100 Lake Street **CHICAGO, ILL.**

YOURS—

The Latest, the Greatest, the Best DICTIONARY of the English Language

Defines 38,000 Words, Including 3,000 New Terms
Over 800 Pictorial Illustrations



De Luxe Limp Leather Edition Denison Thumb-Index Price, $4.00

SIZE 8¾ x 6¼ WEIGHT 2 LBS.

FREE

THE COMPREHENSIVE STANDARD DICTIONARY is especially designed for convenient use, in the office and the home, by busy people of all classes who desire quick reference to a reliable dictionary. It contains over 38,000 words and phrases in common use among the English-speaking peoples, and more than 800 instructive pictorial illustrations, definitive aids to the comprehension of words, scientifically accurate and artistically exact, which were made especially for the work.

The high standing of the Editor, JAMES CHAMPLIN FERNALD, L.H.D., is a sufficient guaranty for the accuracy, comprehensiveness, and general excellence of the work. In his treatment the Editor has kept constantly in mind the necessity of giving in the simplest form the Orthography, Pronunciation, Definition, and Derivation of all words that are not self-defining.

What some noted authorities say about it.

President Martin Kellogg, M.A., LL.D., University of California, Berkeley, Cal.: "An enterprise which can not fail to meet with wide acceptance. I approve especially the full account of derivations."

Gen. James Grant Wilson, President of the American Authors' Guild, and well-known Author-Editor: "Superior to any similar volume that has yet come under my notice. I fail to see any feature of the work that can not be commended."

The St. Louis Globe-Democrat, St. Louis, Mo.: "For its size the work is very complete and inclusive; the definitions are vital and inspiring to new thought."

The Philadelphia Times, Philadelphia, Pa.: "The pronunciation is clearly marked, and there is much condensed information in etymology. The illustrations, also, are remarkably good."

OFFER

In order to make you acquainted with THE COLUMBIAN MAGAZINE, the best all-round family magazine published, for the next thirty days we will give away absolutely FREE a copy of the above-described flexible leather, thumb indexed dictionary (the list price of which is $4.00), to any person sending us $2.25, which includes a year's subscription to THE COLUMBIAN MAGAZINE, also charges for packing and shipping Dictionary.

....

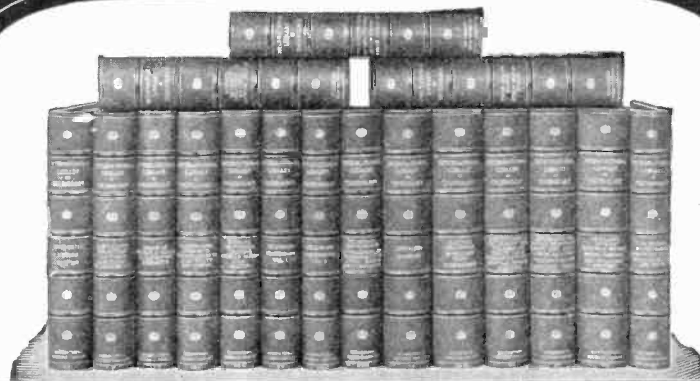
COLUMBIAN MAGAZINE PUBLISHING CO.,
1 Madison Avenue,
NEW YORK CITY.

Gentlemen:

Please send for my examination the Standard Comprehensive Dictionary described in this advertisement, also enter my subscription to THE COLUMBIAN MAGAZINE for one year, for which I enclose you $2.25. It is understood that if I am not satisfied with my purchase you will refund the amount paid.

Name..

Address..



The Greatest Electrical Library in the World

The Electrical Engineering Library is part of the International Library of Technology that cost **$1,500,000** in its original preparation. It contains the knowledge given from the life experience of some of the best electrical engineering experts in the country, edited in a style that nineteen years of experience in publishing home-study textbooks has proved easiest to learn, to remember, and to apply. There is no other reference work in the world that so completely meets the needs of the electrician as the Electrical Engineering Library. The volumes are recommended by the highest authorities and are used in nearly all the leading universities and colleges. They treat of practical electrical methods, starting from the simplest problems and comprehensively covering every branch of the work. Not only can they be used to great advantage by superintendents, foremen, and engineers as an authoritative guide in their work, but since they can be so clearly understood, even by persons having no knowledge of higher mathematics, they can be used by all classes of electricians that are desirous of advancing to higher positions. The Electrical Library contains 17 volumes durably and handsomely bound in three-fourths red morocco, stamped and numbered in gold. The books are printed on a high-grade book paper, and the type is large and easy to read. Each volume is 6 by 9 inches in size. If you wish to know more about the most practical electrical library in the world, **send the coupon NOW.**

International Textbook Co.
Box 1102, Scranton, Pa.

Please send, without further obligation to me, full particulars in regard to your Library of Technology, with special reference to the Electrical Library.

*Name*____________________

*St. & No.*____________________

*City*__________ *State*__________

CHIEF DRAFTSMAN

Will INSTRUCT PERSONALLY a limited number selected, ambitious men in

Practical Drafting, Detailing, Designing

Draftsmen Drawing $125-$150 Monthly

Are NOT MADE in Schoolrooms,
Are NOT MADE by Reading Books,
Are NOT MADE by making Copies,
Are NOT MADE at home drawing pictures from printed book lesson.

LET ME TELL YOU:

It requires actual, practical, up-to-date DRAFTING-ROOM WORK to train YOU to gain the PRACTICAL EXPERIENCE that your employer will demand of you.

FREE

This $13.85
DRAWING OUTFIT
and Free Position

As Chief Draftsman of Engineering firm I know exactly the Quality and Quantity of PRACTICAL training, knowledge and actual up-to-date experience (not school knowledge) you must have, in order to obtain a good position and advance to highest salary.

I give INSTRUCTIONS UNTIL COMPETENT and PLACED in POSITION at above Salary

DON'T waste TIME and MONEY trying to learn from books or printed "STUFF" you can only learn on PRACTICAL WORK which I furnish you.

Address CHIEF DRAFTSMAN

Div. 10, Eng's Equip't Co. (Inc.), Chicago

POPULAR ELECTRICITY
IN PLAIN ENGLISH

HENRY WALTER YOUNG. Editor

Vol. III January, 1911 No. 9

CONTENTS

RENEWALS When your subscription expires, you will find a renewal blank enclosed here. You should fill out and return same with remittance at once, to avoid missing a number. Positively no copies will be mailed on any subscription after same expires unless renewed, and we cannot agree to begin subscriptions with back numbers. The date on wrapper of your magazine shows the issue with which your subscription ends.

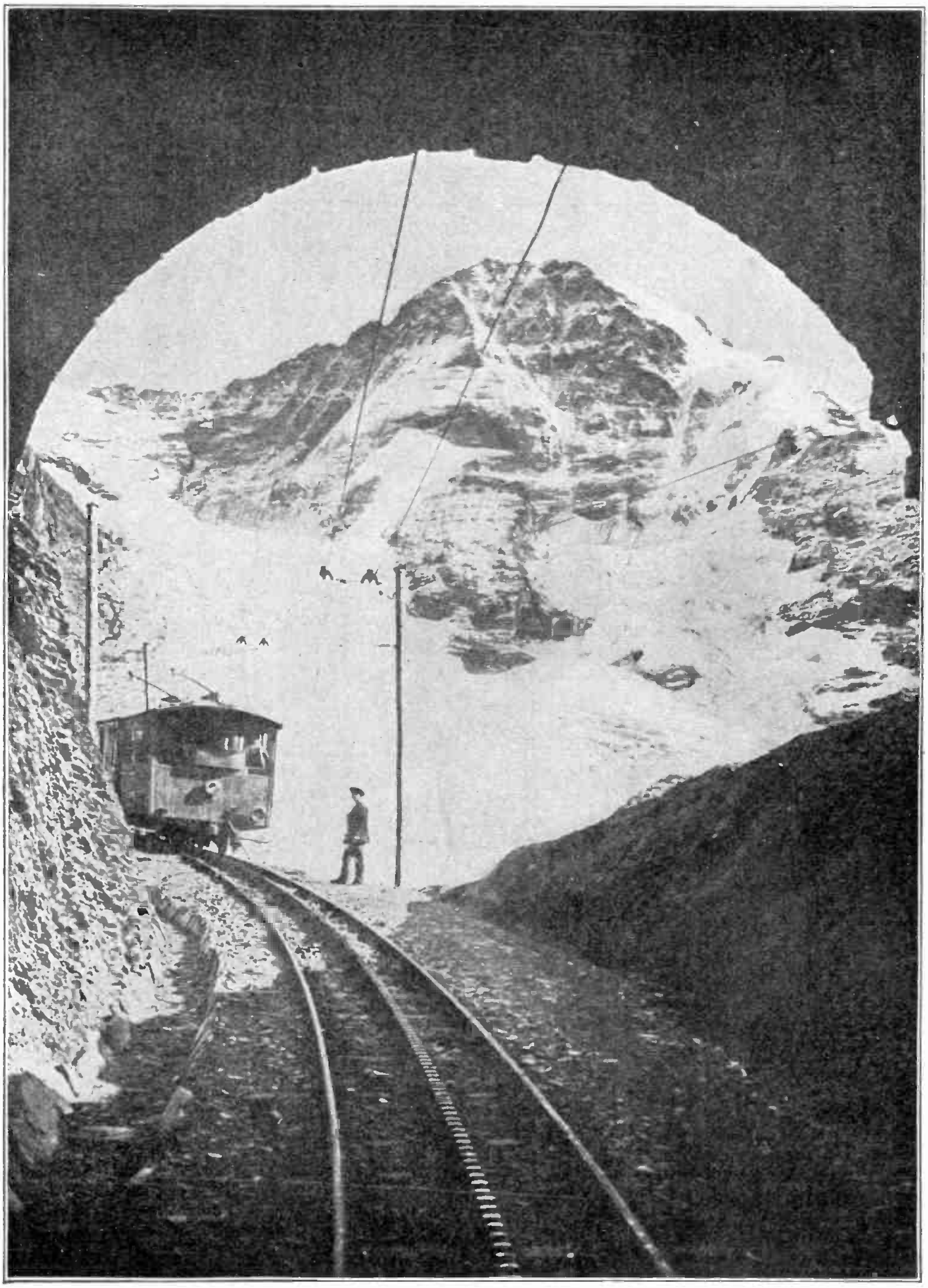
CHANGE OF ADDRESS Notify us promptly of any change in your address, giving both the old and new location. Since each issue is printed a month before the date it bears, we should be notified at least four weeks in advance, in order to make the necessary change in our records.

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

No additional copies will be sent after expiration of subscription except upon renewal

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



LOOKING OUT OF THE TUNNEL OF THE JUNGFRAU RAILWAY—MOENCH PEAK IN THE BACKGROUND

Popular Electricity
In Plain English

VOL. III JANUARY 1911 No. 9

Up the Jungfrau by Trolley

By FRANK C. PERKINS

Early in the history of steam railroading Adolph Guyer Zeller designed the Jungfrau railway. At the Scheidegg he noted that the Wengernalp railway had already attained an elevation of 6,770 feet and the future Jungfrau railway ought to start, not from the valley of Lauterbrunnen, which is 2,644 feet above the sea level, but from the point at which the Wengernalp railway attains its greatest elevation, at the Kleine Scheidegg. By this plan the altitude to be overcome in order to reach the summit of the Jungfrau at an elevation of 13,671 feet, would be reduced by more than 4,000 feet. And so the Jungfraubahn was built and operated for many years as a steam road. Like most of the railroads of Switzerland, however, it came in for electrification with the advent of the "White Coal", as the electric current from the magnificent water powers of that country is familiarly called, and was one of the first electrically operated lines in the Republic. From this mountain road and from the little stations, the sites for which were literally hacked out of the side of the mountain, are to be viewed some of the most entrancing of Alpine scenes.

Before the electric mountain railway was constructed only men of sturdy frame and considerable muscular power were able to undergo the fatigue of climbing to the summits of these lofty mountains. They are now, however, accessible even to the weak without great effort or exposure. Upwards of 100,000 tourists climb the Jungfrau each year by means of this electric mountain railway, and it is estimated nearly a million tourists have taken advantage of this marvelous engineering undertaking since the road was built.

Engineer Zeller held that a route should be selected which would give a gradient of one in four, the same as that which was adopted for a majority of mountain railways at that time. This Swiss engineer planned to start from the Scheidegg and follow the pass of that name as far as the Eiger; and then to cross this mountain, as well as the Mœnch, and passing beneath the Jungfraujoch, reach the summit of the Jungfrau.

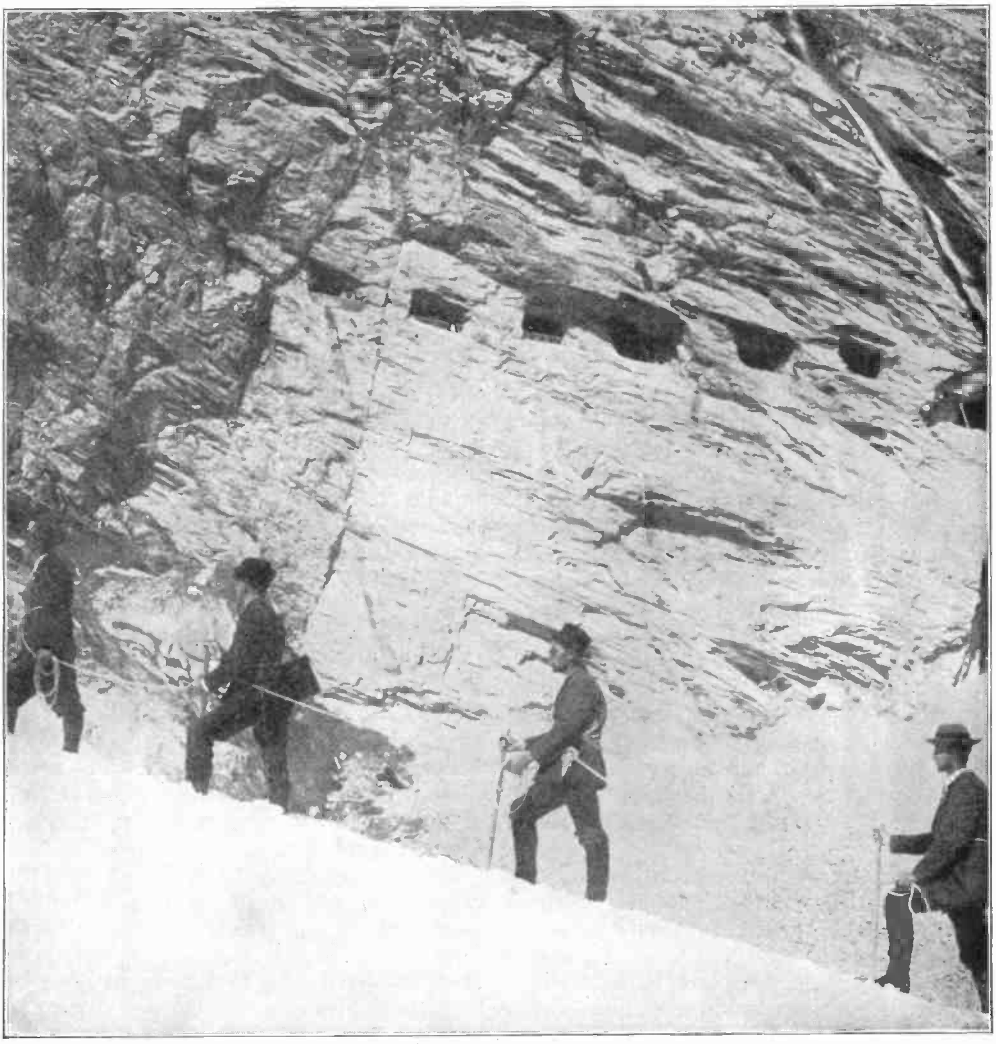
Really this route was necessarily longer than those which had been planned previously, but it was so ingeniously devised that, by the establishment of several intermediate stations on the north and south sides of the Jungfrau chain, it afforded a number of new viewpoints and constituted as it were several mountain railways, the whole forming the Jungfrau railway.

It may be stated that the distance from the Kleine Scheidegg to the Eigergletscher station is 2,187 yards, and the latter is located 7,624 feet above the level of the sea. From time to time enormous masses of ice are detached from the mountain, especially from the Geissen Glacier, the side of the Jungfrau, and fall with a crash like thunder into the deep and dark valley of Trummelten, and there gradually melting, they feed the Trummelbach, which forms the well-known waterfall near Lauterbrunnen before joining the water of the White Lutschine.

The train glides gently forward on this electric rack railway without any of the disagreeable shocks and jolts so common on mountain railways worked by steam, with no inconveniences from smoke and sulphurous fumes of steam locomotives.

The necessary current for operating the Jungfrau railway is conducted along two

SLOPING WALK WHICH STARTS FROM EISMEER STATION OF THE JUNGFRAU RAILWAY, 10,000 FEET ABOVE THE SEA



SHOWING THE JUNGFRAU RAILWAY AS IT PASSES AT ONE POINT THROUGH A TUNNEL, WITH EXCAVATED "WINDOWS" THROUGH THE ROCK WALL

copper cables from the power house at Lauterbrunnen to the Scheidegg. The track was built on the system employed by Engineer Emile Strub, of Zurich, as now applied to all the new mountain railways. The electric locomotives are fitted with all the necessary safety appliances and, whether ascending or descending, they cannot exceed a speed of $5\frac{1}{4}$ miles per hour. Should this speed be exceeded an automatic brake comes into play and stops the train. Measures have also been taken to provide for other emergencies, such as the sudden failure of the current.

One locomotive and two carriages, each seating 40 passengers make up each train. It wends its way along the pass, having on its right the valley of Lauterbrunnen and on its left that of Griendelwald. It then enters a tunnel 95 yards in length, when automatically the electric lamps in the carriages and the locomotives are lighted. But in a few moments they go out again and the sun once more pours its rays into the cars, and the glaciers and ice-covered slopes of the Eiger, the Mœnch and the Jungfrau come into view.

The Jungfrau Railway and the Weingernalp railway are not worked after October in consequence of the heavy fall of snow.

About 220 yards above the Eigergletcher station the line enters the main tunnel, which is six miles in length and measures ten feet wide and fourteen feet three inches in height. The top is semicircular in section. It is said that the rock through which the tunnel was pierced was very favorable for boring, being what is known as "hochgebrigskalk," a limestone which, though easy to bore through is yet hard and tenacious enough to make a lining of masonry unnecessary.

This is the highest tunnel in the world. From here the Eigerwand is reached in about 20 minutes, when the tunnel suddenly expands into a large hall and the train comes to a standstill. The Eigerwand station is lighted electrically and is 9,410 feet above the sea and 4,810 yards from the Scheidegg. It was the first station excavated in a mountain side in the world, and there is nothing like it elsewhere.

It may be mentioned that nowhere except on the Jungfrau railway is there a station blasted out of the interior of a mountain and yet commanding a magnificent view. Between Eigergletch and Eigerwand stations is Rotstock station, at an elevation of 8,300 feet, on a rocky plateau reached by a short lateral.

It is held that never before has a work been accomplished in climatic conditions such as prevails in these regions of eternal snow, and for many reasons the engineers of the Jungfrau railway could not profit by experience acquired in the construction of other railways. They had to invent and construct devices and appliances which have been found serviceable to those who followed them in similar undertakings.

There is provided gratuitously for the use of the passengers an execllent telescope of 108 diameters, by which the buildings on the Rigi, Pilatus Stanserhorn, Breinzer, Rothorn and Faulhorn may be seen, as well as the tourists around them.

There is also an electric searchlight of enormous candle-power which has a reflector 3½ feet in diameter which is used in the evening. It throws its beams far and wide and exchanges salutations with its less powerful colleagues on the Stanserhorn and other peaks. It is said that by its light a newspaper can be read in the streets of Thun, and it is clearly visible at a distance of 60 miles.

The Eismeer station is a masterpiece of constructive ingenuity, and consists of a large hall excavated, like Eigerwand station, in the "hochgebrigskalk," and pierced with several openings on the south side. The width of these apertures and of each of the pillars separating them is 20 feet, and the width of the station from the internal face of the pillar to the opposite wall is 26 feet. A large part of the underground chamber forms a comfortable room which is electrically heated and provided with a parquet floor and glass windows. The room also contains on one side the apartment of the station master, with a postoffice, which is said to be the highest in Europe, and on the other side an electric kitchen and restaurant. Neither wood nor coal is used in this kitchen, as everything is cooked by means of electricity, which is also used for heating the restaurant itself. This great electric kitchen at Eismeer station is the first of its kind to be installed in Switzerland.

A Divided Orchestra

At night there is usually little for the operators and night station agents at the smaller railroad stations to do. In former years when the commercial wire was cleared of its business they would all cut in and have a general conversation.

Since the 'Frisco Railroad has adopted the telephone for train dispatching, the night men cut in on the Western Union wire with their telephone sets and converse with each other without hindering the use of the wire for the Morse telegraph instruments, as one wire will carry both telephone and telegraph messages simultaneously.

The feature of these evening chats is selections by their orchestra. Three of the operators at widely separated stations play musical instruments, one the violin, another the guitar and the other the clarinet. Each one has prepared a paper megaphone which he places with the small end against the receiver of his telephone, adjusts his head piece and they are off. They tune up and render such selections as they have worked up together while the other operators along the line listen and occasionally join in and sing.

Sometimes the dispatcher's call puts a quick stop to their selection when he is in a hurry to find out the whereabouts of Extra 822 or Second No. 10.

In Quest of a Voice

By FLOYD HAMILTON HAZARD

PART II.

"I beg a thousand pardons," said the man, mechanically, almost without looking to see who it was he had stumbled against. "I didn't——Why! It can't be possible! Ted Van Doren! After all these years? I never knew the beat! Don't you know me, you old owl? Where in the name of sense have you kept yourself?"

Osgood had stepped back when he saw the door open and was as wide-eyed at such a greeting from an utter stranger as was Van Doren. He waited to see what his friend would do.

Suddenly Ted came to life.

He grasped the young fellow by the shoulders and shook him delightedly.

"Will Barringford, by all that's wonderful!" he ejaculated. "Why, you old skee-zicks, how was I to know you all in an instant? You've grown up, you rascal! But what are you doing here? Thought you were in business down in Maryland."

"I'm the manager of The Southern Construction Company," answered Barringford. "We've only had an office here in the city for about a month and I've been so busy that I haven't had a chance to look around. I thought you located in South America."

"So did I, but I changed my mind and came back."

"Suppose you're married, and all the rest of it?"

"No, I'm living at the club. Are your father and mother here too?"

"Yes, We're living up town and you've just got to come along with me to dinner. We're expecting some old friends tonight and, by Jove, I've just found another one to make the party complete."

Ted was blessed with an inspiration.

"And you dine at seven o'clock and your name is 'Will!' You bet I'll come!" he exclaimed with a searching look into Barringford's eyes.

"Fred," he continued, smiling knowingly at Osgood, "allow me to present one of my old chums, Will Barringford. We were great cronies when he was a youngster and I was down on that job in Maryland."

"Always glad to meet any friend of Ted's, Mr. Osgood, and I hope he'll bring you up to see us soon," said Barringford, cordially, although he seemed puzzled by Van Doren's reference to the hour he had mentioned and to his first name. "I'd like to ask you to join us at dinner, but I know you will excuse me, under the circumstances. Isn't this the limit, the way we've met?"

Osgood had understood at once, when Barringford's dinner hour was mentioned and Ted had remarked upon it, that, as far as he was concerned, the puzzle was all put together.

"It certainly is most remarkable, Mr. Barringford," he replied. "I'm mighty glad, both on Ted's account and on my own account. I hope we shall become better acquainted."

The trio had, during the latter part of their conversation, moved down the corridor, taken the elevator, and were about to leave the building.

Barringford gave Ted his address and hurried away after receiving renewed assurance that the latter would not fail to present himself at the house just as soon as possible.

"I suspect that the pleasure of meeting our guests will not be all your own," had been his parting words.

"You've been deceiving me all these years, Ted, you old scoundrel," said Osgood, as they were about to separate. "I never even supposed you capable of campaigning for a lady's hand, but when you institute such a relentless search because of having taken a fancy to the voice of some unknown female, the revelation of the depths of your duplicity and absolute recklessness is appalling."

"So!" laughed Van Doren. "Well, I'm all excited about it anyhow, however it may turn out. It's evident that the lady will be there tonight, but who she will prove to be, is as much a mystery as ever. Will seems to hold the last card."

"I hope you fall head over heels in love with her, marry her, and live happily ever after," said his friend, sincerely. "It would be the best thing that could possibly happen to you. I'll be anxious to learn what comes of it, so don't fail to let me know, tomorrow. Good-night."

HE SEIZED IT EAGERLY FOR A CLOSER LOOK

Van Doren returned to his rooms to dress for the evening. He made a careful though hurried toilet and took a taxicab to Barringford's residence. His friend, Will, had evidently been watching for him, for it was he who opened the door as Ted came up the steps.

"You certainly must have hustled to have reached here so soon," he said, drawing Ted inside. "But then, you always were a hustler."

"I was impatient to learn what you meant by that remark about the 'pleasure not being all my own,'" explained Van Doren, as he removed his overcoat.

"Oh, you were, eh?" said Barringford, smiling mysteriously. "Well, step into the drawing-room while I go up stairs and tell the folks that you've arrived. That'll be the quickest way to settle it.

"Afterward you can explain to me why you were so glad to remember that my name is 'Will' and that we were to dine at seven o'clock," he added, from the stairway.

Van Doren entered the cozy drawing-room and seated himself before the open fire. He glanced about the room, noting with interest some of the furnishings with which he had formerly been familiar. A book of travel, on the table, close at hand, caught his eye, and he idly picked it up to glance at the title page. Inside was a photograph and he seized it eagerly for a closer look.

"Lillian! Oh, Lillian!" he murmured, devouring it with eager gaze. "Oh, you splendid, splendid girl!"

The portrait was evidently a recent one and he sighed as he studied the features which were still so dear to him, in their greater maturity.

Thoughts of the past and of what might have been, possessed him.

He remembered the time when he had first gone south; how he had had an introduction to the influential Mr. Burkwell; and how he had been helped by him in getting that work started. He recalled his first meeting with Lillian Burkwell, in her father's house; and how completely she had captivated him. He had loved her from that first moment and had not hesitated to display it.

He smiled, sadly, as he recollected how all of her old admirers had thirsted for his heart's blood; and how earnestly he had endeavored to cut them all out.

Then had come lack of progress in his suit. It had almost driven him to distraction. They had been such good friends, but she was soon to go abroad to study how to be famous, and would listen to nothing which was likely to interfere with her plans.

He shivered as he thought again of the calm firmness with which his proposal had been rejected; and of the long, weary years of strenuous effort with which he had attempted to repair his broken spirit and to drive all thoughts of her from his mind.

How many?

Eight.

Oh well, it might as well have been a thousand. Time was only an eternity in a matter as deep as that.

So completely was he absorbed in retrospection, that he had forgotten his surroundings. For this reason, he was unfortunate enough to miss the charming pantomine, that was being enacted in the mirror which he faced.

It reflected the hangings that covered the entrance to the room, and the fortunate one who had happened to be gazing into it at that moment, would have seen them parted noiselessly by a woman who was dressed in a clinging evening gown of soft black lace.

She stood there, silently and duskily beautiful, scarcely breathing, and with a quizzical smile hovering around the corners of her mouth.

Then, catching sight of the photograph he was holding, she blew a kiss to the lonely man.

"How dare you look at my portrait, sir, and turn your back upon the original?" she said, reprovingly, as she held out both her hands to him, and advanced into the room.

Van Doren sprang to his feet, dropping the picture like a guilty child as he heard the voice for which he had been searching, and turned toward her. To him, it seemed as though the portrait had come to life.

"Why, Lillian!" he stammered, scarce believing, and groping for her outstretched hands while his eyes searched hers. "You—that is, I mean I—you startled—I mean I was so startled——"

"Why of course you were, you silly boy," she said, lightly. "I wanted to surprise you."

Her bright look wavered under his direct gaze.

"I thought I had lost you forever," he murmured, huskily.

His hands tightened on her own and she made as if to withdraw them.

"Tell me, quick," he whispered. "Am I free to ask you a question *again*?"

"Oh, not now! Not now!" she answered timidly. "Wait."

"No!" said Van Doren, decisively. "I've waited much too long already. Tell me. Is there still no place in your heart for me, little one?"

"There is a place in my heart for no one else, Ted," she answered tremulously. "There never has been; but it has taken me, oh! such a long, long time to realize it."

It was seven o'clock, and, considering this fact, the house was strangely silent.

(THE END)

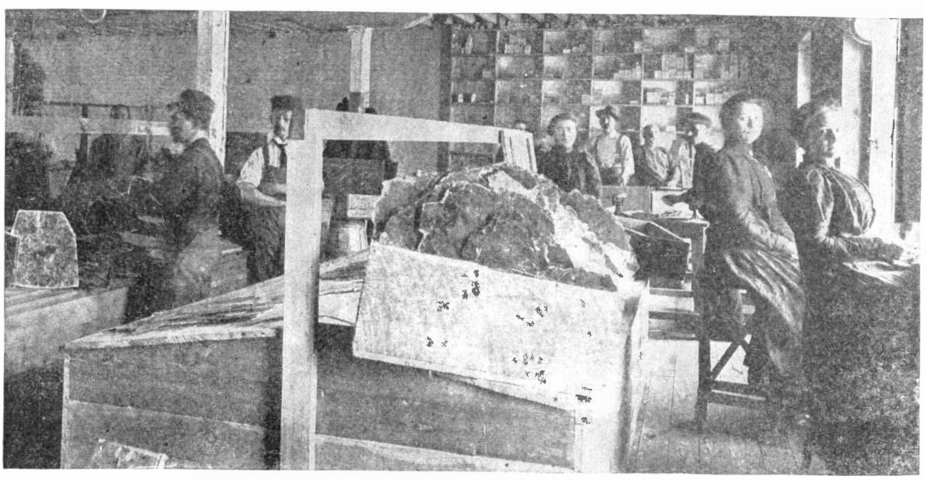
The Story of Mica

By ORLO A. FOOTE, JR.

Did you ever stop to think what a wonderful product mica is, and what an important part it plays in the electrical field? Mica is the prime factor of electrical insulation and is used throughout the civilized world. There are but few of the many electrical appliances and machines that do not depend directly or indirectly upon mica in one form or another for their very existence. Stop and think what the results would be if it were possible for one man, like the magicians of old, to utter a few magic words and cause all the mica in use to-day to disappear. The outcome would be a badly crippled world without electric light or power. The mammoth generators you have seen humming busily away in the great power houses would commit suicide by burning out their own delicate anatomy, fast speeding electric trains and street cars would come to a standstill and remain lifeless, ponderous electric cranes carrying their tons and tons of heavy burden would lose their power and drop their cargoes to the ground.

No doubt your first actual contact with mica was in the doors of the old base-burner or gas stove at home. Your father probably told you it was isinglass, and if you were curious enough to consult the dictionary you would have found the definition to be "A substance made from the air-bladders of certain fish." Queer, wasn't it, to think that the delicate membrane of a fish could stand the heat given out by the glowing bed of coals in the stove. You no doubt were suspicious, and your suspicion was well grounded as that crackly material was not isinglass but mica, just as it comes from the mine, for mica is mined just as coal and iron.

Mica, like diamonds, is found only in a very few and widely separated parts of the globe. We will deal in this article, however, with only the first grade mica that is used in the electrical field. The first and most important is a soft white mica mined high up among the barren hillsides of far-away India. The second is a dark brown or amber mica found in Canada, principally in British Columbia. The third, a hard and more brittle product, is mined here in our own country, the largest deposits of which are found in the Carolinas and Montana. Vermont also furnishes some of the mica used in this country.

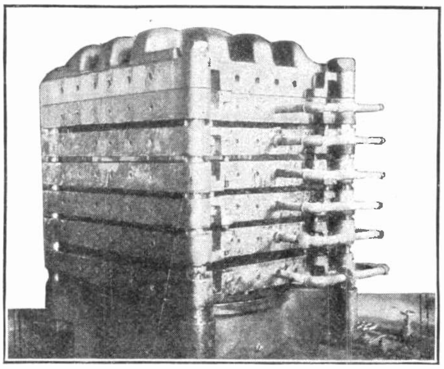


THE MICA IS CAREFULLY SORTED AND SPLIT INTO VERY THIN SHEETS

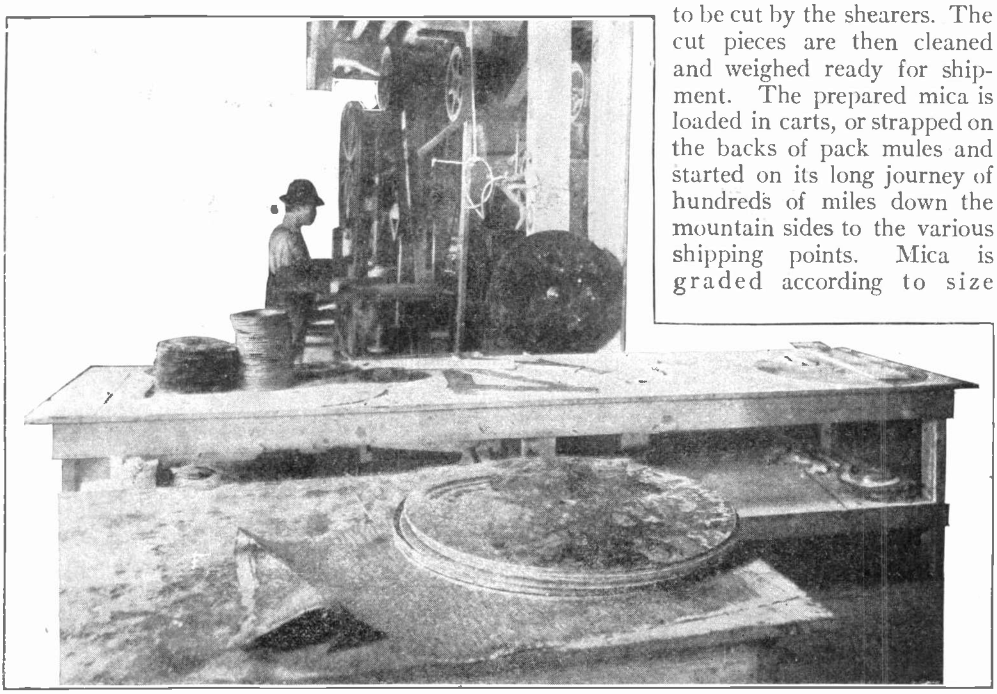
Mica or muscovite is an anhydrous silicate of calcium and aluminum, and is found at depths varying from two to 200 feet below the earth's surface, where it was crystallized ages ago under very high pressure and heat. Mica is found in pockets, in a homogeneous, laminated mass and is easily split along its axis. Expert mica workers can split mica into leaves as thin as five ten-thousandths of an inch.

Mica however, unlike most minerals, cannot be located by the surrounding geological formation, and owing to this, many mica claims have cost more to develop than the mica produced could be sold for. After the vein or pocket is located the only engineering skill required is for the proper drainage of the mine and the economical removal of earth and rock.

You have no doubt seen workmen removing old asphalt pavement from city streets, by tearing it up in large slabs with their picks, and it is in just this way that mica is torn from its native bed, with drill and hammer, although in recent years electric tools have been installed in some of the mines. After the mica is torn from the vein it is carried to the surface in large baskets, and on reaching the surface it is thoroughly cleaned to remove all traces of clay and shale which cling to it. The crude product is then roughly trimmed and sorted into different grades according to size and quality, and passed on to the mica workers who split it up into pieces varying from one-sixteenth to one-eighth of an inch in thickness. Each piece is then marked the size it is to be cut by the shearers. The cut pieces are then cleaned and weighed ready for shipment. The prepared mica is loaded in carts, or strapped on the backs of pack mules and started on its long journey of hundreds of miles down the mountain sides to the various shipping points. Mica is graded according to size



THE CEMENTED MICA SHEETS ARE BAKED FOR HOURS IN A HUGE STEEL PRESS

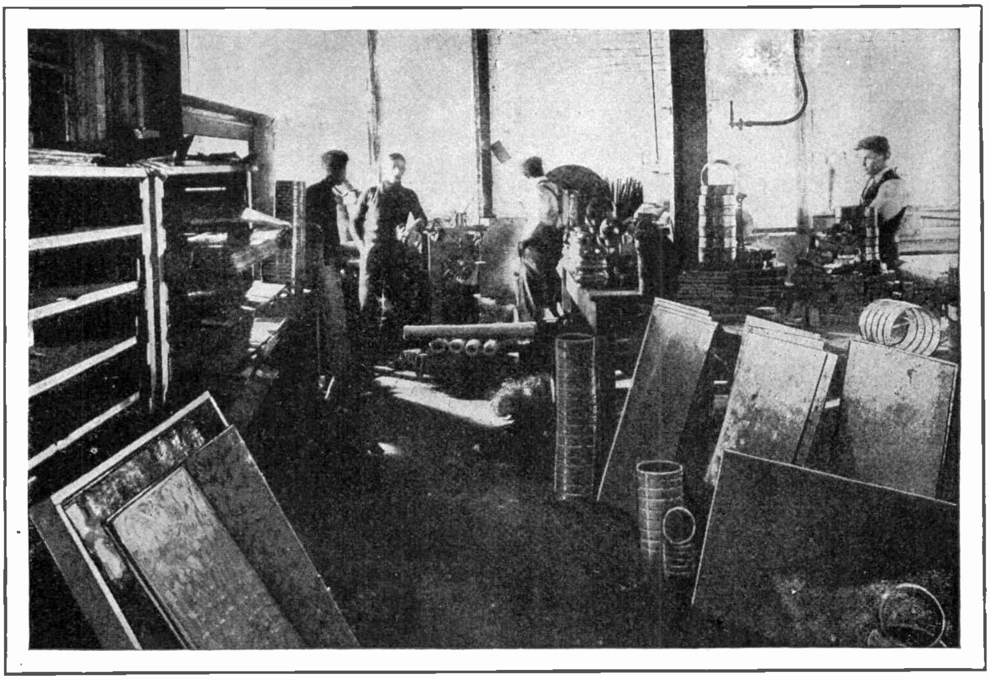


SAWING UP THE MICA INTO STANDARD SHEETS. THE CIRCULAR SHEETS IN THE FOREGROUND ARE FOR STATIC MACHINES.

and not quality, as is the general opinion, the quality is designated by the name, thus: India quality for mica produced in India, domestic for mica mined in our own country, and amber for mica found in Canada. The grades of crude mica are, A-1, 1, 2, 3, 4 and 5. A-1 being the largest and 5 the smallest. This grading applies to mica of any quality.

Owing to the high cost of carting mica to railways and shipping points and the increased cost of transportation, the extreme high prices asked for mica almost prohibited its use, until some years ago, when there was put on the market a form of re-constructed mica called "Micabond." As this re-constructed mica was adaptable to so many forms of insulation, and as the price was within the reach of all desiring a good product, it met with immediate success. We will give a brief account of the processes in manufacturing micabond.

As soon as the crude mica is received at the factory it is put through what is called an inductive tester, an instrument which records all traces of iron that may be in the mica. Mica showing the slightest trace of iron is discarded, as mica of this sort cannot be used for insulating purposes. Those pieces free from iron are sorted and split into very thin scales and sent to the assembling room, where they are re-assembled into large sheets with an insulating bond or cement of very high insulating properties, which absolutely excludes all moisture and makes the finished product impervious to water. After the crude sheets have been formed by alternate layers of mica and cement, they are put into large steel presses and baked for many hours under high pressure and temperature.



PACKING ROOM. ON THE TABLE AT THE RIGHT ARE MICABOND COMMUTATOR SEGMENTS AND RINGS. THE ROLLS ON THE SCALES ARE MICABOND CLOTH.

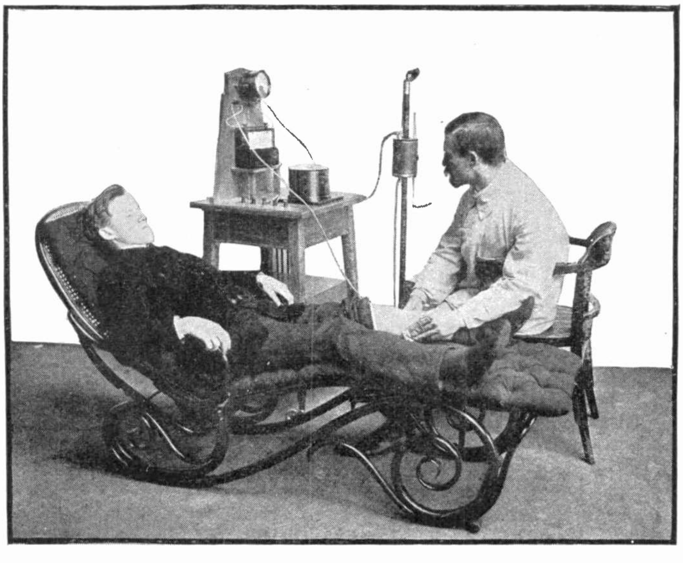
This baking and pressing process forms the sheets into a solid, homogeneous mass of such solidity as to emit a metallic ring when struck. The sheets of micabond are then air cured for 24 hours, after which they are sent to the milling and saw room where they are milled down to the proper thickness and cut into standard sheets 18 by 36 inches.

Micabond is made in four qualities. The first is 102 plate and is built up of soft white India mica, and will stand a breakdown test of 1,012 volts to one-thousandth of an inch of thickness. This style of plate is used in making commutator segments, washers and other flat work. The second style of 101 plate is also built up of soft white India, but is unbaked and can be molded or formed to any shape, as it becomes flexible under heat. Owing to its ability to be moulded, this plate is used for commutator rings, tubes, armature troughs, magnet spools and other work where special shapes are required. The third quality of micabond is 104 plate and is built up of only soft Canadian amber mica, and is used almost entirely for commutator segments as it wears down smoothly with the copper bars of the commutators. All of the above-mentioned micabond plates can be milled, stamped, sawed and drilled and can be made in thicknesses to resist any voltage, as the breakdown test is 1,012 volts per one-thousandth inch of thickness.

Last but by no means least, is a style of plate called flexible micabond. This material is naturally flexible and will remain so for an indefinite length of time. Flexible micabond is built up of India mica split exceedingly thin and will stand a breakdown test of 750 volts per one-thousandth inch. This plate is used largely in insulating transformers, spark coils and armature slots.

Making Heat Penetrate the Bones

A new way of applying electrically generated heat as a therapeutic agent has been devised by two German scientists, Gebbert and Schall. It provides for the application of heat locally and to a greater depth than can be reached by any superficial means, the principle involved being that of the high frequency current which, as is generally known, can be applied with safety to the human body. The treatment is used in the case of rheumatism, neuralgia, etc., and is even useful in case of diseases of the heart and lungs.



MAKING HEAT PENETRATE THE BONES

The apparatus consists of two copper electrodes to be applied to the parts to be treated. These electrodes are connected to a source of high frequency current, the necessary meters and indicating devices being also connected in the circuit.

A very comfortable feeling is provided by the electric heat traversing the part of the body under treatment, and as the heat is produced within the tissue it is retained for a long time after the treatment, particularly within the bones which are said to cool down very slowly.

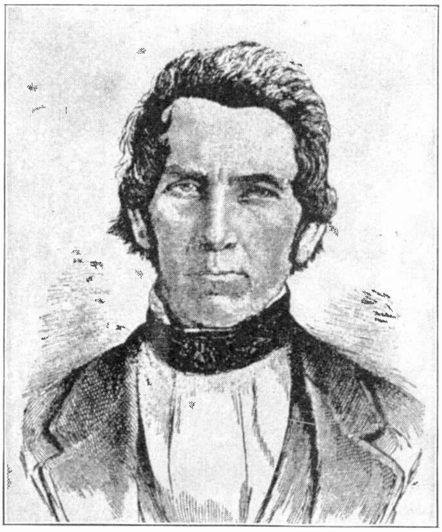
The electric heat penetration treatment varies from five to ten minutes according to the parts to be treated, the shape of the electrodes and the current intensity used. The high frequency of current employed is similar to that used in wireless telegraphy and it is claimed affords means of applying electrical treatment to the body without any risk of injury.

It has not been possible heretofore by artificial means to increase the temperature of those parts of the body which are affected by disease, thus assisting nature in its work, as the effects were merely superficial. The heat did not penetrate to the parts desired, but resulted in a general heating of the whole body. The new German process using high frequency current allows any parts of the body to be heated to any temperature desired.

An Appreciation of Thomas Davenport[1]

By T. COMMERFORD MARTIN

My special duty and honor today is to emphasize, in this region where he lived and dreamed and suffered and wrought, the name of Thomas Davenport of Brandon, Vermont, the first American patentee and builder of the electric motor; the first man in all time to apply electric power to the operation of railways; the first man in the world to hitch together those two tremendous forces, electricity and the printing press.



THOMAS DAVENPORT

Thomas Davenport was born at Williamstown, Orange County, Vermont, a descendant in direct line of the Davenport family conspicuous in the early annals of the New Haven Colony. Thomas was only ten when his father died, only fourteen when he was apprenticed to the blacksmith trade. All the formal education that Davenport got was for six weeks a year, for a briefly indefinite number of years, in a common district school house in a remote mountain town. But he did get hold of some fragmentary portions of a scientific book, and as he blew the bellows, so with it he fed and fanned the fires of his intellect. Meanwhile he lived at Forestdale, then a center for a little iron industry, the blast furnace being located there doubtless because of the availability of charcoal. He was a slender, thoughtful lad, and never appears to have been in very robust health. The whole drift of his thought is indicated by the fact of having made the acquaintance of another clever young fellow named Orange T. Smalley, wagon builder and wheelwright, he formed the ambitious plan of going from place to place to deliver experimental scientific lectures. The question of apparatus came up, and very naturally with the discussion came the wonderful "galvanic magnet" of Joseph Henry in operation at the Penfield Iron Works at Crown Point, only 20 miles away, for sifting magnetic iron ore. This magnet, it was rumored, would hold up a blacksmith's anvil, like Mahomet's Coffin, between heaven and earth, and Davenport determined to see it and get one. During the intervening years the peripatetic lecture scheme seems to have been wholly abandoned, a reason being found in his settlement at Brandon in 1823 as an independent working blacksmith and his marriage in 1827 to Emily Goss, of that town, a beautiful girl of seventeen, granddaughter of the famous American traveler, Jonathan Carver. Under such stimulus he worked hard at his trade, prospered thereby and built himself a brick house.

He was altogether in a fair way to accumulate a comfortable property, for he was intelligent, sober, upright, diligent; but electromagnetism was his undoing. We might almost call it "malicious electro-magnetism." Going to the Penfield works in 1833 with $18 to buy iron for his business, he spent the money there instead in buying an electromagnet and batteries. The iron was needed at the shop, but how much more he needed that magnet!

As he handled the primitive little equipment, "Like a flash," he says, "the thought occurred to me that here was an available power which was within the reach of man." Yes, it was there, and his was the superb divination of genius to detect it. He was like another Saul hunting down his father's asses and finding a kingdom.

[1]Abstract of an address read at Brandon, Vt., September 28, 1910, on the occasion of putting up a bronze tablet in commemoration of Davenport.

Certainly from the materialistic point of view, that magnet was a curse, like those legendary possessions inflicting injury upon their fatuous owners. Never again was Davenport to know peace of mind. Never again were his family to enjoy a home of comfort. Indeed, they were called upon to share his sacrifices. It was supposed in those days that wire needed silk for insulation. His brave young wife took her silk wedding gown, cut it into narrow strips, and with them were wound the coils of the second motor, which in October, 1835, he showed in successful operation upon the judges' bench in the courtroom at Troy, New York. Wifely devotion could hardly go much farther. Later on Davenport learned that silk was not so essential but that cotton wound wire would do.


UNVEILING THOMAS DAVENPORT TABLET, FORESTDALE, VT. BY VERMONT ELECTRICAL ASS'N, SEPT. 28, 1910.

Of course the inventor had friends in all his struggles, though many of them, including his shrewd and kindly father-in-law, urged him to quit and settle down to the commonplaces of life. Others, like the talented Smalley, worked with him awhile, and then drew off. One of his strongest supporters was Ransom Cook, a furniture manufacturer of Saratoga Springs, who gave Davenport for some years the aid of his purse, and the assistance of his unusual mechanical ability. From Professor Turner, of Middlebury College; from President Eaton of the Rensselaer Polytechnic Institute; from General Van Rensselaer, of Troy; from Professor Henry, of Princeton, he received generous and substantial help.

Going sanguinely to Washington in 1835 to secure a patent on his first motor—he had already built about a dozen—he was obliged to return home penniless, his errand unaccomplished, like Mark Twain's politician who drove to the National Capital in a four-in-hand to get his appointment, and then after months of weary waiting slunk away on foot—without it. Time and again we find Davenport playing the part of a showman, glad to pick up a few casual dollars in that way; but at no time getting out of financial difficulties or planting his feet firmly on the rock of commercial success. He remained an inventor to the end of his brief life in 1851.

And now for a brief glance at what Davenport actually did. When Davenport came on the scene, Faraday and Henry had already done their great work; and the principles of both the electric generator and the electric motor had been clearly perceived and enunciated. Yet there were no real motors before Davenport's time; and had the dynamo then been known his work would have been carried to instant fruition. In Davenport's day they had not learned to convert either the energy of steam or that of the waterfalls into electric current; and thus all the electrical arts lingered and languished, except telegraphy. The reason is simple. Beginning at the same time as Davenport, and deriving, it would seem, both suggestion and inspiration from his apparatus, Morse was able to make practical the art of communicating intelligence because it took such a small amount of energy to transmit signals by dots and dashes over a wire. But when Davenport told the great Joseph Henry that he proposed to build his motors up to one horsepower, the cautious philosopher warned him to "go slow," and hinted that electricity could not compete with steam.

In Europe, Jacopi, like Davenport, as early as 1834, had obtained rotary motion from electro-magnets, and in 1838, at the expense of Emperor Nicholas, he propelled a boat on the Neva with his motor energized from batteries. Here again the demonstration failed and ceased for lack of an economical source of current. There is close rivalry as to dates between the physician in Russia and the blacksmith in Vermont, but both at least encountered the same fatal obstacle, the lack of cheap current. So far, moreover, electricity has made no triumphal entry into navigation, but at a time when his native State had not a single mile of steam railroad, Davenport built his model electric road and asserted that that was the best way to do it.

In July, 1834, Davenport had built his first motor with two stationary electro-magnets and two revolving, the changes of polarity in the two sets causing attraction and repulsion, with consequent rotation, thus, as he says, "producing a constant revolution of the wheel." We have not advanced a bit since that hour nor can we, for as Davenport wrote at the time of securing his patent the principle of his invention "was the production of rotary motion by repeated changes of magnetic poles." If anyone can improve on the method or the description of it he is entitled to a high place in history. That patent, granted February 25, 1837, first of its kind in America, was broad as a Papal Bull, and embodied this claim: "The discovery here claimed and desired to be secured by letters patent consists in applying magnetic and electro-magnetic power, as a moving principle for machinery in the manner above described, or in any other substantially the same in principle."

The crude motor of 1834 was soon followed up by an improved form in 1835 and by many others as the years went by. The motor of 1835 is interesting as being the earliest known instance of the application of the modern commutator. An elastic contact-spring or brush pressed against metallic segments fixed upon a revolving shaft, so that the shifting polarity of the magnets was maintained as current was received from the battery. In 1836 and 1837 motors and models were built illustrative of electric railway work, and the motor was shown to the public running on a miniature circular track 24 inches in diameter. The battery was not carried by the car but was placed in a tray at the center of the circle and contact was made through mercury cups. This device embodies, therefore, remotely but inevitably, the idea of a central station source of supply. Later inventors still carried their batteries on the car, just as a storage battery car does today. Moreover, the magnetic field magnets and those of the armature were connected in parallel, so that at that early date we have a shunt wound motor, each core being wound twice with 24 convolutions of No. 16 wire, connected in parallel. Another striking fact was that as the model itself showed, the circular track was used as the return circuit, just as every trolley car uses it today. In 1836 his motor model filed at the Patent Office in Washington was destroyed by fire as well as 7,000 others; just as another Davenport motor at the Rensselaer Institute, Troy, was destroyed in 1862 by fire. This kind of fatality pursued much of his work. In 1893, the present speaker exhibited at the Chicago Columbian Exposition one of these Davenport railways where it received an award. Its exhibit was requested for the American section of the Paris Exhibition of 1900, and it was shipped early in that year with the Government exhibits on the steamer "Panillac". Violent storms swept the Atlantic, and the steamer has never been seen since. In like manner disappeared the first dynamo ever placed on a ship. Mr. Edison equipped the Arctic exploring ship "Jeannette" with a little dynamo arranged so that if necessary it could be driven by manual power "to help keep the men warm." The ill-fated "Jeannette" like the "Pauillac" now lies in ocean depths awaiting some cataclysm thousands of years hence, when men may see again these relics of their remote ancestors, preserved in the museum of Eternity.

Nothing daunted by fire, Davenport made a third trip to Washington in 1837 and secured his memorable patent, first of a long line in which the inventive genius of our people has shone forth so strikingly. During the same year, Davenport and his friend Cook established themselves in New York with a laboratory and shop, and gave exhibitions of their apparatus to crowds of visitors, including Morse, already busy on his telegraph, and Page, who fourteen years later operated a battery driven locomotive of twelve horsepower on the Washington and Baltimore Railroad. In March, 1837, the partners, to raise funds for their work, organized the Electro-Magnetic Association with its stock divided into shares. So far as can be ascertained this was the first electric stock company in America, first of several thousands now representing a total capitalization of ten billions of dollars in bonds and stock and which are earning over $800,000,000 annually.

The manager of the financial transactions of the partners was not, however, particularly honest, and it required a chancery suit to secure an accounting, as he turned in only $1,700 out of $12,000 received. This disgusted Cook and led to his withdrawal from the enterprise.

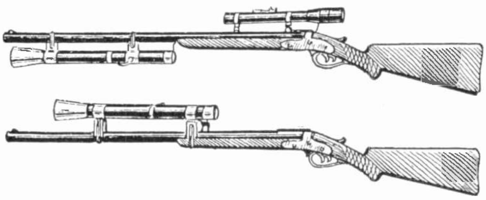
As a piece of misfortune the incident was matched by another later, about 1840, when a gentleman in Ohio proposed to join Davenport and gave him $3,000 in Ohio bank notes for an interest. Davenport had spent just $10 when he learned that the bank had broken, and that the money was worth nothing.

Davenport was not only the first man to drive a printing press by electric motor but he was the editor and publisher of the first electrical journal in the world. In 1859 he gives details with regard to the operation of a rotary printing press with a motor weighing less than 100 pounds. In January, 1840, he began in New York City the publication of a journal which he called *The Electro-Magnet and Mechanical Intelligencer*, which was not only devoted to electricity but was printed by electrical energy. The paper seems to have gone prematurely to its death, but only a few months later, on July 4th, Davenport came out with another journal which he called *The Magnet*. This had a real live editor, salary unknown, but it does not appear to have had any longer life than its predecessors.

These then are in brief the reasons why we electricians honor Davenport and revere his memory. These are the reasons why his native state and his country should be proud of him. These are the reasons why struggling against adversity, dying in poverty, and long obscured by forgetfulness, this modest simple son of Vermont stands forth as conspicuous as one of her granite mountains among the immortals who for the benefit of their fellowmen have tamed and utilized the lightnings of the Almighty.

Flashlights for Hunters

Not content with using portable lamps for lighting their way through the forests on their hunting trips, some sportsmen have learned the advantage of having an electric searchlight attached to the barrel of the gun so as to locate the intended prey in the dark. The illustration on the front cover gives a conception of the advantage of the arrangement.

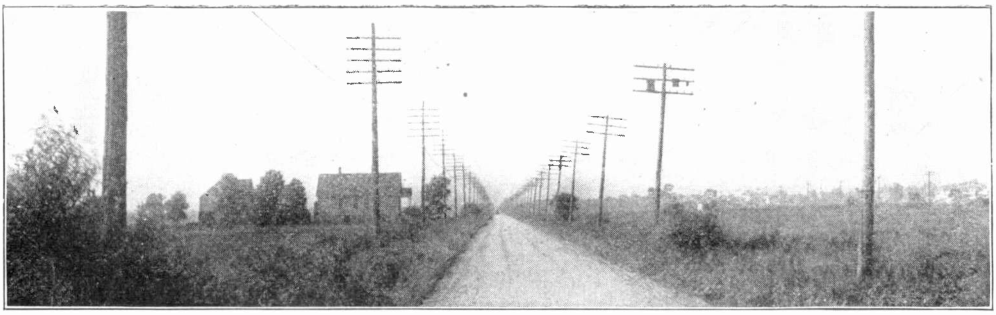


METHOD OF ATTACHING THE SEARCHLIGHT

A lamp attachment made for this purpose by a firm in Cassell (Germany) is reported as having done excellent service in locating deer at distances of from 75 to 200 feet. Some hunters prefer it attached below the barrel, in which case a telescopic sight can be used with it; others like it mounted high above the ordinary sight. On long jaunts the hunter carries an extra pair of dry batteries and an extra lamp with him as a reserve.

Burglars Fear the Light

Shakespeare has Macbeth and Lady Macbeth kill King Duncan under the cover of darkness. Now as then, evil deeds are committed in dark places. Police authorities assert that nine-tenths of the crimes, especially in suburban districts, take place at night in unlighted or poorly lighted streets. The electric light is the criminal's foe. Such lights in the business districts give shoppers a feeling of security obtainable in no other way. Electric lights in the home are the best protection against burglars. One turn of a switch, a burst of light, and the boldest burglar in the land is ready to beat a hasty retreat. Light, too, is a safer weapon than a revolver, which in nervous hands is liable to injure an innocent party. What is called "burglar alarm matting" obtainable at electrical supply houses may be connected in a circuit so as to close a switch and flood the porch with light and ring a bell when Mr. Burglar stands on the mat trying to pick the lock and gain admission.



Talking Between Chicago and New York

By R. M. WINANS

The miracles of yesterday are the commonplaces of today. That which sets the crowd huzzaing at its appearance is soon quietly relegated to its appropriate corner in the world's vast workroom. Man admires and wonders readily and ceases to admire and wonder just as readily.

It is but a few years since the idea of an actual conversation between one party in Chicago and another in New York would have been flouted as lunacy—still fewer since the idea, seriously and scientifically propounded, was rejected as impracticable. Today, when that idea is a reality—"now none so poor as do it reverence!" Yet, could anything be more subversive of former conceptions of space and time than for Smith in Chicago simply to take the receiver off his telephone, inform the operator that he wants to talk to Brown in New York and in a minute or two be in communication—actual voice to voice communication—with Brown who is geographically about one thousand miles away?

Between Chicago and New York six lines are available for use. With these facilities over 1,600 conversations per month were held last year.

Let us see what happens when you tell the operator who responds to your call that you wish to talk to New York. You find yourself immediately connected with the long distance "recording operator" to whom you say, perhaps, you wish to talk to Mr. Robinson, of Brown, Jones and Robinson at New York, and give her your name. You are then informed the "toll operator" will call you and you hang up your receiver. The "recording operator" while talking to you has made out a ticket showing the facts to a "directory operator" who has the telephone directories of all the larger cities in front of her and who fills in Mr. Robinson's exchange telephone number. The ticket is now placed in a pneumatic tube or in a mechanical carrier and passes directly to the line operator in front of the toll or long distance board from which the wires run to New York. This operator then makes connection through a distance trunk operator with your line but does not ring your bell. This is done to keep anyone else from calling you.

The toll operator then calls New York and has the answering operator connect to Robinson's line. His bell is rung and he is informed "Chicago" wants him. When he responds, the toll operator at the long distance Chicago board rings your bell and your conversation commences.

The information ticket is then placed in a calculagraph, a time-recording machine, and stamped with the exact time the conversation starts. On completion of your conversation you hang up your receiver and the electric signal in front of the operator shows that you have done so. Making sure the conversation is finished the operator stamps the ticket a second time, indicating the close of the conversation.

Automatic signals are then given for the disconnection of both your line and Robinson's line.

During the busy time of the day, when there are more calls than wires, the service is supplemented by the use of the telegraph. At the elbow of the long distance telephone operator sits a telegraph operator who arranges for the connection of the parties to the next conversation ,using for this telegraph service the telephone wire, without interrupting the talk going over it.

Telephone communication between Chicago and New York is frequently established in less than one minute—this measuring the time from the giving of the order to the actual commencement of the conversation. This, of course, is hardly possible during the busy hours when many calls for service accumulate. For the demands for service between Chicago and New York limit the number of wires that can be provided commercially. At present there are two direct talking circuits between the two cities and four others which may be connected through Pittsburg. These are kept constantly in use during those hours in which the "load" is heavy.

Boston may be the hub of the universe, but Chicago has become the hub of the telephone system.

Do you ever realize that as you sit at your desk in your office in Chicago you can by simply reaching out your hand talk to any one of probably 20,000,000 people? That all the exertion necessary on your part is that required in giving the long distance operator the name and location of the person you wish?

From Chicago the extremes of distance which may be covered by telephone may be represented in the East by points in New England, in the north by the territory north of Duluth and in the south by New Orleans. On the west extensions now being made will include Denver. In all the cities and towns embraced in this area, the associated Bell companies have telephone exchanges established and toll lines radiating from them which may connect to the long distance lines, thus making available nearly 6,000,000 telephones and a service practically universal in its character. And it is not yet 35 years since Bell exhibited the first telephone at the World's Fair in Philadelphia.

TYPE OF SWITCHBOARD TO WHICH SUBSCRIBERS' LINES ARE CONNECTED

The story of how this baby of 1876 grew into the giant of today is fascinating indeed one of the "fairy tales of science." Through all of the rebuffs and doubts that invariably impede the first steps of any successful inventor, Bell and his intimate friends apparently never doubted the successful realization of Bell's prediction that sometime the telephone would be in universal use—that every person in this world would be able to talk to any other person no matter where he might be at the time. To these men this never was a dream—they *knew*.

When Bell published his first prospectus he said in it: "The proprietors (of the Bell Patents) are now prepared to furnish telephones for the transmission of articulate speech between instruments not more than 20 miles apart."

LONG DISTANCE TELEPHONE SWITCHBOARD

The people looked on the telephone as of local use but laughed at Bell's ideas of ultimate universal service, and when Theodore N. Vail, who has done as much and is doing so much to make universal service a fact, built a line from Boston to Providence it was called "Vail's folly." This "folly" gave us the metallic circuit and made certain the long distance line.

It was soon learned that the use of iron wire on long distance lines would have to be abandoned and copper substituted, because, although iron has a very decided advantage in point of first cost, in all other respects except tensile strength copper is vastly superior. But copper wire had one serious drawback—it would stretch and at first that fault called a halt in its use. As always in such an emergency, the men were found to overcome the difficulty.

Mr. F. B. Doolittle and Col. Mason were the "men of the hour" and after many experiments at Bridgeport, Conn., discovered that after the copper wire had been drawn while hot, if it was redrawn cold through dies, the inner core remained soft while a hard shell was formed on the outside which prevented any material stretching.

About this time Vail organized the American Telephone & Telegraph Company, and after building an experimental line from Boston to New York, this company built its first commercial line between New York and Philadelphia in 1885. This line was built of hard drawn copper wire weighing about 172 pounds to the mile.

In the early days of telephony one wire only was used, the return current being sent back through the ground. With this method in use, serious difficulties were encountered, chief among which were the strange and unaccountable noises heard in the receiving instruments. There were many causes for these noises—a swinging wire, the passing of clouds or bodies of air charged with electricity causing currents to flow to or from the earth—the proximity of other wires, etc. Telegraphic signals could be heard in the telephones on a line running parallel with a neighboring telegraph line for a very short distance.

When two telephone lines ran side by side, a conversation carried on over one line might be heard on the other. This phenomenon was aptly termed "cross talk."

Cross talk was a serious handicap and had to be removed. After many months of experimentation a plan was hit on to remove induction and cross-talk interference.

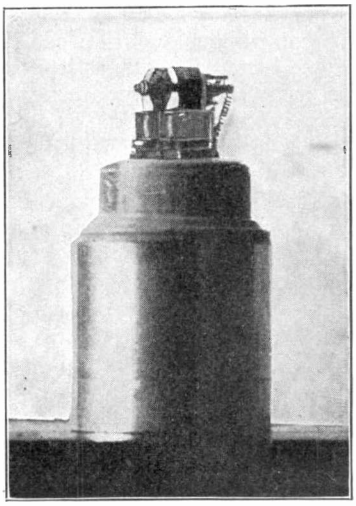
This was accomplished on the Philadelphia line where there were ten or more pairs of wires on the poles and was done by "transposing" as it is called. This means simply the changing of the relation of each wire with its neighbors by crossing over at short distances, a change every mile on some wires to every quarter mile on others.

The Philadelphia line. was followed by the construction of a similar line to Boston, another to Albany and Buffalo and an extension of the Philadelphia line to Pittsburg, using wire 172 pounds to the mile. As a result of a long series of experiments it was found that the use of this size of wire was good only for about 500 miles, and this fact led to the adoption of copper wire weighing 435 pounds to the mile as the size to be used between New York and Chicago, the great objective point of the long distance lines at that time.

The first line to Chicago was completed in 1892 and Alexander Graham Bell, on the 18th of October talked from the New York office to the Mayor of Chicago and others present at the Chicago end of the line on Quincy Street.

SMALLEST MOTOR IN THE WORLD

M. G. Trevet, a French mechanic, recently constructed at Bellevue an electric motor so exceedingly small as to be worthy of the honor of being submitted to the French Academy of Sciences. This motor though probably the smallest in the world is a carefully constructed machine, comprising all the essential parts of an industrial unit, with a Gramme ring armature, the inductor shaft of which is only 0.59 inch in length. The field coil of the machine (which is practically the same size as shown in the illustration) comprises no less than 600 turns of a wire obviously of extremely small diameter, some hundredths of a millimeter.



SMALLEST MOTOR IN THE WORLD

The rotating part or armature of the motor is only 0.244 inch in diameter. In spite of these minute dimensions it is most carefully subdivided, being provided with twelve teeth and coils wound in six sections of an aggregate of 288 turns, the useful length of wires being 65.5 inches.

The commutator consists of six minute plates kept together by ivory cones and insulated by ebonite plates, the diameter of the whole being only 0.11 inch. Each of the brushes consists of two plates kept together by three rivetted cross-stays and pressed permanently against the commutator by a ring, screw and spring. They are 0.118 inch in length, 0.039 inch in width and only 0.027 inch in height, and capable of a most accurate adjustment. The shaft of the motor is 0.031 inch in dameter.

The consumption of energy in full operation is 0.7 watt or 0.00093 horsepower. The total weight of the machine is 0.0154 pound.

Edison and His Work

It is a good thing that Americans should be made better acquainted with their greatest living fellow countryman, Thomas A. Edison. Most people will arise from reading the recent biography of him, it is certain, with a very different impression from what they had before. This life, by Frank L. Dyer and T. Commerford Martin, issued in two volumes by Harper & Brothers, is not only the story of a wonderful career, typically American, but reveals the amazing extent of one man's inventive work and his deep imprint on several leading industries. Incidentally, with Eidson as the central figure, it is a vivid and complete history of electrical development during the most fruitful period of the most modern of arts and sciences.

There are some advantages in getting the biography of a great man while he is still alive, even if he goes on adding to the luster of his fame after it appears. For one thing he has a chance to know something about it himself. In this instance, Edison has read every word, and the book is published with his express consent. Little chance for error or misstatement there! Moreover at many points in the narrative Edison contributes racy pages of autobiography, some dictated but much of it written in his own hand. One of the authors, Mr. Martin, to whom the bulk of the text is due, has been a leading electrical editor and author for thirty years, and began such work in Edison's laboratory and service. The other, Mr. Dyer, has charge of Edison's business and legal affairs, and for years has conducted all his patent suits and the patenting of his multitudinous inventions. In other words, the biography has been written from the inside, and not from the outside by some one attracted by the opportunity of the theme. To the aid of Messrs. Dyer and Martin came Mr. W. H. Meadowcroft, another old Edison man and electrical writer, who spent over two years ransacking Edison's papers, files, notebooks and records, to make sure of every point. Other competent men have helped, like Mr. Samuel Insull, for years Edison's private secretary and *Fidus Achates;* or like Mr. Francis Jehl, who gives an intensely interesting account of early days at the famous Menlo Park laboratory, from which came in such swift and startling succession the Edison telephone, incandescent lamp, dynamo, complete lighting system, phonograph, motion picture apparatus, and a host of other inventions there conceived but hammered out at Llewellyn Park. Last but not least Mrs. Edison has furnished from her own collection several special and unique photographs of her distinguished husband. All this goes to the making of a remarkable book, not only lifelike in its picture, but authentic and authoritative forever.

The scheme of the book may be commended. The story of the life is allowed to proceed naturally from stage to stage, and around it is woven the story of the art. Thus we see the youthful environment of the inventor and come to understand the process of his mental development and his relation to the times. Then other chapters are devoted to the social side of Ed son; to his methods of inventing; to his place as a manufacturer; to his vast struggles in the courts to sustain fundamental patents; to the value of his inventions. All this is done in a stirring manner; with an excellent style in narration; and the book literally teems with anecdote, always the more racy when told, as it often is, by Edison himself. Picture after picture of events is presented: Edison as a little boy sitting on goose eggs to hatch them; as a telegraph operator in the South in war days, getting free lunch at night at a church nearby, where the man with the Reno wheel was in the pulpit and the gamblers sat in the pews; as a youthful experimenter in Boston making nitroglycerine and dropping it into the sewer in alarm to get rid of it; as a ticker operator on Black Friday in New York climbing on top of the Western Union booth in the Exchange to watch the excitement and glad he was poor; as an inventor listening awestruck to his own first telephone as it talked and sang; as a leader of the workers at Menlo Park watching the fitful gleam of the first incandescent lamps; as a pioneer of lighting in New York, sleeping on iron pipes in a cellar or listening through the watches of the night while his friends "Adonis" Dixey recited to him or Remenyi fiddled; as a visitor to Europe occupying the French President's box at the Opera by invitation; as an American story teller trying in Germany to make Helmholtz

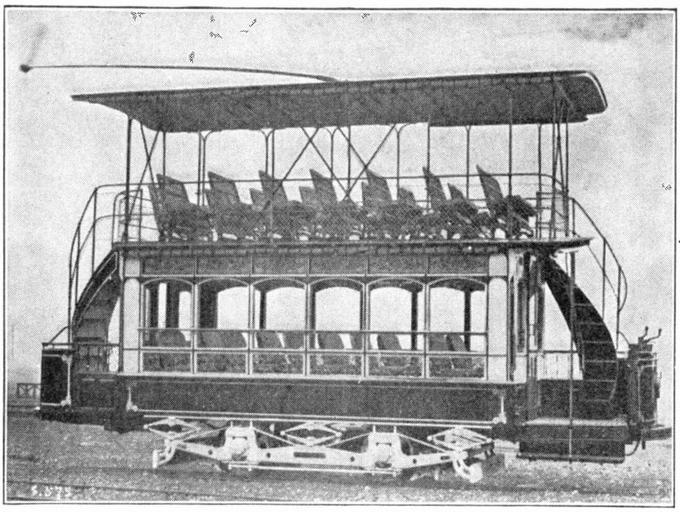
HITHERTO UNPUBLISHED PHOTOGRAPH OF THOMAS A. EDISON IN FRIENDLY POSE WITH T. COMMERFORD MARTIN, ONE OF THE AUTHORS OF THE EDISON BIOGRAPHY catch the point of a joke. Such striking episodes are endless and all go to complete the portraiture.

But the great impression given by the book, when all is said, is that of Edison's marvellous patience and perseverance. Here we put our hand on the secret of the long series of gifts to mankind; of his additions to our resources of civilization; of his triumphs over nature and the unknown. It does not follow that every man, with equal effort, could produce like results; but it may safely be asserted that no one, young or old, can read this record of indomitable and dogged resolution to reach each goal, without being stimulated in other strenuous tasks. It is a splendid book to put in the hands of young men. They may not work 48 and 72 hours at a stretch, or be called on to make 50,000 experiments as he has done along a single line, but if they are to amount to anything they will have difficulties and obstacles to overcome. Edison bids them follow his path to success and shows them how.

This "book of the year," is all the more valuable for having a complete, dated list of all Edison's patents; and a series of appendices each devoted, in the style of POPULAR ELECTRICITY, to an illustrated analysis of his patents or any group of inventions. In this manner the pages of the story are not overloaded with technique, but he who wants to know all about it, has the one part of the work to supplement the other. Electrical biography has need of such books as this, which cannot be given too hearty a welcome.

FRESH AIR TROLLEY CARS

The history of electric street cars has been replete with vacillations, as there are many tastes and ideas to be met, and yet there is a general sameness to the types used throughout this country. But when we cross the ocean we find other types, embodying changes due partly to the easier going pace of the public and partly to the milder climate which is more conducive to outdoor traveling. In countries like England, where locked compartments are still expected on the railroads, our summer style of cars open to a running board at the side would hardly meet with general favor. But there is an approach to these in a closed car with an open smoking compartment at each end.



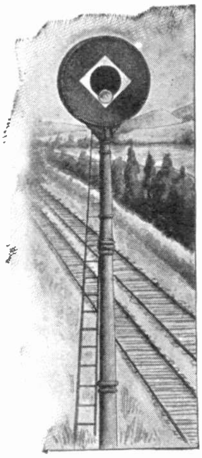
FRESH AIR TROLLEY CAR

In this country the recent tendencies have all been towards cars which can be filled and emptied with the least delay, hence the stairways and small platforms of the British types would be out of the question. Where the delays when stopping are not so serious, a much better chance for viewing the scenery along the route can be given by double-decking the cars, as is done in the tramway cars of which Hurst, Nelson & Co. Ltd. have built nearly a thousand for the London County Council during the last few years. Some of these British double-deckers have open observation platforms at each end, while others have the whole upper story open down to its floor. Perhaps if the fresh air agitation fathered by the anti-tuberculosis societies continues, we will have similar cars in this country, but at present Great Britain is certainly ahead of us.

Electric Block Signaling

By SIMON DEUTSCH, E. E.

PART II



Although quick to voice its opinion, the general public is as yet entirely unfamiliar with the requirements, operation and detail features of train protection. For this reason, among others, Congress but recently appointed a body of experts, and appropriated a considerable fund for investigation and recommendation of appliances properly to protect and facilitate train movements. This work is in the hands of the Interstate Commerce Commission, and has for its purpose the enactment of legislative measures by Congress, compelling railroads to install protective devices to safeguard the lives of their patrons and employees.

That train accidents are of too frequent occurrence on our railways is generally recognized, and perhaps, strange as it may seem, by no one more keely than by the operating officials of these railways. Accidents and delays are items of enormous expense to a railway, and it is safe to assume that these same officials on whom we generally place all blame, expend more energetic effort to prevent accidents than onyone else. Still these same men must show profit from the divisions for which they are responsible just as would be expected of any department managers of a mercantile business, and investments tending to cut heavily into these profits necessarily must be eliminated.

With the equipment and ingenuity now available it is theoretically possible to protect every foot of rail for all classes of traffic, but it must be understood that the expense of installing, operating and maintaining such complete protection would be so enormous as to be prohibitive on all but a very few railroads, as same would in all probability exceed the net revenues of the road.

LANGUAGE OF SIGNALS

Fig. 1 is a graphical representation of the language of signals. The presence or absence of a train in a "block" is indicated by the signal or signals governing that "block."

The "home" semaphore, or "position" signal, indicates "danger" or "stop" when the blade or arm is at right angles to the signal pole.

The "clear" or "proceed" indication is given when the blade is 60° or 90° from the horizontal. The same indications are displayed at night by lights, red for "danger" and generally green or white for "clear".

The same positions and indications displayed by "distant" signals, regulate the approach of trains to the "home" signals; the "distant" signal being the warning signal.

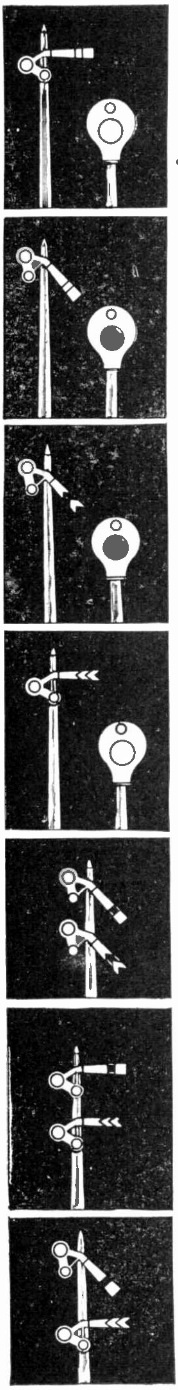
Where no semaphore signals are used, all indications being given by lights placed behind colored lenses, the red and white are generally used, conveying the same information as the lights of the semaphore or disk signal.

LOCK AND BLOCK SYSTEM

The numerous difficulties arising in the proper signaling of single track road, is due to the fact that it is necessary to protect trains not only moving in the same direction, but also in opposite directions on the same track.

Most of the mileage of the railroads in this country is single track, on which trains operate in both directions. Over the greater portion of this mileage, trains are still handled under the simple telegraph block system, described briefly in the preceding article, and with which most of us are more or less familiar. This system depends entirely upon the care and watchfulness of the operator and becomes inefficient with increase in traffic.

It can be somewhat safeguarded by adding to it such features as to compel the operators at both the entrance and exit of a block to co-operate with each other before being able to give a clear signal to an approaching train. This is generally accomplished by means of a



Home signals showing "Stop".

Home signals showing "Clear" or "Proceed."

Distant signals showing "Clear" or "Proceed"

Distant signals showing "Proceed" with caution to next signal.

Signals showing two blocks in advance are "Clear".

Home and distant signals showing "Stop".

Home signal showing "Clear" or "Proceed" but distant signal, showing second block in advance occupied and to be approached with caution.

FIG. 1. THE LANGUAGE OF SIGNALS

combined operating and locking device similar to that shown in Fig. 2.

Fig. 3 shows the interior of the instrument, the upper part containing the electric locking and release device, and the lower part the mechanical signal operating mechanism. The locking and release feature consists of a rotary switch, for closing and opening the controlling current, and a pair of electromagnets, which when properly energized unlocks the plunger mechanically locking the signal operating mechanism. By pulling out the plunger, the signal operating lever is unlocked, and same can be rotated, which it will be noted, operates the signal blade.

Fig. 3 clearly shows the pipe connections between the signal blades and station instrument.

For communicating with each other, a bell code is generally installed between block stations, operators conveying information by pressing a push button a prescribed number of times, which rings an electric bell a like number of times. This is a very simple circuit, and generally installed independent of the station instrument circuits.

Fig. 5 shows diagrammatically, a typical layout and wiring between block stations. (A), (B) and (C) represent the three block stations on a single track road, and all trains approaching or entering the blocks (AB) and (BC) are governed by the train order signals in front of each of the stations.

Supposing a train wishes to move from (A) to (B); the operator at (A) must ask the operator at (B), by means of the bell code, to unlock his machine so that he (A) can turn his signal to "proceed" position.

No train being in the block and the opposing signal at (B) being at "stop," the operator at (B) so manipulates his unlocking key as to close an electric circuit from a battery at (B) through the interlocking key, held in its proper position, and the coils of an electromagnet at (A). This action releases a hand lock, which is moved to unlock the signal crank, allowing the operator at (A) to clear his signal. After the train has entered the block and has been so reported, the signalman at (A) must return his signal to the danger position. In doing so the lock on the operating crank is forced home, thereby compelling the operator to obtain another release in order to again clear the signal.

Referring to the same diagram, the description of the circuit is as follows:

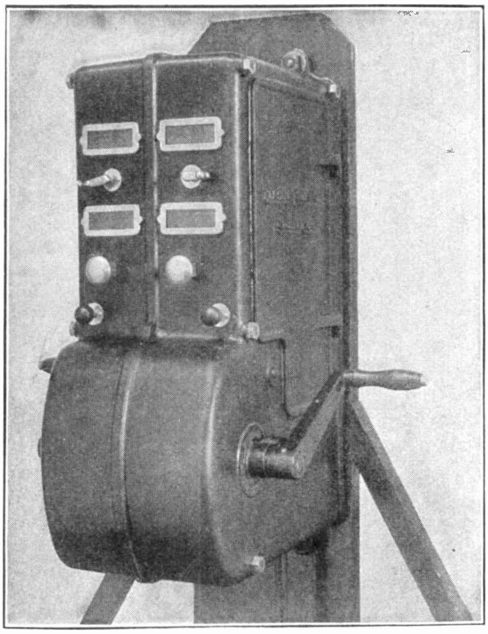


FIG. 2. COMBINED OPERATING AND LOCKING DEVICE

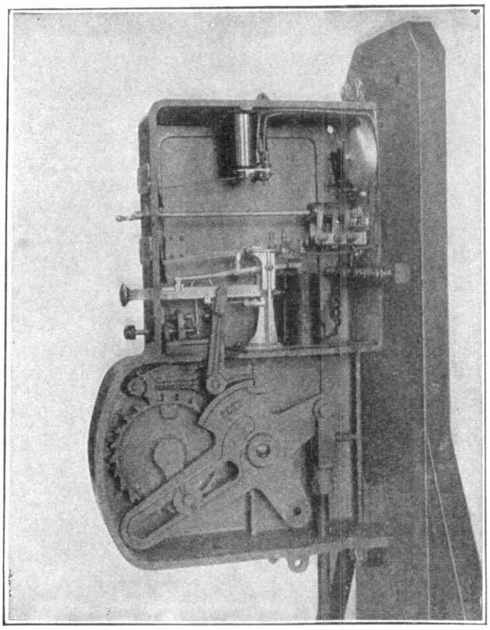


FIG. 3. INTERIOR OF OPERATING AND LOCKING DEVICE

The operator at (A) wishes to clear signal for train from (A)' to (B). (A) asks (B) to unlock (A's) machine; the conditions being right, (B) closes the circuit controller by moving the handle (12). The opposing signal at (B) being in the danger position and the operating lever locked, the circuit breakers on the signal arm and on the electric lock are closed. The operator at (A) now closes contact (10) by moving handle (13). Current then flows from the battery at (B) over wire (1), contact (2), contact (3), wire (8), through magnet coils in the indicator at (B), and magnet coils on the indicator contact (10), wire (11), coils of the unlocking magnet to ground. The unlocking magnet is now energized to release the lever of plunger lock (15). Plunger (15) being moved in turn releases the lock (17) on signal lever (19). The operator at (A) may now move lever (19) one-half revolution to clear the signal. After the train has passed the signal is restored to the "stop" position by the operator. To restore the signal to stop position, the lever (19) is moved in the same direction as to clear the signal, the revolution being completed.

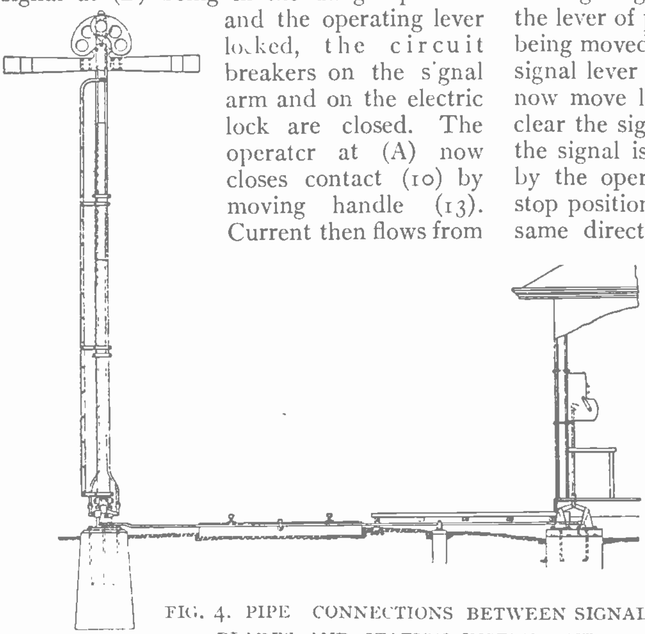


FIG. 4. PIPE CONNECTIONS BETWEEN SIGNAL BLADES AND STATION INSTRUMENT

To prevent the lever from being turned except in the proper direction, a ratchet wheel (18) is mounted on the crank shaft. On this ratchet wheel a lug (22) is fixed, which, when the signal lever (19) is almost restored to its normal position, so engages with arm (23) as to force the lock (17) home, thereby preventing the signal from being again cleared until it has been again unlocked. The

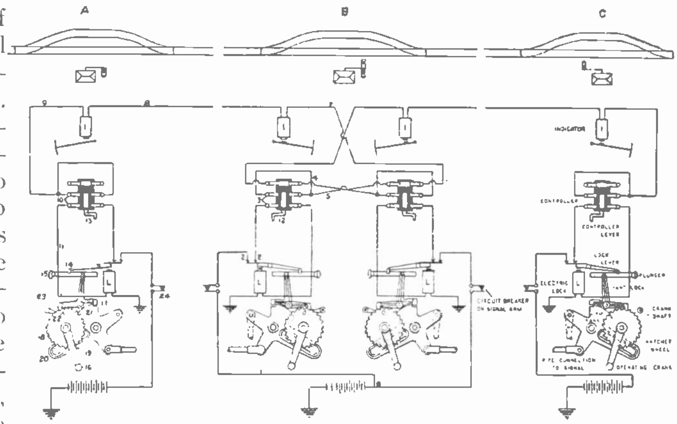


FIG. 5. TYPICAL LAY-OUT AND WIRING BETWEEN BLOCK STATIONS

electric indicators are part of the machine, and serve to tell the operators when the machine is unlocked or "released".

In this particular arrangement of the system no semi-automatic device is used to restore the signal to the stop position after the train has passed it. To obviate the danger arising from the neglect of a signal man to restore his signal to the normal position, there is usually embodied in the rules, one, that when enginemen do not see a signal change from "stop" to "proceed," such a signal must be regarded as an imperfectly displayed signal, and be governed accordingly. That is, enginemen and trainmen must see the signal change from "stop," to "proceed," otherwise must not pass it, *irrespective* of the position of the signal. Inasmuch as enginemen and trainmen must be depended upon for the proper observance of the block signals, this rule is considered sufficient for the purpose.

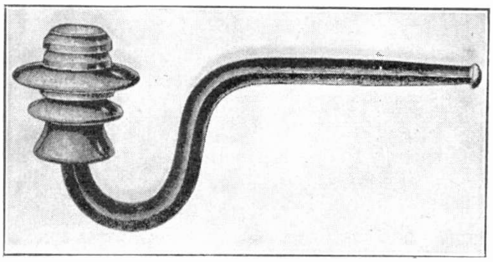
Although controlling devices of this kind installed in the manner described do not afford absolute protection in the movement of trains, still a large measure of safety is obtained by this system, which holds two signalmen responsible for the proper display of signals at each end of the block.

The realization of the need of still better means of protection and the solution of these needs in the simple manner made possible by the introduction of the "track circuit" will be of much interest to the followers of these articles, and will be fully described in the following issue.

(To be continued.)

A High Voltage Cigar Holder

The superiority of some classes of American electrical apparatus over those made in Europe has given the impression to many that electrical devices are not familiar to the average European. In the more progressive countries this certainly is not the case. Indeed, the use of electricity and its economical distribution at high voltages is now so common that the very shape of the insulators used on high voltage transmission lines has become a symbol of the up-to-date. Various novelties and items of jewelry have been fashioned in this shape and now an enterprising German firm is making pipes and cigar holders patterned after the electrical line construction. For these the bowl is shaped


A HIGH VOLTAGE CIGAR HOLDER

like the high voltage insulators used on the continent, while the shank copies the lines of the steel brackets which support these insulators on the better class of construction.

Electric Dredges in the Klondike

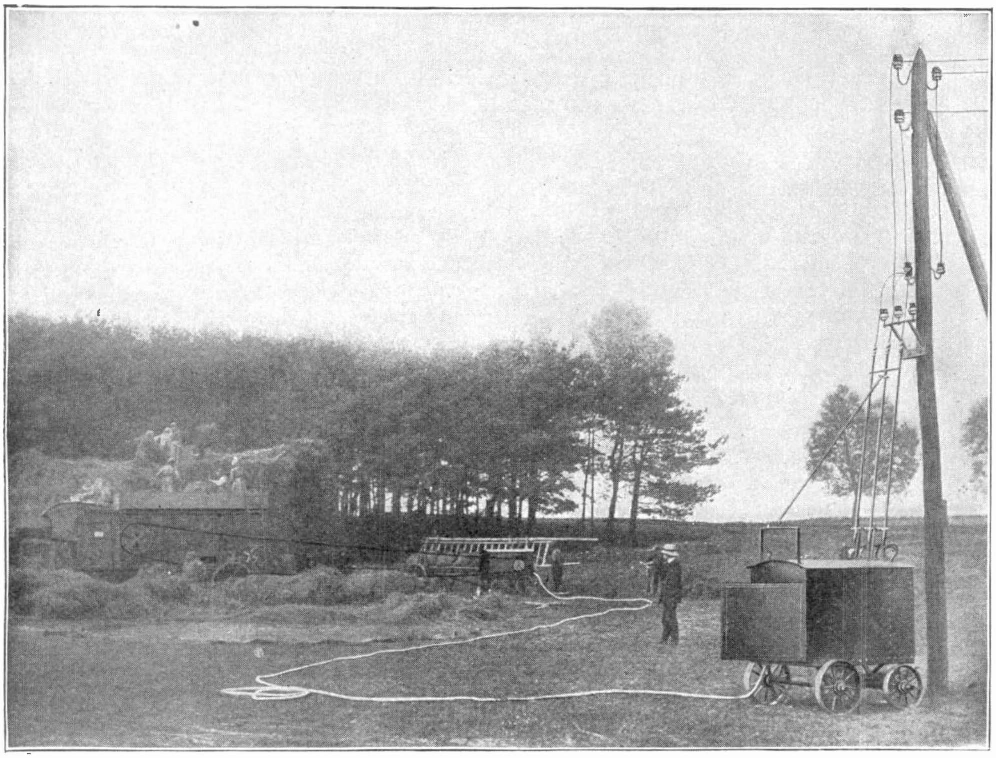
One gold mining company is building a six-mile ditch capable of carrying 20,000 miners' inches of water to supply a powerhouse for furnishing electrical power for dredges it intends building in the near future. It also intends furnishing power to other dredging companies.

Part of the machinery for this plant has already arrived at Dawson and the balance is on the way. The company contemplates decreasing the size of the ditch and adding to the powerhouse in a short time. The machinery and supplies for this powerhouse were principally purchased in the United States.

Electrical Threshing

One of the live problems now agitating both the electrical manufacturers of Europe and the leading agriculturists is that of using electricity as a source of power for farm work, preferably from central stations located in neighboring cities. All parties agree that the hours during which the power would be used in and about the fields would be almost wholly during the summer days or at the very time when there is little demand upon any electric light company for current to be used in lighting houses or stores. But when it comes to figuring out the distances to which such electric power can be transmitted economically for field use, the authorities disagree, partly because conditions vary so much at different points. However, it now seems to be generally acknowledged that the farms offer a paying class of current-users for what the Germans call "Overland Central Stations." By this they mean electric light companies supplying a network of cities not far from each other but with farm lands intervening, to which current can be supplied at a fair profit for the electric lighting company and at a decided saving in time and labor for the progressive farmer.

Of course the transmission of the current from one city to another is at high voltages which cannot be used with safety unless first transformed to a lower potential. This is usually done for city purposes by transformers located in substations or mounted on poles, but the scattering of transformers over a large farm would take too much of an investment. The modern German farmer therefore uses a portable transformer mounted in a little wagon, from which poles can make contact with the wires at various parts of the field while the low voltage current is led through an insulated cable to a motor on another cart. This makes threshing easy without the former risk of fire from the portable boiler and the motor-transformer carts can be quickly moved about for use with other machinery or implements.



MODERN GERMAN FARMER'S THRESHING OUTFIT

SIDE-LIGHTS ON ANCIENT HISTORY

TRANSCRIBED BY

EDWIN HULL ARMSTRONG

Egyptologists will be overjoyed to learn that recent excavations have brought to light some ancient newspapers printed in the land of the Pharaohs. It seems from the wording of the few clippings here reproduced that electricity was known to the ancients. Of course there are some who will question the authenticity of these records. May be so. We simply offer them at their face value.

Rameses II was seriously indisposed last Saturday night. These spells of indisposition to which Rameses II is subject are not, as a rule considered dangerous. At such times the Court Physician wraps a wet rag about the forehead of Rameses II and puts him to bed. Should anyone call, the attendant is instructed to say that his Royal Highness is suffering from Champaignus Quart Cupus or some such medical term, and that he will be O. K. in the morning.

Last Saturday night, however, Rameses II got so bad that something had to be done and that suddenly. The Court Physician was over attending a reception in the "Queen Room" in the Cheops Pyramid. As there was no one else handy the attendant called in an electric "Specialist," the kind that advertises the great curative properties of "Electric Belts," etc.

Magnetic friction of the cerebral torque

A call was left for the eminent Electro-Therapeutic Specialist, Dr. Potipariaoh and together with the "Belt Doctor" they worked over the distinguished patient.

After an examination Dr. Potipariaoh issued the following bulletin which speedily quieted public fears. This is the bulletin, word for word.

"Found patient suffering from magnetic declination, which was immediately followed by magnetic concentration. This condition quickly gave way to "Frying of the Arc" which everyone knows is usually fatal. We applied the battery and magnetic friction of the cerebral torque began to assert itself and magnetic limit was soon reached.

The ammeter showed anomalous deviation and valvular hysteresis.

The selenium resistance was series-multiple. Applying the cryptoscope was able to remove the cupric electrolysis that had accumulated as a result of the electric belt.

We cut out the heliotropism and succeeded in harveyizing the left-handed helix. My companion wished to experiment farther but I told him never to monkey with a right-handed helix."

The patient is doing nicely now, but the above shows that he had a close call.—*Cheops Therapeutic Record.*

◇

Cleopatra mailed Mark Antony a postal card. On it she asked him to meet her under the arc light near the Post Office. She suggested that Mark should have a white rose in his right hand, and that it would look cute if he could wear a couple of kingdoms under his tunic. Mark was there and Cleo took the kingdoms home.—*Wireless message to the Rome Sentinel.*

◇

The plague of locusts was on. Locucts came in such clouds that the city was in darkness four days and the people did their chores by the light of lanterns. Many appealed to the city electrician that their incandescents were faulty. That official informed complainants that he had to haul away four wagon loads of locusts from the front of the plant before he could get the door open. The locusts literally mashed the electric light poles into the ground. It was incidentally discovered that locusts are good to produce static electricity, for during the darkest hours of yesterday it lightened and thundered from this cloud of locusts. Along about four o'clock it began to hail, and what was our surprise to find that it was hailing locusts. The original dispatch sent out to the Associated Press indicated that it hailed hail, but we declare and stick to our present contention that it hailed locusts.—*Cairo Meteorologist.*

◇

Mark Antony of Rome attended our Electrical Show the other night. There is a rumor that we are likely to lose our Queen. Those who heed any such rumor do not know Cleo. It would be just as well to let Rome or any of our rivals know that Cleopatra knows a thing or two herself. Egypt has made no specialty of the Queen business, but she is well able to hold her own when other nations trot out two such easy marks as Mark Antony and Julius Ceasar.—*Egyptian Statesman.*

◇

Benjamin, younger brother of our prime minister, must have been kept pretty close at home before coming to our great city. Over at the Electrical Show the other afternoon he had to be continuously jerked away from the machinery, and once got tangled up in a dynamo and had to be laid out.

When his brothers started for home he got separated from them, and some confidence men persuaded him to go up on the plateau to see an explosion While there, another man came up and succeeded in selling him the tomb of Rameses II for $350. He made a deposit of $40, and was going to look at some other tombs, that were still better bargains, when Inspector Flanagan in company with Ruben appeared and made the sharper give the money back.

Sold him the tomb of Rameses II

Benny will get onto the ways of this town in time, we dare say.—*Sahara Daily News.*

◇

Cleopatra and some of the Court ladies left yesterday in Cleo's new electric launch the "Dawn." They were bound for Rome, to meet Julius Caesar. The new vessel is a beauty. The body of the boat is aluminum inlaid with pearl, and the stern is solid gold. The reclining couch is silver lined with satin.

Cleopatra represented Venice rising from the waters. It is said that she looked the part. We hope the voyage will be successful as the outcome means much to Egypt. With the application of storage batteries to launches and land vehicles it appears that we are at the beginning of a slaveless age —*Nile Marine News.*

Bound for Rome to meet Julius Ceasar

◇

The editor of the *Age of Mystery* is an old mossback fossil. He has not had a real thought since he undertook to record the aimless wanderings of a disordered fancy.

When he alludes to us as an "upstart" because we have ceaselessly advocated the use of electricity, he displays his ignorance and invites his friends to walk slow behind him. Unless he makes himself less frequent in passing remarks about us we will put a dent in his jawbone, and scatter his false teeth to the desert winds. If he feels the least bit interested in how well we like him, let him step up to the plateau where we have a large force of men working on his tomb. Let him come over some day and try our newly patented electric chair. We will guarantee entire satisfaction. After that he can enter into that perfect rest where he will be more appreciated than at present, while we continue our march of progress.—*Cairo Electric Shock.*

◇

The locusts fell so thick that they broke the backs of all the cattle that were exposed to the fury of that terrible east wind, And where the cattle were under sheds, the locusts broke down the sheds and the cattle were exposed to danger by falling timbers.

The Cairo and Alexandria electric cars were put out of commission early the first day. As the line operates upon the third-rail system the contact shoes were able to collect no juice other than locust juice, which will not drive the motors. The frog plague is even worse. Frog legs have gone down until you can buy them for 20 cents a gross. Dr. Potiplaris suggests that we import Frenchmen to eat the frogs legs. The Nubian electric freight line brought in a carload of frog legs and they stood on a sidetrack until the ice in which they were packed melted and then the shippers were compelled to sell them for a dollar and a half a ton for pig feed. Two or three department stores used frogs legs instead of trading stamps, and one newspaper (it was a yellow journal) used frogs legs for premiums in a voting contest.—*Egyptian Outlook.*

◇

About the time electricity was first used the city of Thebes was very corrupt. They would try a man for bribing a legislator. Then they would try the jury that tried the man. Afterwards they would try the judge. They did not get that system entirely weeded out until they tried the judge and the jury first. Often they would have to electrocute the whole bunch.—*Cairo Legal News.*

Talks With the Judge

LONG DISTANCE TRANSMISSION

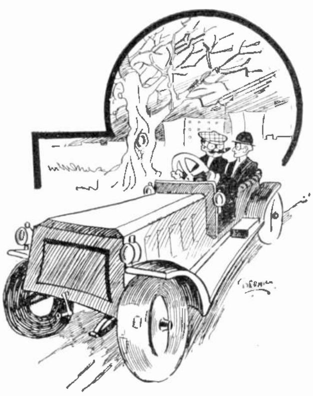
"I see by the paper that they are going to build another big power plant in California and are going to transmit current one or two hundred miles. How is it done"?

We were both in the Judge's automobile. He had just shaken hands with the crank without being hurled as usual and he was in a satisfied frame of mind. As he advanced the spark to let her out a bit, of course his mind traveled to the cylinder and then back along the ignition circuit to the induction coil, which was enough to get him started on electricity.

"Very simple proposition, I assure you," I replied. "Want the dope on it?"

"Sure," said the Judge, reprimanding an old man with a glance while he sawed his legs with the running board.

"Well, then," I began, "two things made long-distance transmission of electricity possible—alternating current and the development of the high tension insulator. The principle involved in sending electricity over great distances is to use a very high voltage or pressure, with a correspondingly small current. The power transmitted over a wire is represented by the product of volts times amperes, or pressure times current. There is another factor entering in alternating current calculations, called the power factor, but I can't explain it to you and besides it does not alter the general principle of the thing. To transmit a lot of power over a wire, therefore, if you use a very high voltage you can get along with comparatively few amperes. As the size of the wire is proportional to the number of amperes carried, you can get along with a small wire by using a high voltage and low amperage. It is just the same as though you were to undertake to pump a given amount of water through a pipe. If you were to use a pressure of ten pounds per square inch, you would need to have a large pipe to get the water through very fast. On the other hand if you were to use 100 pounds pressure per square inch, you could get the same amount of water through a very much smaller pipe, thereby saving money on the pipe.



We were both in the Judge's automobile

"Before alternating current came into use, it was impossible to obtain current at high voltage except by building a special and very costly dynamo, and even then they could only get a few thousand volts. To attempt to transmit many miles with only, say, five or six thousand volts available pressure meant that to get much power over a line a very great current in amperes would need to be sent over it—remember power equals volts times amperes. As a consequence the copper wires would have been so large and costly as to be out of the question. They would have needed to have been veritable bars of copper.

"Then along came alternating current, and with it the transformer, a comparatively inexpensive device, which will take the current from an alternating dynamo and step up the voltage almost to any point desired. Suddenly, then, engineers had equipment available for producing current at high voltages, first, 20,000 to 50,000 and lately even at 125,000 volts. Then long distance transmission became possible, for with the high voltages it was possible to use wires small enough so that to transmit current over a distance of several hundred miles, the interest on the money invested in copper wires would not be out of proportion to the receipts from the sale of the power.

"The development of long-distance transmission from fifteen or 20 miles, at first, to over 300 miles, has been largely a matter of developing insulators which would prevent the current from leaking out of or slopping over from the line. Lately, as I said, they have produced insulators which will carry 125,000-volt wires safely. When 200,000-volt insulators are made, wires will be reduced in size and the lines may then increase in radius another hundred miles."

Electric Bells Scare Birds

So familiar have electric bells become to most of us that even their sound at unexpected times or in unusual places rarely startles us. Not so with birds, to whom the sudden ringing of a bell on a tree or a post means something far more uncanny than any scarecrow flapping in the wind. Knowing this, the head master of an Austrian school has patented an electric scarecrow system in which a clock makes the connections at irregular intervals to electric bells scattered over the orchard. This unexpected ringing of bells now here, now there, is said to be quite effective in driving off the birds.

Angle Worms Sensitive Electrically

Most laymen, even if interested in the historic experiment which led Galvani to his memorable discoveries, do not find it either convenient or pleasant to repeat these tests with frog's legs. But the same principles which underlie this experiment, as suggested by a German teacher of physics, Dr. L. Spilger, can be performed with more generally available material. Place a bright silver dollar or half dollar on a sheet of either zinc or copper and lay an angle worm carefully on the coin. As soon as it starts to crawl off the coin to the zinc or copper it completes a galvanic circuit as is plainly shown by its twitching.

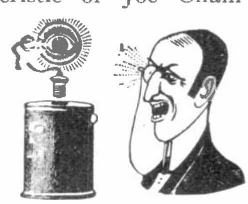
Gold vs. Silver for Mirrors

Seven centuries of silvered or silvery glass mirrors have impressed us with the idea that the really efficient looking-glass or reflector must have a silvery surface. Hence the surprise even to scientific men in finding a rival offered for this purpose, consisting of a copper reflector coated not with silver but with pure gold. With such a gold-colored reflector the percentage of red and yellow rays in the reflected light is higher than with the silvery toned mirrors and as these red and yellow rays are least absorbed by the atmosphere the light penetrates fogs more readily. In other words, a lamp of a given candle power will carry farther through the fog with a gold than with a silver reflector of the same size and shape. It is also claimed that with the former fine color distinctions can be more easily made.

This point is important not only in textile lines but even more so in warfare where protective colors are used, as for instance when a searchlight is to pick out a grey torpedo boat on a gray sea with the sky of about the same hue. A new electrolytic process recently developed in England makes it possible to obtain a fine reflecting surface during the gilding of the reflectors, and the surface thus obtained withstands the action of salt sea air better than the older mirrors.

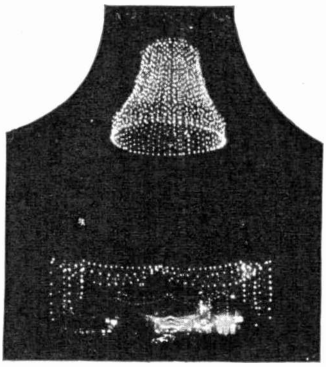
The Hypnotic Eye

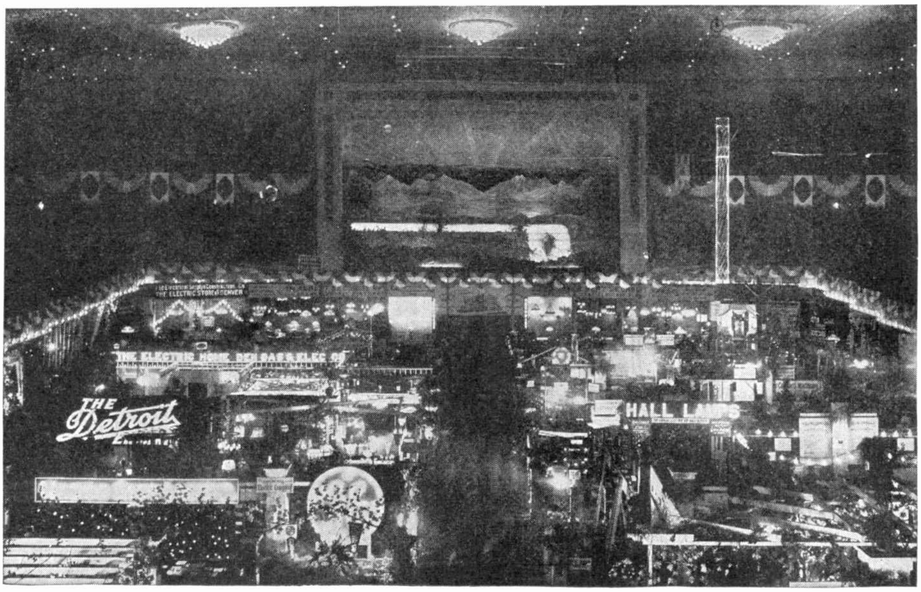
Fancy talking to a stylishly dressed man whose clothes need no label to prove their hailing from London and who is wearing that typical characteristic of Joe Chamberlain's country, the monocle. Involuntarily your eye rests on the strange monocle when suddenly this flashes with a light of its own, outdoing the dreaded "hypnotic eye" of our imaginative novelists. Such is one of the novelties offered on the British market for the benefit of those who enjoy surprising their friends. Of course it is a miniature electric lamp concealed behind the monocle which has an imitation eye painted on it, that does the flashing, current being supplied to it from a pocket battery.

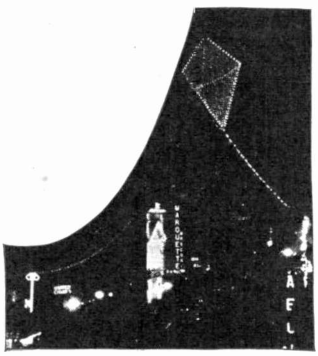

THE HYPNOTIC EYE

Illuminations at Denver's Electrical Show

On the occasion of its first Electrical Show, held in October, Denver took special steps to uphold its reputation as the City of Lights. From Eighteenth Street to the auditorium, Champa Street was curtained with electric globes, red, white and blue. In front of the Telephone Building a huge bell, constructed of lights, blazed in ultramarine blue. Curtis Street was decked in ruby lights, and at the corner of Seventeenth Street a kite, fashioned of red and white lights, seemed to hang from the sky. From the Telephone Building and the new Gas and Electric Building bomb after bomb was fired, sending into the sky little balls of pink, fluffy smoke.





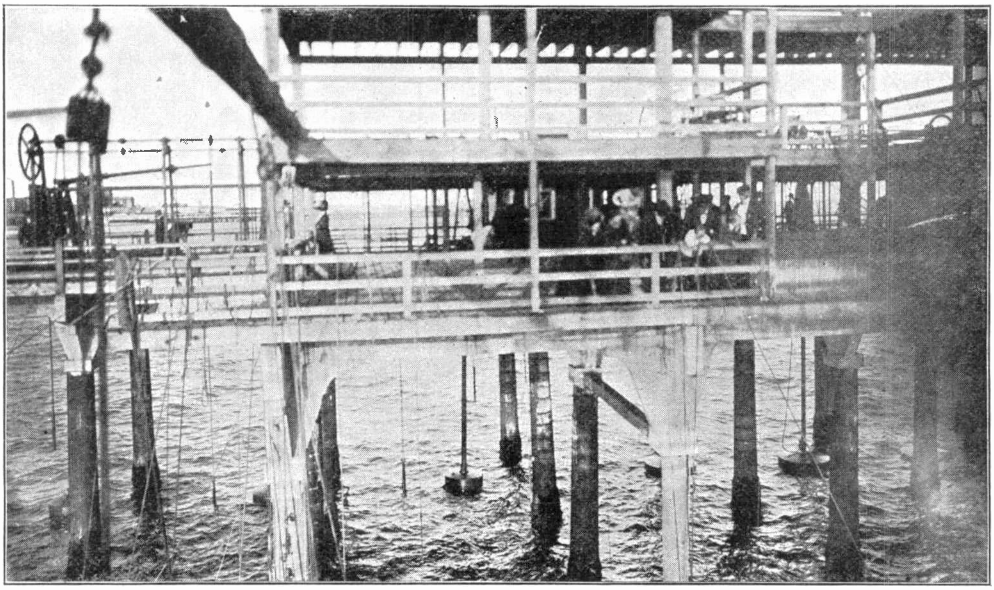


The show was held in the Auditorium, which was ablaze with light resembling Fairyland. The building was occupied by the usual manufacturers' exhibits, while in the basement the Denver Gas and Electric Company occupied a large floor space with its display, showing everything in the way of machinery and appliances used in the work of lighting a city.

There was on exhibition also in the basement the work of the boys who were taking part in the electrical competition. There were wireless telegraph outfits, electric engines, monoplanes, biplanes and a triplane, all of them made by boys from 12 to 19 years of age.

Power from Ocean Waves

The subject of the production of power from the waves of the ocean is one which has engaged the attention of scientific men and practical mechanics for many years. Whether or not a scheme will finally be evolved which will be practicable from an economic standpoint it is at present impossible to say. Some engineers in Italy have proven to their own satisfaction, if not to that of others, that the idea is not feasible as a commercial proposition. But while this arguing was taking place in Italy, a fair-sized installation which has been on the pier at Atlantic City, for some time has been demonstrating that, on a modest scale, some power at least can be developed.



THE WAVE MOTOR AT ATLANTIC CITY

Without taking sides in the argument it is not out of place here to say something of that Atlantic City installation, which some will remember having seen on one of the piers, merely as a record of one of the steps taken toward the utilization of wave energy.

In the Atlantic City wave motor an attempt is made to utilize both the up and the down motion of the waves. That this can be done was shown some time ago by Mr. D. K. Bryson of Pittsburg, with a model built into a trunk seven feet long and two feet wide, holding a seven-inch depth of water. This was fitted with a pair of buoys fourteen inches in diameter, the buoys being three-quarters full of water and attached to upright shafts connected to the mechanism by universal cone joints and ratchets. When waves were produced in the water with a swinging paddle, the buoys being lighter than the water would rise with the swell of the wave and would follow the same to its lowest depression no matter in which direction it was moving. The ratchets on the transmitting mechanism applied the power continually in one and the same direction so that the manifold motions of the water would rotate the horizontal shaft steadily in one direction. With this model the wave power would drive a six-volt generator at a speed of 2,200 revolutions per minute and at the same time would run a small air compressor.

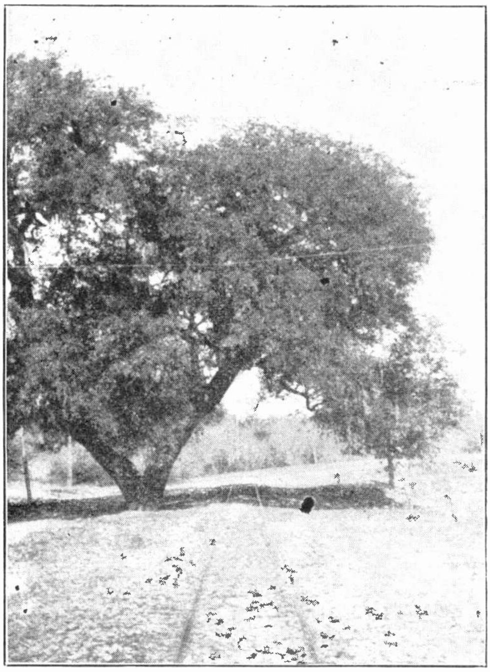
The same principles underlie the larger installations as recently tried at Atlantic City, which had buoys four feet in diameter (each displacing about 50 cubic feet of water) loaded with water to a total weight of 2,150 pounds each. This weighting of the buoys gives a larger displacement together with more power on the downward stroke and in the lateral movement. On certain occasions this installation is said to have been capable of running a 22 kilowatt dynamo also a triple action pump and another little dynamo of 2½ kilowatt capacity. No data is given, however, on the continuity of this service, the number of days on the average that the waves would run it or the cost of the installation in comparison with the possible returns from it.

It did prove however that sea waves could on occasion be made to drive quite a good-sized dynamo; which is a step of considerable importance.

For commercial installations the makers propose to use buoys in four or more parallel rows with at least eight buoys to each row, weighing about five tons each when filled, so as to insure a more uniform stroke regardless of the direction in which the sea is rolling. For electrical purposes this uniformity might be further improved, if necessary, by using some one of the speed regulators that have been developed for steadying irregular water powers. So they would have it appear the only remaining problem would be that of installing buoys sufficient in both size and number to supply the needed amount of power.

"Woodman, Spare that Tree"

The name of David Crockett is familiar to every reader of Western tales and Indian stories. In front of the old home of the famous Indian fighter still stands an ancient tree said to be over 300 years old. In extending the interurban line recently from San Antonio, Texas, to Alamo Heights sentiment refused to allow this tree to be cut down. By trimming out a few branches the traction company made a tunnel with ample space for its cars to pass through, as shown by the picture, reproduced by courtesy of the *Electric Traction Weekly*. The trolley wire was suspended from a cross-arm secured to one of the main branches.



TREE IN FRONT OF THE HOME OF DAVID CROCKETT, WITH ELECTRIC RAILWAY BENEATH

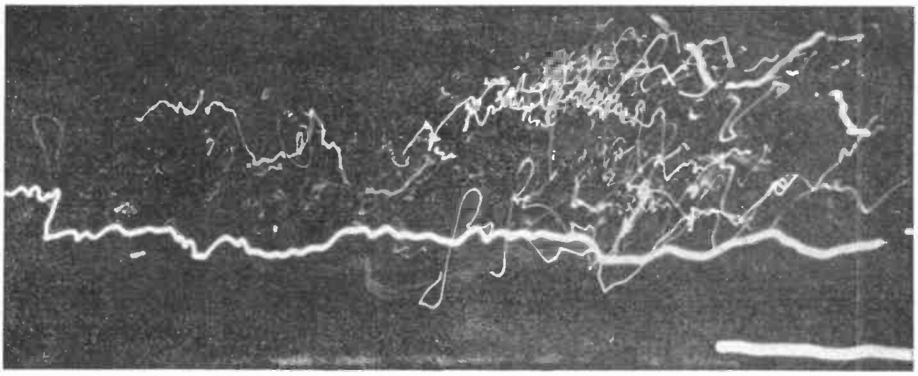
What a Moving Camera Film Shows

A writer in the *Illuminating Engineer* describes some very interesting tests made to determine the relative amount of glare produced by the window lights, electric signs, etc., in various sections of a given street. The scheme employed was in a way that of moving pictures; that is, the camera was mounted on a moving trolley car and negatives exposed directly toward the side walk and building fronts.

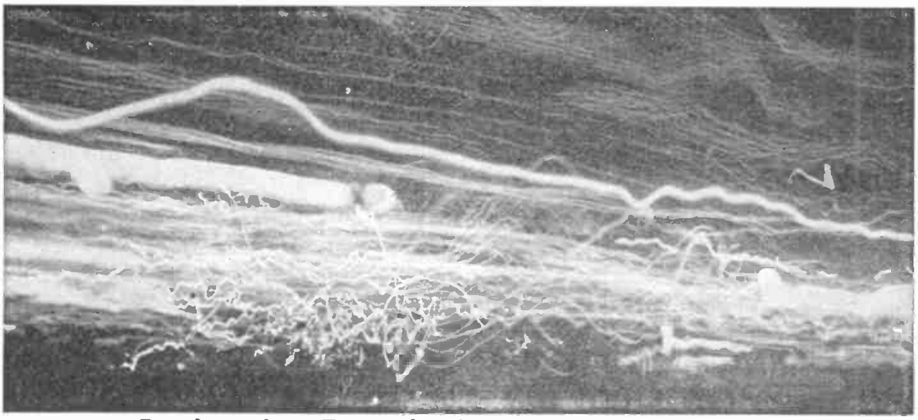
Each film was given an exposure of 90 seconds at U. S. 8 stop. An endeavor was made to screen off the camera from the headlights on automobiles and passing street cars as well as from the rows of street lamps.

The pictures were taken from a surface car running north on Broadway, New York, August 18, 1910, at about 11:30 p. m. with the camera directed towards the west side of the street.

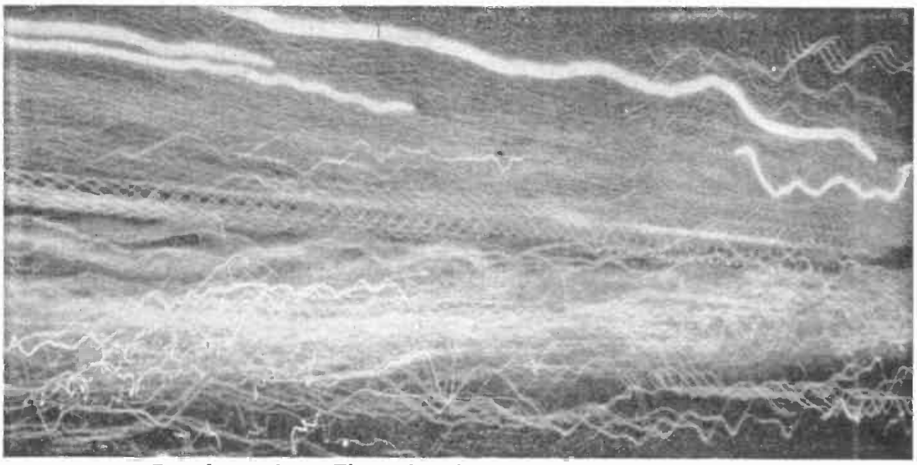
The views here shown illustrate in a novel manner the building up of street, sidewalk and show window illumination from the lower business section of Broadway, between Fifteenth and Twenty-third Streets, up and into that section known throughout the world as having the highest percentage of light flux per cubic foot of street of any English-speaking community. As the exposures were made shortly before midnight, they are but slightly representative of the business houses and show windows.



Broadway, from Fifteenth Street to Twenty-second Street



Broadway, from Twenty-fourth Street to Thirty-first Street



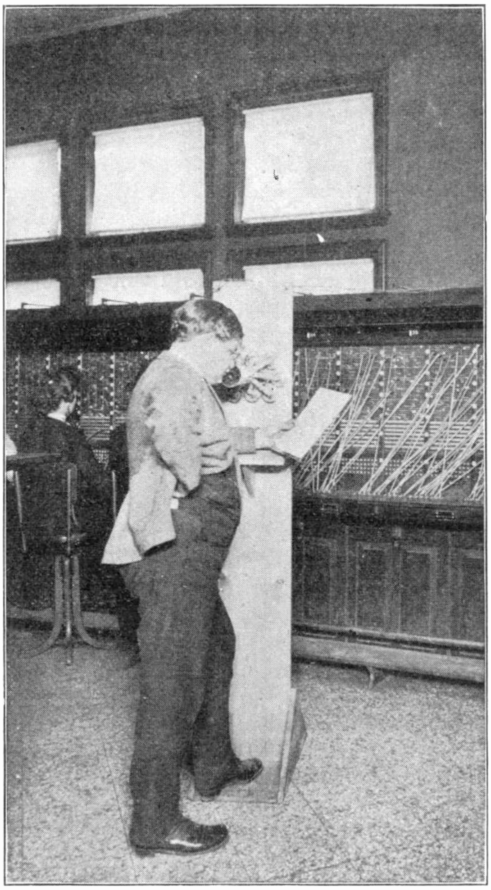
Broadway, from Thirty-fourth Street to Forty-first Street

RELATIVE GLARE ALONG BROADWAY, NEW YORK CITY, AS SHOWN BY THREE EXPOSURES OF A MOVING CAMERA

A Telephone System on Election Night

The excitement of a Mexican bull fight or of a battle for the National baseball championship pales to insignificance when contrasted with the wild, apparently distracted multitudes who fill the streets in front of newspaper offices and political clubs in a big city after the polls of a presidential or general election have closed.

Much like wild animals at feeding time, the crowd awaits hungrily and ravenously, bulletins of results from various parts of the country, and breaks into wild cheers or sullen groans or a mingling of both when the fate of this or that doubtful state or candidate is announced as swinging one way or the other.



A "READER" AT ONE OF THE EXCHANGES

Back of all the noise and human energy being set free is the silent, systematic and accurate gathering and editing of news of which the public knows little and in the doing of which the telephone is a most important factor.

On such a night in Chicago if you step to your telephone, take down the receiver and say "Bulletin, please," the operator replies, "Just a moment, and the bulletin will be read." Your call is received through what is called the "A" board and is quicky transferred, to avoid interruption of regular traffic, by way of the "B" board to other special operators who care for these inquiries and you are then at liberty to listen to the latest news condensed into the bulletin. If you saunter down the street a little later, you will probably find just being posted the information you received ten or 20 minutes before.

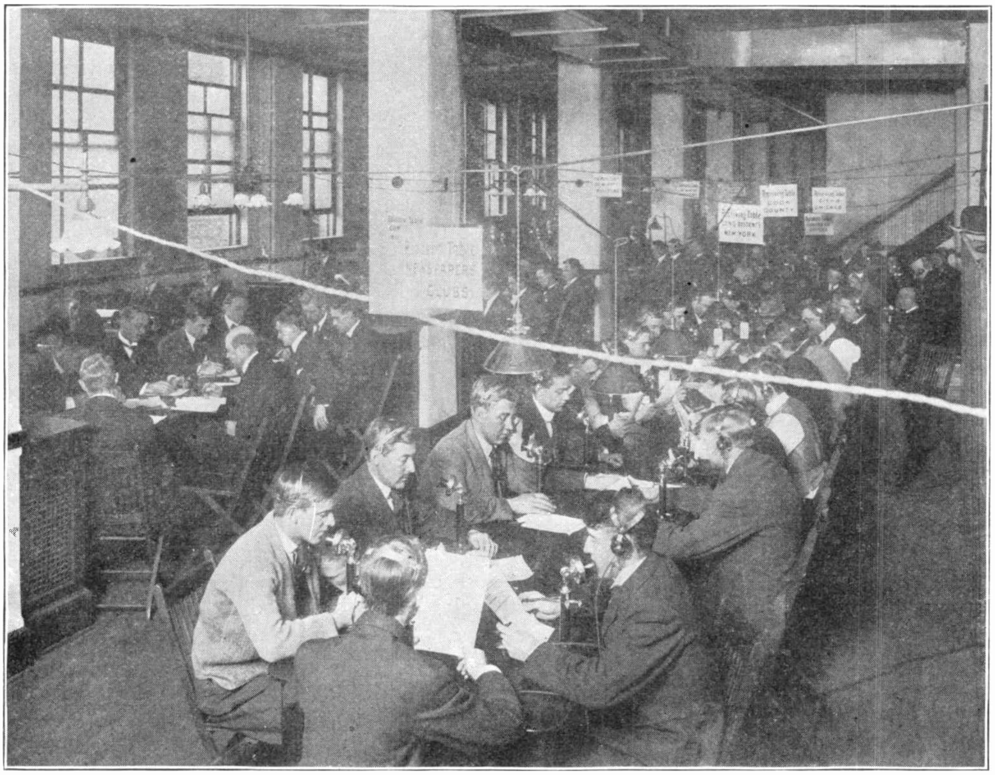
At a general election over 50,000 calls for election returns may be received in Chicago from subscribers of the Chicago Telephone Company and briefly the story of how this great increase in traffic can be cared for without delay to regular telephone calls is here told.

The picture on the next page shows you a force of men in a large room, on the sixth floor of the Toll Building. Into this room pours the information from five different sources. During the last presidential election the returns from the Chicago precincts and wards were obtained through a force of fifteen men on duty at the city hall, who transmitted the news to the receiving table in the Toll building as rapidly as it was sent in from the polling places

The toll lines throughout the ten counties covered by the company were utilized to obtain returns as fast as they were assembed at the various county seats.

The wires of the American Telephone and Telegraph Company brought returns from distant cities and especially from New York, and news was exchanged with the City Press Association and several Chicago newspapers.

The receiving table for information is shown located under the windows in the picture. After being taken down in its crude shape, the bulletin sheets were passed to the table at the farther end of the room where the matter was edited and arranged in shape to give out. Fifteen carbon copies were then made and one handed to each of the fifteen men "readers" who were telling the returns to the exchanges located in various parts of the city. At each exchange the returns were copied and placed in the hands of other readers, one of whom is shown in the picture, reading a bulletin to 100 subscribers at one time. To do this a funnel was arranged, from the base of which branch tubes ran to ten ordinary transmitters. Each transmitter was connected to ten subscribers, making a total of 100. As the reading of



RECEIVING AND EDITING THE ELECTION RETURNS

the bulletin was completed, an operator pulled out one set of 100 plugs indicating to the listeners that the bulletin was completed for the time being, while the reader by throwing a switch was connected to 100 waiting subscribers which the operator had just connected. The readers working in relays read continuously until relieved.

Such special, quick and accurate ten-minute, thirty-minute and continuous bulletin service thus provided at a time when news agencies are rivals should afford telephone users much satisfaction.

Department Store Delivers by Electrics

Electric vehicles have now been in service long enough to pass the experimental stage and to demonstrate their great superiority over horse-drawn vehicles and other tractors, especially for service in congested districts. From standpoints of economy, speed, reliability under all conditions, durability, cleanliness, in fact from almost every conceivable viewpoint the electrically driven delivery wagon has much the advantage.

One of the most recent installations of this character is that ot the Gimbel Brothers of New York, the requirements of their large store needing the service of 36 small package delivery electrics, and 30 more for heavy hauling.

These vehicles are a splendid advertisement for the owners as they go about the city streets.

Stiffening Honey Combs

One of the serious problems encountered by the apiarists or beekeepers has been that of providing a comb "foundation" or midrib upon which the bees will build the honeycomb. To get a maximum of productivity from the bees, this foundation must also serve as a source of wax from which the material for the comb can be drawn without compelling the bees to secrete it as they would consume honey if they did the latter. To make such a wax midrib inexpensively, light and yet rigid, it requires some stiffening and cardboard or paper has been repeatedly tried for this purpose. However the bees usually sense the presence of such foreign pulpy matter and in tearing it out they waste time besides damaging the comb. This is not true when a mesh of wire or a series of parallel wires are imbedded in the wax to stiffen the same, but the difficulty in that case has lain in imbedding the wires centrally. Now this problem has been solved by simply connecting the wires to an electric light circuit or a battery powerful enough to moderately heat them, the current being shut off when the wires have sunk half way through the wax. The softened wax readily rejoins over the wires, leaving these as an effective and inexpensive means of stiffening the wax rib.

Camden's Unique Fire and Burglar Alarm System

Burglars and holdup men steer clear of Camden, N. J., and for good reasons. By a combination system of mechanical signals, telephones and lights, the bold, bad man finds himself in the toils before he gets very far from the scene of any unlawful activities. The Electrical Bureau is justly proud of the whole equipment, which includes also a fine alarm system.

In the police service patrolmen are required to report to headquarters every hour. A policeman is shown in the act of doing this by pulling down a lever inside a patrol box. An officer at the station receives the report punched on a paper tape by an electric register the circuit of which the man at the box is operating. At the same time the policeman knows he is getting credit for his call by the bell in the box tapping back in response to the register. If he does not get this signal he uses the telephone in the box which lights a red lamp in front of the operator at the station who then receives the report by telephone.

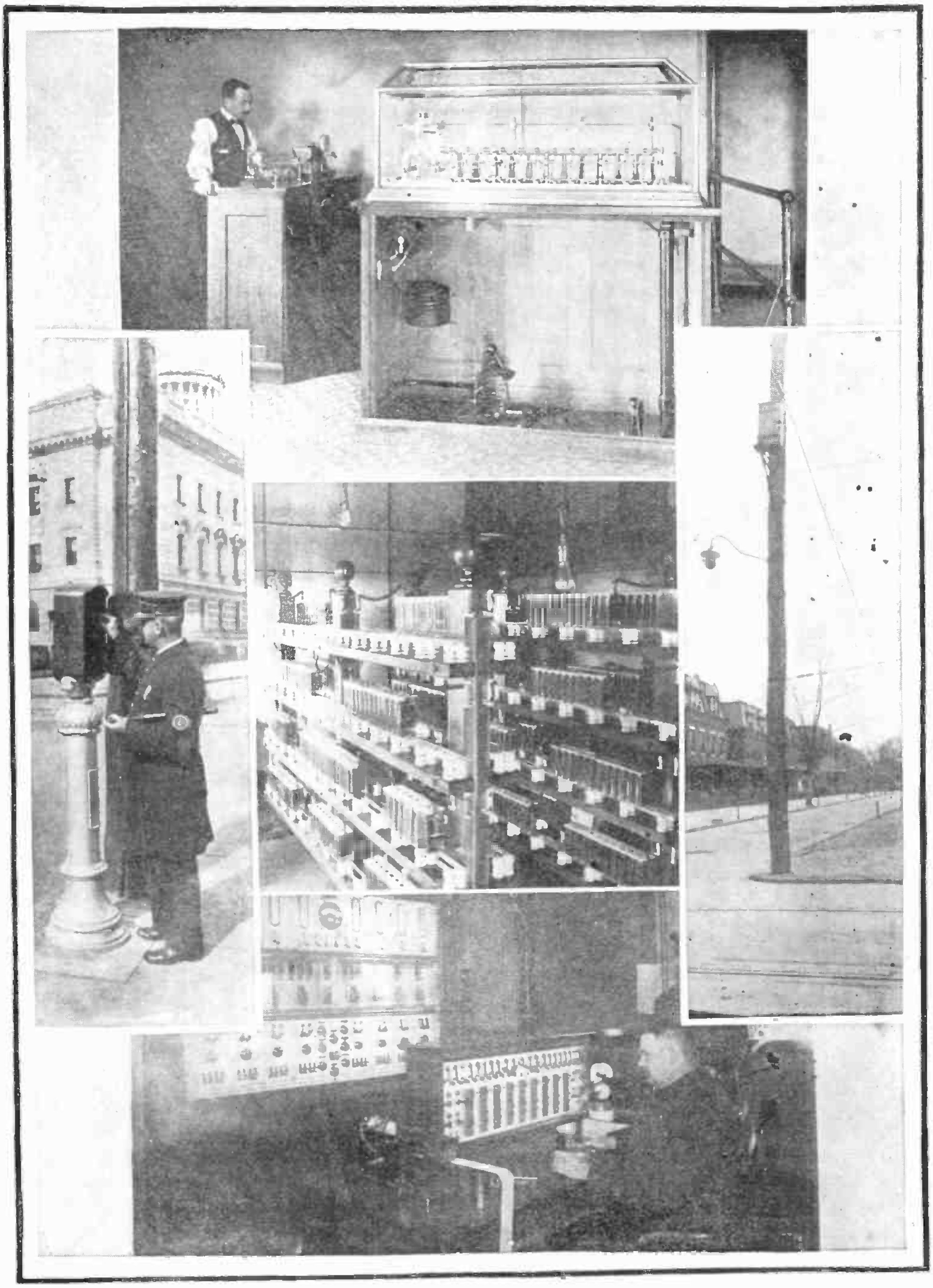
One of the best and most serviceable things in the whole system is "the lamp that flashes red." A telephone call comes in to headquarters that a residence has been burglarized. The location and a partial description of the thief is given but the patrolman has just "pulled the box" and ordinarily would not be within reach for an hour—plenty of time for the robber to escape with his booty. Not so with this system. On his way down the block from the box the patrolman is suddenly roused to action by the flashing of a red light ahead. He hurries back to the box and over the telephone receives orders to catch the thief. At the same time other patrolmen are being notified and the whole force is at once on the look-out.

Chief J. W. Kelley says, "The lights work well with us. Recently a stabbing affair took place, the offender being a colored man. It was promptly reported to the Police Department, the red lights were turned on and the man captured in 30 minutes. We got him just going on board a ferry-boat. Five minutes later he would have been out of the State."

The lights are also used in arresting "joy-riders," the first officer telephoning in the automobile number which is relayed to the man at the end of the street. Five red lights to a circuit located 23 feet in the air on convenient electric light or telephone poles are so arranged that no matter which way the patrolman may go from the box, it is impossible for him not to see one of these lights ahead of him if it flashes. Bells are also used, but the lights get a quicker response, a recent test on one circuit getting five men in two and a quarter minutes.

The Bureau's automatic fire alarm register shown in the picture is fondly called a "$3,000 beauty," the insulating blocks upon it being of onyx. This instrument records the alarm calls on a tape stamping the date, hour, minute and second. In an almost human manner it forwards the calls to the proper engine houses. Every operator in the place might drop dead but the alarms would be cared for just the same ten at a time.

To guard against any failure of current to run the systems a storage battery capable of supplying service for five days without charging is kept in readiness.



Patrolman Reporting

Automatic Fire Alarm Register
Storage Battery Room
Operator's Desk in Police Station

The Lamp that Flashes Red

Uncle Sam's New Money Car

One of the largest and heaviest electric automobiles in the world has just been specially designed and constructed for the United States government at a cost of $5,000, and, for all that it has just been placed in commission it has brought about an innovation of method and equipment so successful that it is already planned to order a second commercial vehicle of this type at an early date.

The new motor truck which is technically designated a "money car" is the property of the United States Treasury Department and its function is to transport newly-completed paper money from the United States Bureau of Engraving and Printing where the currency is printed to the Treasury Building proper, where silver and gold certificates, bank notes, etc., are stored in the huge reserve vaults, to be drawn upon as needed for the replenishment of the circulating medium.

The money manufactory is located about half a mile from the Treasury Building and inasmuch as from eight to twelve tons of the new made money must be transferred daily it will be seen that the task is of no mean proportions. In this delivery service the new motor car is to displace a heavy steel-lined wagon weighing 6,800 pounds and three heavy draught horses which have engaged in this task continuously for more than eleven years past.

Investigation and experiment by the government officials proves that on an even basis as to carrying capacity the new electric van would be more economical to operate than the three-horse wagon, but on top of this economy in what might be termed basic operating expenses is the fact that the new electric vehicle with its carrying capacity of five tons will carry, under the standard Treasury method of loading its valuable freight, fully 50 per cent more money than the old car. And finally the speed of the self-propelled vehicle will enable it to do extra work over and above that possible with the horse-drawn vehicle. Indeed, it is planned to have this new electric car not only deliver the paper money to the Treasury but also to deliver to the Post Office Department at Washington all the postage stamps printed

UNCLE SAM'S NEW MONEY CAR

to its order,—another important product of the Bureau of Engraving and Printing for the handling of which extra wagons have heretofore been required.

The Treasury's new electric, which is expected to save the government $1,200 a year over the cost of maintenance of horses and harness, is not in mechanical and electrical details very different from other five-ton capacity trucks of the newest pattern. It has a 25 plate battery of 50 per cent overload capacity and will run 30 to 35 miles on one charge. It is the special body which makes this car unique. The car will carry from $7,000,000 to $10,000,000 in money every trip it makes to the Treasury and with a view to safeguarding this valuable cargo the Treasury officials designed a special body of steel and wood construction of the staunchest character and with the rear doors closed by locks of the heaviest pattern.

The floor of the interior of this new car,—more capacious than any circus van in the country,—is laid with steel rails and on these will be run the trucks or packing cases on wheels in which the money is transferred. Each of these boxes weighs, loaded, about 1,500 pounds and will carry a total of 412,000 notes which means $412,000 worth of notes if the denomination be one-dollar bills and $4,120,000 if greenbacks of the ten-dollar denomination be in transit. The new automobile will accommodate six of these boxes as compared with four which was the limit of the old wagon. The new car is provided with a seat at the rear for four armed guards while two other special policemen will occupy the seat with the chauffeur on every trip and a seventh officer accompanies the van on horseback in order to hold up street traffic to allow its passage and to prevent any other vehicle from approaching close to this precious carrier.

FROM OUT THE LEYDEN JAR

The work of compiling a magnetic survey of Africa has been practically completed.

* * *

Cleveland, Ohio, has a vacuum street cleaner which will, it is said, do the work of 40 men.

* * *

Canada's first great electric smelting plant for the treatment of ores is to be erected at Sault Ste. Marie, Ont.

* * *

Half a million telephone messages were sent from the Waldorf-Astoria hotel in New York last year.

* * *

A zigzag arrow has been adopted in Germany as a danger sign to be displayed on high tension electrical apparatus.

* * *

Investigation by a French chemist shows that gold boils in an electric furnace at a temperature of 2,400 degrees Centigrade.

* * *

The attention of the oil operators in California is now directed to tests being made with electric motors for pumping and drilling oil wells.

Experts have estimated the waters of the state of Washington as capable of producing 3,000,000 horsepower, of which but 163,000 horsepower has been harnessed.

* * *

All of the 20 steamers of the Union Oil company's fleet on the Pacific coast are to be equipped with wireless as fast as possible. Several of the vessels already have been so equipped.

* * *

Electrical fittings valued at $1,110,000 were imported into British South Africa during the first seven months of 1910, against only $368,000 worth in the same period last year.

* * *

To handle the telephone business in the five largest office buildings in New York City, no less than 2,360 miles of wire are required. Of these the Hudson Terminal building—or buildings, since it is a twin edifice—take 750 miles.

* * *

An electro-magnet was recently used to "fish" a broken steel drill from the bottom of a 500-foot driven well. The magnet not only brought up the broken drill but all the metal particles or borings which were in the hole.

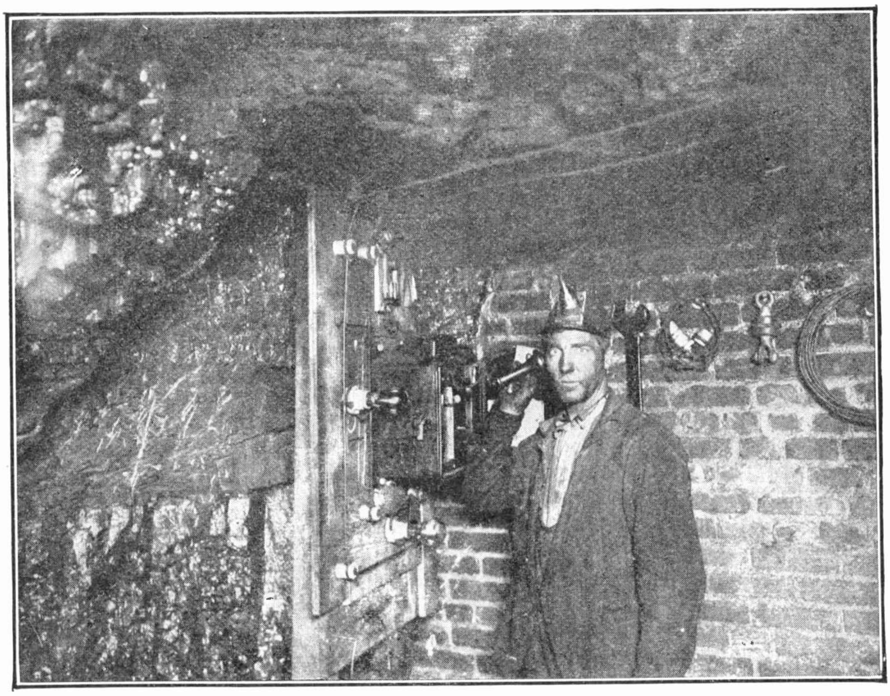
A Telephone 12,000 Feet from Daylight

The man at the telephone in the accompanying illustration is a Pennsylvania miner, standing in the engine room, 12,000 feet down a four per cent grade, from the entrance to the shaft. To obtain a flashlight photograph under these conditions was a difficult task, but the picture makes very apparent the usefulness of an underground telephone system.

The instrument shown, similar to the one described in the August, 1910, issue, is designed especially for this service. The inner parts of the telephone are protected by two iron doors, only one of which is opened when the wire is being used. The set is well protected against moisture, gases and fumes, which would make the ordinary commercial telephone useless for work in mines.

It is reported that in one of the coal mines of Pennsylvania not long ago these ironclad telephones were instrumental in locating and checking a blaze which might have proved disastrous. In another instance the telephone called a surgeon to the entrance of a shaft, to meet a car bearing an injured miner, and in this way a fatality was averted.

Through connection with a switchboard on the surface it is possible to transact the business of the mine by the telephone method. Communication between man and man underground, and connection with the upper air, once an impossibility, are now an established fact.



USING AN UNDERGROUND TELEPHONE

Induction Motor Runs Under Water

Because of the absence of a commutator and brushes from the induction motor the wires and coils can be thoroughly insulated, making this type of motor adaptable to places where such power could not otherwise be used.

A most remarkable performance under trying conditions was made by a twenty-horse-power General Electric motor of the type mentioned, the motor being located at the bottom of a shaft in the mines of the Richmond Iron Works, Richmond Furnace, Mass. Water broke in on one of the upper levels of the mine, rising so rapidly that the motor which was connected to a pump could not remove it fast enough. The motor was soon under two feet of water, but the current being left on, the motor pumped itself clear in two hours. It was then stopped, oiled and cleaned and put into service again, having suffered nothing from the severe test.

Little Batteries that Corrode Metal

Through modern research and investigation it is known that corrosion of iron and steel is caused by the carbon, sulphur, phosphorus and manganese becoming segregated, during the process of manufacture, this theory having been fully demonstrated both in the laboratory and under actual working conditions. The corrosive action takes place in the following manner:

When the impurities—carbon, sulphur, phosphorus and manganese—become segregated in iron or steel; that is, when they are not equally and evenly distributed throughout the metal, occurring in small spots or areas, an electrical current will be set up between these segregated points whenever the sheet, in which they are present, becomes covered with a film of moisture from the atmosphere. Due to differences in composition, some of these points of segregation become positive others negative, which, when connected by the film of moisture, set up numerous electrical batteries of greater or lesser energy according to the extent of the segregation, so that there are limitless numbers of small electrical batteries continually at work throughout the sheet.

It is a well known fact that a current of electricity cannot be generated in a battery without destruction or dissolution taking place at the positive pole so that in any sheet iron or steel in which segregation has taken place and the surface of which through exposure to the atmosphere has become covered with a film of moisture, there are numerous small electrical batteries at work, at the positive poles of which the iron or steel is being destroyed, resulting in the form of corrosion known as "pitting." The more marked or strongly defined the segregation, the stronger will be the electrical action, consequently the more rapid will be the destruction of the metal or sheet. On the other hand, the less well-defined the segregation, the weaker or milder will be the electrical action, and consequently the life of the sheet will be longer. Again, in a well-made sheet of iron or steel in which the impurities have been properly incorporated and segregation reduced to a minimum, the electrical action will be so slight that pitting will not take place, but instead an even coating of rust will be formed over the entire surface of the sheet in such a way that the rust itself will become, to a great extent, a protective coating, greatly retarding the process of decomposition or rusting. It was for this reason that the old time iron sheets, made by the old time slow but thorough method, withstood so phenomenally the ravages of corrosion. It was not because they did not rust that caused them to last, but the way which they did rust, that made them so long-lived.

The problem which confronts the modern maker of sheet metal, therefore, is how to produce the great quantities now required fast enough to supply the demand and at the same time of a quality approaching that turned out by the slow methods of the old metal workers.

After a long series of exhaustive experiments and tests a material has been produced which is said to meet the requirements as regards corrosion resisting properties and working qualities. This new metal is called Toncan metal. In the structure of this metal the segregation of impurities has been reduced to a minimum doing away to a large extent with the little "batteries" which make the trouble.

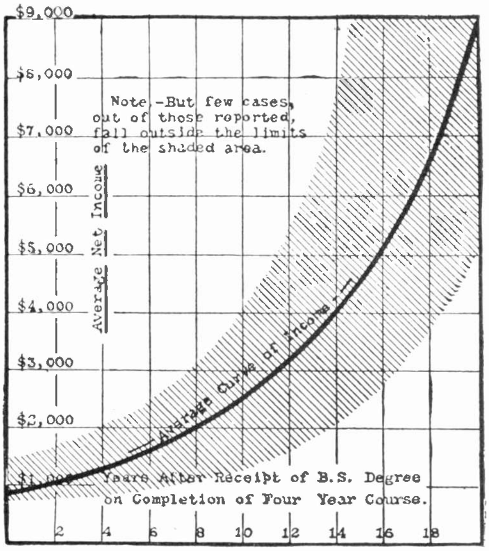
Correct Time by Telephone

The Hamburg observatory in Germany has made arrangements by which anyone in telephonic communication with that city can at any time in the day set his watch to exact Central European time. The telephone subscriber calls up "No. 4000 IV Hamburg," and can then in the last five seconds of every minute perceive a tone like that of a siren. The cessation of this tone indicates the end of the minute. In order to get the minute right, every five minutes—five, ten, fifteen, etc.—there is given an audible signal like the noise of an alarm clock. It is assumed that the watch which is to be set is within at least five minutes of being exactly right; which is usually the case. There is no charge for this service, other than that for the use of the telephone. As the signals are given automatically, it is not necessary to give the number of the caller. As soon as "central" in Hamburg IV says "connection is made," the signal can be heard. It is so loud that it can be heard in Munich, Copenhagen, Cologne, and even Paris. The signal is given by a pendulum clock in the observatory, which is provided with a number of contacts, that make and break electrical connection.

Electrical Engineers Well Paid

What returns financially does a technical school training in electrical engineering offer the average student who expects to make that profession a life work?

The self-explanatory diagram given herewith is probably as definite an answer as



CURVE SHOWING AVERAGE ANNUAL INCOME OF GRADUATE ENGINEERS

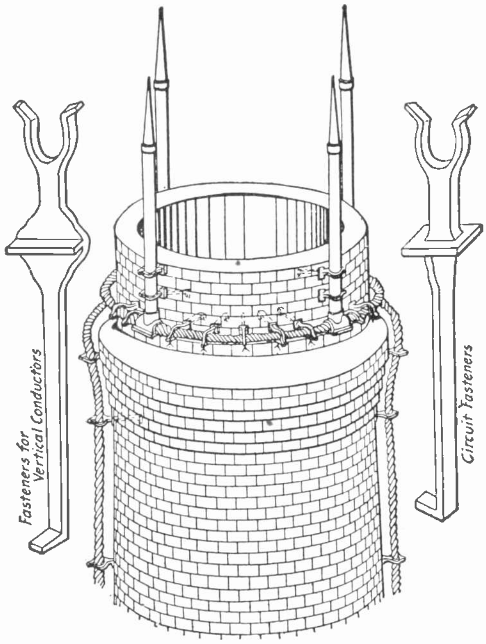
can be made to this question and is the work of Prof. H. B. Smith, showing the results of a canvass among the electrical engineering alumni of the Worcester Polytechnic Institute. The curve indicates an average annual income of $2,000 eight years after graduation, and $4,000 fourteen years after, a very substantial compensation.

Protecting Chimneys from Lightning

In relation to an item which appeared in the November issue of POPULAR ELECTRICITY concerning the utilization in Germany of steel rods embedded in concrete chimneys as lightning rods, Mr. Carl Bajohr writes as follows:

"The writer wishes to state that such action was tried in this country, about eight years ago. But one day when Mr. Lightning came and inducted the chimney, then the concrete chimney cracked in every direction where the reinforcement was placed, and the consequence was that the chimney had to be taken down and a new chimney had to be erected with lightning conductors placed on the outside where they belong. There are many such cases on record and perhaps the people at Ober Cassel in Germany will meet with the same problem some day."

The illustration shows the method employed by Mr. Bajohr for the protection of brick and concrete chimneys. The lightning conductor is of copper cable made in



METHOD OF RODDING A CHIMNEY

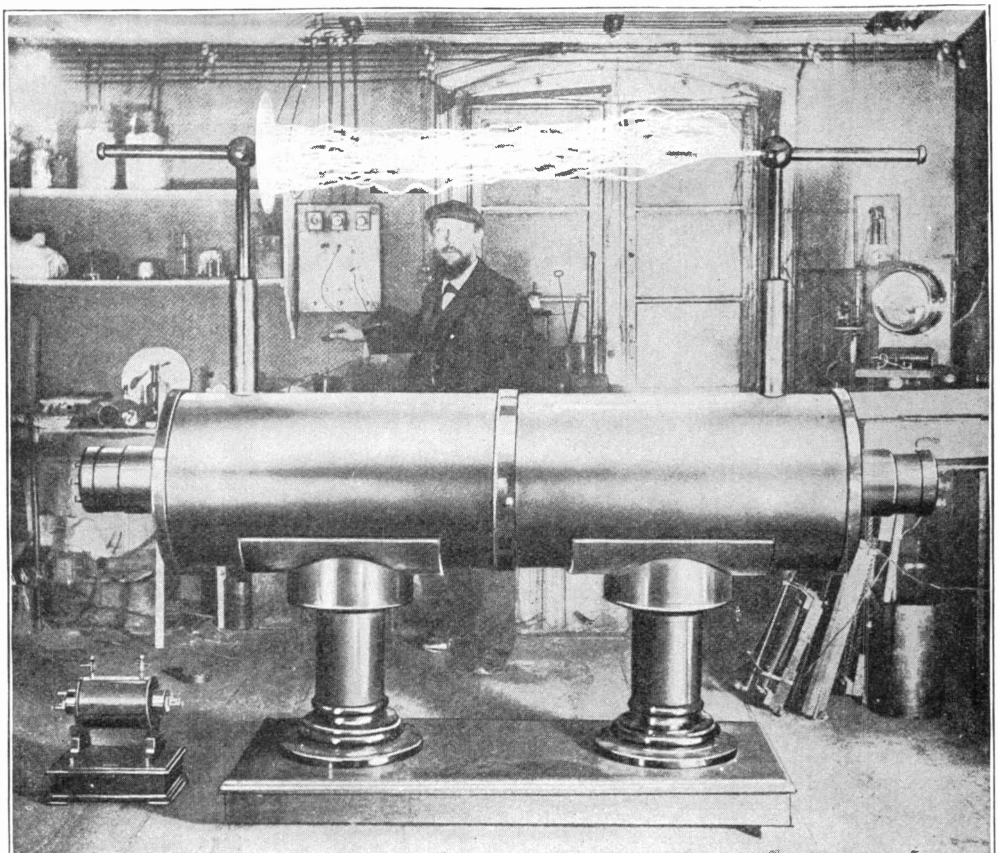
one continuous piece and connected at the top to suitable points or tips. The cable is fastened to the sides of the chimney by patented fasteners of various types made so as to be laid in with the brick work or else driven or screwed into holes, depending on the kind of chimney.

In Kansas City was established the first central station using the Thomson-Houston system of electric lighting, and also one of the first stations employing the Edison system. In Kansas City was also established one of the first commercial electric street railways using the overhead trolley. The rolling stock consisted of two cars, each equipped with a $7\frac{1}{2}$ horsepower, 250 volt, direct current motor.

A Giant Induction Coil

The great induction coil shown in the illustration is truly a giant not only in its outward appearance but in its construction and performance as well. That such a mammoth "inductorium" (as the Europeans term it) can be durably built is proved by the photograph, which shows the coil giving a rapid succession of sparks four feet long, and this after the coil had been in service for ten years. It was built for the Royal Technical High School of Vienna by the Swiss firm of Klingelfuss and Company, some features of the coil being designed by Prof. Carpentier of Paris. Our picture of it shows the sparks which passed between a positive point and a negative plate during a photographic exposure of one second. What these sparks mean in the way of high voltages can be readily imagined from the fact that 815,000 volts are required to make a spark jump through a distance of 40 inches, on the basis of investigations made by the builder of the coil.

The little coil down in the left hand corner, although it is capable of producing a five-inch spark, appears diminutive in comparison.



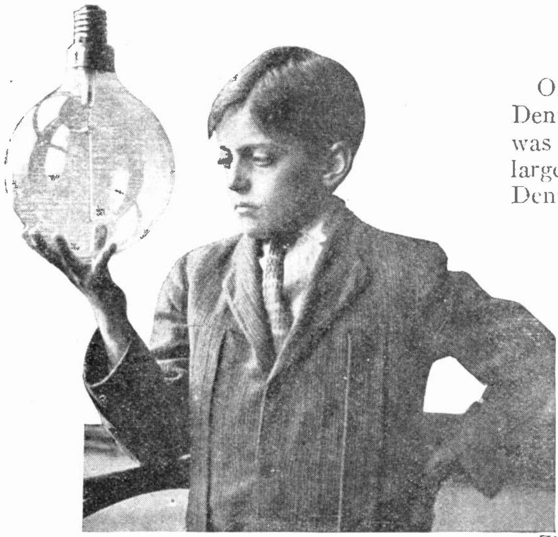
GIANT INDUCTION COIL IN THE ROYAL TECHNICAL HIGH SCHOOL IN GERMANY

Telephone Stations for Taxicabs

The Detroit Taxicab Company has contracted with the Home Telephone Company of Michigan, for sixteen branch stations similar to those used in the company's well known "wayside service," to be located on the two main thoroughfares. One station will be placed at the interesction of each mile circle. Drivers of cars will carry so-called "wayside type" of telephones, consisting of transmitter and receiver mounted on a light and durable handle inserted in a convenient leather case.

The Jumbo of Filament Lamps

We are fairly familiar with the amount of light an ordinary sixteen candle power lamp will give, but to have any definite mind picture of a filament lamp that gives 27 times that much light or 442 candlepower is out of the question. The accompanying illustration helps somewhat to give an idea of the size of a General Electric Mazda lamp of this type. The bulb is eight inches in diameter and over all 11¾ inches high.



A 442-CANDLEPOWER LAMP

The light from this lamp is steady and during the entire life of the lamp does not become poor in quality. As it requires no trimming it is adapted to lighting department stores, store fronts, billboards, and for the general illumination of large interiors such as auditoriums, armories, skating rinks, factories, yards and streets.

Making Insulation from Milk

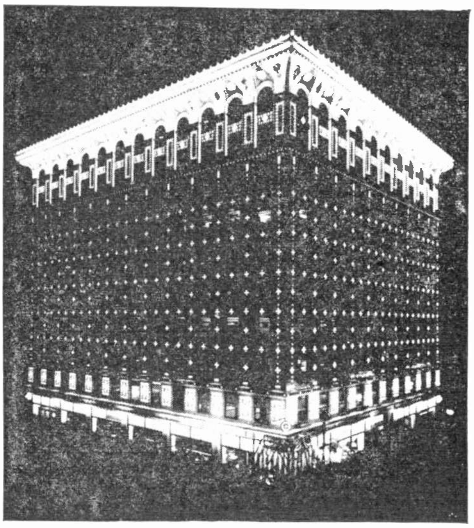
A Russian named Schuetze has invented a new process for making insulating pieces cut of milk curds. He stirs the curds into a paste with cold water, adding coloring material if a colored product is desired and heats them to the boiling point. After the paste has been boiled for some ten minutes, continued stirring reduces it to a uniform pulpy consistency. This pulp is taken while still hot to a hydraulic press fitted with hot molds of the shape in which the insulation pieces are wanted. After being pressed into this shape the pieces are cooled and dipped into formalin which adds the needed quality of a preservative. The product is said to resist the action of acids, to be much cheaper than hard rubber and to be easily colored in imitation of agate, marble or the like.

The Best Lighted Office Building in the World

By Joseph A. McMeel

On the evening of November 12th, the Denver Gas & Electric Company's building was illuminated for the first time. The largest crowd ever assembled on the streets of Denver turned out to see the initial illumination of the structure. The streets, roofs and windows in the vicinity were crowded. About 50,000 people jammed the thoroughfares as the time grew near for the turning on of the lights. Street car and vehicle traffic was suspended on Fifteenth Street, the railway company being forced to divert their traffic to Sixteenth Street where conditions were little better after the great throng had formed.

The building was decked in its splendor of light at 8 o'clock. About fifteen minutes before this time it was enveloped in darkness, this being done in order that the contrast might be shown more effectively. Mayor



DENVER GAS AND ELECTRIC COMPANY'S BUILDING AT NIGHT

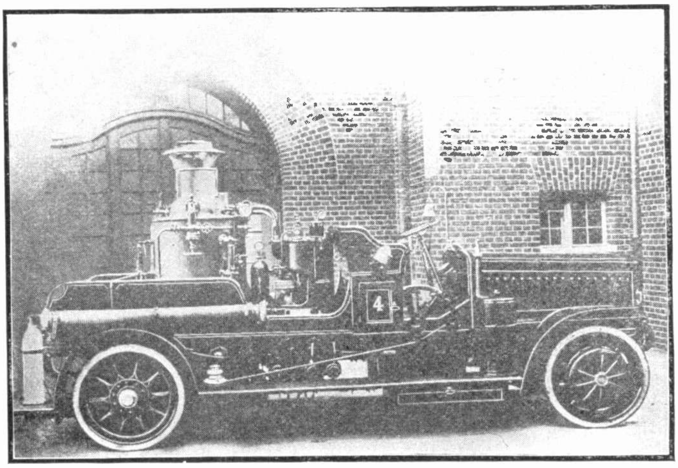
Speer and Frank W. Frueauff, General Manager of the Denver Gas and Electric company, mounted the platform on the Fifteenth and Champa street corner of the building, where was situated the enormous push button that the Mayor would push, a few minutes before the time set. Exactly at 8 o'clock the building burst forth in a brilliance that reflected to the heavens. A great roar went up from the multitude below as they witnessed the lightning of the best illuminated office building in the whole world.

It shines out like a gigantic jewel sparkling in the bright light of the sun. It dispels the darkness and does truly turn night into day. It is a tribute to the genius of the illuminating engineer. The piers of the structure are one mass of dazzling light. The second floor is a band of light forming a base for the field above. The tenth floor crowns the building. Over the windows sparkle huge diadems of light enclosed in crystal globes and above them is a cresting set with jewels of light like a king's crown.

It is the most palatial office structure in the entire West. Nothing in Denver can be compared with it. The main floor is decorated with the most expensive fixtures available. The floor is of solid cork. The counter tops and office enclosures are furnished in vitrolite. The piers and walls wainscotted ten feet high with glazed terra cotta all snowy white, make an impressive appearance. Imported African mahogany was used for the woodwork. Solid bronze fixtures weighing 100 pounds are suspended from a ceiling paneled with ornamental stucco designs that set off the interior in resplendent luxury.

On the main floor are situated the general offices and the private offices of General Superintendent W. J. Barker and Secretary C. N. Stannard. The second floor houses the bookkeeping room, the assembly room, some general offices and the offices of General Manager Frank W. Frueauff and J. T. Brady the treasurer. Three floors and the basement of the building are occupied by the company.

A HORSELESS FIRE ENGINE



A HORSELESS FIRE ENGINE

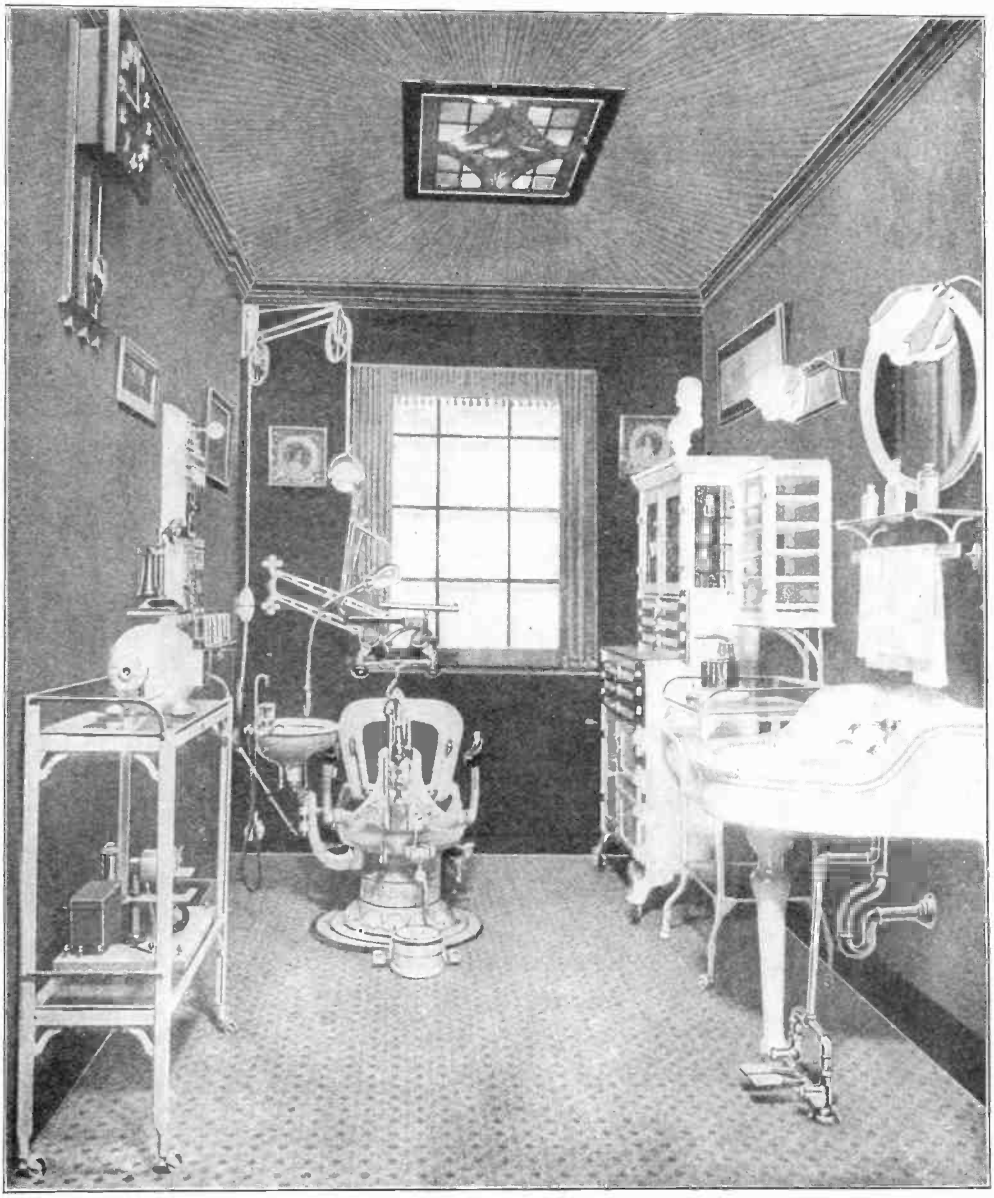
Ever since 1901, when fire engines mounted on automobiles were displayed at the International Exposition of Fire Fighting Appliances, those in charge of the fire department of the city of Berlin have been pioneers in the effort of eliminating horses from the service. Steam propelled engines have been tried, but they require a continual head of steam to be maintained in their boilers to insure an early start and this means a tremendous waste of fuel. Gasoline propulsion also involves delays and uncertainties in the starting, as clearly proven by the fact that German firms building gasoline fire engines mount them on vehicles propelled by storage batteries. For immediate starting in all kinds of weather and freedom from both repairs and adjustments, the use of electric motors supplied by storage batteries evidently has no equal. Hence Berlin is using electrically propelled fire fighting appliances of several different makes, our illustration showing one made at Bautzen.

The Modern Dentist

Schools and other public institutions are giving more and more attention to the matter of hygiene and along with this has come the physical examination of pupils in school which includes the condition of the teeth and recommendations as to their preservation and care. This means that the next generation at least will have much use for the dentist.

Electricity in the hands of the conscientious practitioner has wrought wonders in the medical field and it is doing as much in dentistry.

Next to the skill and care which your dentist exercises in relieving you of a fierce toothache or in saving a tooth by filling or crowning it, is the general appearance of his



A MODEL DENTAL OFFICE WHERE ELECTRICITY PREVAILS operating room as to cleanliness and modern equipment.

To demonstrate what can be done in this line the accompanying picture shows a Ritter model outfit. It not only looks clean but is clean, with white enameled stands and cabinets, plate glass shelves and electricity assisting. Of the electrical equipment, the engine by which work can be done in quick time is first. Then there is the switchboard from which low as well as high voltage instruments are operated.

From this switchboard may be operated a root canal dryer, an electric cautery for burning away tissue when necessary to cauterize, a hot air syringe for allaying toothache and drying out cavities in a much more effective manner than the old way of drawing the flame up into a syringe and putting it into the tooth. Also operated from the switchboard is an electric gold annealer for preparing gold and a mouth lamp. Then there is the electric sterilizer for boiling water in connection with the sterilization of the instruments, the electric spray-bottle heater which makes it possible to have warm solutions in the spray bottles and hot water in readiness all the time whether there is hot water in the office or not. The electric laboratory lathe is for polishing and grinding teeth and an electrically driven air pump supplies both the laboratory and the operating room with compressed air, at all times keeping the pressure at a uniform point. It is next to impossible for an up-to-date dentist to do without such an equipment or at least some parts of it.

The Magnetic Traction Fake

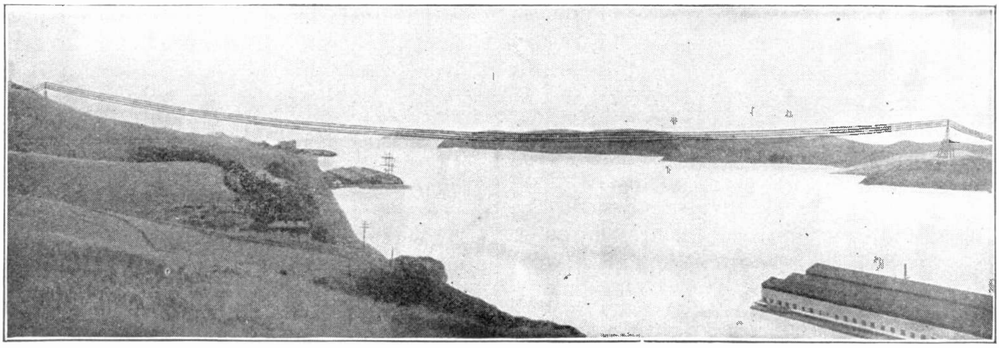
That "a little learning is a dangerous thing" is particularly true in the case of those whose slight knowledge of electrical and mechanical principles has led them to invest in fake schemes of which the magnetic traction brake is an example. Many of those whose money was ensnared by it have never understood just why the scheme would not work in practice. For, when a device is so simple that any person of average education can readily understand it and when a working model demonstrates it right before your own eyes, how could it fail to be commercially practical on a larger scale?

To demonstrate the system a miniature railroad track had been built with one end tilted at an incline far too steep for the little locomotive even when not pulling a load. Then by sending a current through coils wound on the axles of the locomotive, this could not only run up the steep grade alone but could also draw up a loaded car.

The model certainly worked like a charm. The underlying principles seemed too simple to involve practical difficulties on a larger scale and unquestionably such an increase in the tractive effect of the wheels on the rails would mean a decided improvement in railroad practice. Hence most of those who saw the demonstrations were easily convinced and many of them invested in stock of the company which was to put the exceedingly simple but promising invention on the market.

That was half a dozen or more years ago and still the railroads are not equipped with the loudly-heralded invention. Why is this, and indeed why should not some of the railroads or locomotive builders have monopolized the device instead of having it offered to the general public? Simply because it would not work in practice, for the reason that in building his model the promoter had cleverly, though inconspicuously, varied the proportions of the rails and cars from what they are in standard railroad construction. His idea of increasing the traction magnetically was correct enough in theory and in fact was old before he ever went to school; but the extent of this increase depends on the intensity of the magnetic circuit, i. e., the so-called magnetic flux through the rails, wheels and axles. The limit would be reached when the part having the smallest cross-section (which in practice is the rail) is saturated magnetically, so that the possible gain depends on the size of the rails. In the model the rails could be unusually large in proportion to the size of the wheels without attracting notice, for models are rarely well proportioned in all respects. If the same ratio employed in the model were followed out in the locomotives used on ordinary railroad work, the rails would have to be about two feet high and nearly a foot across the top. With such immense rails and with both axles and wheel flanges correspondingly increased, the plan should work in practice just as readily as it did in the model but such size would of course be out of the question.

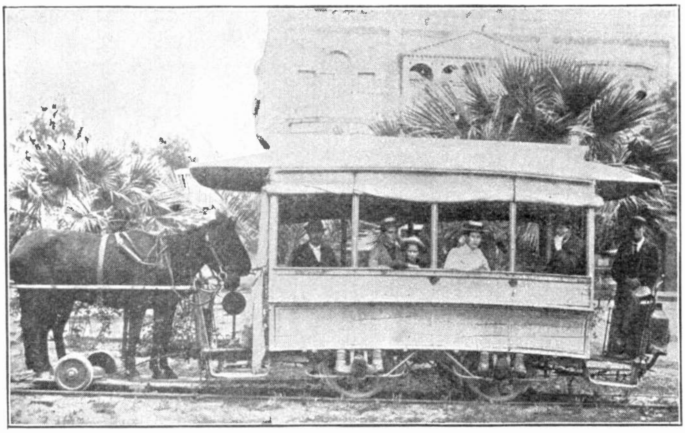
Albert Scheible.



This picture is a concrete example emphasizing the skill of the electrical engineer in overcoming the seemingly impossible problems in building miles and miles of high voltage lines in the West. This span of wires across the Carquinez Straits is 4427 feet (almost a mile) in length and is supported by strong steel towers on the banks. To lay heavy moisture-proof insulated cables on the bottom of the waterway or in a tunnel beneath would mean a heavy expense, so the Pacific Gas and Electric Company solved the problem in the manner shown.

Turn About is Fair Play

This picture shows, not what electricity is "doing," but what is has "done away with," and is a view of the former street railway equipment of Ontario, California. The track from the centre of Ontario to San Antonio Heights runs on a steady up grade for a distance of about seven miles. The transportation company economized the strength of its horses by a unique method.



A MODE OF TRANSPORTATION THAT ELECTRICITY HAS DISPLACED

A truck was attached to the rear of the car and when the horses had pulled the little bobtail to the top of the grade the truck was placed in the rear the horses driven aboard and the car started on its downward journey by gravity, the horses riding with their heads over the back platform.

Like many other bits of picturesque westtern life this unique railroad has been modernized, and is now an up-to-date electric road.

C. L. EDHOLM.

Popularizing Electricity

A soft answer may turn away wrath but it takes hard facts to destroy it. How can an electric company expect to establish friendly relations with its patrons by tact and courtesy when the public knows so little about what they are buying? Confidence and ignorance are never chums. The first essential is to educate the layman, to introduce scientific terms into the vernacular so that the buyer and seller may speak in the same language.

That the layman is eager to learn is attested by the increased demand for books and articles on popular science. Yet the jokes in books are not half as funny as when told on the stage; so likewise it is necessary to talk directly to the people to make them understand how electricity is produced and what it will do. Just as the clown is the smartest man in the circus, so it requires the most brilliant minds to explain scientific matters simply. In these respects at least, science and humor are akin.

During the past summer a number of electrical manufacturers employed a college professor to roam around their works, just as does a "business doctor" who is sometimes called in to diagnose and prescribe for business failure. But this professor's mission was somewhat different. He simply talked with the men, encouraged them to ask questions and explained in simple language the scientific principles underlying the work they were doing. The companies considered the investment so good that they plan to repeat it at frequent intervals in the future. This professor possessed the rare faculty of popularizing science, of making technical matters clear to the common people. He taught the rudiments of a new language.

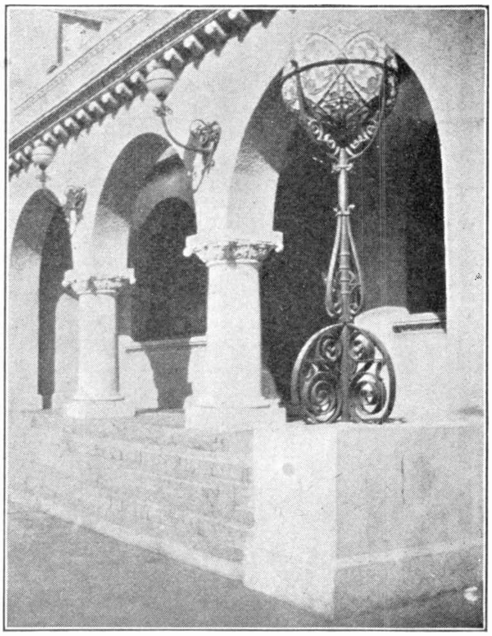
True it is that they learn only a sort of "pidgin" English, a makeshift that has little scientific use insomuch as what is gained by generalities is lost in definiteness. An English translation seldom does justice to a German original, for certain beauties of language are lost in the interpretation just as power is lost in transforming a high voltage current to one of lower potential. The petrographer uses a high power microscope to examine rocks but a cheap magnifying glass suffices for the prospector, giving a larger field but smaller resolving power. We do not use a thirteen inch gun to shoot rabbits, nor is it necessary that the layman be equipped with the ammunition of the scientist to gain a general knowledge of electricity. But if he be supplied with an elementary knowledge he can be brought to a sympathetic appreciation of the wonders of electricity and if he so desires may even use it as a sketeton key to unlock the more intricate subjects.—*Journal of Electricity, Power and Gas.*

Making Quartz Vessels

The intense heat which the mineral quartz is capable of standing, makes it unusually suitable as a material for retorts, crucibles and the like when these are to be used in chemical work requiring high temperatures. But if these quartz vessels themselves are to stand such high heats, how are they to be moulded? This problem has recently been solved in a novel and practical way by the manager of the Deutsche Quarzgesellschaft, Dr. Voelker. He packs beach sand (which is composed largely of quartz) around a carbon rod in the center of a carbon cylinder with a bore of about eight inches. Then he sends sufficient current through these carbon terminals to melt the sand and let the quartz form into a single tube weighing over a hundred pounds. This tube is drawn out of its carbon furnace with tongs while still hot and the hole in it is stuffed with either potatoes or lime, after which the tube is squeezed shut at each end. and the hot mass is put into moulds of the desired shape. Owing to the heat, the potatoes or lime generate considerable gas which presses the hot metal out against the sides of the mould. For cutting and finishing the quartz vessels when cold, Dr. Voelker uses both sandblast and saws fitted with teeth of carborundum, another product of the electric furnace. But the start in every case is obtained by melting the quartz crystals into a single mass in the intense heat of a simple electrical furnace.

Artistic Illumination

Probably as artistic an effect in electric illumination as one may have the opportunity of seeing is shown in the accompanying

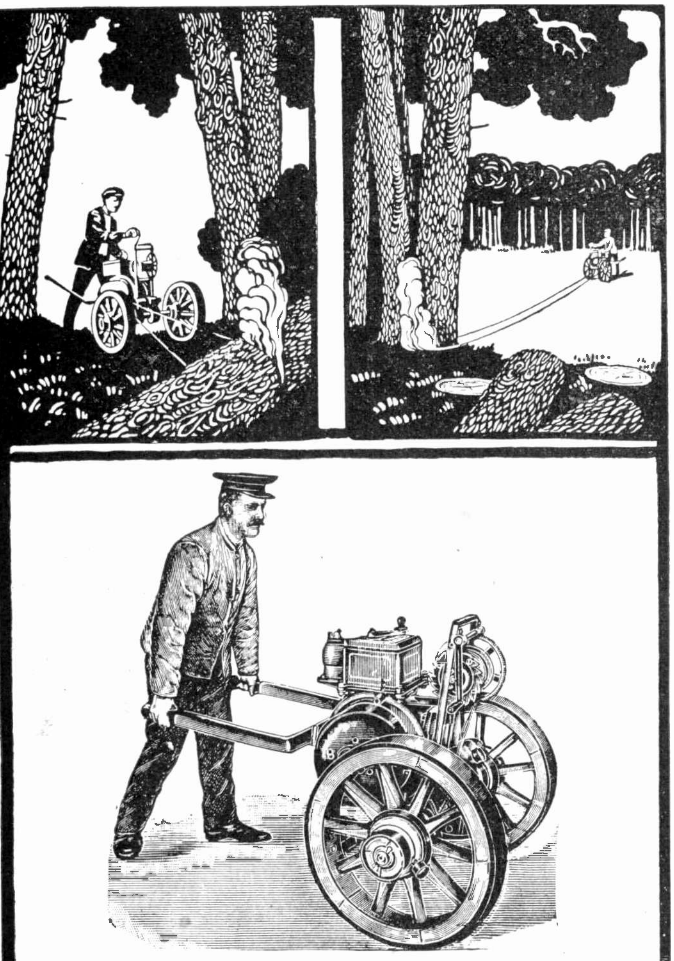


ARTISTIC ILLUMINATION

picture. The two lamps which are in the form of globes of stained glass are mounted upon frames of wrought iron and adorn either side of the entrance to the Carnegie library at Riverside, California.

Electric Tree Felling

The oft repeated suggestion that trees be felled by burning through the trunks with an electrically heated wire, while very pretty in theory, has not proven either feasible or economical in practice. It requires a wire of high resistance, which is not a cheap article, particularly in the lengths needed for the trunks of large trees. However, that was only one way of attacking the problem electrically and already another solution has been developed by a German manufacturer (Hugo Gantke), which seems much more practical and economical.



ELECTRIC TREE FELLING

The new method uses a fine steel wire which is wrapped partly around the stem and is pulled back and forth by cables attached to an electric motor-driven drum. The friction of the wire which is moved to and fro 1,500 times per minute, heats it red hot so that it literally burns its way through the trunk in half the time it would take two men to saw down the tree. In doing so, the heat carbonizes the severed ends, leaving them protected against easy rotting in case they are left on the ground for some time. If the tree is to fall in a certain direction, this can be insured by notching the trunk with an axe. However, time is usually saved by simply placing the motor at a safe distance (100 to 150 feet) and letting the tree fall wherever it will. A new steel wire is used for each cut, the cost in Germany ranging from one-fifth to one-half cent each, according to the length and nature of the wood, which is less than the cost of filing and setting saws or of sharpening axes for the same work. Besides, the cutting can be done flush with the soil, or as much below ground as the root structure will permit, thereby saving the work of grubbing in many cases.

The motor equipment is mounted on a two-wheeled cart and as it weighs only 570 pounds, it can easily be managed by one man even for trees measuring as much as ten feet in diameter.

Where no source of electric current is available close to the forest, this can be supplied by a portable gasoline and dynamo outfit from which the current is led to the sawing motor by a flexible cable.

A Diver's Electric Lantern

A curious situation arises when it comes to designing an electric lamp for the use of divers. The under-water man does not wish to be hampered by having to drag around a conducting cable from the boat above. To him the storage battery lamp appeals as the most adaptable, and the very thing which makes such an outfit prohibitive on the surface, the weight, is a distinct advantage when under water. It helps to keep the diver down.

For this purpose the casing which houses the battery and lamps, as well as the glass front, are heavily built to withstand both bumping and the pressure of the water. The result is a combination which it would tax a man to carry with him while on deck but which makes a desirable weight for helping to keep the diver far below the surface. In using it, the outfit is strapped to the diver's breast by chains hooked into ears at each side of the casing, so that the light shines steadily in front of him while he is free to use both arms.

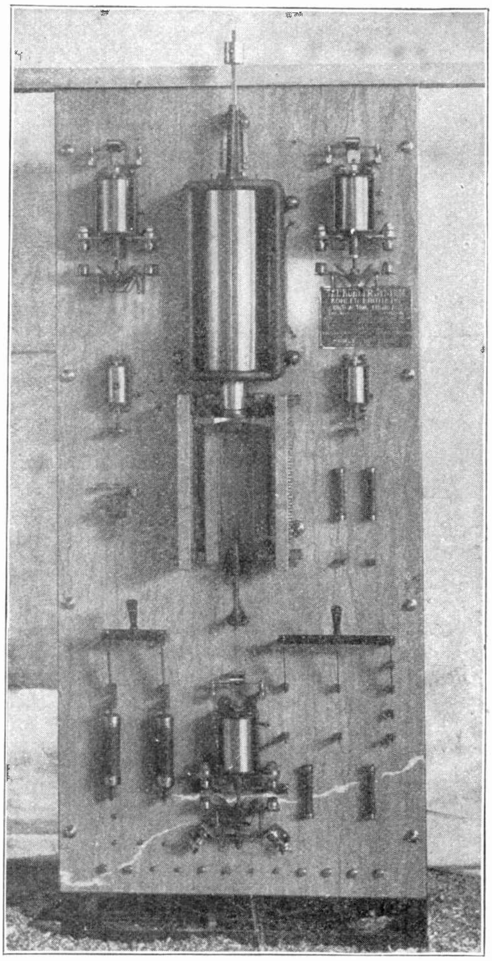
ELECTRIC CURRENT AT WORK

NEW DEVICES FOR APPLYING ELECTRICITY

A Switchboard that "Thinks"

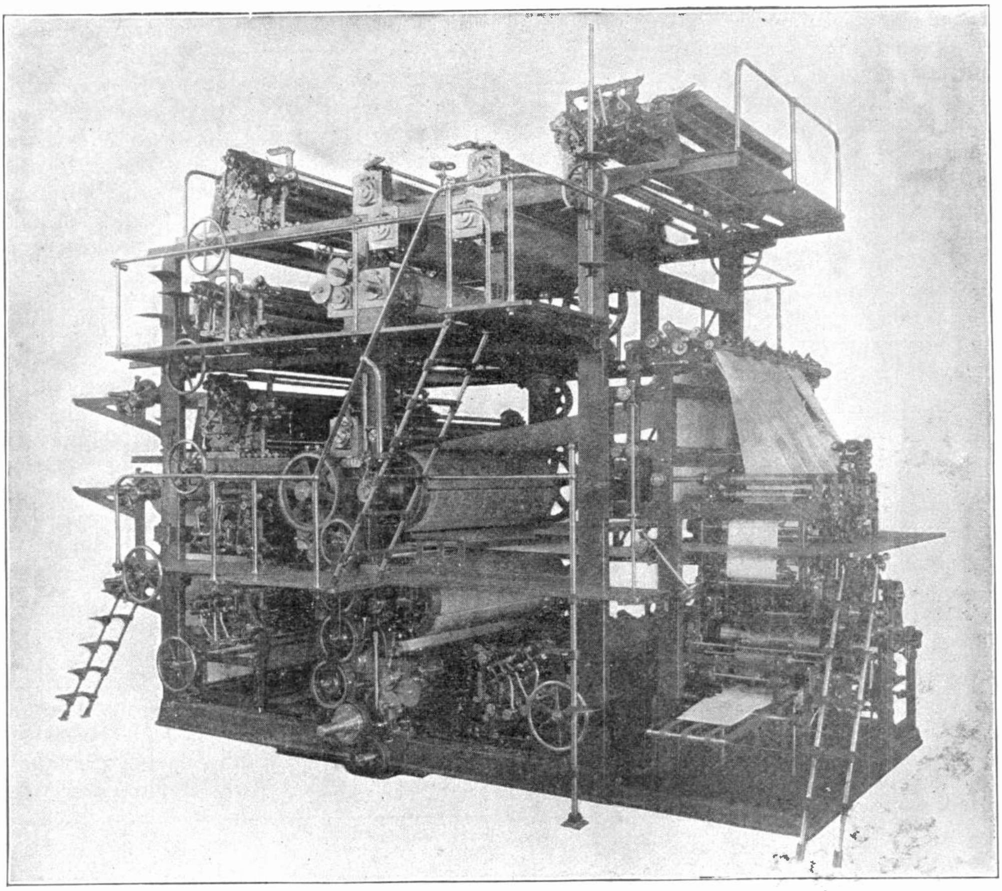
By C. B. EDWARDS

Since the perfection of the telephone and telegraph perhaps no single invention has influenced rapid magazine and newspaper printing more than the electric press control. Few indeed are they who have not wondered at the motorman on a car who controls accurately the speed from the manipulation of the controller handle. But far more wonderful than this, the electric control on the modern magazine press allows of speed in infinitely finer gradations from the turn of scarcely more than a hair's breadth of the great printing rollers to a speed which sends 80-paged magazines on the delivery webs in bewildering profusion. The almost incredible part of it all is that the man who is controlling the machine is not standing in front of a great marble switchboard or even with his hand on a controller handle, but when he desires a higher speed, say of a thousand more issues an hour, he reaches up and touches one of five buttons much the same as you would ring your doorbell. The great press instantly responds and when the delivery man at the output end perceives that the counter records the required increase he so notifies the pressman who is still holding his finger on the button and he removes it.



THE SWITCHBOARD THAT "THINKS"

Located about the press at eight different points or stations are found press button switches scarcely larger than the switches on the wall that control the lighting of a chandelier. Instead of having two pushes, however, each of the eight stations has three buttons in the top row labeled "on," "stop" and "off" and in the lower portion of the same plate are located two smaller buttons with "run" under one and "safe" under the other. In connection with this control two motors are required on account of the great starting load and the desirability of slow speed for adjusting the plates before the run is commenced.



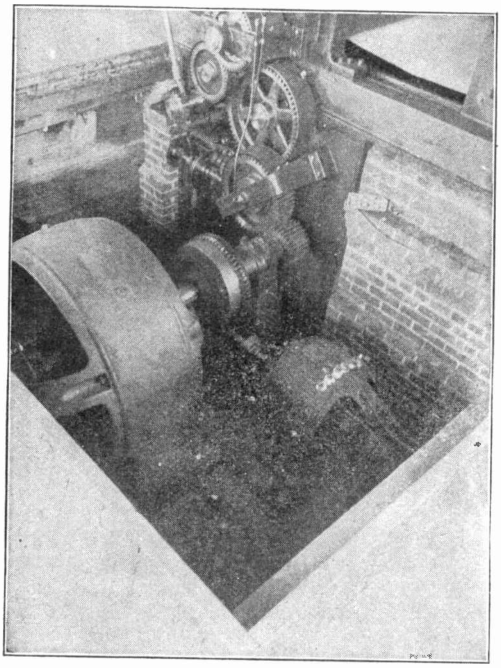
A MODERN MAGAZINE PRESS THAT DELIVERS COMPLETE 80-PAGE MAGAZINES AT THE RATE OF 9,000 PER HOUR

One motor of $7\frac{1}{2}$ horse power, connected to a worm gear and giving a reduction of 25 to 1, starts the press and when it reaches its speed limit the other 50 horse power motor lifts the load from the smaller machine and brings the press to running speed, which may vary from seven to nine thousand 80-page magazines per hour.

The push button control practically thinks for the man who starts the press and relieves him of the responsibility, to a great extent, of being held liable for the damage of the tons of costly machinery placed in his care. Before the automatic push button control was invented an ordinary controlling rheostat was used in starting up and it was "up" to the man holding the controller handle to see that he did not cut out his resistance too fast and strip the driving gears or start the press while some of the pressmen were endeavoring to tighten a stereotype plate. In the use of the push button control it is practically impossible for such accidents to happen, for by merely pushing the "safe" button on the nearest station the pressman goes on safely with his adjusting and tinkering and it is impossible for anyone else to start the press from any other station till he has pressed the other lower button marked "run" at his station.

It is likewise provided for that no gears shall be stripped, for the solenoid shown in the center of the photograph of the board that "thinks" moves so slowly when the start button is pushed and cuts out the resistance of the motor starter and brings the motor up to speed so gradually that a large factor of safety intervenes to prevent the stripping of a single tooth.

Essentially the whole device depends upon the attraction of an iron core which is movable up and down inside of a solenoid located in the center of the switchboard. In operation when the "on" button is pressed a current energizes a ratchet dog magnet, the dog is pulled away and the iron core, which is full up in the solenoid when the press is still, starts downward by gravitation. An oil dash pot keeps the plunger attached to the iron core from descending at a rapid rate and as the plunger descends it makes successive contacts with the terminals located in the exact center of the board, which first throw the main switch to the small motor and then cut out the resistance till it approaches its highest speed. When this is



MOTOR WHICH DRIVES A MODERN MAGAZINE PRESS

reached the still descending plunger breaks the main switch of the small motor and throws in the main switch of the large motor and then the starting resistance of the latter is gradually cut out again till running speed is reached.

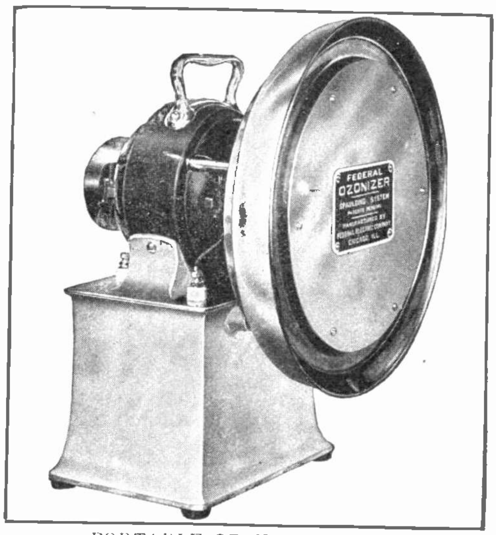
All the time that the press is accelerating its speed from the time the button under the "on" is first pressed the button must be held down until the desired speed is reached or the dog will re-engage the ratchet on the plunger and hold it there. When the desired speed is reached the button is released and the press remains running at that speed. To slow down or stop after the run is over the "off" button is pressed and a "relay" coil on the switchboard is energized, allowing current to travel through the large solenoid; the core is attracted and the operation described under the starting of the press is reversed as long as the button is depressed. In case of an emergency the center "stop" button is pushed and through the lowest solenoid switch on the board all of the current is automatically switched off and a dynamic brake applied which is positively and absolutely regulated through an adjustable resistance to meet every condition.

It is therefore seen that from any one of the eight stations situated about the press the finest variations in speed and the quickest stopping are under the positive and instant control of any one of the pressmen.

The photographs reproduced herewith show a typical magazine press of the most recent type, its drives and motor, and the controlling board.

Portable Ozone Machine

A new comer among the various types of ozone machines is designed to meet the demands for a small and portable generator. It is made of polished aluminum with the



PORTABLE OZONE MACHINE

exception of the motor case which is black enamel. With the transformer in the base and a convenient handle on the top it affords a most compact and convenient machine for office and home use, connection being made by a plug and cord to any electric light socket.

Aid to the Deaf

A French inventor, Doctor Laimé, has devised an aid to deaf people somewhat similar to the electrophone and the acousticon now quite commonly used in this country. As in the case of the two systems mentioned it consists of a compact battery, a transmitter and a watch-shaped receiver to be held to the ear. In fact it is a very compact telephone system so small as to be packed complete in a pocket case.

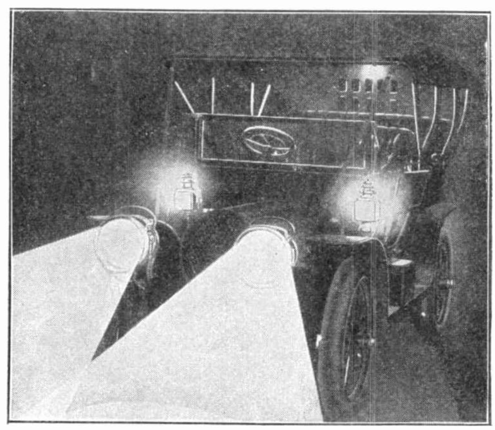
DR. LAIME'S POCKET TELEPHONE FOR THE DEAF

The transmitter which receives the sounds is circular in shape and can be carried in the pocket or laid on a table. It is connected by flexible conductors to the battery and to the receiver. The sounds are taken up by the transmitter and intensified in the receiver so that people who are not absolutely deaf are able in many cases to hear quite clearly.

The receiver is held close to the ear, like an ordinary telephone receiver, being kept in position by a spring whenever both hands have to be disengaged. This part comprises a special device for controlling the sensitiveness of the apparatus which enables the latter to be adapted to the degree of deafness of the patient, thus avoiding any hurt due to excessive sound intensities. This regulating device is a variable resistance controlled by a small handle shifted along the five divisions of a dial. Each of these divisions corresponds to a given sound intensity, whereas in a sixth position (designated "O") the current is broken.

An Auto Electric Lighting Plant

Motoring will always be considered a daylight sport, but night lends many advantages and pleasures to this form of recreation through the development of a device by which a light almost duplicating daylight is shed upon the road stretching before the speeding car making travel safe, and relieving the strain felt by every motorist



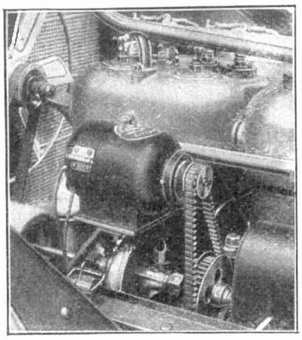
THE LIGHTS IN FULL BLAST

on account of imperfect roads and inefficient light.

An outfit is now in use by which electric current for lighting the lamps, is generated by the car itself. It consists of a small multipolar dynamo weighing 24 pounds and having a positive drive from the engine of the automobile. And in addition to this there is a storage battery.

The dynamo is so constructed that even on a slow speed it produces sufficient current to light all the lamps brilliantly. It is controlled by what is known as a load-regulator, so that when the car is speeding or the engine running "wild" only the proper amount of current is supplied to the lamps.

The storage battery is so connected that it is charged while running and maintains the lights when the engine is at rest. The lamps are all controlled from the seat of the chauffeur, making it unnecessary to leave the car either to light or extinguish the lamps. The headlights may be fitted with 20-candle-power tungsten lamps, while the side, dash and tail lights use the four-candle-power lamps.



AUTOMOBILE ELECTRIC POWER PLANT

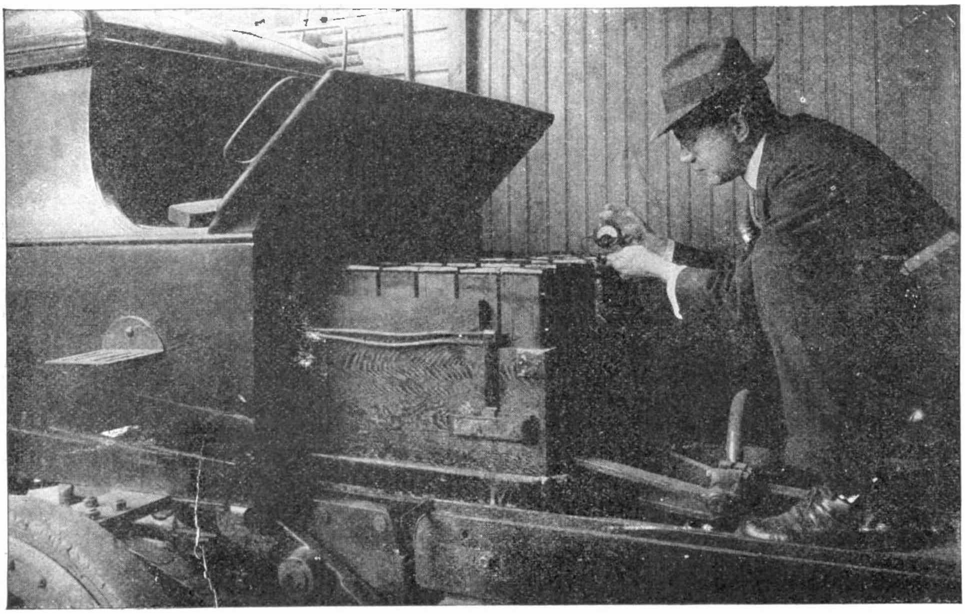
The illustrations show a touring car with lamps going at full blast; also the interior of the engine bonnet showing the dynamo attached to the engine. The apparatus is so constructed that it can be adapted to any make of car.

FOR THE MAN WITH A STORAGE BATTERY

Every battery man knows that the condition of a cell can be very closely determined by finding its voltage with a low reading voltmeter.

The illustration shows the Electric Storage Battery Company's pocket voltmeter being used to check up the cells of an electric truck. The instrument is heavily nickel plated and when enclosed in its aluminum case, $3\frac{1}{8}$ by $3\frac{1}{8}$ by 1 inch, weighs only eleven ounces. The scale reads from 0.2 volt to 2.8 volts and is furnished with a silk-covered contact cord and nickel plated terminal contact points.

The next piece of apparatus to have at hand in caring for a storage battery is some sort of a gravity tester. The syringe type is very convenient and is operated by pressing the air out of the rubber bulb and allowing the electrolyte to enter the glass compartment where its specific gravity is read on the hydrometer.

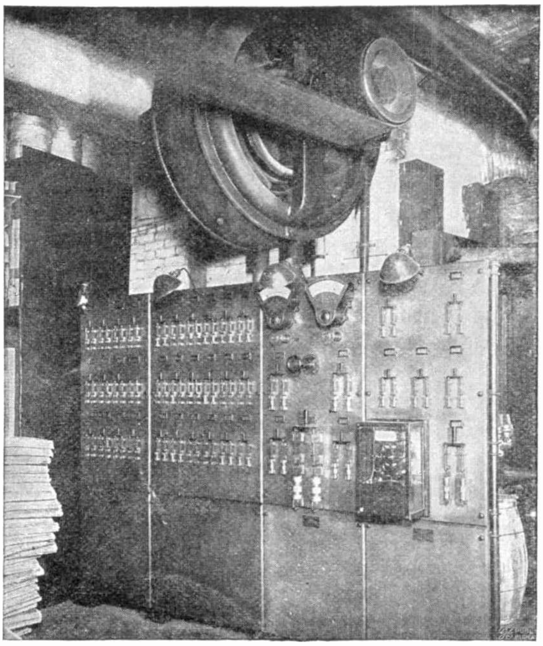


USING THE POCKET VOLTMETER

Electricity in Book Making

A soiled book or magazine is a ways shoved aside for one well bound and clean. Cleanliness as well as despatch is imperative in a bookbindery where hundreds of sheets of printed matter must be folded, bound and kept spotless. Overhead shafting with its bearings and belts cause loss of production from falling oil and grit, but electric drive is able to remedy this and give at the same time economical operation as is attested at the plant of the Williams Bookbinding Company, New York City, recently equipped with 35 General Electric motors varying in size from one-fourth to five horse-power.

The installation as is seen by the illustrations is an economizer of space, even the generator, which is driven by a slow speed Corliss engine, being located on the ceiling. The folding machines which pick up the large sheets of printed paper and wrap them up one fold after another until they reach the page size of the book or magazine of w..ich they are to become a part, are equipped with two-button push-button stations located at six different points about each machine so that in case anything goes wrong the machines may be quickly stopped by pushing the nearest button.



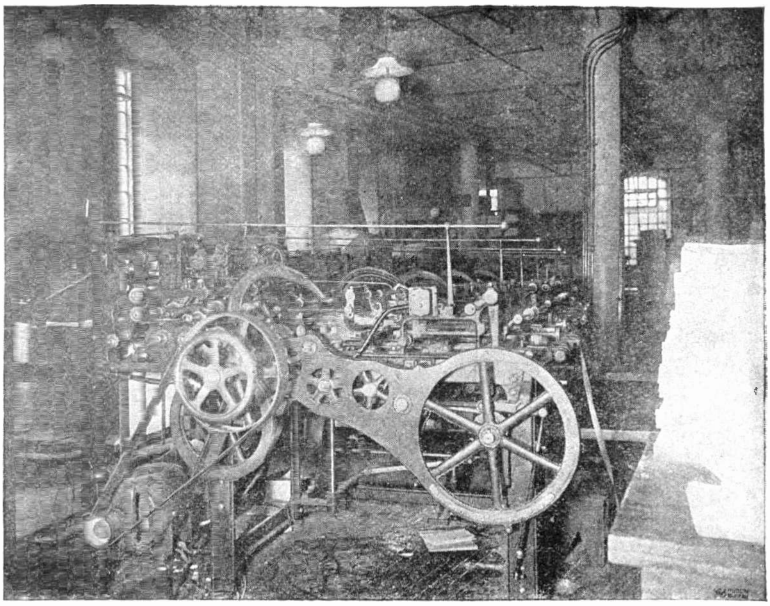
THE DYNAMO AND SWITCHBOARD IN A MODERN BOOK BINDERY. NOTE THAT THE DYNAMO IS MOUNTED ON THE CEILING

IN THE VARIOUS SMALLER OPERATIONS MOTOR-DRIVE : MACHINERY IS USED EXCLUSIVELY

The paper cutter is shown in operation while the pasting machine, a piece of apparatus which it was thought impossible to run by a motor because it must stop very quickly, was made manageable for a girl attendant by a starter and brake controlled entirely by a push button.

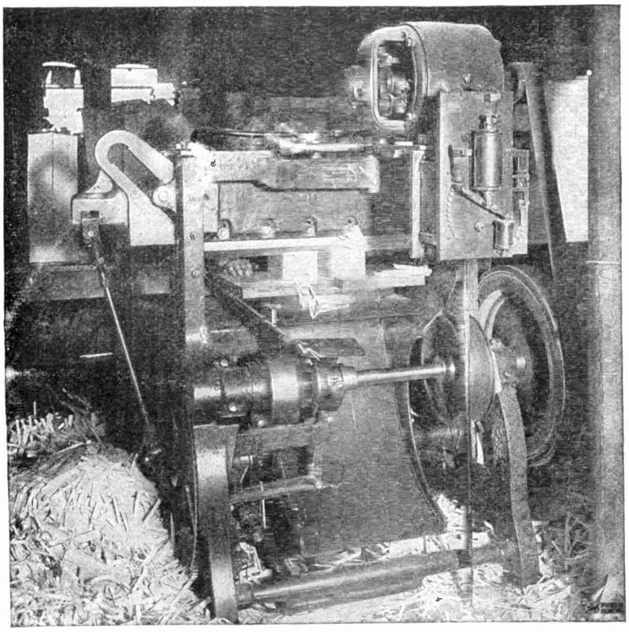
The machine which rounds up the back of a book finishes from 30 to 90 books an hour according to weight, size and material.

A very interesting machine is that which, from its use, is known as the "gatherer." A book is usually made up of sections which will ordinarily vary in number from 25 to 60. It is the purpose of this machine to gather these sections in proper order so that when delivered the pages read consecutively. The starter for this gatherer is mounted on the far wall in the picture, the operating buttons being located on the machine at the receiving end. The motor is mounted on pipe supports out of the way. Nearly all motors larger than one horsepower are provided with automatic starting devices, the result of which is an increase of 15 per cent in the output for a given number of men and machines. This increase in production has not been due alone to the speeding up of various machines, but to the time saved through not having the employees concerned with starting the motors.



SIX DEXTER FOLDERS FITTED WITH MECHANICAL FEEDERS AND DRIVEN BY ELECTRICITY

At first, when hand operated rheostats were used, the girl attendants would pull away from a rheostat handle when a spark occurred, several attempts usually being made before the lever was finally set on the holding coil. The male attendants, on the other hand, would hold the handle on a point until smoke came from the rheostat, when they would let the handle go and wait for the rheostat to cool. It was to eliminate these losses that the company installed automatic starting devices and the results have more than justified the expenditure.



A MOTOR-DRIVEN PAPER CUTTER

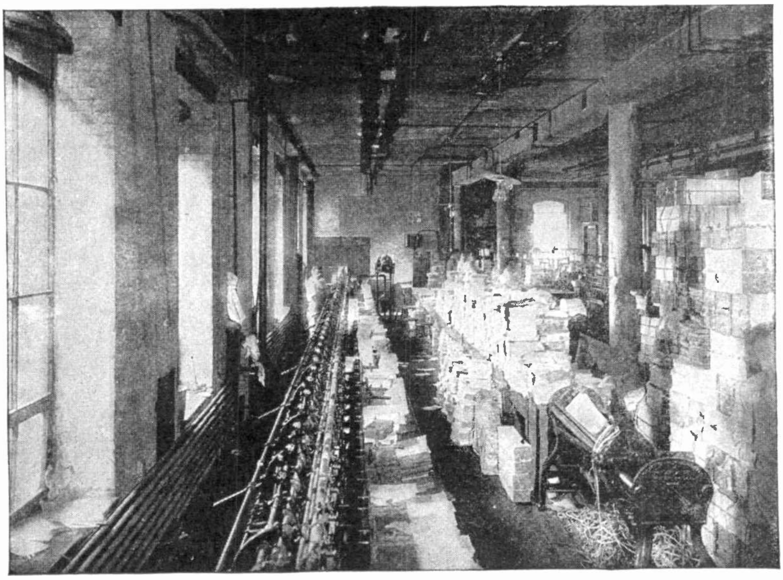
Electrically Hardened Stairs

The maintenance of stairs has long been a serious problem in large city depots and in other public places where the large number of persons tramping on the same wear them out rapidly. Even as hard a material as granite soon has its rough surface rendered slippery and quickly wears away. Now one of the hardest products of the electric furnace has come to the rescue, it being carborundum, the crystals of which are almost as hard as a diamond. When mixed with the ingredients of ordinary concrete this makes a stone so much harder than the shoe soles as to easily resist their wear. Trials at the Paris subway after an estimated traffic of over 14,000,000 persons showed no appreciable wear on these carborundum-concrete stairs. Besides they are reported to be remarkably noiseless for cement stairs, which makes them all the more pleasing.

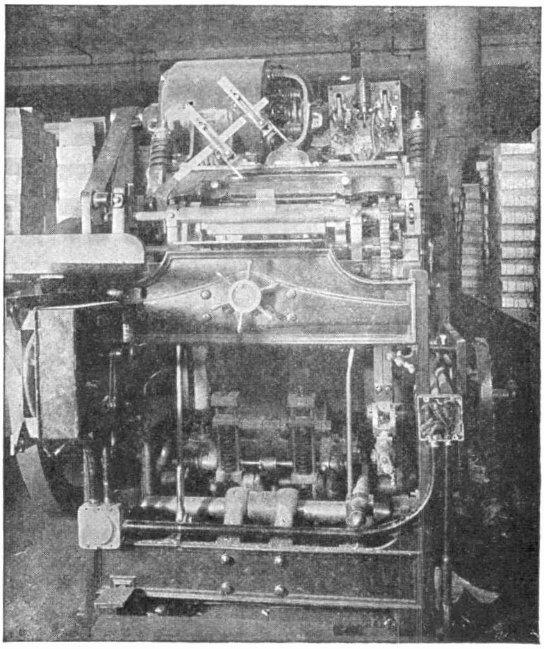
The city of Tokyo, Japan, is soon to be provided with an electric elevated railway. The line will be supported on brick arches at an elevation of twenty-two feet above the street, and the estimated cost is $13,500,000.

A Quarter of a Million Miles of Cable

There are about 225,000 miles of cable in all at the bottom of the sea, representing $250,000,000, each line costing about $1,000 a mile to make and lay. The average useful life of a cable nowadays is anything between thirty and forty years, according to circumstances. About 6,000,000 messages are conveyed by the world's cables throughout the year, or 15,000 a day, the working speed being up to 100 words a minute under present conditions. About 90 per cent of these are sent in code or cipher.



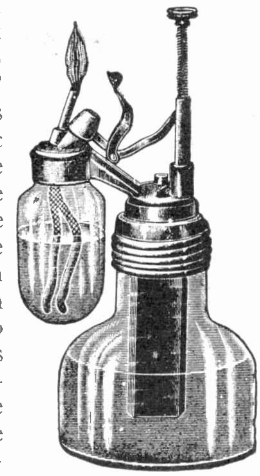
THE ALMOST HUMAN GATHERING MACHINE



THE ROUNDER AND BACKER WHICH PREPARES AND GLUES THE EDGES OF A BOOK BEFORE BINDING

A Curious Cigar Lighter

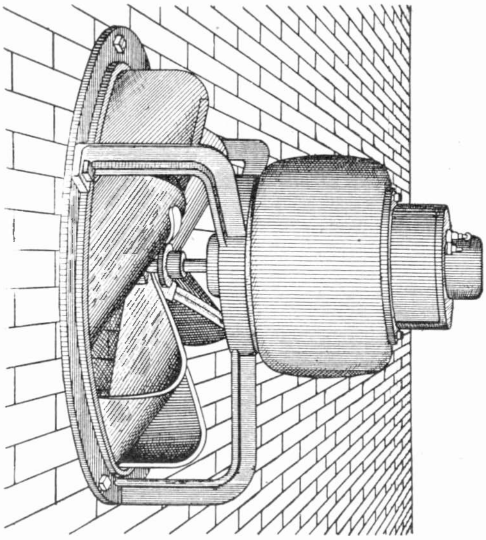
If any slogan were needed for expressing the feeling that has lately been prompting many inventions in Germany, it might be: "Anything to beat the match tax!" Where current is available, electric cigar lighters have found a ready sale and even where there is no wiring, the demand for such lighters has been strongly felt. To meet it, one firm is putting out a primary battery of the familiar bichromate of potash and sulphuric acid type, with a little alcohol lamp supported by it. Depressing the zinc uncaps the wick and gives a spark to light it, while a spring slowly draws the zinc out of the solution and snuffs out the wick.



CIGAR LIGHTER

Ventilation Easily Controlled

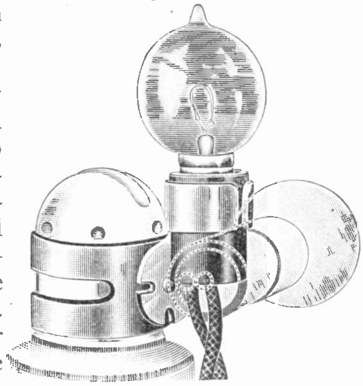
When one is seated in a cool, comfortable theatre waiting for the curtain to go up, it is quite easy to give no thought as to how this condition of the air is attained. The accompanying illustration reveals one means in the ventilating fan operated by an electric motor secured to the wall. The device takes up and forces out the foul air. This method of forced ventilation can be and is used also in both large and small restaurants. One of the features of the illustration is the fact that during the periods when many people are to be cared for the fan may be run at full speed, while during the lax or closed hours the system may be run at slow speed or shut down entirely by the simple adjustment of a lever or the throwing of a switch.



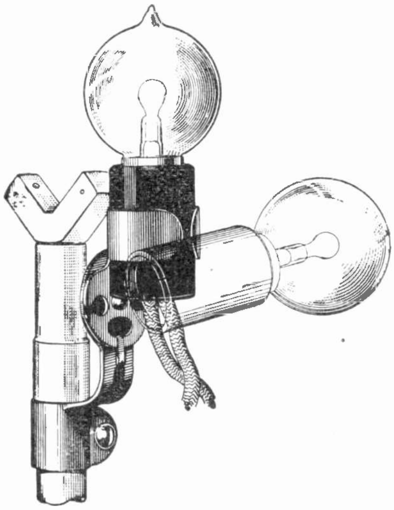
MOTOR-DRIVEN VENTILATOR

Converting Oil or Gas Lamps to Electric

The automobilist who wishes to light his machine with electric lamps and at the same time retain his oil or gas burners for emergency use will find the Gil-Bo lamp brackets here illustrated very suitable for the purpose. On either type the electric bulb is easily turned out of the way when the oil or gas burner is lighted.



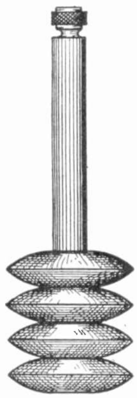
FOR OIL BURNER



FOR GAS BURNER

New Method of Grounding

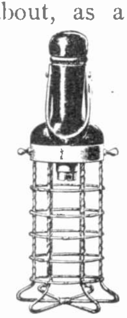
The question of how to provide a ground in electrical construction so that it will be permanent is the subject of much discussion. The illustration shows one method, the Lord hydroground. This consists of several ovoids which are made of a composition which is absorbent, non-metallic, and not affected by acids. A galvanized iron pipe runs down through the ovoids, this pipe being covered on the outside with cotton hose saturated with asphaltum. The hydroground is buried at least six feet in the ground and a pail or so of strong salt water thrown over it after the ground wire is connected to it by a lug provided.



HYDRO-GROUND

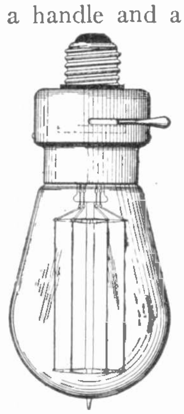
An English Hand Lamp

While in America we refer to an electric light arranged to be carried about, as a "portable lamp," our English cousins call it a "hand lamp." Such a device if made in accordance with Underwriters' rules in this country and as prescribed by the Board of Trade in England must be protected by a wire guard of which there are many styles. The one illustrated is of English manufacture. It is constructed with a handle and a base so that it may be set down upon any flat surface like a lantern.



AN ENGLISH HAND LAMP

Lamp with Three Degrees of Light



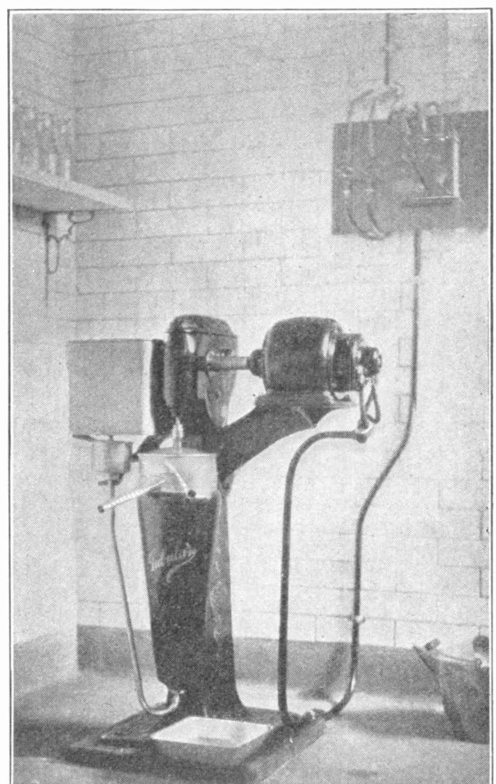
LAMP WITH SEVERAL FILAMENTS

A patent has been issued to Delo Hoke Bering, Pittsburgh, Pennsylvania, on an invention for increasing or diminishing the light given by an incandescent lamp by the movement of a switch shown in the illustration in the base of the lamp. The lamp is provided with two single filaments and two sets of double filaments. Moving the switch to the first contact places a single filament in circuit for a night lamp. Contact two brings the second single filament into use. The next two advancements of the switch connect filaments until all six are aglow.

Motor Skims the Milk

Cleanliness is the watchword in modern dairies, processes and apparatus being sought which afford the greatest improvement in this direction.

Because of its cleanly qualities the electric motor is conceded first place as a means

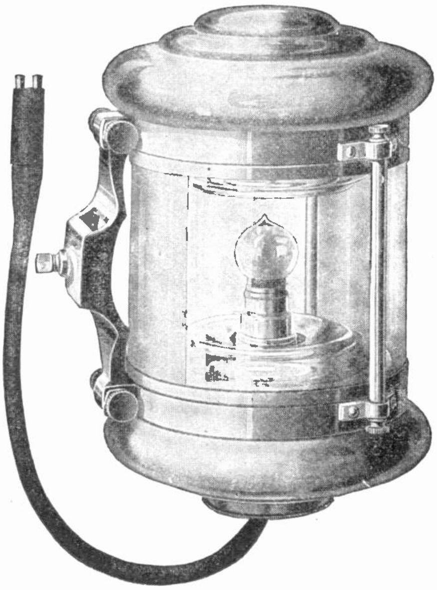


TUBULAR CREAM SEPARATOR, MOTOR OPERATED

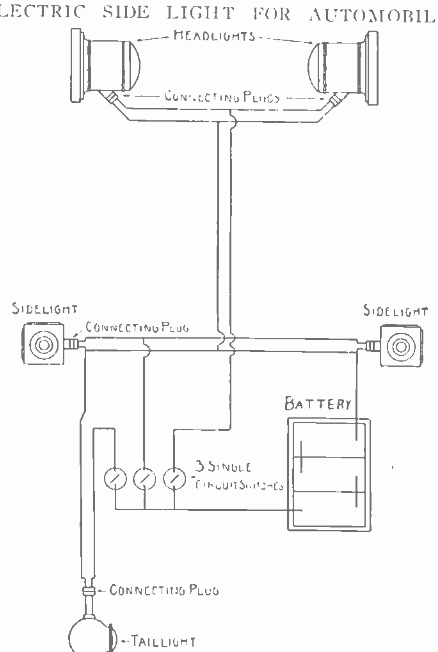
of power for operating cream separators, ice cream freezers and similar machinery. Mounted on a pedestal of metal arranged to support it the motor is shown in the picture operating a tubular cream separator on the same metal base.

Electric Automobile Lights

The cylindrical "Hyray" electric side light shown in the accompanying cut is a new design for the lighting of motor cars. For ordinary purposes it is equipped with a two or four candlepower tungsten lamp. The cylinder of glass which forms the sides is $4\frac{1}{2}$ inches in diameter and $3\frac{3}{4}$ inches high.



ELECTRIC SIDE LIGHT FOR AUTOMOBILES



WIRING FOR AUTOMOBILE HEAD LIGHTS

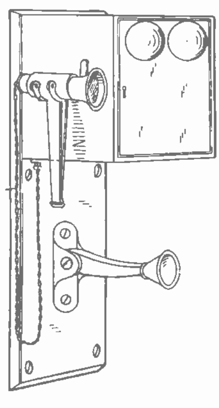
There is also manufactured by the same company an electric fitting for headlights which can be adapted to the ordinary cylindrical gas lamp or "flare front" lamp, making it possible to convert from gas to electric lighting. The method of wiring is shown.

Torches for Show Windows

The never-ending fascination of watching the color play of a flame would lend itself readily to show window displays, were it not for the fire risk introduced by any real flames. To reproduce this catchy effect without its danger, a German firm is offering electric fire urns with opalescent glass globes moulded in the shape of flames. Within each globe are a number of miniature lamps of various colors, some of which burn continuously, while others are lit in rapid succession.

AN ELECTRIC TORCH

Telephone Receiver Handle



TELEPHONE RECEIVER HANDLE

The object of the invention here illustrated is to provide a convenient, light, cheap and readily attachable handle for telephone receivers. The handle is so made that when the receiver is not in use the hook supports the handle and the handle, the receiver. The patent is issued to Chas. A. Barnes, Sr., Greenfield, Indiana.

The Romance of Power

By WARREN H. MILLER

II.—SUPERHEATED STEAM UNITS

I suppose that in 100 years from now our great-great-grandchildren will look back on this era with pitying wonder, not unmixed with rage at the clumsy manner in which we dug into the priceless stores of the world's combustibles. No other century in the world's history has seen such prodigious wastes. Our descendants will fume at the way we went through the stored energy of millions of years in a single century,—how we threw away nine times as much coal to get out a single horsepower of work as was necessary, and how we used 30 times as much power for a single candle-power of light as Nature does with her glowworms and fireflies. *They* will probably have the glowworm's secret by that time, and will use steam so as to convert from coal to power with about the same efficiency as our dynamos, but meanwhile *we* will have used up all the coal, so the world will be little better off for all those improvements.

We may think that we now understand electricity pretty well, but, just for instance, —can anyone on earth explain the battery of the electric eel, and how he succeeds in directing a shock through three or four feet of a universal conductor like salt water? You perceive that there *is* still a good deal about electric power and its transmission that we do not understand, for that shock has force enough to kill a horse.

One hundred years ago Watt built the first steam engine. From a coal-using point of view it was surprisingly economical, since our present-day small dynamo engines use twice as much coal for the same power. During these hundred years we have not done much to save coal, but have been rather perfecting the mechanical side of the engine, so as to get lots of power out of a comparatively small mechanism of iron and steel, until there is virtually no greater mechanical perfection obtainable. And now, with the opening years of the Twentieth Century, the scientific-minded Germans are turning their thoughts in advance from mere mechanical perfection into a consideration of the whole question of steam power from coal, taking the fire, boiler, steam and engine as a single unit.

Let us study our ordinary modern steam plant as such a unit and see if a few criticisms cannot be made. In the first place Science tells us that the engine is using a great deal too much steam. During the exhaust stroke the cylinder-walls cool down to the temperature of the condenser, and when steam is again admitted a lot of it condenses on the walls in heating them up again. This condensed steam passes out to the condenser with the next exhaust, doing no work, and this waste is not less than a third of all the steam used in the engine. So the engine could be one-third smaller for the same power, that is use a third less steam, and, if so, the boiler could be *more* than a third smaller, say one-half the size, because the boiler introduces its own losses in making the steam.

Criticism No. 2. Twenty per cent of all the heat in the coal goes up the stack. That's quite a loss, for it is not necessary to waste twice as much energy as the engine itself delivers (ten per cent) in simply creating chimney draught. Better use a small fan than that. But these stack gases *are* wasted, mostly because their temperature is too low to use them on the steam.

Then our plant seems entirely too much spread around. There is a boiler in one room and an engine in another and a lot of piping in between, with still more piping to run a couple of little steam feed-pumps, which use up four times as much steam to the horsepower as the big engine does. Evidently the whole question of what we are going to do with our coal needs reconsideration, because this piping wastes by radiation five per cent of all the steam made, the boiler shell wastes another five per cent, and finally the grate wastes another five per cent in direct radiation from the under side of the grate into the ash pit.

All this is when the plant is new. As it gets old and the boiler gets scaly in spite of all our efforts to clean it, all these losses increase several per cent each until we take *five times* as much coal to make a horsepower as the Germans do with some of their new and more scientific steam units.

For theirs *is* a unit—a compact machine for taking literally a pound of coal and delivering from it a horsepower. Let's see how they do it. Science tells us that the way to get rid of cylinder condensation is to superheat the steam. If the engine is compound condensing, superheat for *both* cylinders, or else you will lose again in the low pressure cylinder just as we do in ordinary compound engines. Science says that 587° F. is hot enough, so that the steam will still be sufficiently hot when exhausting not to condense. To get this temperature we must shorten up the boiler tubes, thus decreasing the amount of water evaporated, but that is just what we want, since the engine will not need so much steam to yield the same horsepower in mechanical work.

As the engine will be compound, so as to get down to condenser temperature without wasting any heat in the steam, it is necessary to re-superheat before admitting the exhaust of the high into the low. Science shows that 360° F. is enough for the second cylinder, so we have here a use for the low-temperature stack-gases that are usually thrown away up the chimney.

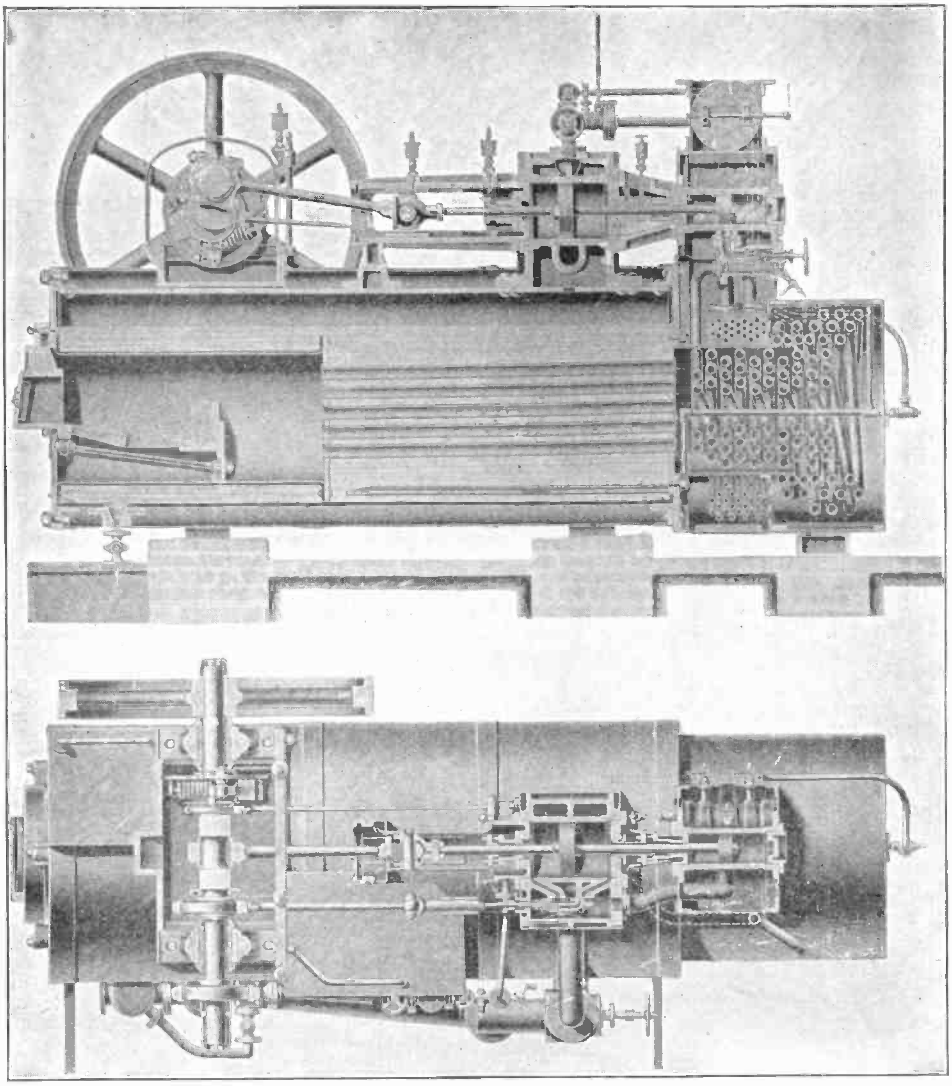
But after exhausting from the low, the steam will now arrive at the condenser too hot, so it had better be passed through a feed water heater and then to the condenser thus using up all the rest of its heat.

Now let us see what can be done with the radiation losses. Suppose we mount the engine right on the boiler. Then we have no steam piping at all, as we can go direct from the first superheater into the high pressure cylinder, right back into the second superheater and back again into the low. Then we can surround the boiler with an airtight Russia-iron shell, making it practically impervious to heat. Again, the cylinders themselves radiate about two per cent of the steam heat, being merely lagged with asbestos and fancy cast iron. Let's lag them with steam or hot gases, by mounting one cylinder in the steam-dome, or rather casting it in one piece with the dome, and mount the other in the chimney. Then the radiation will be *into* the cylinders, not out of them. It makes little difference which cylinder is mounted in the stack, as the steam pressure is about 180 pounds and its saturated temperature therefore about 380° F., so that for tandem compounds the high is usually put in the stack and for cross compounds both are mounted together in the dome, the temperature being about the same in either stack or dome.

Browsing around a little more with the pruning knife; those little steam feed pumps of our ordinary plant do not appeal to us. They use up so much steam that they take, first and last, one-seventh of all the steam made just to feed the boiler. Suppose we mount a feed pump on the boiler and drive it off the main engine with an eccentric, cutting down this expense to the mere mechanical work done on the pump. For a stand by and to feed the boiler when the engine is not running we will use a small injector.

Now if all these economies are added up, they amount to a saving of 65 per cent of all the steam required in the ordinary wasteful steam plant; and actual tests running on electric light service agree with this, for they show the steam consumption to be less than *nine* pounds of steam per hour per horsepower, whereas it takes 30 pounds for a good engine with us. Therefore a boiler only one-third the size is required, and, since the boiler wastes 20 per cent of its heat up the stack in ordinary plants, this loss also is reduced one-third. Whence it is not surprising to find that the coal consumption of these German units is only *one* pound of coal per horsepower for a 75 horsepower unit, against four pounds for an ordinary 75 horse boiler and engine.

Our illustrations and sections show how these engines are built and what they look like. They are, in effect, a small, compact, semi-portable power plant, no larger than some agricultural steam threshers requiring



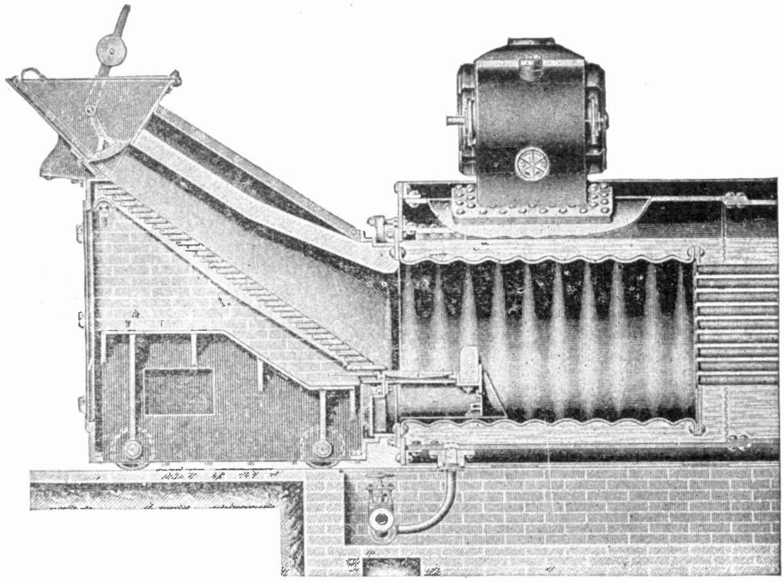
SECTION OF A TANDEM-COMPOUND "LOCOMOBILE"

only a small power house, easily kept clean and in good order.

Is it any wonder that with such a unit, of economy equal to the largest ocean steamer turbines, that over 6,000 such plants, ranging from 40 horsepower up to 1,000, are installed all over Europe? And, moreover, the engine today supplying over one-half the entire light and power for the Brussels World Exposition of 1910 (shown in the December issue) is not a large, lengthy steam-engine, but a 1,000-horse Lanz superheated steam unit, occupying complete with generator a floor space of only 25 by 35 feet.

And now, we come to where this economical steam consumption fits into the scheme of things for the power of the future. You will note that this low steam consumption and small boiler permits the use of all sorts of low-grade fuels by simply arranging special grates for fuels that an ordinary boiler firebox couldn't think of handling. These units have for good coal a grate only one-fourth the size of our ordinary fire box. When they make it larger it is to burn bark or straw or corn husks—something that will not even make good fertilizer. And, as these plants can be set down in the tropical forests of Africa right out of a steamer's hold, ready to run on cocoanut shells or sugar-cane *bagasse,* they have been pushed by enterprising German and French traders to the uttermost parts of the earth.

What will be the next step in advance toward the steam power of the future? Science indicates it as clearly as she pointed to the superheated steam unit to avoid cylinder condensation and general waste losses. Suppose we combine the superheated steam units with a low pressure turbine and catch some of those heat units rejected into the condenser, turning them into useful work?



HOPPER GRATE FOR LOW GRADE FUELS

In a pound of steam at 150 pounds pressure expanded down to ten pounds absolute, or ten inches vacuum, there are 155,000 foot-pounds of work. If we keep on down to one-half pound absolute or 29 inches vacuum, there are 275,000 foot-pounds of work available, or nearly twice as much. But, after the superheated steam engine—or any engine for that matter—has expanded the steam down to about four pounds absolute, or 22 feet vacuum, it is *forced* to reject it into the condenser without getting out any of these 100,000 foot-pounds of work still remaining. Why? Because of the enormous volumes of space that a single pound of steam at these low vacuums occupies. No cylinder big enough to use it can be built. At four pounds absolute a single pound occupies about 90 cubic feet, which is about the limit for the low-pressure cylinder. At 28 inches vacuum the same pound of steam takes 350 cubic feet of space, and at 29 inches it takes 715 cubic feet! We can get the vacuum easy enough, but *we can't use it.*

And right here steps in the low pressure steam turbine. Large volumes of steam do not worry it any. The more you shoot over its blades the better—half a dozen nozzles around the same wheel if need be. From four pounds absolute down to one-half pound is no great drop to expand through, so that it is easy to arrange the blades to convert all the pressure into work, no matter how much volume of steam has to be handled. The combination of reciprocating engines with low pressure turbines has been adopted with signal success in large central power stations, the turbines being inserted between the exhaust of the reciprocating engine and the condenser on purpose to catch these 100,000 foot-pounds of energy.

The combination of the superheated steam unit with the low-pressure turbine has not been tried as yet, except on a laboratory scale, but there is no reason mechanically why such a turbine should not be mounted on the engine and geared to the crank-shaft. With such an arrangement nearly doubling the already high economy of the superheated steam unit, we should see a horsepower of work forthcoming upon the evaporation of five pounds of steam on one-half pound of coal; or $1\frac{1}{2}$ pounds of refuse.

As this is more than twice better than the gas engine and producer can do at present it will be some time before the funeral knell is tolled over the steam engine. The logical place for each will be—for the gas engine the large central station, for the steam engine, the moderate-sized isolated plant.

(To be concluded.)

Twenty-five Storage Battery Suggestions

Manufacturers usually furnish explicit directions as to care and operation of their storage batteries and these should be carefully adhered to. The following directions, however, may assist the beginner:

(1) Learn to prepare the electrolyte. Use a large earthen crock or lead vessel with burnt seams. One part of chemically pure concentrated sulphuric acid is mixed with several parts of water, the proportion of water varying with the type of cell, from three parts to eight parts. Specific gravity of a suitable acid 1.76.

(2) Always pour the acid into the water, never the reverse.

(3) Use pure water either distilled or rain water.

(4) Allow the electrolyte to cool before placing in the cells. The specific gravity should be 1.200 or 25° Baume. Add distilled water if a higher reading is obtained.

(5) Grids should always be at least ½ inch below the surface of the solution.

(6) Woolen clothing is little affected by acid.

(7) Ammonia immediately applied to a splash of acid on the clothes neutralizes the acid and prevents a hole being burnt in the material.

(8) In case a bit of acid splashes into the eye wash well with warm water and put into the eye a drop of olive oil.

(9) Avoid the use of an open flame in a room where a storage battery is being charged or in which it has been left for some time, as an explosive mixture of air and hydrogen may be formed.

(10) Prepared electrolyte may be purchased if desired.

(11) Storage batteries are rated in ampere-hours, this being based on the *steady* current the battery will discharge for eight hours. A battery that will discharge at five amperes for eight hours without the voltage falling below 1.75 is rated as a 40-ampere-hour battery. This does not mean that 40 amperes would be the output of the battery if discharged in one hour. The ampere-hour capacity decreases with the increase in current output.

(12) The current in charging should be kept within the maker's specified limit. One authority advises for rapid charging covering a period of three hours, 50 per cent, 33 per cent and 16⅔ per cent of the total current for each consecutive hour.

(13) The e. m. f. of the charging current at starting the charge should be about five per cent higher than the normal e. m. f. of the battery. After a few minutes this voltage may be 10 or 15 per cent of the normal battery e. m. f. However, the battery is kept in the best condition by using a constant charging current and if necessary to maintain this the voltage may be raised to 40 per cent of the normal battery voltage.

(14) Be sure the positive pole of the charging mains is connected to the positive side of the battery.

(15) To determine the polarity hold the two wires in a glass of acidulated water or electrolyte, keeping them at least ½ inch apart. Gas will collect most at the negative lead.

(16) A cell is fully charged: (a) If, with a constant current, the voltage and specific gravity do not change for 25 or 30 minutes. (b) When the plates decidedly increase the quantity of gas given off. (c) When the specific gravity measures 1.2, and the voltage from 2.5 to 2.7. (d) When the negative plate assumes a light gray color and the positive plate turns a dark brown.

(17) Never short circuit the terminals of a cell to determine if it is charged. This may be found out approximately by connecting a two-volt lamp across a single cell and noting its brilliancy. A small dead-beat voltmeter reading from zero to three volts is a convenient instrument and is not expensive.

(18) Lead cells should not be discharged below 1.7 volts.

(19) Boiling does no harm unless the paste is loose, when the agitation will remove it.

(20) If the cells are hot while charging reduce the charging current.

(21) If a battery is not in use give it a short charge once a week.

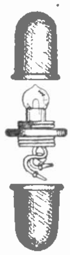
(22) If white sulphate is formed on the grids it may be reduced by charging at a high rate or overcharging at a low rate for two or three hours.

(23) Continued sulphating will buckle the plates as will also too rapid discharging.

(24) A cell that has been short circuited should be disconnected from the battery and charged and discharged several times separately.

(25) Makers furnish directions for keeping batteries when not in use. One way to do this is to charge the battery fully, then siphon the electrolyte out of the jars, to be kept until again used. Then fill the cells with clear water and discharge the cell at the normal rate until the cell shows less than one volt. The plates may then be removed and stored.

Pocket Testing Lamp

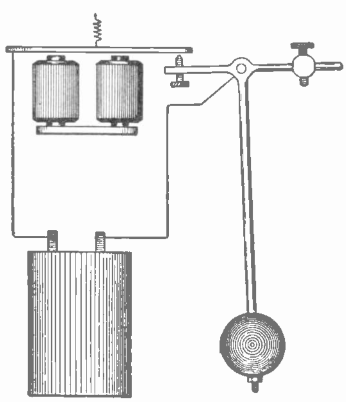


TESTING LAMP

Instead of using pocket voltmeters, many European motorists carry miniature four-volt lamps with short flexible terminals, mounted in boxwood cases. The brightness of the lamp gives a sufficient indication of the condition of a battery cell to make it serve as a cheap and compact substitute for a voltmeter.

An Electric Pendulum Clock

Those who have wondered how electrical clocks were driven and how complicated an arrangement of magnets and springs they require will be interested in the accompanying sketch showing the mechanism of an electric pendulum clock designed by Prof. M. C. Fery of the School of Physics and Chemistry of the city of Paris. Prof. Fery has equipped a simple pendulum with a crossbar having a screw tip which just touches the tip of a magnet armature at one end of the pendulum's swing, thereby closing a battery circuit through the magnet. This immediately draws the armature to it, giving the pendulum a fresh start and breaking the circuit which is only closed for a very short time. Thus at each swing of the pendulum the battery gives it enough of a push to overcome the friction of the gears driven by it and the result is a simple timepiece having no springs except the little one that raises the armature after each impulse.



ELECTRIC PENDULUM CLOCK

Making New Solvents

Some of the intensely interesting work which has been done during recent years by electrochemists is reflected by certain of the foreign patent applications of Mr. Clancy covering new methods of treating ores which contain precious metals. They are based on the remarkable discovery that certain chemical solutions which will not dissolve ores under ordinary conditions, will do so readily if a current of electricity is passed through them. Consequently the reducing and refining of ores can be done by means of chemicals which heretofore were believed to have no effect upon the same ores and a similar situation will undoubtedly apply to other chemical processes. For instance, Mr. Clancy proposes to utilize some of the cheap fertilizers which are now produced in France by electrical means, using an electric current to liberate oxygen in the liquid and thereby change its possibilities. If this line of research is extended we may have to revise our present lists of the solubilities of chemicals in liquids, as many heretofore considered insoluble may prove to be easily dissolvable in the presence of an electric current.

Cleaning an Edison Primary Cell

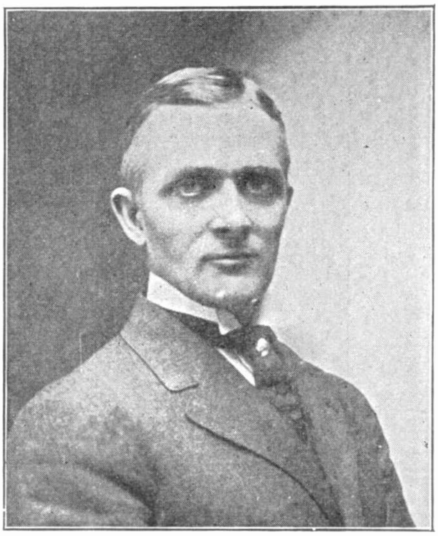
As many have trouble in cleaning the Edison or Gladstone primary cell before recharging I submit the following directions, which I have found work well: Remove the cover, stir the solution well and empty out quickly, thus leaving no sediment in the jar. Wipe the jar out with a piece of cotton waste. If oil adheres to the jar use a little muriatic acid on the waste, then wipe finally with clean waste. Clean the copper plate also with acid. and wipe with a dry cloth. Handle the acid with care and use as little as will do the work.

R. S. KRAUSE.

Electrical Men of the Times

C. H. THORDARSON

We are accustomed to associate with men of the Northland a certain steadfastness of purpose and seriousness of mind engendered by constant strife with unfavorable elements. Although C. H. Thordarson is an American in every sense of the word, having come to the United States at the age of six, he is by birth an Icelander and his parents lived in Iceland until they exchanged the rigors of the Arctic Circle for the wild woods of Northern Wisconsin, which was in 1873. Such were the environments in which young Thordarson lived until he came to Chicago in 1885 to take up the study of physical science, which had for him an intense fascination.



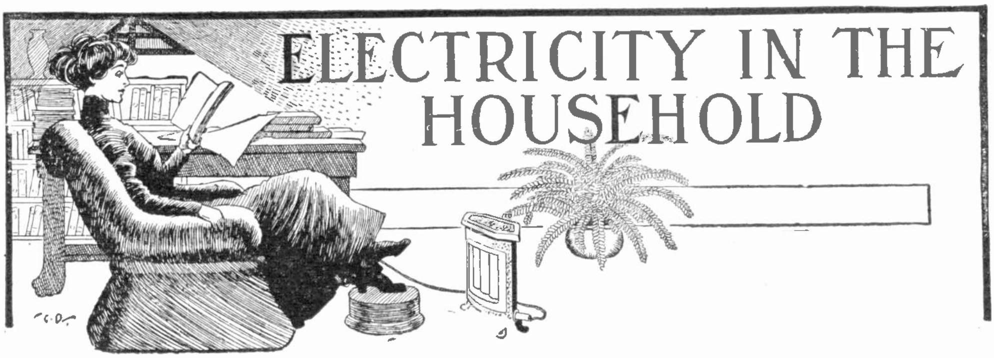
In those days Professor H. V. Richards conducted a supply house devoted to physical science apparatus of all kinds and here Thordarson received his first real scientific training under the guidance of Professor Richards, and incidentally learned the commercial side of the business. During the next ten years he became associated with various manufacturing enterprises and also with the Chicago Edison Company, which was the last firm for which he worked before going into business for himself in 1895.

When this young man started out for himself he had two things on which to build—a capital of just $75, and an unbounded determination eventually to have the most fully equipped electrical high tension laboratory in Chicago. He has made that $75 go a long way, and slowly and persistently he has evolved from it a business in which 100 people are now employed in a shop and laboratory which in many respects is unequaled anywhere. Not a cent of outside capital has ever been put into the business, which nowadays is an unusual thing.

Almost every university and technical school in the country bears evidence in its physical and electrical laboratories of the work of Thordarson. Therein you will find transformers, high frequency apparatus, electric welding and heating appliances, and experimental equipment of a multitude of kinds—special types every one, which are individually the products of his inventive genius.

Some years ago, when the International Electrical Congress was in session at the St. Louis Exposition, they wanted a great transformer of 150 horsepower which would deliver current at the enormous pressure of a million volts. They sent a hurry call to Thordarson. In 28 days that transformer was standing in a little building on the Fair grounds—the largest apparatus of its kind which had or has ever been built. So much for size, yet Thordarson has gone to work just as enthusiastically and designed a little transformer to ring a door bell.

In disposition, Mr. Thordarson is of the retiring kind, and, like most deep thinkers, so absorbed in mind as to be considered by casual acquaintances as always serious. As acquaintance reaches a closer friendship, however, it is found that the somewhat dreamy eyes of the inventor can twinkle with amusement, and his quick, nervous way of appearing to wish to hurry back to his enthralling experiments gives place to hearty geniality—but, then, you must know him pretty well before he will fool away much time with you. Just now he is engrossed in the plans for a greater and more complete laboratory, although he can gather from them no more pleasure than when he was planning on spending that first $75.



Where Art and Science Meet

By T. VERNETTE MORSE

The present almost universal desire to return to the simple life seems to me to be the result of a better understanding of the fitness of things and a healthy release from the bondage of conventionality.

The writer, at one time a landscape painter of some repute, has devoted a life time of study to this phase of art expression. The painting that is a mere copy should never be allowed space in an exhibition. It is only when the painter interprets intelligently Nature's handiwork, translating her message as it is revealed to him that his work rises above the mediocre. The art that puts into action the best forces of mankind, the art which is so strong and broad that it contains the formative principles of true character is the only significant art.

The real laboratory for the promotion of such an art is the home—not the home of great paintings, but the home of love and joy. The home where spontaneous invention bursts forth like a joyous peal of laughter, a home where pictures and other esthetic things are appreciated for the message they bring and not for their technique.

To the woman of good taste and artistic training the home offers a field more far-reaching in its influence than either studio or great exhibition, for the home has to deal intimately with that greatest of all things—life—from which all else must be developed.

To live the life the Greeks lived is quite impossible in this modern electrical age, but it is possible to achieve in the home life of today as great and lasting a cultivation of the artistic side of life as it was 3000 years ago. The principal evil to be combatted in these times is the tendency to become buried in the details which are an accompaniment of our complex mode of living and which cause us to lose sight of the higher things which make life more enjoyable. In the home this tendency is perhaps more marked than elsewhere, and too often it is found that the housewife is a slave to the burdens of caring for or superintending the operation of the establishment. To make possible the conservation of her energies to the end that she may enjoy life to a fuller extent is a great problem.

Continuous study and application of these theories gave to the writer early in life, a desire to keep constantly in harmony with Nature's great and inspiring lessons, and art study was the avenue selected.

There was at that time no American art except that little group now referred to as the Hudson River School, but there was always an opportunity to awaken local interest, through the organization of art clubs, which were as a rule, more social than artistic, however they served as a nucleus for better things. I recal one where nearly everyone of the younger members have made a reputation in the art world and several that afterwards developed into strong healthy art schools.

The Columbian Exposition suggested a still broader field of endeavor, opening the way for the publication of the first Chicago art magazine to acquire both a national and international reputation.

With no assistance whatever, having no knowledge of the publishing business but with absolute confidence in my subject, I launched the *Arts for America*, and stood at the helm for nearly ten years. The constantly increasing circulation bringing with it the usual cares and responsibilities.

This experience taught me that an art magazine was merely another means of promoting theories, and the desire to stop preaching and enter the field of real activity became greater each year.

In the meantime the Paris Exposition of 1900 had awarded to *Arts for America* a medal and diploma for excellence which was most gratifying—as I looked at this medal and compared it with a former one that had come to me as a landscape painter, the temptation to adopt one of the professions as a life work was uppermost, but they had failed to satisfy me in the past and I had no reason to believe that the future would be different. Whatever honor or glory the medals carried with them was put aside for the purpose of entering a new and, at that time, untried field.

As a means to the end the Artcraft Institute was established in Chicago, December, 1900, incorporated without capital and not for profit, but for the sole purpose of uniting the best elements of the home, school, club and workshop on a common ground so broad in its scope that the principles of art should be recognized as the legitimate property of the individual, who, by virtue of that ownership should be encouraged to adopt the occupation through which he could best express himself, no matter how commonplace it might seem to others.

This somewhat unique plan was a success from the first and has been approved by the leading educators and manufacturers of the country. All instruction is individual—all unnecessary side lines are eliminated. Diplomas are awarded for the work accomplished and not for the time consumed.

The graduates occupy responsible positions of trust because of the knowledge that comes from practical experience.

Another feature of the Artcraft Institute is the philanthropic department under the auspices of the Guild and patrons, who give time and money for the purpose of assisting women of culture and refinement who are unexpectedly thrown upon their own resources, how to select and develop some occupation whereby they may support themselves and families. Women as a rule do not need more "all round" education, but they do need a working knowledge of at least one craft.

Every department of woman's work is practically covered. Drawing, designing and modeling is taught for the purpose of applying the principles to the work in hand.

In the domestic department all demonstrations are conducted on the most modern scientific principles, a regular home laboratory where up-to-date labor saving devices take the place of old time drudgery. Under the new regimé housekeeping may be a joy to the young matron who does not care for the services of a maid.

Throughout the entire year practical demonstrations of recent labor saving devices are given by inventors and manufacturers. Materials and foods are tested. A complete record of all approved goods is placed on file for references.

This unique educational combination is not the result of a definite plan, but has been a natural growth arising from present day conditions. It encourages the freedom of personal expression. It admits of the use of the machine as well as the hand.

In the work thus undertaken electricity has been recognized as one of the most successful modern agents in the simplifying of household tasks, and it is my intention in succeeding chapters to explain to the readers of this department, in a perfectly simple and non-technical way, how they may employ this unseen force; how, by its use that occupation which we have been pleased to term "housekeeping" may be made an incidental rather than an all-absorbing task, leaving part, at least, of a woman's time to be occupied in the cultivation of those things which make for a higher intellectual and artistic development. In these talks I will attempt to explain not only where art and science meet but how they overlap and by united forces add to the joy of living.

Woman's Influence in the Automobile Field

While the electric automobile can hardly be classed as a household article, still it is an accessory to so many homes that it may very well be given some attention in this department. That buyers this year are paying more attention than ever before to those features which add to comfort and convenience and less to speed may be attributed largely to woman's influence.

It is doubtful if the average woman *ever* cared for as much speed in a motor car as a man. Her delicate nature does not take kindly to being bumped over rough roads at the speed of an express train and her love of the beautiful demands a pace that will permit an intelligent appreciation of the scenery along the way. Her influence is seen, too, in the exterior finishing of the car—flaming reds, feverish yellows, etc., having given place to more subdued and artistic color tones.

But while woman's influence has undoubtedly done much to subdue the speed mania, it would be wrong to give her all the credit. There has been even more potent force working to bring about this change—the psychological fact that when a man gets what he wants, he no longer wants it.

Before the advent of the motor car, man was forced to travel the road at a speed not to exceed fifteen miles an hour. The motor car offered a way to obtain 60. Man took advantage of it, demanded it for a while, then found that he didn't want it—didn't need it.

For comfortable traveling, 30 miles an hour is enough. The real value of a motor car to the average individual is not that it can make 70 to 80 miles an hour on a track, but that it can make 20 to 30 miles an hour on a road, and be ready to repeat the performance day after day.

The motoring public has come to realize this and so the speed era has been succeeded by an era of comfortable motoring.

As an illustration of this one need only cite the largely increased use of the electric vehicle. The handsome appearance, the ease of operation, cleanliness, noiselessness of the electric makes a strong appeal to women. It requires little if any attention on the part of the operator and can be driven without danger of soiling the daintiest toilette.

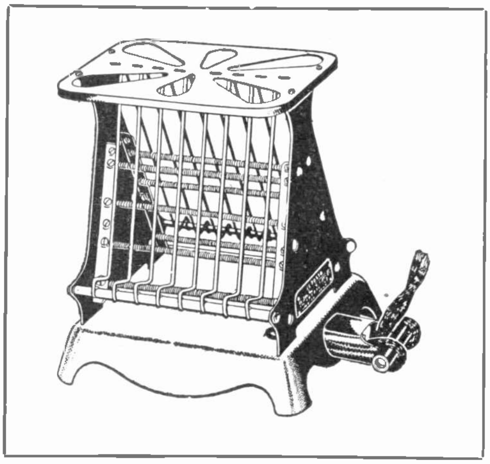
Of course the increased mileage capacity of the electric has something to do with the largely increased use. Eight years ago 40 miles on a single battery charge was about the limit for any electric. Today it is not unusual to hear of electric vehicle owners driving 70 to 100 miles without stopping for a charge and electric cars have been driven over 200 miles on one charging of the battery.

This big increase in mileage capacity is largely due to the perfection of batteries, among them the new Edison battery, and to the fact that a more thorough knowledge of the battery has enabled electric vehicle manufacturers to build motors which work in better harmony with it.

As an illustration of what has been accomplished along this line a recent run made by the Detroit Electric—the first electric to adopt the Edison battery—is of interest. This run, which was made in Detroit on October 5th, resulted in the remarkable record of 211.3 miles on a single battery charge.

Improved Toaster

"Improved" seems to be the watchword as to household electrical devices. The Pacific



AN IMPROVED TOASTER

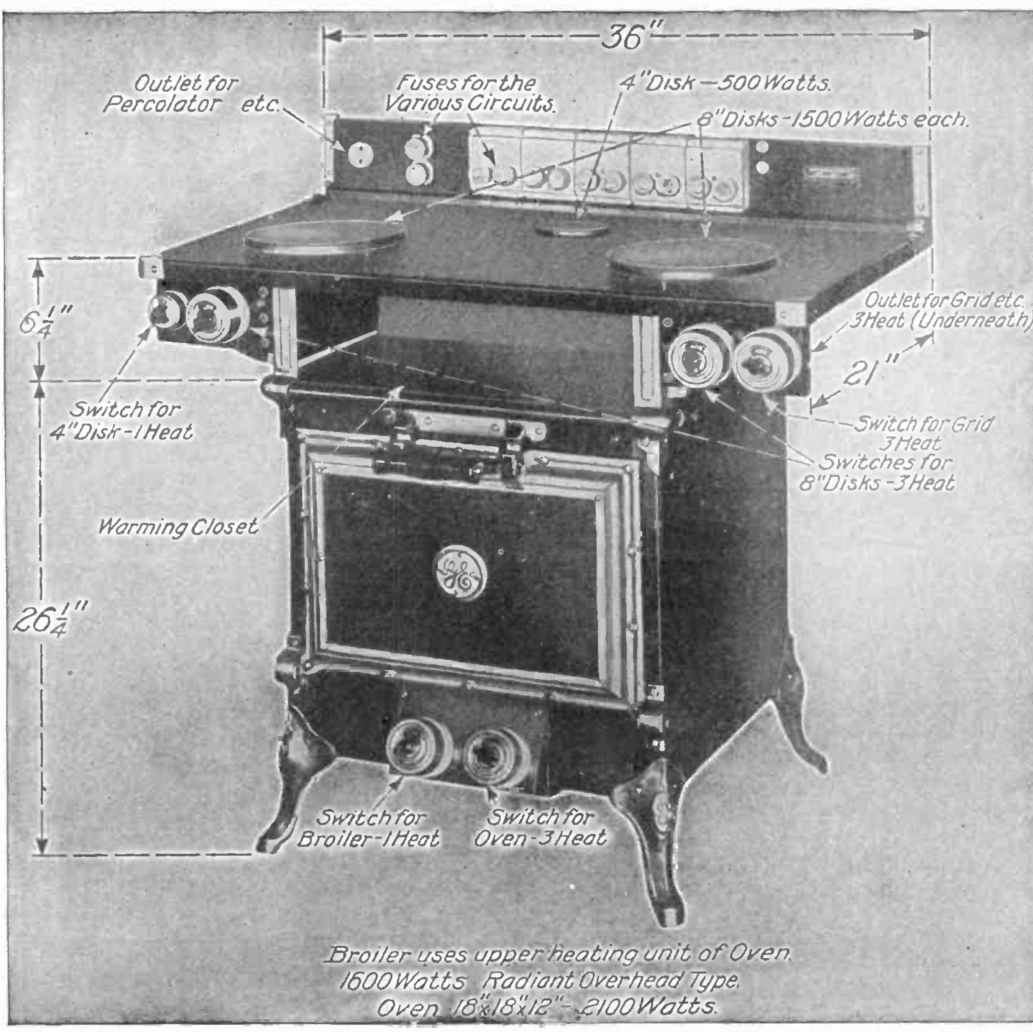
El Tosto here illustrated shows something new—a warming table on the top to keep the coffee pot or any other dish warm during the meal. If you wish to prepare zwieback just lay the toast upon this shelf until it is well dried through.

A New Electric Range

The domestic electric range recently perfected by the General Electric Company is a decided advance in the right direction. The stove as illustrated is similar in pattern to the ordinary gas range. The three disks on the top of the range are used like the burners of a gas range.

A turn of the snap switch turns on the heat instantly at full intensity, while another turn cuts it off and so avoids any expense for current when the stove is not actually in use, without incurring a delay in getting it into operation again. The two larger disks are provided with a switch which admits of a three-heat regulation, thus making it possible to get a low, moderate or high heat as conditions may require. The three disks permit cooking one, two or three things at a time.

The combination oven and broiler is commodious, being 18 by 18 by 12 inches, ample for the needs of a large family and is provided with heating units at both top and bottom. By removing the ceiling plate of the oven, the top heating element of the latter is exposed and may be used as an overhead radiant broiler for the purpose of adding a pronounced brown to pies, biscuits, roasts, and the Thanksgiving and the Christmas turkey. The broiling pan (which is furnished with the range) is also suitable for use as a roasting pan. Printed instruc-

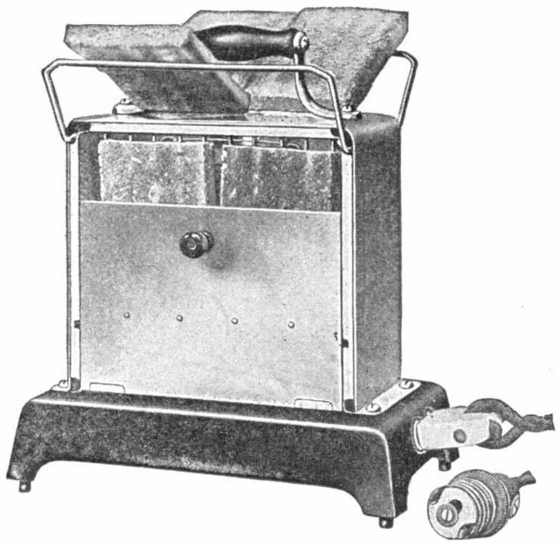


NEW ELECTRIC RANGE

tions accompany each range, and tell what "heat" to use and how long to leave it on to bake or roast the various kinds of meat, bread, cake, pie, etc. The stoves, broiler, and oven all have independent controlling switches.

Not forgetting that the modern housewife knows that a breakfast of nicely browned griddle cakes accompanied by a cup of such coffee as can be made only on an electric percolator will start *him* off to his work in the proper frame of mind, a connection for a coffee percolator and one for a grid on which to make the cakes are provided.

A New "Wrinkle" in Toasters

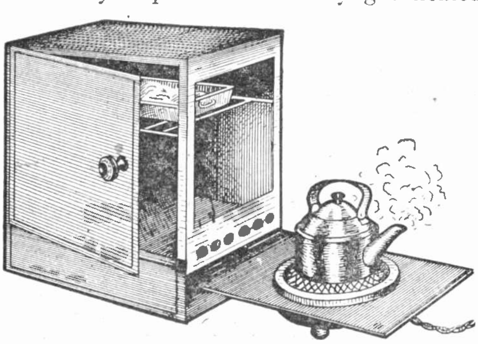


A NEW "WRINKLE" IN TOASTERS

The improved Simplex electric toaster embodies two wire supports projecting upward at an angle of 45 degrees from either side, coming out of the top of the toaster. This provides a supporting bar to rest one end of the slice upon. The other end rests on the frame. This in no way interferes with the operation of the device but provides a way of drying fresh bread while other toast is in the making or keeping warm toast which is already made. When toasting is finished the supports drop out of sight inside the frame. Like a good servant, the toast rack is never in evidence except at the time when its services are desired.

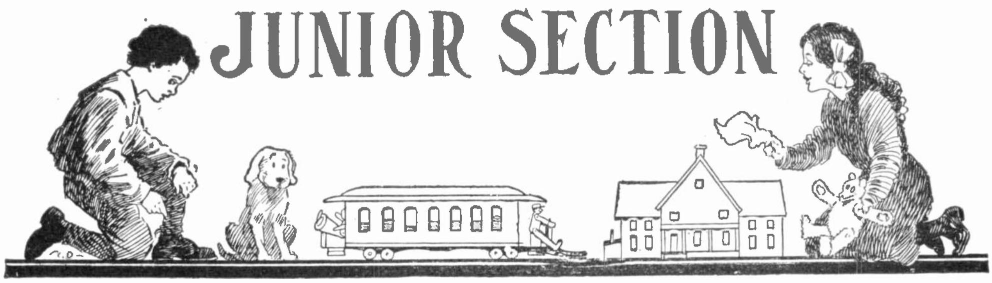
Combination Oven and Warming Plate

In using gas, it is usually difficult to obtain the heat other than in an upward direction, even though this may not always be the most desirable for the purpose at hand. Most of the gas stoves used in kitchens show this limitation and the makers of electric heating devices have been delighted at being unhampered by this objectionable feature. With electric ovens or stoves the heating element can be placed in any position or location that may seem best suited for the cooking to be done by it and it may even be movable. An interesting illustration of this is found in a new electric oven offered by a Scotch firm which has the heating element fastened to one side of the oven. When the oven is not needed, this whole side of the oven can be swung outward to form a heating plate for use with teakettle, coffee pots, or the like. Such a change would be manifestly impossible with any gas heated



OVEN DOOR USED AS WARMING PLATE

device, yet it is but one of the wide range of new combinations which electricity is bringing to our kitchens.



Construction of Small Motors and Dynamos

By CHAS. F. FRAASA, JR.

CHAPTER I.—BUILDING THE BORING MACHINE AND DRILL-PRESS

In every amateur's electrical laboratory there is always need of two or three small dynamos and motors, for experimental and other purposes. Many amateurs purchase these from dealers, getting good machines, while many others find it profitable and instructive to construct their own apparatus. While effecting a considerable saving by doing this the amateur also receives the benefit of the construction, since he makes each part and is thus in a position to understand the principle of operation of the whole machine after it is assembled.

To build good serviceable dynamos and motors, ordinarily requires the use of a number of shop machines to which the amateur generally does not have access. It is for the benefit of such amateurs that these articles will tell how to construct cheaply without the use of a lathe or other regular machine-shop machine, good, efficient and serviceable dynamos and motors. Along with the usual complement of tools, it is assumed that the amateur has a pair of heavy shears, or tin-shears, and a stock and dies that will work on bolts and nuts up to about one inch in diameter. The stock and dies are not necessary, but better work can be done if they are available.

BORING MACHINE

For doing the machine work on these models the apparatus shown in Figs. 1 to 6, should be built. This machine is to serve as a drill press, a boring machine or a lathe. It can be constructed at very little expense, and will be found of much service in building a dynamo or motor, and later makes a handy lathe or drill-press for other work.

The machine, Fig. 1, consists essentially

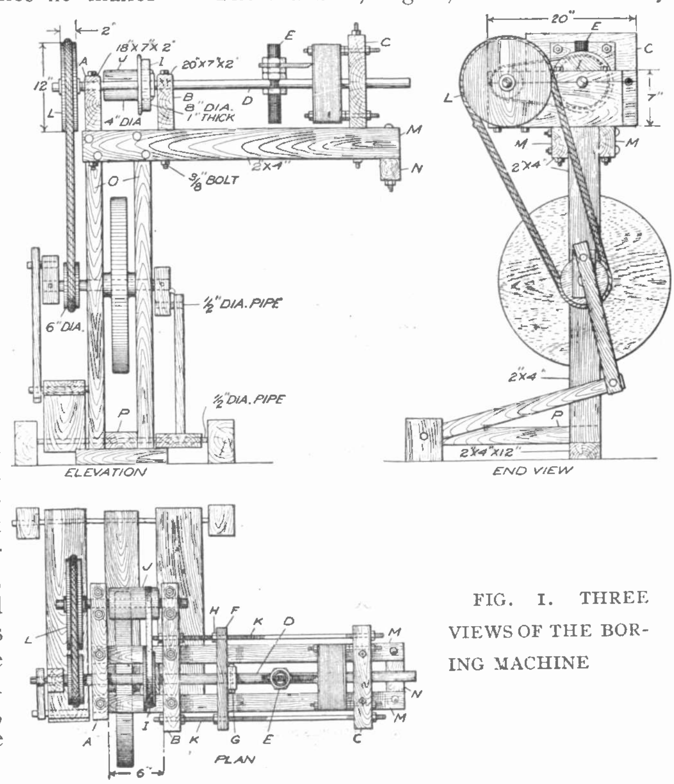


FIG. 1. THREE VIEWS OF THE BORING MACHINE

of a shaft (D) which carries with it upon revolving, the tool-holder (E) containing the tool; the combination of a key (G), strip (F) and nuts (H) on the bolts or threaded rods (K) which feed the tool for cutting, also a tight narrow pulley (I), and the wide pulley (J) which is fastened to a shaft driven by a belt from the pulley of the foot power to the pulley (L).

The operation of the machine is as follows: the power from the foot-power fly-wheel, which may be of metal or heavy hard wood, is transmitted to the grooved pulley (L) either by leather or rope belt. From the pulley the power is transmitted through the shaft to the wide pulley (J); by belt it is then transmitted to the narrow pulley (I). Since this narrow pulley (I) is fastened to the shaft, the shaft carrying the tool revolves, turning the tool with it. If the nuts (H) are now screwed up, the strip (F) will move forward and the tool will cut any material that may be on the board (C).

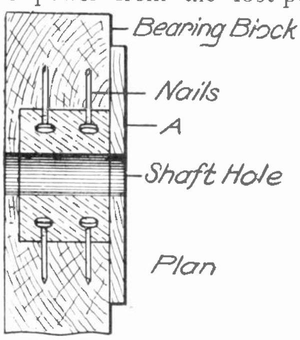


FIG. 2. DETAIL OF BEARING

The first operation in constructing the machine for any size of model other than the one here dimensioned, is to determine the proper size of all its parts. In general the blocks (A), (B), and (C) should be at least two inches thick, and if possible, should have similar dimensions otherwise, but (A) and (B) may be made only of sufficient height to hold the bearings, and long enough to support the pulley (J). If they are of the same size, it will be easier to line up the blocks and the bearings. The distance between the blocks (B) and (C) should be equal to the length of the bore to be made, plus the length of the dynamo shaft, and that between (A) and (B) should be about one inch more than the length of the bore plus the width of the pulley (I). The pulleys should be of such diameters that with the greatest diameter of bore, the cutting speed in feet per minute shall not exceed fifteen feet. The pulley (J) should be as long as the length of the bore plus about two times the width of the pulley (I).

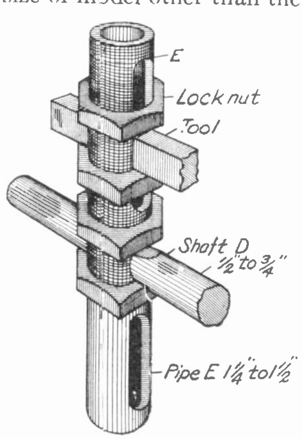


FIG. 3. TOOL HOLDER

The shaft (D) and the shaft of the pulley (J) should be at least $\frac{1}{2}$ inch in diameter, but (D) should preferably be $\frac{3}{4}$ inch in diameter. The length of the shaft (J) may easily be calculated from Fig. 1, and the shaft (D) should be equal in length to the distance between the external faces of the blocks (A) and (C) plus, say, one inch more than the bore or feed. The bolts (K) should be about $\frac{3}{8}$ inch in diameter and of ample length, as shown. The blocks should be bolted down with $\frac{3}{8}$ inch bolts. The base should be large enough to support the whole, and strong enough to hold it firmly, say of two-by-fours as in the diagram. If the amateur already has a foot-power, or a motor, he may belt it to the machine

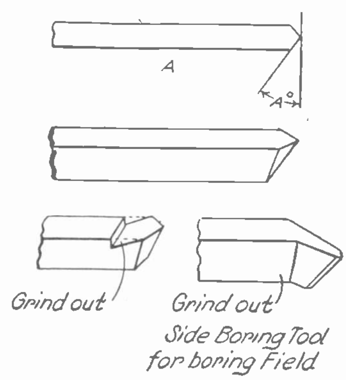


FIG. 4. CUTTING TOOLS

CONSTRUCTION OF A BORING MACHINE FOR BUILDING A FIFTY-WATT GENERATOR OR MOTOR

For the base and the foot-power support two pieces, one 2 by 4 by 36 inches and the other 2 by 4 by 42 inches will be required. Spike the parts together, or bolt, as shown in Fig. 1. The piece (N) should be about eight or ten inches long. This piece serves to hold the two parts (M) four inches apart on the one end, while the two legs (O) hold them at this distance at the other. When the machine is completed, the end may be supported and given additional strength by fastening it to the wall of the shop. The legs (O) should be about three or four inches apart at the top and bottom, and should have as a bottom piece a 2 by 4 by 12 inch piece spiked to them. Between the two legs, fasten a 2 by 4 by 20 inch piece to bear the treadles.

Now cut the bearing blocks (A), (B) and (C). Drill the holes for the ⅜-inch bolts which fasten the blocks to the base, and also drill for the bolts (K). Then after taking careful measurements drill the bearing holes so that they will be in line when placed in position. To make the bearing holes, drill to within one-fourth inch of cutting through with a drill of more than one inch greater diameter than the shaft. Then complete the hole with a drill of the same diameter as the shaft. The resulting projection will hold the bearing in line while pouring in a babbit, and will give a tight fit which will prevent the metal from running out. To cover the other end of the bearing hole, cut from a board of ¼-inch wood, a piece (A), Fig. 2, about one or two inches larger than the bearing hole and drill a hole in the centre of it the same size as the shaft.

Drill a ½-inch hole from the top of the bearing down to the shaft hole, and then with a wood saw, cut the bearing in two horizontally through the center of the shaft hole, and drive a number of nails into the wood in the larger hole to secure the babbit in place. The top of the bearing should now be put in place, and the bolts slipped through the holes in both parts. Raise the top and on each side of the shaft, insert a piece of thin cardboard, which has a saw-toothed edge, the serrated edge touching the shaft. This edge should have very coarse teeth, so that the babbit from the top will run to the bottom when pouring. Put the block of ¼-inch wood on the opposite end of the shaft, (A), Fig. 2, The shaft should now be chalked or smoked to prevent sticking, and put through the bearing hole. The bearing should then be bolted down tight, the block (A) held tight against the bearing block, and the molten metal poured through the one-half inch hole in top. When it has cooled the shaft may be driven out and the bearing split along the toothed edge by driving a tapered pin in the hole.. A ¼-inch hole may now be drilled in the top part of the bearing through the one-half inch column of metal, for an oil hole. This should not come quite into the shaft hole. Now drill a small hole through the thin metal remaining sufficient to allow the oil to pass to the bearing.

For the shaft of this machine which will later be used as the shaft of the model, cold rolled steel shafting which you can obtain at a machine shop may be used though blacksmith's rolled soft steel rods which are much cheaper will do just as well. The shaft should be one inch in diameter and four inches longer than the distance between the external faces of the bearing blocks (A) and (C).

For the tool-holder (E), shown separately in Fig. 3, will be required a piece of pipe slightly larger in diameter than the shaft, 1¼ to 1½ inches in diameter internally and just short enough to clear the rods (K) when revolved at its centre upon (D) as an axis. When purchasing this from the plumber, have him cut threads on it from end to end. Provide also four lock-nuts, or make them yourself of strip-iron or blank nuts threaded by the plumber. With a file and a hack-saw cut holes on opposite sides at the middle of the pipe for the shaft (D) to pass through. Cut slots also on opposite sides of the pipe to hold the tool at the proper distance for boring. These slots should be rather long so that the tool may be arranged for turning different diameters. Now file on opposite sides of the shaft, at the position the tool-holder is to occupy, slots equal in size to the lock-nuts, and about ¼ inch deep. Then slip the pipe on the shaft, and turn one lock-nut on each side tight to the shaft so that the pipe is held securely. The two other nuts should now be placed on the end of the pipe which is ready to receive the tool.

For the cutting tools, grind down small files to the shapes shown in Fig. 4. These should be ground cold without taking out the temper of the file, but if the amateur desires, they may be worked hot, tempered to a light yellow color and ground to a cutting edge. The tool may be clamped in the slot in the pipe (E) between two lock-nuts on one end by tightening the nuts. The tool may be fed for different diameters by moving the nuts.

The strip (F), Fig. 1, should be about ½ inch thick and should have a hole drilled in the centre greater in diameter than the shaft, or if of the same diameter should be reamed out. At both ends of it should be drilled holes for the bolts (K) on which it should slide freely. The rods or bolts (K) should now be threaded on both ends, being sure that the thread is long enough to give the proper feed for the tool. The bolts (K) besides acting as a feeding device also serve as braces for the block (C).

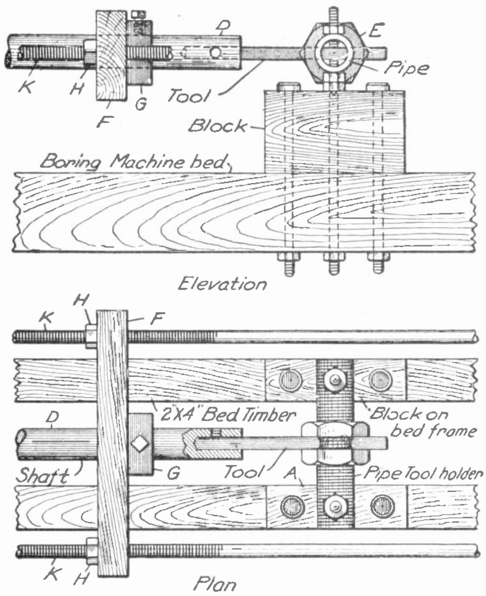


FIG. 5. ARRANGEMENT OF MACHINE FOR DRILL PRESS

The pulleys should be cut out with a small saw or jigsaw, and if not true enough, may be turned true by fastening one to a shaft as a driving pulley, while the other is turned on the same shaft using a chisel on a block temporarily rigged before the pulley as a rest. The pulleys should be fastened to the shaft by screwing or bolting to a strip of iron fastened to the shaft in the same way as the strip (G). This is shown in Fig. 1, on pulley (I). The construction of the remaining minor details is left to the reader.

The belts may be made either of leather or rope. For the leather, grooved or smooth pulleys may be used, but for the rope, they should be grooved. Pulley (J) should in all cases be smooth.

Some changes are necessary to convert this machine into a drill-press. In Figs. 5 and 6, these changes are shown. For this purpose provide a shaft and fasten the piece (G) on it in the same way as on the other shaft after slipping the shaft through the bearings, the strap (F) and securing the pulley (I), Fig. 1. The shaft may now be revolved by the pulley, and fed by the nuts (H). Bolt temporary blocks (A) Fig. 5, in position on the bed timber, remove the tool-holder from the other shaft, and drill a hole in each end and bolt these ends to the blocks (AA). A nut each side of the pipe, on the bolt which holds it, is shown in Fig. 5. These nuts serve also to raise or lower the pipe for centering the tool. The drill (A) Fig. 4, made by grinding a file

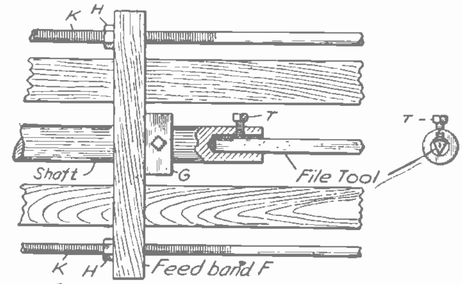


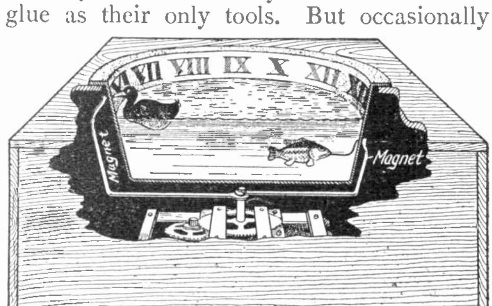
FIG. 6. METHOD OF MOUNTING DRILL

to the shape shown should be bolted in place in the holder Fig. 5, between the lock-nuts, and the work fed up and bored. The hole should be bored to a depth of from $\frac{1}{2}$ to $\frac{3}{4}$ inch. This is for the drill tool. A hole (T) should be drilled and tapped for the tightening screw (T) Fig. 6. When this is done the drill may be put in the hole and tightened with the screw for drilling. The drills may be made from various sized files, ground to shape, or by cutting off the end of regular drills so that their shanks will go into the hole. This completes the boring-machine.

(To be continued.)

A Clock with Swimming Pointers

Sailors have always been proverbially fond of whittling and many are the curiosities built by seamen with a jack knife and some glue as their only tools. But occasionally



CLOCK WITH SWIMMING POINTERS

the modern seadog goes further and extends his tinkering even into the electrical lines. Thus a British mariner, Capt. A. Norgate, has built a clock which is unique in that the pointers are moved by unseen forces, being apparently free to float in a large bowl of water around which the figures are marked. Instead of the usual pivoted hands he employs a couple of hollow metal animals, one being a duck which floats on the surface of the water and indicates the minutes with its bill; the other is a fish, weighted so as to stay below the level of the water and hence pass freely under the duck. This fish has in its mouth a brass wire bent upward so as to indicate the hour on the same set of figures to which the duck points. The bowl is set into the top of a neat wooden box and on shaking the same the animals float freely about but soon return, as if by magic, to the points at which they tell the correct time.

The secret of this ingenious clock is easily understood from our cut showing the two light magnets attached to the hour and minute hand of a clock contained in the box. The duck and fish each have a soft iron stem in the mouth so as to be attracted by these magnets, thus moving with them as the time passes. Of course the outside of the globe is painted or covered with an opaque cloth so that the clockwork cannot be seen through it. While built by Capt. Norgate merely as an interesting curio with which he might puzzle his acquaintances, such a clock if placed in a show window would probably make a novel window attraction.

Electrical Stunts

By "SPARKS"

Not so very long ago in POPULAR ELECTRICITY there was an article entitled "Induction Coils in Vaudeville." I also have been enticed by the rather blatant ads of this greatest of the greatly great electrical wizards, this man who tamed electricity, and I also don't doubt that he wore bracelets connected by cords over his shoulders, used prepared paper to ignite from all parts of his anatomy except his sacred moustache, and other such fakery. Maybe the writer of that article was a bit hard on the "Prof." but he ought to stand it almost as well as the "millions" of volts from his six or eight inch induction coil.

I wish to say that "it can be done" and even then by almost anyone. Even to lighting unprepared paper from the fingers. It takes more than one quick spark though.

A year or so before this so-called professor came to the footlights on the American stage, Weary and I were fooling with a new one-inch induction coil of mine and doing some of the tamer stunts with it such as watching the effect of different things in or near the gap, the electric ladder, lighting Geisler tubes, piercing cardboard and paper and so on.

Then I accidentally noticed that if I touched either one of the secondary terminals while the coil was going I got a lot of short thin sparks on my hand that stung slightly, but didn't shock at all; and that if I took tight hold of the binding post, it only tickled. Weary tried it and didn't mind it any more than I had. Those little sparks surely did sting though on the quick under the finger nails and on our ears, nose, neck and other sensitive places. The worst was a spot right near the pulse of either arm that nearly doubled us up into a knot. We tried it on our tongues and it didn't hurt a bit.

We noticed that if one of us had hold of a terminal and the other touched him, we could get just as good a spark between us as between the one next to the coil and the coil terminal. Also in the gap between terminals, we noticed the smaller the points, the longer the sparks.

Then we tried grounding one terminal of the secondary and we couldn't get any spark to us from that, but when Weary touched the other, he got a much longer and fatter spark than before, but it shocked him so that he nearly sat himself on the floor. I tried to take them and did likewise. By trying persistently and making a good handle out of a bicycle pump and some wire, we could easily hold on and give shocks with the same unconcerned manner that the "Prof." later used on the stage.

I took the sparks on my tongue with no worse effects than a feeling like the pricking of a pin from its tip way to the back. Weary tried it, but the spark jumped to a sore tooth and that set him to doing an Indian war dance around the room, howling like the wild man from Borneo (Greene County, state of Virginia). He said that he might have had a tooth hurt worse, but he couldn't remember when. He let a "painless" dentist extract a molar once and take it from me, that's going some. Then he took it out on me for ha-ha-ing at him when he was hopping around.

One time when I had hold of the handle and the coil was going good and strong, Weary sneaked up behind me and gently placed his pedal appendage against the bosom of my pants and I then attempted to imitate bossy on her justly famous jump over the moon, while Weary joined the little dog in a hearty laugh.

Nowadays we always look twice to see how conditions are before we touch a secondary wire or go near the coil together.

Weary and I found that crepe paper such as that used in making paper napkins was the quickest lighter of any we tried. The way we would light it was to wrap some loosely around our first fingers and hold them as near to the terminal of the coil as possible, but still leaving a gap. Sometimes it would take as long as half a minute before the paper would light. And holding it in the same place for half a minute with sparks streaming into you through that paper is no cinch, but it is worse with an irregular vibrator.

Later we got up a young exhibition for a party that a friend of ours had. We showed them a lot of the simpler stunts and then had our spark eating contest. Of course, we got a couple of the audience up by our apparatus and used them as goats. It worked fine. We had all our coils and gaps fitted up with brass knobs taken from an old bed. It is surprising how the apparent size of a coil is increased by a few knobs and other brasswork. We borrowed a three-inch coil for the evening and let it spark between two sharp points so it would do its longest. The way we fitted it out, it looked like a six-inch coil. The program and paraphernalia are given below:

PARAPHERNALIA

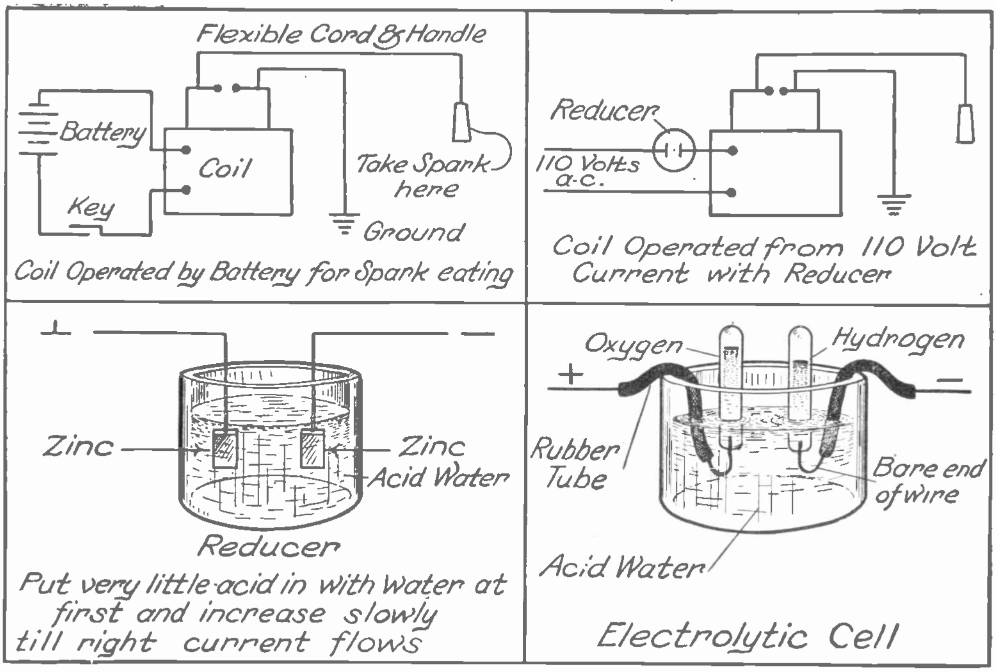
1 Spark coil (one inch or larger, the larger the better).
1 set batteries.
1 single-pole, double-throw switch.
1 piece glass.
1 candle.
Matches.
Paper, crepe paper and cardboard.
1 handle and long flexible cord.
Wire and pliers.
Acid.
1 electrolysis outfit (home made).
1 old lamp bulb.
1 Geissler tube (more if possible).
1 condenser plate (home made).
Iron filings.
Powdered carbon.

PROGRAM

1. Sparks, fireball, brush discharge.
2. Sparks around glass.
3. Spark into candle flame.
4. Piercing paper, card board, etc.
5. Lighting paper and matches in the gap.
6. Powdered carbon, iron filings, etc., in the gap.
7. Electric ladder.
8. Decompose water, burn match in oxygen and explode hydrogen (just light a match by it).
9. Taking sparks from either secondary terminal.
10. Taking sparks from secondary terminal with the other grounded.
11. Wireless.
12. "Spark eating."
13. Shocking some assistants from the audience (make them be the goat).
14. Lighting paper from the fingers.
15. Leakage around condenser plate.
16. Geissler tubes.

Anyone can do the above stunts and more too, with a little practice, but they certainly need the practice. It takes quite a lot of confidence too, to take sparks, but with the practice and remembering not to touch both secondaries or a secondary and a primary at the same time, you're safe. In taking sparks from one secondary with the other grounded the current is not going through you into the floor and then to the ground. It only comes into you and out of you using you and the ground as capacities, and the air, floor and your shoes forming the dielectric of a large condenser. Or in other words, you are very kindly serving as aerial for a capable wireless telegraph transmitter. Thus in number 11 of the program, just explain this while your assistant works the coil to sound something like noise; they do not need to be Morse signals unless there are some in the audience who know the code, and the chances are they will be few.

If direct current is available, it can be run through a reducer to run the coil. A good reducer can be made from two battery zincs or lead plates in an electrolyte of water with a little acid added. Be sure to have fuses on the table with your coil and fuses that will pop on less current than the house fuses so it won't be necessary to delay the game to put new fuses in the house circuits.



PARAPHERNALIA

Rehearse everything once at least before the performance and have a list of what you are going to do on the table in front of you. Otherwise, you will forget half and then won't know when you're done. Practice "spark eating" and develop some new stunts with it if possible.

In the electrolysis experiment, be sure to know which is the positive wire and which is the negative. The positive wire leads to the carbon pole of a dry cell. Less gas forms at the positive pole and is oxygen. The hydrogen, of which there are two parts to each one of oxygen, forms at the negative pole.

In the electrolysis experiment; that is, making hydrogen and oxygen from water by the electric current, you pass direct current through an electrolytic cell, from your batteries, or if there is direct current in the house circuit take it from that, through the reducer. The cell consists of a jar containing slightly acidulated water in which are hung wires from the two terminals of the circuit so that current passes from one to the other through the water. Oxygen will then form in bubbles around one wire and hydrogen around the other, oxygen being formed at the positive terminal or the one which leads from the carbon of the battery. There will be twice as great a volume of hydrogen formed as of oxygen. Collect in test tubes as shown. Try putting a lighted match in each tube after collecting the gas. Of course before inverting the tubes over the terminals they must be first filled with water. The gases will then slowly collect in the tubes and displace the water.

The condenser plate is made of a piece of glass with the foil put on so it sparks around the edges. This and most of the others look better in the dark but the light is needed for several. In the electric ladder bend two stout wires parallel. They must be connected in place of the gap and must be vertical as it is the heated air in rising that causes the spark to climb as heated air is a better conductor than cold air. Many suppose that it is the field of the coil acting as a blowout magnet that causes it, but that can be disproved by mounting the wires horizontally.

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 IX.—A TWO-KILOWATT CLOSED CORE TRANSFORMER

PRIMARY

The primary is composed of 250 turns of No. 8 B. & S. gauge double cotton covered magnet wire. Between thirteen and fourteen pounds will be required. The wire will occupy about three and one-half layers. The remaining space in the fourth layer can be filled in by winding with some insulating cloth. Taps are led out on the 175th, the 200th, and the 225th turn. The best way to lead out a tap is to wrap one end of a copper strip (Fig. 100) around the wire and solder it there. The thickness of the strip being negligible it will not interfere with the adjacent turns or layers.

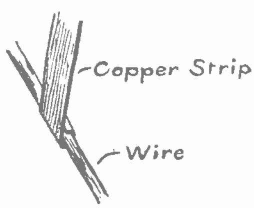


FIG. 100. METHOD OF LEADING OUT TAP

The winding is covered with three or four layers of Empire cloth to give it a finished appearance (Fig. 101). The terminals are both led out through holes in the fibre head. In winding the wire do not forget to allow space for the remaining fibre head which is not yet in position.

SECONDARY

The secondary winding is composed of about 80,000 turns wound in sixteen separate sections or "pies." About twenty-three pounds of No. 32 B. & S. gauge enameled wire will be required.

The sections are wound on a form (Fig. 102) in flat coils. The form is best constructed of brass as wood is liable to shrink and warp. If the flanges were not perfectly true or should warp, the effect would be to make one side of the coil wider than the other and cause the depth from the circumference to the centre to vary considerably.

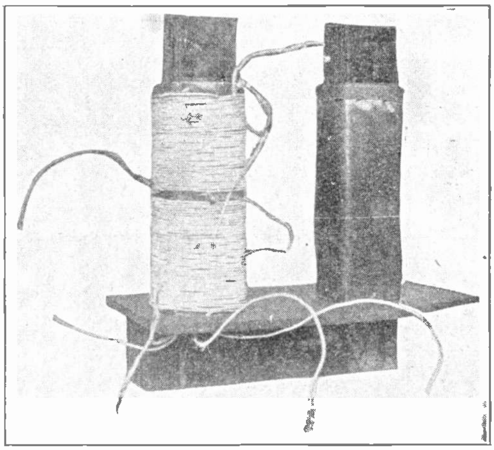


FIG. 101. CORE WITH WINDINGS IN PLACE AND ONE LEG WRAPPED

The flanges are eight inches in diameter and $\frac{1}{8}$ inch thick. The centre is four inches in diameter and $\frac{1}{4}$ inch thick. One side is somewhat smaller than the other so that the taper will facilitate the removal of the finished coil. The form is held together by three threaded binding rods and winged nuts which can be screwed up tightly. The form must be held together firmly or there will be a space between the centre and the flanges through which the wire might slip. Eight saw cuts are made at equal distances in the flanges and the centre of the form so that silk threads can be passed in under and around the completed section before it is removed. (Fig. 102.) The lower ends of the saw cuts are enlarged with a drill so that there will be no difficulty in passing the threads through.

The form is placed in a lathe chuck and the lathe belts arranged to give slow speed without the back gear in mesh. Place the

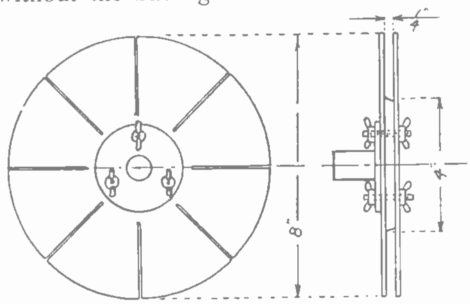


FIG. 102. DETAILS OF FORM

large reel of wire on a rod or support, revolve and allow the wire to run easily.

Commence to wind with the form turning away from you. Keep the wire taut and wind on as evenly as possible, trying to prevent the turns from crossing each other. Do not allow any snarls or kinks to be wound in. If the wire should break, splice and *solder* it. Continue to wind until the form is filled to a depth of 1½ inches or is seven inches in diameter.

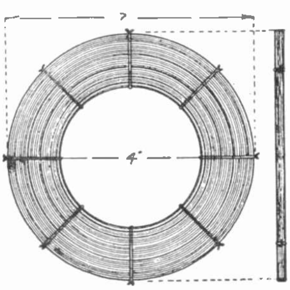


FIG. 103. THE WIRE AS IT COMES FROM THE FORM

Then stop the lathe and break off the wire leaving about six inches for a lead. Pass a piece of strong silk thread through each slot and tie it tightly around the wire coil. (Fig. 103). Remove the form from the lathe and unloosen the winged nuts so that one flange may be taken off. Slide the section out gently onto a piece of stiff cardboard. If the operation is done carefully not a wire will be disturbed. Then slip the cardboard together with the section into a shallow pan containing a molten mixture of beeswax and paraffine. Use good care not to allow the preparation to boil hard or its insulating value will be considerably depreciated.

When all bubbles have ceased to arise lift the coil out on the cardboard and allow it to cool. Treat the remaining fifteen sections in the same manner.

Cut some long strips ¾ inch wide from Empire cloth for use in taping the sections (Fig. 104). Take a coil in the left hand and notice in which direction the wire runs, that is, in which direction the coil is wound. Place one end of the tape under the left hand thumb and with the right hand pass the tape through the hole in the centre and over and around the coil. Lap it each time about one-half of its width. After four or five complete turns have been put on mark

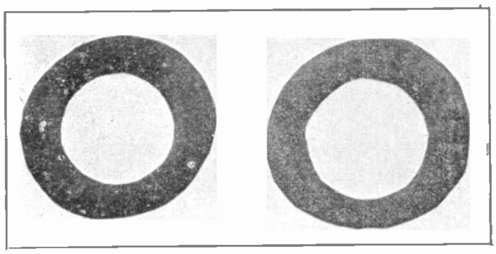


FIG. 104. TAPED SECTIONS

an arrow on the tape showing in which direction the section was wound. Then complete the taping of the coil. If the end of a strip is reached before a coil is finished place the end of a new strip on the end of the last and proceed. It is possible by careful taping to allow each terminal of the sections to come out from under the tape in the direction in which it was wound. This will avoid any possible difficulty in assembling and connecting.

ASSEMBLING

Eighty to one hundred separators (Fig. 105) will be required for insulating the secondary, depending on whether the sections are wound and impregnated carefully or not. They are made of circular disks of blotting paper eight inches in diameter which have been soaked in the molten

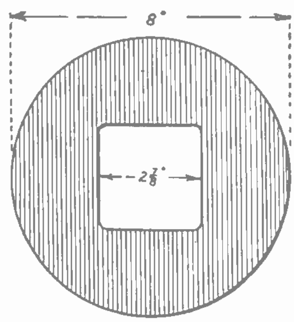


FIG. 105. SEPARATOR

mixture of beeswax and paraffine. Cut a square hole in the centre of each separator which is just large enough to allow it to slip snugly over the Empire cloth on the secondary leg. The separators should be kept in the insulating mixture until they are ready for use. Slip enough of them (about twenty-five) to make a pile one inch high over the secondary leg of the transformer and push them tightly against the fibre head.

The method of connecting the sections is shown diagrammatically in Fig. 106. The

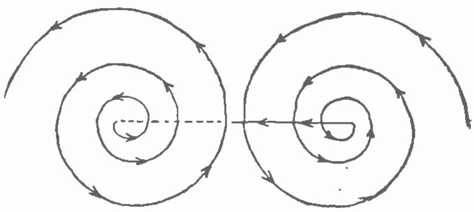


FIG. 106. METHOD OF CONNECTING THE SECTIONS

coils are turned completely around so that the arrows on every alternate one point in the opposite direction. The inside terminal of one section is connected to the inside terminal of the adjacent section and the outside terminal of that is connected to the outside terminal of the next and so on. The current will then flow through all the coils in the same direction.

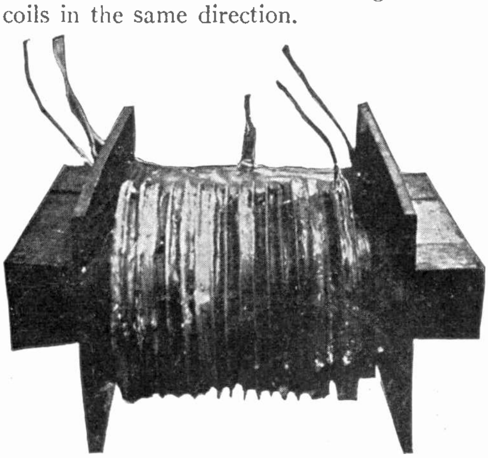


FIG. 107. SECTIONS IN PLACE ON CORE

Group the coils together in pairs placing two separators between each pair. Then connect the inside terminals of each pair together and solder them. In brightening the wires preparatory to soldering them do not scrape with a knife but rub with a piece of fine emery paper. Do not use acid as a flux. Instead use rosin.

Place two coils on the transformer leg and push them snugly against the separators. Then pour some molten beeswax and paraffine into the spaces formed between the Empire cloth and the inside of the section. If the mixture is hot enough it will find its way down through all the cracks and interstices. Then slip on two separators and place two more sections in position. Proceed likewise with all the others. When all are in place (Fig. 107) slip enough separators over the leg to fill up the space between the last section and the fibre head when it is in position. Put the head on and then replace the strips forming the side of the core. Connect and solder the outside ends of the adjacent sections. Solder the terminals of the outside section to two strips of sheet brass about twelve inches long and $\frac{1}{4}$ inch wide.

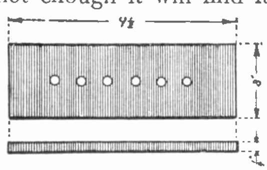


FIG. 108, FIBRE BRIDGE

The core is clamped tightly together by four strips of angle iron each eighteen inches long. Two holes are bored in each and a bolt run through so that when the nuts are tightened it will pull the transformer core tightly together. The tongue is placed opposite the primary. A piece of thin sheet fibre is placed between it and the angle iron wherever they would touch. The distance between the tongue and the ends of the core will vary considerably with the amount of condenser across the secondary. It can be adjusted after the transformer is in use and locked in position by tightening the bolts.

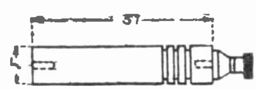


FIG. 109. SECONDARY PILLAR AND TERMINAL

A strip of fibre $9\frac{1}{2}$ inches long and $\frac{1}{4}$ inch thick forms a bridge (Fig. 108) between the two fibre heads and serves as a support for the primary terminals. Five large binding posts are mounted upon it and connected to the terminals and taps.

The secondary terminals (Fig. 109) are supported upon two hard rubber pillars, five inches long and one inch in diameter. The pillars are fastened in position by a machine screw passing up through the angle iron.

The secondary is wound with several layers of Empire cloth to prevent sparks from jumping into the primary.

The transformer when complete and with the full primary in use will consume about two kilowatts on the 110-volt, 60-cycle current. It will deliver a potential of about 32,000 volts at the secondary and give an

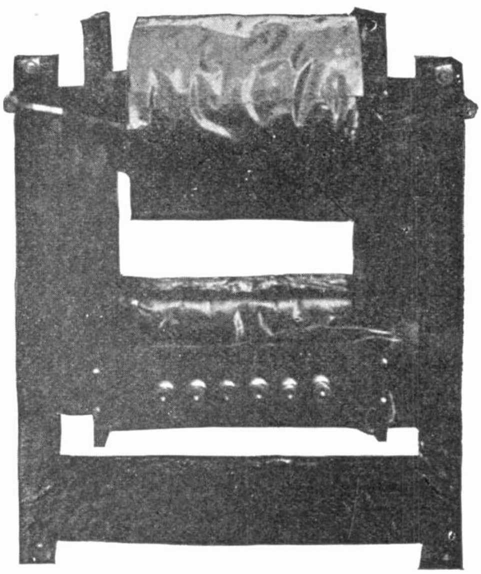


FIG. 110. COMPLETE TRANSFORMER, TOP VIEW

intense spark having considerable volume (Fig. 111). I need hardly caution care but it may be well to say that when working with the transformer use all precaution to avoid a shock from the secondary, because such an occurrence would not only feel unpleasant but would be serious and probably fatal.

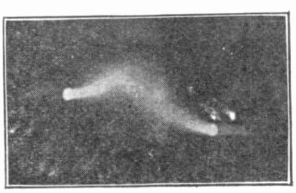


FIG. 111. DISCHARGE OF TRANSFORMER

The wiring diagram is illustrated in Fig. 112. The condenser is connected directly across the secondary terminals. The spark gap is in series with the condenser and the closed circuit of the tuning helix.

The transformer should be placed in a strong wooden box and covered with transformer oil or a mixture of paraffine and resin. The primary terminals can be brought out to binding posts mounted on the cover but the secondary wires should be led out through hard rubber tubes.

The transformer should be raised up off

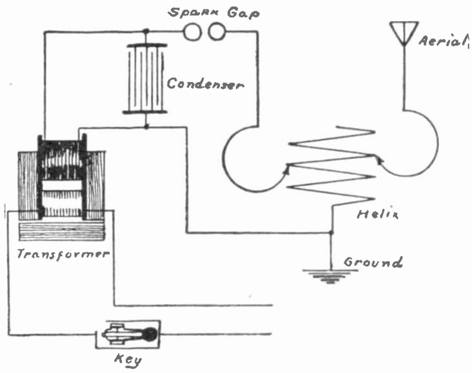


FIG. 112. WIRING DIAGRAM

the bottom of the box by wooden blocks placed under the core.

By varying the number of turns on the primary and using the taps so as to obtain 175, 200 or 225 instead of 250 the capacity of the transformer and its secondary voltage are somewhat increased.

Wireless Association of Montana

Any one in Montana who owns or operates a wireless station is eligible to membership in the Wireless Association recently formed at Butte, Montana. The officers of the Association are: C. E. Spitz, president; H. H. Mees, vice-president; K. T. Sparks, secretary. For further information address the secretary, 927 Utah Ave., Butte, Montana.

Haverhill Wireless Association

The Haverhill (Mass.) Wireless Association was recently formed with the following officers: Wilfred Vigneault, president; Riedel G. Sprague, vice-president; Leon R. Westbrook, secretary and treasurer. Persons in and about Haverhill who operate either a sending or receiving station or both are invited to join.

Wireless Club of Baltimore

An evidence of the widespread popular interest in wireless telegraphy is given in the formation of the Wireless Club of Baltimore. The club meets weekly at the Y. M. C. A. building and the growth in membership has been rapid. Baltimore has probably 100 to 150 private wireless stations conducted by amateurs. They have been talking to one another for some time without seeing one another, and the formation of the club was only a logical outcome. At every meeting there is a lecture by the wireless consultant, who is a man with technical proficiency in electricity and wireless telegraphy. The members, too, give short accounts of their experiments, their triumphs and failures, and occasionally bring out ideas which are almost discoveries. One of the pleasures the members derive is disseminating news which one or more of the number will get from a newspaper office by telephone when there is some important event or development expected. The club solicits its new members by wireless. "Hello, who are you? Do you belong to the wireless club? If not, why not? Aren't you daffy on the subject, too? Hello I catch it, now, yes, you are. Then come to the Y. M. C. A. Friday night. Your instrument sends well, can you hear, yes, all right, I'll expect you." That is the way the membership committee catches a new member by wireless. Here are the officers. President, Walter E. Hartlove; vice-president, Harry W. Richards; secretary, Preston S. Wicks; treasurer, E. R. McLaughlin; consultant, H. E. Kerwan.

Directory of Wireless Stations

With the publication of the government's wireless-telegraph directory, just out, some idea is gained of the extent to which wireless is now used. In this directory, perhaps the most extensive in existence, are listed 1,520 stations. This includes shore stations and ships, but does not take into consideration warships of foreign governments, nor the hundreds of stations equipped and operated by amateurs.

The directory is the work of the bureau of steam engineering of the United States navy. First are listed the wireless telegraph shore stations throughout the world according to country, giving call letters, wave length, power, range and character of station.

There are about 700 shore stations scattered about the globe. Eighty-eight are on the Atlantic and Gulf coasts of the United States, three in the interior, 48 on the Great Lakes, 51 on the Pacific coast and sixteen in Alaska.

As an index, the final list contains the call letters of every station arranged alphabetically. From this operators can distinguish the name of ship or station calling.

Copies of this publication can be obtained from the Superintendent of Documents, Government Printing Office, Washington, D. C., at a cost of 15 cents each.

Progressive Wireless Club

The Progressive Wireless Club of Poplar Bluff, Missouri, was recently organized with the following officers: George Holt, president; Silas Pace, vice-president; T. E. Story, secretary and treasurer. Four stations are in operation and more are under way. Wireless students in the vicinity are invited to join.

WIRELESS QUERIES

Answered by A. B. Cole

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

Leading In From Aerial; Tubular Type Condenser

Questions.—(A) Would it improve a wireless receiving outfit to have a potentiometer if there are no batteries used? (B) Will high-tension cable be sufficient to lead in for receiving only? (C) I have a tubular type variable condenser and when I move the inside part outward, it only dulls the message. What is the trouble? (D) If more wires are added to an antenna, does it increase the receiving capacity?—G. H. W., Brooklyn, N. Y.

Answers.—(A) No, there would be no need for the potentiometer.

(B) Yes.

(C) Evidently all the capacity of the condenser is required, and it looks as though still more capacity might improve the set.

(D) Yes, but not directly in proportion to the number of wires.

Spark Coil Windings; Condenser; Leyden Jar from Test Tube

Questions.—(A) Must the primary of a spark coil be wound in the opposite direction to the secondary? (B) Is it necessary to have a condenser shunted around the vibrator? Why? (C) Is there danger of winding too much wire on the helix for a two-inch coil? (D) I wish to make Leyden jars out of test tubes, the outside tinfoil, the inside a mixture of salt and water. Can you give me a formula?—S. P., Milwaukee, Wis.

Answers.—(A) No, either may be wound in either direction.

(B) Unless a condenser is used here, the spark length will be small, and the interrupter contacts will be rapidly worn away. At the moment the current is cut off from the coil by the separation of the contact on the spring and that on the adjusting screw, a high electromotive force is developed in the primary, opposite in direction to that in which the battery current had been flowing. This produces the spark at the contacts, and is much higher in value than the voltage of the battery. Being of only momentary duration, it will pass through the condenser, and if allowed to do so, will induce a current in the secondary of much higher voltage than that induced by the battery current itself, and consequently a longer spark will be produced by the secondary. Moreover, there will be less sparking at the interrupter contacts, and they will last longer.

(C) No.

(D) One part of salt to ten of water.

Tuning Transformer

Questions.—(A) Would these be about the right proportions for a tuning transformer—primary 8 by $4\frac{3}{4}$ inches wound with 223 turns of No. 22 D. C. C. wire, two sliders, secondary 8 by $3\frac{3}{4}$ inches, wound with 384 turns of No. 29 D. C. C. wire, one slider? (B) What would be the wave length in meters? (C) How far can I expect to receive with this transformer in connection with a silicon detector, 75-ohm receiver and an aerial consisting of two aluminum wires, 50 feet high and 40 feet long?—A. W. H., Johnstown, Pa.

Answers.—(A) Yes, but better results will be obtained by reducing the clearance between the primary and secondary.

(B) Maximum, about 4,000.

(C) An average distance of about 400 miles over water, from high power commercial wireless stations.

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.

Figuring Resistance and Drop

Questions.—(A) The resistance of a certain wire is 4.3 ohms and its length is 20 feet. What is the resistance of 50 yards (150 feet) of this wire? (B) If the resistance of 1,000 feet of copper wire at 20° F. is 100 ohms what will be the resistance per foot at 75° F.? (C) If current is supplied from a center of distribution over a two-wire system to two sixteen-candlepower, 110-volt lamps, No. 1 B. & S. gauge wire being used and the distance is 100 feet, what is the drop in volts? (D) If a group of 100 sixteen-candlepower 110-volt lamps at a distance of 400 feet from the center of distribution are to be supplied with current, what size wire must I use to have but two volts drop?—F. E. K., Asbury Park, N. J.

Answers.—(A) The resistance of a wire increases directly as its length if the cross-sectional area remains the same. The resistance of 50 yards of the wire would, therefore, be $7\frac{1}{2}$ times 4.3 ohms or 32.25 ohms.

(B) In general, pure metals increase or diminish by one per cent their resistance for every 4.5° F. or 2.5° C. up or down the scale. In other words, the resistance of a metal changes four-tenths of one per cent for every degree Centigrade, or 22 hundredths of one per cent for every degree Fahrenheit. This value is called the temperature coefficient for pure metals.

An increase in temperature of 55° F., therefore, increases the resistance of 100 ohms by (55x.0022)x100=12.1 ohms, making the total resistance of 1,000 feet of the wire at 75° F. equal to 112.1 ohms or .1121 ohm per foot.

(C) By Ohm's law

$$E = C\,R.$$

The resistance of one foot of No. 1 B. and S. gauge copper wire (Matthiessen) is .0001237 ohm at 20° C. The resistance of 200 feet is then .02474 ohms. Applying Ohm's law

$$E = 1 \times .02474$$
$$= .02474$$ volt drop, a negligible amount, assuming the current to the two lamps to be one ampere.

(D) Use the formula

$$C.\,M. = \frac{C \times L \times 10.8}{V}$$

where C. M. = circular mils in wire required
C = current
L = length (two wires)
V = volts loss.

$$\text{Then } C.\,M. = \frac{50 \times 800 \times 10.8}{2}$$
$$= 216{,}000$$

Wire required slightly larger than No. 0000. The National Electrical Code requires No. 5 wire for 54 amperes, but does not take into consideration the voltage drop.

Residual Magnetism

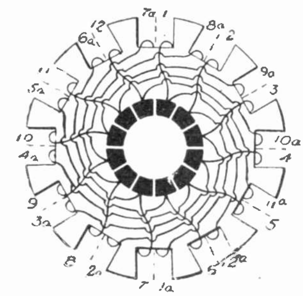
Question.—What is meant by residual magnetism?—C. F. J., West Baden, Indiana.

Answer.—If a bar of iron is temporarily made a magnet by winding a number of turns of wire about it and passing a current through the wire, there will still remain in the iron a small amount of magnetism after the current has ceased to flow through the coil. This remaining magnetic charge is called residual magnetism. The presence of residual magnetism in the pole pieces of a dynamo enables the machine to "build up." The magnetism retained by a piece of iron or steel depends upon the retentivity of the metal. The retentivity of hard-tempered steel is large, that of soft wrought iron small. The harder the steel the greater the retentivity and the amount of residual magnetism it will have after being magnetized by a current carrying coil or permanent magnet.

Winding 12-Slot Armature

Question—Will you please explain by diagram how to wind a 12-slot drum armature?—J. W. B., Jr., Spokane, Wash.

Answer.—See diagram.



ARMATURE WINDING DIAGRAM

Principle of Vacuum Cleaner Operation

Question.—Please explain how a vacuum cleaner works.—R. I. B., Grand Rapids, Mich.

Answer.—In one make of cleaner a motor direct connected to a centrifugal suction fan produces the suction. The motor is situated outside the fan chamber. The mouth of the "sucker" which runs over the floor is fitted, a few inches back from the opening, with a coarse wire screen to stop the coarser dirt, a drawer being provided for the dirt to drop in. The finer dust passing through the fan is blown into a bag of stout cloth arranged in layers so that the air must pass through these layers and be cleaned before being set free. The strainer cloth is so arranged as to be a single piece. To remove the dirt the cylinder which holds the dirt sack is taken off the pipe leading to it, the top removed and the sack and dirt taken out. In one type of sweeper this sack is suspended on the handle used to propel the cleaner over the floor.

Direction to Wind Secondary of an Induction Coil

Question.—Should the secondary of an induction coil be wound in the same direction as the primary?—A. W. F., Chester, Pa.

Answer.—The secondary may be wound in either direction without reference to the primary winding.

To Find Frequency of Alternator

Question.—Please give rule for finding the frequency of an alternator.—B. B., Greenville, Mich.

Answer.—Divide the revolutions per minute by 60 and multiply the quotient by the number of pairs of poles in the field.

Compensation for Patent Infringement

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

IN GENERAL.—The patentee can recover, as a compensation for the invasion of his rights, the damages he has suffered through the infringement, and, under certain circumstances, the profits made by the infringer.

DAMAGES—IN GENERAL.—There is no rule of damages which will apply to all cases. But the damages must be actual, and not speculative or exemplary.

LICENSE FEE AS MEASURE OF DAMAGES.—Sales of licenses of machines or established royalties constitute the primary or true criterion of damages. But this rule is applicable only where the royalty is the fixed and established price at which a license is granted to use the particular patent, without other inducements, and under circumstances fairly similar. The established license fee is not the proper measure of damages where the infringement is only a part of the invention for which such license fee is charged, unless such license fee is apportioned, except where the portions not infringed are merely structural and are included within those infringed. The license fee must be for the infringed rights, and not for other rights under the patent. So where the patented improvement has been used only to a limited extent and for a short time, the license fee is not the proper measure of damages, but a smaller sum should be found as the damages sustained. The license fee is simply evidence of damages, and not an absolute and invariable test.

WHERE TEST OF LICENSE FEE IS INAPPLICABLE.—*Compensation for Actual Loss.*—Where the test of a license fee cannot be applied to determine the amount of damages the patentee will be entitled to an amount which will compensate him for the injury to which he has been subjected by the piracy, and the jury may consider what would be a reasonable royalty under all the circumstances. What the plaintiff has lost, not what the defendant has gained, is the measure of damages. The damages recoverable are, of course, limited to such as are the proximate and not the remote result of the infringement, and should be estimated not for the whole term of the patent, but only for the period of the infringement. No damages are recoverable for the use of the invention prior to the issuance of the patent upon which suit is brought. The profits lost by the patentee by reason of the infringement are a proper element of damages. Speculative profits cannot be recovered. It must be proved with reasonable certainty that the profits claimed would have been realized except for the infringement. The burden of proving damage is upon the plaintiff, and in the absence of sufficient proof only nominal damages may be recovered. The ordinary rules of evidence are applicable to this subject. Full damages should be given only for full infringement according to the nature of the patent. Infringement by selling and infringement by using the patented article are essentially different. For the mere making of a patented article without either selling or using it the damages should be nominal. Counsel fees and expenses in prosecuting the action cannot be included in the verdict.

Infringement in Conjunction with Other Devices.—Where the patent covers only part of a device, or is for a mere improvement, an infringer is liable only for so much of the value as is due to the patented improvement. But when the entire commercial value of a device depends upon the patented part, no deduction is to be made for the other parts of the device.

Profits of Defendant as Measure of Damages—The defendant's profits can be taken as the measure of damages in an action at law only under peculiar circumstances, and where no other rule can be applied.

INCREASE OF DAMAGES.—By express statutory provision, whenever a verdict is rendered for the plaintiff the court may enter judgment thereon in any sum above the amount found by the verdict as the actual damage, according to the circumstances of the case, not exceeding three times the verdict. This provision does not extend to profits recoverable in equity. It is in lieu of the right of the jury to award exemplary damages, and takes away that right.

When Increase Will be Added.—The court will increase the damages when the infringement is deliberate and intentional, or wanton and persistent, but ordinarily not otherwise. The increase or non-increase of damages rests in the discretion of the court.

FORFEITURE OF DAMAGES BY FAILURE TO MARK IN ACCORDANCE WITH STATUTE.—The statute provided that in case of failure to mark an article "patented," as prescribed by the statute, no damages shall be recovered for infringement except on proof that the defendant was duly notified of the infringement.

MITIGATION OF DAMAGES.—Damages may be mitigated by good faith and ignorance of the existence of a patent upon the part of the infringer, or by the conduct of the patentee whereby the infringer was misled or the recovery of full damages is otherwise rendered inequitable or unjust. At least, under such circumstances, exemplary or increased damages should not be awarded, though compensation for the actual damages suffered may doubtless be recovered.

INTEREST ON DAMAGES.—Where a royalty is taken as the measure of damages, interest may be allowed from the date of infringement, and generally the jury, in estimating damages, may, in its discretion, take into account the interest and allow it as damages.

NEW BOOKS

MAGNETS AND MAGNETISM SIMPLY EXPLAINED. By Alfred W. Marshall, A. M., I. E. E., M. I. Mech. E. New York: Spon and Chamberlain. 1910. 89 pages with 49 illustrations. Price, 25 cents.

This book gives the general properties and theory of magnets. The explanation is without mathematics or figures.

TELEPHONE CONSTRUCTION, INSTALLATION, WIRING, OPERATION AND MAINTENANCE. By W. H. Radcliffe, E. E., and H. C. Cushing, Jr., E. E. New York: Norman W. Henley Publishing Co. 1908. 171 pages with 125 illustrations. Price, $1.00.

A work for the amateur, the wireman or the engineer who desires to establish telephonic communication between the rooms of his home, office or shop; also for the contractor who wishes to build small exchanges in factories, mills, or small towns.

PRACTICAL ELECTROPLATING. By George Gentry. New York: Spon and Chamberlain. 1910. 106 pages and 41 illustrations. Price, 50 cents.

A book intended to describe the principles and processes of electroplating in such a way as to appeal to amateurs and beginners.

ELECTRICITY IN FACTORIES AND WORKSHOPS. By A. P. Haslam, M. I. E. E. New York: Norman W. Henley Publishing Company. 1909. 312 pages and 70 illustrations. Price, $2.50.

This book shows what a convenience the electric motor in its various forms has become to the modern manufacturer.

WIRING A HOUSE. By Herbert Pratt. New York: Norman W. Henley Publishing Company. 1909. 21 pages and six illustrations. Price, 25 cents.

A book of useful information to the electrician on how to lay out systematically and install electric wiring in a residence.

WIRELESS TELEPHONES AND HOW THEY WORK. By James Erskine-Murray, D. Sc. New York: Norman W. Henley Publishing Co. 1910. 66 pages with 17 illustrations. Price, $ 1.00.

This book is intended for the use of the non-technical reader and gives a clear, intelligible account of wireless telephone systems now in various degrees of development.

WORKSHOP WRINKLES AND RECIPES. By Percival Marshall. London: Percival Marshall & Co. (New York: Spon and Chamberlain). 1909. 96 pages with 44 illustrations. Price 50 cents.

A collection of useful workshop hints on mechanics and electricity for the amateur mechanic who is familiar with the ordinary run of workshop operations.

N. E. L. A. "Proceedings"

The National Electric Light Association is now issuing to its members the annual "Proceedings". These two volumes include the report of the Thirty-third Convention held at St. Louis last May, and mark the twenty-fifth anniversary of the Association. The volumes include 2,070 pages and 483 illustrations. Among the latter are a fine portrait of President Frueauff and several elaborate colored engravings in the paper on Street Arcs, by Mr. Ryan. The Proceedings embrace some 70 papers and committee reports, all of which are carefully indexed and an abstract is given of each paper or report for ready references. A year ago the edition was 4,500 sets. This year, owing to the rapid increase in membership, the edition is not less than 7,000 sets, and it is interesting to know that these represent about 28 tons of printed matter. Many of the State and Company sections are now so large that these books are delivered to the local secretaries, in bulk, by freight or express.

ON POLYPHASE SUBJECTS

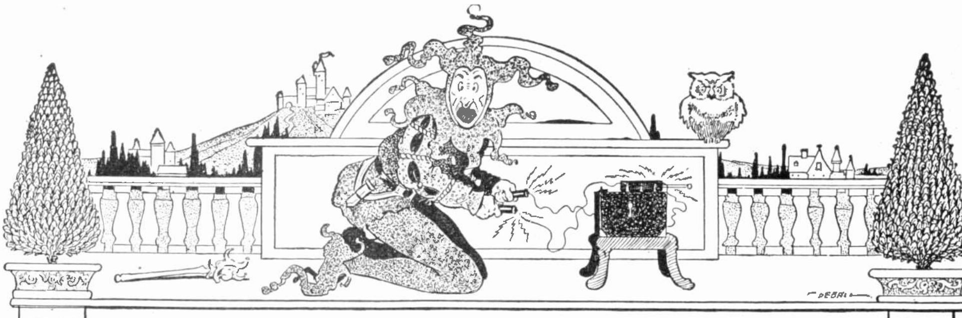
Electricity by the Wagon Load For originality and persistence a St. Paul, Minnesota, man should be awarded first prize Eleven years ago he built a fine home some distance beyond the electric lighting limits and although informed that it would be years before lighting mains would be run into the neighborhood he wired his house. He owned also what few men then possessed, an electric automobile. Each day for years this machine has taken him to his work and is then placed where, in accordance with his orders, it can be "loaded to the brim with electricity." When he reaches home in the afternoon the automobile battery is connected to the service switch of the house and the electric lights are ready to be turned on.

Vacuum Cleaned Car Tracks When one of our comic papers pictured a brigade of street cleaners as using crumb brushes, crumb trays and magnifying glasses, the cartoon was enjoyed because of its striking contrast with the street conditions then existing in so many American cities. Yet the tendency is towards just such an exacting cleanliness, and happily so, as the old plan of cleaning streets thoroughly once before every election is hardly conducive to the general health of the community. Having much shorter and narrower streets in proportion to their population than we do in America, it is logical that European cities should excel in this phase of cleanliness and they have been the first to introduce electrical vacuum cleaners into the street service.

A novel type of these is now in use at Hanover for removing the dust and dirt which clogs the rails of the street cars. This equipment consists of an electrically driven vacuum cleaner mounted on a special trolley car which has a sprinkler for moistening the rails and laying the dust before the vacuum tip comes along; also a large tank for receiving the dirt. This rail cleaning car which requires no attendant besides the motorman, cleans about 45 miles of track daily.

The Institute Edison Medal The Edison Medal Association which was formed by the friends and admirers of Mr. Thomas A. Edison to found a gold medal in the American Institute of Electrical Engineers, celebrating the invention of the incandescent lamp and 25 years of its successful use has just closed up its accounts. The association began its work five years ago and raised a fund of somewhat over $7,600 for the purpose. Of this account $5,000 was placed in the hands of the Institute for the Medal Award Fund. The contract for the design of the medal was made with Mr. James Earle Frazer, the well known sculptor, who, owing to the change in the deed of gift, was called upon to make two separate designs and who received about $1,500 for his work. The medal was at first to be awarded to students of electrical engineering but this was changed and only one award was made to a student competing, the amount being $150 without a medal but with a special certificate. Under the new deed of gift, the medal is awarded for meritorious achievement in electricity, and this year Professor Elihu Thomson was the first recipient.

A Good Investment If it were proven to you that a small sum of money in the form of an investment would yield two or three times its value at once you would not hesitate to jump at the chance. Such a form of speculation is represented every time a building is wired. If you still doubt, consider a six-room house which in some localities can be wired for about $60. From the real estate man's point of view he will be able to dispose of the improved property at an advance of from $150 to $200 over the former price. Setting aside all other appeals such as convenience, safety, etc., to induce an owner or landlord to use electric lighting the investment idea ought to win consideration.



SHORT CIRCUITS

A man down East by the name of Moon got married and that was a change of the Moon. In due time his wife presented him a daughter; and that was a new Moon; then he went down town and got drunk for joy, and that was a full Moon; when he started home he had only 25 cents, and that was the last quarter. His mother-in-law met him at the door with a rolling pin, and that was a total eclipse.

* * *

A young lady who is teaching a class of small boys in Sunday School desired to impress on them the meaning of returning thanks before a meal. Turning to one of the class whose father was a deacon in the church, she asked him: "William what is the first thing your father says when he sits down to the table?" "He says, 'Go slow with the butter, kids; it's forty cents a pound'," replied the youngster.

* * *

A gentleman in a restaurant had waited patiently for fifteen minutes to get a chance to use the telephone. The gentleman who was using it held the receiver to his ear, but had not spoken at all and finally in desperation the man who was waiting politely said, "Pardon me, but m y I use the telephone for a moment? I see you have not got your party." "You are mistaken," said the other. "I am talking to my wife."

* * *

POPULATION OF THE WORLD

Actors who played with Booth and Barrett	11,456,189
People who knew you when you were poor	78,546,987
Oldest inhabitants....................	56,187,354
Assorted liars........................	356,456,100
People with a grievance...............	108,567,876
People who remembered you when you were "so high".....................	76,345,567
"Old Subscribers".....................	64,456,782
Damphools (all varieties).............	763,453,657
	1,515,470,462

* * *

On a starlit night an Irishman was rowing two Englishmen across a river.

"S y, Pat," said one of the men, "Do you know anything about astrology?"

"I do not," replied Pat.

"Then the best part of your life has been lost," said the Englishman.

The other passenger inquired:

"Pat do you know anything about physiology?"

"I do not," was Pat's response.

"Then that's the best part of your life lost," he answered.

Just then a squall struck the boat and all three were thrown in o the w ter.

"Say, fellows, do yez know anything about swimin'ology?"

"No," gasped both the Englishmen as they floundered in the water.

"Thin, begorra, both of yiz lives is lost," said Pat, as he struck out for the shore.—National Food Magazine.

Flushed and breathless, the well-dressed young man picked up the hat he had been chasing down the street and leaned against a lamp post to rest. Another, also breathing heavily, came running up and took the hat out of his hand. "I'm much obliged," he said. "For what?" "This is my hat." "Where is mine then?" "Hanging behind you, at the end of a string."

* * *

"Our fleet of torpedo destroyers seems to have stirred up our friend, the enemy," remarked the naval chief of one great power.

"Yes," replied his assistant, "it is said they will build a fleet of torpedo destroyer exterminators now."

"Let 'em; we'll build a fleet of torpedo destroyer exterminator annihilators."

* * *

Merton—I'm going in for athletics now.

Burton—Yes?

Merton—I roll all of my cigarettes myself now.

* * *

Mrs. Johnson had gone away from home, leaving Mr. Johnson disconsolate. On arriving at her destination, she missed her gold lace pin, and wrote her servant girl, asking the girl to let her know if she found anything on the dining-room floor.

The servant wrote as follows: "When sweeping the dining-room floor this morning, I found thirty matches, four corks and a pack of cards."

* * *

A Harvard football player after an unfortunate encounter with Yale thought he would escape the public eye by cutting across the fields. A big bull, which looked as if it could do good work in a mass play, bobbed up and cast an evil eye upon the jersey of Harvard crimson.

"Why didn't I take my father's advice," the young man reflected, "and go to Yale! This is no place for a Harvard man."

* * *

"Mamma," said little Ethel, with a discouraged look on her face, "I ain't going to school any more."

"Why, my dearie, what's the matter?" the mother gently inquired.

"'Cause it ain't no use at all. I can never learn to spell. The teacher keeps changing the words on me all the time."

* * *

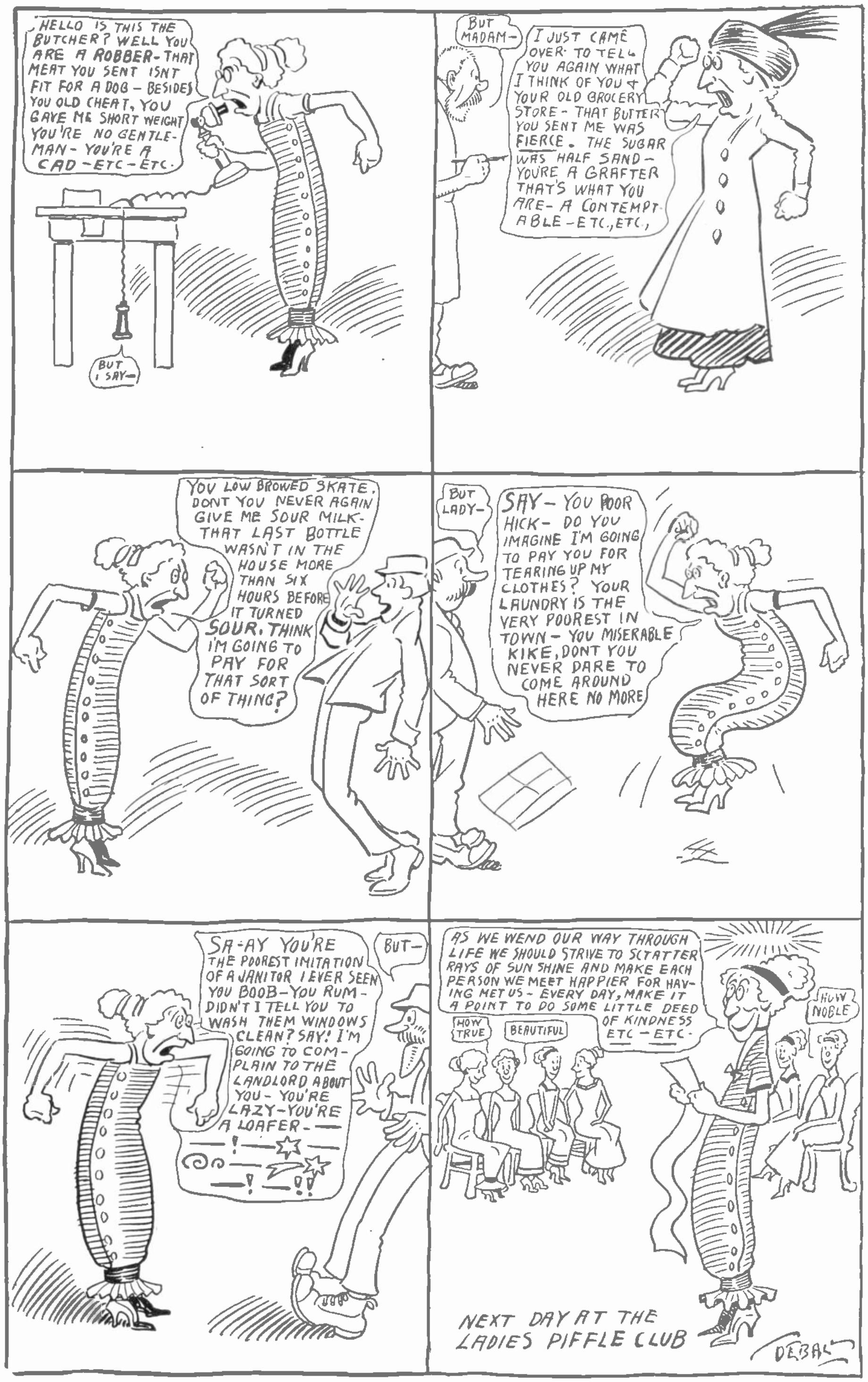
An old dweller in the hills of Arkansas who had lived all his life in one township recently took a trip to Little Rock, forty miles away, and was full of his subject on his return.

"By jing!" said he, in voicing his impressions, "if this hyar world's as big crossways as hit is f'm hyar to Little Rock hit's shore a whopper!"

* * *

"What state do we live in?" asked the teacher in the primary geography class.

And little Elmer, thinking of his Sunday-school catechism, promptly replied: "In a state of sin and misery."


HELLO IS THIS THE BUTCHER? WELL YOU ARE A ROBBER - THAT MEAT YOU SENT ISNT FIT FOR A DOG - BESIDES YOU OLD CHEAT, YOU GAVE ME SHORT WEIGHT YOU'RE NO GENTLEMAN - YOU'RE A CAD - ETC - ETC.
BUT I SAY -
BUT MADAM -
I JUST CAME OVER TO TELL YOU AGAIN WHAT I THINK OF YOU & YOUR OLD GROCERY STORE - THAT BUTTER YOU SENT ME WAS FIERCE. THE SUGAR WAS HALF SAND - YOU'RE A GRAFTER THAT'S WHAT YOU ARE - A CONTEMPTABLE - ETC., ETC.,
YOU LOW BROWED SKATE. DONT YOU NEVER AGAIN GIVE ME SOUR MILK - THAT LAST BOTTLE WASN'T IN THE HOUSE MORE THAN SIX HOURS BEFORE IT TURNED SOUR. THINK I'M GOING TO PAY FOR THAT SORT OF THING?
BUT LADY -
SAY - YOU POOR HICK - DO YOU IMAGINE I'M GOING TO PAY YOU FOR TEARING UP MY CLOTHES? YOUR LAUNDRY IS THE VERY POOREST IN TOWN - YOU MISERABLE KIKE, DONT YOU NEVER DARE TO COME AROUND HERE NO MORE
SA-AY YOU'RE THE POOREST IMITATION OF A JANITOR I EVER SEEN YOU BOOB - YOU RUM - DIDN'T I TELL YOU TO WASH THEM WINDOWS CLEAN? SAY! I'M GOING TO COMPLAIN TO THE LANDLORD ABOUT YOU - YOU'RE LAZY - YOU'RE A LOAFER -
BUT -
AS WE WEND OUR WAY THROUGH LIFE WE SHOULD STRIVE TO SCATTER RAYS OF SUN SHINE AND MAKE EACH PERSON WE MEET HAPPIER FOR HAVING MET US - EVERY DAY, MAKE IT A POINT TO DO SOME LITTLE DEED OF KINDNESS ETC - ETC -
HOW TRUE
BEAUTIFUL
HOW NOBLE
NEXT DAY AT THE LADIES PIFFLE CLUB
DEBAL

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.

CIRCUIT, INTERNAL.—That part of the electric circuit included within the source of current supply.

CIRCUIT, LINE.—That part of a telegraph circuit carried on the poles.

CIRCUIT, LOCAL.—A circuit supplied by a battery or auxiliary source apart from the main source and brought into operation by a main line relay. A notable example is the circuit of the ordinary telegraph sounder.

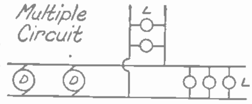
CIRCUIT, MAGNETIC.—The path through which the lines of magnetic force pass in a magnet, generator or motor frame, or other magnetic or electromagnetic devices.

CIRCUIT, MAIN.—The circuit supplied by the main battery in distinction to that operated by the local battery.

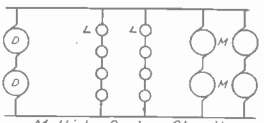
CIRCUIT, METALLIC.—A circuit in which metal conductors are employed throughout; that is, in which the earth forms no part of the path of the current.

CIRCUIT, MULTIPLE.—An arrangement of several sources of electrical energy or of receiving devices so that the positive poles are all connected to one conductor and the negative poles to a negative conductor. (See cut.)

Multiple Circuit



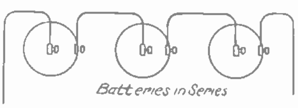
CIRCUIT, MULTIPLE-SERIES.—A circuit in which sources of electrical energy such as batteries or dynamos; or receiving devices, as lamps or motors, are connected in a number of groups in series and these separate groups then connected in multiple or parallel. (See cut.)



Multiple-Series Circuit

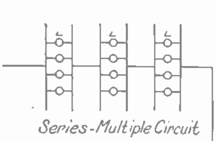
CIRCUIT, OPEN.—A circuit in which the continuity of the conductor is broken, in short, a broken circuit.

CIRCUIT, SERIES.—The arrangement of several sources of electrical energy or receiving devices so that current which passes through one passes successively through each of the others from the first to the last. (See cut.)



Batteries in Series

CIRCUIT, SERIES-MULTIPLE.—A circuit in which sources of electrical energy or receiving devices are first connected in parallel or multiple groups and these groups then connected in series. (See cut.)



Series-Multiple Circuit

CIRCUIT, SHORT.—A by-path of small resistance by which the current passes back to the source, without going through all of the main circuit.

CIRCUIT, SHUNT.—An additional circuit taken off a wire and again returning to it, the current dividing so that part still flows in the original wire and part over the shunt wire in proportion to the resistance of each.

CIRCULAR MIL.—The area of a circle one mil in diameter. Equal to .7854 of a square mil. Used in measuring the cross-section of wires and cables. A mil (length) is 0.001 inch.

CLARK'S COMPOUND.—A cement used for the outside of the sheath of telegraph cables. Prepared, by weight, as follows: mineral pitch, 65 parts; silica, 30 parts; tar, 5 parts.

CLEARANCE SPACE.—The space in a dynamo or motor between the faces of the pole pieces and the armature.

CLEATS.—Blocks, usually of porcelain, for supporting electric wires on the surface wired over. Often made of hard wood where used to install wires of very low voltage systems.

CLOCK, ELECTRIC.—A clock wound and regulated by electric current.

CLOCK, MASTER.—In a system of clocks the clock which controls all the others, being connected to each by an electric circuit. Each clock is provided with proper magnets, and motors in some instances, for regulating and winding purposes, these devices being operated by the master clock.

CLOCK, SELF-WINDING, ELECTRIC.—A clock wound periodically by a motor or electromagnet, the circuit closing switch being a part of the clock mechanism.

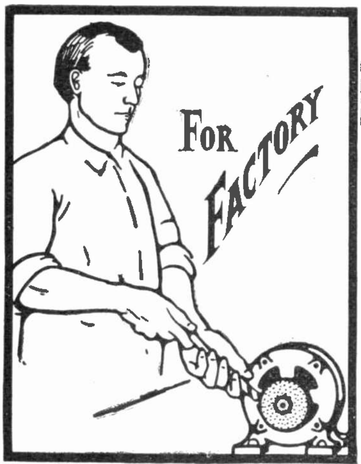
CLOSED CIRCUIT BATTERY.—See Battery, Closed Circuit.

CLOSED MAGNETIC CIRCUIT.—A circuit in which magnetic lines of force follow a path of metal throughout their course. The core of a ring or closed-core type of transformer is an example of such a circuit.

CLUTCH.—In an arc lamp a plate or bar through which a hole is made for the upper carbon to pass. One end of this plate is raised and lowered by an electromagnet in the lamp thus allowing the carbon to feed by dropping through. This is what occurs when an arc lamp flickers.

CLUTCH, ELECTROMAGNETIC.—A device for connecting a shaft with a source of rotation, electric current being used to cause the connection. In one form it consists of two flat faces on the ends of the shafts to be joined. In a groove of one face is a coil of wire. When current is sent through this coil the face of the disk becomes a magnet, attracts the other disk and causes the two shafts to rotate as one.

CODE, CIPHER.—In cable transmission words or phrases are often used to express whole sentences. This makes messages much shorter and affords a means of secrecy. In manufacturers' catalogues a code word is frequently given to each device, one manufacturer, for example using the word "fishwoman" to designate an Edison, porcelain cap, fusible attachment plug.



Small Motors For All Purposes

We manufacture motors (both alternating and direct current) for every small power purpose. We build them in sizes from one-hundredth horse-power up.

Regardless of what mechanical appliance you wish to operate, we can supply you with a Fort Wayne motor particularly adapted to your requirements.

No one motor ever built can run all kinds of devices equally well, so we have developed a variety of types to meet all conditions. For years we have been making the motors used on the leading vacuum cleaners, water pumps, meat grinders, washing machines, vibrators, etc. Tell us what you want to run and we will advise you what kind of a motor it will need and how much it will cost to buy and operate it.

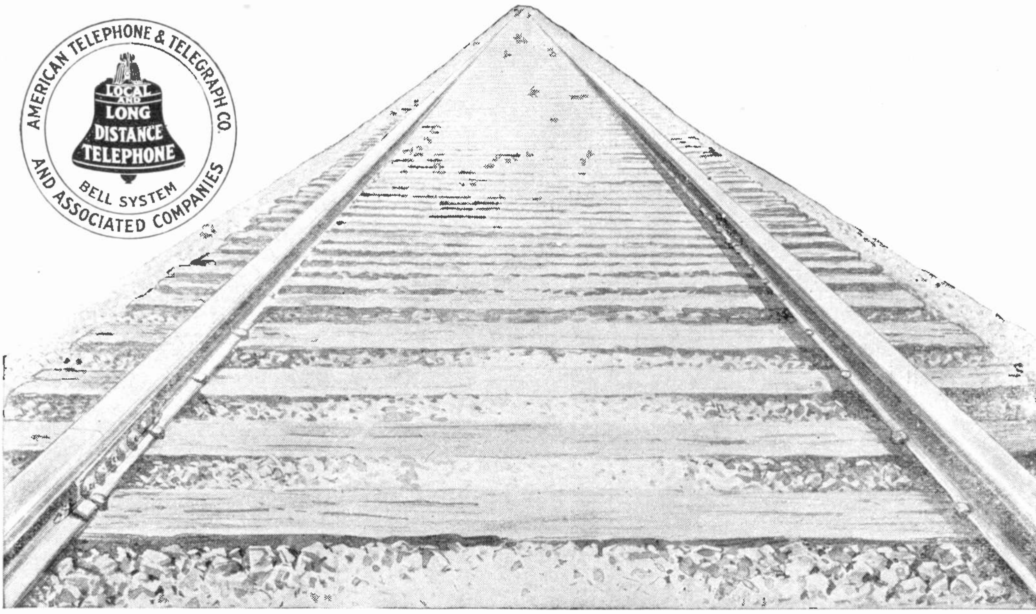
Our new bulletin 1122 contains descriptions and illustrations of some twenty applications which have saved time and money for Manufacturers, Merchants, Doctors, Dentists, Housewives, etc. We want to mail you a copy—FREE. It will pay you to send for this bulletin and read it before you buy motors of any kind.

Fort Wayne Electric Works

"Wood" Systems

1603 Broadway
Fort Wayne, Ind.

Branch Offices:
Most Large Cities



"The Clear Track"

Two men a thousand miles apart talk to each other by telephone without leaving their desks.

Two wires of copper form the track over which the talk travels from point to point throughout a continent.

Moving along one railroad track at the same time are scores of trains carrying thousands of passengers. The telephone track must be clear from end to end to carry the voice of one customer.

The Bell system has more than ten million miles of wire and reaches over five million telephones. This system is operated by a force of one hundred thousand people and makes seven billion connections a year—twenty million "clear tracks" a day for the local and long distance communication of the American people.

The efficiency of the Bell system depends upon "One System, One Policy, Universal Service."

AMERICAN TELEPHONE AND TELEGRAPH COMPANY
AND ASSOCIATED COMPANIES

CLASSIFIED ADVERTISING

¶ Advertisements in this section of Popular Electricity will cost 5 cents per word with 5% off for 3 times, 10% off for 6 times, 15% off for 9 times and 20% off for 12 times, cash with order.
¶ In order to secure the proper classification, advertisements must be in this office the first of each month preceding date of issue.

AERONAUTICS

BI-PLANE GLIDER FOR SALE—ONLY $50. Particulars, Ray Herrington, 654 Mt. Prospect Ave., Newark, N. J.

MODEL AEROPLANE—INSTRUCTIVE TO experimenters. Self-propelled. Flies considerable distance. 50c prepaid. Agents wanted. AEROPLANE MFG. CO., 309 15th St., Brooklyn, N. Y.

AERO, PUBLISHED WEEKLY, $2 A YEAR; ten cents a copy. Illustrated news of the Aero world, descriptions and drawings of latest aeroplanes and engines, every week. Aero, 19 N. 9th, St. Louis.

"BOY AVIATORS' SERIES," SIX THRILLING airship books for young Americans. New, exciting and absorbing. Send for Vol. 1, and you will quickly want the others. Postpaid 50c. At all bookstores. Our immense catalogue free. Hurst & Co., 395 Broadway, New York.

AGENTS WANTED

2-TICKLE-U, 3c. STIX, STOCKTON, CAL.

See what I say under "Typewriters." ATCHISON

DON'T ACCEPT AN AGENCY UNTIL YOU get my samples and particulars. Money-makers. Address SAYMAN, 706 Sayman Bldg., St. Louis, Mo.

"AGENTS MONTHLY," 3 MONTHS SUBscription 10c. None free. P. E. Walter, 35 Dean St., Brooklyn, N. Y.

"PERFECTION POCKET ADDING MAchine—Lightning seller. Agents wanted. Cincinnati Specialty Mfg. Co., Dept. E, Cincinnati, Ohio.

AGENTS—RECEIVE BIG MAIL FREE. SEND ten cents to have your name registered in our mailing directory. Printing Department. Success Supply Company, 247 West 139th St., New York.

AGENTS SELL ADDISON WONDERFUL IMproved gasoline system lamps. No smoke—no smell. No dirt. Simple, instantaneous, big profits. Addison Light Co., 109 W. Michigan St., Chicago.

AGENTS MAKE BIG MONEY SELLING OUR new gold letters for office windows, store fronts and glass signs. Any one can put them on. Write today for a free sample and full particulars. Metallic Sign Letter Co., 400 N. Clark St., Chicago, Ill.

LIVE AGENTS WANTED—HUSTLERS TO handle our attractive 1911 combination packages of soap and toilet articles with valuable premiums. One Michigan agent made $65 in 47 hours, another $21 in 8 hours, another $22.50 in 10 hours. Write today. E. M. Davis Soap Co., 27 Union Park Court, Chicago, Ill.

EASY MONEY—DISTRIBURORS BAG PROFit on all coal used for heat or power; Consumers save half without changing plant. Write quick. Kol-Saver, Glen Ellyn, Ill.

AGENTS WANTED

BOKARA DIAMONDS—AGENTS, EVERYONE wanted to wear and sell these Famous Gems. Big profits. Sample offer and catalog, Free. Northwestern Jewelry Co., 80 Northwestern Bldg., Chicago.

OUR ELECTRIC SPECIALTIES ARE EASY sellers and Agents' profits are big. Some choice territory still open. A penny postal will bring you full particulars. Send now. STANDARD ELECTRIC WORKS, 1200 Washington Ave., Racine, Wis.

AGENTS MAKE BIG MONEY—BIG PAY, NO experience, no capital required. 5,000 new art specialties, photo pillow tops 25c, portraits 30c, bromides 25c. New 1911 catalog and samples free. Write. Daniel H. Ritter Co., Madison St., Chicago, Ill.

IMPROVED KEROSENE MANTLE LAMP! 100 Candle-Power! ¼ coal-oil used! Best on American market! greatest campaign bargains ever offered! Get our prices! Establish business! Control territory! large profits! Webster Specialty Co., Waterbury, Conn.

MAKE $60 TO $100 WEEKLY SELLING OUR small bottling outfit for saloons. New article—easy seller—large demand. Nothing like it. Write now for free information. Simplex Mfg. Co., Dept. 13, Kewanee, Ill.

125 PER CENT PROFIT TO YOU, 97 PER cent saving to customer. Hand rope machine makes better, stronger rope than factory. NEW, ABSOLUTELY no competition. Farmers, ranchers, factories, boats, builders, liveries, saddlers, stores buy on sight. One man sold 10 first 20 minutes ($25 profit), another 100 weekly. Appoint sub-agents. Act now for ground floor contract. Chicago Specialty Factories, "Dept. N," 40 Michigan Ave., Chicago.

AGENTS—BIGGEST MONEY-MAKER known. The new Canchester Incandescent Kerosene Lamp revolutionizes old lighting methods. Burns air, not money. Six times brighter than electricity, gas or acetylene at 1-10th cost. Burns with or without mantle. Burner fits any lamp. Saves 75 per cent oil. No trimming wicks. Showing means selling. Territory going fast. Write today. Handsome outfit furnished. Canchester Light Co., Dept. P. E., 1, Chicago.

BOOKS

STIX, STOCKTON, CAL.—MENDER 3c.

"THREE LITTLE BOOKS FOR LADIES," postpaid in plain cover for 25c. (They tell what you want to know.) O. K. Pub. Co., Decatur, Ill.

TELEPHONE TROUBLES AND HOW TO Find Them, new 14th edition, price 25c, Hyde Pub. Co., Telephone Building, 183 Fifth St. Milwaukee, Wis.

DRAFTSMEN WANTED

THAT CAN DRAW THE HIGHEST SALARY

$ $

ONLY THE BEST PRACTICAL MEN WANTED

$ $

MEN WITH BRAIN NOT WITH BOOKS CAN ONLY SUCCEED

Good Draftsmen are ALWAYS in Demand ALWAYS Busy, ALWAYS Drawing Good Salary

The Work is Pleasant, Interesting, Clean and Leads to Best Paying Highest Positions

If you are ambitious, bright and anxious to learn I can train you at home on practical, actual Drafting room work in a short time for a position $125-$150 monthly. Only a limited number can receive my personal training.

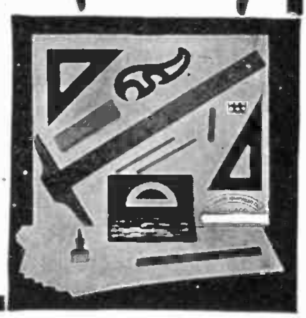
I DON'T SELL YOU a lot of books to look at with disgust or to lay on a shelf to be covered with dust.
I DON'T SELL YOU printed school lessons or pictures to copy. You MUST learn on actual Drafting room work.
I DON'T SELL YOU or give you a worthless "cheap-skin" Diploma to hang on the wall and that will be all.
BUT I TRAIN YOU until competent; more than that, until placed in position at above salary.
AND I TRAIN YOU personally and individually to advance you as fast and far as you can go.
AND I TRAIN YOU on practical work to give you required UP-TO-DATE, PRACTICAL WORKING EXPERIENCE.

Remember:

I AM NOT teaching 227 different trades — ONLY ONE and THAT ONE right.
I AM NOT looking for students—they look for me, for I have been at this over 22 years.
I AM NOT accepting every one that has the price—only those anxious to succeed with me.

I rather satisfy a few than dissatisfy too many.
I furnish all Instruments and Working Outfit (not school set), this HIGHEST GRADE FREE.
If you want to be a GOOD DRAFTSMAN, drawing good salary, write to me NOW.

Address, **CHIEF DRAFTSMAN, Div. 10**
Eng's Equip't Co. (Inc.), CHICAGO



FEDERAL
ELECTRIC COMPANY

Federal Vacuum Cleaners

do not need repairs, they will last for years. They are built with a positive action rotary pump in which the wear on the bearings is reduced to a minimum, and there are no valves to get out of order. Buy a cleaner that is a permanent investment, not a novelty.

For Churches, Halls and Stores

The Federal Type "A" Cleaner

is mounted on rubber tired wheels for easy moving. The tools are kept in the cabinet, which can be kept locked to prevent theft or unauthorized use. The handle of this machine folds down when not in use. Especially adapted for janitors' use in Churches, flat buildings, stores or other large buildings.

For Household Cleaning

The New Type "C" Cleaners

are built on the rotary principle and run without noise or jar. Type "C" Cleaners are especially adapted for household use, are light, compact and smooth running. Cannot be heard in the next room. Demonstrated at Electric Shop, Chicago. Write us for Bulletin No. 1438. ∴ ∴ ∴ ∴ ∴

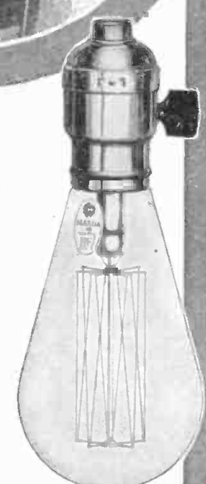
Federal Electric Company

MANUFACTURERS

Lake and Desplaines Sts. CHICAGO

One dollar will now buy three times as much electric light as formerly because

Mazda Lamps



are as light producers nearly three times as luminous as old style electric incandescent bulbs.

Triple light and no increase in your monthly bills for current.

A trial will show you why General Electric MAZDA Lamps are replacing other illuminants everywhere.

Begin with the rooms you want brightest during the long winter evenings and compare the brilliant "bottled sunshine" with any other light you ever saw.

Ask the electric light company in your city to show you what the General Electric MAZDA actually does.

Do you realize that everyone can now afford electric light?

Write today for a helpful little booklet on "The Dawn of a New Era in Lighting." It tells how, when and where those lamps can be used to advantage, gives sizes and prices of lamps and reflectors, lighting plans and costs and much valuable information on modern illumination. 2815

General Electric Company, Schenectady, N.Y.
Dept. 30

One Dollar
Puts the
"RICHMOND" Suction Cleaner in Your Home

This is a reduced reproduction to show detail. The actual height of the machine is 12 inches.

ONE Dollar forever frees you from brooms, mops and dusters—and the backaches and drudgery they bring.

One Dollar forever stops the expense and the nuisance of Spring and Fall housecleaning.

One Dollar enables you to do, *easily*, by electricity, the *worst work* a woman has to do.

And One Dollar is the only cash outlay.

It will bring you the "RICHMOND" Suction Cleaner complete—ready for instant use.

The balance you pay for month by month out *of the actual money you save.*

For Vacuum Cleaning is the greatest of all household economies.

You are paying the price of a suction cleaner, *right now*—whether you have one or not.

You are paying its price out in twice-a-year house cleaning alone—for a "RICHMOND" makes housecleaning needless.

You are paying its price out—many times over—in the hard labor of sweeping and dusting which the "RICHMOND" makes unnecessary.

You are paying its price out again and again in the damage which dust does to your furniture, to your carpets, to your hangings, to your clothing—to YOU.

You are paying the price of a "RICHMOND" when a single dollar would save the waste.

YOU see here the lightest and simplest suction cleaner *ever designed*.

1.—is the motor—not a "stock" motor, but one built expressly to operate the powerful suction fan to which it is directly connected, under

2.—a suction fan which embodies the best of all that was learned in two years of steady, scientific experiment.

3.—is the suction nozzle which is pushed over the surfaces to be cleaned—or to which can be attached a twelve-foot hose for high wall, drapery and upholstery cleaning.

The "RICHMOND" Suction Cleaner enables you, now for the first time, to clean by electricity without lugging a 60 to 80 pound machine from room to room—upstairs and down

It represents as great an advance over heavy weight vacuum cleaners as these cleaners represented over brooms and carpet sweepers.

But light weight and easy operation are but two of the "RICHMOND'S" exclusive superiorities. There are many more.

The vibrating brush, which taps the caked dirt out of otherwise uncleanable rugs and carpets—the hair-drying and pillow-renovating attachments—the seven special tools which make the "RICHMOND" the most complete cleaner ever offered.

Manufactured exclusively for the RICHMOND SALES CO. by

THE McCRUM-HOWELL CO.
103 Park Ave. and 41st St., New York

Five Factories: Two at Uniontown, Pa.--One at Norwich, Conn. One at Racine, Wis.--One at Chicago, Ill.

MANUFACTURERS OF "RICHMOND" Boilers and Radiators, "RICHMOND" Enameled Ware, Bath Tubs, Sinks, Lavatories, "RICHMOND" Suds Makers, "RICHMOND" Concealed Transom Lifts, and "RICHMOND" Stationary Vacuum Cleaning Systems

Inquiries regarding built-in-the-house Vacuum Cleaning systems should be addressed to The McCrum-Howell Co., New York and Chicago.

Limited Offer

The Dollar Offer is limited. It is made to show our unbounded confidence in the "RICHMOND"

But by its very liberality, it is bound to swamp the factory. And when the limit of factory output is reached, the offer must be withdrawn.

So send the coupon today while the opportunity is still yours! Don't wait. Do it NOW.

THE RICHMOND SALES CO.
Dept. 321, 103 Park Ave. New York

DOLLAR COUPON

THE RICHMOND SALES CO., Dept. 321, 103 Park Ave., N. Y. City

I hereby order one "RICHMOND" Suction Cleaner, complete with the following attachments:

1 Hose Attachment Shoe
1 12-ft. covered Suction Hose
1 Book and Wall Brush
1 10-in. Drapery Tool
1 3-in. Suction Tool
1 Felt-Faced Floor Tool
1 Adjustable Wall Brush
1 30-ft. Electrical Cord
1 Complete Hair Drying Attachment

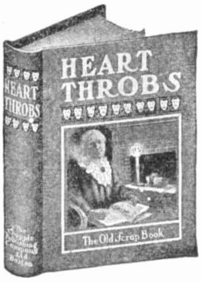
—for which I agree to pay to your order, $1.00 herewith, and $6.00 on the first day of each of the next 12 consecutive months. Title to be given me when full amount is paid.

Name...

Address...

Gift Books the People Built

A Gold Mine of Nuggets



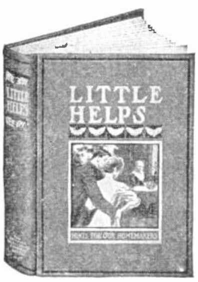
50,000 People

joined in making, by personal selection, this book **Heart Throbs.** The most wonderful collection of old-time prose and poetry in existence. Price $1.50 net.

"He would have a heart of stone, Indeed, who would not feel a throb of better feeling as he reads its pages."

Have you Heart Throbs on your Library Table?

Home-Makers' Exchange



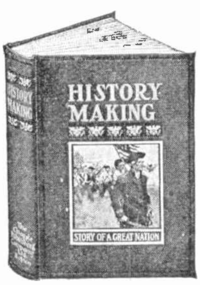
10,000 Women

joined in making, by personal experience, this exceedingly helpful volume of home hints. Worth its weight in gold to the new bride or any woman who wants to know "a better and an easier way." Price $2.00 net.

"One of the best books ever published. Not spoiled by editoria hands."

The time you need a little help is the time you need "Little Helps."

Story of a Great Nation



5,000 People

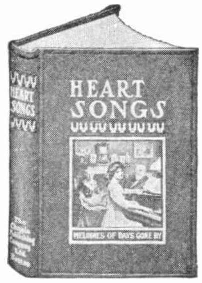
joined in making, by personal requests to the Federal officials, this complete resume of the intimate internal management and operation of the departments comprising the National government. Price $2.00 net.

"History making must stir the pride of every true American."

A storehouse of valuable information in attractive, readable form.

Every Good Book Dealer Sells these great Gift Books = or You Can Order Direct

Old Songs Recall Old Friends



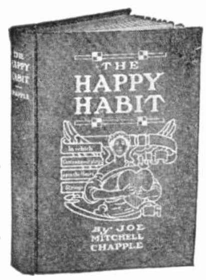
25,000 People

joined in making, by personal selection, this singing volume of familiar old-time favorites to flood memories of by-gone days. Price $2.50 net.

"I am sure that the vast majority of people who have *tried* will find this collection made as though especially for themselves."

An informal gathering of friends of an evening in the home is "Heart Songs" time. Have you it ready?

Footprints on Life's Way



8,000 Old Friends

subscribers to the National Magazine, joined in making, by personal selection from the writings of the editor, this book of irrepressible good humor and wide-awake living.

"It genially transmits the rays of passing fellowship."

The Happy Habit is a friendly book—a book for lonesome moments.

CHAPPLE PUBLISHING CO., Ltd.
Boston, Mass.

Enclosed find .... *for which send me a copy of* .... *postage paid.*

Name ....

Address ....

Town .... *State* ....

(If you wish to take advantage of a great combination subscription offer send 50 cents additional to the price of the book, and we will mail you the National Magazine for one year.)

LOFTIS SYSTEM DIAMONDS WATCHES ON CREDIT

A Good New Year Resolution—Use the Loftis System It enables you to buy beautiful and valuable articles, either for your own use or as gifts, without the outlay of much money. By giving credit and lowest prices, we make $5 or $10 do the work that $50 does in a cash store. MAKE YOUR NEW YEAR SELECTIONS NOW from our New 1911 catalog and we will send them for your inspection. If you like them pay one-fifth on delivery; balance in 8 equal monthly amounts. Don't delay. Write Today for our Catalog.

LOFTIS BROS. & CO. Old Reliable, Original Diamond and Watch Credit House, Dept. A685 92 State St., Chicago, Ill.

Big Mail FREE

Your **NAME PRINTED** in our Mailing Directory and sent to 10,000 firms all over the world so they can send you **FREE Samples, Catalogs, Books, Papers, Magazines, etc., etc.** Send 20c to cover cost of printing your name and you will receive a big mail Free.

Ingram, Va., Jan. 7, 1910. Mr. Anderson, I have already received more than 2,000 parcels of mail, and still they come, scores of papers, samples, magazines, etc., for which I had often paid 10 to 25c each. R. T. James.

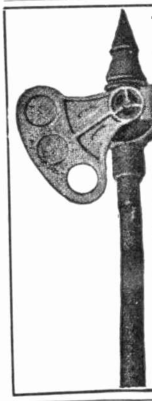
Send to ANDERSON, The Mail Man, 565D, Jamestown, N. Y.

NULITE GASOLINE TABLE LAMP

A beautiful lamp for homes, hotels, offices, stores, banks, cafes. Portable, safe; can be turned upside down or rolled on floor without danger or affecting the light. 300 C. P. of soft, brilliant light; one-third cent per hour.

Agents—We want town, county and travelling salesmen. Best proposition ever offered. Sells everywhere. No experience necessary. Write for Special Offer.

CHICAGO SOLAR LIGHT COMPANY
219 South Jefferson Street CHICAGO



Be a Signal Engineer!

Signal Engineers and Supervisors receive $125.00 to $350.00 monthly. Other signal positions pay from $65.00 up.

This is **your** opportunity to train yourself in your spare moments for a profession always **needing a man who knows.**

We send the entire Course of Self Instruction with Complete Sturdy Practical Working Models, upon receipt of the first small payment.

Don't miss your chance. Write for details at once.

DEPARTMENT OF SIGNALING
Under the personal supervision of
S. DEUTSCH, B. S. E. E. & STAFF
315-321 Dearborn St. Chicago, Ill.

For **Men and Women Alike**
A BOOK of VITAL INTEREST on the subjects of

MARRIAGE, PARENTAGE & SEXOLOGY

Comprehensive—Interesting—Instructive

Dr. Foote's "Home Cyclopedia"

of plain home talks is certain to awaken thought in every reflective reader; every page bristles with facts about self and sex and their relation to life and health. It imparts the information in a clear and wholesome way. It ought to be in the hands of every husband and wife, or those who ever expect to be either. It is written by a specialist of 50 years' practice. It contains 1,248 pages; 330 illustrations from color plates and half tones; cloth bound. It is endorsed by Physicians, Teachers, Clergymen, Lawyers, and others in all parts of the world. Send TODAY for our FREE descriptive booklet with table of contents, opinions of people, and other interesting matter, and also for our SPECIAL OFFER. Regular Price $2.00.

MURRAY HILL PUB. CO., 106 East 28th St., New York.

Do You Like to Draw?

That's all we want to know

Now we **will not** give you any **grand prize**—or a lot of **free stuff** if you answer this ad. Nor do we claim to make you **rich in a week.** But if you are anxious to develop your talent with a successful cartoonist, so you can make money, send a copy of this picture with 6c. in stamps for **portfolio of cartoons and sample lesson plate,** and let us explain.

THE W. L. EVANS SCHOOL OF CARTOONING
325 Kingmoore Bldg., Cleveland, O.

MAKE MORE MONEY

than you ever dreamed possible decorating china, burnt-wood, metal, pillow-tops, etc., in colors from photographs. Men successful as women. Learned at once, no talent required. Takes like wild-fire everywhere. Send stamp quick for particulars.

C. K. VALLANCE CO., ELKHART, INDIANA

Young Man Get Into the Auto Business

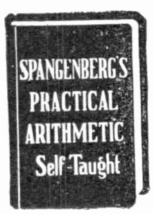
There are better opportunities and greater possibilities in this business than in any other line. There is a big demand for trained men. A course of training in the N.Y.S.A.E.—the automobile trade school—will give you the right start. Write for Catalogue E.

NEW YORK SCHOOL OF AUTOMOBILE ENGINEERS, 146 West 56th St., New York. Phone Columbus 4314

ARITHMETIC
SELF-TAUGHT

A plain, easily-understood volume for *all* who have not had the opportunity of learning this subject thoroughly, or who have forgotten what they once learned. *257 Pages. Requires no teacher.* This great little book sent postpaid for *60 CENTS.* Stamps accepted, leather binding $1.

GEO. A. ZELLER BOOK CO.
Est. 1870. 4464 W. Belle Place, ST. LOUIS, MO.



UNCLE SAM WANTS YOU

and thousands of others to work for him. Common school education sufficient. 40,000 appointments yearly in Railway Mail, Postal, Customs, Internal Revenue, and other branches of U. S. service, Philippines and Panama. Full particulars **free** concerning positions, salaries, examinations (held soon in every State), sample examination questions, etc. **NATIONAL CORRESPONDENCE INSTITUTE, 96-97 Second Natl. Bank Building, Washington, D. C.**

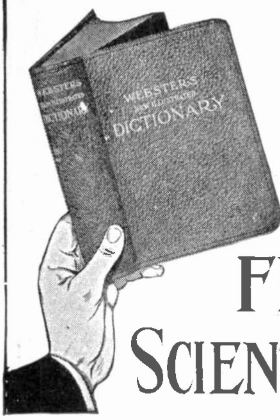
Complete Course on Instruments and Meters—By Mail

Our Course covers the design, theory, construction, operation, calibration, care and maintenance of all makes and types of electric **Instruments** and **Meters.**

BIG DEMAND FOR COMPETENT METERMEN

A Course in our School will qualify you for a good position where you can demand a splendid salary. Our booklet, **Instruments and Meters,** explaining the entire Course, with valuable **Information** on **Meter Testing,** FREE on request. Write for it—TODAY.

FORT WAYNE CORRESPONDENCE SCHOOL, FORT WAYNE, IND.



Webster's NEW 1911 Illustrated Dictionary FREE with the SCIENTIFIC AMERICAN

YOU don't *need* Webster's Dictionary to enable you to *understand* the SCIENTIFIC AMERICAN'S articles—for they are written in a clear, fascinating and *popular* vein.

We give you the Dictionary solely to induce you to become a regular subscriber to the *only weekly* journal of the world's progress in science, industry and invention.

With every two years' subscription to the SCIENTIFIC AMERICAN (price $6.00), we send the Dictionary *free*, express paid.

If preferred, we will send the SCIENTIFIC AMERICAN for *one* year to *two* addresses, sending one Dictionary to either address, or for $4.00 we will send the SCIENTIFIC AMERICAN to you for one year and also send you a copy of the Dictionary, express prepaid.

The Dictionary contains 50,000 words, 11,000 synonyms and antonyms, many colored illustrations and charts, and a vast amount of valuable tables, data, and special articles. Has all the new words, such as "aviation, biplane, cordite, hook-worm, lettergram, taximeter." A 1911 "working encyclopedia," for the home, office, school or college. Bound in genuine flexible leather, with gold titles and red edges.

Scientific American

is the oldest and the leading authority on the *most interesting and absorbing topics* that are to-day engaging the best brains and skill of the civilized world—aeronautics, aviation, automobiling, naval affairs, industrial progress, popular science, railways, transportation, etc., etc. Not dry or technical, but written so that anyone can understand and enjoy every word.

The SCIENTIFIC AMERICAN, together with Webster's Dictionary, will enable you to answer many important and timely questions, and keep you posted on the newest developments in the world's progress.

Our special offer applies to either *new* or *renewal* subscriptions, but will be withdrawn as soon as our supply of books has been entirely taken up.

Don't delay—don't miss this chance—fill in and return the coupon *to-day!*

MUNN & CO., Inc.

367 Broadway, New York

Tear off along this line. Write plainly

P. E.
MUNN
& CO., Inc.
New York

Gentlemen:—Enclosed find $............(postal or express money order or N. Y. bank draft), for which send me the SCIENTIFIC AMERICAN for............year, and a *free* copy of Webster's New Illustrated Dictionary, as described in your special offer, express prepaid.

Name..

Street and No. ....

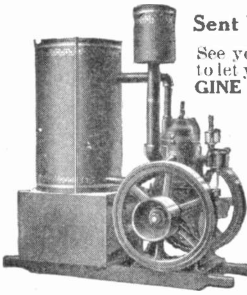
City.............................. State..............................

This Kerosene Engine Cuts Your Expenses 75%

YOU should not even consider engines that operate on gasoline only. The rapidly rising price of gasoline, now 6 to 16 cents higher than kerosene, absolutely makes operation on this fuel too expensive. The Perfection Kerosene Engine operates on **any** engine fuel. When you purchase it you are on the safe side—proof against all fluctuations of the market. You can always run this engine at a great fuel saving and get the greatest amount of work done. The Perfection **vaporizes its own kerosene** and so makes it as efficient as gasoline—something other engines **cannot** do.

The Perfection is very light, portable, has only three moving parts, runs everything about the place, is lower in price than any other engine of its capacity on the market.

PERFECTION Kerosene Engine



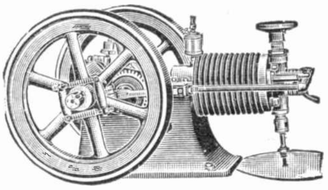
Sent You on 15 Days Free Trial

See your dealer at once and ask him to let you have a copy of our **Free ENGINE BOOK**, which shows the sizes and styles of the "Perfection" and explains this very attractive offer. Your dealer will send any "perfection" engine to your farm for 15 days and let you return it if you are not satisfied. Ask him about it. If he does not carry the "Perfection" write to us and we will send you our **Free Engine Book** direct.

CAILLE PERFECTION MOTOR CO.
202 Second Ave., Detroit, Mich.

We Will Send You THIS ENGINE FREE

FOR 30 DAYS



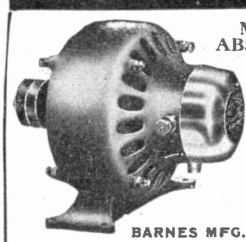
so you can test it out and prove to yourself it's the best little all-around gasoline engine ever produced. It is adapted for all uses in Shop, Farm and Home. We ship complete—all set up and connected—ready for use. It's so simple a woman can run it—simply fill in the gasoline—give it a turn and away it goes.

Thompson Gasoline Engines

are built on correct lines. Piston and rings are of special design, like those in the finest motor car engines. Let us send you free book and tell you all about our wonderful 30-Day Free Trial Offer. **Write today.**

J THOMPSON & SONS MANUFACTURING CO.
41 Oak Street, BELOIT, WIS.

$\frac{1}{12}$ AND $\frac{1}{8}$ Direct and Alternating Current Motors
VARIABLE SPEED - SINGLE PHASE



MOTORS THAT WILL ABSOLUTELY NOT HEAT

"The Barnes Motors" are especially adapted for Washing Machines, Vacuum Cleaners, Air Purifiers, Ventilating Devices, Coffee Mills, Meat Choppers, Printing Presses, etc., etc. —Dental and Medical work a specialty. Positively the best motor for use where motor driven work is necessary —greatest power, highest efficiency. We want Reliable Agents everywhere —write at once for prices and catalog. Let us figure on your requirements.

BARNES MFG. CO., SUSQUEHANNA, PA.

Electric Light at Cost

¶ Why not have your own Electric Light plant and make a brilliant sanitary light, at the small cost of generating the current?

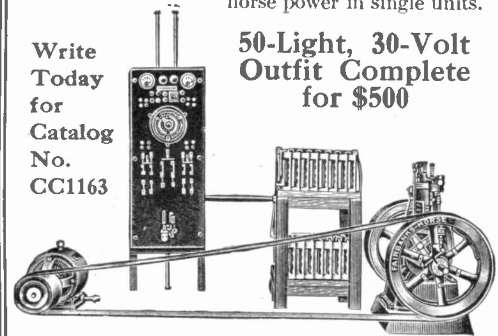
¶ No dangerous gases to explode. It is absolutely safe.

¶ The battery can also be used to run small electric motors for driving pumps, fans, sewing machines, etc.

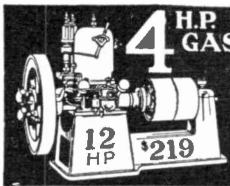
¶ The same engine can be used for operating a water supply system or other machinery. We also make larger electric light plants up to 500 horse power in single units.

Write Today for Catalog No. CC1163

50-Light, 30-Volt Outfit Complete for $500



Fairbanks, Morse & Co.
481 Wabash Avenue Chicago, Ill.



4 H.P. STATIONARY GASOLINE ENGINE COMPLETE $76.00

For Farmwork, Irrigation or Pumping, Factory use and Electric Lighting.

3 to 20 h.p.—perfectly governed —guaranteed by a responsible firm. Write for full description.

GRAY MOTOR CO., 128 Leib St., DETROIT, MICH.

Stop Paying for Marine Engine Experiments

Reputable agents wanted to handle popular-priced marine engine. **Absolutely guaranteed for 5 years.**

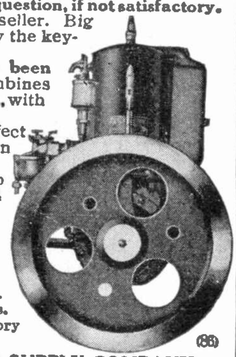
Thirty days' trial by the purchaser. Your money promptly refunded, without question, if not satisfactory.

A sure favorite and quick seller. Big returns assured. Simplicity the keynote of construction.

Just the engine you have been looking and waiting for. Combines the good features of the best, with all the bad ones eliminated.

Fool-proof. As near perfect as anything mechanical can be produced.

All sizes in stock from 2 to 50 h. p. Ready to ship on 24 hours' notice if necessary.



Write today for catalog and details of the greatest selling plan and agents' money-making proposition ever offered.

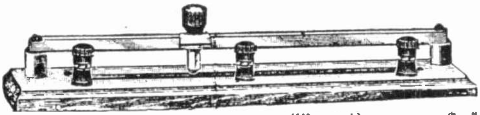
Liberal discount, specified territory and absolute protection to accepted agents.

Some very productive territory still open.

DETROIT MOTOR CAR SUPPLY COMPANY
18 Mt. Elliott St. Detroit, Mich.

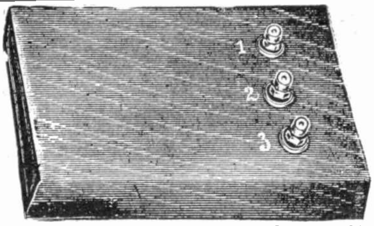
"BROOKLYN WIRELESS" Mark of Quality.....Nuf-Sed

WATCH THIS SPACE



"Bwaenco" Non-Inductive Potentiometer (like cut)............ $ .75
"Bwaenco" Improved Spark Gap................................ .50
"Bwaenco" Tuning-Coils, Double Slide........................ 1.50

No. 10-14-Bare Copper wire per lb...$ .40
No. 18-22-Bare Copper wire per lb..... .45
No. 8-14-Aluminum Aerial or Helix wire .50
No. 18-22 Enameled-Enameled-Enameled wire per lb. .... .50
No. 36-Single-Cotton-Covered wire lb.. $1.75



"Bwaenco" Fixed Condenser (like cut) 65c

Brooklyn Wireless Co., Inc., 766 Broadway, Brooklyn, N. Y.

Belden Magnet Wire

Our SILK and COTTON covered MAGNET WIRE is accurate to gauge with insulation of perfect uniformity and continuity and is put up one piece only per spool.

Beldenamel Magnet Wire is insulated with several layers of tough elastic enamel separately applied and baked on. It possesses the highest insulating strength and will not become brittle and flake off.

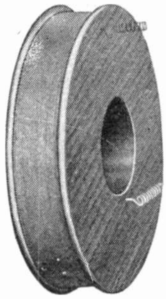
We quote the following net prices to readers of this paper and will ship postage or express prepaid on receipt of cash. **No orders filled amounting to less than $1.00.**

Prices are per pound.

Size	Single Cotton	Beldenamel	Single Silk	Double Cotton	Double Silk
16			.48		.61
17			.49		.62
18			.50		.64
19			.52		.65
20	.35	.48	.53	.38	.67
21	.36	.49	.54	.42	.69
22	.37	.51	.55	.44	.73
23	.39	.53	.58	.47	.77
24	.41	.56	.61	.50	.83
25	.44	.60	.66	.55	.89
26	.48	.66	.72	.60	.99
27	.52	.71	.78	.66	1.11
28	.55	.77	.84	.72	1.20
29	.59	.84	.92	.78	1.33
30	.65	.93	1.02	.85	1.54
31	.74	1.06	1.15	.92	1.85
32	.77	1.19	1.30	.98	2.04
33	.86	1.35	1.48	1.13	2.40
34	1.04	1.60	1.74	1.32	2.76
35	1.12	1.86	2.03	1.60	3.17
36	1.27	2.16	2.35	1.80	3.59
37	1.62	2.56	2.80	2.58	4.42
38	2.16	3.07	3.35	3.42	5.06
39	2.82	3.72	4.05	4.32	5.85
40	3.60	4.48	4.88	5.40	6.92

Belden Mfg. Co., 2306 S. Western Ave. CHICAGO, ILL.

SECONDARY "UNITS"



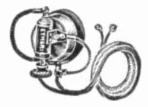
Been having trouble winding your Secondary for your Induction Coil or Transformer? Why not put your worries on our shoulders? The winding is not a WORRY to us, as we have the equipment, and winding coils is a part of our BUSINESS.

Our Secondary "UNITS" are wood spool sections wound, parafined, etc., and all ready to connect up. You can buy a spool at a time or as many as you want, and they will cost you but little more than the wire alone.

Send 2-cent stamp for our large catalogue which tells all about it and many other things "WIRELESS" besides.

Dawson & Winger Electric Co
429 Dearborn Street: Chicago, Ill.

NEW WIRELESS WONDER



Aero-Field Receiving Outfit. Weight only 4 oz. Receives up to 75 miles. The Wireless Sensation of the year. Consists of 1000 Ohm, receiver and attachments all assembled on regular size leather Insulated head band. Price $4.00 (not including light field aerial). A wonderful instrument at a wonderful price. Boy scouts and all requiring light outfits send 2c for description of the Aero and catalogue. **Etheric Electric Co.,** Salesrooms and Factories, 278 Lenox Ave., cor. 124th St., 71 Barclay St., New York, N. Y.

WIRELESS APPARATUS

Our Wireless Goods are the best on the market, and are guaranteed to *work*. Our instruments are made of the finest materials, and are sold at present at a price within the reach of every experimenter. Send 2c stamp for our large catalogue which contains a full list of Wireless Instruments, Novelties and Electrical Goods, and also a great deal of Wireless information for the Wireless experimenter.

The I. W. T. Wireless Co., 726½ Broadway, Brooklyn, N. Y.

10 AMP.-HOUR STORAGE CELL

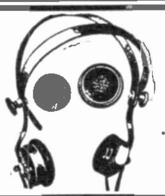
PRICE $1.00

The most durable and reliable battery made. Your Wireless Set will send signals from 25-30 per cent. farther when these Storage Cells are used in lieu of other forms of battery. We also **MANUFACTURE** a complete line of Wireless Telegraph and Telephone Apparatus, Dynamos, Motors, Rectifiers, Transformers, Gasoline Engines, Model Aeroplanes, etc.

Send 2c stamp for descriptive matter.

ADAMS-MORGAN CO.
"The Experimenter's Supply Co."
Box 72a Upper Montclair, N. J.

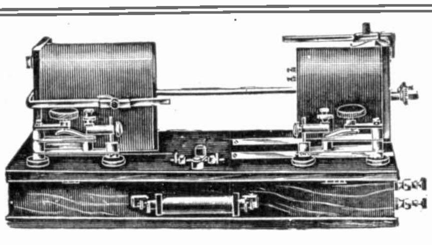
Beware of Imitators



Owing to the great success of my **Improved Navy Wireless Receivers** for long distance work, some concerns are misrepresenting them. The receivers I make have my name on them. **Look for it.**

Send for new catalog and testimonials.

C. BRANDES, 111 Broadway, New York
San Francisco Agent:
C. F. King, 163 Belvedere Street.



BIG 200 Page Electrical Catalog

The Greatest Line of Wireless and Electrical Goods Extant

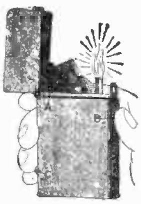
Send 4c stamp (to cover postage only) for this catalog, deducting same, if desired, from first order.

The Receiving Set shown in-cut, is mounted in a mahogany cabinet, and costs but $40.00. Instruments unmounted cost considerably less. Set consists of two of our **Celebrated Ferron Detectors,** special wound **Receiving Transformer** with exclusive patented features. **Tubular Condenser** and our specially wound 1000 ohm Double Head Set. **Set cannot be duplicated elsewhere for less than twice the price.** Approximate range 1000 miles.

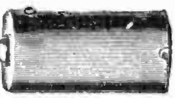
J. J. DUCK, 428 St. Clair Street, TOLEDO, OHIO

Wireless Supplies and Electrical Novelties

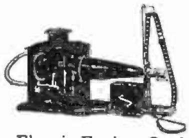
FOR HOLIDAY GIFTS



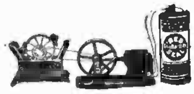
Combination pocket light and cigar lighter. The best metallic friction spark lighter on the market. Will last a lifetime. Press the button, the lid springs up, and the sparks from the "Ceric-Iron" pill ignite the wick. Unscrew valve and fill with 40 drops benzine, gasoline or alcohol which will last 8 days. Benzine preferred. Regular price $1.50.
Our price. By mail postpaid..........**95c**
Extra "Ceric-Iron" refill Pill..........**10c**



Nickel Tungsten Flashlight, with (new process) Merchlor Battery, and enameled Tungsten Bulb.
Price by mail postpaid...........**95c**
In silver finish................**$1.35**
In gold finish.................. **1.50**
Extra Battery (Merchlor)..........................**25c.**
Extra Tungsten Bulb (flat)..........................**35c.**

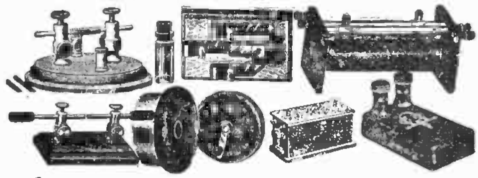


Acetylene Moving Picture Machine. Throws a 5x5 picture 20 feet. 500 candle power. Safer than kerosene oil. Regular price, $10.00.
Our price, with 5-ft. film.....**$4.35**

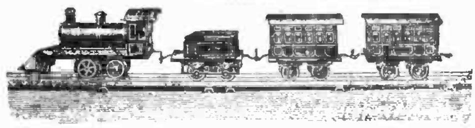


Electric Engine Outfit. Red Seal battery, engine and water bucket.
By Express.................**$ .95**
With extra piece of shafting and wind-mill added........**1.35**

We carry a complete stock of Wireless Goods, Flash Lights and Batteries, Tungsten and Carbon Battery Lamps, Telegraph Outfits, Motors, Engines, Trains, Toys, and Pocket Cigar Lighters.



Complete Wireless Outfit. Will receive 50 miles, and send two miles. Consisting of Auto Coherer, Receiver, Fixed Condenser, Double Slide Tuning Coil, 1 inch spark Coil, Rheostat Regulator, Key, Spark Gap, and 1 pound aluminum wire. Will operate on from 4 to 6 dry cells, and can be tuned perfectly. Regular price $11.50.
Special, by express.. **$9.35**



No. 2 Complete Electric Train Outfit, consisting of Locomotive, Tender, 2 trailers, and set of third rail track (2 straight and 4 curved). Will operate on 1 or 2 dry cells.
Holiday price, complete, by express **$1.65**
No. 9. Larger Locomotive with headlight, larger trailers, and 4 sections straight and 4 sections curved track. Price complete.....**$3.90**
Extra sections (1 foot) third rail track.................................**15**

Send 4c stamp for our Wireless Booklet and General Catalog of Electrical Novelties.

PRICES: Wireless Booklet, Net; Large Catalog, 20 per cent Discount.

ANDERSON LIGHT & SPECIALTY CO.
Known as LA SALLE LIGHT STORE
70 La Salle Street (Opposite the New City Hall), CHICAGO

They Last Longer

BECAUSE they are handmade, of **superior** materials, with greater carbon surface than used in ordinary tossed-together by machinery batteries,—

Rock Island DRY CELLS

have won **international** distinction as **dependable** batteries for **all** electrical purposes.

Price 25 cents

Battery Booklet N FREE. Write for it TODAY.

THE ROCK ISLAND BATTERY CO.
Winton Place Station,
CINCINNATI, OHIO

ENAMEL INSULATED — FRENCH *Feval* PROCESS — **MAGNET WIRE**

ENAMEL WIRE is supplanting silk and cotton covered because **The Insulation is better,** because **it requires less space,** because **It is cheaper.**

FEVAL WIRE has a dielectric strength in excess of 75 volts per .0001 inch of insulation. The evenly distributed enamel covering adheres tenaciously yet is resistant and elastic, never cracking. No change at 400° to 500° F. All sizes, Nos. 16 to 40.

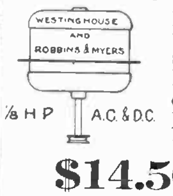
MANUFACTURERS: We have an attractive contract proposal to offer covering your requirements for 12 months.

INDIVIDUALS: We will furnish small quantities for spark coils and magnets.

FEVAL ENAMEL INSULATED WIRE CO.
129 N. Curtis Street CHICAGO

HALF PRICE—SMALL QUANTITY

SMALL MOTORS



Just right size for all household purposes or light mechanical work—Operate perfectly from any electric light socket—Absolutely dust proof — Operates either vertically or horizontally. First checks or postoffice orders for

$14.50 Get Them

State whether direct or alternating current, also voltage and cycles. Motors guaranteed in perfect running order. Address

THE W. H. HOOVER COMPANY
Dept. "M" **New Berlin, O.**

A Live Boy's Choice for Christmas

THORDARSON'S TOY TRANSFORMERS

Attach to any alternating current lamp socket and have a miniature Power Plant of your own. Operates any class of electrical toys, rings bells, lights small lamps and does any of the dozens of things you want to do. **Indestructible.** Besides the fun you get you learn the fundamental working principles of electricity—no more battery trouble. Show this to your father.

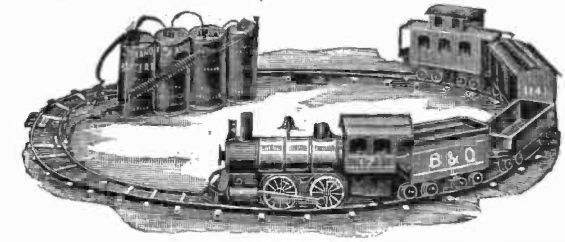
Write us for descriptive circular

Thordarson Electric Mfg. Company

220 So. Jefferson St., Chicago

ELECTRICAL TOYS FOR BOYS

SOME CHRISTMAS SUGGESTIONS } **SCIENTIFIC ELECTRICAL NOVELTIES** Practical, Complete, Durable, Harmless



EVERY boy in the country can easily *own* a railroad. Costs little and pays big dividends in fun. Our Models of **Locomotives, Trains, Trolley Cars, Dynamos, Lamps, etc.** are practicable and durable inventions. Equipped with dry batteries, no acids or liquids used, perfectly safe and harmless. Electrical toys instruct as well as amuse.

Catalog B, fully illustrated, quoting low prices—SENT FREE.

THE CARLISLE & FINCH CO.

264 E. Clifton Ave., Cincinnati, Ohio

Largest Manufacturers Electrical Novelties in the World.

Type M 1-15 H P Price $5.50

New Toy Motors For Boys

WITH ALL THE LATEST IMPROVEMENTS

WOUND FOR 110 VOLTS BOTH ALTERNATING AND DIRECT CURRENT

No more trouble or expense with batteries. Simply use an attachment cord connected to any lamp socket. The best motors made for operating mechanical toys, models, advertising devices, 8-inch fan blades, etc. No boy's experimental laboratory complete without one of these motors. ***Exact reproductions of large commercial motors*** beautifully finished in black enamel; brass parts polished.

TYPE C.	1-30 H. P.	WEIGHS	2 1-4 LBS.	$3.50
" D.	1-25 "	"	3 "	4.50
" M.	1-15 "	"	4 "	5.50

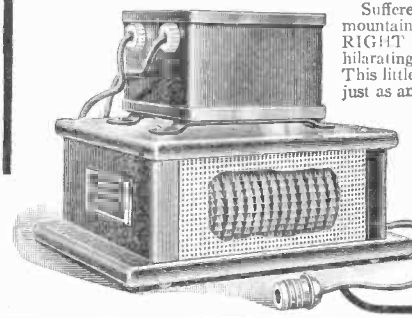
Type C. and D have field ring made in one piece. Type M. has laminated field and armature built of the best grade of electric sheet steel, 3-16-inch self-adjusting carbon brushes, mica insulated commutator, long bronze bearings, brass oilers, large brass pulley and brass terminals. This is the most efficient small motor on the market. Positively will not run hot.

Special for the Electrical Student—These motors complete, in parts, ready to assemble, with blue prints: Type C. $2. Type D. $2.50. Type M. $4.00 Special offer for a limited time only. A chance for the ambitious boy to perform numerous experiments to which he can point with pride and say: "I did it."

Send Express or P. O. Money Order

JOSEPH WEIDENHOFF, Manufacturer of Electrical Specialties, 1215 SOUTH ASHLAND AVENUE, CHICAGO

Let Electricity Make Pure Air for You



Sufferers from many ailments travel thousands of miles to breathe the OZONE of the mountains and pine forests. Yet a recent scientific invention enables everyone to have—RIGHT IN THEIR OWN BEDROOM—air constantly as pure, refreshing and exhilarating as the purest oxygen-filled atmosphere of the piny woods and mountain peaks. This little apparatus is operated by electricity and "ozonizes" the air of the closest room just as an electric storm purifies the out-door air. The

OZONE PURE AIRIFIER

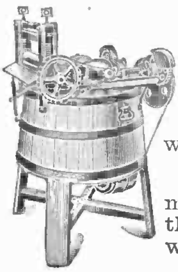
is of greatest benefit in the treatment of **Asthma, Hay Fever, Catarrh, Insomnia, Nervousness, Pneumonia, Typhoid and Scarlet Fevers, Diphtheria, Bronchitis, Tuberculosis, etc.** Endorsed by highest medical and scientific authoritiesa thoroughly tested and demonstrated success.

Central Station, Electric Jobber and Dealer, this is the latest Electrical Appliance on the market. Write now for illustrated catalogue, price list and descriptive matter and plan of placing for liberal trial.

We want distribution throughout the United States in Every Place Where Electrical Appliances are Sold.

OZONE PURE AIRIFIER COMPANY
307-314 Rand McNally Bldg. CHICAGO, ILL.

Back Gears Save Power Enough to Pay For It



The back gear drive of the Elmo Power Washer enables it to do a big washing with the same amount of power that ordinarily does a small washing.

It is like the muscular man who does twice or three times the work of a weak man.

The Elmo

has also a positive action wringer, an easy-opening lid, a protected motor. It is noiseless, strongly built, has cypress tub good for fifty years use, and will do a week's wash at an average cost of 1c. for power.

Write for booklet that tells the whole story of Elmo supremacy.

Grinnell Washing Machine Co.
Grinnell, Ia.

Canadian Trade Supplied by the Gem Motor Co., 419 Portage Ave., Winnipeg, Man.

Holiday Suggestions

Simplex Electric Chafing Dishes, Coffee Percolators and Dining-Room Sets, make unique and acceptable Holiday and Wedding gifts. Other seasonable suggestions are Water Cups, Toasters, Travellers' Stoves, Heating Pads, Baby Milk Warmers and Household Irons—packed in Holly Boxes. At your lighting company or dealers. Descriptive folders "P" on request.

Simplex Electric Heating Co.
CAMBRIDGE, MASS.

CHICAGO — Monadnock Block
SAN FRANCISCO — 612 Howard St.

BE CLEAN!!

YOU WANT

The "BEE" SUCTION CLEANER

BECAUSE

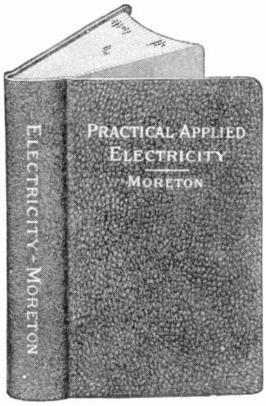
It costs only $65.00 with complete equipment
It weighs only 20 lbs. No jar or vibration
It equals the highest price machines in efficiency
Best work with the least effort
New and exclusive features

BIRTMAN ELECTRIC CO., CHICAGO, U.S.A.

AT LAST A GOOD ONE!
Practical Applied Electricity

By DAVID PENN MORETON, B. S., E. E.
Associate Professor of Electrical Engineering at Armour Institute of Technology.

....**Price $1.50 Postpaid**....



A new book from cover to cover. Just fresh from the press, 300 pages, 200 illustrations, diagrams and descriptions. Bound in Black Seal Flexible Leather, front and back stamped in gold; round corners, red edges, just fits the pocket. It is authentic, up-to-the-minute, complete and contains no useless matter. Just such information that will advance the Electrical worker in place and pay; intended for the practical man as well as the expert and presented in a practical way in plain English. Practical examples and careful, detailed line drawings are given to illustrate the theory and their solution is indicated.

Sold by Booksellers and Supply Houses Generally.

THE CHARLES C. THOMPSON CO.
PUBLISHERS
545-549 Wabash Avenue, Chicago

N. B. Advance orders may be placed for the new "mechanical-Electrical Vest Pocket Dictionary" by Prof. Moreton, 50 cents leather, 25 cents cloth. Ready soon.

The History of The Telephone

By HERBERT N. CASSON
Author of "The Romance of Steel," etc.

WHO can deny that a history of the rise of the telephone, through untold vicissitudes to its present commercial importance, and the financial support of over a billion dollars in the United States alone, to say nothing of the rest of the world, is interesting.

Yet in spite of our familiarity with this indispensable instrument, and our absolute dependence on it in many ways, how few of us know anything of its remarkable story.

Mr. Casson has a unique faculty of describing the evolution of commercial enterprises in such a way as to make his writing decidedly entertaining, and in **"The History of the Telephone"** he has produced a work that every one interested in electricity will find highly instructive as well.

Profusely illustrated. Cloth Bound, 299 Pages. Indexed. $1.50 net.

At All Bookstores
or from

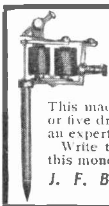
A. C. McCLURG & CO., Publishers
NEW YORK CHICAGO SAN FRANCISCO

LEARN TELEGRAPHY

Any one can learn to be a perfect telegraph operator in a few weeks. Send us sixty cents for our new Learners Telegraph. Set consisting of **KEY, SOUNDER, BATTERY** and complete instructions. This set is warranted to work as loud and clear as any commercial set. 500 feet on one dry cell. Dealers Write!

Send 3c in stamps for large catalogue of **WIRELESS APPARATUS.**

Franklin Electric Novelty & Mfg. Co.
BRANCH: Biloxi, Miss. 846 NINTH AVE., NEW YORK, N.Y.
Levey Electric Co., San Francisco, Cal., Western Agents



MAKE MONEY TATTOOING WITH AN
Electric Tattooing Machine

This machine can be operated on any 5-volt battery circuit (four or five dry cells give plenty of current) and anyone can become an expert at the art by using my machine and methods.

Write today—now—for particulars and information regarding this money-making proposition.

J. F. BARBER, 1019 VINE STREET, CINCINNATI, OHIO

BIG PROFITS
For Men of Moderate Means

THE NEW ADVERTIGRAPH

The ADVERTIGRAPH is an Automatic Advertising Stereopticon, showing advertisements brilliantly in Store, Show-window, Street or Theatre. Any man with $300 can double his money every month with the ADVERTIGRAPH, at odd times or evenings. No experience necessary—we tell you how. Write today for full information. Others do it—why don't you.

WILLIAMS, BROWN & EARLE, Inc., Dept. 43, 918 Chestnut St., Philadelphia, Pa.

Dieterich's 50 Perpetual Motions

With 100 Mechanical Movements
Books tell all about Perpetual Motion and how to obtain Patents
BY MAIL **25** CENTS STAMPS or SILVER
F. DIETERICH · 61 ··· OURAY · WASH · D · C ·

LANGDON MOORE

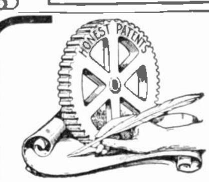
Counselor-at-Law and Patent Attorney

Patents, Trade-Marks, Designs and Copyrights

520 9th Street WASHINGTON, D. C.

Formerly Examiner U. S. Patent Office
SEND FOR BOOKLET C

PATENTS: A Talk to the Inventor



A book: tells what you should know before applying for patent—**Free.**

From a client: "I am very sorry that I have wasted two months' time with another firm." From another: "I have had one firm in Washington attend to my business up to this, but they do not seem to enter into matters with the same spirit (thoroughness) as you do." Names given on request.

I take your work seriously. Let me demonstrate this. Send sketch for advice.

H. L. WOODWARD, 726 9th Street, N. W. Opposite U. S. Patent Office, WASHINGTON, D. C.

Here is the way through

OUR **"Deferred Tuition Scholarship"** supplies the way and removes the last barrier between the progressive, ambitious young man and the higher position and salary to which he aspires.

Read every word of this offer. We mean it, and there is a fine chance for you if you improve it.

OPPORTUNITY COUPON

American School of Correspondence, Chicago, U. S. A.

Please send me your Bulletin and advise me how I can qualify for the position marked "X." Pop. Elect. 1-'11

....Book-keeper	....Draftsman
....Stenographer	....Architect
....Accountant	....Civil Engineer
....Cost Accountant	....Automobile Operator
....Systematizer	....Electrical Engineer
....Cert'f'd Public Acc't	....Mechanical Engineer
....Auditor	....Moving Picture Op'r
....Business Manager	....Steam Engineer
....Commercial Law	....Fire Insurance Eng'r
....College Preparatory	....Reclamation Engineer

NAME ....

ADDRESS ....

This country is full of energetic, capable men whose days are spent in work which is not suited to their natural talents. Thousands of these men realize that all that stands between them and good positions with big pay is their lack of special training in some one thing. They lack the time and the means to stop work and take a course of training, and so they go on year after year, always getting farther away from what they most want. We are going to help these men. We are going to lend them the cost of the training they need and let them make their own terms about repaying us.

This is the greatest offer ever made to men who have "got it in them to rise." We have studied the matter very carefully, and are fully prepared to help everyone who comes to us in earnest.

If you are one of these capable, ambitious fellows, willing to study for an hour every evening after working hours, willing to stick to it with the kind of persistence that wins, and without which nothing worth while is ever won; then you are on the right track.

Check the coupon, mail it to us, and we will explain fully our **"Deferred Tuition"** plan, how we will lend you the cost of the tuition, and allow you to pay us back when the increase in your yearly income equals the amount of the loan.

No Promotion—No Pay—that's what our **"Deferred Tuition"** scholarship means.

Ask for the little book, "Profitable Worldly Wisdom." It will be sent to you free and will help you.

AMERICAN SCHOOL of CORRESPONDENCE
CHICAGO, U. S. A.

$795

Buys the Material Needed to Build This Home!

Price Includes Blue Prints; Architect's Specifications; Full Details; Working Plans and Itemized List of Material.

OUR HOUSE DESIGN No. 131

Here is a handsome Colonial residence of eight rooms, bath, pantry and numerous closets. It is 28 feet square, not including porches; full two stories high, and provided with every modern labor-saving convenience. Every detail has been carefully worked out, so that the finished product shows a happy blending of the useful with the ornamental. If you intend to build it will pay you to investigate our offer. This house will please you. You will enjoy it while you use it, and when you are through with it you can easily sell it at a good profit.

We Save You Big Money on Lumber and Building Material!

The Chicago House Wrecking Co. is the largest concern in the world devoted to the sale of Lumber, Plumbing, Heating Apparatus and Building Material direct to the consumer. No one else can make you an offer like the one shown above. We propose to furnish you everything needed for the construction of this building except Plumbing, Heating and Masonry material. Write for exact details of what we furnish. It will be in accordance with our specifications, which are so clear that there will be no possible misunderstanding.

How We Operate

We purchase at Sheriffs' Sales, Receivers' Sales and Manufacturers' Sales, besides owning outright sawmills and lumber yards. Usually when you purchase your building material for the complete home shown above, elsewhere, it will cost you from 50 to 60 per cent more than we ask for it. By our "direct to you" methods we eliminate several middlemen's profits. We can prove this to you.

What Our Stock Consists of

We have everything needed in Building Material for a building of any sort. Lumber, Sash, Doors, Millwork, Structural Iron, Pipe, Valves and Fittings, Steel and Prepared Roofing. Our stock includes Dry Goods, Clothing, Furniture, Rugs, Groceries, etc., Machinery, Hardware, Wire Fencing—in fact, anything required to build or equip. Everything for the Home, the Office, the Factory or the Field, besides everything to wear or to eat. Send us your carpenter's or contractor's bill for our low estimate. We will prove our ability to save you money. WRITE US TODAY, giving a complete list of everything you need.

Free Book of Plans

We publish a handsome, illustrated book containing designs of Houses, Cottages, Bungalows, Barns, etc. We can furnish the material complete for any of these designs. This book is mailed free to those who correctly fill in the coupon below. Even if you have no immediate intention of building, we advise that you obtain a copy of our FREE BOOK OF PLANS. It's a valuable book.

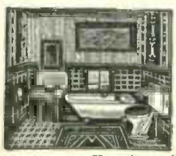
Our Guarantee

This company has a capital stock and surplus of over $1,000,000.00. We guarantee absolute satisfaction in every detail. If you buy any material from us not as represented, we will take it back at our freight expense and return your money. We recognize the virtue of a satisfied customer. We will in every instance "Make Good." Thousands of satisfied customers prove this. We refer you to any bank or banker anywhere. Look us up in the Mercantile Agencies. Ask any Express Company. Write to the publisher of this publication. Our responsibility is unquestioned.

$2.00 Buys a Complete Set of Blue Prints

We send you a set of plans for the house described above, including the necessary specifications and complete list of material, transportation charges prepaid, for the low cost of $2.00. This is only a deposit, a guarantee of good faith, and the proposition to you is that after receiving these blue prints, specifications and list of material, if you can place an order with us for complete bill of material, we will credit your account in full for the $2.00 received, or we will allow you to return these plans, specification and list of materials to us and we will refund $1.50, thereby making the total cost to you 50 cents.

High Grade Bathroom Outfits!



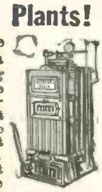
The price of this Bathroom Outfit $37.50. Plumbing material direct to you at Bargain prices. We have everything needed in Plumbing Material. Our prices mean a saving to you of 30 to 60 per cent. Here is an illustration of a bathroom outfit we are selling at $37.50. Your plumber would ask you about $60.00 for this same outfit. It is only one of many other complete outfits that we are offering at prices ranging from $25.00 to $50.00. Our catalog describes them in detail. Get our prices on Pipe and Fittings. Write us today.

Hot Air Furnaces!

Don't let the contract for your hot air furnace until you get our figures. We will cut your local dealer's price in half. We can furnish you a complete equipment including **pipes, registers, furnace;** everything required at a price not much more than what an ordinary heating stove would cost you. Complete hot air heating plants **$48.00 up. Get our heating catalog at once.** Tells you all about it. Write us today. We guarantee to save you money. We loan you tools. We make you plans. Every heating plant we sell is backed by our guarantee bond.

Hot Water Heating Plants!

We guarantee to save you 50 to 75 per cent on a modern hot water heating plant for your home. We make you complete plans and instructions, and help you out every way we possibly can. We loan you tools. Every plant backed by our guarantee bond. We furnish the material; you get the plant installed. **Cut out the local dealer's profit** and cut the cost in half. Thousands of our plants installed and working perfectly in every part of the country. **Write today for our Special Heating Catalog.** Tells all about our heating proposition. We can furnish Heating Apparatus for any building, no matter how large. Tell us your needs.



Water Supply Outfits

Modern Air Pressure Water Supply Systems at prices ranging from $48 to $200. They are strictly new, first-class and complete in every detail. It makes no difference whether you live in the country, you can enjoy every city comfort at little expense. Why not investigate this? We are ready to furnish you with all facts free of charge. All material fully guaranteed. We also have a complete stock of Pipe, Valves and Fittings at 40 to 60 per cent saving. Gasoline engines at low prices.

Free Publications

Write for our Free Catalog. Fill in the coupon to the right and we will send such literature as best suits your needs. We publish a 1000 page mammoth catalog fully illustrated, giving our business history and showing all the vast lines of merchandise that we have for sale. We buy our goods at Sheriffs', Receivers' and Manufacturers' Sales. Ask for Catalog No. 391. Our Book on Plumbing and Heating Apparatus contains 150 pages of useful information. Our free "Book of Plans" is described elsewhere in this advertisement.

CHICAGO HOUSE WRECKING CO., 35th and Iron Sts., Chicago

Send Us This Coupon

Chicago House Wrecking Co. 891

I saw this ad in Popular Electricity

I am interested in ________

Name ________

Town ________

Co. ________ State ________