

PRICE 10 CENTS

IN THIS ISSUE

The Search for Submarine Treasures
An Electrical Violinist

POPULAR ELECTRICITY

Trade Mark

IN PLAIN ENGLISH



ILLUMINATING THE INTERIOR OF THE SKULL

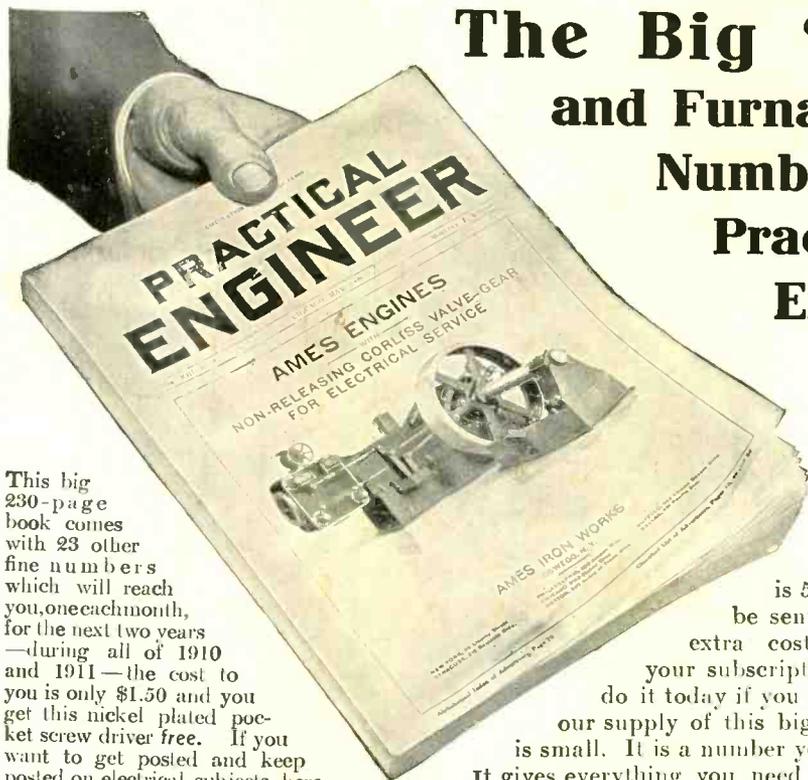


Vol. II.

FEBRUARY 1910

No. 10

The Big "Fuel and Furnace" Number of Practical Engineer is Out.



This big 230-page book comes with 23 other fine numbers which will reach you, one each month, for the next two years—during all of 1910 and 1911—the cost to you is only \$1.50 and you get this nickel plated pocket screw driver free. If you want to get posted and keep posted on electrical subjects, here is your chance. It means a steam and electric engineering magazine of authority reaching you each month—a big complete manual on Furnace Practice and a convenient pocket tool all for \$1.50. Your money will never again get you so much. Simply sign and tear out and return the attached coupon with your check, money order or \$1.50 cash, and you'll receive the Fuel and Furnace Number and Pocket Screw Driver by return mail. When you get them if you don't like them you can have your money back. During 1910 and 1911 the articles in each number of PRACTICAL ENGINEER on electrical matters will alone be worth to you far more than the \$1.50—many times more.

Get your copy now. Its price is 50 cents, but will be sent to you without extra cost if you mail us your subscription this month—do it today if you possibly can, for our supply of this big special number is small. It is a number you ought to have. It gives everything you need to know about Combustion, Fuels and Furnaces—packed full of practical, usable information that you can apply. Make this big fine number a permanent part of your engineering library. Nothing on the subject is so strictly up-to-date. Its carefully worked out tables will save hours of your valuable time and a lot of tedious figuring.



Feb.

Practical Engineer
359 Dearborn St.,
CHICAGO, ILL.

Tear out and send in the coupon today—with your \$1.50. Canadian Subscribers add one dollar extra for postage.

For the enclosed \$1.50, send me Practical Engineer for two years and include without cost, the big 230-page "Fuel and Furnace" number and the combination pocket screw driver, which I understand will be sent by return mail. I understand that my money will be cheerfully refunded if I'm not thoroughly satisfied with my bargain.

Practical Engineer

359 Dearborn St.
CHICAGO

Name.....
 Address.....
 City..... State.....
 Occupation.....

Cut out along this dotted line and mail today.

The Strongest and Easiest Way

To fasten things electrical,
is by the use of

STAR SCREW ANCHORS



Will positively resist any pull within reason. Easy to fasten your switch-boards and motors now. Simply insert shield in hole. Run screw through object to be fastened, on into shield in wall and fasten tight. The Anchor expands and the inner end grips hard and tight and can't be pulled out.

Samples and complete catalogue 10 will be mailed you upon request.

STAR EXPANSION BOLT CO.

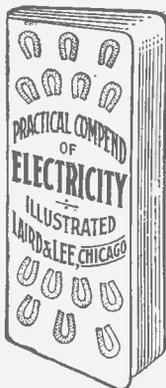
Catalogue Department 10
149 Cedar St., New York City

Only
25c

Postpaid

Special Stamped
Cloth Covers

Thorough
Instruction in
Theory
and
Application



Only
50c

Postpaid

Full Leather
Full Gilt

272 pages
Vest Pocket
Size
with 116
Illustrations

A wonderful, unique little work. Note a few of the press comments:

"A most remarkable book, the like of which has never been attempted before in this country or Europe."—*Philadelphia Item*.

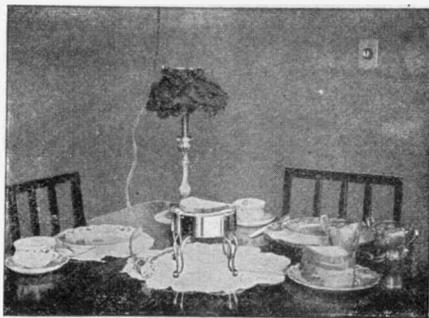
"Will prove of immense value to students of electricity and to all those interested in any way in penetrating into the mysteries of this strange force."—*St. Paul Globe*.

"The make-up of this very compact little work is especially pleasing. It will be found very convenient to the electrician or the student."—*Milwaukee Journal*.

"One of the most useful of Vest Pocket Reference Books is the 'COMPEND OF ELECTRICITY,' a desirable handbook for the student and the practical electrician."—*Chicago Evening Post*.

Send for a copy today

POPULAR ELECTRICITY BOOK DEPT.
Monadnock Block, Chicago, Ill.



Place the Electric TOASTOVE on your table—

A charm to every meal. It is so cheerful!
You cannot resist it.

The most fascinating application of Electricity. Simply connect to any lamp socket, snap the switch. The wonderful heating element glows— is radiant with incandescence! Its compelling attraction warms, delights every face centered around it.

A Hundred Happy Uses—

It makes toast, quickly, perfectly; serves all the purposes of a small, compact "stove," clean, simply operated; is readily movable, producing just the heat wanted in any part of the house, at any time; a joyful help in entertaining, unique, serviceable;—a need in your home.

And You Have This Definite Assurance—

Should a "burn-out" occur in the heating unit of a TOASTOVE within one year from date of purchase, while operating at the voltage for which designed, we guarantee to replace the entire device without charge.

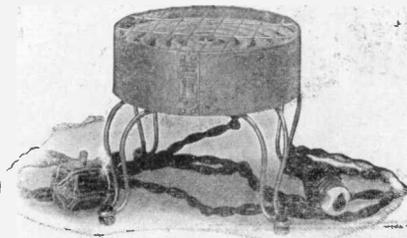
We will prepay the delivery charges right to your home for its net price of \$5.00.

Direct us Now

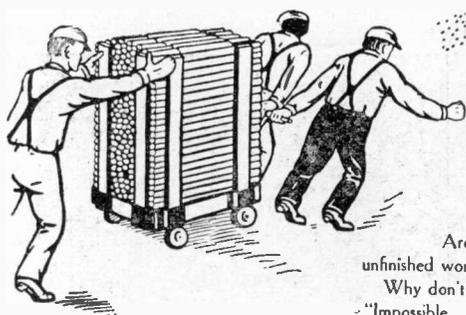
HOSKINS MANUFACTURING CO.

Electric Furnaces and Heating Appliances

463 Lawton Avenue, DETROIT



Sent Free on Request—a copy of our handsome descriptive booklet, "The Cheery Toastove"



How Much Does This Cost You?

Are you wasting valuable time and paying good money to have unfinished work hauled around your factory from one machine to another? Why don't you locate your machines where the work is? "Impossible," you say. "can't run line shafts and belts there."

That's the point exactly

Equip Your Machines with Fort Wayne Motors

and you can locate them anywhere

The chances are they will save from 35% to 50% of the power you are now wasting in transmission, and even more when only a part of your machines are running.

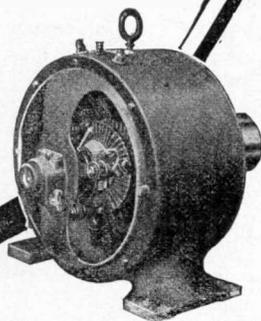
Dispense with an engineer, save floor space, get rid of the cumbersome shafting and belting, and pay for just the power you use.

You can save the price of the motors in a short time, and greatly increase the quantity and quality of your work.

BUT -- there's a big difference in motors and it will pay you to investigate our claims

FORT WAYNE ELECTRIC WORKS
1604 BROADWAY, FORT WAYNE, INDIANA

Factories: Fort Wayne, Indiana and Madison, Wisconsin
Branches: All Large Cities



Send Today for 24 page Bulletin "Motor Drives"

M 7

WIRELESS TELEGRAPHY MADE SIMPLE!



HERE'S THE ANSWER

To your "Wireless" Questions and by the best authorities on the subject.

Includes, in addition to "Wireless Telegraphy Made Simple," in five parts, by *Victor H. Laughter*, "Wireless Telephone Receivers" and "Construction of a Wireless Transformer," by *Alfred P. Morgan*, and "How to Make a Polarized Relay."

ALL FOR 25 CENTS

This entire series of articles appeared in issues of **Popular Electricity** now out of print. They contain just the information necessary for the construction and operation of simple wireless equipments, in plain, simple language within the comprehension of any amateur.

We have revised and printed them in book form, fully illustrated, with wiring diagrams and wireless codes, which will be immensely helpful to you in your work.

PRICE, ONLY 25c. PREPAID

The edition is limited, so send in your order at once.

POPULAR ELECTRICITY BOOK DEPT.,
MONADNOCK BLOCK, CHICAGO, ILL.

POPULAR ELECTRICITY

IN PLAIN ENGLISH

HENRY WALTER YOUNG, Editor

Vol. II

FEBRUARY, 1910

No. 10

CONTENTS

	Page		Page
THE NAVIGATING COMPASS. By Brother Potamian	631	A SIMPLE WIRELESS TELEPHONE SET—INDUCTIVE SYSTEM. By A. B. Cole	682
Frost and Fans in Show Windows	634	Intermountain Wireless Association	683
ILLUMINATING THE INTERIOR OF THE SKULL	634	WHAT ONE CAN DO OTHERS CAN DO	684
When Incandescent Lighting Reached Russia	634	Wave Length of Tuning Coil	685
CHARGING "ELECTRICS"	635	Condenser for Receiving Circuit	685
An Electrical Valentine	638	Tuning Coil; Condenser Capacity	686
ELEMENTARY ELECTRICITY. CHAPTER 22. By Prof. Edwin J. Houston	639	Long Distance Receiving and Transmitting	686
Count Zeppelin's Unique Gift	643	Marconi Receiving Set	686
THE LATEST WAY OF MILKING COWS	645	Wireless Telephone; Pan-Cake Tuner	686
Great Electrical Growth in the West	645	Connections of Receiving Station	687
TALKS WITH THE JUDGE	646	One-sixteenth inch Spark Coil	687
ELECTRIC LIGHT AND POWER FOR COUNTRY HOMES. Part 1. By Louis A. Pratt	648	U. S. A. Field Service Outfit	687
WHERE ELECTRICITY STANDS IN THE PRACTICE OF MEDICINE. CHAPTER 2. By Noble M. Eberhart, M. D.	652	Sending and Receiving Connections	687
A Radium Institute	657	QUESTIONS AND ANSWERS	688-693
AN ELECTRICAL VIOLINIST	658	Three Phase System	688
Oil Testing Centrifuge	659	D. C. Machines in Parallel	689
THE STORY OF A NEWSPAPER SCOOP	660	Moving Picture Arc Lamp Current from Two Sources	690
Unusual Application of Electro Magnets	662	Voltage Drop; Electroplating	690
What Happens on a Short Circuited Line	663	Rectifier; Arc Lamp Current; Dry Batteries; Bell Ringing Transformer	690
An X-Ray Proof Box	664	Lightning Arresters on Insulated Wires; Grounding Cable Sheaths and Messenger Wires	690
Time Service by Telephone Company	664	Alternating Current	691
Electrically Heated Oil Tempering Bath	665	Chemical Automatic Telegraph	691
THE SEARCH FOR SUBMARINE TREASURES. By B. Vorbin	666	Copper Plating on Carbon	691
Making Blue Prints by Arc Lamp	668	Bi-polar Motor; Spark Coil Secondary; Transformer Heating; Storage Battery Questions	692
Resistance, Current and Voltage	669	Armature Building; Winding a Tri-polar Armature	692
Suggestions Wanted	670	Bell Diagram	692
Christian Science Healing by Telephone	670	Dry Batteries and Lamps	693
Boiler Indicating System	671	Batteries and Small Lamps	693
Clock That Winds Itself	671	Antique Plating	693
Wall Paper Trimmer	671	Installation of a short three-instrument telephone line	693
ELECTRICITY IN THE HOUSEHOLD	672-675	Equalizer Connections on Generators	693
COOKING ON THE TABLE	672	NEW ELECTRICAL INVENTIONS	694
ONE DAY IN THE ELECTRIC HOUSE	674	Unique Magnetic Separator	694
JUNIOR SECTION	676-681	Protected Lamp Cable	694
AN ELECTRICAL LABORATORY FOR TWENTY-FIVE DOLLARS. PART II	676	Hot Box Alarm	694
By David P. Morrison	676	NOTES ON PATENT INFRINGEMENT. By Obed C. Billman	695
Electric Mouse Trap	680	Book Reviews	696
A "Fool Proof" Alarm Clock	681	ON POLYPHASE SUBJECTS	697
POPULAR ELECTRICITY WIRELESS CLUB	682-687	SHORT CIRCUITS	698-699
		ELECTRICAL DEFINITIONS	700

RENEWALS. When your subscription expires, you will find a renewal blank enclosed here. You should fill out and return the 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., Monadnock Block, Chicago, Ill.
YEARLY SUBSCRIPTION, \$1.00; CANADIAN, \$1.35; FOREIGN, \$1.50; SINGLE COPY, 10 GENTS

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.

Copyright 1910 by Popular Electricity Publishing Co.

Will You Give a Home Test to Johnson's Under-Lac At Our Expense



We want you to know Johnson's Under-Lac by actual proof and real test.

One trial will convince you how far superior it is to shellac or varnish.

How much simpler, more economical, easier and more satisfactory to apply.

Let us send you a bottle free and prepaid and our illustrated booklet "The Proper Treatment of Floors, Woodwork and Furniture" which answers every question on the care, preservation and beautifying of every wood surface—is full of valuable hints and helps on home decoration.

Johnson's Under-Lac

imparts a beautiful, brilliant and lasting finish to floors, woodwork and furniture—over surfaces being dressed for the first time, over dye stains, filler or the bare wood; over an old finish of any kind.

You know the fault of varnish. It is thick, sticky—dries slowly in a mottled way.

Under-Lac dries evenly and quickly—but not too quickly, like shellac, which laps and crawls and dries before it is well on. Under-Lac is thin, elastic—dries hard in half-an-hour. Use it for **any** purpose for which you would use shellac or varnish. Johnson's Under-Lac produces splendid **permanent** finish.

For Linoleum and Oil Cloth

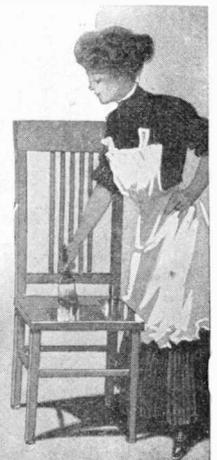
It brings out the pattern to best advantage, giving a finish as glossy as new; protects from wear and makes cleaning easy. The most economical because it goes farthest and lasts longest. Gallon cans \$2.50. Smaller cans down to half pints.

Write today for the samples and our book of Home-Beautifying Suggestions. Edition P. E. 2. Clip coupon, or take down address now.

S. C. Johnson & Son

Racine, Wisconsin

"The Wood Finishing Authorities"



S. C. Johnson & Son, Racine, Wisconsin

I accept your offer of a sample of Johnson's Under-Lac better than varnish or shellac, also booklet, Edition P. E. 2. I agree to test the sample and report results to you.

Name

Address

For our Mutual Advantage mention Popular Electricity when writing to Advertisers.

POPULAR ELECTRICITY



Come! Quick! Danger!

Are you prepared for this call—no matter from which department it comes? Just think what it would mean to have constantly at your elbow for consultation, an expert on the very problems that puzzle you. That's just what you would have in the

Cyclopedia of Applied Electricity

Six Big Volumes—Bound in Half Morocco—2,896 Pages 7x10 inches—printed on special paper in large, clear type—2,000 full page plates, diagrams, formulas, etc.

Written by thirty expert Electrical Engineers, the biggest men in the profession. It is a working guide for the student or practical electrician, or a ready reference work for the expert.

Examine These Books 5 Days at Our Expense

So confident are we that the books are just what you want, that we will send them to you by prepaid express—you keep the books 5 days—examine them carefully, test them, apply them to your every-day work. If satisfied that the books are the most complete and comprehensive work ever published on electricity, keep them, send \$2.00 within five days and \$2.00 a month until you have paid \$18.80, the special introductory price—the regular list price is \$36.00. If not suited to your needs, notify us. We will send for them at our expense. **Fill in and mail the coupon today—the books will be sent you at once.**

IMPORTANT SUBJECTS TREATED IN DETAIL

Electric Wiring—Electric Telegraph—Wireless Telegraphy—Telautograph—Theory, Calculation, Design and Construction of Generators and Motors—Types of Dynamos and Motors—Elevators—Direct Current Motors—Direct-Driven Machine Shop Tools—Electric Lighting—Electric Railways—Alternating Current Motors—Single Phase Electric Railway—Management of Dynamos and Motors—Power Stations—Central Station Engineering—Storage Batteries—Power Transmission—Alternating Current Machinery—Telephony—Automatic Telephone—Wireless Telegraphy—Telegraphone, etc.

Special Offer If You Mark and Mail Coupon Promptly

For a short time we will include, as a monthly supplement, for one year, the **TECHNICAL WORLD MAGAZINE**. This is a regular \$1.50 monthly, full of Twentieth Century Scientific facts, written in popular form. Also contains the latest discussions on timely topics of invention, discovery, industry, etc.

**AMERICAN SCHOOL OF CORRESPONDENCE
CHICAGO, U. S. A.**

FREE OFFER COUPON

P. E.
2-10
A. S. of C.
Please send me Cyclopedia of Applied Electricity for five days' free examination. Also T. W. for one year. I will send \$2.00 within five days and \$2.00 a month until I have paid \$18.80, or notify you and hold the books subject to your order. Title not to pass until fully paid.

Name
Address
Occupation
Employer.....

For our Mutual Advantage mention Popular Electricity when writing to Advertisers.

Help the Magazines get a "Square Deal"

Let every reader of POPULAR ELECTRICITY lend a hand to prevent contemplated legislation which if passed will increase the postage rates on all magazines and publications, aside from newspapers, to an almost unbearable degree. You are all magazine subscribers and if the tax upon magazines proposed by President Taft goes into effect it will seriously hamper the publisher in giving you biggest and best magazine for your money and at the same time will necessarily cause a general increase in the price of magazine subscriptions.

Some years ago Congress authorized the Post Office Department to carry all magazines through the mails at a uniform rate of one cent a pound. This was done for *your* benefit as readers not for *our* benefit as publishers. It was done to give you access to good literature at a moderate price—to encourage people to read.

Now it is shown that there is a deficit of \$17,000,000 in a year in the Post Office Department, which the President says is largely due to this one cent rate on second class matter. Consequently he wants the rate raised sufficiently to wipe out this deficit, which may amount from five to seven cents a pound additional.

It is true that the magazines themselves are carried at a loss but look at the profitable first-class mail business which they originate, which is money in the pocket of the Government. Look at the tons of letters that go back and forth between the publishers and their subscribers and patrons, look at the tons and tons of other letters which go between magazine advertisers and magazine readers.

The deficit due to magazine carrying is only an *apparent* deficit—money taken out of one pocket and put into another, so to speak.

Now as to what you can do: This matter is up before a committee in Congress. It must not be *pushed through* without public protest, for it is fundamentally wrong. To help prevent this unjust tax write (1) a postal today to Hon. J. W. Weeks, Chairman, House Postal Committee, Washington, D. C. Just say: "I wish respectfully to protest against any increase in the postage on periodicals." (2) Address a similar postal to your Congressman, Washington, D. C. (3) Get up a simple petition addressed to "The Honorable Senate and House of Representatives of the United States in Congress assembled," and send it to Washington with as many names attached as possible.

Do one or all of these things and do them *now*.

Remember this new tax is going to affect *you* in the end, for it would be a specific tax on each and every publication mailed and would be so burdensome that eventually the subscriber would be called upon to bear at least a large portion of it.

Popular Electricity Publishing Co.

POPULAR ELECTRICITY

Electric Light is Now Cheaper



By leaps and bounds that have amazed the commercial world, electric lighting has forged to the front. Introduced only thirty years ago, today one thousand millions of dollars are devoted to lighting this country by electricity. The latest electric lamp doubles the light efficiency of man's most useful servant—Electricity.

General Electric MAZDA LAMPS

The latest development in metal filament (tungsten) lamps give double the light for equal cost

You should now have electric light in your store because more people buy more in the pure-air bright-light store, you should have electric light in your home because now G. E. MAZDA lamps make it a low-cost luxury.

You should have electric light in your factory because workers work better in pure air under ample and steady light.

You should have electric light in your office because progress, health and economy all now demand it.

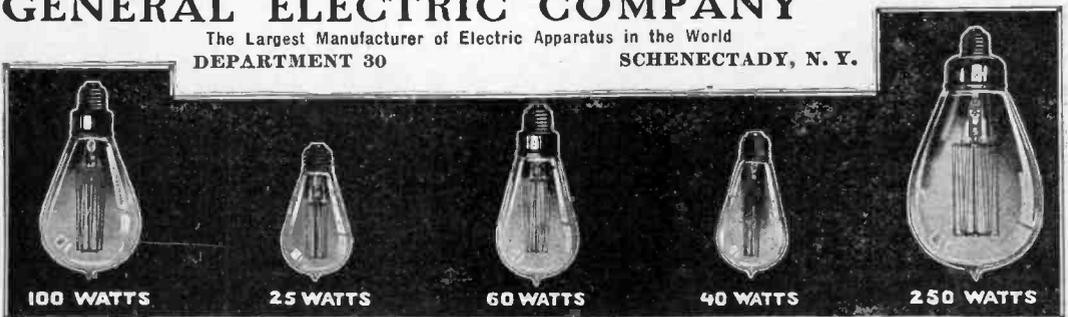
Ask Your Electric Light Man or Dealer

He will tell you the merits of G. E. MAZDA Lamps.

Call him up today for detailed information of cost and saving—or, write direct to us.

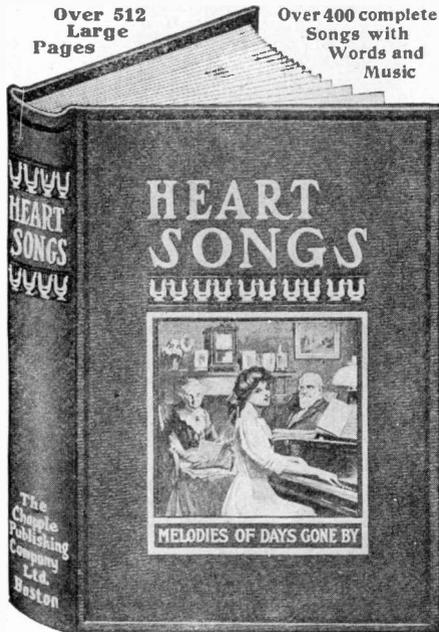
GENERAL ELECTRIC COMPANY

The Largest Manufacturer of Electric Apparatus in the World
DEPARTMENT 30 SCHENECTADY, N. Y.



For our Mutual Advantage mention Popular Electricity when writing to Advertisers.

Don't Buy this Book until You have Seen It



Of all new things the newest is "Heart Songs," companion volume to the world-famous "Heart Throbs," and yet it contains some of the oldest things in the world—the good, old, favorite songs and melodies that will never die. We haven't space to list its four hundred titles, but one thing is sure—that old song you've almost forgotten is there, words and music, to open up again the floodgates of memory.

"Heart Songs" is the only book in the world in which 25,000 music-loving people united in their selection of the "best" four hundred songs.

HERE IS OUR OFFER

HEART SONGS must be seen to be appreciated. If your book store does not have it fill in the coupon, giving name of your dealer, and we will send a book to you through him for your inspection. It costs us money to do this, but we have so much faith in the book itself that we know if this advertisement has interested you to the extent of asking us to let you see a copy, it will practically sell itself, and a lot more to your friends.

Handsomely bound in Gold and Garnet with illuminated cover. Price \$2.50 net

CHAPPLE PUBLISHING CO., Limited, Boston, Mass.

Kindly send me through.....
(dealer's name)

a copy of "Heart Songs" for inspection. If it fulfills the promise of your advertisement I want it.

Name.....
Address.....

If you prefer you can omit the dealer's name and enclose \$2.50 direct to us. We will return your money if the book is unsatisfactory.

What the New York Times Says About "Heart Songs":

"As might have been expected, the book contains nearly all the favorites of an earlier and less sophisticated generation. Old, yellowed sheets of music published before the war, and the songs of the war itself; love songs and college songs, and the hymns that are dear to a plain people were sent in by the contributors. Yet the proportion of music that is really good music is not small. The 'Tannhauser' song of the 'Evening Star' is sandwiched between Raymond's 'Take Me Home' and George Cooper's 'Sweet Genevieve.' The classics of popular song, from 'The Cannibals Are Coming' and 'Annie Laurie,' the folk songs that have withstood a sea change, the persistent airs of Michael William Balfe, are as inevitably in such a book as Stephen Foster's once-familiar tunes, and the old American love songs of the 'Bonny Eloise' and 'Juanita' type. Nobody would expect to miss here, of course, a single song of Franz Abt. They are all in evidence, including 'When the Swallows Home-ward Fly.' But Handel's 'Angels Ever Bright and Fair,' Mendelssohn's 'I Would That my Love,' Schubert's 'Sylvia' and the familiar setting of Ben Jonson's 'Drink to Me Only with 'Thine Eyes' are music of a different quality, music that no cultivation of the ear and the mind can ever banish to obscurity. Of course, we have the 'Lohengrin' bridal chorus, and Verdi's 'Trovatore' melodies, with adapted words. They are surely a long the popular songs. Sullivan, too, is largely represented, while the patriotic songs, the national hymns of various countries, the real darky songs and the imitations of black minstrelsy's palmy days are all here.

"There has been no attempt whatever at arrangement or classification. That was found impracticable. One may pick up the book at random and surely encounter an old friend by merely turning the page. Words and music alike are given, and it would be difficult to say what has been omitted. The range is large in date and quality. There are melodies whose origins are forgotten. There are songs of the present hour by Victor Herbert, 'Yankee Doodle' and 'The Star-Spangled Banner,' 'Kathleen Mavourneen' and 'Bohunkus' jostle each other, with the 'Ermeline' lullaby, 'When the Springtime Comes, Gentle Annie,' and 'I Lost My Money on a Bobtail Nag' close at hand. 'Barbara Allen' and 'Believe Me, If All Those Endearing Young Charms' are side by side. The book has a positive historical value."—*New York Times*, October 30, 1909.

What the People Who Have Bought "Heart Songs" Say:

These rare selections can spring from nothing short of soul depth. I hope they will spread as far as books can be made known.—*Guy Brink Morse*, Minneapolis, Minn.

Heart Songs received. I would say that I am very much pleased with same. I expect many hours of pleasure in reviewing some of the songs I hummed as a boy, forty to forty-five years ago. Heart Songs should be in all homes.—*E. G. Reid*, Boston, Mass.

Why do I like Heart Songs? Because there are songs in it that my grandfather used to sing—songs that I used to sing when a child with my father. My father had one of the sweetest voices I ever heard and I cannot keep the tears from falling when I hear the old songs.—*Mrs. M. Hubbard Fieldhouse*, Elkhart, Ind.

I think it is a grand book; a fine collection of dear old songs and hymns. Some are among the first I learned to sing, and some we used to sing in Sabbath school and in the schoolhouse. I think it is all we could desire in such a book, and I think they will make ideal Christmas presents.—*Mrs. A. T. Terry*, Iron-ton, Wis.

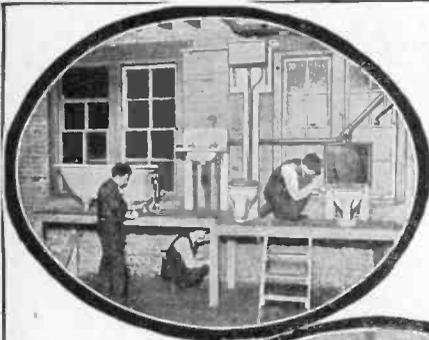
I cannot tell how much I appreciate the copy of Heart Songs I just received. I have glanced through it, and am certainly delighted to know that at last there is a book wherein one can practically find all the favorites, and in such a substantial form, too. As a friend and a Canadian I thank you for gathering this magnificent collection of gems.—*Louis E. Schwartz*, Literary Editor, The Berlin Daily Telegraph, Berlin, Ont.

Heart Songs, which must take its place in American musical literature, and which I prize most highly, is now with me, to hold and to keep.

Do you have time to think how many households are speaking in praise and thankfulness to you for the beautiful result of your patient, persistent, high-minded, extensive research and labor, real labor, in giving us our favorite songs in this most valuable collection under one cover? Now we have the dear old songs at hand. Books and books there may be, but only one Heart Songs.

Being a young enthusiast during the Civil War, there is no group of songs to fit all states of mind, in my view, as the war songs.—*Mrs. Louise M. Stewart*, Somerville, Mass.

Learn a Profitable Trade in a Practical Way



PLUMBING

Don't Spend 3 to 5 Years Learning a Trade

We Teach you Quickly and Thoroughly

We teach you more thoroughly and more accurately than the old apprentice system. Hundreds of satisfied money-making graduates who

Earn \$5.00 to \$8.00 Per Day

prove it. Our equipment and our methods are far ahead of any other institution in America. Our schools are open every working day in the year. You can enter any time. There is no age limit. We have students from 16 to 60. We have no classes—you get individual personal instruction. Tools and practical working ideas take the place of books. Drawing and estimating are included with each trade, and prepares the students for the best positions, or to start a business for themselves

Let us teach you *Plumbing, Electricity, Bricklaying* or *Mechanical Drafting* and assist you to a good paying position upon graduation.

No woman or machine can take your job in these trades. Now is the time to begin.

Sent FREE—Large illustrated Catalog giving full particulars of our entire instruction. Write for it today and start on the road to independence and a large income. Address me personally.

L. L. COOKE, Director
COYNE NATIONAL TRADE SCHOOLS
 1730 N. Ashland Ave., Cor. Wabansia Ave.
 CHICAGO, ILL.

It pays to learn a trade. The skilled worker is given preference everywhere and the man with a trade is independent for life. No trades will pay you as well as those of the

**Electrician
 Plumber
 Bricklayer
 and
 Mechanical
 Draftsman**

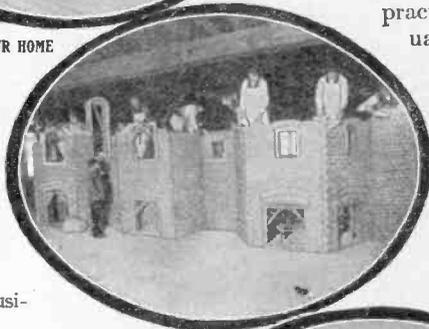
We teach these trades by practical, individual instruction under actual working conditions, and are the first and only schools that do it.



ELECTRICAL



OUR HOME



BRICKLAYING



DRAFTING

MAZDA LAMPS

For the purpose of ensuring that the incandescent lamps manufactured by them, respectively, shall have the advantage of the latest discoveries and inventions in the art, wherever made, the foremost lamp companies of America have made arrangements whereby the technical staff of the Research Laboratory of the General Electric Company, in collaboration with the technical staff of the National Electric Lamp Association and others, shall regularly follow the work which is being done in the factories and laboratories of the leading foreign and American lamp companies, and shall keep constantly informed as to the progress and development in methods and processes in each, distributing the information thereby secured to the lamp manufacturing companies enjoying the benefits of this arrangement, and selecting from all known materials and processes those best fitted for each different style and type of metal filament incandescent lamp made for or by the respective American companies.

For the purpose of identifying the lamps made in accordance with the information thus obtained, the Research Laboratory has adopted as a trade-mark the word

MAZDA

and its presence on any metal filament lamp evidences that the expert knowledge and selective skill of its technical staff entered into the production of that lamp and that the best materials and processes known to it as fitted for that type of lamp have been employed in its manufacture.

National Electric Lamp Association
CLEVELAND

THE MEMBER COMPANIES OF THE

National Electric Lamp Association

have an annual capacity of 50,000,000 incandescent lamps.

Their Aggregate manufacturing floor space exceeds 35 acres.

They employ 6,000 people.

They expend \$400,000 annually in Research, Development and Engineering.

They maintain the most extensive lamp testing facilities in the World by which their acknowledged supremacy in Lamp Quality is maintained.

They manufacture a more varied line of Incandescent lamps than any other interest in the world.

The Member Companies of the NATIONAL ELECTRIC LAMP ASSOCIATION were the

First to develop and place on the market a 40 watt Tungsten Lamp.

First to develop, demonstrate and put on the market the Tantalum Lamp for Street Railway Service.

First to develop and place on the market the 5 watt Tungsten Sign Lamp.

First to develop and place on the market Tungsten and Tantalum Lamps for Train Lighting Service.

First to develop and place on the market Tungsten Lamps for Automobile Service.

They now announce

THE MAZDA LAMP

These are a few of the latest achievements of the Member Companies; some of whose individual records date from the first commercial appearance of the incandescent lamp.



Co-Operation, Progress, Quality

POPULAR ELECTRICITY



Co-Operation, Progress, Quality

MAZDA LAMPS

The MAZDA lamps will be furnished by the following member companies of the

National Electric Lamp Association

- | | |
|--|---|
| The Banner Electric Company
Youngstown, Ohio | The General Inc. Lamp Company
Cleveland, Ohio |
| The Brilliant Electric Company
Cleveland, Ohio | Monarch Inc. Lamp Company
Chicago, Ill. |
| The Bryan-Marsh Company
Oakland, Cal.
New York City
Chicago, Ill. | The Munder Electric Company
Springfield, Mass. |
| The Buckeye Electric Company
Cleveland, Ohio | New York & Ohio Company
Warren, Ohio |
| The Buckeye Electric Lamp Co.
City of Mexico | The Shelby Electric Company
Shelby, Ohio |
| The Cleveland Minia. Lamp Co.
Cleveland, Ohio | The Standard Electrical Mfg. Co.
Warren, Ohio |
| The Colonial Electric Company
Warren, Ohio | The Sterling Electrical Mfg. Co.
Warren, Ohio |
| The Columbia Inc. Lamp Company
St. Louis, Mo. | The Sunbeam Inc. Lamp Company
Chicago, Ill.
New York City |
| Economical Electric Lamp Company
New York City | The Sunbeam Inc. Lamp Company
of Canada, Ltd.
Toronto, Ont., Can. |
| The Fostoria Inc. Lamp Company
Fostoria, Ohio | The Warren Elec. & Spec. Company
Warren, Ohio |

For our Mutual Advantage mention Popular Electricity when writing to Advertisers.

FEDERAL ELECTRIC COMPANY



Federal Couch Bracket

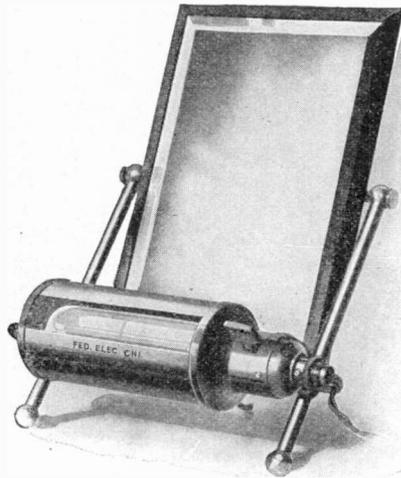
A portable reading lamp for table or desk. Can be hooked over head of bed by adjustable handle for reading at night. Handsomely finished in antique Brass.

Price Complete - Each, \$4.50

Federal Shaving Mirror

For men who shave themselves. Throws strong light on face below the eyes, relieving the eyes of strain and making a quick shave possible.

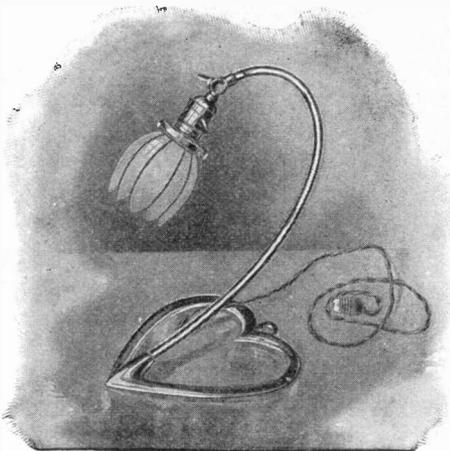
Price Complete - - Each, \$3.75



Old Vienna Portable Electrolier

An artistic lamp which can be used on the table or hung on the wall. Its graceful proportions and lines make it harmonize with any furnishings. Low priced and convenient.

Price Complete - Each, \$3.75

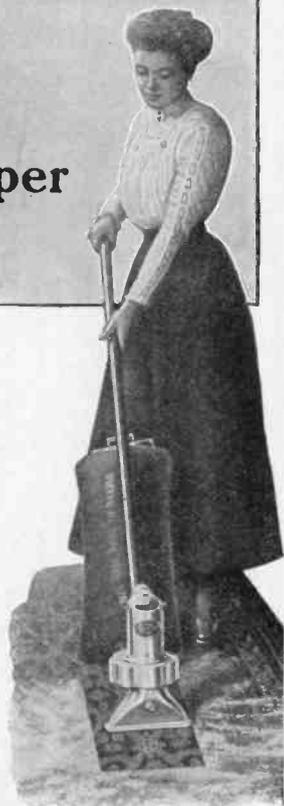


Buy of Your Dealer or Write Us Direct

Federal Electric Company

Lake and Desplaines Streets, Chicago

One Dollar Puts the **"RICHMOND"** Suction Sweeper in Your Home



You see here an electric suction sweeper which weighs but *ten* pounds—instead of sixty.

All that any vacuum cleaner or suction sweeper can do, this one does.

And it does, besides, some things which no other machine can do.

You can, for example, use this **"RICHMOND"** Suction Sweeper either *with*, or *without* the hose.

For Hair Drying

Also a special attachment for hair-drying, pillow renovating, etc.

The hose attachment slides on and off with the same ease that your foot slides into an easy slipper.

Slip on the hose and you have a machine that cleans everything, for we furnish, without extra cost, special tools for cleaning portieres, walls, books, bedding, upholstery, clothing, hats.

Slip off the hose, and you have a floor machine which weighs two pounds less than an ordinary carpet sweeper—and glides over the floor more lightly, more easily than even the lightest carpet sweeper.

But light weight and easy operation are but two of the "Richmond's" exclusive superiorities. There are many more.

There is, for example, the vibrating brush, *which you find in no other machine.*

This brush fits in the floor nozzle of the **"RICHMOND"**. It vibrates at the rate of 10,000 times a minute. Not a rotary motion to wear out the carpet, but a light up-and-down *tapping* motion.

Taps Out The Dirt

The vibrating brush taps the caked dirt out of the carpets and fabrics which no other machine could clean.

The brush slips in or out, without the use of tools. It is but the work of ten-seconds to take it out or put it in.

And without the brush the **"RICHMOND"** will do all that any machine—vacuum or suction—can possibly do without working injury to even the finest fabrics.

Points about the **"RICHMOND"**

- costs less per month for electricity than the average family spends for brooms.
- after a year of consistent use you couldn't find a thimbleful of dirt in a fourteen-room house if you took all the carpets up.
- no more spring or fall "house cleanings"—no more "sweeping days"—no more "dusty Fridays."
- its total cost is less than the cost of one single annual house-cleaning—to say nothing of saving the wear and tear which house-cleaning brings to furniture.
- cleans furniture, walls, upholstery, bedding, clothing, decorations, bookshelves, tile floors, hardwood floors, nooks and crannies, as well as making old carpets look like new.
- equally valuable in homes, offices, stores, hotels, hospitals, libraries, schools, churches, theatres, public buildings.
- without any change or adjustment, uses either direct or alternating current; universal motor of our own construction.
- thirty feet of electrical cord, with connecting socket, comes with the sweeper—everything ready to start—any one can do it.
- handsome in appearance—all exposed parts are highly polished—operates with easy gliding motion, no pressure required.
- absolutely guaranteed for one year, and without abuse should last as long as a watch.
- One Dollar brings it—you pay the balance out of the month-to-month money it saves you.

DISCOUNT COUPON

THE McCRUM-HOWELL CO., P. E.
Park Avenue & 41st St., New York

I enclose \$65.00 in full payment of one "RICHMOND" Suction Sweeper, including hose attachment and seven special tools, upon the distinct understanding that if, after a ten days trial I find your machine not so good as you represent it to be, I agree to return it at your expense, and you are to refund my \$65.00 in full.

Name _____
Address _____
Name of Electric Light Company _____

DOLLAR COUPON

THE McCRUM-HOWELL CO., P. E.
Park Avenue & 41st St., New York

I hereby order one "RICHMOND" Suction Sweeper, complete, with hose attachment and seven special tools, for which I agree to pay to your order \$1.00 herewith, and \$8.00 per month for twelve consecutive months. Title to be given me when full amount is paid.

Name _____
Address _____
Name of Electric Light Company _____

THE McCRUM-HOWELL Co.

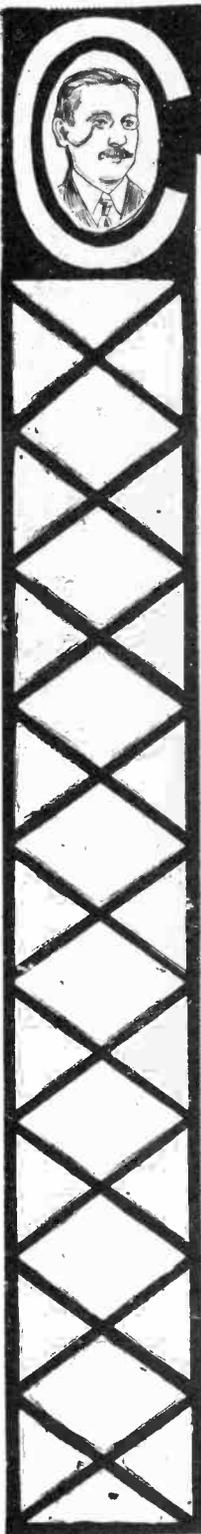
Manufacturers of

"RICHMOND" Heating Systems, **"RICHMOND"** Enameled Ware, **"RICHMOND"** Household Utensils

Two Factories at Uniontown, Pa.—One at Norwich, Conn.—One at Racine, Wis.

General Office : Park Avenue and 41st Street, New York

For our Mutual Advantage mention Popular Electricity when writing to Advertisers.



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

ELECTRICITY

By

SAM DAVIS

Many persons who have heard about the old Western mining-camp dance-hall sign; "Do not shoot the piano player; he is doing the best he can," do not know that this world-traveled joke is the product of Sam Davis, a Nevada humorist. Curiously enough, many who know him as a humorist are not aware of the fact that he can thrill with majestic English as easily as he can amuse with lighter words or move to grief with darker tones. Yet such is the fact, proof of which is afforded in the following speech which Mr. Davis delivered in Virginia City, Nevada, a few years ago, at a banquet held to celebrate the introduction of electric power in the Comstock mines.

BORN from nothing, it leaps into existence with the full-fledged strength of a giant, dies, is born again; lives a thousand lives and dies a thousand deaths in a single pulsating second of time.

It soars to every height, plunges to every depth, and stretches its vast arms throughout illimitable space.

It plants the first blush upon the cheek of dawn; with brush of gold upon the glowing canvas of the West, it tells the story of the dying day.

At its mere whim and caprice, a thousand pillars of light leap from the dark and sullen seas which surge about the poles, while from its shivering loom it weaves the opalescent tapestry of the Aurora to hang against the black background of the Arctic night.

It rouses Nature from her winter sleep, breaks the icy fetters of the frost that binds the streams, lifts the shroud of snow from off the landscape, woos the tender mold and bids the birth of bud and blossom; dowers the flower with perfume and clothes the earth with verdure of the spring.

It rides the swift courses of the storms that circle round the bald crest of old Mount Davidson; cleaves the black curtain of the night with simular of flame; rouses the lightnings from their couch of clouds and wakes the earthquake.

Beneath its touch, the beetling crag, which took Omnipotence a thousand years to rear, crumbles into dust, the mere plaything of the idle wind; and yesterday, where stood the glittering spire, the shining tower, the frowning battlement, today the cold gray ocean rolls in undisputed might.

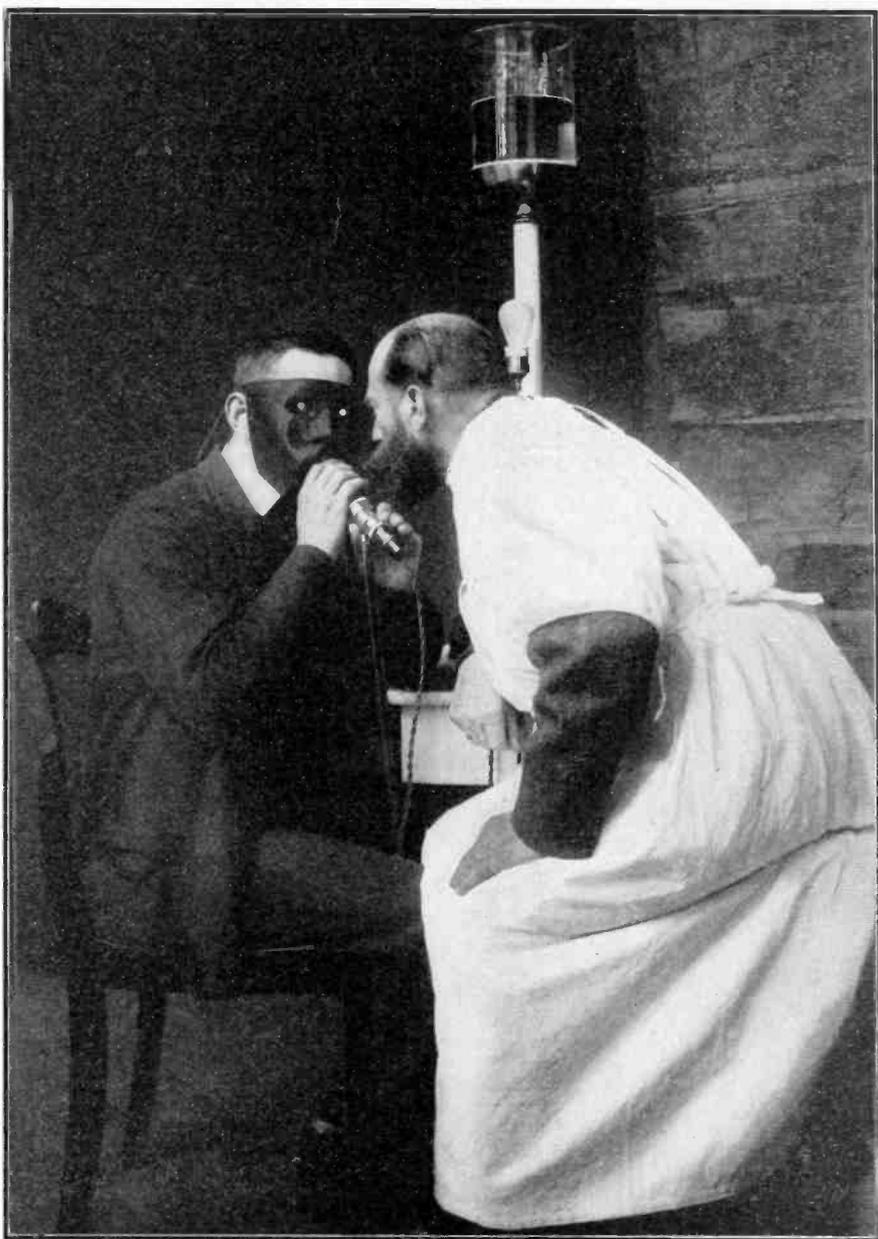
It gathers the doings of the day from the four corners of the world, the tales of love and death, of fire and flood, of strife and pestilence, and under 8,000 miles of shivering sea, whispers the babble of two hemispheres.

It turns the wheels of peace where poor men toil, and helps the husbandman to plow and plant and reap his whispering grain.

It rides the wings of war where brave men die; and when it stalks between contending hosts, exalts the kingly crest and helps an empire plant its flag of conquest.

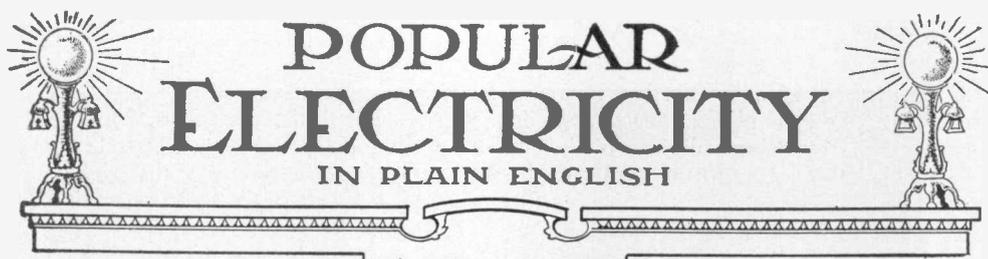
It glows in lonely attics where weary workers toil to earn their crust. It shines o'er scenes where feet of feasters tread the halls of revelry. It lights the mourners on their pathway to the tomb. It glares in haunts where jeweled fingers lift the cup of pleasure to the mouth of sin, 'mid the sobbing of sensuous music and flow of forbidden wine; and speeding on its way, illumines the dim cathedral aisle, where surpliced priest proclaims the teachings of the Master, and golden-throated choirs lift their Hosannas to the King of Kings.

It was the Maker's ally at the dawn of Time, and when God from the depths of infinite space, said "Let there be light," it sent the pulse of life along Creation's veins, baptized Earth's cold brow with floods of fire, and stood the sponsor of a cradled world.—*From the Live Wire.*



ILLUMINATING THE INTERIOR OF THE SKULL

(See Page 634)



VOL. II

FEBRUARY 1910

No. 10

The Navigating Compass

By BROTHER POTAMIAN, D. SC., London, Professor of Physics in
Manhattan College, New York

The compass came into use for navigating purposes towards the middle of the Thirteenth Century mainly through the fine magnetic work accomplished by a Frenchman, one Pierre de Maricourt, better known as Petrus Peregrinus, or Peter the Pilgrim. He derived his title of Pilgrim from the fact that he made a pilgrimage to the Holy Land, doubtless as member of one of the crusading expeditions of the time. He was a man of uncommon ability and brilliant originality who made discovery after discovery in the domain of magnetism, describing its phenomena, laying down its laws and placing it for all time on the solid basis of observation and experiment.

Having outlined on paper what he deemed a perpetual-motion machine consisting of a wheel with magnets to supply the driving-power, he wrote to a friend of his in Picardy to inform him of the invention giving at the same time certain details necessary for its construction. Peregrinus was prevented from testing his views on the magnetic motor by being away from home while serving as military engineer with the French forces then (1269) encamped before the revolted city of Lucera in southern Italy. It is unfortunate that he had neither the time nor the tools necessary to construct his machine, as he would have certainly recognized and proclaimed to the world the delusive character of perpetual motion and thereby saved both labor and money of other pursuers of this will-o-the-wisp for better investment.

That his friend might the better understand the mechanism of the wheel, Peregrinus described in a systematic manner the various properties of the lodestone, all of which he had investigated and many of which he had discovered. This letter of his, written in the camp before Lucera and entitled *Epistola de Magnete* (Letter on the Magnet) is, therefore, the earliest regular treatise in any language on the magnet. It stands out prominently as the first great landmark in magnetic philosophy, the second being Gilbert's "*De Magnete*" (On the Magnet) published in the year 1600. Both these works have been translated into English within the last few years.

In one of the thirteen chapters into which the "Letter" is divided, the author describes the compass which he devised and in which the needle is supported on a double pivot as shown in Fig. 1. It will be observed that the magnet is thrust through a wooden upright, while at right angles to it is added a pointer of non-magnetic material, brass or silver. Fig. 2 shows the pivoted compass as well as a light movable bar with a pair of terminal pins for the purpose of sighting an object in the horizon and recording its position by means of a circle divided into 360 degrees. This is the earliest pivoted compass known, the prototype of all others; and as such, is of special interest. Figs. 1 and 2 do not appear in the "Letter" of Peregrinus but are drawn according to the description therein given.

It is evident that the compass of Peregrinus would have been more sensitive if the needle had been supported on one point only rather than on two. It is likely that Flavio Gioja, the Italian pilot, simplified the compass in the year 1302 by using only one pivot and by attaching the needle to the card with its thirty-two divisions.

To be sensitive and respond promptly to changing magnetic conditions, it is necessary that the needle and card should be as light as is consistent with the practical conditions of construction. Lord Kelvin in our own day gave this matter much consideration with the result that we have in the Kelvin compass an instrument which is the joy of every navigating officer.

In this compass as usually constructed, there are four strongly magnetized needles arranged in two sets placed respectively to the right and the left of the north-

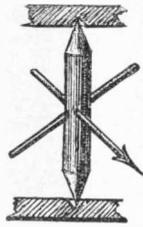


FIG. 1. THE FIRST PIVOTED NEEDLE (1269)

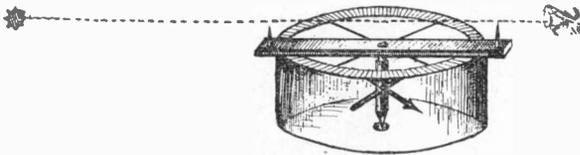


FIG. 2. THE FIRST PIVOTED COMPASS (1269)

and-south-line and enclosed and sealed in very light brass tubes shown in Fig. 3. To diminish the pressure on the pivot and thereby augment the sensitiveness of the instrument, the light, brass "card" with its magnetic outfit is immersed in a liquid consisting of 45 per cent of alcohol and 55 per cent of water. The liquid serves not only the purpose of buoyancy but also that of steadiness, which is an important matter when a ship is rolling or tossing in the trough of the sea; it also renders all motions of the "card" smooth and easy; and, at the same time, saves the pivot and sapphire cap from injury by concussion which might frequently occur.

As to the direction in which the needle points, there was considerable diversity of opinion in the Thirteenth and subsequent centuries. Some said that it pointed to the pole star, while others held that it was con-

trolled by magnetic mountains located near the poles of the earth.

When the pilots of Columbus came to notice that the needles of the "Santa Maria" veered away to the West instead of standing true to the pole, they grew alarmed believing that the laws of nature were changing as they advanced over the trackless ocean into the unknown. The moment was a trying and dangerous one for the great Admiral; but his ingenuity and tactfulness rose to the occasion. He told his seamen that the needle did not point to the "Cynosure" (Polaris) or last star in the tail of the Little Bear as commonly supposed, but to a point in the heavens at which there was no star and around which the "Cynosure" itself and all other stars regularly revolved. The esteem in which Columbus was held by his men on account of his knowledge of astronomy and cosmography led them to accept the proffered explanation; their fear was allayed and the westering of the compass needles of the caravels bothered them no more.

When Columbus returned to Spain, he did not fail to report the strange behavior of his compass, when to his surprise, he met with nothing but incredulity, the learned ones of the day declaring that *he* was in error and not the compass, because the latter was everywhere true to the pole.

Even Gilbert, the philosopher of Colchester, (England) who published his great

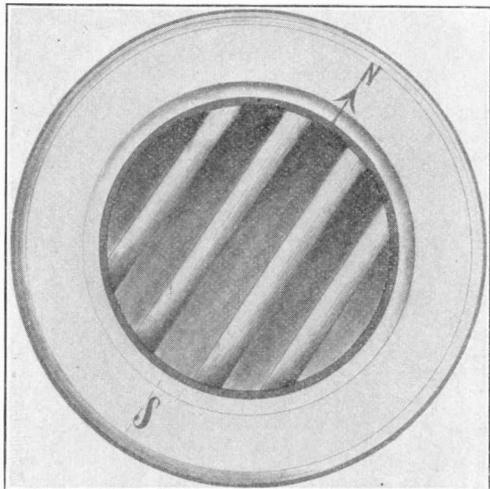


FIG. 3. THE PRESENT KELVIN COMPASS

work on the magnet in the century year 1600 believed in this fidelity of the needle to the pole because he allowed himself to acquire the conviction that the magnetic pole of the earth coincides with the geographical pole, the pole of rotation.

It was this Gilbert (1544-1603) who showed that the controlling influence on the compass needle is not in the pole-star or in any of the constellations, that it is not in the heavens above but in the earth itself. He attributed the magnetic condition of the earth to the masses of lodestone contained in its crust to which may be added that this condition also arises from currents of electricity flowing in the earth from east to west arising from the heating action of the sun.

As the vertical circle passing through the geographical poles and the place of an observer is called the geographical meridian, so the vertical circle passing through the poles of a compass-needle determines the magnetic meridian of the place. In few, very few places do these two meridians coincide; whence it follows that in very few places does the needle stand true to the pole, the couplet of the poet to the contrary notwithstanding—

So turns the faithful needle to the pole
Though mountains rise between and oceans roll.

In New York, the needle points nine degrees west of true north; while in San Francisco, it points 16 degrees east. This departure from true orientation is technically called "magnetic declination." Popularly it is known as the "variation of the compass." It is clear that a surveyor who wants to register the true bearing of an object or a navigating officer who wants to set his course must know the amplitude of this variation. Its value has been determined for a great many places in the United States by the Coast and Geodetic Survey; for the purposes of navigation, charts have also been prepared for a number of places on the Atlantic, Pacific and other oceans, copies of which are to be found in the chart-room of every ship.

As this variation of the compass changes with time, its value has to be determined at intervals and new charts prepared. Just now, we have a non-magnetic yacht, the "Carnegie," out on the work with an able body of expert observers under the general direction of Dr. Louis A. Bauer, Director of the Department of Terrestrial Magnetism,

Carnegie Institution, Washington. Numerous determinations have already been made and reported along the route in the North Atlantic followed by our fast liners to Europe showing that the corrections required do not, in general, exceed one degree. A result has just been announced which is of great importance to the navigators of vessels on this part of the ocean highway, viz., that in steaming from Europe to the neighborhood of Sable Island with the compass as sole guide, a ship would be about 30 miles too far north of her regular course, so that if the oceanic currents encountered happened to set in in the same direction, the vessel would be exposed to shipwreck. From Sable Island to New York, the chart errors are reversed in sign in which case the vessel would be put out of her true course in a southerly direction.

As already said, the "Carnegie" is built of non-magnetic materials, the gas-engine used when the sails are inefficient being made of manganese-bronze.

A similarly built and equipped yacht the "Galilee" was used in recent years for the magnetic survey of the Pacific Ocean.

It has been noticed by all Arctic explorers that the compass becomes more and more sluggish in its action the nearer it is to the magnetic pole. This is accounted for by saying that the part of the earth's directive force which controls the needle, the horizontal component as it is called, becomes less and less as we approach the magnetic pole, at which place it vanishes altogether. This may be made clear by the following analogy: Suppose you drive a peg in the earth to represent the magnetic pole. Attach a long rope to the peg and pull on the end. The force which you exert is nearly horizontal and is the same as the force which would turn the needle. Then draw up hand over hand on the rope. The horizontal pull becomes less and less, and when you are immediately over the peg the horizontal force has all disappeared and the pull is all vertical. Vertical pull will not turn a magnet needle, but only makes it press more heavily on its bearing.

In his account of magnetic work carried on in the vicinity of the magnetic pole a few years ago, Captain Roald Amundsen, the Norwegian explorer and discoverer of the North West Passage, wrote: "At Prescott Island, the compass which for

some time had been somewhat sluggish, refused entirely to act, and we could as well have used a stick to steer with."

Since the directive force on a compass-needle vanishes entirely at the magnetic pole, it follows that the needle will remain indifferently in any position in which it is placed; you may turn it to the East or the West and it will point accordingly.

If you are east of the magnetic pole, the needle will point west; if at a station west of the pole, the needle will point east. If, on the other hand, you go up to a latitude higher than that of the pole (70° N.), the needle will point south, from which it follows that the compass is of little use in the Arctic Highlands or in circumpolar exploration generally.

In aerial navigation, however, the compass is serviceable if kept away from masses of iron; the same is true in mines of coal, salt or silver as well as in submarine boats. On shipboard, the standard compass by which the steering compasses are corrected, is always placed aloft and away from smokestacks, iron masts, machinery, dynamos and motors.

Frost and Fans in Show Windows

During the last month the writer, who is an electrical inspector, has had occasion to inspect something like 400 show windows in various stores and shops. In cold weather these windows, especially if open into the store, are often coated upon the inside with frost. Just as a pitcher containing ice water will in summer condense moisture from the air and "sweat," as we call it, so warm air from the store will come in contact with the glass which is chilled by the outside air, and give up its moisture, which forms frost. To avoid this an electric fan is indispensable. By its use the air is kept in motion and the interior of the window is warm and dry. If the window is enclosed, frost will gather only during the coldest weather, because the temperature within the window is nearly the same as that of the outside air. At times, even in this class of window, the electric fan is effective in clearing the frost from the glass. Portable fans for this purpose should be equipped with reinforced cord rather than with the ordinary drop cord very frequently used.

Illuminating the Interior of the Skull

A German scientist, Dr. Carl Hertzell of Berlin, has recently devised an electrically operated Ophtho-diaphanoscope, as he calls it, for illuminating the retina of the eye from the back so that a surgeon may examine the eye from the front, the lighting being accomplished by the patient holding a high candle power electric lamp in his mouth.

The frontispiece illustrates a special form of electric lamp used and shows the inventor in the act of examining a patient's eye with the apparatus. The examination must be made in a dark room.

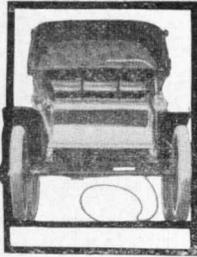
The back of the human eye is examined by this equipment to far greater advantage than is possible by means of an eye mirror and reflected light, as the retina of the eye may be illuminated from the back by an electric lamp of as high as 80 candle power without discomfort to the patient, who wears a black mask over his face.

A system of water cooling is employed for the electric lamp, this being necessary on account of the large amount of heat generated in producing this intense light. A water jacket is provided over the lamp and the circulating cooling water is stored in a glass tank mounted on the top of a column from which the cooling liquid is conducted by an auxiliary flexible tube into the lamp cooling chamber, a waste tube carrying away the heated water.

An electrically operated signal is provided which shows when the cooling water has been exhausted from the upper tank, an electric lamp being lighted when the cooling stream ceases to flow, lighting the chamber which is darkened while the observations are being made by the surgeons.

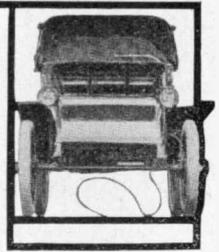
When Incandescent Lighting Reached Russia

By 1883 Edison's incandescent lighting system had spread to far points of the world. At the coronation in Moscow the illuminations were as follows: the Tower of Ivan the Terrible and its side galleries were lighted with 3,500 small Edison lamps supplied by dynamos and portable engines located on the opposite shore of the Moskwa. This portable plant was connected with the tower by 70 overhead lines.



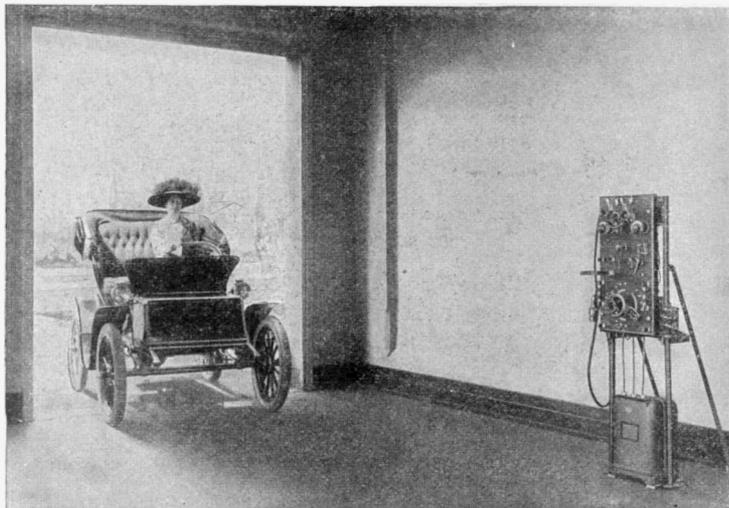
Charging "Electrics"

Showing the simplicity of the process of charging vehicle batteries



Without question the electric automobile possesses advantages which are paramount in a particular field—that is, a field where simplicity, cleanliness and ease of operation are most to be desired. The question however arises in the minds of many who are contemplating the purchase of an electric: "How shall I charge my automobile batteries?" They are under the impression that this is an operation which requires a considerable knowledge of electricity and is

illustrations, procured through the courtesy of the General Electric Company, what a simple matter it is, for a woman even, who is not supposed to know a great deal about volts and amperes, to recharge the batteries of her electric vehicle. Suffice it to say that the mercury arc rectifier consists essentially of a mercury vapor tube something like the tube of a Cooper Hewitt mercury vapor lamp which gives that peculiar ghastly greenish light. The rectifier tube has special ter-



YOU ENTER THE GARAGE WITH YOUR MACHINE

not to be attempted by other than an electrician. On the contrary, however, any one may learn to do it after one demonstration, and right in the home garage at that.

The mercury arc rectifier system of battery charging is simplicity itself and is used wherever alternating current is available. As alternating current is used almost entirely in the residence portions of any city it is the only kind with which we need concern ourselves.

It is not the object of this article to describe minutely the working of the mercury arc rectifier, but to show by the series of

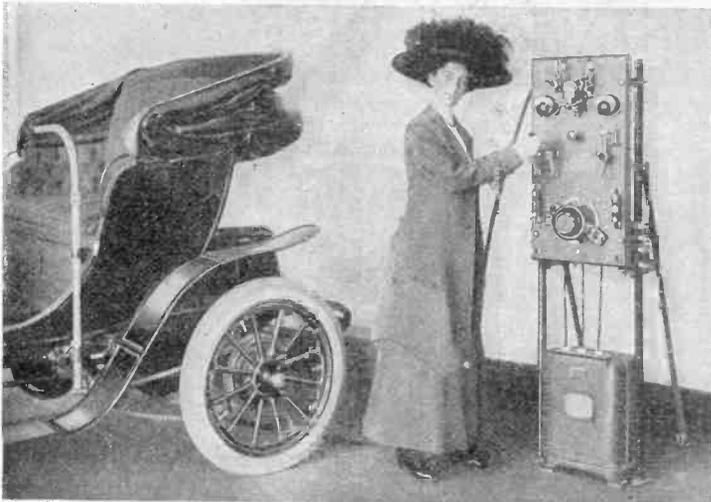
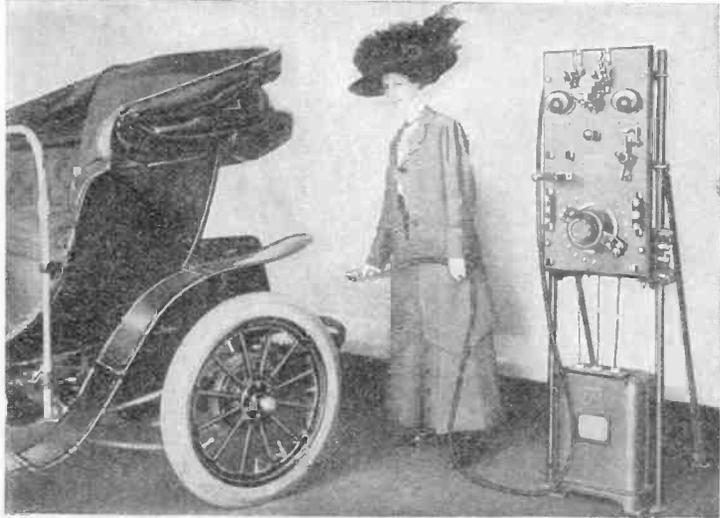
minerals for attachment of the current carrying wires. Send alternating current from the lighting circuit into one set of terminals and you can take out direct current, which is the only kind that will charge a battery, from the other set. Connections are already made on the board to do this. You only need to concern yourself with plugging the cable into your battery terminals (you can't get it wrong), the closing of simple switches and the manipulation of a rheostat handle.

In the first picture you are entering the garage with your machine. At the right stands the mercury arc rectifier, its tube be-



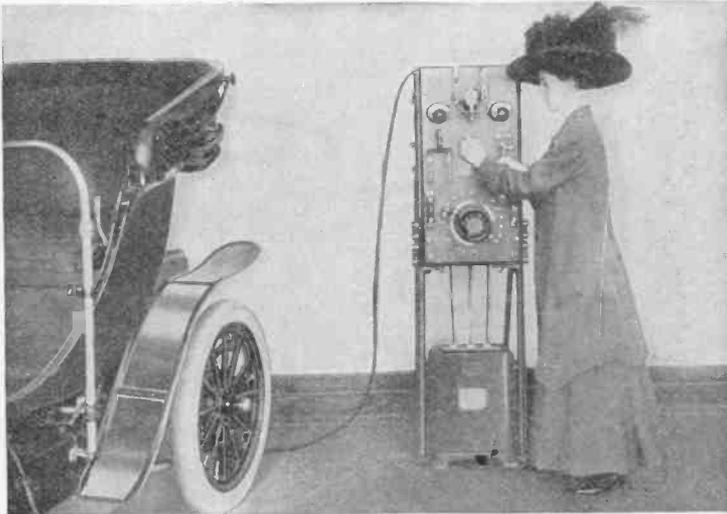
AND
GRACEFULLY
ALIGHT

THEN YOU
CONNECT
THE CABLE



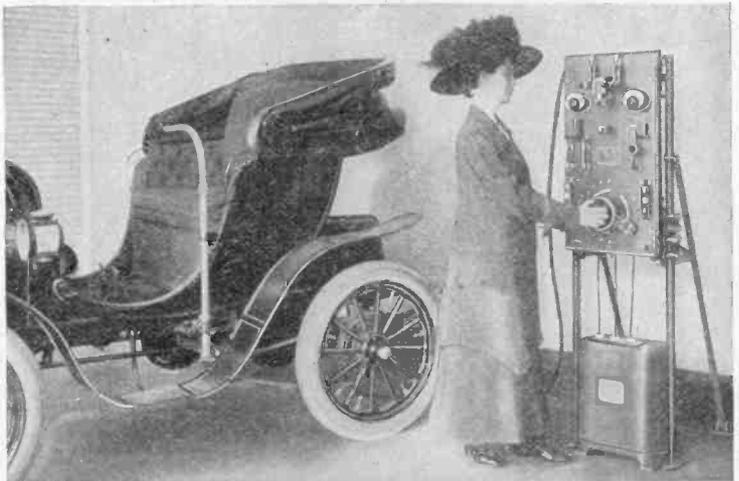
CLOSE THE
LINE
SWITCH

AND
THEN THE
CIRCUIT-
BREAKER



HOLD THE
STARTING
SWITCH DOWN
AND GENTLY
ROCK THE
HANDLE

RAISE AND
LOWER THE
VOLTAGE
BY THE
RHEOSTAT
HANDLE



ing hidden from view behind the switch board.

You back up close to the rectifier and alight from the machine gracefully. Be sure to alight gracefully otherwise the charging process will be seriously hampered.

Then you take the connecting cable, which is already properly attached at the switchboard, and plug it into your battery terminals as shown in the third picture. The plug and terminals are so shaped that you can't make a mistake.

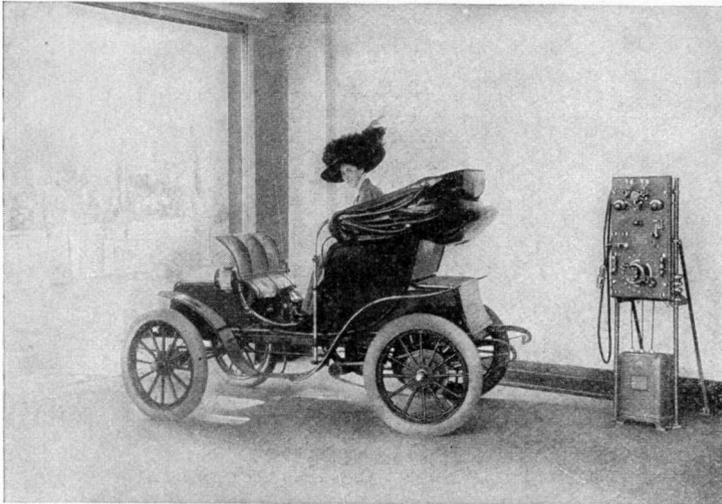
Now close the alternating current line switch as in picture four, which lets current from the lighting circuit into the tube; then the circuit-breaker as in picture five. This latter is what might be termed an electric safety valve. Next hold the starting

be for your battery you regulate to the right amount by turning the rheostat handle as in picture seven. There are an ammeter and a voltmeter on the board which show at a glance how many amperes are flowing and at what voltage.

That is all there is to it. When the battery is charged you open the switch, disconnect the cable and gaily ride away.

An Electrical Valentine

Professor Clerk Maxwell who died over a quarter of a century ago used to be in the habit of penning amusing physio-comic parodies on well known poems, as a mode of relaxation from his scientific work. One of these which appeared in the Scientific



GAILY RIDE AWAY

switch down (you will find it at the right side of the panel) and start the tube in operation by gently rocking the handle which you will find in the center of the panel, as in picture six.

The battery is now being charged and you can release the starting switch.

Batteries must, however, be charged at a certain voltage or electrical pressure, and a certain number of amperes per minute or per hour must be sent into them; the same as if you were charging a watertank at a rate of so many gallons of water per minute from a hose stream under a pressure of a given number of pounds per square inch. This charging rate depends upon the number of cells and other conditions. Knowing what this charging rate should

American in 1880 is entitled "An Electric Valentine," and runs as follows:

TELEGRAPH CLERK A TO TELEGRAPH CLERK B

"The tendrils of my soul are twined
With thine, though many a mile apart;
And thine in close-coiled circuits wind
Around the magnet of my heart.

"Constant as Daniell, strong as Grove;
Seething through all the depths like Smee;
My heart pours forth its tide of love,
And all its circuits close in thee.

"O tell me, when along the line
From my full heart the message flows,
What currents are induced in thine?
One click from thee will end my woes.

"Through many an Ohm the Weber flew
And clicked this answer back to me:
I am thy Farad, staunch and true
Charged to a volt with love for thee."

Elementary Electricity

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

CHAPTER XXII.—THE DYNAMO-ELECTRIC MACHINE

A dynamo-electric machine is a device for filling and emptying conducting loops with magnetic flux and employing the electro-motive forces so induced in such loops for producing currents for employment in external circuits.

The great value of dynamo-electric machines can be seen from the fact that nearly all the electricity employed today for commercial purposes, such as arc and incandescent lighting, electric power, trolley systems, electric furnaces, and other purposes in electro-chemistry, for electric heating, welding, and forging, etc., is produced by various types of dynamo-electric machines.

The operation of the dynamo-electric machine is dependent on a principle discovered by Faraday in 1831, and generally known as dynamo-electric induction. This principle is substantially as follows: If a coil of insulated wire, the ends of which are connected to a galvanometer, be moved across the poles of a magnet, so as to pass through its magnetic flux, an electro-motive force will be produced in the coil as shown by the movement of the galvanometer needle in a certain direction. If the coil be moved in the opposite direction a current will also be produced but now in the opposite direction as indicated by a change in the direction of the galvanometer needle.

The value of the electro-motive force and therefore of the current produced depends on the rate at which the flux produced by the magnet enters or leaves the loop and not on the amount of the flux itself; for, while the coil is stationary although flux is passing into and out of it, yet no electro-motive forces, and consequently no current is produced.

A comparatively small flux entering or leaving the loops rapidly may produce in them a higher electro-motive force than a much larger flux entering or leaving slowly.

The dynamo-electric machine consists practically of means whereby conducting loops are rapidly revolved through a magnetic field so as to be successively filled and emptied with flux. As the loops are revolved in the magnetic field, the flux passes

through them in alternately opposite directions during each complete rotation between two opposite magnet poles.

Generally speaking, that part of a dynamo-electric machine which is provided with conducting loops and is so moved as to pass through magnetic flux is called the armature, while the means for producing the flux, generally consisting of electro-magnets, is known as the field magnets.

The direction of the electro-motive forces induced in the moving loops and therefore of the current produced in them, depends on the direction in which the flux passes or threads through them; that is, on the position of the magnet poles as well as on the direction of the motion.

If, for example, a conducting loop (A), Fig. 147, be moved downward between the

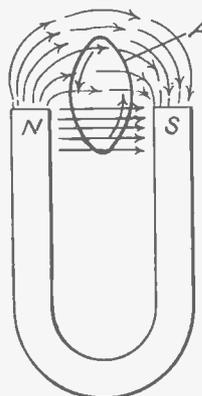


FIG. 147. HOW ELECTRO-MOTIVE FORCES ARE PRODUCED IN A MOVING COIL

poles (N) and (S) of a permanent horse-shoe magnet, then since the flux comes out at the north pole of the magnet and enters at the south pole its direction will be as indicated by the small arrows, while the direction of the electro-motive forces produced will be such as to establish a current flowing in the direction of the longer arrows. When, however, the coil is moved upwards the direction of the current produced is changed.

The direction of the electro-motive force produced can be determined as follows:

Regard the face of the loop as the face of a watch. Then if the flux passes through the watch face towards the observer's eyes in the same direction as the light by which he sees the face, the electro-motive force and current produced will have the same direction as the motion of the hands of the watch. If, however, the flux is poured into the loop against the direction of the light rays the electro-motive force and currents induced will be against the motion of the hands.

It is evident that during each complete rotation of an armature between field magnets consisting of two magnet poles such as (N) and (S), the direction of current induced in any of its loops will be reversed. In other words, the electric current produced will not be direct but alternating.

Field magnets consisting of two poles only are said to be bi-polar; those consisting of four poles are said to be quadri-polar, and those containing a greater number of poles, multi-polar. It is evident that the number of changes in the direction of the currents produced in a quadri-polar machine will be twice as great as in a bi-polar, and that the number of reversals will increase with the number of poles.

Since the number of reversals depends on the number of turns the coils pass the magnetic pole, the number of reversals per second will increase with the number of revolutions per second.

In many cases the currents are taken directly from the armature by means of copper or other conducting brushes, resting on metallic rings suitably supported on the armature axis. When, however, it is desired to obtain direct currents, or those flowing continually in one and the same direction, a device called a commutator is employed consisting of insulated conducting segments suitably supported on the armature axis and provided with conducting collecting brushes.

In some forms of dynamo-electric machines instead of moving the armature coils through the magnetic field the magnetic field is moved past the coils. In other words, the armature coils are stationary and the field magnets movable. Such machines are called revolving-field dynamos or generators. The currents, however, in such machines are produced in accordance with the principles above described.

While the strength of the electro-motive forces produced in the armature does not depend on the total amount of flux in the field yet it does depend on the total rate-of-change in the amount of flux that passes through the armature loops. Other things being equal, this will be greater, the greater the amount of flux that is passing through the field. The value of the electro-motive force generated will also depend on the speed with which the armature is rotated; that is, the speed with which the loops are successively filled and emptied with flux.

Since electro-motive forces are produced in each of the loops the total value of the electro-motive force produced will depend on the number of the loops in which the electro-motive forces are induced, as well as on their connection and grouping. Evidently if all the separate coils are connected in series, the electro-motive force will be greater than if, as is the case in some forms of armature windings, such as the Gramme-ring and others, they are connected in multiple or parallel.

In order to increase the quantity of magnetic flux passing through the field magnets, which in all large dynamos are electro-magnets, it is of course only necessary to increase the number of windings or turns on the electro-magnet as well as the current strength passing through them; or, in other words, to increase the number of ampere-turns.

It is necessary that care be observed in the character of the magnetic circuit or the path provided for the passage of flux through the cores of the electro-magnets and the armature; for, other things being equal, the smaller the magnetic reluctance the greater will be the amount of magnetic flux that passes. For this reason the materials of the cores of field-magnets and the armature should consist of soft iron or soft steel.

The cores of the field magnets are made of solid masses of soft iron or steel. The armature cores must be made of thin sheets or plates of iron or steel. Were the armature cores made like those of the field magnets of solid iron or steel, an increase of temperature would result, shortly after the starting of the machine, sufficient to burn the insulation on the armature coils. The reason is evident. The currents passing through the armature coils are rapidly alternating. These rapid alternations set up electro-

motive forces in the mass of iron or the core, producing currents known as foucault, eddy, or parasitic currents. Though the electromotive forces thus generated are not very high, yet if the cores consisted of solid iron or steel their electric resistance would be so small that the currents produced in them would be sufficient to raise the temperature of the core very markedly. If, however, the iron or steel is laminated in a direction at right angles to that in which these currents tend to flow, the resistance of the circuits is greatly increased, so that the strength of the foucault currents generated is comparatively small.

Although it is unnecessary to laminate the cores of the field magnets, yet it is necessary to laminate their pole pieces, the name given to the prolongations of the field magnet poles into shapes that permit them nearly to surround the revolving armature. Marked changes occur in the intensity of the magnetic flux produced in the pole pieces by the rapid rotation of the armature.

Foucault or eddy currents are also set up in the armature wires or conductors constituting the armature coils. Where ordinary wire is employed in the armature coils the strength of the eddy currents is comparatively small. When, however, heavy copper bars or conductors are used it is necessary to form them of a number of separate bars or wires, since, otherwise, strong currents would be induced in the wires.

The electric energy produced by the dynamo is a result of a transformation into electric energy of the mechanical energy required to drive the armature. Were this transformation complete any given amount of mechanical energy put into the machine would produce an equal amount of electric energy and the efficiency of the machine would be 100 per cent; that is, the ratio between the amount of electrical energy produced in the armature and the mechanical energy required to be expended in order to drive the armature would be unity.

The cause of the difference between the output and the intake is to be found in losses that occur whereby energy uselessly expended in the machine fails to appear as electricity in the external circuit, but appears in the machine as heat. It is easy, therefore, to determine roughly whether a dynamo is working efficiently or not. If it remains cold while running and doing satisfactory

work, it has a high efficiency. If, however, it heats, this heat indicates a loss and therefore a decreased efficiency, and the hotter it becomes after working under a load the greater is the loss of energy and the less the efficiency.

The principal losses in the operation of a dynamo are:

1. Mechanical losses, such as those due to air churning or the setting in motion of air by the rotating armature; losses due to friction of the shaft of the generator; and losses due to the friction of the collecting brushes on the commutator. Mechanical energy so lost appears as heat in the air, in the journal bearings, and in the brushes and commutator segments respectively.

2. Electrical losses. These can be divided into two kinds: i. e., losses in the circuit or circuits of the machine; losses in the iron core of the armature or pole pieces; or in the copper wire or bars forming the armature coils. The energy so lost appears as heat in the machine or especially in its revolving armature.

3. Magnetic losses, or those due to what is called magnetic hysteresis.

By magnetic hysteresis is meant that quality of a magnetic substance, like iron or steel, in virtue of which energy is dissipated on the reversal of the magnetization. A certain amount of energy is dissipated or lost by hysteresis which may be regarded as a variety of molecular friction attending magnetization and demagnetization. As ordinarily constructed in direct-current dynamos, work is done in magnetizing the field magnets, not only to give the iron its initial magnetism, but also to reproduce the magnetism it loses during running. The loss, however, by hysteresis is especially found in the armature core which is subjected to rapid magnetizations and demagnetizations.

In order to decrease the loss due to journal friction the diameter of the armature shaft is made as small as ample strength will permit, and efficient lubrication is provided. The energy lost by brush friction increases with the number of brushes and the pressure on each brush. The amount of this loss, however, is not very appreciable in large dynamos, although in very small dynamos it forms an appreciable part of the losses. When not excessive the loss due to air churning by the rotating armature, is not altogether objectionable from the ventilation

and consequent cooling of the armature that is thus ensured.

The commercial circuits on which by far the greater amount of current produced by dynamo-electric machines is employed, are either series circuits or multiple or parallel circuits. Series circuits are employed generally for arc lighting, or for street car trolley systems.

In series or multiple circuits as the number of electro-receptive devices is increased or decreased, some device must be employed whereby either the electro-motive-force or the current produced can be maintained constant.

In the case of a series dynamo, such as that employed for series arc lamps it is the current strength that must be maintained constant, since each additional lamp introduced into the circuit increases its resistance. The regulating device employed must therefore be able to increase the electro-motive force to such an extent as shall result in the current strength remaining constant. Suppose, for example, that a single arc lamp requires a pressure of 50 volts at its terminals in order to produce the requisite current. Then, thirty such lamps connected in series would require the machine to produce a pressure of fifty times thirty or 1500 volts, while sixty such lamps would require a pressure of 3000 volts.

In the multiple circuits, however, it is the pressure that must be maintained constant and the current strength that must be varied, since for every additional device added to the circuit an increase of current is necessary.

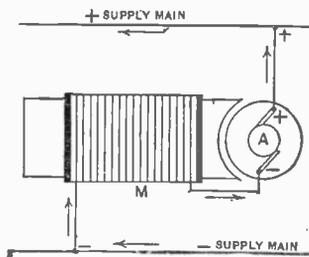


FIG. 148. DYNAMO WITH FIELD IN SERIES

A generator suitable for connection with mains feeding multiple-connected devices; that is, suitable for connection with constant-potential mains, should be able while maintaining the pressure constant to vary the current strength in proportion to the number of separate devices added or removed.

Dynamo-electric machines must therefore be provided with means whereby the pressure can be regulated for series circuits, and the current strength regulated for multiple or parallel circuits.

The E. M. F. produced by a dynamo can be changed by varying the speed of rotation; by varying the number of conductors on the armature; by varying the magnetic flux passing through the armature; or by shifting the position of the brushes on the commutator.

The number of conductors on the armature remains constant in the same machine, and its speed of rotation must for practical purposes also remain unchanged. There

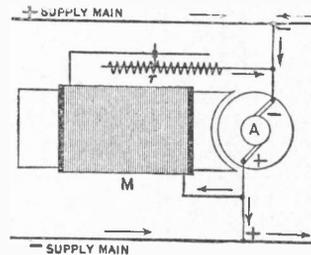


FIG. 149. DYNAMO WITH FIELD IN SHUNT

are, therefore, only two ways in which the E. M. F. produced can be varied. This is by a change in the amount of the magnetic flux, or by a change in the position of the brushes. In the case of series arc-lighting dynamos the variation in the E. M. F. is obtained by shifting the brushes either automatically or by hand. In generators employed on constant-potential mains, the necessary variation in the amount of current, is effected by a change in the amount of magnetic flux.

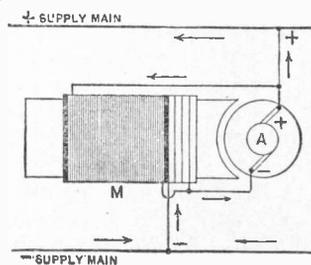


FIG. 150. COMPOUND WOUND DYNAMO

Dynamos suitable for feeding series circuits are known as series-wound dynamos, of the type represented in Fig. 148. Here, the magnet coils (M) are connected in series with the armature (A).

Generators suitable for feeding multiple or parallel circuits are known as shunt-wound dynamos. Here, as shown in Fig. 149 the magnets are not in series with the armature circuit but are connected at the brushes in shunt with the external circuit so that a portion of the armature current is always employed for developing the magneto-motive force in a field magnet.

It will be observed that in the shunt-wound generator the field-magnet circuit is connected with a rheostat or adjustable resistance (R), by means of which the magneto-motive force of the field magnets can be regulated by varying the current strength of the circuit. This regulation is obtained either by hand or by the action of an electro-magnet.

Another method of making a generator self or automatically regulating is by what is known as compound-winding. In a compound-wound generator, as shown in Fig. 150, the magnet coils are partly excited by a shunt-winding taken from the brushes and partly by a series winding connected with the main circuit. Want of space prevents any further explanation as to the manner in which these different forms of machines are capable of regulating either the pressure or the current.

Dynamo-electric machines producing alternating currents, or those in which the direction of the current rapidly changes, are called alternators. Although the details of construction differ somewhat from those of direct-current machines, yet, generally speaking the construction of both machines is the same.

The changes or reversals in the direction of the E. M. F. or current in alternating circuits are called alternations. A generator is said to produce 16,000 alternations per minute when it reverses the direction 16,000 times per minute, or produces 8,000 waves in one direction and 8,000 waves in the opposite direction. Such a machine is said to produce 8,000 cycles per minute, a cycle being a double-reversal or a complete to-and-fro motion. By the frequency of alternations of a machine is meant the number of cycles it produces per minute. A machine producing 16,000 alternations per minute, or 8,000 cycles per minute, would have a frequency of 8,000 alternations.

Alternating electric currents are employed extensively in the operation of alternating

motors. For this purpose what are known as multiphase alternating currents are employed. These consist of a number of separate alternating currents differing in phase by a certain amount.

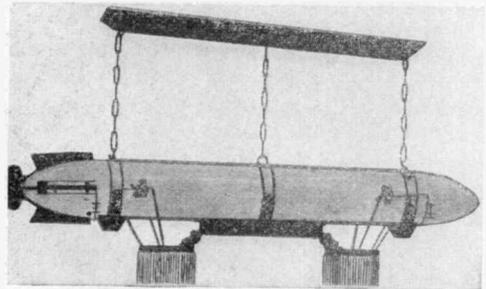
Waves of current or pressure are said to be in phase or step when their crests or tops occur simultaneously, and are said to differ in phase when the crests or tops do not occur simultaneously.

There may be a great number of multiphase alternating current systems. In practice not more than three separate systems are employed. These are single phase, two phase and three phase.

(To Be Continued.)

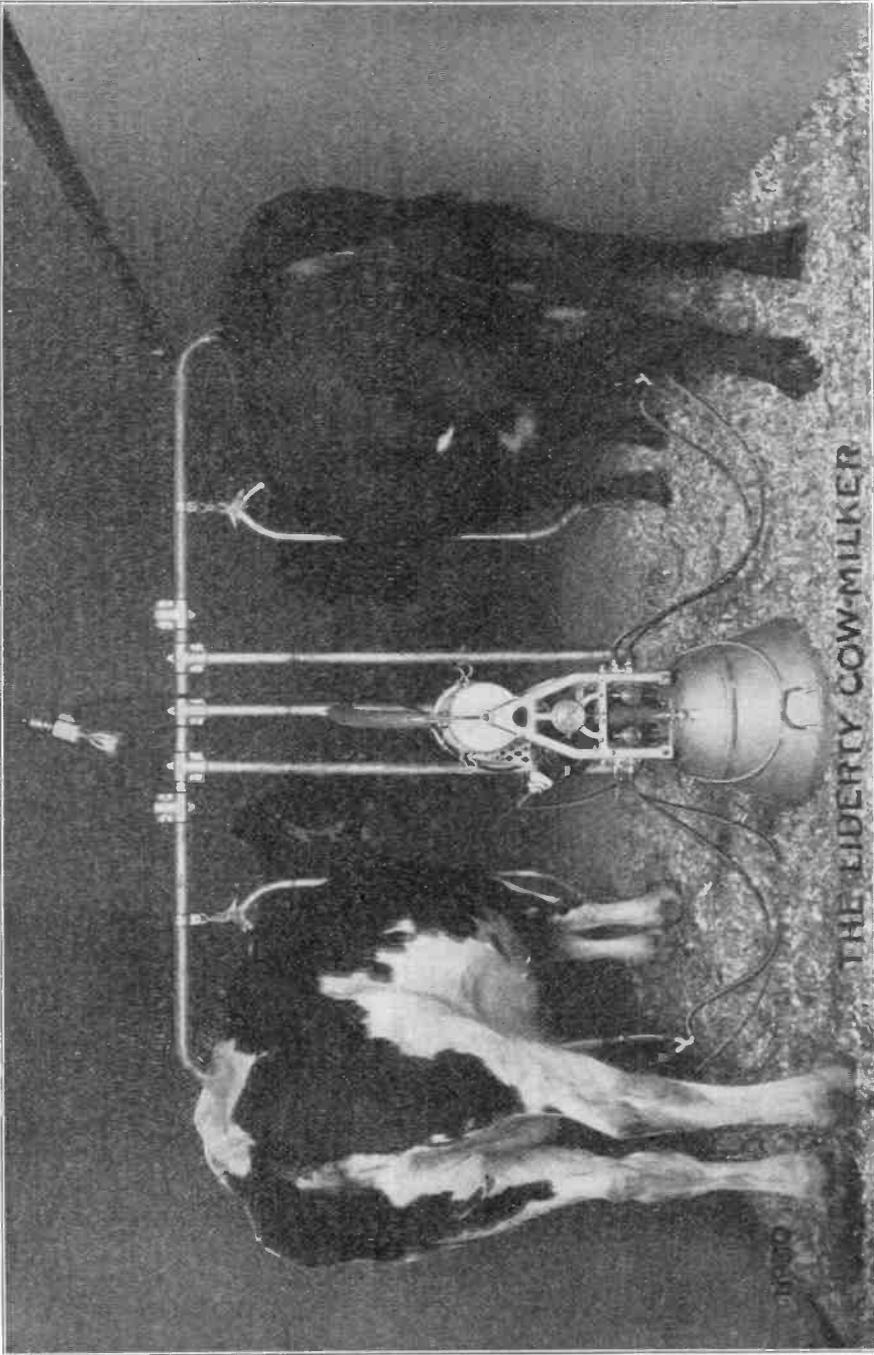
Count Zeppelin's Unique Gift

Count Zeppelin, the famous aeronaut, has accepted the godfathership to the recently born third child of the German crown prince. It is customary to make presents on such an occasion and the ingenious count ordered a miniature airship in the shape of an electric chandelier. He visited recently the factory in Berlin and was cheered by the public who recognized him at once.



ELECTRIC CHANDELIER IN THE FORM OF AN AIRSHIP

As we see from the picture all details are well represented, such as the various apparatus for steering sideways and up and down, the propellers, cars, connecting gangway, etc. The main body consists of glass and has a crystal-like surface. The metal parts are well ground until they assumed a matt surface, and are of silver color. In each car there is one electric bulb lamp, also two more in the long body. When these are lighted it gives a wonderful effect. The whole is suspended on three chains and will for a long time be an attraction in the castle of the German crown prince.



THE LIBERTY COW-MILKER

AN ELECTRIC VACUUM COW MILKING MACHINE IN OPERATION

The Latest Way of Milking Cows

In these days when the inventive spirit has managed to solve almost all mysteries of the days of our forefathers, progress has been made in every line and particularly in the dairy business. We call it business as it has to be run as a factory and each minute means money. Where are the days that a machine separating milk to cream and skim milk was looked upon as a mystery or fake? And how near are the days when hand milking will be ridiculed as are at the present day the gravity system "to get the cream," and hand threshing "to get the crop?"

A really practicable cow milking machine is now obtainable and as is usual in new things electricity has made it possible. It is a simple affair. First there is the air tight milk can or receptacle from which lead the long flexible tubes with suction cups attached for extracting the milk in the most natural and sanitary manner possible. Then there is the milking machine proper, consisting of a pulsating vacuum pump driven by an electric motor which creates a partial vacuum in the can.

The vacuum in the can is indicated by the vacuum gauge. By means of an operative connection between the crankshaft and double valves, the latter will be in operation as soon as the crankshaft is in motion. The valve is so constructed that a hollow cylinder connects the vacuum created in the can with the suction cup in one position, thereby drawing milk from the cow, and in the second position it breaks the vacuum and opens to the air, thus destroying the vacuum in the suction cup and exposing it to the normal atmospheric pressure. After this operation is finished suction is again applied and milk drawn and the operation as above described repeated. It is readily seen, therefore, that nature's operation is imitated very closely. The calf, when he gets his mouth full of milk is bound to take a breath and swallow, thus destroying the vacuum for a moment exactly the same as in the milking machine.

After the milking process is finished all that is necessary to clean the machine is to hang the cups in a pail of water and suck the water through the cups and tubing. Then warm water is used, with a 10 per cent solution of common salt.

"From where does the electric current come?" Many of the largest dairy farmers in this country have for a long time recognized the great importance of having electric light in a sanitary cow barn. They have realized all the benefits given to the world by this great discovery. Electric light in a cow barn is the best and safest. The great Chicago fire in 1871, as we all know, was started by a cow kicking over a lamp in the barn of Mrs. O'Leary, DeKoven street, and the history of fire insurance shows that destruction of a large proportion of the dairies starts in this very way. Electricity in dairy establishments is therefore becoming more common than is ordinarily supposed.

The electric current required to operate one of these cow-milkers is very small, and a one-kilowatt dynamo (a little over one horsepower) will create all the current needed to run a number of milking machines and have lights in the barn besides. The dynamo can be operated direct from the fly wheel of a small engine, if the regular lighting current is not available. A couple of wires can easily be run in any barn and an attachment provided at each lamp socket so as to run a cord therefrom to operate the motor of the cow-milking machine.

Great Electrical Growth in the West

According to the 1910 edition of Blanchfield's Western Electrical and Gas Directory, the development of the electrical industry in Arizona, California, Idaho, Nevada, Oregon, Washington, British Columbia and the Hawaiian Islands has indeed been remarkable. The directory contains the names of 940 companies and individuals under the heading of Electric Light and Power and 201 names under Electric Railways.

A condensed history of the development of these industries presents facts that are startling. In one city, alone, it is possible to deliver over 275,000 electrical horsepower, from steam and gas (or distillate) engine driven plants, and over high potential, long distance lines from hydro-electric stations—traveling, in one instance, 351.95 miles. Another city can be supplied with over 135,000 electrical horsepower. The largest installation, under one roof, provides 40,000 kilowatts, normal rating, which is over 50,000 horsepower.

Talks With the Judge

"What is a watt? What is a kilowatt? What is a kilowatt hour?" The Judge almost shouted the questions. "Every month I use and pay for a mysterious something which we call electric current. When I pay my bill, if I make any inquiries, they tell me that the month before my meter read so many kilowatt hours, this month it reads so many, the difference is so many, and at my rate per kilowatt hour it amounts to five dollars and seventy-seven cents. That all 'listens' fine, and I am glad it isn't six dollars and I go away. But just the same, I wish I could know what it is I am buying. A watt is a most elusive thing. To buy one is like buying imagination, as it seems to me."

"Judge," I said, in my most impressive manner, "the watt is the unit representing the rate of work of electrical energy. It is the rate of work of one ampere flowing under a potential of one volt."

"Fiddlesticks!" said the Judge, "Why don't you tell me that it is perfectly elastic, incompressible entity, which, traveling at the rate X to the n th power miles per hour will amount to five dollars and seventy-seven cents in n minus one years. It would mean just the same to me."

"Wait a minute," I said, "seven hundred and forty-six of these watts equal one horsepower, and a horsepower as you know is the energy required to lift 550 pounds one foot in one second."

"Now you are talking sense," said the Judge. "A horsepower is something tangible. Keep right down on that physical plane and I can follow you."

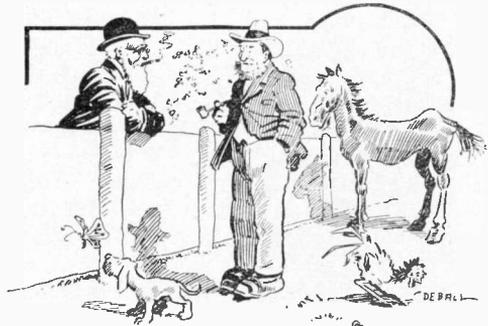
"But the watt is rather a small unit for everyday use," I continued, "so they devised the kilowatt, which is one thousand watts. A kilowatt, therefore, is equal to almost exactly one and one-third horsepower."

"However, you don't buy kilowatts of electric current energy from the central station company. You buy kilowatt-hours. If you were to go to your neighbor and say, 'I will pay you five dollars for the use of your horse,' the first question he would ask would be 'For how long?' He would want to know how many horsepower hours of energy you were going to take out of the animal. The chances are he would then ask you a certain

price per day, or, in other words, for 10 horsepower hours, if the horse were used 10 hours a day.

"So you see the time element enters into the problem. If you use one kilowatt for 10 hours, from your circuit, your total is 10 kilowatt hours. Or if you take out 10 kilowatts for one hour the total is 10 kilowatt hours just the same.

"Now to make this kilowatt hour even more comprehensible to you, let us take a few concrete examples of what a kilowatt hour of electrical energy will do. A kilowatt hour of electricity will burn 20 ordinary 16 candle power carbon filament lamps for one hour; it will keep four domestic irons in use for one hour; it will cook 15 chops in 15 minutes; it will run a sewing machine for 21 hours; it will carry you three miles in an electric brougham; it will run an electric clock for 100 years."



He Would Want to Know "For How Long"

"Well, I think I understand now what a kilowatt hour is, but I don't understand why all do not pay the same price for a kilowatt hour of electricity. As far as I can find out the rate is not uniform. That doesn't seem fair."

"There are different rates, it is true," I replied, "but these rates are uniform to all those requiring a particular class of service. For instance, here is a little shoemaker who has only one lamp which burns an hour or two hours in the evening. He has to have his meter installed, meter men must come and take readings, clerks must make out his little bill, his lamp must be renewed occasionally, etc. You can readily see that his little service requires about as much attention as the good sized manufacturing

plant next door which has several hundred horsepower in motors in operation.

"Then again there are certain classes of service which are supplied in the daytime or late at night, when a large part of the great generating equipment is idle. Such service



His Little Service Requires About as Much Attention as the Manufacturing Plant Next Door

as this is encouraged and an attractive rate made, and might be spoken of as 'velvet' to the central station. Such a customer as this *ought* to have a better rate than the one who comes onto the lines between five and eight o'clock in the evening when lights are burning full blast all over the city and what is known as the 'Peak of the load' is on and the generating equipment is working at full capacity.

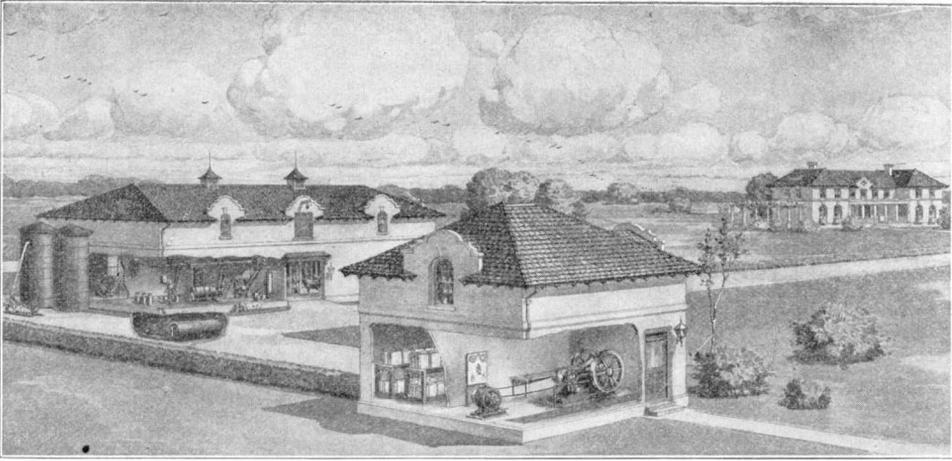
"In your own city, Judge, they have a way of equalizing the rates in a way which is as near fair to all as possible by using what they call the maximum demand system. Your lighting rate is 12 cents net, per kilowatt hour for all electricity consumed in each month up to and including an amount that would be equivalent to 30 hours constant use of your maximum demand in such month. For all above that they only charge you six cents. By the maximum demand is meant the greatest number of lamps which you have turned on at any one time during the month—they have meters to register that. This maximum demand indicator on the meter works something on the principle of a physician's thermometer. You know when a physician puts the little thermometer under your tongue the mercury runs up the tube to the point which registers the temperature. Then the mercury will stay up

at this point in the tube until the latter is shaken in a particular way. It is the same way in a maximum demand meter. There is a tube something like a thermometer tube and a mercury column is made to rise in the tube to a height proportionate to the number of lamps burned on the circuit. The mercury will not drop back in the tube but always registers the highest number of lamps or in other words the maximum current demand at any time during the month. When the meter reader comes around at the end of the month he releases the mercury column so that it falls back and is in shape to register the next month's maximum demand. This will explain to you why it is that your neighbor who uses more current than you do, may some months pay less per kilowatt hour, the reason being that he uses more than the 30-hour maximum demand equivalent and so gets in on the lower rate for some of his current. That's only fair. He is a customer who burns his lamps a greater number of hours and current to him costs the company proportionately less than it does delivered to you, for the "fixed expense" connected with his installation is no more than yours.

"In your city, also, users of electric current for power get a different rate because they are great big users of current, wholesale users you might say, and also their power is ordinarily taken during the daytime and they shut down as the peak of the load due to lighting comes on. Ten cents a kilowatt hour is their rate, up to 30 hours of the maximum demand, after which it is five cents for 30 hours more; all in excess is then three cents.

"To find out exactly what the various rates are you should send to your lighting company for a complete schedule. Remember, however, that this rate proposition is one of the most complex problems which the big central station companies have to encounter. Years have been spent in studying it out and trying to make it just to all the various classes of customers. The maximum demand system just referred to is one way—perhaps the most satisfactory way—but in other cities different methods of charging may be employed."

A 20-watt tungsten lamp gives one-fourth more light than the carbon filament lamp of 16 candle-power, on one-half the current.



Electric Light and Power for Country Homes

By LOUIS A. PRATT

PART I.

The object of this article is to set forth in plain and simple language some of the facts of interest to any person wishing light and power for a country residence, farm, or small manufacturing plant, where central station current is not available.

The need of the electric lamp in isolated localities not reached by central stations, has long been felt and has been one of the deterring influences in the trend of population from city to country.

The safety, cleanliness and convenience of electric light is so generally recognized that there is every incentive to make it universally available, the principal obstacle being the lack of a sufficiently cheap and dependable source of energy.

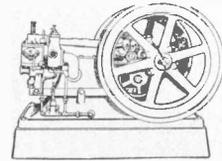
The gas engine, however, now supplies this want and independent plants are not only possible, but they are also comparatively inexpensive to install, and can be operated at extremely low cost, both in the matter of fuel and attendance.

Abundance of light can therefore no longer be classed as a luxury, but must be considered as a necessity to home comfort within the reach of a moderate income. Power is also needed by every farmer in keeping pace with modern methods and the ever increasing scarcity of labor, and is available on a basis which makes it an attractive and profitable investment.

For much of the data which follows, I wish here to acknowledge my indebtedness to the engineers of the Alamo Manufacturing Company, the Westinghouse Storage Battery Company and to Mr. T. H. Amrine of the University of Illinois.

THE GASOLINE ENGINE

As noted in the introduction, the principal obstacle in the way of private electric generating plants has been the difficulty of obtaining a satisfactory source of energy. This obstacle has been removed by the introduction of gas engines, that is, engines operating on natural or manufactured gas, gasoline, distillate, kerosene or alcohol. In this country the fuel most generally used is gasoline. The type of engine in general demand is the horizontal or vertical water-cooled, four-stroke-cycle engine.



FARM GASOLINE
ENGINE

These engines have what is commonly called the hit-and-miss system of control, are very economical of fuel and do not easily get out of order. They are successfully used for operating the electric dynamo or generator where current is wanted for power only, for charging storage batteries, or for

lights for places where a slight variation, or flicker, is not objectionable.

When the engine is required for operating the generator for lighting purposes, a closer speed regulation is required than can be obtained with the ordinary gas engine, because the voltage or electrical pressure produced by a dynamo varies with the speed and if the speed is not constant the lights flicker. To meet this requirement there has now been perfected standard throttling governor engines, and by this method of construction it is possible to produce lighting outfits having a regulation producing as steady lights as are obtained by the use of the best makes of steam engines.

THE ELECTRIC GENERATOR

The electric generator has reached such a stage of development that little need be said in explanation. The generator, or dynamo as it is called, is a machine used for generating the electric current.

From the generator the current can be either taken direct over wires for use in lighting or to run electric motors for operating various machinery, or it can be run into storage batteries and taken out for use as needed.

For isolated electric plants two classes of direct current generators are now considered. First—generators of 110 to 125 volts of a

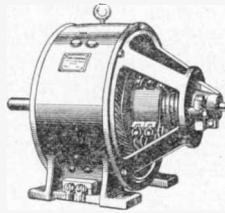
variety of speeds, either for belted drive or connected direct to the engine; and, second—generators of 30 to 50 volts for use in charging the storage batteries for low voltage domestic lighting service; 50 volts being high enough voltage to charge a battery of 18 cells, should one wish to use so many cells in a low voltage system.

The distinction between a generator and a motor is that the generator converts the power of the engine into electric energy, while a motor converts this electric energy into mechanical power again.

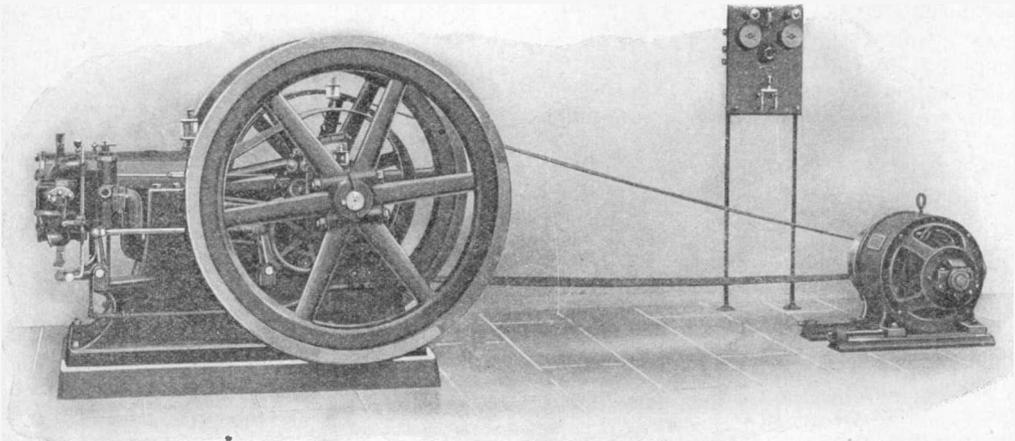
THE STORAGE BATTERY

The storage battery may be considered simply as a reservoir for storing electricity. The use of the storage battery makes it possible to store up electrical energy which can later be used for lighting and power. The convenience of such an equipment will be readily appreciated. The gas engine and generator may be operated during the day, the battery charged and the engine shut down. The battery is then ready to furnish current for lighting the house and premises during the evening and night hours.

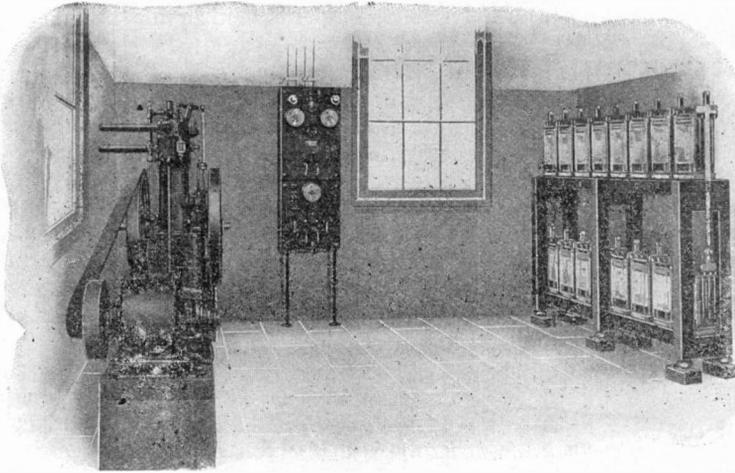
A battery is made up of one or more cells. The capacity of a battery cell is designated in ampere-hours, that is, it will deliver a certain number of amperes for a given number of hours. The normal rating or condition of greatest efficiency, is the number of amperes that the cell is capable of supplying on discharge for eight hours. This rating has been accepted as normal for storage batteries in lighting service by all battery manufacturers. As an example:



A DIRECT CURRENT GENERATOR



TYPICAL FARM PLANT, INCLUDING ENGINE, GENERATOR AND SWITCHBOARD



LOW VOLTAGE STORAGE BATTERY PLANT

a battery cell which may be called a 10-ampere cell, will deliver 10 amperes for eight hours, and, therefore, has a capacity of 80 ampere-hours.

A cell may, however, be discharged at a rate higher than the eight-hour rate, depending upon the load upon the circuit, that is, the number of lamps that are to be lighted. A cell will supply for five hours one and four-tenths times the normal eight-hour rating, or for three hours twice the normal rating, or for one hour four times the normal rating. To illustrate: The discharge ratings of the 10-ampere cell would be

10 amperes for 8 hours, or
14 amperes for 5 hours, or
20 amperes for 3 hours, or
40 amperes for 1 hour

It will be seen that the capacity in ampere-hours decreases as the rate of discharge increases, the capacity at the one-hour rate, as shown in above table, being 40 ampere-hours while the normal rating is 80 ampere-hours.

To determine the capacity of cells required for lighting service it is necessary to know the number of lamps to be lighted at one time, their candle power and efficiency.

The efficiency of a lamp depends upon the amount of energy, or watts, required per candle power to light the lamp to full brilliancy. There are a number of different types of lamps on the market, showing a great variety in efficiency. It, therefore, becomes necessary in determining the amount required to light a given number of lamps,

to know not only the candle power of the lamp but its type, whether of the old style carbon filament, which is called a $3\frac{1}{2}$ -watt lamp, or one of the newer type metallized filament lamps, which furnish a candle power on from 2 to $2\frac{1}{2}$ watts, such as tantalum and gem, or the more efficient tungsten lamp which will supply a candle power on $1\frac{1}{4}$ watts. Compared on the basis of 16 c. p., these lamps will require the following energy:

Carbon Filament.....	55 watts
Metallized Filament	40 watts
Tungsten	20 watts

To determine the amount of current required to light each of the three types of lamps just mentioned, divide the number of watts by the voltage. Assuming that the voltage of the circuit is 110, it will be seen that each of the lamps will require the following amount of current to burn them to their full candle power:

Carbon Filament, or 55-watt lamp,	$\frac{1}{2}$ ampere.
Metallized Filament, or 40-watt lamp,	4-11 ampere.
Tungsten, or 20-watt lamp,	2-11 ampere.

Since batteries are more expensive than lamps, it will be found in most cases, that it will pay to use the high efficiency tungsten lamp, or the metallized filament lamp, and reduce the cost of the battery. If, on the other hand, one figures battery cost on the basis of the carbon filament lamp and has the battery large enough to supply a certain number of this type of lamp, and afterwards finds that more light is required, it will be very convenient to increase the lighting capacity of the battery by substituting the high efficiency lamp for the carbon filament lamp. For this reason it is recommended that batteries be figured on the basis of the carbon filament lamp, and if it is afterwards found that the capacity is too low, the battery need not be overworked, to its detriment, but the load

may be decreased by the use of the tungsten lamp, which, as above stated, is equivalent to increasing the capacity of the battery.

Having determined the number of lamps which are to be used for a given number of hours, the number of amperes required may easily be calculated and the result compared with the capacity of standard size storage battery cells at their various discharge ratings, for the different numbers of hours. These ratings and capacities are scheduled in manufacturers' catalogues.

The number of cells to be used in a battery in series (or tandem) will depend upon the voltage required for the circuit. If the system is to be of low voltage, for strictly domestic lighting purposes, where $27\frac{1}{2}$ or 30-volt lamps are to be used, a battery consisting of 15 or 16 cells will be sufficient. Where the system is to be one of 110 volts, at least 56 cells should be used. In figuring the number of cells required, divide the voltage of the circuit by 2.05, which is the voltage of each cell when fully charged. A few extra cells are usually required for overcoming the resistance of the circuit.

In thus determining the capacity of a battery cell, the use of 16 c. p. lamps is assumed.

Another point to be considered when determining the capacity of the battery is the convenience with which it may be charged, that is, whether it is to be charged once a day or whether the charge must last a number of days. In any case, the capacity must be calculated in ampere-hours. Naturally, a battery to supply current to a given number of lamps for three nights must have a greater capacity than one which will supply current to the same number of lamps for one night.

If motors, such as used in domestic service, are to be operated from the battery, they must be considered, when determining the capacity. Usually the number of amperes required for driving the motor are stamped on the name plate, and the motor can be considered as so many amperes, or the equivalent of so many lamps. The number of minutes or hours the motor is to be operated should be considered as so many ampere- or lamp-hours.

As an illustration of how one may determine the capacity of a battery for lighting country homes, we would quote from page 14, Bulletin No. 25, written by Mr. T. H.

Amrine and published by the University of Illinois:

"Now that we have decided upon the number of lights in each room the next step in the design of our lighting system is to estimate the hours during the day that the lights in each room will be lighted. This will give us an idea of how large our storage battery will have to be to operate the lamps. Of course, the size of the battery will also depend upon how often it is convenient to charge it. Let us assume that we wish our battery to be of sufficient capacity to operate the lights on one charge the entire day when there is the maximum amount of light used. This will be in the winter when the nights are long and when there is some special occasion that keeps the family up later than usual. We will make out a probable lighting schedule for this day. The schedule is given below. In the column to the right are given the lamp hours per day. The lamp hours per day for each room are the number of lights in that room multiplied by the number of hours during the day that they are lighted.

"Dining Room—two lights on during breakfast and supper, 5:00-6:30 a. m.	} 6 lamp-hours
5:30-7:00 p. m.	
"Living Room—Three lights on only after supper, 7:00-10:30 p. m.	10½ lamp-hours
"Kitchen—Two lights on while preparing dishes morning and evening, 5:00-7:30 a. m.	} 10 lamp-hours
5:00-7:30 p. m.	
"Front-Hall—One light, 8:00-10:30 p. m.	2½ lamp-hours
"Front Porch—One light, 7:30-9:00 p. m.	1½ lamp-hours
"Rear Hall—One light, 5:00-6:00 a. m.	} 2½ lamp-hours
6:00-7:30 p. m.	
"Bedrooms—Two lights, 5:00-5:30 a. m.	} 2½ lamp hours
9:00-9:30 p. m.	
One light, 10:30-11:00 p. m.	
	35½ lamp-hours

"This gives a total of 35½ lamp-hours. Hence, we wish a battery that will operate one lamp approximately 36 hours, with one charge."

A complete copy of this report may be obtained from the Experimental Station, University of Illinois.

(To Be Continued.)

Where Electricity Stands in the Practice of Medicine

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

CHAPTER II.—ELECTRICITY IN TUBERCULOSIS.

Never has there been so much attention given to the treatment of tuberculosis as at the present time and the whole world seems aroused to the necessity of combating this disease. It is equally true that never has there been so much done to combat disease in general; not only in seeking methods of cure but also in that other equally important field, searching for means of prevention. In both, electricity has proved a useful and willing ally of the physician.

In treating tuberculosis, the earlier the disease is recognized, the better the chance of cure, so that electricity has proved doubly important because of its diagnostic as well as its therapeutic properties. Tuberculosis frequently may be shown by the X-ray, long before it is recognized by ordinary methods. This does not mean that the X-ray should be used to the exclusion of other means. On

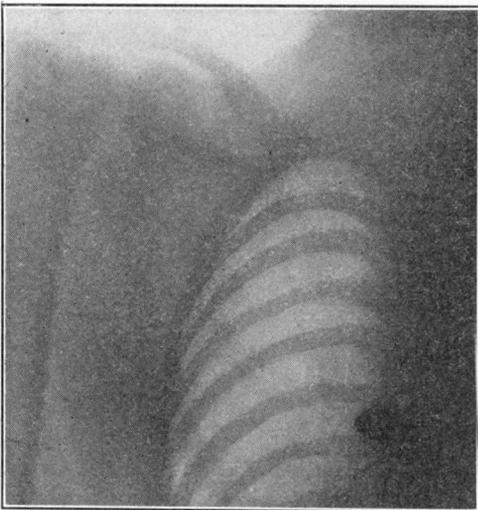


FIG. 1. X-RAY SHOWS NORMAL HEALTHY LUNG

the contrary I am distinctly opposed to this. But it should be used in connection with the customary physical and laboratory methods of diagnosis.

You say, What will the X-ray show?

Before answering this question it is necessary for the sake of the lay reader to remember that tuberculosis is not limited to tuberculosis of the lungs or consumption, but that the germs producing this disease attack many other parts of the body, such as glands, kidneys, tendons, bones, peritoneum, skin, etc.

Now, of what use is the X-ray in enabling us to recognize any of these forms?

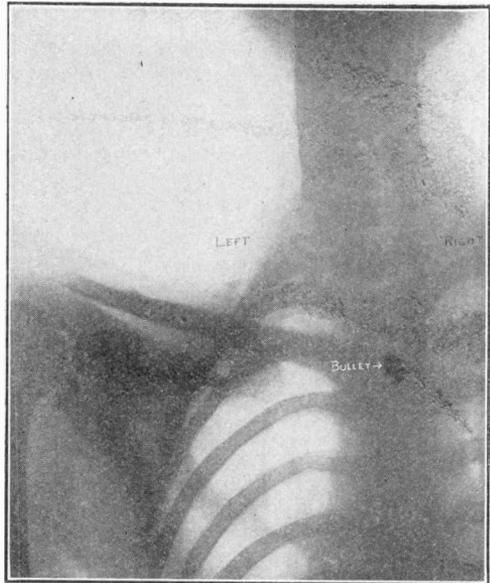


FIG. 2. A HAZINESS IN THE UPPER LUNG CAVITY INDICATES THE FIRST STAGES OF CONSUMPTION

First, let us consider tuberculosis of the lungs and let us remember that the X-ray is a transmitted and not a reflected light and that which we see in the X-ray picture is super-imposed shadows, resulting from the obstruction to the passage of the rays offered by the varying densities of the tissues traversed. Thus it is that we have a marked contrast between bones and the

soft parts, but little or none between the structures making up the latter. For this reason some knowledge and experience are necessary in properly interpreting X-ray pictures or plates.

When a fluoroscope is used with the X-ray for the purpose of directly examining any portion of the body, the screen lights up (fluoresces) when the rays strike it, and the shadows which appear on it are the result of the interference with the rays.

When the lung is normal and healthy it offers practically no resistance to the passage of the X-ray, and, therefore, in looking through a person with the fluoroscope it

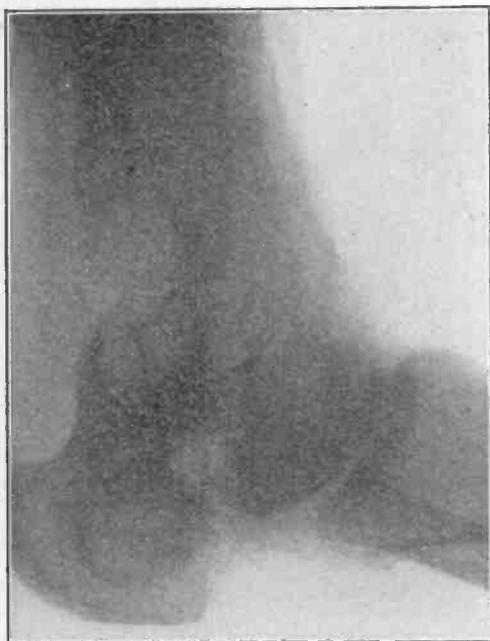


FIG. 3. SHADOWS OF THE BONES INDICATE PRESENCE OF TUBERCULOSIS

appears light and of an even tone between the ribs or shows thus when an X-ray picture is taken. Fig. 1 is an X-ray picture taken for the purpose of locating the bullet shown plainly by the dark spot. This picture shows also a perfectly normal and healthy lung, as indicated by the clearness of the lung cavity.

When the individual takes a full breath the light areas increase and become still lighter.

If a portion of the lung is diseased, it shows a haziness, or a spotted or mottled

condition where diseased places offer obstruction to the passage of the rays. Fig. 2, also taken for the location of a bullet, shows on the right side and in the upper part of the left lung cavity a haziness indicating the first stages of consumption.

When the lungs are inflated with air a tuberculous portion will remain the same as before instead of increasing in luminosity as in the healthy lung. Cavities may be shown by the ray, and hardening and calcification of lung tissue. All the findings should be confirmed by physical examination or tuberculin reaction.

In an X-ray picture of a healthy bone the outline is clear, distinct and regular, showing where present, the canal containing the bone marrow and where there are articular cartilages on the ends of the bones they are clearly shown, with well-defined margins. When tuberculosis invades a joint these articular surfaces lose their distinctness and the shadows of the bones tend to fuse with one another as shown in Fig. 3.

Also if the process involves the bone it changes the character of the shadow, and



FIG. 4. X-RAY PICTURE SHOWS THAT THE PERIOSTEUM IS INVOLVED

ordinarily may be recognized. (Fig. 4.) If the covering of the bone (periosteum) is

involved the irregularity in the outline is seen plainly.

So much for the use of electricity in recognizing tuberculosis; now of what value is it in treating or preventing this disease?

In tuberculosis of the lungs three forms of electric treatment are of the greatest value, their relative usefulness being in the order named: high frequency currents by auto-condensation, ozone inhalations, and the X-ray.

named, compares most favorably with that obtained by all other forms of treatment.

By the word "cure" in consumption is meant the arrest of all of the symptoms of the disease and maintenance of this state over a definite period of time. Doctors call this a "symptomatic cure."

In using auto-condensation the patient is placed on the auto-condensation couch or pad, (Fig. 5), holding the handles or electrodes, before the current is turned on, and

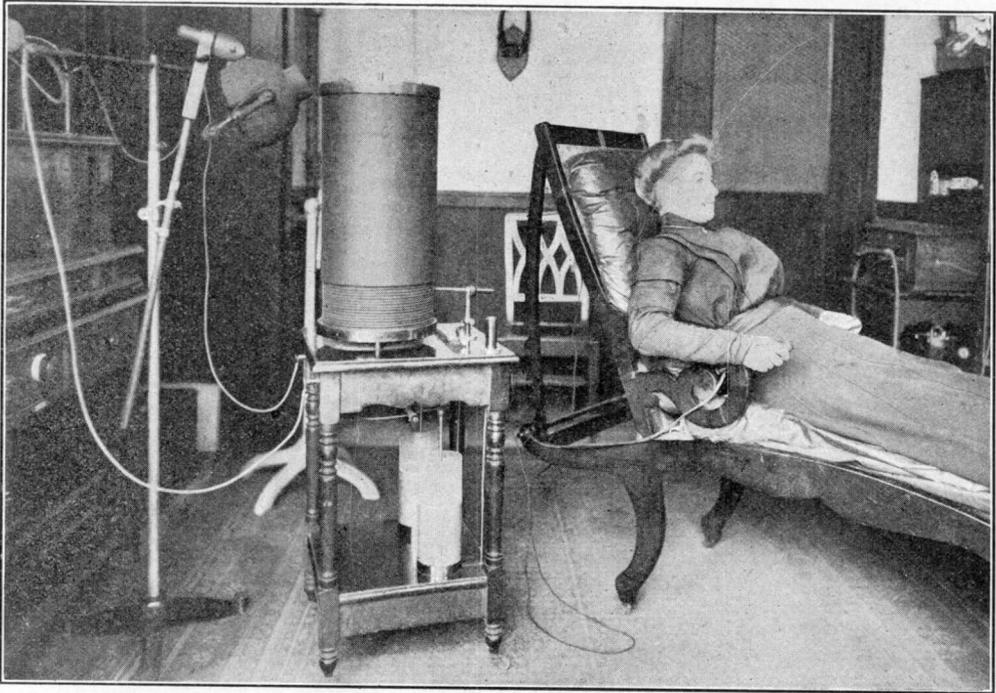


FIG. 5. METHOD OF TREATING BY AUTO-CONDENSATION

Some will not agree with me in this statement, but it is in accordance with my experience, which has been considerable, and there is an old saying that "he knows the water best who has waded through it."

Practically I believe in the suitable combination of all three, and also in the use of all other measures, medicinal, dietetic and hygienic which have been demonstrated of value, and it should be understood that the electro-therapeutic treatment in no wise interferes with other treatments, but gives the sufferer just that much added chance for recovery.

On the other hand the percentage of cures brought about by the three measures

keeping hold of them until the seance is ended and the current turned off again; thus avoiding all shock.

The average duration of each treatment is ten minutes and ordinarily a daily treatment is indicated, the exception being in cases which are running a high temperature, and the reason is that auto-condensation raises the temperature and in some cases might do so to an alarming extent if care were not exercised. On this account if a patient carries a temperature of 102.5 degrees or over, the first treatment should never be longer than five minutes, and a second treatment should not be given until the reaction from the first has subsided, which often

will be about the third day after the preliminary seance.

In this respect (temperature) a similarity will be noted between auto-condensation and tuberculin reactions. After two or three treatments a toleration is established and daily ten-minute treatments may be employed.

Cough, expectoration, and other symptoms are aggravated somewhat during the first

handles; the cushions preventing the two charges from neutralizing one another.

Thus the patient forms one layer of a condenser and as the charges are rapidly withdrawn and alternated, a nutritional wave or cellular massage takes place, upon which the value of this treatment largely depends.

Ozone may be used by means of the various instruments on the market for use in the physician's office, the inhalations

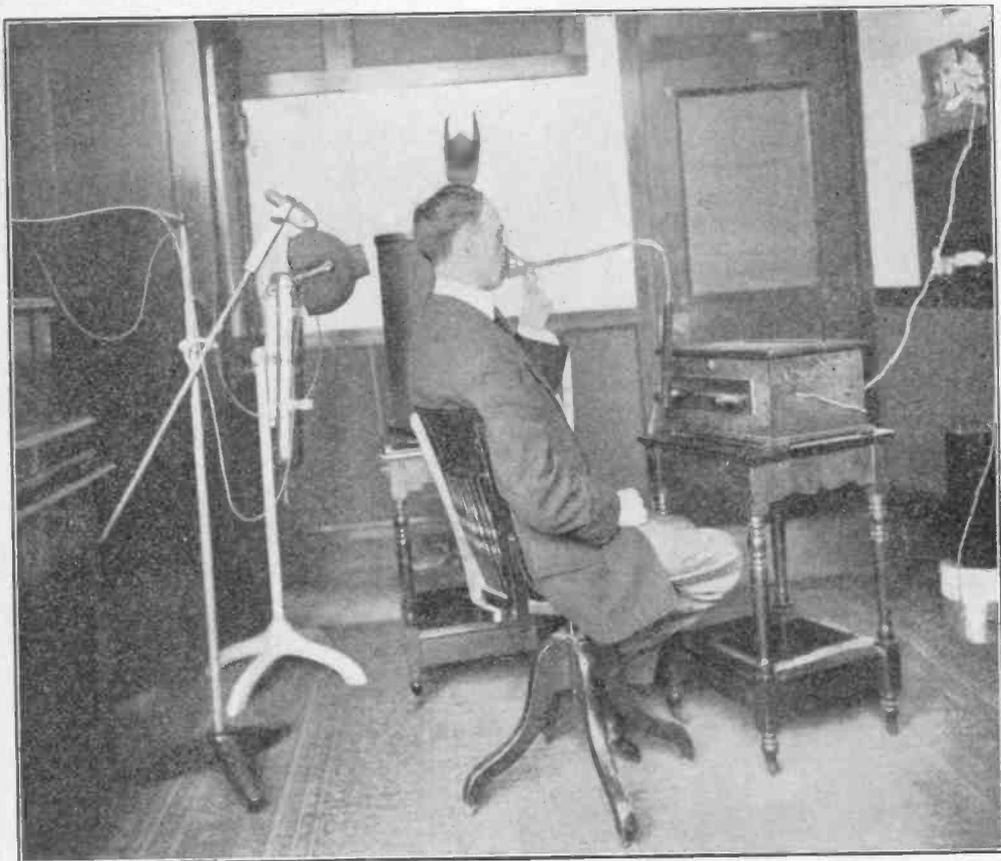


FIG. 6. PATIENT INHALING OZONE

three weeks of treatment by auto-condensation, after which noticeable improvement takes place.

In Fig. 5 the method of treating by auto-condensation is illustrated. Beneath the cushions of the couch are plates of zinc, a portion of one showing above the upper cushion in the illustration. The plates are charged with one form of electricity (either positive or negative) while the patient is charged with the opposite kind, through the

lasting from five to 30 minutes, as tolerated by the patient. One method of office treatment is illustrated in Fig. 6.

In my opinion a better method is the use of an ozone generator placed in the patient's room and run night and day, thus keeping the air constantly charged with the ozone. A moment's thought will convince anyone that this is much more sensible than crowding in the ozone for a few minutes and then being without it for the remainder of the

twenty-four hours, though equally necessary.

Ozone is produced whenever an electric spark passes through the air. At the same time nitric and nitrous oxides are liberated which are entirely unfit for inhalation. With the average machine, air charged with the ozone and the oxides is filtered through essential oils to remove the objectionable gases. I am inclined to believe that the greater part of the ozone is also disposed of by this process.

Theoretically it is possible to get the ozone strong enough to exert some corroding effect upon the red skin (mucous membrane) lining the air passages, but in reality there is no danger with any of the machines that I have investigated.

The ozone also removes offensive odors from the room, being a remarkable disinfectant.

The action of the X-ray upon the tubercle bacillus is first to stimulate its growth but

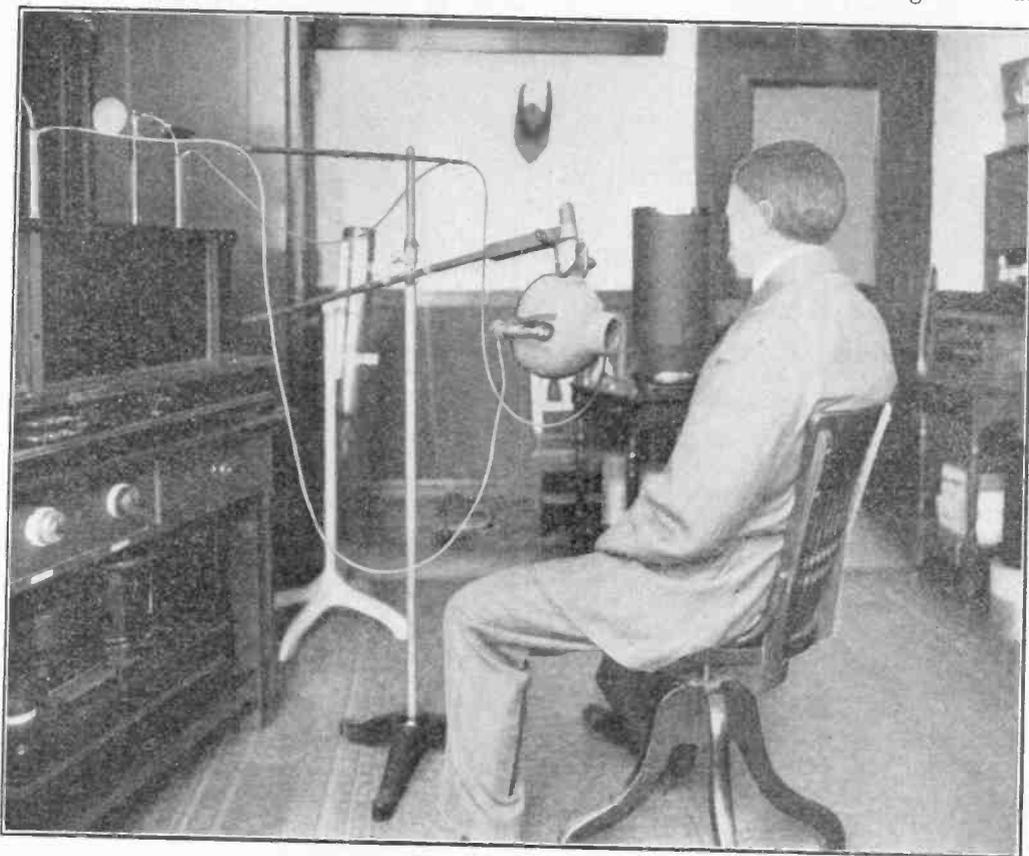


FIG. 7. TREATING A PATIENT WITH X-RAYS

Where the ozone is made by numerous fine contact points, so little of the nitrous and nitric oxides are produced that no filtration is necessary and this style for ozonizing the air of the room is my choice.

The instrument works directly from the alternating current light plug, and should be placed on a stand near the patient's head, if the latter is confined to the bed. The windows of the room usually should be kept open, top and bottom.

finally to carry this to the point of overstimulation and death as a result of inability on the part of the germs to reproduce themselves. It also calls out from the system its natural anti-toxic or disease-overcoming properties. It is our best electro-therapeutic method for tuberculosis of glands, bones, and all superficial forms, except lupus (tuberculosis of the skin); but in consumption the difficulty of introducing enough of the ray into the lung without first producing a burn on the skin

of chest or back has interfered with its more extended use.

In using the X-ray in tuberculosis of the lungs it is customary to expose first the chest and at the next treatment the back of the patient, thus avoiding too frequent exposure of the skin of either chest or back. In the illustration, Fig. 8, the position of the patient sitting in a chair with the X-ray shining on the chest is shown. The tube is enclosed in a protective shield, which only allows the rays to pass out through an opening toward the patient. The rays separate as they emerge, so that they may be considered as possessing the shape of a cone with the base entering the body of the patient. Although the aperture in the shield is small, they diverge sufficiently to include the entire chest at the distance which the tube is placed from the body.

In the illustration the patient is shown with all clothing on and it is my custom only to remove the outer garments, believing that a moderate amount of clothing protects the skin from some of the softer rays, which are those most apt to produce a burn, and at the same time the clothing offers no obstruction to the stronger rays that are required to penetrate to the lung tissues. The average duration of each treatment is from seven to ten minutes and the frequency about three times per week. Where used, as I advise, in connection with auto-condensation and ozone, a five- to eight-minute treatment two or three times a week is ample. The patient may be placed in the recumbent position if preferred, and the clothing removed, protecting the face with lead foil or other shield. Some operators use a thin sheet of aluminum over the chest, or else sole-leather, for the purpose of cutting out the soft or weak rays.

In treating tuberculosis of glands, bone, etc., the tube is brought relatively nearer the area treated than in treating the lungs, and a tube of medium vacuum at about 10 inches is suggested with five- to eight-minute treatments three times a week, protecting neighboring parts with a protective shield, or using a shield on the tube itself. Follow up each X-ray exposure with from three- to

five-minute treatments with the spark from the glass vacuum tube attached to the high frequency machine.

In tuberculous peritonitis the high frequency spark is superior to the X-ray, and should be used daily for eight or 10 minutes with two or three five-minute X-ray exposures each week.

Tuberculosis of the skin (lupus) is so extensive a subject that it will be separately considered next month. The result of X-ray treatment in various forms of tuberculosis has been the subject of some investigation, and the following table will give an idea of approximately the percentage of symptomatic cures which may be expected. By using the other measures described in this article in connection with the X-ray, the number of favorable results may be considerably increased.

Tuberculosis of the lungs	25 per cent
Tuberculosis of the glands	60 per cent
Tuberculosis of the joints	40 per cent
Tuberculosis of the long and flat bones	35 per cent
Tuberculosis of the peritoneum	40 per cent
Tuberculosis of the tendon sheaths	70 per cent

In all forms of tuberculosis except where the lungs are involved, a judicious combination of surgery with the X-ray frequently is indicated, and gives better results than either method alone.

GLOSSARY

Articular Cartilages—Cartilages between the articular surfaces of bones.

Bacillus—A rod-shaped germ.

Calcification—The deposit of a lime or chalk in the tissues.

Diagnosis—The art of distinguishing one disease from another.

Diagnostic—Aiding in or pertaining to diagnosis.

Expectoration—Spitting.

Fluoroscope—An instrument used to intercept the X-rays on a screen so that the shadows may be seen by the eye.

Ozone—A form of oxygen liberated by the passage of an electric spark through the air. Its chemical symbol is O₃.

Peritoneum—The sack or membrane lining the abdominal walls.

Peritonitis—Inflammation of the peritoneum.

Therapeutic—The application of any substance or method to the treatment of disease.

Tuberculin Reaction—A visible local or general reaction to a product of the germ of tuberculosis.



An Electrical "Violinist"

Musical purists will scoff at the idea that an electro-mechanical device of any description can draw real music from a violin. They will say that the delicacy of touch, the finesse of bowing and above all the feelings of the musician himself can never enter into a production, the interpretation of which is not inspired by the human soul. But comparatively few of us are musical purists, and no one with an ear attuned to musical harmony can listen to a performance of that latest triumph of human ingenuity—the automatic electric violin player—without having aroused in him the feeling that he is hearing and witnessing the supernatural; feelings which might have inspired Poe when he imagined that he heard an orchestra that "played fitfully the music of the spheres." This music which we hear is not produced by human hand but by that subtle force, Electricity, which pervades all the Universe, yet, in spite of the majesty of its power consents to divert a infinitesimal

portion of this force to the production of sweetest melody.

The automatic violin and piano or Violano-Virtuosa as it is called is electrical in its operation, the instruments being played separately or in unison as desired. Any

full-sized violin of the Stradivarius model may be fitted into the machine and played.

The violin is clamped in a horizontal position as shown in the picture. Directly over the strings are mounted a number of plungers so arranged as to press upon any string on any position, the same as the fingers of a human performer. These plungers are

not normally in engagement with the strings but when the right impulse of electric current flows through the little solenoids which operate them they are forced down upon the strings as long as the current flows.

Bowing is done by little disks suspended just above the portion of the strings usually touched by the bow. These disks are constantly revolving, driven by an electric motor. They also are pressed down to engage the strings by electro-magnet devices similar to those which operate the fingers. Lightly or heavily they operate; singly, or in unison for duets, trios and quartettes. This electric instrument



THE VIOLANO-VIRTUOSA

will also produce the tremolo, no fingering is too difficult for it and the fast passages can be played faster and more accurately than by a violinist.

At this point you ask "What is the solenoid or electro-magnet like, that

moves the fingers and the disks downward?"

A solenoid consists simply of a coil of wire through which current is passed. A strong magnetic field is at once produced within the coil. An iron plunger within the coil will then be sucked up or forced out of the coil, depending upon which way the current is flowing in the latter. By this principle the marvelous effects are produced. Special magnets produce the pizzicato, staccato, legato, bouncing bow, etc. The method of producing the tremelo is novel in that it is brought about by shaking or vibrating the tail-piece of the violin sideways, this as well as all other expression devices being brought about by electro-magnet plungers.

Another question which you will ask is how the current is supplied to the electro-magnets for exactly the right lengths of time. This is accomplished by a perforated paper roll similar to the one in an ordinary pneumatic piano player. The sheet passes constantly over a metallic roll which is always electrically connected to one terminal of all the electro-magnets. The other terminals of these magnets are then connected to as many metallic fingers, which bear upon the upper side of the moving paper strip. This strip, as we have said, is perforated in accordance with the music to be played, and as a consequence the various fingers of the electro-magnet circuits are allowed to come in contact with the metal roller through the perforations and complete the circuits of the individual electro-magnets at the proper time to play a particular note, bow a certain string, vibrate the tail-piece, etc. At the same time other perforations operate similar electro-magnets for the operation of the piano movement.

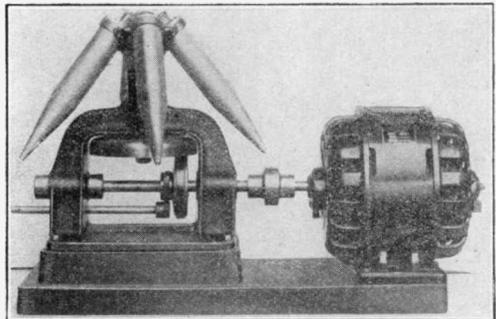
The violin is tuned by pressing a button, this causing the proper note on the piano to be struck; the "A" string on the violin is then tuned to harmonize with this note. The other strings may be tuned by pressing down on the bows and tuning the different keys until the strings exactly harmonize with each other.

A simpler and much easier way of tuning the violin is provided by pushing tuning buttons each arranged to sound two strings in unison and turning the keys until the two strings sound as one note. The violin is never taken out to be tuned, but is tuned in its position while in the machine.

Oil Testing Centrifuge

This odd appearing machine is an electric driven centrifuge for determining the percentage of sediment and water in crude oils. It operates by virtue of the centrifugal force developed by rapidly whirling the torpedo shaped tubes mounted on the machine at the left, and which are rotated by the electric motor shown at the right.

At a velocity of 1,500 revolutions a minute there is an outward pull of 320 pounds,



OIL TESTING CENTRIFUGE

exerted on the contents of each tube; or, in other words, the average apparent difference in specific gravity between the oil and the water it contains is 320 times the actual difference and is about twice this in the point of the tube where most needed. The separation is thus made about 300 times as rapidly as would be the case without rotation, and if the water and sediment were allowed to separate by merely letting the liquid stand.

The glass tubes are arranged so as to be surrounded by water in aluminum shields and this acts as a cushion and reduces the danger of breaking to a minimum. The arrangement provided for transmitting the power permits of gradually increasing the speed from rest to the desired speed, thereby eliminating the slopping of oil out of the tubes, while the power transmission system used permits the motor or shaft to be mounted with the axis in horizontal position.

It may be stated that the weight of tube, shield, water and oil sample, ready for rotation, is one pound and the distance from the axis of rotation to the center of gravity of each tube is five inches. About a one-fourth horsepower motor is required.

The Story of a Newspaper Scoop

At Glasgow, Scotland, in the city hall, Lord Rosebery delivered on a Friday afternoon in September a remarkable speech on matters of supreme importance to the people of Great Britain. He spoke from two to four o'clock continuously. In its own offices in Carmelite House, London—401 miles away—the London *Evening News* reported the speech, printed it verbatim, and had its edition on the street before the speaker had left the Glasgow city hall.

This extraordinary journalistic achievement was accomplished solely by virtue of

the *Evening News* to make a special effort to put London in possession of it with the absolute minimum of delay.

The task of organizing and carrying out a scheme such as this was no easy one. In the first place, the work of preparation had to be accomplished at lightning speed. The necessary permission was only obtained at 10:40 p. m. on the previous Wednesday. Two expert electricians went north by the midnight trains, and between 10 a. m. on Thursday and 10 a. m. Friday, the day of the speech, all the arrangements were completed.



Reproduced by Courtesy of the Telephone Engineer.

SCENE IN THE "ELECTROPHONE ROOM"

the powers of the electrophone—a specially constructed and extremely sensitive telephone devised by Giuseppe Angelini, an Italian scientist.

Had the ordinary means of telegraphic transmission been relied upon, it would have been impossible to give more than a summary of Lord Rosebery's eagerly awaited utterances.

But the importance of the promised speech at the existing juncture was such as to lead

Attached to the rostrum of the Glasgow city hall were the electrophone transmitters, in tiny brass fittings so unobtrusive that it is doubtful whether any of the vast audience noticed them. In the electrophone room at Carmelite House sat twelve shorthand reporters, each with a receiver at his ears.

Connecting these two distant points was a total length of 2,000 miles of telephone wires, weighing 1,600,000 pounds.

Along those thin strands of copper wire came the words of the great statesman. The well-turned phrases dropping from the lips of the speaker were caught up by the little transmitters, and with the incredible speed of electricity flashed into the ears of the waiting stenographers at Carmelite House.

For two minutes the trained pencil sped over the paper. For two minutes only, and then the timekeeper gave the signal and the writer stopped. It was the turn of the second reporter. He, too, accomplished his two-minute task, and so on down the line.

Meanwhile the first experts were transcribing their notes and handing them to sub-editors.

Slip by slip the copy went out to the linotype operators, who rapidly set it up in type, and a few minutes after Lord Rosebery had resumed his seat in the Glasgow City Hall, London was reading the speech; the vast audience 400 miles away had hardly finished applauding.

For the day's unique achievement the telephone trunk lines between Glasgow and London became practically private wires. At the Glasgow postoffice and at St. Martin's-le-Grand the wires were temporarily disconnected from the exchange operating boards, thus connecting Glasgow and Carmelite House direct.

While the speech was being reported, one of the staff of the London *Daily Mail*, the morning edition of the *News*, entered the electrophone room. He was moved to put his impressions into the following form:

"Cardboard labels with the printed word 'Silence' on every door in a certain corridor of the Carmelite House; guards at the top of both stairways leading to the corridor, keeping out all unauthorized persons; office boys and messengers hurrying, but hurrying furtively, treading as though on eggshells; a long row of mats, to deaden sound, leading to a green-curtained doorway.

"What is the meaning of these mysteries; what strange secret is behind that solemn curtain, from the other side of which not even a whisper comes? I—being an authorized and privileged person—am permitted to pass within.

"A dozen or so men are sitting round a long table, down the middle of which runs a baize-covered board. Attached to the board are many wires, which are twisted

together above and extend up and out of the room. Each of the men sitting at the table is holding with one hand a telephone receiver of unusual shape, fitted for both ears while with the other hand he writes.

"At one end of the table is a young man with a long bamboo wand. Every now and then he touches, with this wand, the head of one or other of the writers. As far as an outsider can tell, nothing happens when the scribe is tapped with the mystic stick—he keeps on writing, and says not a word. Standing round the table are other men—a few of them holding receivers to their ears, others looking on.

"It is a scene such as would cause a savage to depart hurriedly, howling 'sorcery,' a scene which even a few years ago would have been incomprehensible to any of us; would have savored of unholy magic. But, knowing what it meant, I took one of the receivers and held it to my ears. And then . . .

"I was tempted, myself, to cry that it must be magic, for surely no miracle of Paracelsus, no wonder of Battista della Porta or Cornelius Agrippa, no garden of glamor that Michael Scott created, was ever stranger than this.

"I held the receiver to my ears, and it took me away—took me like the Arabian Night's carpet—from London into a great hall 400 miles distant, where the greatest orator in the United Kingdom was delivering a speech of surpassing importance.

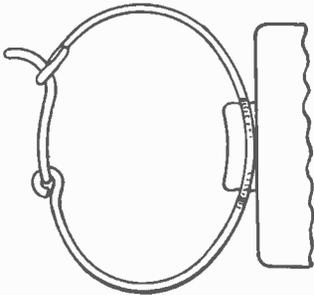
"Every intonation, every inflection, was as plain as if the speaker had been in the same room as myself. I listened, captivated, bewitched. I closed my eyes. Lord Rosebery thumped the table beside which he stood—in Glasgow. I heard him do it. He dropped his voice, raised it—that clear and marvelous voice. He was earnest, scornful, ironic, bitter—in Glasgow. I heard it all. I heard the applause (in Glasgow), the laughter, the 'Hear, hears,' the murmuring. He quoted a number of figures in connection with an assurance company. Every number was heard plainly at this end of the 400-mile-long wires.

"And so, from grave to gay and gay to grave, with its satire and scornful irony, its polished periods, its low-pitched sentences culminating in ringing eloquence, the speech was heard as perfectly here in London as in the Glasgow city hall."

Unusual Applications of Electro-Magnets

For the removal of iron and steel filings, and other magnetic substances from the eyes, the value and method of using the electro-magnet have long been recognized, but the cases under consideration are of rather an extraordinary nature, and show the possibility of adapting the electro-magnet to various other uses.

The first patient had accidentally broken off a sewing needle in the hand, and had failed to remove the broken piece at the time. The wound healed nicely, and no



A MAGNET TO BE APPLIED TO THE ARM

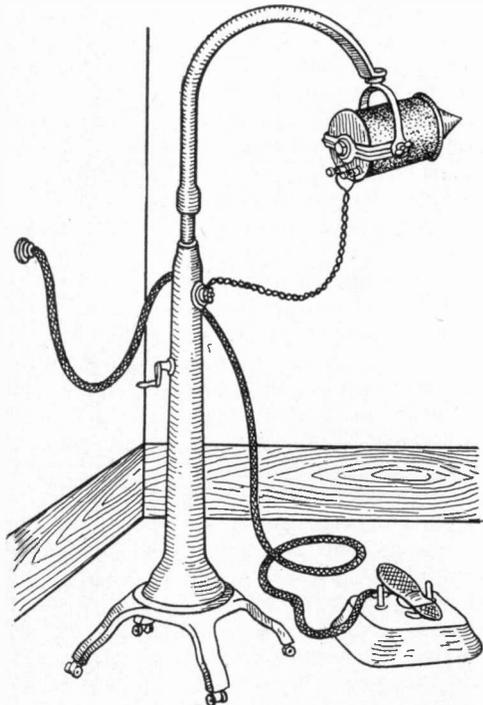
further difficulty was noticed for some months, at the end of which time a sensitiveness and a sharp pricking sensation was frequently felt at about the middle of the forearm, which indicated that the needle had traveled up to this point.

It was decided to try the experiment of drawing the needle to the surface by means of a powerful electro-magnet which would save a painful operation and leave no scar. A magnet was constructed of such a shape that it could be applied to the arm by means of straps, and connected to a source of current with a flexible cable. This magnet was applied to the arm and worn continually for several days, with the result that the needle worked itself to the surface, but was unable to perforate the skin. The magnet was removed, and a very slight incision enabled the broken piece to be removed with forceps, and avoided the necessity of a deep incision to extract same.

It was not necessary for the patient to be confined for several days, for this, of course, would have been very monotonous. The magnet was energized by means of a small storage battery, and a flexible cable, con-

necting the magnet and battery, allowed the patient almost complete freedom of the arm, and the battery was sufficiently light to permit of its being suspended over the shoulder by a small strap.

Another patient had accidentally swallowed a horse-shoe nail, which became lodged in the windpipe, too far down to be reached by external means without great danger of dislodging it and causing it to fall deeper into the passage way. It so happened that a very large medical electro-magnet could be had right away, and use was made of this to withdraw the nail by the following means: The patient was laid in a reclining position with the pole of the magnet close by the mouth, and the current turned on, after which a flexible silver tube



A LARGE MEDICAL MAGNET

was introduced through the patient's mouth and passed down the throat until it came in contact with the nail, which was dislodged by a few careful manipulations of the tube, and as soon as released it immediately jumped up through the tube to the pole of

the magnet. This simple operation undoubtedly saved the life of the patient, as it would have been extremely difficult to extract the nail, had it passed down the air-passages below the windpipe.

The magnet used in the latter case was of the straight-core type with a conical end, and capable of exerting a pull of 400 pounds on a tip one inch in diameter.

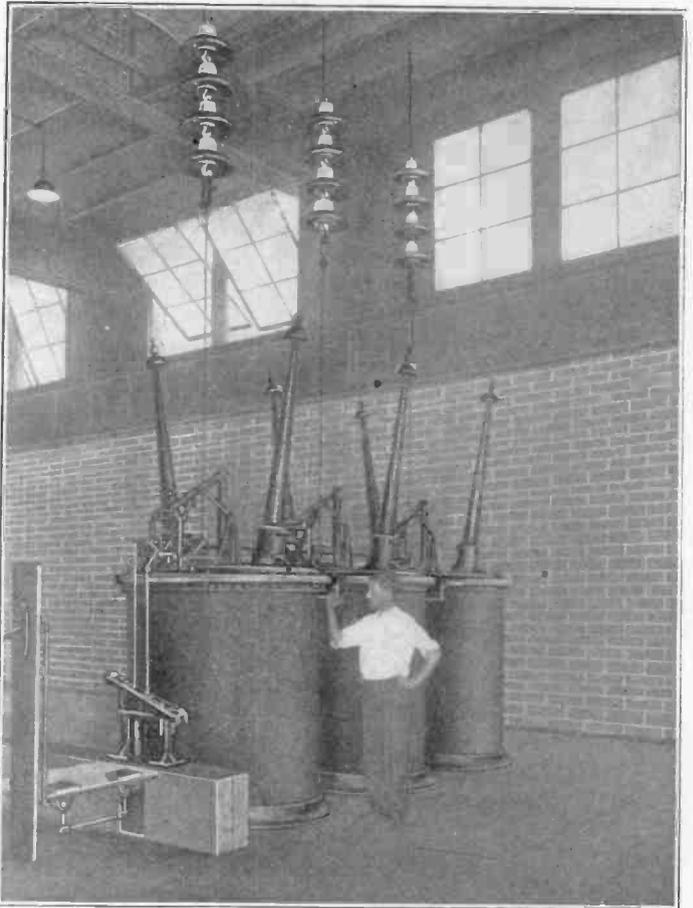
What Happens on a Short-Circuited Line

In any electrical power transmission system there are what you might call three sections or elements: first there are the dynamos which generate the current at a comparatively low voltage or pressure; next to them come the transformers which step this pressure up to enormously high values; finally the transmission wires themselves leading away from the transformers miles and miles across the country. The voltage or pressure which at all times exists between the wires of the line is enormous, although a charge cannot escape from one wire to the next because of the wide air space between them which is almost a perfect insulator.

We say that a charge cannot escape from one wire to the next—by this we mean under normal conditions. But accidents may happen which will allow current to flow from one of the wires to the next of many thousand volts lower potential. For instance, a small boy, or maybe a foolish grown-up person comes along and wants to see some fire-works, so he throws a piece of wire across the transmission wires. Here then is a path of small resistance for the eager current to flow across from one wire to the other,

which it does in a flash, forming what we call a short circuit. The wire which caused the trouble does not last for a breath of time. Thousands of horsepower of energy trying to rush across it melt it in an instant, even converting it into metallic vapor. This vapor will also carry current and constitutes what we call an arc—a veritable flaming discharge. Such arcs between the wires have even been known to have been started by owls or hawks trying to fly between the wires and touching the two with their flapping wings.

Now when such an arc or short-circuit is started there is trouble enough in the power station if protective apparatus is not installed. The dynamos, as we have said, supply the line with current in much the same manner that big pumps supply a



CIRCUIT-BREAKERS WHICH ARE THE SAFETY VALVES OF AN ELECTRIC SYSTEM

system of water mains. In a water system if one of the big mains should happen to burst it would correspond to a short circuit in an electrical system, only in the case of the pumps no particular harm would result. The pumps would simply deliver all the water they could into the system and let it go at that.

But a dynamo is constituted differently. If the engine back of it is powerful enough the dynamo will work so hard that it will burn out its own windings in order to pump current through the short-circuit. In fact it would work itself to death, unless, perchance, the transformer should commit suicide first.

When a short circuit occurs, therefore, it is necessary to take the dynamos off the line very quickly so that they cannot do themselves harm—and this is done automatically by what are called circuit-breakers, which are a form of automatic switch to break the connections before harm can result to the generating apparatus.

There are various kinds of circuit-breakers, and of all sizes, from the little ones which occasionally you have seen open with a blinding flash on the front platforms of street cars to the great oil type taller than a man as you may see in the accompanying picture.

These oil circuit-breakers are large oil tanks. One of the line wires enters each tank and is connected to a plunger-like terminal. This terminal normally rests in contact with another terminal near the bottom of the tank. By a gravity operated mechanism these terminals can, however, be separated to a distance of 47 inches. The gravity operated mechanism is released by the tripping of a little catch, the tripping being accomplished automatically by what is called a solenoid and which responds to any undue rise of current in the line such as would be caused by a short circuit.

When a short-circuit occurs somewhere out on the line the circuit-breaker immediately acts and opens the line before harm is done, the opening or breaking being done under oil so that there is no dangerous flash to present a fire hazard.

The circuit-breakers which you see in the picture will open safely a line carrying 110,000 volts pressure. They are used in the service of the Southern Power Company in the vicinity of Charlotte, N. C.

An X-Ray Proof Box

Physicians and others who employ X-rays find at times that their photograph plates have been spoiled without their knowledge, till too late, by the penetrating rays from the apparatus which may reach these plates even though they are stored in another part of the room. Dr. M. H. Farmer sends us the following description of a simple means of protecting the plates when not in use.

"I took a tin can that originally contained Nabisco wafers, which was kindly donated by my grocer. He also gave me a lot of heavy lead foil backed with paper that came around tea cases. The foil in this case was extra heavy and excellent for the purpose.

"I covered the box, lid and all, using a good carpenter's glue. I then made a wooden box large enough to take in the tin box, lining the former also with the lead foil and providing it with a tight fitting foil lined cover.

"With this X-ray proof box I found that plates kept perfectly for six months and they would probably keep much longer if not required for use."

Time Service by Telephone Companies

Selling time service as a by-product is the newest field upon which a telephone company may enter. The furnishing of standard time by the Western Union Telegraph Company for many years has proved such a scheme to be practicable, although the latter company has never extensively pushed the sale of its by-product. That a telephone company might profitably give this kind of service in the homes and business places of its subscribers was the idea of H. C. Todd of Missouri, secretary of the Telephone Association of the "Show-Me" state. Mr. Todd was the manager of a telephone exchange and one of his customers was using an electrical time stamp. The manufacturers of this stamp asked Mr. Todd to return it to them as they wished to replace it with an improved type. But he refused to do this, saying that one of his customers was paying him good money for the service. He said further that, while on the subject, he wished that the manufacturers would send him some

time clocks as he thought he could sell time service to some of his business people.

This idea set the manufacturers thinking, with the result that they have originated and developed to a practical stage a complete electrical clock system by means of which any telephone company may furnish standard time over its lines to any of its customers. This system is the product of two years of painstaking research and experiment.

At the subscriber's station is located an imposing clock. In the back of this clock will be found only a ratchet wheel to move the hands and a relay to operate the ratchet. Once every minute the current from the telephone exchange, under the control of a master clock there, moves the hands ahead.

The master clock is controlled and regulated to standard time automatically as in the case of master clocks employed by the Western Union. The master clock does not send the current impulses direct to the subscribers' clocks but to a number of secondary or intermediate clocks. These in their turn operate the subscribers' clocks.

Electrically Heated Oil Tempering Bath

The oil tempering bath is very largely used by manufacturers for the purpose of tempering steel tools or dies. It has been common practice to heat the bath by gas, but as very close regulation of temperature is essential for a uniform quality of product, gas heating has not proved satisfactory. Added to this is the ever present fire hazard due to the excessive heat possible when gas is used.

As is often the case, the use of electricity has been advocated as a solution of the problem of proper oil tempering, and there has recently been perfected an electrically heated oil bath which seems to meet all the requirements of such apparatus.

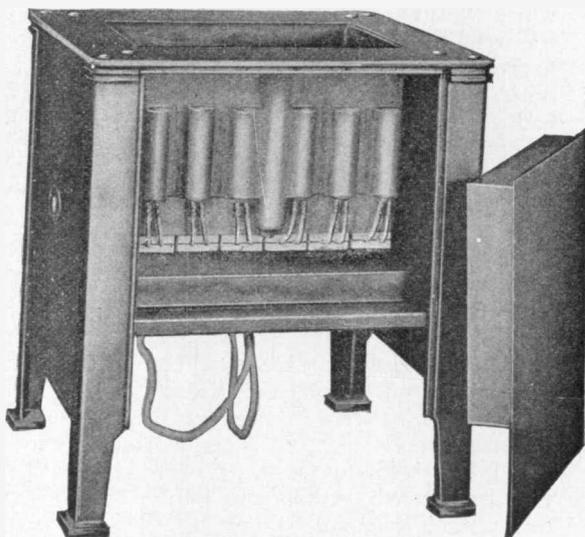
The bath proper consists of a cast iron tank, or pot, having twelve lugs evenly spaced around the sides. These lugs are drilled to receive standard cartridge type electric heating units which embody coils of fine wire which are heated to a high temperature by

the passage of electric current through them. Around the pot is placed a heat retaining jacket consisting of an inner and outer wall of sheet metal, the space of three inches between the walls being filled with mineral wool. There is a protected recess in one end of the pot, not shown in the illustration, in which a thermometer can be placed to indicate the temperature of the oil.

There are two methods of using the oil bath. In the first method the temperature of the oil is raised to about 250° F., the work placed in the bath and full heat turned on.

When the oil reaches the desired temperature, the work is removed and the current turned off. This method requires a single heat bath. The second method is to turn on full heat, bring the oil to the desired temperature, then introduce the work, and by means of regulating switches maintain that temperature constant any length of time desired.

Where desired, a cast iron basket or tray is supplied in which the work can be placed. The basket has eye bolts at each end to facilitate handling. The bottom of the basket is perforated with $\frac{3}{8}$ -inch holes permitting free circulation of the oil. There are also legs provided on the bottom of the basket which keep the work, which is to be tempered, an inch or more above the bottom of the bath.



ELECTRICALLY HEATED TEMPERING BATH

The Search for Submarine Treasures

By V. FORBIN

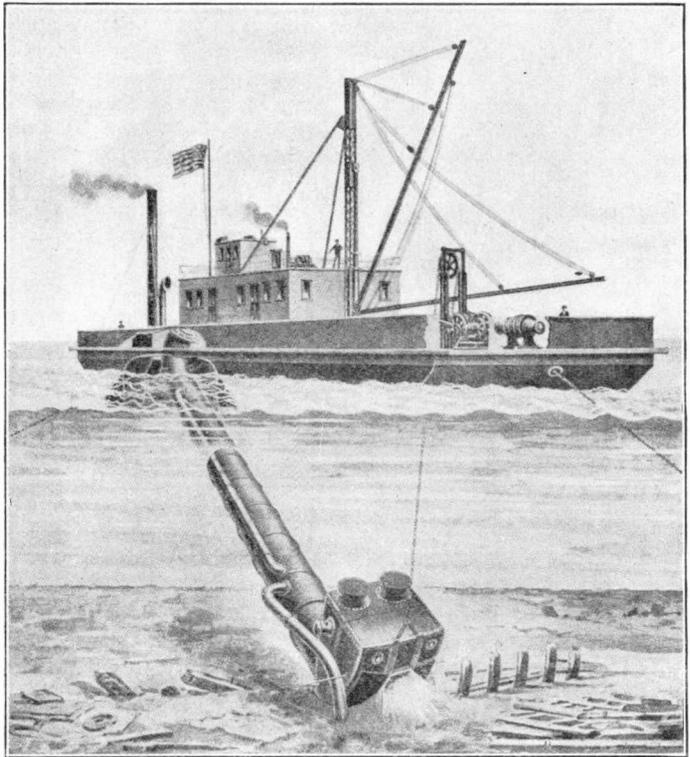
Two years ago, a great deal was said about a submarine engine invented by an Italian engineer, by the aid of which it was going to be easily possible to recover treasures lying at the bottom of the sea in shipwrecked vessels. It appears that the hopes founded on this apparatus have not been realized, inasmuch as Mr. Simon Lake, inventor of the type of submarine that bears his name, has been commissioned to construct an engine intended for the same purpose, for an English salvage company.

We note to begin with, that this company is not engaged in a vain quest, as have been so many other companies which, at various times, have been organized for the exploration at the bottom of the sea, for a Spanish galleon of problematical existence.

On the 9th of October, 1799, the English ship-of-war, Lutine, carrying a treasure of nearly 30 millions of francs in gold and silver bars and in coin, which the London cabinet was sending to Hamburg, to avert a great financial crisis there, and which had been insured for £1,060,000, ran aground in the offing of the entrance to the Zuyder Zee. Under the pressure of France, at that time at war with England, Holland took possession of the precious wreck, and the salvors were set to work. But the encroachment of the sand produced by a tempest, soon forced them to abandon the enterprise.

After the re-establishment of peace in Europe, towards 1820, the King of Holland ceded his rights to the King of England, who transferred them to the Lloyds Company. This company, during the course of the nineteenth century, tried five times to

explore the wreck, taking advantage of the calms succeeding violent tempests, during which the sand had been washed away from above the ship. These efforts were not without results, as they permitted the recovery of 198 bars of precious metals and 12,000 pieces of gold and silver, making a total value of more than 2,700,000 francs. Finally, the Lloyds Company entered into



SEARCHING FOR SUBMARINE TREASURES

a contract with a special maritime salvage company, which company commissioned Mr. Lake to design an engine which would facilitate the thorough and systematic exploration of the wreck. Constructed at Wyvenhoe, England, the machine designed by this eminent engineer, will go at once into service.

It was, first of all, a question of raising a quantity of sand, estimated at 40,000 tons, accumulated on the wreck and around it,

and also to take out the sand from the interior of the hull, after having removed the deck in case it still exists. For this purpose, the inventor has constructed a large pontoon with a flat keel, 41 meters long by 14 meters wide, furnished with powerful electric windlasses and admitting of a kind of well to serve as a protection to the submarine engine that we are about to describe. The engines on board operate two powerful centrifugal pumps, constructed especially to suck up the sand. Two other pumps of less power are connected with the submarine working chamber; these serve more especially for the clearing out of the interior of the wreck, and will be used to good advantage for the protection of the divers against the encroachment of the sand.

These four pumps have a capacity of evacuation, of 40,000 tons per 24 hours of work. Their enormous power will permit of the clearing of the wreck in a few days, and this to take advantage of the summer calms. They will rapidly remove the sands washed up by great storms.

Our illustration shows the method of operation of this submarine apparatus, which is composed of a pipe and of a working chamber. The first, 51 meters long, with a diameter of one meter is made of steel plate; its upper extremity is connected by hinges with the interior of the pontoon. An interior ladder gives the operators access to the working chamber; water-ballasts running the length of the exterior walls, facilitate the plunge.

The working chamber, also constructed of steel plates, is based on the same principle as that of the submarines of the Lake type. Being eight feet in length and width, it allows of two large doors which give passage to the divers, and it can instantly be filled with compressed air. Finally, it is pierced by several light-ports through which the operators can examine the bottom of the sea by powerful electric searchlight reflectors arranged in the interior of the chamber.

This is the way in which the curious engine is managed: If it is a question of working

on a wreck the location of which is already known, the surface boat, drawn by a tug, takes its place, and the tube, with its working chamber, is let down by chains in the direction and to the depth desired. On the contrary, if it is necessary to search for the location of a wreck, the submarine chamber, thanks to the action of the water-ballasts, will be kept at the bottom of the sea, in such a way that a wheel, ingeniously fastened below the chamber, comes in contact with the earth. This wheel, provided with great teeth, can bite into the most slippery rocks. It is operated by an electric motor placed in the chamber, and mounted so as to turn in any direction required, like a unicycle, and to pass around rocks and other obstacles. In its action, it carries along, not only the submarine parts of the engine, but also the surface boat. This happy arrangement permits, therefore, of the thorough and methodical exploration of the bed of the sea.

The principle of the mixed submarine of Mr. Lake will be applied later to another use, notably that of the exploitation of pearl-oyster banks. Our illustration shows the engine applied to an operation of this kind. Two dredges, operated mechanically, will be connected with the axis of the chamber by hinge-levers, and the dentated wheel described above will drag the engine (including the surface boat) along the whole length of the bank. The dredges, when filled, will be managed by an interior lever which will make them turn on the axis so as to pour their contents into a car sliding along on rails arranged the length of the tube, and which will bring the oysters to the surface.

It is expected that this engine will yield excellent returns in the clear waters of Ceylon, and that in one day as many oysters will be harvested as could be brought up by several hundreds of divers; but the recovery of submarine treasures will remain its principal application, and there will be no lack of employment in this direction. The hunters for treasures of this kind have already made out a list of the most famous wrecks.—*Translation for Popular Electricity from La Nature, Paris.*

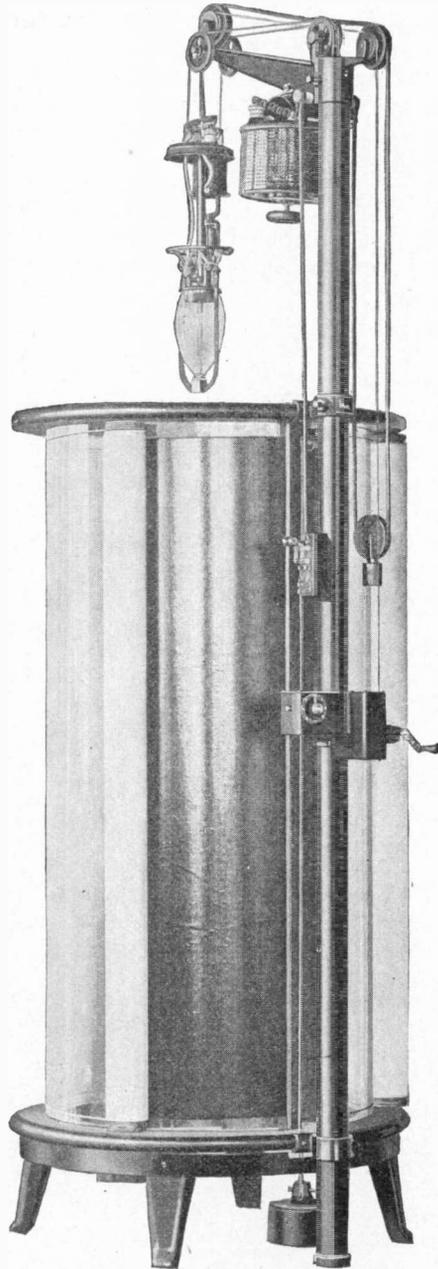


Making Blue Prints by Arc Lamp

The reproduction of original drawings in the form of blue prints, black, brown and VanDyke prints has become an important subject, and, by the way, quite a problem to the great majority of manufacturing, railroad, construction and engineering companies requiring them. Original drawings, which are usually of considerable value, are now considered a part of the permanent records and as a result are not allowed outside of the drafting room or office of the company owning them, necessitating therefore the production of exact and accurate copies for use in the operating end of the plant, and for mailing, advertising and numberless other purposes. In many cases these copies are required in large quantities and upon a moment's notice, and an efficient apparatus for making them should be provided.

Until quite recently Solar printing, which was accomplished by exposing the tracing and sensitized paper to the sun's rays by means of a frame with a glass top so arranged and located that it could be easily exposed to the sun, was the method in general use. The impracticability of making these frames large enough, the limited capacity of them, unfavorable weather conditions and countless other objections, such as the demand for prints for night working forces, prints in large quantities at reduced cost and uniformly clear and distinct prints at all times, opened a field for the electric blue printing machine which substitutes electric light for sunlight. Such a machine is shown in the picture.

It is composed mainly of a cylinder formed by two half cylinders of bent plate glass held in position by a frame. Each half of this glass cylinder is provided with a curtain, the duty of which is to hold the tracing or drawing and the sensitized paper tight against the glass during the exposure, without slipping and bulging. The arc lamp, which is supported by the crane, travels down centrally through the glass cylinder while making the exposure, its speed at the time being regulated by a suitable governor. The printing process is the same as in photography, the sensitized paper, which afterwards becomes the blue print, taking the place of the photograph printing paper and, the tracing from the drawing, made on transparent tracing cloth



ARC LIGHT BLUE PRINTING MACHINE

taking the place of the photograph plate or film.

The arc lamp used for this purpose is especially constructed for blue printing and gives out light rich in actinic or violet rays.

The travel of the lamp through the glass cylinder while an exposure is being made is controlled by an automatic shaft governor.

Resistance, Current and Voltage

There is a popular and deep-rooted notion among some students in electricity that the greater the resistance of a wire, the more current will be required.

This is a fallacy that should be "pulled out by its roots" to prevent further confusion in the minds of the students and also to prevent further dissemination of such a notion.

In order to correct the above fallacy, let us refer to Ohm's Law, which is the most important one in the study of electricity.

According to this law, $C = \frac{E}{R}$, that is, the

current (measured in amperes), is equal to the electromotive force (measured in volts), divided by the resistance (measured in ohms).

If, in this formula, $C = \frac{E}{R}$, we substitute fig-

ures in place of letters, and alter the figures in such a way as to still have a correct equation, the fallacy of the above statement will become apparent.

Let us take some figures and form an equation which we know is true, such as

$6 = \frac{12}{2}$. Here the C is represented by 6, the E by 12 and the R by 2.

Keeping in mind this last equation, $6 = \frac{12}{2}$,

it will be evident that as soon as we change the denominator (the 2 in this case), we alter the value of the quotient; it will be either increased or decreased. Let us change the 2 to 4, and our fraction now

reads, $\frac{12}{4}$. But now the quotient of this

number no longer equals 6 but 3. The quotient 3, thus derived, is evidently less than 6. Hence, increasing the denominator of the formula, decreases our quotient. Likewise decreasing our denominator in

the formula, $C = \frac{E}{R}$, increases (C), our quo-

tient obtained by dividing E by R. Therefore if the resistance of a wire is increased the less is the quotient or the less the current that will flow through such a wire.

This, of course, holds true only when no change is made in the voltage. When the resistance has been increased and it is desired to place the same amount of current in a circuit as it had before, this can be accomplished only by raising the electro-motive force.

To illustrate: Assuming we have a circuit where the electro-motive force is 12 volts and the resistance 2 ohms; the current

then would equal, by Ohm's Law, $\frac{12}{2}$ or 6.

Now supposing conditions were such that the resistance had been increased to 4; our current then would equal the quotient

$\frac{12}{4}$ or 3, therefore 3 amperes. If the

current is to be the same as it was before, i. e., six amperes, the only way this can be accomplished is to raise the voltage; in this case it would have to be a voltage equal to a number, which when divided, by 4 would equal 6; this number evidently is

$\frac{24}{4} = 6$.

Therefore, to furnish the same amount of current in a wire, the resistance having been increased, it will be necessary to raise the electro-motive force.

The electro-motive force in such a case must be increased in the same proportion as the resistance is increased. Therefore, the greater the resistance, the greater must be the electro-motive force, if the current (in amperes) is to remain the same as it was before.

S. NOLTE, JR.

Corrections

In the December issue, on page 548, there is a typographical error in the first line of the announcement "In the Beginning," the year 1850 being mentioned, whereas it should have been the year 1880.

On page 487 of the same issue, in Prof. Edwin J. Houston's serial article "Elementary Electricity," the statement is made that the quantity of electricity flowing in a circuit "decreases with a decrease in the resistance." This should have read, "increases with a decrease in resistance."

Suggestions Wanted

To the Editor of Popular Electricity:

We are told that the average efficiency of an ordinary steam boiler and engine in output of energy is equivalent to approximately seven per cent of the total heat energy in fuel consumed, and that the maximum result secured under ideal conditions does not exceed 17 per cent. Then a method of generating energy which shall increase the output 100 per cent, or, say, decrease the cost of power by 50 per cent, would mark a revolution in the business of power production all over the world. Granted that such a plan is feasible by the use of more or less well known natural laws, I would like to obtain, through *Popular Electricity*, the opinion of as many readers as possible, of the best method of setting about to reap the largest financial reward from such a discovery, yet at the same time avoid the disturbance to established industries which might arise from such a proposal.

The argument is, that the means adopted for bringing about such a result may not be patentable and therefore cannot be disclosed prematurely, nor should one nation be placed in a position to take advantage of the discovery ahead of others, but that the method should be on some predetermined date given to the world simultaneously, and controlled by proper interests in each country who would recoup themselves for the cost, and reap a substantial profit besides in the exploitation of the energy throughout the civilized world, thus cheapening production.

I would like your readers to kindly favor me with an expression of opinion on how this should be best attained on the assumption that, that which is referred to is available.

F. P. RONNAN.

[The above may appear like seeking means for disposing of our chickens "before they are hatched." But it will not do any harm to give the subject some thought. Every one laments the fact that under what are ordinarily termed good working conditions 90 per cent or more of the energy in coal is lost and never performs useful work. Bright minds are however constantly at work on the problem and some day a world-startling discovery will be made. How to reap the most substantial profits when the discovery is made is one question.]

Christian Science Healing by Telephone

To the Editor of Popular Electricity:

In an item published in your January issue under the heading, "Christian Science Healing by Telephone," reference is made to what is reported to be the custom of giving "absent treatments" over the telephone between certain points named. Will you permit me to say that no legitimate use of the telephone could be made in such a manner as that described. The telephone is often found to be very convenient for those who feel in need of help and who wish to ask a Christian Science practitioner for treatment. In such instances the patient would merely use the telephone to acquaint the practitioner with his condition, and the practitioner would not be at all likely to do more at the moment than to say a few words of encouragement to the patient and assure him that the treatment would be given immediately or as soon as possible. The mental process known as the treatment would take place entirely within the consciousness of the practitioner and therefore would not be "projected" to the patient over a telephone wire. It is obviously impossible for silent prayer to be conveyed from place to place by wire. So in answer to your question, let me say that it would make no difference whether the telephone connection was "pulled down" or not after the practitioner had received the call for assistance. As you say, the question "is non-electrical," and I have therefore undertaken to answer it briefly from the metaphysical standpoint.

Christ Jesus said, "Ye shall know the truth, and the truth shall make you free." According to Christian Science it is Truth which makes free from bondage to sin and sickness. It need make no difference to the one seeking help from Christian Science whether the liberating truth comes to his thought through conversation, through reading and study, or through what is known as present or absent treatment.

Thanking you for the privilege of making this explanation, I am.

Very truly yours,

GEORGE SHAW COOK.

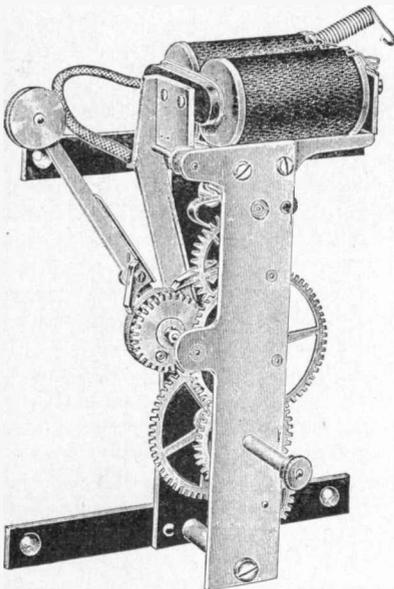
Christian Science Committee on Publication for the State of Illinois.

Boiler Indicating System

An electrical indicating system similar to the hotel and theatre carriage call device is employed in the great power house of the New York Edison Co., for indicating in the boiler room at any moment the number of boilers needed during the next 15 minutes. The system operator stamps the perforating card with the hour and date and places the card in the signaling machine, the corresponding number instantly appears on the board in the boiler room.

Clock That Winds Itself

The cut shows the interior mechanism of a new kind of clock which winds itself by means of two little electromagnets. The clockwork is operated by a weight and this weight is wound up at regular intervals by the electromagnets. The method is exceedingly simple. When it is time to wind, the circuit carrying current from a battery to the coils of the electromagnets is closed by



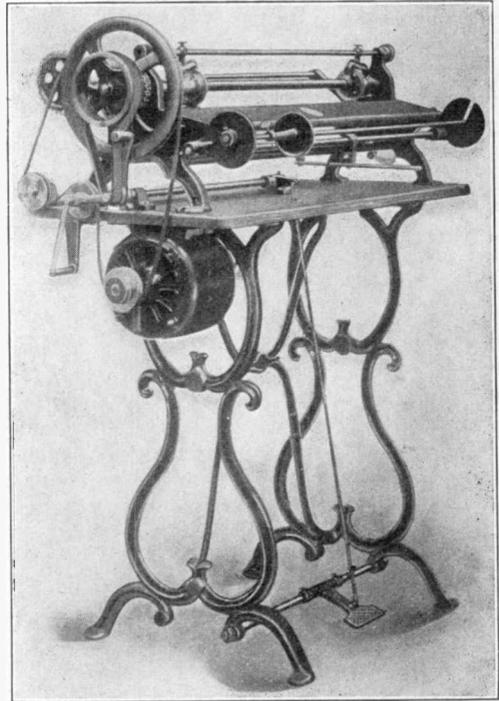
SELF-WINDING CLOCK MOVEMENT

a simple means actuated by the clock work. The electromagnets then begin to operate like the magnets in ordinary induction coils or in a telegraph sounder; drawing down the armature and letting it go again automatically. This movement of the armature to and from the pole pieces of the electro-

magnets moves a lever which, by a system of pawls and ratchets familiar to mechanics, moves the winding mechanism. The current is automatically shut off by the clock when the proper amount of winding has been done.

Wall Paper Trimmer

Development of a means for further increasing the usefulness of wall paper trimmers has recently been successfully com-



WALL PAPER TRIMMER

pleted by the addition of a small electric motor to drive a modified form of the hand wall paper trimmer. The construction is such that the operator has full control of the machine, being able to start and stop instantly, go slow or fast, and the only effort required being a pressure of the foot.

It will be readily seen that this is a great advantage over the old way of turning the crank, as it gives the operator free use of both hands. While the user can turn out double the work in the same time with the greatest ease, the cost for power is very small, as the motor used is of only $\frac{1}{2}$ horse power.

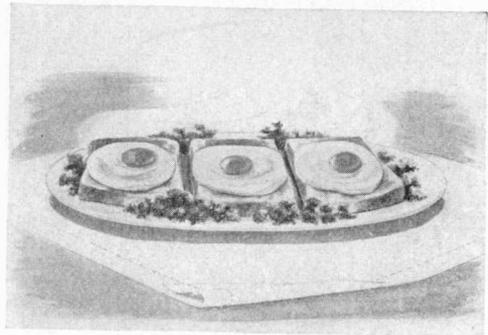
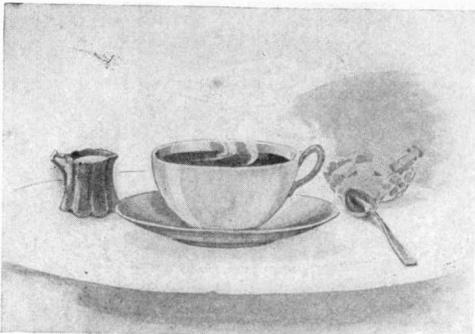


ELECTRICITY IN THE HOUSEHOLD

Cooking on the Table

We hear a great deal nowadays about being able to cook a breakfast on the dining room table by the aid of electric cooking utensils. Some few are inclined to think that this is more or less playing at the game of house-

of year, in 18½ minutes, starting with the stove cold. It will make two slices of toast and fry an egg in 4½ minutes from the time the current is turned on. It may be operated constantly for an hour at a cost of from three



AN APPETIZING BREAKFAST

keeping. But that it is not is evidenced by the increasing number of electric breakfast table utensils going into the homes.

Is the idea new to you? Have you ever wished for a device to make cooking easier? Your grandmother was satisfied with a fire-place; your mother was delighted with a stove or range; you once thought a gas range to be the acme of perfection. But perfection is never reached and electricity is right now working a change in household methods as radical as did the cook stove and the gas stove in their times.

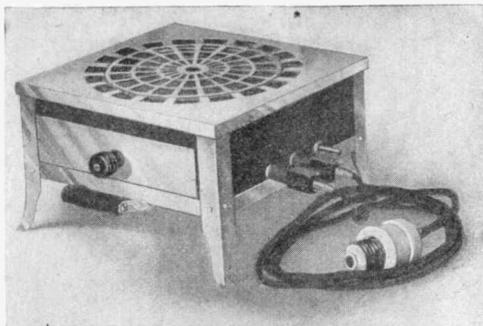
For instance there is the electric stove and toaster—a table outfit. Think of it! Your optimistic dream is realized. It does any kind of light cooking, toasting and chafing dish work. It will actually boil a full quart of cold water, from the hydrant at this time

to six cents, depending on the heat used and the cost of current.

Toast is made in the little sliding grid. On the top the coffee is made and the eggs fried or any dish whatever kept constantly warm on the table.

Do you enjoy a hot lunch after the theater? Have your friends learned to expect something dainty from the chafing dish when they call upon you? You and they will enjoy these things if the smelly alcohol lamp, which splashes over or goes out at just the critical moment, is discarded and its place taken by the electric stove which can be used in such a variety of ways.

The following dishes are a few of the many which can be prepared on this little table stove without the necessity of starting up the range.



ELECTRIC STOVE AND TOASTER

Lyonnaise Potatoes

One tablespoonful of butter,
One onion chopped fine,
Twelve cold
boiled potatoes, cut into
dice,
Parsley, salt,
pepper.

To the butter and onion add the potatoes and stir quickly for five minutes, using the high heat, taking care they do not stick to the pan; season with salt and pepper, add chopped parsley, drain and serve.

Oyster Pan Toast

One dozen large oysters
One tablespoonful of butter
One cup oyster juice
Two slices toast.
Salt, pepper.

Melt the butter and as it creams add oysters and juice. Season with salt and pepper. Cover and cook two minutes. Serve on hot toast, moistened with oyster juice. Use thin slices of stale bread for the toast, toasting it in the stove drawer.

Shrimp Wiggle

One cup shrimps
One cup canned peas
Four tablespoonfuls butter
One and one-half cups milk
Two tablespoonfuls flour
Salt, paprika.

Melt butter and add flour, with salt and paprika, stirring constantly, then pour the milk on gradually as soon as the sauce thickens. Add the shrimps broken in pieces

and the peas drained from their liquor.
Golden Buck

Two cups grated cheese.
Salt, paprika.
One cup milk
One-quarter teaspoonful mustard.
Six squares buttered toast
Six poached eggs.

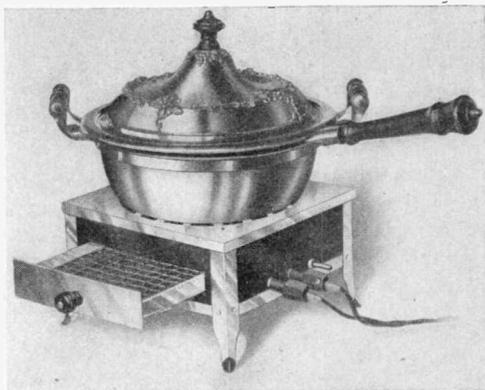
Boil the milk in a granite saucepan; add the cheese, mustard, salt and paprika; stir constantly until the cheese is melted. Have the toast ready (made in the drawer) and pour enough of the cheese over each piece to cover it; place a carefully poached egg on the top of each piece; dust lightly over with pepper and salt and serve immediately.

English Monkey

One cup soft bread
crumbs
One cup milk
One cup grated
cheese
One tablespoonful
butter
Two eggs
Salt, paprika
Toast or saltines.

Make the toast in the stove drawer while you are preparing the rest. Soak bread crumbs in milk; melt butter and add cheese; when cheese has melted

add soaked crumbs. Slightly beat the eggs and add to the cheese mixture. Season, cook three minutes and pour over toast.



IT IS IDEAL FOR THE CHAFING DISH



OR FOR MAKING THE COFFEE

One Day in the Electric House

Jones was what you might call well-to-do. He wasn't rich by any means, but he owned his home and took pride in it. As a consequence he determined to make it up-to-date by using electric current for household purposes wherever possible, especially as electricity was no longer looked upon as a luxury but a convenience which was at the same time an economy. It is needless to say that Mrs. Jones was heartily in accord with his determination to "modernize." When everything was finally installed and the "push-the-button" regime had begun, a typical day in the Jones' household was something as follows:



A Delightful Breakfast

Jones wanted to get down to the office early that morning so the electric alarm clock "got busy" at the specified time of arising and kept going till Jones turned off the switch. It was one of the first wintry days of late fall, and as he hopped out of bed he snapped the switch of the luminous electric radiator which immediately gave out a comforting heat by which to dress.

The household didn't boast of an early rising janitor and consequently the heating plant in the basement was not up to working pitch so early in the morning and the radiator became almost a necessity to Jones. For the same reason, real good, hot water for shaving was not available at that early hour. But this made no difference for attached to the spigot in the bathroom was an instantaneous electric water heater. After the shave he indulged in an electrical massage, congratulating himself meanwhile that he could indulge in this 25-cent luxury every morning without raising his current bill more than a few cents in a whole month.

Having shaved and dressed he repaired to the dining room, without delay, for since the advent of electricity it was not necessary to rout the whole family out at an early hour for a "regular" breakfast. On the dining room table stood the coffee percolator, an electric frying pan and a bread toaster, the electrical connections already made to the sockets of the electrolier above the table. Snap, snap, snap—the three switches were

turned in a jiffy and the water almost immediately began to bubble in the percolator.

The cook had left some slices of bread, a few strips of bacon and a couple of eggs on the table the night before and had also "loaded" the percolator. It was only a few minutes before he had turned these materials into an appetizing breakfast. Did it taste good to

him? Of course it did. He made it himself, didn't he?

Glancing up at the electric clock he saw that he had plenty of time to make his train, so he passed leisurely through the hall, not forgetting to light his cigar at the electric lighter which hung conveniently near the door.

Only one incident occurred to mar his "get-away." He inadvertently stepped on the electric burglar alarm matting without first disconnecting the circuit for the day, and set bells ringing in different parts of the house. But as he said to himself, it was time somebody else was up besides himself anyway.

Jones had no more than left the house before Sarah the cook was busy in her electrical domain. Sarah, by the way, had been with the family ever since the electric "fixings" as she called them, had been put in, and in all that time there had been no indications of an uprising. Her kitchen was a model of simplicity, compactness and neatness. There was the electric range with a full complement of utensils from cereal cooker to oven, each responsive to the turn of a switch. In addition there were an egg beater, meat chopper, coffee grinder, potato parer, ice cream freezer, cream whipper and other "tools of the trade," all mounted on a circular table and arranged to be driven by a single motor at a moment's notice. She also had an electric refrigerator which would keep the meat and vegetables cool and at the same time make 10 or 15 pounds of pure ice in a day for the family consumption.

In the meantime, Marie, the maid, who was the only other servant, had been through the downstairs rooms with the electric

vacuum cleaner and the rugs and curtains were clean and fresh as the day they were bought.

After she had arisen, Mrs. Jones' first care was the baby's bath, and she called Marie over the house telephone to come and prepare for this delightful function which



This Delightful Function

took place beside the electric radiator in a tub of electrically heated and sterilized water.

Breakfast over and the children off to school, Mrs. Jones did some sewing which to her seemed more of a diversion than real work because the machine was operated by a motor and there was no exhausting pedaling to do.

Lunch was a function which the children enjoyed, because mother always cooked it



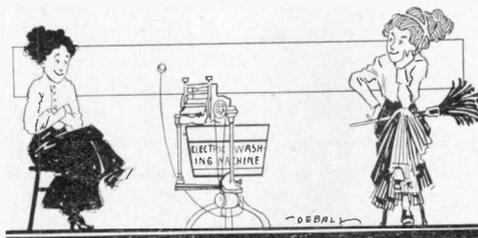
Marie Dried Her Hair With an Electric Blower

for them herself, "Without fire," as they expressed it.

In the afternoon Mrs. Jones was due to appear at a reception. Marie shampooed

her hair and dried it with an electric blower, which sent a blast of either hot or cold air through the golden fluff. Then she perfumed it with an electrical atomizer, curled it with the electric tongs and finally did some expert work with the electric vibrator. An electric hat cleaner renewed the latest millinery creation and a vacuum brush removed the last speck of dust from her gown.

During the afternoon there was little for the two servants to do, as electricity had done away with most of the cumbersome tasks. The day before they had between them done the laundry work, which couldn't be called much of a task because of the electric washing machine and wringer and the mangle which ironed most of the coarse work.



Between Them They Did the Laundry Work

But this afternoon they ironed out the fine work with the electric iron to fill in the time.

Father and Mother were both going to the theatre that evening, but this did not prevent them from spending their usual half hour with the children in the electric nursery at the top of the house, where Willie ran his electric trains and Elsie lighted up her doll house with electricity, to her mother's never failing astonishment and delight.

After the theatre these two had a habit of dining in Jones' den instead of at a restaurant. He produced his electric chafing dish and connected it by a cord and plug to the sockets in the baseboard of the room. Then he produced the elements for his Chef-d'œuvre and chicken a la King on toast, the latter made on his private electric toaster. The coffee was made in his copper percolator.

When it was time to retire Mrs. Jones turned the current into the electric heating pad and slipped it into the baby's bed, first being careful to adjust the thermostat so that the pad would develop a mild, even heat all night long; and Jones set the burglar alarm.

So ended the day in the electric house.



JUNIOR SECTION

An Electrical Laboratory for Twenty-Five Dollars

By DAVID P. MORRISON

PART II.

There is one other form of cell I shall describe on account of its wide range of use. This is the dry cell. A dry cell can be made almost any size you desire, the voltage remaining the same, however, but the capacity of the cell for producing current increasing with increase of size. The dry cell is really nothing more than a modified form of what is termed a Leclanche, it being a liquid cell. The elements of the Leclanche cell are zinc and carbon while the liquid is sal ammoniac. To construct a dry cell that is equivalent to a one-quart Leclanche you will proceed as follows: Secure a piece of sheet zinc say No. 22 gauge about $6\frac{1}{2}$ by 7 inches and a small piece about $2\frac{1}{2}$ by $2\frac{1}{2}$ inches. Form the large piece into a cylinder seven inches long having first turned the edges about $\frac{1}{8}$ of an inch so that they may be hooked together, forming a lap seam. Pound this seam down by placing the cylinder on a rod of iron or piece of pipe. Next mark out a circle two inches across, by means of a compass on the smaller piece and cut it out, this is to form the bottom. It might be well for you to cut this a little larger and trim it down to the size of the cylinder afterwards. Now solder in the bottom and also the seam which makes a water tight cup. Next solder a piece of copper wire to the upper edge of the cup which will form the negative terminal of the cell. In soldering the zinc you should use hydrochloric acid as a flux, applying it to parts to be soldered

after they have been thoroughly cleansed. After soldering, all parts should be thoroughly washed to remove any trace of the acid as it eats away the zinc.

The carbon element may be made from a square or round piece of carbon eight inches long and not more than three-quarters of a square inch in cross section. A bare copper wire may be wrapped around the upper end of the carbon element to serve as the positive terminal of cell. This method of connecting the wire may be improved upon in the following way: File the upper end of the carbon until it has the



FIG. 12. FILE THE END OF THE CARBON
THUS

form shown in Fig. 12. Then wrap a thin piece of pasteboard tightly around the body of the carbon several times, allowing it to project about an inch above the end just filed and tie it firmly in place. Now take the end of a piece of No. 16 copper wire and wind it around the end of the carbon rod. Then melt a small quantity of lead and pour it into a mold formed by pasteboard. When lead cools it will contract and grip the carbon very firmly, thus making a good connection. The cell is now ready for the electrolyte which in this case will be in the form of a paste.

Two methods will be described for making the paste, and you can use either or both just as you wish. First mix about one-half pound of manganese dioxide and one half pound of powdered carbon or graphite; after these dry powders are thoroughly mixed then pour in a saturated solution of sal-ammoniac and thoroughly mix, adding only enough solution to make a paste about like soft putty. The saturated solution is made by dissolving the sal-ammoniac in water until some of the sal-ammoniac remains in the bottom of the vessel. Cut from a heavy piece of cardboard a disk that will just fit into the bottom of the zinc cup. Soak this disk in hot paraffin and push it down against the bottom of the cup. Now secure a piece of pipe or round piece of wood about $1\frac{1}{2}$ inches outside diameter and 12 inches long; stand it up in the center of the cup, the end resting squarely on the bottom of the cardboard. Make a mixture of about ten ounces of plaster of paris and one ounce of common flour, or in this proportion, and add some of the saturated solution of sal-ammoniac until the mixture can be easily poured. Now hold the pipe or stick firmly against the bottom of the cup with one hand and pour in around it the plaster of paris mixture to within about $\frac{1}{2}$ inch of the top of the cup. This mixture will harden quickly and you can remove the pipe or piece of wood by watching the mixture carefully and removing the core when the mixture will just hold itself together. You must use some care in doing this for if you wait too long the plaster will be so hard you cannot remove the core. If, on the other hand, you try to remove the core too soon the plaster will not remain in place at the side but run down into the bottom of the cup. Let the plaster dry for at least an hour, in order that it may thoroughly harden, before proceeding.

Place your carbon element in the center of the opening in the plaster of Paris and pack tightly around it the first mixture you made, up to the same height as the plaster of paris. You must be careful in packing the putty in place not to force the carbon rod out of the center of the opening or to break it. A short piece of $\frac{3}{8}$ inch iron rod will be a great help in tamping the putty down. Tamp the putty slowly and evenly all around the carbon rod and you will in that way prevent breaking or moving it from place. Your battery is now complete with the ex-

ception of sealing it, which can be done by melting some sealing wax or pitch and pouring it into the top of the cup, filling the same to its upper edge.

Another method that is sometimes used is as follows: Make a canvas bag of such a size that when filled and placed in the zinc cup there will be a space of something like $\frac{1}{4}$ inch all around between bag and cup. Place your carbon element inside of this bag and pack in around it sufficient paste to fill it up to a distance of six inches. The neck of the bag should then be tightly tied around the carbon rod. Care must be used in tamping the paste into place to keep the carbon rod always in the center of the bag.

The paste used in filling this bag can be made as follows or in this proportion.

Powdered graphite or carbon	...5 parts
Powdered manganese dioxide	..5 parts
Sal-ammoniac1 part
Chloride zinc1 part
Glycerine1 part

Dissolve the sal-ammoniac and zinc chloride in a little water and add the glycerine. After having thoroughly mixed the carbon and manganese add the above solution making a paste like soft putty. If there is not sufficient solution add a little water.

Place the filled bag into the zinc cup and fill the surrounding space with the following flour paste or in that proportion. Mix one teaspoonful of flour, $\frac{1}{4}$ oz. zinc chloride, $\frac{1}{2}$ oz. of glycerine, $\frac{1}{2}$ oz. of sal-ammoniac and 4 oz. of water. It might be well to bring this mixture to a boil and avoid any lumpiness. Pour this paste into the cup, keeping the bag standing in a perfectly upright position in the center until the paste has set, filling it to within $\frac{1}{2}$ inch of the top. Your cell is now complete and may be sealed as in the previous case.

HOW TO USE POWER FROM THE LIGHTING CIRCUIT

The various cells described will be useful in supplying limited amounts of electrical current but where the demand is rather large you must resort to some other source of supply. If you have the good fortune to have at your disposal a power or lighting circuit from which you can obtain electrical current you will no longer be limited in your experiments for want of sufficient supply. This supply may be either alternating or direct current. The difference between the two was explained in first article of this

series. If it is direct current the pressure between the wires will usually be 110 or 220 volts. This pressure will be, in the majority of cases, entirely too high for your use and means must be provided for reducing it to the desired value. As an example, suppose you want to operate a 10 volt lamp and it takes a current of $\frac{1}{2}$ ampere when this voltage is impressed. If the voltage of the circuit to which you want to connect your lamp is say 110 volts, then some device must be connected in circuit so as to adjust the voltage upon the lamp to the proper value. Such a device is called a rheostat. Since there is to be only ten volts impressed upon the lamp and there is a total of 110 volts available there must be 100 volts pressure between the terminals of the rheostat, it being in series with lamp. The rheostat will carry the same current as the lamp which in this case is $\frac{1}{2}$ ampere. By applying Ohm's Law to that part of the circuit corresponding to the rheostat you can determine the value of the resistance that must be in the rheostat to meet the above requirements.

$$\text{Resistance} = \frac{\text{Pressure}}{\text{Current}}$$

$$200 = \frac{100}{\frac{1}{2}}$$

Hence there must be a resistance of 200 ohms in the rheostat. In a similar manner the resistance of any rheostat can be determined if the current it is to carry and the difference in pressure that is to exist between its terminals are known. The construction of the rheostat will be taken up shortly.

When the source of supply is alternating current you can still use a rheostat in series with the apparatus that you desire to pass a current through; but in this case you cannot use Ohm's Law to calculate the resistance of the rheostat as it holds for direct current only. You will have to determine the value of the resistance by experiment, as the quantities involved in calculating its value are too numerous and complicated to allow an explanation at the present time.

The majority of your experiments will require a direct current and if you have only alternating current available some means must be provided for changing it to direct current. There are a number of means that may be employed in accomplishing this. An alternating current motor may be driven by

the alternating current and either belted or direct connected to a direct current generator or dynamo. Direct current can then be drawn from this generator of any desired value up to the ultimate capacity of the generator or motor. Such an arrangement is called a motor-generator set. When the two machines are combined and constructed as a single machine it is called a rotary converter. Such a machine may be used in changing direct current to alternating current, but it is usually beyond the scope of the amateur to build one. Likewise with the mercury arc rectifier which has been developed within the last few years. It fulfills the above requirement very well and at a high efficiency, but it is out of the question for you to try to construct one. So you must resort to some form of electrolytic rectifier.

ELECTROLYTIC RECTIFIER

The efficiency of the electrolytic rectifier is low at best compared to that of the motor-generator, rotary converter and mercury arc rectifier, but the simplicity of its construction leads to the selection of this particular type to be described in this article.

The action of the rectifier in the electrical circuit is the same as that of a check valve in a water pipe. It will allow the passage of current in one direction without offering very much resistance; but will offer a great resistance where the current tends to flow in the opposite direction. This being the case one-half of the loops shown in Fig. 5 (Part I) will be reduced to practically nothing on account of the resistance of the rectifier. With such a device the current will flow in



FIG. 13. CURRENT WOULD FLOW ONLY HALF THE TIME

the circuit only half the time and would be represented by curve shown in Fig. 13. This would be an undesirable condition to have; but fortunately it can be overcome by making use of four valves and arranging them as shown in Fig. 14.

The small arrow in each circle indicates the direction in which the current will meet with least resistance in passing through that

particular valve or cell. If there is an alternating pressure applied to the terminals marked (A C) it will tend to produce an alternating current through the circuit composed of four cells. Suppose the pressure is acting toward the right in the upper wire of (A C). The greater portion of the current will flow through the circuit of least resistance, which in this case is through cell

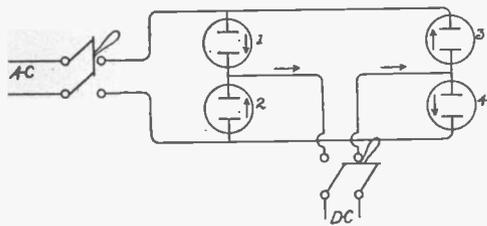


FIG. 14. RECTIFIER ARRANGED WITH FOUR VALVES

(1) to (D C) and through cell (4) back to the lower wire of (A C). Next suppose the pressure is acting towards the right in lower wire of (A C). Then the greater portion of the current will flow through cell (2), to (D C) and through cell (3) back to the upper side of (A C). In both cases the current in flowing through the (D C) leads in the same direction. This current is constant in direction but not constant in value. It is really an alternating current with one-half of the loops reversed in direction giving a pulsating current as shown in Fig. 4, (Part I). It can be used in charging storage batteries and in practically every case where a perfectly steady current is not required.

Each of the cells consists of an aluminium plate and a conducting plate, such as carbon, lead, iron, etc., or any metal that is not acted upon by the solution into which they are immersed. The solution that the plates are immersed in is called the electrolyte. This electrolyte is capable of acting upon the aluminium in a very peculiar manner, when a current is passed through the cell from an external source. When the current flows from the conducting plate to the aluminium there is very little resistance offered to its passage through the cell; the only resistance being that of the electrolyte. If, however, an attempt is made to send the current through the cell in such a direction that it must flow from the aluminium plate to the conducting plate, there will be a great resistance offered by the cell to its passage and

practically no current will flow in the circuit. This action is accounted for by the fact that a very thin coating of oxide forms on the surface of the aluminium plate. Cells possessing this property are called asymmetric cells.

The following instructions show how to construct an electrolytic rectifier that will deliver a direct current of three to six amperes at a pressure of 15 to 25 volts. The alternating pressure need never be more than 30 volts, hence means must be provided for reducing line voltage to desired value. In this case you can use either a rheostat or a transformer in regulating the voltage impressed upon the alternating current (A C) terminals of the rectifier. The transformer is much more efficient than the rheostat and its construction and operation will be taken

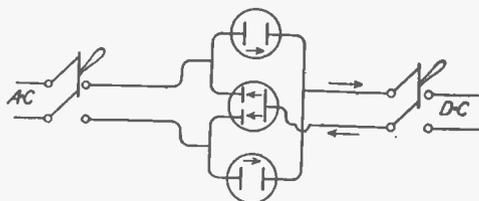


FIG. 15. RECTIFIER ARRANGED WITH THREE VALVES

up shortly. The number of separate cells required to complete the rectifier as shown in Fig. 14 is four. This arrangement would require four containing vessels which can be reduced to three, however, by arrangement shown in Fig. 15. The middle jar in this case contains really two cells. The path of the least resistance to current flow is indicated by the arrows.

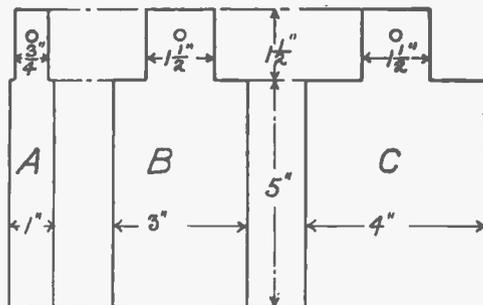


FIG. 16. DIMENSIONS OF CARBON AND ALUMINUM PLATES

You will want three jars of approximately the following dimensions, 6 by $4\frac{1}{2}$ by 3 inches. If you can not secure jars of this

kind three ordinary battery jars, such as are used for the "crow foot" battery will serve very well.

Cut out of some $\frac{1}{8}$ inch sheet aluminium four pieces of dimensions given in Fig. 16 (A). The material to be used as the conducting plate in this case will be carbon. The carbon plates should be cut from some $\frac{1}{4}$ inch carbon which can be done by means of a hack saw. There should be two pieces corresponding to dimensions (B) and one piece corresponding to dimensions (C). The two smaller pieces are to be used in the outside cells while the larger one is for the center cell. Both the aluminium and carbon plates should have holes in their upper ends to be used in fastening binding posts to them by means of screws. After the binding posts are fastened, dip the upper end of all plates in melted paraffin, which will prevent the salts from creeping. It might be well to dip the upper edge of the jars in the paraffin.

The top of each cell can be cut from some $\frac{1}{2}$ inch seasoned wood and should be of such a size as practically to cover the top of the jar as it will prevent impurities falling into the cell and the solution from evaporating. Openings should be cut in each top to allow the upper ends of the aluminium and carbon plates to project through. These openings should be such a distance apart that the two elements when fastened in them will be parallel and $\frac{1}{2}$ an inch apart.

The efficiency of the electrolytic rectifier decreases very rapidly as the temperature rises. Since there will be quite a temperature rise if the rectifier is used for any length of time, means must be provided for keeping its temperature as low as possible. This can be accomplished by passing cold water through some glass tubing placed in the electrolyte. Secure some $\frac{3}{8}$ inch glass tubing and bend it into the form shown in Fig. 17. Place two of these worms in each cell and connect them all in series by means of a short piece of rubber tubing. The rubber tubing must be securely wired to the ends

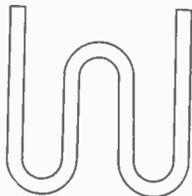


FIG. 17. GLASS TUBE COOLER

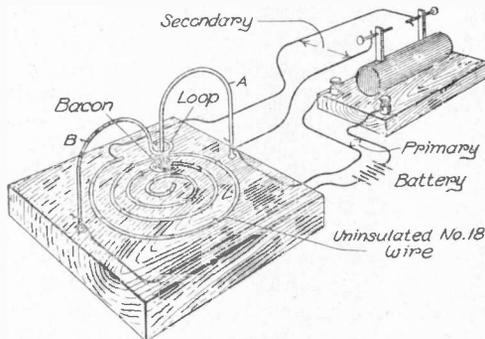
of the glass tubing. Arrange connections so that cold water will first enter the middle cell since this cell will carry double current.

The electrolyte to be used is acidulated sodium phosphate. A saturated solution of the phosphate is prepared and the jars filled, with plates and cooling worms in place, to within one inch of the top. The rectifier cannot be started however until some means is provided for adjusting the alternating current voltage, to be impressed upon its terminals. Assuming we have such a device and the (A. C.) voltage can be maintained at a value of 30 volts, add sulphuric acid to each cell until the ammeter in the direct current circuit reads five amperes on full load. (An ammeter will be described later.) Acid should be added to each cell in proportion to the amount of sodium phosphate solution it contains. The rectifier will operate much better if it is allowed to run under full load for two or three hours as the aluminium plates have to be formed.

[NOTE: Part III will take up the construction of an alternating current transformer.]

Electric Mouse Trap

I believe the readers of the Junior Section will be interested to know how I constructed an electrical mouse trap. The store where I worked was over-run with the little pests and I have been able to get rid of them by



ELECTRIC MOUSE TRAP

using the trap described in the following paragraphs.

I took a piece of board about five inches square and one inch thick and upon the upper surface fastened a spiral of uninsulated copper wire, No. 18, making the spiral about four inches in diameter and the turns of wire about $\frac{1}{8}$ inch apart.

I also have a one-half inch spark coil such as is used in wireless telegraphy, and which as you know gives a very high voltage across the secondary. One of the secondary ter-

minals of this coil I connected with the wire spiral. The other I connected to a wire (A) which was bent up and over in a curve so that its point came down in the center of the spiral but not touching the latter and ending about one-half an inch above the board. A similar bend of wire (B) was also mounted on the board and terminated in a little loop surrounding the end of (A) as shown in the cut. On the end of (A) I stuck a piece of bacon.

The wire (B) was connected through the battery to one of the primary terminals of the spark coil. The other primary terminal was connected to (A).

Now the mouse comes along to eat the bacon. To do this he must necessarily stand on some of the wires of the spiral. As he nibbles at the bacon he moves it around till the loop of (B) touches (A). This closes the primary circuit of the spark coil as you will see. Then a high voltage is developed across the secondary terminals. Of these secondary terminals the mouse has one (A), in his mouth and is standing on the other [the spiral]; the result is a dead mouse.

—Elmer Rhynerson.

A "Fool Proof" Alarm Clock

The "quad" chief in one of the large telegraph offices sends in this suggestion for an electric alarm clock, which has solved the "getting-up" problem for him for many years. He says that it has never failed to work and is "fool proof."

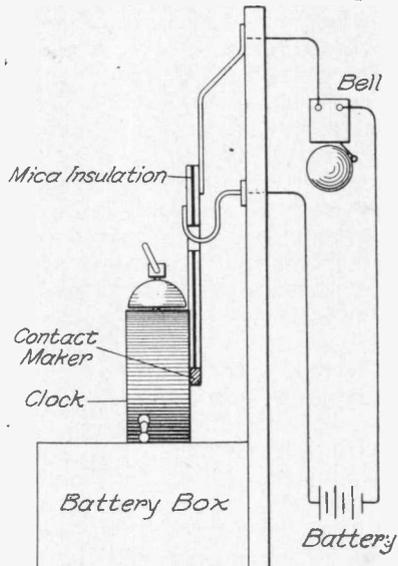
He made a neat box to hold the cell or two of dry battery required. On the upright board is mounted the electric bell, also a hook shown in detail in the diagram. To the back of the clock are screwed two pieces of metal separated by a strip of mica insulation, with a large hole to fit over the hook as shown. When the clock is set on the box with the metal strips over the hook the front metal strip touches the hook and the back one touches a spring fastened to the upright board. From the spring a wire runs to one terminal of the bell; from the other terminal of the bell a wire runs to one side of the battery. From the other side of the battery a wire runs to the hook. The only break in the circuit, therefore, is the mica insulation between the strips.

To complete this break and cause the bell to ring at any desired time a brass strip



A "FOOL PROOF" ALARM CLOCK

is mounted on the alarm shaft of the clock and when this shaft begins to turn at the predetermined time this brass strip turns



ELECTRICAL CONNECTIONS OF THE ALARM CLOCK

and its edge rubs across the edges of the two metal strips before mentioned and the circuit is completed, ringing the bell.

POPULAR ELECTRICITY WIRELESS CLUB

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

A Simple Wireless Telephone Set— Inductive System

By A. B. COLE

Many experimenters have their own wireless telegraph stations, but comparatively few have constructed wireless telephone apparatus. The purpose of the present article is to show how to build a simple wireless telephone set at small expense.

Now if the secondary coil is moved away from the primary, still keeping the planes of the coils parallel, or nearly so, electromotive forces will still be induced in the secondary coil, but will become weaker as the distance between the coils is increased.

The primary and secondary of the induction coil are replaced, in the wireless telephone outfit, by two coils of wire six feet in diameter, one of these coils corresponding to the primary, and the other corresponding to the secondary

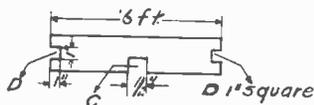
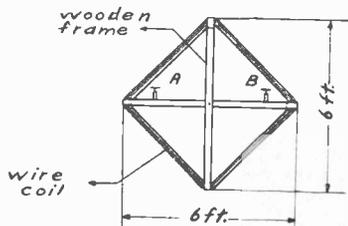


FIGURE 1

The outfit is of the "inductive" type, that is, speech is transmitted from one station to another by means of the electro-magnetic action of one coil, carrying current, upon another coil. One way of explaining the principle underlying the operation of the set is as follows—

if we have two coils of wire, one of which is carrying alternating or interrupted direct current, an electromotive force will be set up in the other coil if the planes of the coils are nearly parallel. The induction or spark coil is a familiar example illustrating this principle. The primary coil is carrying interrupted direct current, and the electromotive force induced in the secondary coil produces the spark at the terminals of this coil.

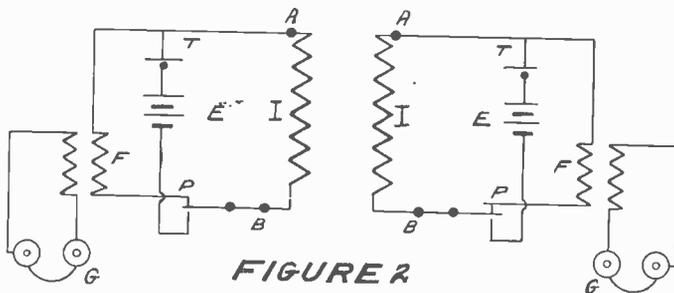


FIGURE 2

of the induction coil. The wire used [is No. 18 single cotton covered copper magnet wire, of which four pounds are required for each coil. Each coil has forty-three convolutions. The wire is wound on wooden frames constructed as shown in Fig. 1. Each frame is made from two wood strips, 6 feet by 1 1/2 inch by 1/2 inch. A slot (D), one inch square is cut in each end of each strip to hold the wire. A slot (C), 3/4 inch

deep by $\frac{1}{2}$ inch wide is cut in each strip, so that the strips may be fitted together. One end of each coil terminates at a binding post (A), and the other end terminates at a binding post (B), both of which are mounted on one of the strips of each frame.

The connections for the two coils are shown in Fig. 2, where (A) and (B) represent the same binding posts as in Fig. 1, and (I) represents the coils of wire. (T) is a telephone transmitter, of the type known as "long distance," or "solid back." This is a standard transmitter, and may be purchased from any electrical supply house. (E) is a battery of eight or 10 good dry cells, or five storage cells; (F) is a telephone induction coil, supplied by any electrical supply house under the name of a "750 ohm telephone induction coil"; (G) is a telephone receiver having a resistance of about 1000 ohms, and must be wound with copper wire to obtain satisfactory results. A pair of good 500 ohm wireless receivers serves the purpose very well. (P) is a push button, known as a "double contact" push. The spring of this push button is normally in contact with an upper contact point, but when the button is pressed, contact with this point is broken, and connection is made with a lower contact.

The transmitter, push button and batteries may be mounted on a box or in any way which the user may desire. A good way to do this is to mount the transmitter and button on a wood box, which is fastened to the frame of its coil, and to have the batteries on the floor or in a separate case, connected to the transmitter and coil by means of flexible lamp cord.

From Fig. 2 it will be seen that when the button is pressed at one station, the receiving induction coil is disconnected from the coil (I) and the transmitter and batteries are connected. The operator may now speak into the transmitter, and speech will be reproduced in the telephone receivers at the other station. When the operator finishes speaking he removes his finger from the push button, and the other operator presses the button at his end, which connects his transmitter in circuit.

The double contact push button is of considerable value here, as the transmitter can be connected in circuit only when the button is depressed, which condition eliminates heating the transmitter, as is often the case when the operator for some reason or other

forgets to disconnect his transmitter when he has finished speaking. This push button also serves to keep the receiving instruments in circuit and ready for use when the transmitting instruments are out of circuit.

It will be found that the best results are obtained, over a distance of from ten to fifteen feet when the planes of the coils are nearly parallel, and when conversation is carried on over greater distances than this the planes of the coils should be turned slightly from the parallel position.

Conversation can be carried on between two or more stations up to distances of from forty to fifty feet, using the set described above, without any ground wire or any connection whatever between the stations, and if a few walls of the building or other obstructions are between the stations they make little difference in the operation of the set.

By increasing the diameter of the coils (II), the distance over which the set will operate will be increased, and increasing the amount of wire on the coils also serves the same purpose.

Such an equipment as the one described above has value mostly as an interesting experiment.

Inter-mountain Wireless Association

The Inter-mountain Wireless Association was organized October 22 by D. R. Adams and Mr. Ritchie at the home of the former in Salt Lake City, Utah. The object of the association is to further the arts of wireless telegraphy and telephony in the Inter-mountain region. A constitution and by-laws have been adopted and the following officers elected: President, E. L. Bourne of the Nat. Guard Signal Corps; secretary, D. McNichol; treasurer, J. G. McCullom. All persons living in the Inter-mountain states are cordially invited to join, and may do so by communicating with D. R. Adams, 219-5 East St., Salt Lake City.

A part of the equipment of the new \$3,000,000 police headquarters in New York is to be a wireless telegraphy outfit operated from the dome. It is expected that branch stations will be established in outlying districts of the city and in other counties, so that if wires fail, communication may be maintained.

What One Can Do Others Can Do

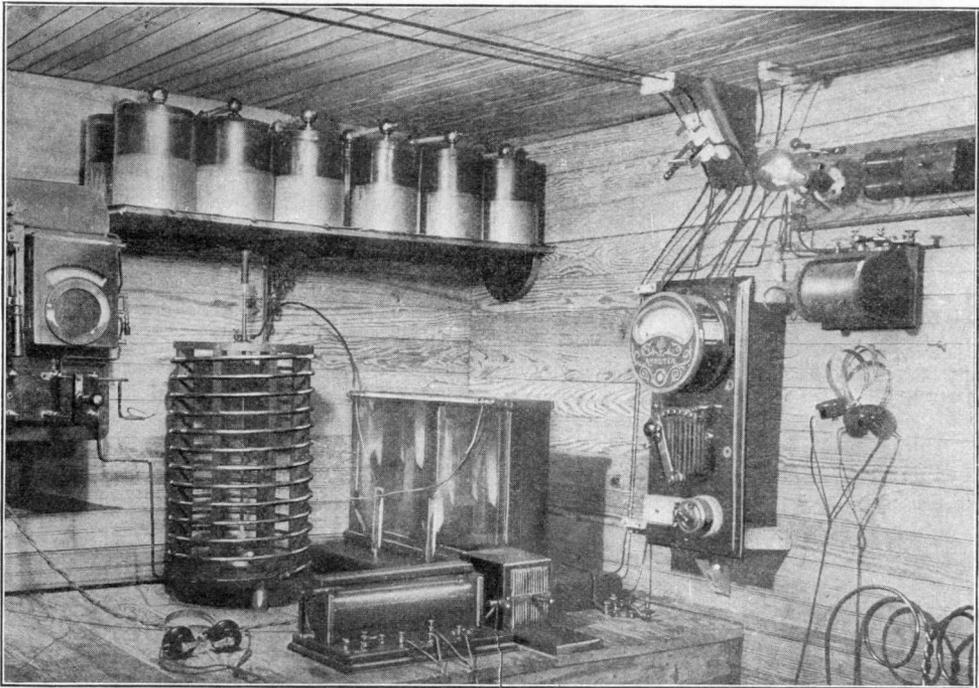
To the Members of P. E. W. C.:

I enclose a photo of my wireless station. While I realize that there are hundreds of stations that are more complete, still there are numbers of them not so large and powerful, and this photo and description might be of interest and encouragement to others who are laboriously traveling the same road.

I began this station eight months ago and have made each instrument, in both transmitting and receiving, at least three times,

meter registers as high as 60 amperes; kicking coil varies from five to 40 amperes, with eight steps of five amperes each. This coil gave a great deal of trouble and was simply a matter of "cut and try" of about 14 times.

The transformer is in the large zinc lined case that just extends above the table, and is immersed in oil. It weighs complete, with case and 35 gallons of oil, 400 pounds. Primary is No. 4 D. C. C. wire, 200 feet.



AN AMATEUR STATION VALUED AT \$1,000

each time making decided improvements. I never saw a wireless station, and at the time I started I knew absolutely nothing about wireless. All the knowledge I have was procured from *Popular Electricity*, *Modern Electricians* and *Electrician and Mechanic*. I also received valuable assistance from The Wireless Equipment Co. of West Arlington, Md.

My source of power is the commercial current—110 volts, 60 cycles a. c. On the right of the photo you see the switchboard which contains cut-out, fuse block, ammeter and variable "kicking coil." Am-

meter registers as high as 60 amperes; kicking coil varies from five to 40 amperes, with eight steps of five amperes each. This coil gave a great deal of trouble and was simply a matter of "cut and try" of about 14 times.

The transformer is in the large zinc lined case that just extends above the table, and is immersed in oil. It weighs complete, with case and 35 gallons of oil, 400 pounds. Primary is No. 4 D. C. C. wire, 200 feet. Secondary is 50 miles No. 32 D. C. C. wound in 60 sections, 10 inches in diameter and $\frac{1}{4}$ inch thick.

I use either of two condensers, glass plates 12 by 14, two thicknesses, connected series-multiple; or 12 one gallon leyden jars connected the same way. Notice the two glass tubes which bring the secondary terminals out of the transformer.

The helix is 12 inches in diameter and 15 inches high and is wound with No. 0000 solid copper with $1\frac{1}{2}$ inch centers on turns. The spark gap is inside the helix and has zinc tips one inch long and $\frac{3}{8}$ inch in diameter.

On the left is the D. P. D. T. switch, ground switch, and hot-wire ammeter. The ground goes straight down from the switch-board and is soldered to the water pipe (No. 20 fiber covered wire). Aerial leads through brick wall in hard rubber tube, two feet long and $\frac{1}{2}$ inch thick lined with porcelain. Hot wire ammeter registers 25 milliamperes when sending and is made of No. 36 copper wire. Total capacity 30 milliamperes.

Transformer has a capacity of $4\frac{1}{2}$ to 5 K. W. In transmitting I use a one-inch spark gap and the spark is one inch thick. By means of the variable kicking coil and adjustable condensers and spark gap I can transmit from 100 to 1000 miles with corresponding current consumption.

The receiving station consists of two sets of phones, each set wound to 3000 ohms and when connected in series makes 6000 ohms resistance, double slide tuning coil, silicon detector, variable and fixed condenser. Fixed condenser is concealed in base of coil; variable condenser is shunted across ground and aerial.

With this set I have received from San Juan, Porto Rico—a distance of 1800 miles, and it is easy to “listen in” when Key West, Fla., is talking to Galveston, Texas. Chicago and Cleveland are also easily heard. I was very much interested when I, at 8:30 received a message from a vessel off the Atlantic coast giving the time, 9:30. I got it an hour before it was sent, but of course they had eastern time and I central.

All of my instruments are made of black walnut and by me, with the valuable assistance of my very dear friend, Thomas Daly. The only things not homemade are ammeter, detector and phones.

I value my station at \$1000. Receiving distance 2000 miles; sending distance 1000. I have used my transmitter very little because I did not want to “butt in” and possibly create confusion.

Will some one be kind enough to furnish me with a complete list of government, commercial and experimental stations with their power and call letters. In exchange I will be only too glad to furnish any one the benefit of my experiments, gratis.

My aerial is composed of 4 wires 200 feet long. 50 feet high at one end and 125 feet at the other.

The photo only shows a part of my experimental apparatus. On the same table, to

the left, I have an open-core transformer, with 25 miles of No. 32 D. C. C. wire also in oil. This operates a very large Tesla coil, also in oil, which in turn lights an 8-inch X-ray tube. And in addition it excites a smaller Tesla coil, not in oil, with which I am able to perform all of Tesla's experiments. These two Tesla coils are controlled by a common condenser. All of these instruments, as well as the wireless, are regulated by the kicking coil and each set is thrown in or out by the D. P. D. T. switch which is directly above the ammeter. E. F. WAITS.

Corinth, Miss.

[By sending 10 cents to the Government Printing Office, Washington, D. C., you may obtain a copy of the pamphlet “Wireless Telegraph Stations of the World”, which gives the names and locations of the important commercial and government stations, their capacities, call letters, etc.—EDITORIAL NOTE.]

WIRELESS QUERIES

Answered by A. B. Cole

Wave Length of Tuning Coil

Questions.—My tuning coil has 75 turns of wire and 16 inches to the turn, the wire is No. 18 double cotton covered. (A) How many meters wave length would the tuning coil respond to? (B) How many meters would the same coil respond to with enameled wire about the size of No. 20 cotton covered?—F. R., Arkansas City, Kan.

Answers.—(A) Your tuning coil will respond to a wave length of about 800 meters, if you use an aerial 50 feet long, and to a correspondingly greater wave length if a longer aerial is used.

(B) If the coil is wound with No. 20 enameled wire, it will respond to a wave length of about 1200 meters with the above aerial.

Condenser for Receiving Circuit

Questions.—(A) Would a condenser consisting of six glass plates 4 by 15 inches and tinfoil pasted on with a margin one-half inch all round and a terminal one inch long be suitable for receiving, the set being set in a box with melted paraffin poured in? (B) Is brass wire more suitable than copper for sending helix?—I. G., Brooklyn, N. Y.

Answers.—(A) Yes, but would advise you to use at least four more plates, to insure best results.

(B) No, except that it is more springy, and therefore better mechanically.

Tuning Coil; Condenser Capacity

Questions.—(A) What are the proper dimensions for a tuning coil and how is the wave length computed? (B) What is the capacity in meters wave length of a tuning coil three inches by 13 inches with 350 turns of No. 24 D. C. C. wire? (C) How is the capacity of a condenser determined, in microfarads? Give formula with glass and paraffine as dielectrics.—R. L., Be. loit, Ohio.

(A) Diameter, two inches, length, 10 inches. The most reliable method we know of computing the wave length to which a coil will respond is to set up the proper instruments in connection with it, and receive signals from a station emitting a known wave length. Observe the part of the coil in use under such condition, and compute the maximum wave length to which the coil will respond by comparing the length in use to the total length of the coil. The method of multiplying the length of wire on the coil by four is far from accurate, as the wave length depends not only on the length of wire, but also on the insulation, the diameter of the coil, and the core.

(B) About 3000 meters if used in connection with an aerial 50 feet long.

(C) The capacity of a condenser is determined by more or less complicated laboratory methods by comparison with a condenser of known capacity. There is no reliable formula involving glass and paraffine dielectrics, as the composition of these materials varies greatly.

Long Distance Receiving and Transmitting

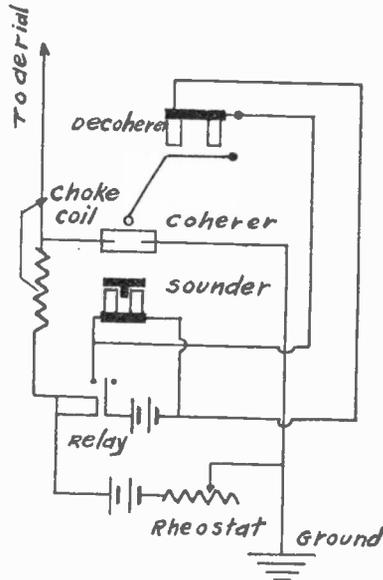
Questions.—(A) What instruments will be needed to receive 2,500 miles? (B) How far will a two K. W. transformer send? A three K. W.?

Answers.—(A) To receive 2,500 miles will require the best of apparatus, this should include receiving transformer, two slide condensers, one stationary condenser, a good detector and a pair of 1,500- or 2,000-ohm receivers used in connection with a clear 125-foot aerial.

(B) The distance covered by a two or three K. W. transformer would depend so much upon all other conditions, that it would be impossible to give a reasonable answer to this question. One K. W. sets have been heard at a distance over 1,000 miles at night. This of course is done under the best of conditions. A good three K. W. set working under fair conditions at night could be relied upon to cover from 300 to 400 miles.

Marconi Receiving Set

Questions.—(A) I have a relay wound for 35 ohms; could I use it on a wireless call system? (B) Could a tuning coil be used on a Marconi receiving set? (C) Please give diagram for Marconi receiving set, consisting of a relay, batteries, coherer and decoherer, sounder, rheostat and choke coil.—S. W., Indianapolis, Ind.



CONNECTIONS OF MARCONI RECEIVING SET

Answers.—(A) Yes.
(B) Yes, and to advantage.
(C) See diagram.

Wireless Telephone; Pan Cake Tuner

Questions.—(A) Can the lighting current (110 volts A. C.) be used to feed an arc for producing a wave train for wireless telephony? (B) Can the ordinary aerials be used? (C) Must one electrode be water cooled? (D) What type of detector should be used? (E) Is there any special method for wiring the receiving circuit? (F) Explain the pan cake type of tuner.—F. E. H., Ottawa, Ont

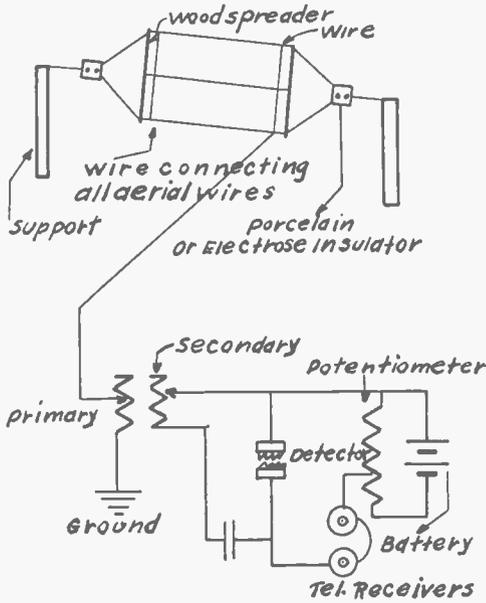
Answers.—(A) No.
(B) Yes.
(C) Not necessarily, but preferably.
(D) Any detector used for wireless telegraphy will do. The mineral type, such as perikon, give good results.

(E) Same as for wireless telegraphy.
(F) Pan cake tuner consists of two flat spirals of insulated copper ribbon, having variable contacts so that a greater or less number of turns may be used. The two spirals, or "pan cakes," may also be moved with respect to each other, thus forming essentially a variable coupling tuning coil.

Connections of Receiving Station

Question.—I have the following equipment: 88-foot antenna, 53 feet high, 42 feet lowest point; 3 wires No. 18 bare copper; loose coupled receiving transformer; potentiometer; tinfoil condenser; silicon and perikon detectors; 1500-ohm receiver; I cannot make the apparatus work. Will you kindly give me a plan showing how to connect the instruments. What improvement could I make in this equipment?—O. I., Attleboro, Mass.

Answer.—See diagram below for connecting the instruments. The equipment con-



CONNECTIONS OF RECEIVING STATION

sists of the proper apparatus to insure good results, but as you do not state the make, or construction of the apparatus we cannot tell whether your trouble is that you are not sufficiently familiar with the use of the equipment or whether the apparatus itself is at fault. We suggest that you read the article entitled "A Variable Coupling Tuning Coil," in the January number, for the proper design and operation of your tuner.

One-Sixteenth Inch Spark Coil

Question.—Give dimensions of core for 1-16-inch jump spark coil, also size and amount of wire for primary and secondary winding.—E. S., Wilson, N. Y.

Answer.—Core—5 inches long, $\frac{3}{8}$ inch diameter. Primary—Two layers of No. 20 single cotton covered copper wire. Secondary—One ounce No. 36 single cotton covered copper wire.

U. S. A. Field Service Outfit

Question.—Please give diagram showing how the U. S. A. Signal Service sets are connected for use in field work.—C. G., Seattle, Wash.

Answer.—The U. S. A. Signal Corps uses

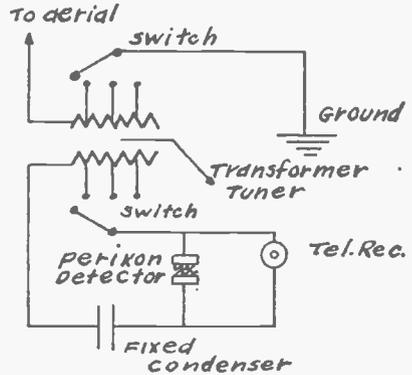


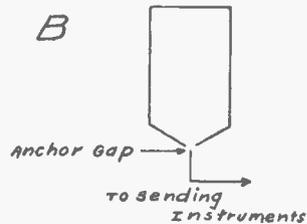
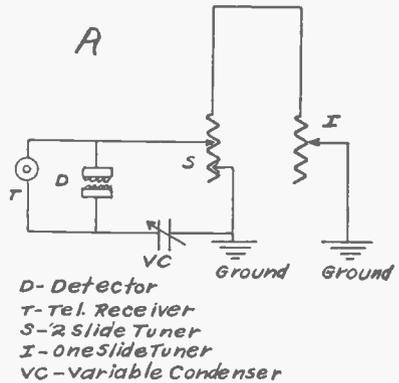
DIAGRAM OF FIELD SERVICE OUTFIT

several systems in field work, and the diagram above shows one of the latest types, using the perikon detector.

Sending and Receiving Connections

Questions.—(A) Please give diagram of receiving set connections for a loop aerial. My set contains a 75-ohm receiver, two slide tuning coil, perikon detector and variable condenser. (B) Please give diagram for sending, using same aerial.—D. J. B., Brooklyn, N. Y.

Answers.—See diagrams A and B.



QUESTIONS AND ANSWERS

Readers of Popular Electricity are invited to make use of this department. State your questions as clearly and concisely as possible. No consideration will be given to communications which do not contain the full name and address of the writer

Three Phase System

Question.—Please explain the three-phase system, giving diagram of alternator winding, and also the principle of the operation of the induction motor.—E. P., South Bend, Indiana.

Answer.—In direct current systems the flow of current is in one direction and may be represented by a horizontal straight line. In

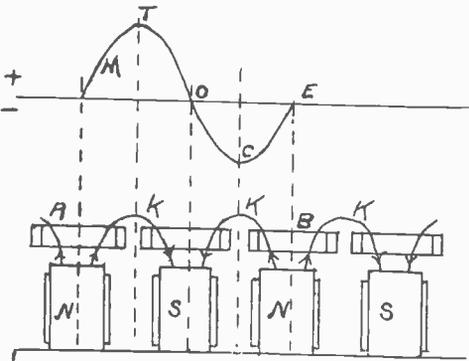


FIG. 1

alternating current systems the direction of the flow is continually changing. The generating apparatus is called an alternator, and for three-phase systems is wound with three distinct coils on the same armature, and located 120 degrees from each other. This armature will generate three equal E.

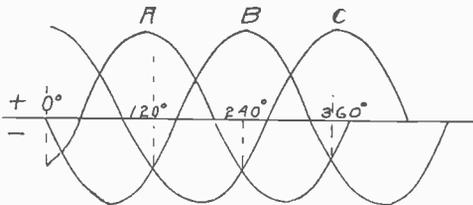


FIG. 2

M. F.'s differing in phase by 120 degrees. Fig. 1 shows the field poles of an alternator laid out, for illustration, in a straight line. The field poles are excited by an independent direct-current machine called an exciter.

In Fig. 1, the curved lines (K. K. K.) indicate the direction of the lines of force from pole to pole. Consider one coil moving in front of the pole pieces. The E. M. F. may be represented by the curved line (M). With the coil in the position (A), the lines of force are threading their way through it in one direction as indicated by the arrow heads. As the coil moves, the E. M. F. rises to a point (T), then, as the coil approaches the pole (S), drops to zero and takes

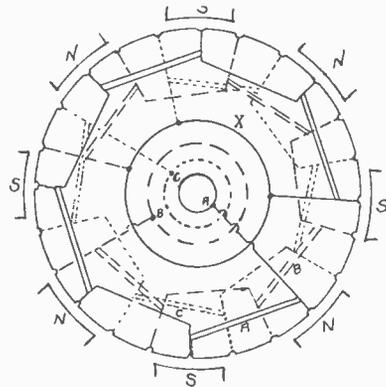


FIG. 3

a negative direction, the lines of force now flowing through the coil in a direction opposite their movement when the coil was at (A). Proceeding from the south pole to the north pole the line (O C E) Fig 1 indicates the values and direction of the E. M. F. A three-phase circuit may be represented by Fig. 2, three alternating currents, one for each armature coil being shown by curves (A), (B) and (C). On a bipolar machine, single phase, one coil, one revolution, 360° completes a cycle. On a multipolar, each coil passes through a cycle by passing a pair of poles. A cycle is one complete set of values, + and - through which an electromotive force or current passes, as represented in Fig. 2.

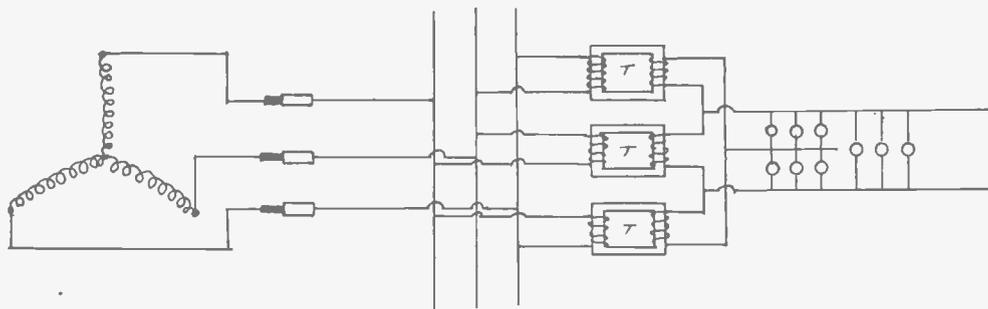


FIG. 4

The frequency is the number of cycles passed through in a second. The period is the time of one cycle. The number of alternations is twice the frequency. If (P) is the number of pairs of poles on an alternator, (N) the revolutions per second of the armature, and (F) the frequency of the E. M. F., then

$$F = P \times N.$$

Fig. 3 shows the arrangement of the windings on an alternator of a three-phase system. Note that one end of each coil is connected to a slip ring and the other end goes to a common connection (X). This machine is Y wound. From each slip ring is brought out a wire, three in all, called phases (A), (B) and (C). Between any two phases the voltage is the same, and with a balanced system each wire in turn acts as a return or sort of neutral.

Fig. 4 represents, in general, the arrangement of an alternating three-phase system supplied by a high voltage alternator, transformers being used to step down to lights and motors. The transformers are delta connected, and with this arrangement the loads on the three branches should be balanced.

A synchronous motor is almost identical in construction with a corresponding alternator, consisting of a field and armature, either of which may revolve. Such motors have separately excited fields.

To understand the action of an induction motor, suppose a direct current motor armature with current sent through it. With an excited field the armature will turn. Now suppose the brushes removed and the ends of the armature coils connected to a common copper ring. Next, revolve the field around the armature instead of allowing it to remain stationary. The lines of force must then revolve and set up an E. M. F. in the armature conductors. With these con-

ductors short circuited, currents are set up in them and these currents react on the field and produce a drag on the armature. This revolving field pulls the armature with it. The field may be revolved by mechanical means, or the magnetic poles are so connected as to continually shift the field around the armature.

In a three-phase system

$$P = 1.73 \times E \times I \times P.F.$$

in which P = total power delivered,

E = E. M. F. between each pair of mains,

I = current in each main, and

$P. F.$ = power factor.

D. C. Machines in Parallel

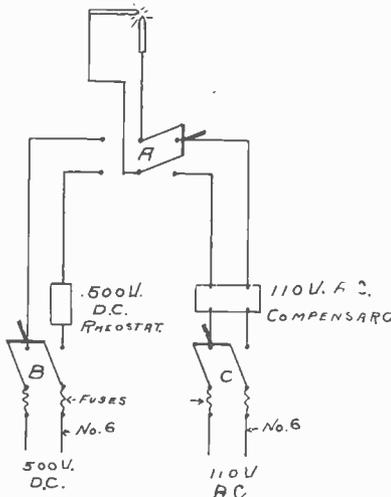
Question.—Will you tell me how to connect a 20 K. W. and a $7\frac{1}{2}$ K. W. direct current generator of 110 volts in multiple? The machines are driven by separate engines.—H. E. W., Indianapolis, Ind.

Answer.—Connect the positive lead of each generator to a common positive bus-bar, and make a similar connection of the negative leads to a negative bus-bar. Each generator must have a switch and fuses in the leads. Now if one generator is running and it is desired to throw in the other, first with the generator switch open bring the second generator up to the voltage of the other generator, then throw in the switch. The second generator will then take its share of the load. If your machines are shunt generators their parallel operation is an easy matter, the connections being made as above stated and the voltage being controlled by a field rheostat. If your machines are compound wound, connect the positive brush of one to the positive brush of the other by a cable of the same size as the mains, this being the equalizer. Other connections are as made for shunt dynamos in parallel.

Moving Picture Arc Lamp Current from Two Sources

Question.—Will you explain how I can use 110 volt alternating current, and also 500 volt direct current on the same arc lamp (moving picture) by using some sort of a double-throw switch; both connections to be made to provide for any emergency, or a breakdown of one source of supply?—C. D. P., Wichita, Kas.

Answer.—The diagram shows how connections may be made in the cut-out cabinet of the lamp booth. By the arrangement of



CONNECTIONS FOR MOVING PICTURE ARC

the double-throw switch, (A), it is impossible to throw but one kind of current on the lamp at one time. Switches (B) and (C) are so arranged as to cut the current off the transformer or rheostat without going to the building service switches. It will be necessary to buy or have made a 500 volt rheostat for your lamp. Regarding the A. C. side see the article on "Current Economy for Moving Picture Arcs" in the September, 1909, issue.

Voltage Drop; Electroplating

Questions.—(A) Please state the distribution of the drop in a 110-volt circuit with two eight candle-power, 110-volt lamps connected in series. (B) Please give a good solution for copper plating, with voltage and current required.—L. L. K., Theresa, N. Y.

Answers.—(A) The lamps would divide the voltage between them, each taking 55 volts.

(B) The subject of "Electroplating" is thoroughly discussed in an article which appeared in the June and July, 1909, issues, and which will give you the information.

Rectifier; Arc Lamp Current; Dry Batteries; Bell-Ringing Transformers

Questions.—(A) How can I change 2, 3, 5 and 10 volts A. C. to direct current? (B) Do open and enclosed street arc lamps operate on direct or alternating current? (C) How many volts do "flaming arc" lamps take? (D) Do flaming arc lamps operate on alternating or direct current? (E) Which is the positive pole of a dry battery, the zinc or the carbon? (F) Do bell-ringing transformers used on 110 volts alternating current operate on the principle of an induction coil or a resistance coil.—S. A. H., Chicago.

Answers.—(A) Run an alternating current motor on the circuit and with this drive a direct current generator, from which take the current desired.

(B) There are direct-current, open and enclosed arc lamps, and alternating-current, open and enclosed arcs.

(C) 45 to 50 volts at terminals of lamp for constant current series, and 50 to 60 volts at terminals for constant potential multiple operation. The current consumed is from 8 to 12 amperes.

(D) The lamp must be designed for the current on which it is to be used. Lamps are built for both A. C. and D. C.

(E) The zinc is the positive element.

(F) The bell-ringing transformer operates on the principle of an induction coil without an interrupter.

Lightning Arresters on Insulated Wires; Grounding Cable Sheaths and Messenger Wires

Questions.—(A) Is it necessary to use a lightning arrester to protect a telephone when heavy insulated wire is run from the central office to the telephone? (B) Is it best to have the lead sheath of an aerial telephone cable thoroughly insulated from the ground? (C) Should the messenger wire be grounded?—L. S., Athens, Ont.

Answers.—(A) Decidedly, yes. If the line is long enough to require protection, the mere insulation of the wire would not protect either it or the phone from a lightning discharge.

(B) It is best to have the lead sheath thoroughly grounded as a protection from lightning and other causes. You would find it very difficult to insulate a cable as they are generally suspended by metal clips from the messenger wire.

(C) Ground the messenger wire. It is best to do so for the above reason; also you would find it hard not to do so because generally either one or both ends terminate in guy anchors or stubs thoroughly grounded.

Alternating Current

Questions.—(A) Will an alternating current generator excite its own field? (B) How do you connect the armature sections of an alternating current dynamo, three-phase, with the slip-rings? (C) How should three phase circuits be connected to lamps.—K. H., Litchfield, Ill.

Answers.—(A) Not with its own current which, of course, is alternating. Alternators are provided with an independent direct-current dynamo which supplies current to

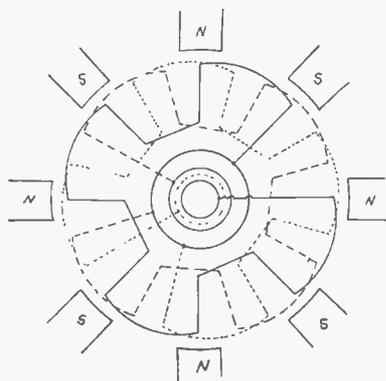


FIG. 1

the field coils. By another method, an exciter is used to magnetize the alternator fields sufficiently to give the rated voltage at no load, and in addition a small D. C. rectifier or commutator is mounted on the shaft

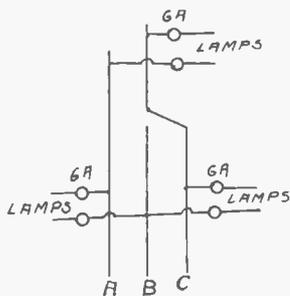


FIG. 2

near the collector rings and from this a series coil is run on the fields which furnishes the magnetism to supply the voltage to overcome the armature impedance as the load comes on.

(B) See Fig. 1 showing connections for a star or Y wound armature. The common connection is omitted in a delta wound armature.

(C) Assume 110 volts between phases on a three-phase system. The load should be distributed so that the phases are balanced. Fig. 2 shows how this may be done by using two and three-way cut-out blocks.

Chemical Automatic Telegraph

Questions.—(A) Will you please state what chemicals are used in recording telegrams on sensitive paper ribbon, so that this paper will under the pen change color when current flows through the pen? (B) Will the action occur whether the ribbon be wet or dry?—E. B., San Jose, Cal.

Answers.—(A) The principle of chemical telegraphy is that of decomposing the electrolyte through which the current is made to pass, and leaving by this decomposition a mark on the paper. Potassic iodide dissolved in water, will have the iodine separated by a current made to pass through moist paper, and a brown line will be left by the pen point. In practice the following solution is used: 1 part potassic iodide; 20 parts starch paste; 40 parts water. A platinum pen should be employed with the solution. A second solution with which a steel or iron pen is used is made as follows: 5 parts prussiate of potash; 150 parts ammoniac nitrate; 10 parts of water. In this mixture the potash is to supply the acid to attack the pen, forming prussian blue, and the nitrate absorbs moisture from the air, keeping the paper in good condition. The solution is made a better conductor by adding a very little dilute sulphuric acid. The resistance from the pen point and across the paper to the cylinder is about 275 ohms with this last electrolyte.

(B) The paper must always be slightly moist for satisfactory operation, this being provided for in the solution.

Copper Plating on Carbon

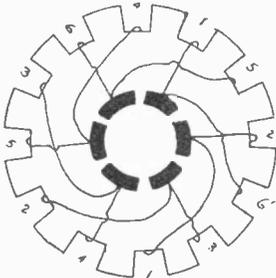
Question.—What is the easiest way that I can copper plate carbon?—E. I. S., Marlboro, Mass.

Answer.—You should find this a very easy job. Use a plain water solution of copper sulphate and a copper anode. Use a weak current for plating. Connect the carbon of the plating battery to the copper plate, and the zinc of the plating battery to the carbon you wish to plate; or, use a low candle power lamp in series with the direct current lighting circuit, making sure to connect the positive wire to the copper plate in the plating bath.

Bi-Polar Motor; Spark Coil Secondary; Transformer Heating; Storage Battery

Questions.—(A) Please explain how to wind a bi-polar motor having a 12-slot armature and six commutator segments. Give size of wire to use. (B) Is soft annealed wire which can be purchased in hardware stores good for ring armature banding? (C) Can double cotton-covered wire be used for the secondary of a jump-spark coil instead of silk covered wire? (D) I have made a small transformer as described in the November, 1908, issue, and after using it a short time it heats considerably. How can this be remedied? (E) Where can I buy torpedo lead for making a storage battery? (F) If a storage battery has been short circuited, how can it be repaired, so as to retain a charge again?—C. J., Chicago, Ill.

Answers.—(A) See diagram. It is not possible to give the size and quantity of wire



BI-POLAR MOTOR WINDING

for the field and armature without knowing the area and length of the pole pieces, as well as the data on the armature. The voltage upon which it is to run should be given and also the desired horse-power.

(B) Yes. Fine brass wire is also satisfactory.

(C) Silk covered will give better results, but single cotton-covered wire soaked in paraffin or wax may be used.

(D) One of the causes for heat losses in a transformer core is the setting up of eddy currents in the iron. Sheets having a thickness of .014 are used on high frequencies. Finer wire for the core in your case might be used. Are you sure you are not overloading the transformer?

(E) Take up the matter with some lead company. The classified telephone directory will assist you. This lead can be had in any size you specify.

(F) In removing storage batteries from service they are short-circuited after the electrolyte has been replaced with water. If "shorted" with the electrolyte in the cell, sulphate would form. Overcharge the bat-

tery by charging at the normal rate until it shows 2.6 volts per cell. Then decrease the current to one-half the normal rate, and continue the charge until the cells show 2.7 volts each, then continue charge twenty or twenty-five minutes longer. This will reduce any sulphate which may have formed.

Armature Building; Winding a Tri-polar Armature

Questions.—(A) Will an armature made in a single piece work as well as one which is not so made? (B) How should a tri-polar armature be wound? (C) How should the field be wound and connected? (D) Should wire on the armature be the same size as that on the field?—C. H., Sullivan, Ill.

Answers.—(A) Tri-polar and quadri-polar armatures are frequently made of cast iron; however, those built up of laminations or stampings are in every way to be preferred, eddy current losses being much reduced.

(B) See diagram in the article "Construction of a Laminated Motor" in the May, 1909, issue.

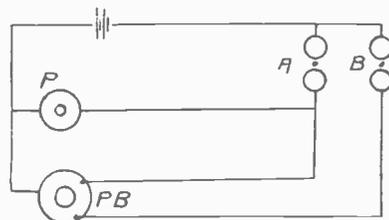
(C) Described in article mentioned in answer (B).

(D) In all cases this will be determined by the voltage and power for which the motor is designed.

Bell Diagram

Question.—Given, two bells and two push buttons. I want one push button to ring only one of the bells, while the other push button rings both bells, neither bell to be single stroke. Please give diagram.—J. O. B., Portland, Oregon.

Answer.—The diagram shows bells (A) and (B). Push button (P) will ring bell



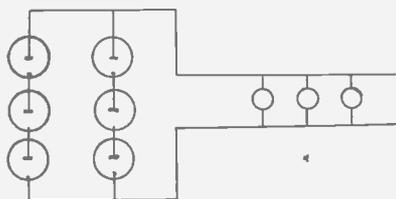
BELL DIAGRAM

(A) only. Push button (PB) has two separate contacts, one for each bell, both of which are closed by pushing it, thus putting battery on both bells. When (PB) is open the two contacts are not common.

Dry Batteries and Lamps

Questions.—(A) How many four and one-half volt lamps can I light with eight dry batteries? (B) Please give diagram for connecting these lamps.—W. S., New York City.

Answers.—(A) It will depend upon the length of time that you wish the lamps to light up. Dry cells are not recommended for continuous service.



DRY BATTERIES AND LAMPS

(B) The diagram gives the number of cells, lamps and connections. Each cell is assumed to give 1.5 volts.

Batteries and Small Lamps

Questions.—(A) Please describe the Gordon cell giving its size. (B) I have a six-volt six-candle-power tungsten battery lamp. Please tell me the best battery to use on same.—S. B., Waldron, Mich.

Answers.—(A) See answer to A. C. H. in the January issue.

(B) Six-volt storage batteries are manufactured which will run one light such as you have for 70 or 80 hours without recharging, and if you are where you can recharge such a battery we would advise its use.

Antique Plating

Questions.—(A) How can I make a plating solution for plating antique or green? (B) In plating a stick pin, how do they get the face of a man's head yellow, and a band around his head, green?—P. H., Springfield, Ill.

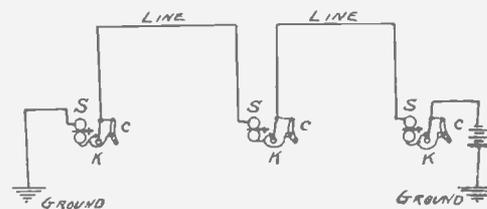
Answers.—(A) This is not done by plating in the ordinary sense of electroplating, but is done by dusting certain pigments over a sticky lacquered surface. These pigments are various oxides and salts of copper, iron, nickel and other metals. The metal to be "antiqued" is first lacquered, and when the lacquer is nearly dry, but still sticky, the color is sprinkled on or applied with a tuft of cotton. Some colors are produced by simply corroding the metal with acetic and other acids.

(B) The face is first lacquered and colored, then the band is colored after the face is dry.

Installation of a Short Three Instrument Telegraph Line

Questions.—I am about to install a three instrument telegraph line about one-half mile in length. (A) Please explain how to install the line correctly. (B) Is it necessary to use relays? (C) Are the instruments wired series or multiple?—L. F. B., Tallman, Mich.

Answers.—(A) Connect the instruments as shown in diagram. The outside line is a single wire. The batteries are of the closed circuit type (gravity cells). The sending keys, (K) are normally open and make circuit only when depressed. The circuit switch (C) is kept closed except when send-



ing and shunts the key (K). The armature of the sounder (S) is always down except when sending or when the switch (C) is accidentally left open, "killing" the line. The grounds for the return are preferably made to water pipes. Use rather high resistance sounders so as not to wear out your batteries too quickly. Install some sort of lightning arrester at each instrument. Probably the best form of lightning arrester for this use is to provide two flat pieces of carbon separated by a thin piece of mica with a few holes punched through it, or by dry silk. Connect one carbon to line and one to a ground.

(B) It is unnecessary to use relays except for a line several miles long.

(C) The instruments are all in series. Telegraph systems are all series systems.

Equalizer Connections on Generators

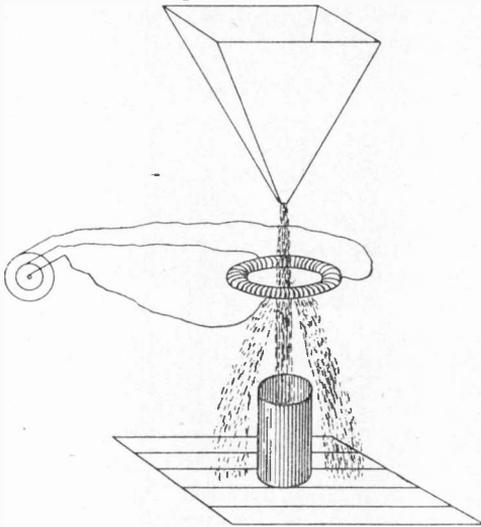
Question.—In connecting two compound generators to run in parallel does it make any difference whether the positive or negative brushes are connected together by the equalizer?—R. E. G., Minneapolis, Minn.

Answer.—In practice, the equalizer is run between the positive brushes, but it would do just as well if the negative brushes were so connected. However it is necessary to see that the equalizer connects those brushes to which the series coils are attached, and also to see that these brushes are of the same polarity on each machine.

NEW ELECTRICAL INVENTIONS

Unique Magnetic Separator

A strikingly original form of electromagnetic separator for separating magnetic metals from mixtures containing them is shown in the illustration, and is the invention of G. D. Rogers of Gloucester, Mass. He uses a continuous coil of wire bent around in the form of a ring. To this wire coil are connected the three terminals of what is called a three-phase circuit. Electricians



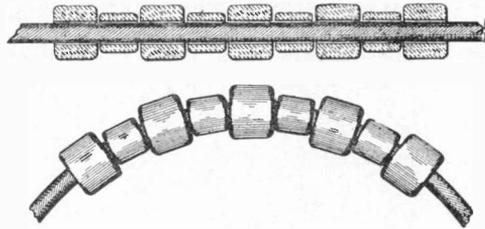
UNIQUE MAGNETIC SEPARATOR

will understand that such a circuit is one which has impressed upon it three distinct current impulses during each period. These current impulses cause the wire coil or solenoid to take on the properties of a magnet and there is created within the circle a magnetic field. The fact that the three current impulses strike the coil successively at three equidistant points on its circumference causes the magnetic field to rotate.

Mr. Rogers has found that such a magnetic field exerts upon magnetic substances falling through it an outwardly directed force which causes them to fall outward and away from the perpendicular. The crushed ore, magnetic sand or whatever is to be separated is therefore caused to fall through the ring.

Protected Lamp Cable

A new idea for the protection of a flexible cable or conducting cord for lamps is shown in the illustration. Flexible beaded cables are generally used in connection with arc lamps for connecting the movable parts in such manner that when the sides of the cable come in contact with the different parts of the lamp, which is almost unavoidable, no



PROTECTED LAMP CABLE

short circuit or ground can be made. In order to afford sufficient protection the beads on the cable must be of fair size, and if these beads are all of uniform size, as has heretofore been the case, and the cable is bent sharply, which is frequently necessary, there is exposed a considerable portion of the bare cable, which is liable to lead to short-circuits or grounding. The flexibility of the cable is also limited by the requisite size of the beads.

According to this invention, small and large beads are arranged alternately upon a cable, and thereby the danger of short-circuits is largely decreased, and in addition the cable is made more flexible. Emile J. Guay, of Lynn, Mass., is the inventor.

Hot Box Alarm

A novel alarm for hot bearings consists of a small tube and bulb containing mercury, so arranged that rise of the mercury with temperature closes an electric bell circuit and attracts the attention of the attendant. The apparatus is attached to the bearing in a box two inches square. When many bearings are being watched, an ordinary electric bell indicator can be used.

Notes on Patent Infringement

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

Use of equivalents (Concluded)—Repairing or Re-Constructing Worn-out Article, by Unauthorized User; Contributory Infringement; Definition.

Repairing or Reconstructing Worn-out Article. By Authorized User.—Where a machine is patented as a whole, one who has the right to use, but not the right to construct, may, so long as the identity of the machine is not destroyed, make repairs or replace the worn-out parts, but can neither build a new machine, nor reconstruct an old one under the guise of repairs.—Thomson-Houston Electric Co. v. Kelsey Electric Specialty Co. (C. C. A.) 75 Fed. Rep. 100.

If a Part of a Machine is Patented Separately, it cannot be replaced without the consent of the patentee. Shickle, etc., Iron Co. v. St. Louis Car Coupler Co. (C. C. A.) 77 Fed. Rep. 739.

Replacement of a Temporary Part.—But a part which, although necessary to the operation of a machine, is temporary in its relation to the whole structure, and which the inventor contemplated would have to be renewed at intervals, may be replaced.—Morgan Envelope Co. v. Albany Perforated Wrapping Paper Co. 152 U. S. 425, even though it is novel, and covered by the claims of the patent.—Farrington v. Board of Water Com'rs, 4 Fish. Pat. Cas. 216, 8 Fed. Cas. No. 4,687.

By Purchaser of Old Parts.—The purchaser of the parts of a patented article which has been taken to pieces has no right to reconstruct and use or sell the article.—American Cottontie Co., v. Simmons 106 U. S. 89.

Making and Selling to Licensee or Repairer.—It is not an infringement to manufacture and sell to a licensee, or to a person entitled to make repairs.—Johnson Railroad Signal Co. v. Union Switch, etc. Co. (C. C. A.) 55 Fed. Rep. 487; reversing 52 Fed. Rep. 86. Thomson-Houston Electric Co. v. Kelsey Electric R. Specialty Co., (C. C. A.) 75 Fed. Rep. 1005.

Unlawful Possession of Patented Article.—Mere possession, when unlawful, may be sufficient to justify an injunction restraining use, whether or not it affords ground for damages.—Adair v. Young, 12 Ch. D. 13; United Telephone Co. v.

London, etc. Telephone, etc., Co. 26 Ch. D. 766.

Contributory Infringement. Definition.—Contributory infringement has been defined to be “the intentional aiding of one person by another in the unlawful making or selling or using of the patented invention.—Thomson-Houston Electric Co. v. Kelsey Electric R. Specialty Co. 72 Fed. Rep. 1016.

By Sale of Element of Combination.—A person is liable as a contributory infringer when, without authority, he makes or sells an element or ingredient of a patented combination with the intent that it shall be combined with the other elements or ingredients for the purpose of infringing the patent, or with the knowledge that it will be so used.—Thomson-Houston Electric Co., v. Ohio Brass Co. (C. C. A.), 80 Fed. Rep. 712.

By Sale of Appliances or Materials for Process.—The same rule applies to the unauthorized sale of appliances or materials for the unlawful use of a patented process, and to the unauthorized sale of machinery which is useful only for making a patented article.—Loew Filter Co. v. German American Filter Co. (C. C. A.) 107 Fed. Rep. 949; American Graphophone Co. v. Hawthorne, 92 Fed. Rep. 516.

By Sale of Unpatented Article.—The sale of unpatented articles is not rendered an infringement by the mere fact that they are intended to be used in effecting the purpose of a patented device. Such a sale becomes an infringement, however, when made with knowledge of a restriction imposed by the patentee that such article may be used in connection with his patented machine only when purchased from him.—Heaton-Peninsular Button-Fastener Co. (C. C. A.) 77 Fed. Rep. 288.

By Making Machine Which Becomes Infringement in Hands of Third Person.—The maker of a machine which is not an infringement, and is not intended to be one, is not liable as an infringer if the machine becomes an infringement in the hands of a third person, either by accident or the natural

wearing of the parts, or by the act of such third person; but he is so liable, if, with intent to infringe, he makes a colorably different machine, which will inevitably become an infringement in the course of usage, or which can easily be so adjusted as to infringe. *American Diamond Rock Boring Co. v. Sullivan Machine Co.* 14 Blatchf. (U. S.) 119, 1 Fed. Cas. No. 396; *Holbrook v. Small*, 2 B & A. Pat. Cas. 396, 12 Fed. Cas. No. 6,595.

Presumption of Intent to Infringe.—When the thing sold is incapable of use except in connection with the patented invention, the mere sale is sufficient to establish infringement, it being presumed in such case that there is an actual concert for that purpose between the parties to the sale.—*Westinghouse Electric Co. v. Dayton Fan, etc. Co.* 106 Fed. Rep. 724. But the sale of a thing susceptible of innocent use is not an infringement, unless it is shown that it is in fact designed to be used in committing an infringement.—*Edison Electric Light Co. v. 15 Peninsular Light, etc. Co.* 101 Fed. Rep. 831.



AUTOMOBILE TROUBLES AND HOW TO REMEDY THEM. By Charles P. Root. Chicago: The Charles C. Thompson Company. 1909. 219 pages with 14 illustrations. Price \$1.50.

At the very beginning of this book we find a very helpful table for diagnosing the troubles of an automobile. An automobile is subject to a host of "troubles," like the human machine. These troubles have "symptoms;" the symptoms have "causes." The table outlines, therefore, in parallel columns, first the failures, then their symptoms, then their causes. In the body of the book these troubles are taken up, one by one, and analyzed from start to finish. The volume is very substantially bound in leather, of convenient pocket size.

SPONS' WORKSHOP RECEIPTS. Vol. II. London: E. & F. N. Spon; (New York: Spon & Chamberlain). 1909. 544 pages with 259 illustrations. Price \$1.50.

The second volume of this very valuable reference library for mechanics, electricians and artisans has appeared. The scope of

the work was outlined fully in the October, 1909, issue. The present volume includes names from "Dyes and Dyeing" to "Japan and Japanning."

SHOP TESTS ON CAR EQUIPMENT. By Eugene C. Parham, M. E., and John C. Shedd, Ph. D., New York: McGraw Publishing Company. 1909. 115 pages with 55 illustrations. Price \$1.00.

The authors approach the difficult project of indicating shop tests in a very thorough and satisfactory manner. The various measurements, such as current, pressure, resistance, etc., are taken up and diagrams clearly setting forth the connections are given so that mistakes should be almost impossible. Miscellaneous tests such as bar-to-bar commutator measurements, differential voltmeter tests, locating grounded or faulty conductors, etc., receive careful attention. Then follow a list of general precautions to be observed in testing, also methods of treating flesh burns from electrical causes and means to artificially stimulate respiration. The volume ends with a series of 296 questions which, as a general review, cover the work gone over in the preceding chapters.

GENERAL LECTURES ON ELECTRICAL ENGINEERING By Charles Proteus Steinmetz, A. M., Ph. D., Schenectady: Robson & Adel. 1909. 284 pages with 48 illustrations. Price \$2.00.

The series of lectures set forth in this book was delivered by the author before Union University, and the use of mathematics has been entirely avoided, thus making them intelligible to those not familiar with the mathematical branch of the electrical sciences. The book covers, first, the general features, including the various uses of direct and alternating current, the commercial frequencies, and the selection of systems for different purposes. The subject of distribution is next considered and the cost item is gone into carefully. Transmission is treated so as to bring in the high voltage problem as affected by harmonics, resonance, oscillation and surges. The discussion of the motive power including water and steam turbines, together with interesting details of operation are taken up together with protection and control. Electricity as applied to traction service and lighting is also discussed in excellently clear and easily comprehensible form. A further chapter on electrochemistry is well worth careful perusal.

ON POLYPHASE SUBJECTS

Prize Story Contest

We will give three prizes for the best three stories on the subject of "Experiences of an Electrical Salesman"—First prize, twenty-five dollars; second prize, fifteen dollars; third prize, ten dollars. In addition we will pay one cent per word for stories contributed in this contest which we find available for publication, whether they be prize winners or not. The contest will close March first.

The stories must be not under 1000 words or over 2000 words long. The manuscripts must be typewritten, and no manuscript will be returned unless postage is enclosed. The stories must be confined to actual experiences connected with the selling of electrical apparatus, although names and localities may be fictitious if so desired.

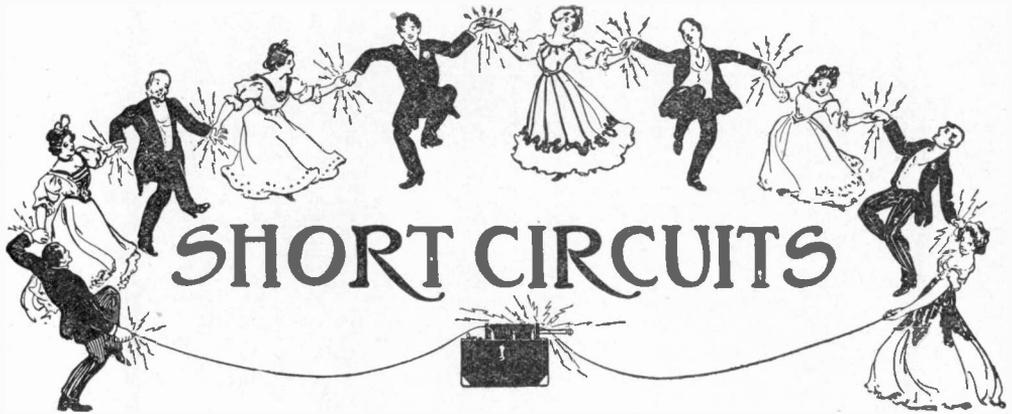
Every man of the grip worthy of the name remembers with pride some pet incident in his selling experience—a large and long-coveted order which he was able to "land" through some train of unusual and perhaps humorous circumstances; through the exercise of unusual diplomacy or some ingenious and maybe adventurous way of getting at the right man in the right way. Stories of incidents such as these are the kind we want in this contest—brimful of "human interest."

"Why do you have the same definitions end each number? Why not have new ones each issue and in time have a complete dictionary?" Just recently one of our subscribers asked these questions and the same have come up on previous occasions. The reason we have done this in the past has been, as we thought, to make the page of the most value possible in interpreting the reading pages of each issue as it came out. The page as it now stands contains definitions of the most commonly used electrical terms—covering all electrical terms which would be likely to come up in any issue. They are right there, from A to Z in every number, ready to turn to, and there is no necessity to look in back numbers.

However, we don't propose to let our opinions stand against those of the majority of our readers. We are here to please you and instruct you wherever possible. To do this we must know your desires and your opinions on matters such as this. So in the matter of this definition page; we will put it to a vote. How many want it continued just as it is? How many want it run in serial form so that they may finally obtain a fairly complete dictionary of the most commonly used electrical terms and phrases?

The average electrician is never so happy as when he is "learning something" as told in the words of practical power house experience. No man is perhaps better qualified to give practical information of this nature, in "plain English," than Mr. Warren H. Miller, who, though he is a highly technical engineer himself is warranted not to talk "over the heads" of practical men. He has consented to write some articles for POPULAR ELECTRICITY, the first one of which will appear in the March issue under the title of "Coupling Big Alternators in Parallel."

Those of you who are electricians will find that it will explain hitherto knotty problems in a way they were never presented to you before. Those of you who are not electricians will find intensely interesting the methods which must be employed to make great dynamos or generators work side by side and pump their current into the same line, when if any one of the big fly-wheels is as much as three-eighths of an inch out of its proper position of turning, all the meters will be soaring like a flock of gulls. And, more than that, all the lights and motors on the city lines will be acting as if possessed.



SHORT CIRCUITS

The householder smothered his wrath and descended to the basement. "Are you the plumber?" he asked of the grimy looking individual who was tinkering with the pipes in the cellar.

"Yes, gov'nor, answered the man.
 "Been long in the trade?"
 "Bout a year, gov'nor."
 "Ever make mistakes?"
 "Bless yer, no, gov'nor."
 "Oh, then, I suppose it's all right. I imagined you had connected up the wrong pipes, for the chandelier in the drawing room is spraying like a fountain and the bathroom tap's on fire."

* * *

Her Father (irately)—Young man, do you know that you've been calling on my daughter since seven o'clock?

The Tarrying Youth—Yes, sir. But she has been sitting on my hat for the last three hours and I didn't want to tell her.

Her Father—Then, hereafter, don't keep your hat on your lap. Hang it on the rack in the hall.

* * *

Mrs. Bart—My husband got a letter today saying something dreadful would happen if he didn't send the writer a sum of money.

Mrs. Smart.—My husband gets dunned for his bills, too.

* * *

He sipped from her lips the nectar,
 As under the moon they sat,
 And wondered if ever another man
 Had drunk from a mug like that.

* * *

The teacher was describing the dolphin and its habits. "And children," she said impressively, "a single dolphin will have 2,000 offspring."

"Goodness!" gasped a little girl in the back row. "And how about the married ones?"

* * *

A little girl, aged three, had been left in the nursery by herself, and her brother arrived to find the door closed. The following conversation took place:

"I wants to tum in, Cissie."
 "But you tan't tum in, Tom."
 "But I wants to."
 "Well I's in my nightie gown, an' nurse says little boys couldn't see little girls in their nightie gowns."

After an astonished and reflective silence on Tom's side of the door, the miniature Eve announced triumphantly, "You tan tum in now, Tom; I tooked it off!"

* * *

Jimmie giggled when the teacher read the story of the Roman who swam across the Tiber three times before breakfast.

"You do not doubt a trained swimmer could do that, do you, James?"

"No, sir," answered James; "but I wondered why he didn't make it four and get back to the side his clothes were on."

Toward the close of a recent lawsuit in Massachusetts, the wife of an eminent Harvard professor arose and with a flaming face timidly addressed the court.

"Your Honor," said she, "if I told you I had made an error in my testimony, would it vitiate all I have said?"

Instantly the lawyers for each side stirred themselves in excitement, while His Honor gravely regarded her. "Well, madam," said the Court, after a pause, "that depends entirely on the nature of your error. What was it, please?"

"Why, you see," answered the lady, more and more red and embarrassed, "I told the clerk I was thirty-eight. I was so flustered, you know, that when he asked my age I inadvertently gave him my bust measurement."

* * *

"You look so pale and thin. What's got you?"
 "Work. From morning to night and only a one-hour rest." "How long have you been at it?" "I begin tomorrow."

* * *

A young father was performing his regular Sunday morning task of washing the twins. As the day was warm and sunshiny the function was taking place on the back porch. As he meditatively soused the twins up and down in a tub of water two small boys of the neighborhood, who were always on the job when anything new took place, rushed frantically up to the pailing, yelling at every jump, "Tey, Mr. Jones, don't drown the pups. Give 'em to us if you don't want 'em."

* * *

"Where are you from?" inquired the New Yorker. "Los Angeles," said the man from California.

"Oh, I see," exclaimed the Empire State inhabitant. "So you're from the West. Well, I've been West some myself. Now last year I was out as far as Cleveland and stopped a while at Pittsburg. I was all around out West."

"Is that so?" said the man from Los Angeles with a great show of interest. "Well, I was up East myself not so very long ago. I was in Denver and Salt Lake City, and all around. It's strange we didn't meet."

* * *

"Well, my man," said a military doctor to a young Irish soldier who had been on low diet for a long time, "how do you feel now?"

"Oh! much better, sir," answered the soldier. "Could you eat a small chicken today?" asked the doctor.

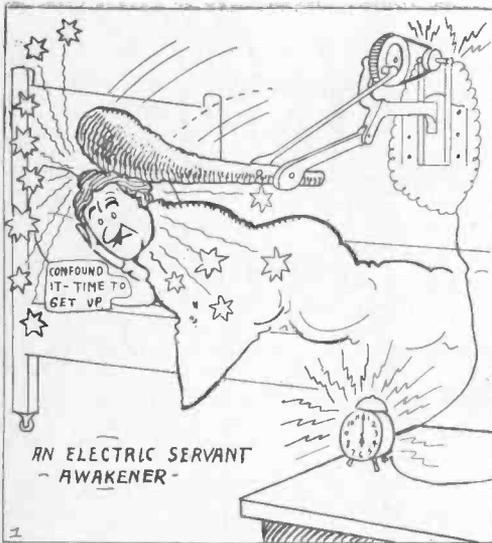
"That I could, sir," said the soldier. "What would you like it stuffed with?" asked the doctor.

"Please," replied the hungry patient, "I would like it stuffed with another."

* * *

"And now," said the teacher, "we come to Germany, that important country governed by a kaiser. Tommy Jones, what is a kaiser?"

"Please, ma'am, a kaiser is a stream of hot water springin' up an' disturbin' the earth."



AN ELECTRIC SERVANT
- AWAKENER -

1



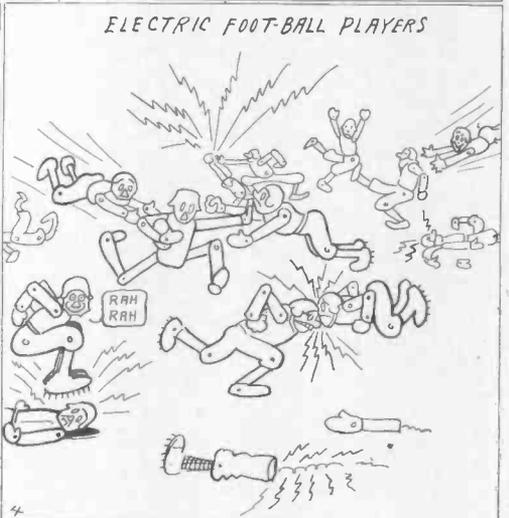
A MACHINE FOR STIMULATING
JANITORS?

2



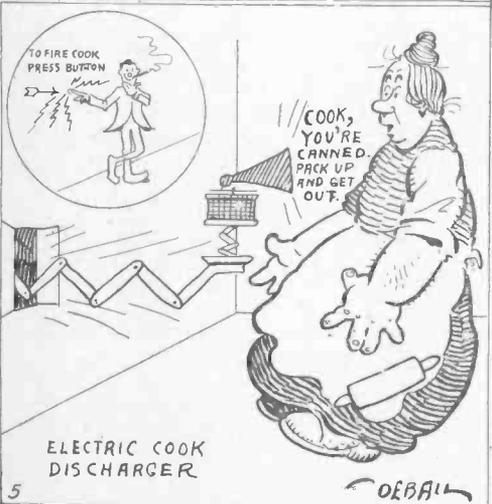
A TACTFUL WAY TO FRUSTRATE BORES

3



ELECTRIC FOOT-BALL PLAYERS

4



ELECTRIC COOK
DISCHARGER

5



AN ELECTRIC HINTER - FOR YOUNG LADIES - A
TACTFUL WAY TO REMIND COMPANY THAT THE
HOUR IS LATE

6

DEBAIL

ELECTRICAL DEFINITIONS

Below are defined a few of the most common electrical terms. They are reprinted from month to month and will be of assistance in understanding the magazine text

Accumulator.—See secondary battery.

Alternating Current.—That form of electric current the direction of flow of which reverses a given number of times per second.

Ammeter.—An instrument for measuring electric current.

Ampere.—Unit of current. It is the quantity of electricity which will flow through a resistance of one ohm under a potential of one volt. The international ampere is the current which, under specified conditions, will deposit .001118 gram of silver per second when passed through a solution of nitrate of silver in water.

Ampere Hour.—Quantity of electricity passed by a current of one ampere flowing for one hour.

Anode.—The positive terminal in a broken metallic circuit; the terminal connected to the carbon plate of a battery.

Armature.—That part of a dynamo or motor which carries the wires that are rotated in the magnetic field.

Brush.—The collector on a dynamo or motor which slides over the commutator or collector rings.

Bus Bars.—The heavy copper bars to which dynamo leads are connected and to which the outgoing lines, measuring instruments, etc., are connected.

Buzzer.—An electric alarm similar to an electric bell, except that the vibrating member makes a buzzing sound instead of ringing a bell.

Candle Power.—Amount of light given off by a standard candle. The legal English and standard American candle is a sperm candle burning two grains a minute.

Capacity, Electric.—Relative ability of a conductor or system to retain an electric charge.

Charge.—The quantity of electricity present on the surface of a body or conductor.

Choking Coil.—Coil of high self-inductance which retards the flow of alternating current. See self-inductance.

Circuit.—Conducting path for electric current.

Circuit-breaker.—Apparatus for automatically opening a circuit.

Collector Rings.—The copper rings on an alternating current dynamo or motor which are connected to the armature wires and over which the brushes slide.

Commutator.—A device on a dynamo shaft for gathering the circuit from the various coils of the armature and sending it out over the line as direct current. On a motor it takes current from the line and passes it on to the armature coils.

Condenser.—Apparatus for storing up electrostatic charges.

Cut-out.—Appliance for removing any apparatus from a circuit.

Cycle.—Full period of alternation of an alternating current circuit.

Dielectric.—A non-conductor.

Dimmer.—Resistance device for regulating the intensity of illumination of electric incandescent lamps. Used largely in theaters.

Direct Current.—Current flowing continuously in one direction.

Dry Battery.—A form of open circuit battery in which the solutions are made practically solid by addition of glue jelly, gelatinous silica, etc.

Electrode.—Terminal of an open electric circuit.

Electromotive Force.—Potential difference causing current to flow.

Electrolysis.—Separation of a chemical compound into its elements by the action of the electric current.

Electromagnet.—A mass of iron which is magnetized by passage of current through a coil of wire wound around the mass but insulated therefrom.

Farad.—Unit of electric capacity.

Feeder.—A copper lead from a central station to some center of distribution.

Field of Force.—The space in the neighborhood of an attracting or repelling mass such as a magnet or a wire carrying current.

Fuse.—A short piece of conducting material of low melting point which is inserted in a circuit and which will melt and open the circuit when the current reaches a certain value.

Generator.—A dynamo.

Inductance.—The property of an electric circuit by virtue of which lines of force are developed around it.

Insulator.—Any substance impervious to the passage of electricity.

Kilowatt.—1,000 watts. (See watt.)

Kilowatt-hour.—One thousand watt hours.

Leyden Jar.—Form of static condenser which will store up static electricity.

Lightning Arrester.—Device which will permit the high-voltage lightning current to pass to earth, but will not allow the low voltage current of the line to escape.

Motor-dynamo.—Motor and dynamo on the same shaft for changing alternating current to direct and vice versa, or changing current of high voltage and low current strength to current of low voltage and high current strength and vice versa.

Multiple.—Term expressing the connection of several pieces of electric apparatus in parallel with each other.

Neutral Wire.—Central wire in a three-wire distribution system.

Ohm.—The unit of resistance. It is arbitrarily taken as the resistance of a column of mercury one square millimeter in cross sectional area and 100 centimeters in height.

Parallel Circuits.—Two or more conductors starting at a common point and ending at another common point.

Polarization.—The depriving of a voltaic cell of its proper electromotive force.

Potential.—Voltage.

Resistance.—The quality of an electrical conductor by virtue of which it opposes the passage of an electric current. The unit of resistance is the ohm.

Rheostat.—Resistance device for regulating the strength of current.

Rotary Converter.—Machine for changing high-potential current to low potential or vice versa.

Secondary Battery.—A battery whose positive and negative electrodes are deposited by current from a separate source of electricity.

Self-inductance.—Tendency of current flowing in a single wire wound in the form of a spiral to react upon itself and produce a retarding effect similar to inertia in matter.

Series.—Arranged in succession, as opposed to parallel or multiple arrangement.

Series Motor.—Motor whose field windings are in series with the armature.

Shunt.—A by-path in a circuit which is in parallel with the main circuit.

Shunt Motor.—Motor whose field windings are in parallel or shunt with the armature.

Solenoid.—An electrical conductor wound in a spiral and forming a tube.

Spark-gap.—Open space between the two electrodes of a spark coil or resonator.

Storage Battery.—See secondary battery.

Thermostat.—Instrument which when heated, closes an electric circuit.

Transformer.—A device for stepping-up or stepping-down alternating current from low to high or high to low voltage, respectively.

Volt.—Unit of electromotive force or potential. It is the electromotive force which, if steadily applied to a conductor whose resistance is one ohm, will produce a current of one ampere.

Volt Meter.—Instrument for measuring voltage.

Watt.—Unit representing the rate of work of electrical energy. It is the rate of work of one ampere flowing under a potential of one volt. Seven hundred and forty-six watts represent one electrical horse power.

Watt-hour.—Electrical unit of work. Represents work done by one watt expended for one hour.

Fighting the Trust

READ!

A Watch Offer Without Parallel



Write for our FREE book on watches; a book that posts you on "selling systems," and explains the reasons for our most remarkable rock-bottom-price offer DIRECT TO YOU on the highest grade Burlington.

IF YOU WANT a highest grade watch (ladies' or gentlemen's), or if you ever expect to own such a watch, write NOW for the free Burlington book. See coupon below.

We won't "knuckle down" to selling systems among dealers, so we have decided to make such a tremendous and wonderful offer direct to the public on a first-class time piece, that no trust, no dealers under contract will or can stop us.

You too will seize this opportunity to get the "Burlington Special" direct on this wonderful offer. You should not buy a worthless watch just because it is cheap. Nor need you pay trust prices now for a top-notch watch. The free Burlington book explains.

\$2.50 A Month At An Anti-Trust Price

\$2.50 a month for the world's most superb time piece! The easiest payments at the rock-bottom—the Anti-Trust price. To assure us that everybody will quickly accept this introductory direct offer, we allow cash or easy payments just as you prefer.

No Money Down

We ship the watch on approval, prepaid (your choice of lady's or gentleman's open face or hunting case). You risk absolutely nothing—you pay nothing—not one cent—unless you want the great offer after seeing and thoroughly inspecting the watch.

Get the FREE Burlington Book

THIS BOOKLET will quickly convince you too that you DO want an Anti-Trust watch—made in the independent factory that is fighting the trust as best it can by giving better quality and superior workmanship throughout; we will quickly convince you that the Burlington watch, on which there is only one rock-bottom price (the same rock-bottom price everywhere) is THE watch for the discriminating buyer; that it is THE watch for the man or woman who wants, not the largest selling brand which everybody has, but the best watch, the watch bought by experts, THE watch that is absolutely perfect in its many points of superiority—the Burlington Watch.

You will be posted on inside facts and prices when you send for the Burlington Company's free book on watches.

BURLINGTON WATCH COMPANY
Dept. 1402, 19th and Marshall Blvd., Chicago, Ill.

Now Write for the free book. It will tell you what you ought to know before you even examine a watch. It will tell you the inside facts about watch prices, and will explain the many superior points of the Burlington over the double priced trust products. Just send your name and address.

No Letter Is Necessary—COUPON Will Do

Name.....

Address.....

BURLINGTON WATCH CO.
Dept 1402 19th and
Marshall Blvd.
CHICAGO • • ILLINOIS

Please send me (without obligations and prepaid) your free book on watches and copy of your \$1,000 challenge, with full explanations of your cash or \$2.50 a month offer on the Burlington Watch.



Are YOU Condemned to

What is life going to mean to you? Is it going to mean comfort and prosperity, or is lack of training going to condemn you to hard labor for the rest of your days?

You are facing a serious problem — one that affords absolutely no compromise. To *earn enough* to command the *comforts* of life you must have *special training*, or else be content to fall in line with the huge army of the untrained, the poorly-paid, the dissatisfied, the *crowd in the rut*.

For you, there *is* a way to success — a true way — an easy way — a short way. Are you willing to have the International Correspondence Schools of Scranton *make you an expert in your chosen line of work*, in your spare time, and without your

The Coupon Means

When I was sixteen years of age I purchased a Course in Interior Wiring. At that time I was an apprentice at the plumber's trade, getting a small salary.

When I reached the age of seventeen years I started in the business myself as an Electrical Contractor. To-day I am not quite eighteen years of age, with an increased income of \$3.10 per day over what I received when I enrolled.

I owe all my progress to the International Correspondence Schools.

WILLIAM G. METTIN,
P. O. Box 49, South River, N. J.

I have increased my salary 50 per cent. I had no experience in Window Trimming before enrolling in the I. C. S. Shortly after enrolling I got a position with Reid & Congers, largest department store in Clinton, Iowa, as Trimmer. I held the position with said firm for 14 months and then got a better position with T. R. Glanville & Son, Mason City, Iowa, with an increase in salary of 40 per cent.

JOHN AHRENHOLZ, Jr.
Mason City, Iowa

At the age of sixteen, while employed by a doctor as driver, I enrolled in the Electric Lighting and Railways Course of the I. C. S. After a year's study, in which I nearly completed my course, I secured a position through my application by mail in the power house of the Ottumwa Ry. & Lt. Co., of Ottumwa, Iowa. At the age of nineteen I was promoted to Operating Engineer, which position I have held for the last two years.

W. A. FULLGRAF,
1024 W. Second St., Ottumwa, Iowa

When I landed in this country on the 5th day of December, 1903, I did not know a word of the English language, and consequently was forced by circumstances to hard work for \$10 a month.

About three years later I heard about the I. C. S., and the same day, in June, 1907, I enrolled with you for the short Coal Mining Course, and in May last I received my Diploma.

Last November I took the complete Coal Mining Course. Recently I successfully passed the examination for mine foreman. Now I am getting \$4 a day and only eight hours work.

PETER STEVENS,
Superior, Wyoming.



Hard Labor for Life ?

having to leave home? *That* is the way. It is the way that meets *your* special case. The *terms* are made to suit *your* means. The *time* is arranged to suit *your* convenience. The *training* is adapted to fill *your* needs. If you are willing, *mark the attached coupon* to learn all about it.

That the I. C. S. can help you is shown by the 300 or so letters received every month from successful students who **VOLUNTARILY** report *better positions and salaries as the direct result of I. C. S. Help*. During November the number was 375. Mark the coupon.

Next month, next week, tomorrow, *even an hour hence* may be too late. Mark the coupon *now* and so take the first step to escape life-long servitude. Marking it entails no obligation—it brings you full information and advice regarding the way to *your* success. **Mark the coupon NOW.**

FREEDOM

I certainly can speak very highly of your Institution, and through its help I have advanced my salary some 300 per cent. I am now with the Wheeler Cond. & Engineering Co. of New York, as Engineer on the road, and give your schools a good deal of the credit, backed up by an apprenticeship with the Providence Engineering Works.

I would be nowhere without the instruction in the Mechanical Drawing connected with my course.

WM. LONSDALE,
87 Arnold Street, Providence, R. I.

At the time of my enrolment I was engaged as helper in a Montreal Machine Shop at \$8.00 per week. Since then I have held many important positions in Canada and U. S. as Chief Engineer and Superintendent with an *8 fold increase in salary*. Am at present General Superintendent, Department of Mines and Minerals, for a large Canadian firm.

My opinion of the Schools is that they supply the only practical way or means of obtaining the necessary technical education for the large class who, like myself, had not the opportunity of obtaining a university education.

JOSEPH BRADLEY,
71 St. Francois-Xavier, Three Rivers, Quebec, Can.

INTERNATIONAL CORRESPONDENCE SCHOOLS, Box 1102 SCRANTON, PA.

Please explain, without further obligation on my part, how I can qualify for the position before which I have marked X.

General Foreman	Banking
R. R. Shop Foreman	Electrical Engineer
R. R. Traveling Eng.	Machine Designer
R. R. Trav'g. Fireman	Electrician
Locomotive Engineer	Mining Engineer
Air-Brake Instructor	Mine Foreman
Air-Brake Repairman	Foreman Machinist
Mechanical Engineer	Chemist
Mechanical Draftsman	Assayer
R.R. Construction Eng.	Architect
Surveyor	Bookkeeper
Civil Engineer	Stenographer
	Ad Writer

Name _____
Employed by _____ R. R. _____
Employed as _____
Street and No. _____
City _____ State _____

5TH
Annual

Electrical
Show

January
15-29, '10



RESERVE
SPACE
NOW

150,000 PEOPLE
Attended the **ELECTRICAL**
SHOW at Chicago Last Year

THIS throng was made up of people interested in the development of electricity; particularly from the consumer's standpoint.

The development of this marvelous force, together with the great strides made in the manufacture of electrical accessories used in the home, in the office, in the factory and on the farm, has made it vitally important that the manufacturer of electrical accessories, the jobber and the supply house should be interested and support the Electrical Show which takes place in Chicago next year.

It is the general opinion that all who have exhibited at this show have received benefits which they could never have secured in any other way. The public has become interested in the exploitation of their products to the extent that the demand made upon the manufacturer to supply the consumer of electric current has been greater than ever before.

The location of exhibitors in the Coliseum is a vital point in the success of their exhibit. By reserving space considerably ahead of time you will be able to secure your desired position in the hall.

Electrical Trades Exposition Co.
115 Dearborn Street :: CHICAGO, ILL.

POPULAR ELECTRICITY

JOURNAL OF ELECTRICITY

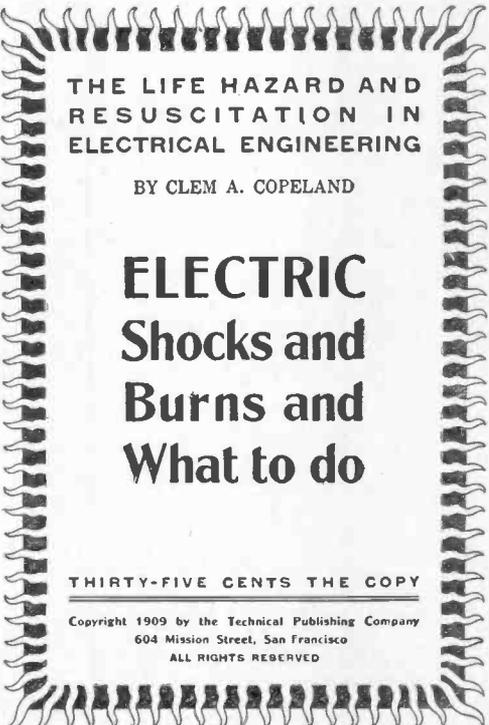
POWER AND GAS

Devoted to the Conversion, Transmission and Distribution of Energy

ESTABLISHED 1887 — WEEKLY

A Magazine valuable at once to the Engineer and Layman. It records the development of the Great West from the Rockies to the Coast. *Admitted to be the most beautifully illustrated Technical Magazine in America.*

75% of all deaths from electric shock can be prevented by promptly applying the methods described in this book the contents of which was originally published in the Journal of Electricity Power and Gas, November 13, '09. The enormous demand necessitated a reprint in book form.



THE LIFE HAZARD AND RESUSCITATION IN ELECTRICAL ENGINEERING

BY CLEM A. COPELAND

ELECTRIC Shocks and Burns and What to do

THIRTY-FIVE CENTS THE COPY

Copyright 1909 by the Technical Publishing Company
604 Mission Street, San Francisco
ALL RIGHTS RESERVED

A copy of this invaluable booklet should be in the hands of every policeman, fireman and electrician. Power companies can provide no better life insurance and protection against claims for damage than by placing this book in the hands of every employee.

The Journal of Electricity, Power and Gas prints the proceedings of the Pacific Coast Sections of the A. I. E. E., Pacific Coast Gas Association, Northwest Electric Light & Power Association, and National Association Stationary Engineers.

Subscription Price, United States, \$2.50; Canada, \$3.50; Foreign, \$5.00.

PUBLISHED BY

Technical Publishing Company

604 Mission Street, San Francisco, Cal.

A Sample Copy for the Asking.

For our Mutual Advantage mention Popular Electricity when writing to Advertisers.

Be a Doctor of Mechano-Therapy

And Earn \$3000 to \$5000 a Year!

You Can Learn in Class or By Mail.



Are you tired of working for wages which barely keep body and soul together? Have you the ambition to enjoy the profits of your own labor? To gain social prominence and financial independence? To go forth among your fellow men with your head up—an honored and respected citizen of your locality?

THEN SEND FOR OUR FREE BOOK

Entitled "How to Become a Mechano-Therapist." It tells how every man and woman, with an ordinary, common school education, can acquire a profession within a few months which will insure financial independence for life. **GET OUR BOOK**—it costs you nothing.

What is Mechano-Therapy?

Mechano-Therapy is the art, or science, of treating disease without drugs. It is similar to Osteopathy, but far superior, being the latest, up-to-date method of treating disease by the Natural Method. It heals as Nature heals—in accordance with Nature's laws.

The Mechano-Therapist is a drugless physician and a bloodless surgeon. His medicines are not drugs, but scientific combinations of food, circumstance, idea, water and motion.

The Mechano-Therapist is skilled in compelling the body TO DO ITS OWN HEALING with its own force, rather than with poisonous drugs of the old school practitioner.

CAN I LEARN IT?

Have you asked yourself this question? We answer, unhesitatingly, YES.

If you have so much as an ordinary, common school education, you can learn.

If you have the ambition to better your condition—to earn more money—to have more leisure—you can learn.

Nor does this require years of patient study to learn Mechano-Therapy—we can teach you in a very short time, so that you may enter this profession—and when you do, you begin to make money. No text books are required, beyond those furnished by us. We supply all lessons and necessary apparatus is used. You do not even need a place to work. All you require is your two hands.

Splendid

Money-Making

Possibilities

in Mechano-Therapy for Ambitious Men and Women

No matter what your occupation may be Mechano-Therapy offers you a new uncrowded field for improving your social position and money-making powers. Hundreds of men and women in all walks of life have taken up Mechano-Therapy and many of them are today independent, earning big money and gaining social prominence in their communities.

If You Possess a Common School Education

Mechano-Therapy Holds Out Equal Opportunities for Men & Women to Earn Big Money

The earnings of the Mechano-Therapist are limited only by the amount of time given to the business. Every community offers plenty of business opportunity for the energetic workers to establish themselves in money-making positions.

Age is No Bar to Your Success

A Personal Word

From the President of the College.

Have you ever thought of going into business for yourself?

Then send for my FREE book. It will tell you how others are enjoying a life of luxury, while putting money away in the bank. How YOU can not only gain independence, but be a benefit to humanity and a highly respected citizen with an income of \$3,000 to \$5,000 a year.

All I ask is that you send me the coupon below for my FREE book. You can then decide, in the privacy of your own home whether you wish to embrace the opportunity which I offer you, or whether you will continue to plod along the balance of your days slaving for others.

We Teach You in Your Own Home

We can teach you an honorable and profitable profession in a few months, which will insure your financial independence for life. We can make you master of your own time—to come and go as you will—an honored and respected citizen, with an income of \$3,000 to \$5,000 a year. We teach you this pleasant, profitable profession by mail, right in your own home, at your own convenience, and without interfering with your present duties. It makes no difference how old you are, any person—man or woman—with just an ordinary common school education, can learn Mechano-Therapy. It is easy to learn and results are sure.

It is simply drugless healing. A common-sense method of treating human life without dosing the system with poisonous drugs—that's all. We have taught hundreds of men and women who were formerly clerks—farmers—stenographers—telegraph operators—insurance agents—railway employees—in fact, of nearly every known occupation—old men of 70 years who felt discouraged and hopeless—young men of 20 years, who never had a day's business experience—salaried men, who could see nothing in the future but to become Ostrichized—laboring men, who never realized that they had within themselves the ability to better their conditions. Write for our FREE book, which explains all—today.

Cut Out This Coupon and Mail It Today

AMERICAN COLLEGE OF MECANO-THERAPY,
Dept. 923, 120-122 Randolph Street, Chicago, Ill.

GENTLEMEN:— Please send your book, "How to become a Mechano-Therapist," free of cost to me.

My Name.....

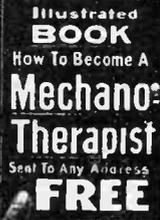
My Post Office.....

R. F. D. or St. No. State.....
(Write name, town and state very plain)

FREE BOOK

Try to realize what this opportunity means TO YOU. If you are contented, and willing to struggle for others all your life for a mere pittance, our proposition may not interest you. But if you have a spark of manhood or womanhood left—any ambition whatsoever to improve your condition socially and financially, learn this pleasant profession. It will make you independent for life. It is so easy—so VERY easy—to get all the details—without trouble or expense. Simply sign and send us the coupon now.

AMERICAN COLLEGE OF MECANO-THERAPY
Dept. 923, 120-122 Randolph St., Chicago, Ill.



Send for this Book Today, It is FREE

These Men and Women

GRADUATES OF THE
American College of Mechano-Therapy of Chicago
 ARE ALL SATISFIED AND ARE EARNING BIG MONEY IN
 THE WELL-PAID AND UNCROWDED PROFESSION OF
MECHANO-THERAPY

Read These Letters

We have many hundreds of letters on file in our office similar to these from professional men, ministers, teachers, clerks, stenographers, laborers—in fact, almost every occupation is represented.

These People Have Succeeded—Why Not You?



The Oldest Student—Seventy-Six Years Old—Says: "Lessons Easily Mastered."

J. H. Conway, M. T., writes:
 "Lessons are easily learned by anyone with ordinary intelligence and a common school education."
 "I am seventy-six years old—most likely the oldest student you have."

"I Make \$10 to \$15 Per Day, and Work Seven Days a Week."

Dr. F. W. Leslie, M. T., writes:
 "I make from \$10 to \$15 a day, and work seven days a week. I am busy all the time."



A Prominent European Instructor Says: "Your Course is Most Complete."

Edward Arffman, M. T., writes: "I passed a four years' course of learning in hospitals, served in the Danish Royal Life Guards, was a physical director, took three-year course in Examination, Theory and Practice in Europe, and now have earned my diploma in Mechano-Therapy. Thanks for it. Your course is most complete."

"I Am Getting a Good Practice in Mechano-Therapy."

Dr. Sam Levy, O. D., M. T., writes:
 "I am doing a good business and getting a good practice in Mechano-Therapy, which goes good with my profession of Optometry."



"Time Spent and Price of Tuition a Fine Investment."

Rev. F. E. Hall, M. T., writes:
 "The time spent and the price of tuition in your course will be a fine investment. I put the principles I learned into practice and demonstrated the wonderful facts."



Mechano-Therapy Worked Wonders Even in the Hands of a Beginner.

Anna M. Davis, M. T., writes:
 "I surprised myself by accomplishing a number of successful cures. Your course is so complete in every way that the student who has earned a diploma should be thoroughly competent to take his place among the other practitioners of the healing art."



Your Instruction Beyond My Expectation

Dr. Louis H. Luetten, M. T., writes:
 "I thank you and the school for the good you have done me through your instructions, which have been beyond my expectations entirely."



Received \$2.50 to \$5.00 for a Single Treatment.

P. W. Dymont, M. T., writes:
 "In my one year's practice I have never given a single treatment for less than \$2.50 and the most was \$5.00."

Makes \$25 to \$30 Per Day

E. L. Stout, M. T. D., writes: "I now get patients from four different States, and make as high as \$25 to \$30 per day. I feel that in Mechano-Therapy there is financial success for all."



Self-Supporting Women Should Take Up Mechano-Therapy

Elizabeth J. Mars, M. T., writes:
 "I would recommend any self-supporting woman to take up Mechano-Therapy as a profession. The lessons are easy and plain, and there is no trouble in understanding them."

Income \$15 Per Day; Formerly a Blacksmith

W. S. McClure, M. T., writes: "I heartily endorse your college and recommend it to others. The man who induced me to take a course in Mechano-Therapy was formerly a blacksmith with an ordinary education. Today he is practicing Mechano-Therapy with an average income of \$15 a day."



"I Am Doing Very Well."

Elizabeth S. Rosensteel, M. T., writes:
 "The course given by your college is plain, clear and easily comprehended. Anyone with an ordinary education can soon master the course. I have succeeded in every case and am doing very well."

Successful Financially; Scores of Satisfied Patrons

C. Alfred Davy, M. T. D., writes: "I get results beyond even what I had anticipated. I have scores of satisfied patrons and of the financial end I have no cause to complain. I recommend your course as thorough and practical."



Doing Better Financially in Mechano-Therapy Than Formerly in the Profession of Electrical Engineering,

John E. Lydon says:
 "I have done better financially since I entered the profession of Mechano-Therapy than when I formerly followed the profession of Electrical Engineering. There is no doubt of one's success in Mechano-Therapy if the instructions as taught are carefully followed."

One of our Most Successful Graduates, located in New York City, writes:
 "I cleared \$30.00 above all expenses in four days' time."

WHY BE A WAGE SLAVE—WHY BE A DRUDGE FOR OTHERS?

Try to realize what this opportunity means to you. If you wish to become independent of job hunting and employers, if it is your hope to have a profitable business of your own, Mechano-Therapy offers to you this very minute a grand opportunity for self improvement, social and financial success. There is no other profession that a man or woman can enter in the same short time or for as small an amount of money that will pay one-fourth as well as Mechano-Therapy.

Send for the free Book—read it—then decide for yourself. Use the coupon on the page opposite.

CLASSIFIED ADVERTISING

Advertisements in the section of Popular Electricity, will cost 40 cents a line, cash with order, and in order to secure proper classification must be in this office the first of the month preceding date of issue

AGENTS

AGENTS MAKE BIG MONEY SELLING OUR new sign 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.

ELECTRIC LIGHT COMPANIES EVERY-where want men to sell electric current and appliances. Learn the How and Why by reading **SELLING ELECTRICITY**, published monthly at 74 Cortlandt St., New York—\$1.00 per year.

AGENTS TO SELL DUTCH COOKING SET; sells every house. Write us. Pace Bros. & Sons Pottery Co., Roseville, Ohio.

WANTED—BUYERS AND AGENTS TO SELL our concrete mixers, cement block and fence post machinery. Send for circulars and prices. Address W. L. Keller Cement Block Machine Co., Kearney, Neb.

EXCEPTIONAL OPPORTUNITY FOR ENER-getic solicitors with grit and selling power. Article absolutely new and guaranteed. Tremendous seller. Everybody buys if shown. 60c. to \$2 profit each sale. Virgin field awaits hustlers everywhere. Write today. Sanitax Co., 2310 Wabash Ave., Chicago.

WONDERFUL INVENTION—CANCHESTER Kerosene Incandescent Lamp burns with or without mantle; 6 times brighter than electricity, gas, acetylene or gasoline at 1-10 cost. Burner fits any lamp; saves 75 per cent oil. No trimming wicks. \$10 daily. Beware of imitations. Handsome outfit furnished. Canchester Light Co. 26 State, Dept. P. E., Chicago.

BUSINESS OPPORTUNITIES

HOME MAIL-ORDER BUSINESS. PLEASANT, Education, Profitable pastime. Everything furnished. Booklet free. Clarence Wright, 1828 E North St., Philadelphia.

CONCRETE—LEARN HOW TO HANDLE this material by reading "Concrete," a monthly magazine devoted to the uses of Portland cement. Practical, instructive articles, written in plain English. Sample copy, 10c. Yearly subscription, one dollar. Concrete Pub. Co., 299 Owen Bldg., Detroit, Mich.

START LEGITIMATE MAIL-ORDER MER-cantile business of your own; possibilities unlimited; cash orders, good profits; conducted by anyone. We print your catalogs, supply everything; sell you merchandise at wholesale, show you how, on small investment. Write for free booklet and sample catalog. Central Supply Co., Kansas City, Mo.

LONG ESTABLISHED MAIL-ORDER BUSI-ness, good for \$50 daily. Easily conducted by anyone, anywhere. Satisfactory terms. Anderson, 6947 North Clark St., Chicago.

BUSINESS OPPORTUNITIES

YOU CAN MAKE FROM \$200.00 TO \$2500.00 in addition to your regular salary under our new salary plan. Special opportunities for employees of electrical concerns, telephone, telegraph, light and power companies, etc. Particulars free on request. Circulation Department, Popular Electricity, Chicago, Ill.

LOVE'S MYSTERIES—EXPLAINS MAGNET-ic Attraction, Gaining Affections of Opposite Sex, etc. 316 priceless pages. Appropriately illustrated; \$2.00. Circulars free. Auguster Martens, Publisher, Burlington, Iowa.

DON'T WORRY! IF CHRISTMAS LEFT YOU broke—you can make lots of money by taking advantage of our special salary offer, without interfering with your regular work. Ask about it. Popular Electricity, Circulation Dept., Monadnock Block, Chicago.

PERSONAL MAGNETISM WINS—NO DIF-ference what you want, develop your latent forces and succeed. Helpful books, 10c, 25c and 50c. Catalogue free. Eleescience Institute, 6945 N. Clark St., Chicago.

RAPID CALCULATION BY "PRODUCTS OR DIVIDENDS" beats any machine. Get free particulars and learn the system G. A. Christensen, Civil Engineer, Box 22-E, San Francisco, Cal.

MESMERISM—MAGIC MONEY MAKER —Lecturing, Healing, Stage Performances, teaching by mail. We furnish everything required. "Secrets and Wonders of Hypnotism" free. Eleescience Inst., 6947 N. Clark St., Chicago.

ATTENTION—OUR PROPOSITION OFFERS you best chance you ever had for making easy money and lots of it. Write for our salary plan. Most generous ever presented. Popular Electricity Publishing Co., Monadnock Block, Chicago.

BOOKS

64-PAGE BOOK, HOW TO MAKE STATIC Machine, Telephone, Electrotypes, etc. 200 Illustrations. 10c prepaid. B. K. Bunch, Marshall, Mo.

WANTED—EVERY BOOKKEEPER TO READ "How to Become a Head-Bookkeeper, Auditor or Public Accountant." Worth reading. Will send it Free. Chas. A. Sweetland, 4 Boyleston Bldg., Chicago.

HYDE'S TELEPHONE TROUBLES AND HOW to find them, and manual of cost units, combined 1909 edition. Price 25c. copy. Address, Hyde Pub. Co., 183 5th St., Milwaukee, Wis.

EVERY SMOKER SHOULD HAVE OUR bully little book which tells just what live men want to know about cigars. Frank and truthful. Gives unprejudiced, straight, inside information. No "ads." Send ten cents silver. Cuba Now Pub. Co., Box 1383, Boston, Mass.

POPULAR ELECTRICITY

COINS AND STAMPS

STAMPS, 100 FOREIGN, 10 CENTS; 40 U. S., 10 cents. Two Tasmania pictures, 4 cents. F. L. Toupal Co., 1410 Lowe Ave., Chicago Heights, Ill.

OLD COINS—\$5.75 PAID FOR RARE DATE 1853 quarters. \$10 for a cent. Keep all money dated before 1880 and send 10 cents at once for our New Illustrated Coin Value Book. Size 4x7. It may mean your fortune. C. F. Clarke & Co., L. B. 12 Le Roy, N. Y.

FOREIGN STAMPS—9 DIF. JAPAN, 5c; 10 Australia 5c., 7 Africa 5c.; 250 mixed Foreign China, Chili, etc., 10 c. 70 dif. Old U. S., worth \$1.50, only 10c. Stamps bought. H. J. Kleinman, 3643 N. Marshall St., Philadelphia, Pa.

ELECTRIC MATERIALS

DRY BATTERIES RENEWED BY ANYONE for 10 to 25c. per doz. Good as new. Formula \$1. Will send this month for 35c. FAIRMOUNT TELEPHONE CO., Leighton's Corners, N. H.

STORAGE BATTERIES, 6 VOLTS, 60 AMPERES, \$7.50. Electrolytic Rectifiers, charge batteries from alternating current, \$5. Electrical Supply Co., York, Pa.

SAVE MONEY—RENEW OLD DRY BATTERIES; make good as new; cost very little. Full instructions 25c. Guaranteed correct. NORTHERN SUPPLY CO., Battery Department 3, 3455 N. Hamilton, Chicago.

FOR SALE

LUBRICANTS, ASBESTOS, GRAPHITE AND mica candles for loose pulleys and shaftings; no drip; no dirt; economical. Swain Lubricator Co., 250 E. Lake St., Chicago.

FOR SALE—COMPLETE SET OF CASTINGS, with blue prints of 3-4 h. p. gasoline-stationary engine; includes governor and timer, screws, etc. \$10. Comet Motor Works, 17 W. Madison St., Chicago, Ill.

FOR SALE—ENGINEERING LIBRARY (12 Vols.) in good condition. Bound in half red morocco. Covers every branch of engineering. Cost \$50.00; my price \$15.00. Address Henry Ward, 124 E. 52nd St.

HELP WANTED

FOR SALE—"TESLA COILS" 8 AND 12 IN. spark. \$10.00 and \$15.00 without condenser. Glen McWilliams, 501 S. Broadway, Decatur, Ill.

WANTED—YOUNG MEN, 16 TO 20 YEARS, to learn armature and field winding, motor assembling and testing. Address Motor Manufacturer, care Popular Electricity, Chicago.

HELP WANTED—IF YOU WILL BUY A slightly used A. S. C. Cyclopaedia from me and study it you will not be looking through the "Help Wanted" column for employment. I can furnish any subject at a great saving to you. M. C. Suttle, McLeansboro, Illinois.

WANTED—YOUNG MEN WHO CAN FURNISH references, to become traveling salesmen; experience unnecessary; WRITE TODAY FOR FULL PARTICULARS. Bradstreet System, Dept. L., Rochester, N. Y.

THE UNITED TRADE SCHOOL CONTRACTING Co., conducts a trade school and wants men to learn plumbing, bricklaying, or electrical trade. No expense and hundreds have learned in a few months. Steady work guaranteed. Address 120 E. 9, Los Angeles.

AGENTS—I POINT THE WAY TO SUCCESS to any agent who will follow my course. I have shown thousands how to make money. I can show YOU. My goods and business methods have lifted mortgages, built homes and scattered prosperity everywhere. Write today for the "SAYMAN PLAN" and FREE SAMPLES. 419 Sayman Bldg., St. Louis, Mo.

CHAUFFEURS—\$5 PER DAY PAID TO COMPETENT automobile drivers; a complete instruction book that will qualify you for these positions will be sent postpaid for 25c. This valuable book tells all about driving and adjusting automobiles; explains all gasoline engine troubles; satisfaction guaranteed or money refunded. George N. Pearson, Bala, Pa., Desk E.

WANTED—1000 CHAUFFEURS AND REPAIR Men. Our demand for automobile engineers exceeds the supply; calls for men of intelligence and mechanical bent, capable of commanding \$100 to \$150 monthly upon graduation. Resident courses \$15-\$50. Home correspondence courses completed by practical road and shop work at any of our branches or affiliated schools, highly successful. Look This Up. Auto Schools of America, 1680 Michigan Ave., Chicago.

WANTED IMMEDIATELY—RAILWAY MAIL clerks, Custom House clerks, many spring examinations. Salary \$600 to \$1500. Steady work. Short hours. Annual vacation. Salary twice monthly. Thousands to be appointed during 1910. Country and city residents equally eligible. Common education sufficient. To advertise we are preparing candidates free. Write immediately for Schedule showing examination places and dates. Franklin Institute, Dept. O., 58 Rochester, N. Y.

INSTRUCTIONS

INSTRUCTIONS—I CAN SUPPLY ANY SUBJECT A. S. C. reference library, at a great saving to you. or if you have a set of A. S. C. Books you wish to sell, I'll pay you a reasonable price for them. What do you say? M. C. Suttle, McLeansboro, Ill.

MISCELLANEOUS

GASOLINE ENGINE CASTINGS, COMPLETE set of castings for one horsepower Marine Engine. Just the thing to pull a small Dynamo. \$8.00 per set. Murray & Allender, Fairfield, Ia.

FLYING MACHINE DEMON 25c, FRENCH Monoplane, 75c, Model Aeroplane \$1.25. Build your own man-carrying machine; instructions \$1.00. Write us. Box 133, Sta. A, San Antonio, Tex.

MAKE YOUR OWN CUTS AND MIRRORS by our simple chemical processes. Each formula complete 10c. Banner Supply Co., Moline, Ill.

BECOME A MAGICIAN—WE HAVE THE latest up-to-date Sleight of Hand Tricks and Magic. Catalog free. Thom-Mickey Co., 546 Rockefeller Bldg., Cleveland, Ohio.

POPULAR ELECTRICITY

MECHANICAL AND ELECTRICAL DRAWINGS, tracings, blue prints, and designs made. Good work. Satisfaction guaranteed. Prices right. Send sketches for estimate. J. W. Whitaker, Francesville, Ind.

HAND PASTE—REMOVES ALL DIRT AND stains from the hands. 5c. will make \$1.00 worth at store price. Directions for making this paste, 25c. Johnson & Bell, 275 12th St., Brooklyn, N. Y.

FREE TO ALL—OUR ILLUSTRATED CATALOGUE of tricks and novelties, etc. National Trick & Novelty Co., Dept. B., 2806 State St., Chicago, Ill.

ANYBODY CAN MAKE GOOD CUTS WITH my simple zinc etching process; price, \$1; specimens and particulars for stamp. T. M. Day, Box E., Windfall, Ind.

ARE YOU INTERESTED IN THE TELEPHONE BUSINESS? Write for our premium offer. Western Telephone Journal, Vinton, Iowa.

100 CARDS PRINTED 50c. POSTPAID ANYWHERE. Card Printing Co., 5213 Carpenter St., Chicago.

GUMMED LABELS—3000 FOR \$1.00 POSTPAID. Any size up to 1x2. Two colors. All work satisfactory or money back. Trial order convinces. Send for FREE samples. E. Terrance Mfg. Co. Belmar, Pittsburg, Pa.

"LIGHT, HEAT, MAGNETISM AND ELECTRICITY are all one and the same thing." If you want to know what they are, send fifty cents (50c.) for a copy of a pamphlet to A. M. Howland, El Paso, Texas.

SEND 2c. STAMP FOR OUR NEW ILLUSTRATED catalog of electrical books you should have, and particulars of our special offer, "An Electrical Library Free." Popular Electricity Book Department, Monadnock Block, Chicago, Ill.

MOTION PICTURE MACHINES, FILM Views, Magic Lanterns, Slides and similar Wonders for Sale. Catalogue Free. We also Buy Magic Machines, Films, Slides, etc. Harbach & Co., 809 Filbert St., Philadelphia, Pa.

"23 FOR DIRT." CLEANS EVERYTHING. Everybody needs it. Ask your dealer, or send 10c. for can. Agents wanted everywhere. C. C. C., 403 S. 12th St., St. Louis, Mo.

GOLD FISH AND AQUARIUMS THE MOST charming, interesting and least troublesome of pets. Our fish are raised from choice stock of hardy breed adapted to aquarium life. Our gold fish book given for the asking. The Pioneer Aquarium Mfg. Co., gold fish hatchery, Racine, Wis.

MAKE MIRRORS AT HOME. BIG PROFITS with little outlay. One 18x36 in. mirror, costs \$2.00 to \$5.00. You can silver a glass this size for 20c. Send 50c. in stamps or money order and we will send you EXPLICIT DIRECTIONS how to do it; also how to emboss, grind, foil, gold leaf, frost chip and make imitation stained glass. How to transfer photos on glass, bore holes in glass and cut skylights. George L. Patterson & Co., Dept. 4, Brooksville, Ky.

WE MANUFACTURE GLASS PAPER. PLAIN glass windows made to look like real stained glass. Easily applied and beautifies the home. Something new for agents. Two sheets of this glass paper sent as a sample with catalogue in colors and complete instructions on receipt of 10 cents. S. H. Parrish & Co., 216 Clark St., Chicago.

BEST PRICES—MOST COMPLETE LINE IN Chicago—of rubber stamps, daters, check protectors, stamping specialties, etc. Big illustrated catalog free. Special short time offer—10c. a line. (of 3 in. or less) on all rubber stamps. Any style type—cushion or moulding mounted. Send me your order today. Theo. Hebling, 709 Marquette Bldg., Chicago.

THREE THOUSAND FORMULAS—MY 368-page volume of recipes and trade secrets, cloth bound, only 40c, prepaid. Worth dollars. Satisfaction guaranteed. SPECIAL—Return this ad and I will include 3 months' subscription to Mechanical Digest. Digest alone for 3 months, 10c. Wiley Sanderson, Dept. E, Ypsilanti, Mich.

MOTORS

BARGAINS—ALTERNATING AND DIRECT current motors, dynamos, also plating dynamos, all makes, sizes, sold, bought and repaired. Eugene L. Richter Electric Co., N. E. Cor. Ueber and Columbia Ave., Philadelphia, Pa.

MUSICAL INSTRUMENTS

MAKE VIOLINS—FULL SIZED PLANS 50c., silver. Ross & Co., Dept. M., Blanchard Hall Los Angeles, Cal.

PATENTS AND INVENTIONS

MODELS MADE FOR INVENTORS. LOW prices. S. H. Merryman, Towson, Md.

PATENTS PROCURED FOR TEN DOLLARS Attorney's fees. Twenty years' experience. M. Pierce, Downing Building, New York.

PATENTS SOLD FOR 5 PER CENT. We force sales by constant advertising. Send for plan. Patent Sales Co., Merchantville, N. J.

PATENT—ADVICE AND BOOKS FREE. Highest references. Best results. I procure patents that protect. Watson E. Coleman, Patent Lawyer, 612 F. St., N. W., Washington, D. C.

MASON, FENWICK & LAWRENCE, PATENT Lawyers. 616 F. Street, Washington, D. C. Established 49 years. Best references. Careful work. Terms moderate. Booklet and advice FREE.

TWO BOOKS FREE—SHEPHERD & CAMPBELL, Patent Attorneys, 2196 McGill Bldg., Washington, D. C.; 246 Canal St., New York; Kimball Bldg., Boston. Prompt service.

PROTECT YOUR IDEAS—PATENT SECURED or our application fee refunded. Advice and booklet free. Milo B. Stevens & Co., Attorneys, 800 14th St., Washington, D. C.; 356 Monadnock Block, Chicago. Established 1864.

PATENTS, SOUND AND PROTECTIVE, bring profits to inventors. J. B. Cralle & Co., Patent Attorneys, Cralle Bldg., Washington, D. C. Write for our free new book and method without delay.

POPULAR ELECTRICITY

PATENTS SECURED—INVENTOR'S POCKET Companion free. Send description for free opinion as to patentability. W. N. Roach, Jr., Metzert Bldg., Washington, D. C.

HAVE YOU AN IDEA? WRITE FOR OUR books, "Why Patents Pay." "100 Mechanical Movements," Perpetual Motions—50 illustrations. Mailed free. F. P. Dietrich & Co., Patent Lawyers, Washington, D. C.

PATENTS—H. W. T. JENNER, PATENT AT- torney, and mechanical expert, 608 F. Street, Wash- ington, D. C. Established 1883. I make an investiga- tion, and report if patent can be had, and the exact cost. Send for full information. Trade-marks regis- tered.

PATENTS OBTAINED OR NO CHARGE made. Easy payments; 15 years' official Examiner U. S. Patent Office; unexcelled facilities. Patents advertised for sale free. Send sketch for free search and report on patentability, also illustrated inventors' guide book. E. P. Bunyea Co., Washington, D. C.

MACHINE DESIGNING AND DRAFTING— Ideas developed to their correct mechanical design. Unsuccessful inventions re-designed, simplified and improved. Mechanical problems solved. Automatic high-speed machinery a specialty. If in trouble write our Engineering Dept. **INDUSTRIAL NEWS BU-** REAU, Ithaca, N. Y.

PICTURES AND POST CARDS

25 BEAUTIFUL POSTCARDS, ALL DIFFER- ent, for 25c. Some of them retail at 5c. and 10c. each. Hudson Novelty Co., Port Ewen, N. Y.

SEND ME 25c. AND GET 15 BEAUTIFUL views of Grand Rapids, the furniture city. J. C. Seven, 646 Wealthy Ave., Grand Rapids, Michigan.

SELL YOUR KODAK NEGATIVES—SEND us proofs and 10c. to cover cost of submitting to ad- vertisers. As soon as buyer is located we will make you offer. Photo Advertising Co., Dept. 2, 4219 Wilcox Ave., Chicago.

SCHOOLS

\$200 TO \$600 MONTHLY EASILY MADE FIT- ting eye glasses. Short, easy mail course. Reduced tuition. Big demand for opticians. Write today for free "Booklet O," National Optical College, St. Louis.

TELEGRAPHY TAUGHT THOROUGHLY and quickly—also "Wireless." Superior methods; posi- tions guaranteed; catalog free. Write today. Eastern School of Telegraphy, Box 60, Lebanon, Pa.

CIVIL SERVICE EMPLOYEES ARE PAID well for easy work; examinations of all kinds soon; booklet 50, describing positions and telling easiest and quickest way to secure them, is free. Write for it now. Washington Civil Service School, Washington, D. C.

AUTOMOBILE SCHOOL—LEARN THE AU- tomobile business, repairing and driving, in which you can earn good wages and have healthful and pleas- ant work. We give a thorough and practical course in road work and repairing. For full particulars address Academy of Automobile Engineering, 1420 Michigan Ave., Dept. "C," Chicago, Ill.

WIRELESS

WIRELESS, ELECTRICAL AND HIGH FRE- QUENCY APPARATUS, 1910 catalog for stamp. Walter W. Hartman, Clay Center, Kan.

ATTACHMENT FOR MORSE KEY—CON- vert your old key to a wireless key Price of attach- ment fitted with heavy alloy contacts, mounted on finished base with binding posts, \$2.50. Complete with key, \$4.00. Anderson Wireless Apparatus Co., Sheidley Bldg., Kansas City, Mo.

WIRELESS TELEGRAPH—WE CARRY A full and up-to-date line of instruments for amateurs and professionals. Stamp for catalogue. Empire Wireless Exchange, 230 W., 111 St., New York City.

SILICON, EXTRA SPECIAL QUALITY, 35c. per ounce. Quantity limited, order at once. Add 5c. for postage. Iron Pyrites, for detectors, 35c. per ounce, 5c. added for postage. John Petri, 217 A. W. 22nd St., Chicago, Ill.

SPECIAL PRICES—1000-OHM WIRELESS RE- ceiver, double pole, special thin diaphragm wound with copper wire, \$1.75. "National" receiving condenser, 30c. Waterhouse Bros., Bourne, Mass.

ALUMINUM—SEND FOR PRICE LIST ON wire, sheet, ingot, solder, and dental plate. Also brass, copper, lead and platinum. John Petri, 217 A West 22nd St., Chicago, Ill.

FREE TO WIRELESS EXPERIMENTERS— Wanted, wireless experimenters to do original work at home during leisure hours. We will pay liberally for your work. Here is a chance for young students and other wireless workers to earn some money and a wire- less education during your spare time and without any expense on your part. Apply as this opportunity may not be offered you again. Address Experimental Department, Collins Wireless Bulletin, Newark, N. J.

1000 OHM RECEIVERS \$1.75. VERY SEN- sitive and reliable. Complete long distance receiving sets with pair receivers (resistance of receivers 2000 ohms), \$12.25. Double slide tuning coils, \$3.50. Fixed receiving condensers, 30c. Send stamp for circulars. T. Alden Wireless Co., Campello, Mass.

TO WIRELESS EXPERIMENTERS EVERY- where: Free Detectors. I have discovered a new crystal detector and claim it is superior to any other. I have a great quantity on hand and will be glad to furnish large crystals FREE to all who apply, as I want your opinion. I would like wireless experimenters everywhere to try this detector at my expense. Apply at once by mail to William Dubilier, 54 & 56 Clinton St., Newark, N. J.

TYPEWRITERS

IT'S A SHAME—GOOD REMINGTONS, \$15.00 to \$24.00, rebuilt \$33.00, sell them all. Olivers, Under- woods, Smiths, 150 stock. Rentals \$1.00 applies. Ribbons 15c. Knight's, 241 N. 12th, St. Louis, Mo.

MAGIC **POCKET TRICK FREE**
Catalog included, send 4c stamp
Dept. 17 270 W. 39th St., NEW YORK.

Vibrate Your Body And Make it Well



VIBRATION FOR THE RACKING BACKACHE OF WOMEN

You have no *right* to be sick. Pain, suffering and disease are unnatural, they are *wrong*. It is your *duty* to be well. Don't try to *stand* pain—**CURE IT**. No matter what ails you—even if others have told you that your case was incurable—**DON'T GIVE UP HOPE**. The great natural forces, *Vibration and Electricity*, are curing more people today than all the *drugs and doctors* in the world put together.

THE WHITE CROSS ELECTRIC VIBRATOR

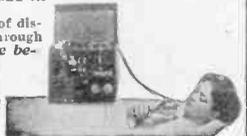
combines both of these great natural curative agents. It gives you your choice of Vibration, Faradic and Galvanic Electricity, either separately or in combination, just as you wish. It relieves pain *instantly*, and its *cures are permanent*.

The *White Cross Electric Vibrator* cures the *cause* of disease. It sends the rich, red blood leaping and coursing through your veins and arteries *straight to where the disease begins*. It tones up your nerves and muscles and every vital organ. It makes you *fairly tingle with the joy of living*.

Don't neglect the FIRST symptoms. If you feel "run down," "out of condition," "if you just feel 'out of sorts'" generally, *something is wrong*. The most serious diseases creep upon you unawares. The *White Cross Electric Vibrator* fills your body so full of vigorous, robust health that pain and disease cannot find a foothold.



Curing Stomach Trouble with Vibration.



Combined Electric Bath and Vibratory Treatment.



Making the Hair Beautiful with Vibration.



FREE BOOK "Health and Beauty"

SEND TODAY for the magnificent free book, "Health and Beauty." This valuable work tells you all about the human body in health and disease in *terms so plain, so clear*, that anyone can *understand*. It tells you how you can get well and *keep* well, no matter *what* your trouble is. This book was not written for surgeons and physicians, but for *you*. Every page, every line, is thrillingly interesting.

Besides, this book tells you all about the wonderful *White Cross Electric Vibrator*—what it has done for thousands of others and what it will do for you. It tells you about the *very special offers* which we are making, for *just a short time*, on this wonder-working instrument, and how you can get a *White Cross Electric Vibrator* on a *genuine free trial*. Your name and address brings this intensely interesting book by return mail. Sign the coupon and mail it to us at once.

CURES THESE DISEASES AND MANY OTHERS

- | | |
|-------------|------------------|
| Headache | Nervous Debility |
| Catarrh | Bright's Disease |
| Insomnia | Heart Trouble |
| Toothache | Deafness |
| Indigestion | Stomach Trouble |
| Rheumatism | Scalp Disease |
| Neuralgia | Constipation |
| Earache | Lumbago |

All these and dozens of other chronic and acute diseases instantly relieved and permanently cured by Vibration and Electricity. Get our wonderful free book, "Health and Beauty." THEN you will know.

Vibrating Chair Free

With the *White Cross Electric Vibrator*, you can transform any ordinary household chair into a Vibrating Chair, equal in every respect to those used in the big hospitals and sanitariums. You can give yourself the same treatments, including the *famous Swedish Movement* treatments, that specialists and sanitariums charge \$2.00 to \$3.00 apiece for. This is only one of the many marvelous things that can be done with the *White Cross Electric Vibrator* exclusively.

Send Coupon Today For Free Book

DON'T DELAY A MINUTE. Whether you are sick or well, you should send for this book *anyway*. You cannot tell when you *may* need it and need it *badly*. When you do there will be *no time* to send for it. Learn *today* what vibration will do for you—for all your loved ones. Learn all about its wonderful health-giving powers. Learn how you can save all doctor bills and cure yourself right at home without expense.

SEND NO MONEY, just your name and address on the coupon. *But write today.*

LINDSTROM, SMITH CO.
253 LaSalle Street
Dept. 1402 CHICAGO



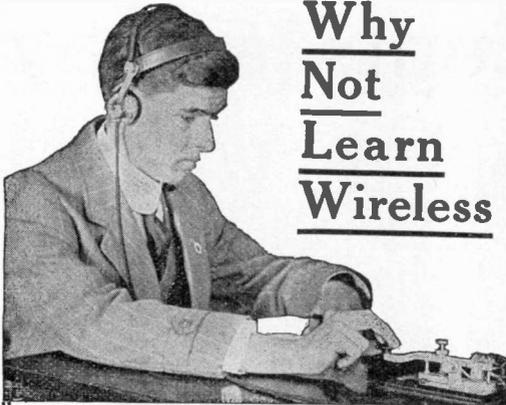
SIGN AND MAIL THE COUPON TODAY

LINDSTROM, SMITH CO.,
253 LaSalle St.,
Dept 1402 CHICAGO

Without obligations on me, please send free, prepaid, your book "Health and Beauty," on treatment of disease by Vibration and Electricity. Also free trial offer.

Name.....

Address



**Why
Not
Learn
Wireless**

¶ All over the country today the big wireless telegraph and telephone corporations are endeavoring to get reliable, trustworthy operators.

¶ The demand is greater than the supply—good men are scarce. It's the golden opportunity for the young man of brains and ability.

**A Complete Course for
Wireless Students**

The American Wireless Institute, which is the most complete school of its kind in the United States, is now preparing hundreds of young men and women to fill positions of trust as wireless operators.

We teach by the only satisfactory method—practical working experience. Our study rooms are filled with complete wireless instruments—students get the actual experience of sending and receiving messages.

We educate our students in Wireless construction in all its branches—teach them the proper care and use of all instruments in Wireless work.

**Wireless Operators Get
Big Salaries**

The pay for Wireless operators and engineers ranges from \$60 to \$175 per month, according to ability.

But this is not all—think of the vast opportunities offered in the Wireless field, for the young man who is industrious and reliable.

Big corporations, with millions of capital, are entering this field and there is absolutely no limit to the advancement offered to the man with push and ability.

Every young man who is mechanically inclined should have our catalog—it gives complete details of our course—shows you plainly how we teach you to become a Wireless operator.

**Positions Waiting for
Our Students**

We are continually receiving at "our office," requests from every part of the country for trained men, and it is an easy matter for us to find good positions for our students as fast as they fit themselves for practical work.

Don't let this chance slip by. Sit down right now and write for our prospectus. We will send complete details by return mail.

AMERICAN WIRELESS INSTITUTE

27 William Street

New York, N. Y.

Wireless Club

If you are a Wireless Operator or are building Wireless Telegraph Equipment you will want to join

Popular Electricity Club

Send for particulars and membership blank.

You will also want this splendid

WIRELESS BOOK



**THE STORY OF
THE WIRELESS
TELEGRAPH**

Non-Technical
In Plain English

Illustrated

Sent with one year's
subscription (new or
renewal) to Popular
Electricity for \$1.50

Popular Electricity Pub. Co.

Monadnock Block

::

CHICAGO, ILL.

I enclose herewith \$1.50, for which enter me for one year's subscription to **Popular Electricity** and send me **The Story of Wireless Telegraphy**.

Name

Address

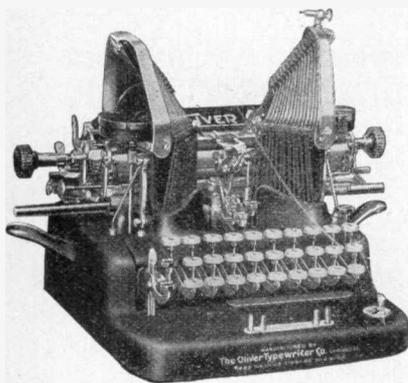
City

State

Seventeen Cents a Day Buys an Oliver Typewriter!

This amazing offer—the New Model Oliver Typewriter No. 5 at *17 cents a day*—is open to everybody, everywhere.

It's our new and immensely popular plan of selling Oliver Typewriters on little easy payments. The abandonment of *longhand* in favor of clean, legible, beautiful *typewriting* is the next great step in human progress..



Already—in all lines of business and in all professions—the use of *pen-and-ink* is largely restricted to the writing of *signatures*.

Business Colleges and High Schools, watchful of the trend of public sentiment, are training a vast army of young people in the use of Oliver Typewriters.

The prompt and generous response of the Oliver Typewriter Company to the world-wide demand for *universal typewriting*, gives tremendous impetus to the movement.

The Oliver, with the largest sale of any typewriter in existence, was the logical machine to take the initiative in bringing about the *universal use* of typewriters. It *always* leads!

Save Your Pennies and Own an Oliver

This "*17-Cents-a-Day*" selling plan makes the Oliver as easy to *own* as to *rent*. It places the machine within easy reach of every *home*—every *individual*. A man's "*cigar money*"—a woman's "*pin money*"—will buy it.

Clerks on small salaries can now afford to own Olivers. By utilizing spare moments for practice they may fit themselves for more important positions.

School boys and school girls can buy Olivers by saving their *pennies*.

You can buy an Oliver on this plan at the regular catalog price—\$100. A small first payment brings the machine. Then you save 17 cents a day and pay monthly.

And the possession of an Oliver Typewriter enables you to *earn money to finish paying for the machine*.

Mechanical Advantages

The Oliver is the most highly perfected typewriter on the market—hence its *100 per cent efficiency*.

Among its scores of conveniences are:

- the Balance Shift
- the Ruling Device
- the Double Release
- the Locomotive Base
- the Automatic Spacer
- the Automatic Tabulator
- the Disappearing Indicator
- the Adjustable Paper Fingers
- the Scientific Condensed Keyboard

Service Possibilities

The Oliver Typewriter turns out more work—of better quality and greater variety—than any other writing machine. Simplicity, strength, ease of operation and visibility are the corner stones of its towering supremacy in

- Correspondence
- Card Index Work
- Tabulated Reports
- Follow-up Systems
- Manifolding Service
- Addressing Envelopes
- Working on Ruled Forms
- Cutting Mimeograph Stencils

Can you spend 17 Cents a Day to better advantage than in the purchase of this wonderful machine?

Write for Special Easy Payment Proposition or see the nearest Oliver Agent.

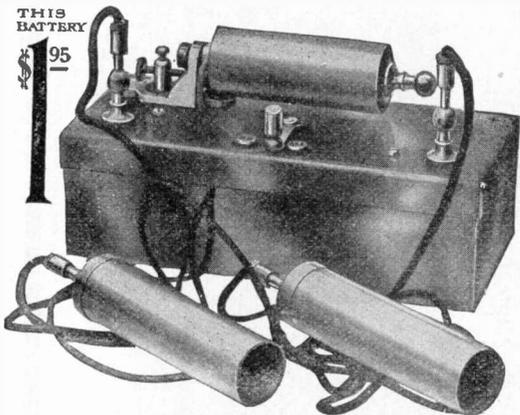
The Oliver Typewriter Co., 47-55 Dearborn St., Chicago, Ills.

For our Mutual Advantage mention Popular Electricity when writing to Advertisers.

ELECTRICITY BOOK FREE

Profusely Illustrated with Photos from Life. Write for it today.

This splendid book is compiled from the best authorities in the world. Explains how electricity as supplied by inexpensive batteries cures Rheumatism, Dyspepsia, Insomnia, Liver and Kidney Trouble and all nerve affections and diseases due to poor circulation. Explains how to enjoy the famous electric baths and beauty and health massage at home at little cost.



THIS BATTERY \$1.95
This book also lists the latest improved Batteries (Prices \$1.95 to \$24.00), which we send on 10 days' free trial.

DETROIT MEDICAL BATTERY CO.
299 Majestic Bldg., Detroit, Mich.
Write today for our free book.

Deaf Persons Can Now Hear

Wonderful Invention Has Delivered Thousands from the Handicap of Deafness.

Don't think you have to worry along if you can't hear well. Every deaf person is at a hopeless disadvantage, deprived of social pleasure, barred from active business. Any dullness of hearing is a constant mortification. But now this misery is unnecessary. Every deaf person can hear as well as ever before by simply wearing a pair of



WILSON'S EAR DRUMS

A wonderful little device that fits into the ears without the slightest discomfort. Invisible when inserted—so tiny, so perfect, that you forget you are wearing them. And the effect is magical.

This marvelous invention was perfected by Mr. Geo. H. Wilson, after years of suffering from hopeless deafness. They enabled him to hear perfectly. And this miracle has been repeated for 200,000 persons.

Send today for a book written by Mr. Wilson that tells the whole story—gives hundreds of letters from grateful users. This priceless book is FREE for your name on a postal. Just ask for Mr. Wilson's book. It will come by return mail. Address Wilson Ear Drum Co., 1660 Todd Bldg., Louisville, Ky. (2)

RHEUMATISM

Don't Take Medicine—Let Me Send You My Dollar External Remedy That is Curing Thousands TO TRY FREE

This Coupon Brings It!



FREDERICK DYER, Corresponding Sec'y.

Magic Foot Drafts cured J. Priest, of Uxbridge, England, after 35 years of pain. Cured 3 years ago. No return.

Magic Foot Drafts cured Robert Nicol, of West York, Ill., at the age of 82, and also cured his wife. No return of rheumatism in two years.

L. J. Holleniers, of New York City, writes: "I have tried your pair of Magic Foot Drafts and it worked like a charm. I was cured in four days and feel perfectly well."

A. T. Farrow, of Melita, Man., Can., writes: "I should be failing in my duty if I neglected to inform you that your remedy has effected a complete cure with me. I have suffered considerably with rheumatism for forty years and have tried all kinds of doctors and supposed remedies, both here and in England, but nothing did what your Magic Foot Drafts have done. Their work was miraculous."

What Magic Foot Drafts have done for hundreds of thousands they can do for you. These letters and many thousands like them can be seen at our offices, but I don't ask you take anyone's word. Send me the coupon today. Return mail will bring you a regular Dollar pair of Magic Foot Drafts, the great Michigan cure for Rheumatism of every kind—chronic or acute, no matter where or how you have suffered. Try the Drafts for yourself and then if you are fully satisfied with the benefit received, send me One Dollar. If not, keep your money. You decide and we take your word. Send no money—just the coupon. Do it now.



This \$1.00 Coupon Free

Good for a regular \$1.00 pair of Magic Foot Drafts to be sent Free to Try (as explained above) to

Name

Address

Mail this coupon to Magic Foot Draft Company, 240F, Oliver Building, Jackson, Michigan.



Salary-Raising Handbooks

The little books shown above are compiled from the Courses of the International Correspondence Schools—the institution whose business it is to raise salaries. The information contained in the books is intended to give to the working man immediate access to the solution of problems met with in every-day work—to enable him to meet emergencies and therefore to make him more valuable.

The Electrical Engineer's Handbook is a storehouse of information about the latest and best electrical theory and practice. It represents the combined work of the best authorities, edited by the staff of experts of the International Correspondence Schools, of Scranton, Pa. In the little book is knowledge that it has taken experts years to acquire—knowledge needed every day, and so hard to find in ordinary textbooks. Thousands of electrical workers have purchased the Electrical Engineer's Handbook; and hundreds of letters on file here bear testimony to its worth. No other book on electricity contains in so small a space so much pay-raising knowledge.

Just think of getting such a book, cloth bound with gilt title and top, printed in clear type on good supercalendered paper, containing more than 400 pages and 200 illustrations—think of getting such a book for 50 cents. The books ordinarily sell for \$1.25, and are worth many times that to busy men. We are using the little books to introduce the value of I. C. S. Training; and we will send them, prepaid, when ordered with the coupon printed below, for the special price of, for each Handbook, 50 cents.

.....
International Textbook Company

Box 1102-P, SCRANTON, PA.

I enclose \$_____ for which please send me the books before which I have marked X.

- Tel. and Tel. Handbook Bldg. Trades Handbook
- Plum. and Fit. Handbook Business Man's Handbook
- Mechanics' Handbook Mariner's Handbook
- Electrical Engineer's Handbook

Name _____

St. and No. _____

City _____ State _____



10 DAYS FREE TRIAL

We will ship you a "RANGER" BICYCLE

on approval, freight prepaid, to any place in the United States without a cent deposit in advance, and allow ten days free trial from the day you receive it. If it does not suit you in every way and is not all or more than we claim for it and a better bicycle than you can get anywhere else regardless of price, or if for any reason whatever you do not wish to keep it, ship it back to us at our expense for freight and you will not be out one cent.

LOW FACTORY PRICES

We sell the highest grade bicycles direct from factory to rider at lower prices than any other house. We save you \$10 to \$25 middlemen's profit on every bicycle. Highest grade models with Puncture-Proof tires, Imported Roller chains, pedals, etc., at prices no higher than cheap mail order bicycles; also reliable medium grade models at unheard of low prices.

RIDER AGENTS WANTED

in each town and district to ride and exhibit a sample 1920 "Ranger" Bicycle furnished by us. You will be astonished at the wonderfully low prices and the liberal propositions and special offer we will give on the first 1920 sample going to your town. Write at once for our special offer. **DO NOT BUY** a bicycle or a pair of tires from anyone at any price until you receive our catalogue and learn our low prices and liberal terms. **BICYCLE DEALERS**, you can sell our bicycles under your own name plate at double our prices. Orders filled the day received. **SECOND HAND BICYCLES**—a limited number taken in trade by our Chicago retail stores will be closed out at once, at \$3 to \$8 each. Descriptive bargain list mailed free.

TIRES, COASTER BRAKE

line at half usual prices. **DO NOT WAIT**, but write today for our Large Catalogue beautifully illustrated and containing a great fund of interesting matter and useful information. It only costs a postal to get everything.

Write It Now.

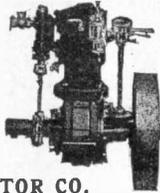
MEAD CYCLE CO. Dept. G234 CHICAGO, ILL.

2 to 25 h.p. \$29 to \$450
1 to 4 c.w.
PERFECTION ENGINES
Marine and Stationary

The most powerful, efficient, highest grade, finest finished engines in the world for the money. Sold under a binding guarantee to give satisfaction.

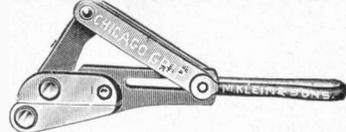
2 H.P. \$48 Complete

Send at once for handsome Catalogue and make us PROVE our claims. The 2 H.P. illustrated is a wonder. Order today or write.



CAILLE PERFECTION MOTOR CO.
1315 2nd Ave. DETROIT, MICHIGAN

KLEIN'S NEW "CHICAGO GRIP."



Is the Best, Cheapest, the most Powerful and Useful Wire Grip on the market. It is made of steel throughout, and Nickel Plated. It is a well proportioned and thoroughly reliable tool. It is just the right shape to handle quickly. It is light, and when placed on the wire will hold itself in place. It can be pushed out on the wire, so as to get as much slack as necessary, and it pulls straight, leaving no kinks in the wire. It covers all the essential points required of a grip to do good work, on either copper or iron wire.

No. 0358 holds Nos. 10 wire to the smallest, each \$1.90 net
No. 358A holds Nos. 6 wire to the smallest, each 2.00 net
No. 358C holds Nos. 0 wire to the smallest, each 3.30 net
No. 358E holds Nos. 0000 wire to the smallest, each 5.00 net

We can furnish any of the above grips with pulleys, extra. We also make this style grip for insulated wire. Write for copy of our catalog and discount sheet, showing all kinds of tools for Electrical Construction Work.

MATHIAS KLEIN & SONS
Station U-3 Chicago, Ill.

\$2,000.00 to \$3,000.00 A YEAR IN VACUUM CLEANING BUSINESS

A steady, sure, permanent income of from \$2,000 to \$3,000 a year is easily and quickly established in cities from 5,000 up, with the Aero Vacuum Cleaning Power Wagon. Running expenses are small and profits remarkably big. Safer, more profitable than any other line of staple investment. Makes money from the day wagon arrives. \$1,000 starts you. The Aero Power Wagons are standard—established by years of test. The only apparatus of enough power to do effective commercial cleaning. Send for wagon catalog.

Largest builders in the world of Built-into-the-house Vacuum Cleaning Systems. Send for "Stationary Plant" catalog, stating kind and size of building.
American Air Cleaning Company
208 Sycamore St. Milwaukee, Wis.



HESS FURNACE

We will deliver a complete heating equipment at your station at factory prices and wait for our pay while you test it during 60 days of winter weather.

The entire outfit must satisfy you or you pay nothing. Isn't that worth looking into? Could we offer such liberal terms if we didn't know that the Hess Furnace excels in service, simplicity, efficiency, economy?

We are makers—not dealers—and will save you all middlemen's profits. No room for more details here. Write today for free 48-page booklet which tells all about it.

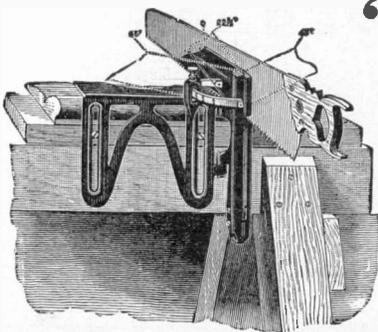
Your name and address on a post card is sufficient.



No. 45 "Leader" Hess Steel Furnace Price \$49

Delivered Size of Omaha and South of Ohio River. Signs and Registers Extra.

HESS, 912 Tacoma Bldg., Chicago



"Seavey" Mitre Box

Meets Every Requirement

Can be used on a scaffold or ladder as well as on a bench. Cuts any angle—special or regular. Needs no special saw. Lightest box made. Can be instantly applied. Made so that it is attachable to inside or outside work without a special attachment. Weighs only 2 pounds \$2.50 each. Your dealer or

Smith & Hemenway Co.

108-110 Duane St., NEW YORK, U. S. A.

BIG MONEY CAN BE MADE WITH THIS BUFFUM AUTOMATIC CARD PRESS

It can turn out cards at the rate of 6,000 to 8,000 per hour. Prints them in two or more different colors, as the register is good. Easily operated by hand, belt or electric motor. No experience needed. Anybody can run it after one day's practice and make big profits.

Mr. V. F. Rodifer, St. Louis, Mo., says: "I have had one of your machines in my possession for several months and find it gives perfect satisfaction. It is a money maker, and I believe the best machine of its kind on the market."

MAKE \$6 TO \$10 A DAY

With the Buffum Press you can establish a big paying card printing business in your community, make big money and be independent. Mr.

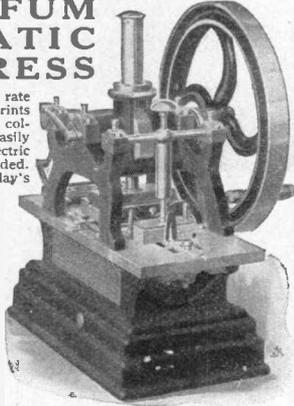
Albert Rosenthal, Denver, Colo., writes: "Opened up at the Golden Eagle Dry Goods Co.'s Department Store, where I averaged about six or seven dollars a day. Moved from there to a small place on 17th street, where I did still better. It is indeed surprising how quickly money can be made on the Buffum Automatic Press."

Even during your spare time you can turn out enough cards with it to make good money. It readily prints all sizes of cards up to and including a postal card, and will automatically feed any thickness of card from two-ply to ten-ply at a speed of from 6,000 to 8,000 per hour. All kinds of jobs, such as visiting cards, business and advertising cards, tickets, coupons, price cards, mailing and listing cards, etc., can be run off at a good profit.

START A PROFITABLE BUSINESS OF YOUR OWN

It has been the means, with a small investment, of establishing others in a nice, profitable business. It will do the same for you. Write us today for particulars.

BUFFUM TOOL CO.
401 Georgia Street, - LOUISIANA, MO.



Electric Light For Everybody

50 LIGHT OUTFIT FOR \$500

Including FAIRBANKS-MORSE Special Electric Engine and Dynamo, Storage Battery and Switchboard.

This outfit will operate fifty 15 Watt, 12 C. P. Tungsten Lamps as steady and reliable as a city plant.

It offers a relief from the dirt, danger and unsanitary conditions arising from old methods of illumination and gives an economical light that is both safe, convenient and healthful, in fact, there is no substitute for the soft, white light diffused by Tungsten Lamps—it is even said to rival day light.

Same engine can be used for operating pumping plant or other machinery. Engine operates on gas, gasoline, kerosene or distillate.

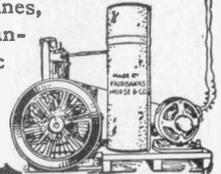
Larger plants in proportion up to 500 H. P.

Mention this publication and send for descriptive catalogue No. 1163CB.

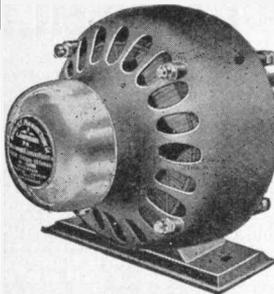
FAIRBANKS-MORSE & CO.

481 Wabash Avenue, CHICAGO, ILL.

Headquarters for Gas Engines, Dynamos and Motors, Incandescent lamps. Pneumatic Water Systems, Belting, Shafting, Pipe, Hose Fittings and Fairbanks Scales



THE BARNES VARIABLE SPEED Alternating and Direct Current Motor



1-12 and 1-8 H.P. The only high speed, single phase, alternating motor that absolutely will not heat.

Armature and field pieces are laminated. Brushes are self-adjusting.

The 1-12 H. P. size for all family washing machines.

The 1-8 H. P. size for coffee mills, printing presses, etc.

We also manufacture a 1-12 H. P. A. C. or D. C. Dental Motor with chucks for emery wheels and buffing purposes. All motors guaranteed. Responsible agents wanted.

BARNES MFG. CO., Susquehanna, Pa.

This Machine Will Earn \$20 to \$50 a Day For You



Our customers report daily profits of \$20 and upwards. Some report as high as \$50 a day. You can do as well.

THE HELM PRESS

produces the highest grade cement blocks and bricks known and at greater speed than any other machine on the market.

80,000 Pounds Pressure

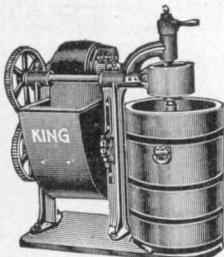
This terrific pressure produces absolutely perfect brick and block. One of our customers landed a \$90,000 government contract after severe tests of Helm products. The Helm Hand Press turns out 1,000 block or 10,000 brick a day. Power press has 50 per cent greater capacity.

WRITE TODAY FOR FREE CONCRETE BOOK

Learn how to make big money in concrete. Don't think of buying any concrete machinery until you have seen this book, sent you free, prepaid. Write today.

QUEEN CITY BRICK MACHINE CO., 212, Bank Block, Traverse City, Mich.

XXTH CENTURY ICE CREAM FREEZER AND ICE CRUSHER



All in one machine and operated directly by an electric motor. The Freezer or Crusher can be run independent of each other or both can be in operation at the same time.

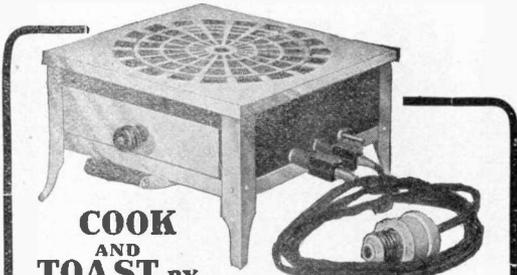
This complete plant occupies but about 8 or 9 square feet of floor space, and is a convenient height of 36 inches. Made in two capacities, 20 quarts and 40 quarts. Especially designed for Hotels, Restaurants, Cafes, Confectioners, Caterers, etc.

We also have a special Central Station and Electrical Dealers proposition, which is not only interesting but profitable. Write today for our Terms.

R. A. DEWSBERRY

216 N. MORGAN ST.

CHICAGO, ILL.



**COOK
AND
TOAST BY
"THE NEW WAY"**

An Electric Cooker and Toaster that you can afford to use.

With the new Electric Cooker you can cook your meals and make the most delicious Toast quickly.

Most invaluable for Toasting, for the Sick Room and for a hurried meal is indispensable.

Ideal for Entertaining—it does away with the disagreeable features of the now used Alcohol Chafing Dishes.

Made absolutely fireproof; high nickel finish, is equipped with three different heats; low, medium and maximum.

Can be used wherever Electric Current is available on the ordinary house current of 100 to 120 volts on either direct or alternating current.

Anyone can connect it by screwing the plug into any electric lamp socket.

Write today for catalog about this wonderful little stove.

The M-V-W Electric Mfg. Co.
Reed City, Michigan

GUDEMAN & COMPANY

Manufacturers and Importers of

**Electrical Decorations
and Novelties**

24 West 33rd St.

NEW YORK, N. Y.



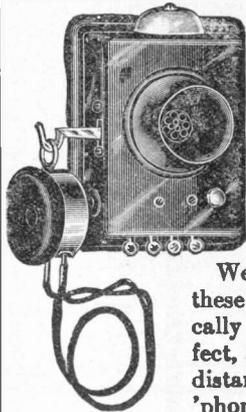
Electrically Lighted Rosebush

**Effective
Electrical
Decorations
such as**

**Fruit Trees
Flower Baskets
Center Pieces
Floral
Garlands
and many other
novel and
pretty
designs**

Table Decorations Our Specialty
Miniature and Decorative Lamps of all
Descriptions

Write for Catalogues and Discount



\$1.50 EACH
or
\$3.00 per pair

**The Lowest Priced
High Grade 'Phone
Made.**

We absolutely guarantee these 'phones to be mechanically and electrically perfect, and to work as long a distance as any battery 'phone made.

Instruments are equipped with push button and bell for signaling.

Distance Phones work depends upon size of wire and number of batteries used. Good for 500 feet on 2 Dry Cells per instrument.

C. O. D. orders accepted if one-half of amount accompanies order.

Shipping weight per pair is 5 lbs.

If more than two 'phones are required on a system advise us of your requirements.

EMPIRE ELECTRIC WORKS
1174, Bridgeport, Ct.

The Guaranteed Cell



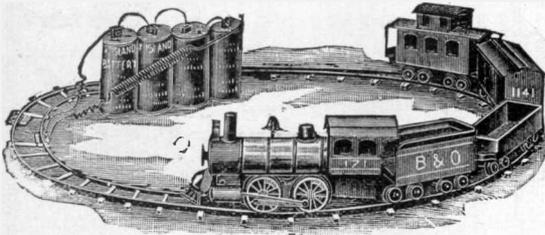
The list of satisfied "Red Seal" customers is growing larger each day. A trial is assuring; a comparative test with other makes it convincing that our "satisfaction guaranteed" cells will do all we claim for them. Catalog 24 E for the asking.

Manhattan Electrical Supply Co.
New York, 17 Park Place Chicago, 188 Fifth Avenue

POPULAR ELECTRICITY

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 practical 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. Clinton Ave., Cincinnati, Ohio

Largest Manufacturers Electrical Novelties in the World.

THE 1900 DRY CELL

IS THE BATTERY OF KNOWN QUALITY



Which can only be proven by its use, at which time you will agree that the high electro-motive-force and great efficiency make it the best battery on the market.

This cell is made with the view of obtaining the longest possible life under the most exacting requirements.

Recommended especially for Experimenters, Small Wireless Outfit, Gas Engine Ignition, Telephones and all open circuit work.

Write today and secure our catalog, which gives full particulars regarding sizes and prices.

The Nungesser Electric Battery Co.
CLEVELAND, OHIO

GENERAL SALES OFFICE
627 W. Jackson Blvd. CHICAGO

A PERFECT LIGHT



FOR THE { HOME, OFFICE, STORE or FACTORY

- ☑ Our Pacific Portable Lamp may be attached to any convenient fixture, bracket or drop light and easily carried to the desired point in a room.
- ☑ The lamps are adjustable and can be raised and lowered at will.
- ☑ The hoods are so arranged that the light can be thrown at any desired angle.
- ☑ This lamp has no equal for convenience—durability and it will be found a necessity—not a luxury.
- ☑ When once used it is impossible to do without one.
- ☑ Price complete, ready for use—\$5.00
- ☑ Send your order today—rejoice tomorrow.

Southern Illinois Electric Co.
508 Missouri Ave. East St. Louis, Ills.

TESTED APPARATUS Means the Elimination of Faults in Your Product.

Electrical and photometrical tests of every description. Checking electrical instruments of all kinds and classes. Inspecting and testing new electrical machinery, apparatus and material at factories and after installation. Tests on any electrical machinery and apparatus made anywhere. A.C. and incandescent lamp tests, either electric, gas, acetylene or oil. Illumination tests made anywhere. Secondary standards of candle-power furnished. Facilities furnished to experimenters and investigators.

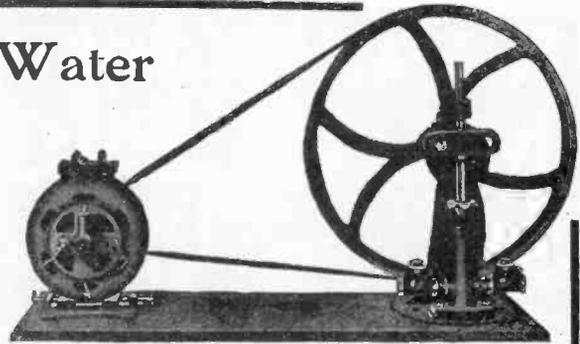
We have recently added to the above, coal testing, and are now prepared to make approximate analyses and calorific determinations on samples of coal, promptly and accurately.

ELECTRICAL TESTING LABORATORIES
80th Street and East End Avenue NEW YORK, N. Y.

For our Mutual Advantage mention Popular Electricity when writing to Advertisers.

Have Running Water Everywhere

You can have running water anywhere on one condition—that you have electricity available to run the Motor. Water—all you want of it—at any time—in every room in the house, in the stable, factory or office, by use of a

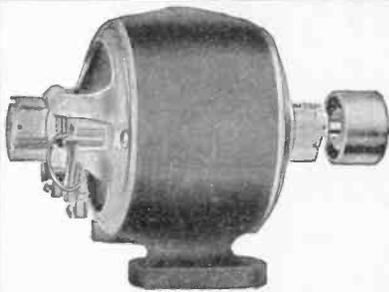


Jarvis Electrical House Pump

Disconnect the Pump and you have all the power needed to run the feed mill, corn sheller, churn, washing machine, cream separator and for scores of other labor-saving purposes. Where electricity is available this outfit is invaluable—especially for country residences, hotels and clubs. A special outfit for every need. Tell us what your requirements are—we'll tell you what combination will best suit you.

There are hundreds of JARVIS OUTFITS in use—each and every one giving entire satisfaction. Write to

JARVIS, 912 River St., LANSING, MICHIGAN



Electric Lighting Outfits

for Motor Boats, Country Homes, Stores, Small Factories and Laboratories.

We have the best and most complete Lighting System for such purposes ever made.

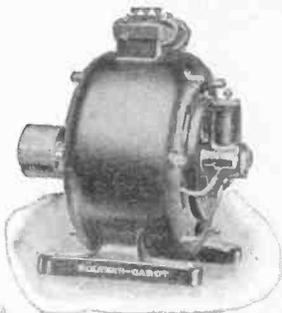
We furnish a High Grade Dynamo, Switchboard and Storage Battery.

It will pay you to write to us at once. Our Lighting System has some very interesting features about it, some of which are: first low selling cost, simplicity, durability and economy.

Schug Electric Manufacturing Co.

Electric Lighting Dept.

DETROIT, MICH., U. S. A.



ALTERNATING CURRENT MOTORS

$\frac{1}{2}$ to 2 H. P. Single Phase, Induction Type, Self Starting.

Send us your plans at once and let us figure your "Motor" wants.

Our Engineering department is especially equipped for this purpose, and therefore guarantee you satisfaction.

Write for special bulletin 30E4.

The Holtzer Cabot Electric Co.

Brookline, Mass.

397 Dearborn St., Chicago, Ill.

BE A FACTORY OWNER-WE TELL YOU HOW MAKE BIG MONEY

**EASY
WORK
YOU CAN
START AT HOME**

**GO IN
BUSINESS
FOR
YOURSELF**

OUR NEW PLAN



Makes it easy for any MAN or WOMAN to start in business for themselves. All you need is a sewing machine. We furnish canvas gloves and mittens all ready to sew. We give you sample gloves, information, instructions and

Equipment FREE

What progress have you made in providing for the future of yourself and family? Are you satisfied with the results? If not, now is the time to turn over a new leaf and get a new start. We are offering you a chance to better your conditions and provide for future emergencies.

We Start You in a business of your own right in your own town. Every man or woman, no matter how humble, is entitled to at least the profits of their own labor. If you have the ambition to better your condition—to be somebody—to provide for yourself and family—to enjoy success, happiness and prosperity—we can help you. Sign and send the coupon now.

Our Business is the manufacturing of canvas gloves and mittens. The demand for these goods has increased by jumps and bounds, way beyond our ability to manufacture them. For that reason we are compelled to look for outside assistance and are willing to help others, who are willing to help themselves, to get a start in this business. There is room today for ten canvas glove factories where we have one now. Start a factory with our help.



Our interesting Book which we send **Write for it. FREE**

Immense Profits are made in this fascinating business. The McCreery Brothers started only a few years ago without a cent. Today they have thousands of dollars, own their own large factory, have interests in others, and do an enormous business. They have started a few other men and women in the glove business, and they will help you to start, too, furnishing you with the necessary equipment for starting free, and teaching you the secrets of the business.

Unlimited Demand There is no class of goods for which there is such a steady demand as for canvas gloves and mittens. Everybody uses them—the farmer, the mechanic, the doctor, the lawyer, the merchant, the laborer—in every section of the country—from Maine to California and from Minnesota to the Gulf.

Opportunity is Knocking at Your Door

Millions of Pairs of canvas gloves are being sold. Somebody is getting the profit on these goods, why not you? Come with us and let us start you in this profitable, legitimate business which with a reasonable amount of light work and attention should make you a prosperous factory owner in a short time. Each Member of the family can help—father, mother, son and daughter can each do their share and as the business grows and develops help can be obtained on the outside. It is to your personal advantage, to the advantage of your pocket book to learn all about this wonderful offer we are making. All you need is the use of an ordinary sewing machine. We supply the other necessary equipment without cost. No matter how small or how large your town; no matter what section you live in, there is always room for a factory. You can start at home or in a small store room nearby. You can work all or only part of the time and can engage others to work for you.

Here is a Chance where you can start on an honorable career as a successful business man or woman. You cannot possibly lose anything by investigation, and it may mean financial success to you. Do not delay. Today the opportunity is open to you; tomorrow may be too late. Our ability to assist others in starting factories is limited to our ability to furnish them with raw material, and just as soon as enough have become associated with us to absorb our capital we shall be obliged to withdraw this offer. It is so very easy to get the full details of our proposition. Simply sign and send us the coupon. Write your name and address plainly.

McCREERY MANUFACTURING COMPANY
1180 Lawrence Avenue, Toledo, Ohio

Cut This Out and Mail Today
McCREERY MFG CO., 1180 Lawrence Avenue, Toledo, Ohio
Gentlemen: Please send me without cost a copy of your book and full information about starting in the glove business.
Name _____
Address _____

Business Opportunity

The Independent Telephone field embraces over 15,000 Companies, operating 20,000 exchanges and employing 200,000 men.



It expends \$50,000,000 a year for apparatus and supplies, while its employes use a like amount for personal requirements, and as much more for their families and homes.



Any article which appeals to a prosperous, buying class is bound to win, and win handsomely, in the telephone field.



Every desirable reader throughout this important industry can be effectively reached through its one representative medium—

Telephony
THE AMERICAN TELEPHONE JOURNAL
CHICAGO

The Standard Telephone Authority
Broad, Comprehensive, Vigorous, Efficient, Reliable, International in its scope and usefulness.
THE TEXT BOOK FOR BUYERS OF TELEPHONE APPARATUS

A "NON-ADVERTISER"
Might be Pondered if he Were Only Considered and Discussed. So think as One Who is Not Putting Around with Bump the Present "Cancer" Form of Advertising

IT REACHES THE BUYERS
TELEPHONY IS CAREFULLY READ BY EVERY BUYER IN THE TELEPHONE FIELD.
Write for our prospectus. It will probably interest you.

THE MAN WHO ADVERTISES
May Have Some Matches. The Man Who Doesn't Advertise Makes the Greatest Mistake of All.

Had You Noticed It?
TELEPHONY Prints More and Better Matter, Contains More Illustrations, Contains More Copy and Carries More Business Than Any Other Telephone Journal in the Telephone Field.

RESULTS FROM TELEPHONY SATISFY

The Best Climber
TELEPHONY is made of strong material, printed on heavy paper, contains important business news, contains important facts, practically every "Snatch" of importance when called to the fore during these "Advertise" days.

EVERY DESIRABLE FACILITY
For Business Getting is Deferred on TELEPHONY and its Associates.

A Good Thing to Remember
TELEPHONY is issued on Saturday of Each Week. Copy for changes of Advertisements Should Reach us as Early as the First of the Week Preceding date of Publication, and not later than Saturday. New advertisements can be inserted as late as Wednesday.

Our BEST Argument
A Sample Copy of TELEPHONY. Glad to send one.

Telephony

THE AMERICAN TELEPHONE JOURNAL

Here is a real opportunity for wide-awake sales managers, or merchants who desire additional trade.

Sample copies, rates and full descriptive matter promptly furnished on request.

TELEPHONY PUBLISHING CO.

Monadnock Block

CHICAGO, ILL.

Credit Tailors

Get first choice of our all-wool spring fabrics



SUITS

\$ 12.95
to
\$ 27.50

Six months to pay

Nothing Down

If you will write us today, we will send you samples of all the newest spring fabrics. They have just come in. We will also send you the Clement Spring Style Book, showing the cleverest styles in America. It is just off the press. Also a tape line and full instructions for taking your own measurement, so we can fit you as perfectly as though you came to our shop.

You can get first choice of all the spring patterns, and have one of the first new-style suits in your town, if you write at once.

Our spring suits run from \$12.95 to \$27.50, yet we use nothing but all-wool fabrics. We employ the highest-priced tailors. If you will send us a few simple measurements we will guarantee you an absolutely perfect fit. Some of the swellest men around you are wearers of Clement clothes.

We send all suits on approval. No money down—no C. O. D. Not a penny will be accepted from you until you have tried the suit on in your own home and found it exactly right. Then we allow you six months to pay, without interest or security. We simply open a charge account.

The lowest prices of cash tailoring establishments are 50% higher than ours. For we have no agents and pay no commissions. And we make clothes for tens of thousands of customers with whom we deal direct. No matter what a man pays, he cannot dress better than the man who wears Clement clothes.

This has become the largest house of its kind by giving the best styles and fabrics, the lowest prices and the fairest terms.

SEND FOR SAMPLES

Write us today for samples, for now you can pick from all the newest fabrics. We will send our spring style book, measuring blanks, tape line and everything. No charge whatever. Old customers and new are entitled to this book and these samples. Get them while our stock is complete. Cut out this ad so you won't forget. (5)

THE CLEMENT CO.

504 Franklin Street

CHICAGO, ILL.

"THE TELEGRAPH INSTRUCTOR"

by G. M. Dodge. One of the best "plain English" treatises on the art ever published. For beginners or practical men. 260 pages. Full illustrated. Cloth covers. Price, postpaid, \$1.00. FREE for two paid yearly subscriptions to POPULAR ELECTRICITY.

POPULAR ELECTRICITY, Book Dept. Monadnock Block, Chicago, Ill.



Mr. Edison's LATEST Supremely Fine Phonograph

A musical wonder—a perfect reproducer of sound—unsurpassable in clearness and beauty of tone.

Double Reproducer Amberol Records
New Style Floral Horn New Style Cabinet
The Latest Model High Grade Edison

OUR OUTFIT No. 10—Just Out

at \$10 less than our former rock-bottom price on the outfit No. 9—and

Free Loan

We ship on a free loan—no money down—do not pay us one cent, C.O.D.—take the outfit to your home on our free loan offer.

You Need Not Buy Anything: All we want on this free loan is that you convince yourself of the absolute superiority of this superb new style instrument. All we ask is that you let your family and a few of your neighbors and friends hear the Edison when we send it to you on a free loan. Let them hear the magnificent music, operas, comic songs and funny recitation—then let them judge. If any of your friends then want an Edison, we will feel thankful to you, or if you want to keep yours, you may keep it, on the easiest monthly payments: as low as \$2.00 a month—\$2.00 a month for an Edison.

But if you and none of your friends want an instrument just now, there is no harm done. Just return the outfit at our expense and we charge you nothing for the free loan.

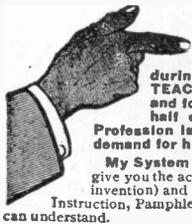
We simply want everybody to hear the latest product of Mr. Edison's skill.

Now Write for the free catalog and free list of Edison records, operas, songs and comic recitations that you want to hear on this free loan. Just put your name and address on a postal or in a letter, or sign and mail the coupon. No letter necessary if you send the coupon.

F. K. BABSON

EDISON PHONOGRAPH DISTRIBUTERS
Edison Block
Dept. 1402
Chicago, Illinois

F. K. BABSON, Edison Phonograph Distributors,
Edison Block, Dept. 1402, CHICAGO, ILL.
Considered *Disfr.* 25% *Power* *Adv.* *W. 25%* *Adv.* *Canada.*
Please send me without obligation your 1910 Edison Phonograph Catalog, list of Edison Gold Moulded and Amberol Records, and Free Trial Certificate entitling me to your grand offer, all free.
Name _____ Address _____
Sign and Mail this coupon today.



Learn the Automobile Trade

during spare time, evenings at home. I CAN TEACH YOU and will GUARANTEE satisfaction and for the small sum of Ten Dollars and payable half cash and balance in 30 days. The Auto Profession is the coming profession. There is a big demand for help in all its branches and good pay.

My System is entirely new and different from others. I give you the actual practice on my models (a new European invention) and the "how and why" is learned from my simple Instruction, Pamphlets and Charts; so simple a boy ten years old can understand.

DYKE'S AUTO INSTRUCTION is something new, wonderful, clever and instructive. M. L. Chico, of Ponce, P.R., (Nov. 7) said: "Sorry I did not know of your Auto Instruction before. I have learned more and quicker than if I had the parts before me."

Wm. Brown, of Butler, Mo., says: "I have learned more in three weeks study than three years of work around the shop." Otto Osborne, Zanesville, O., says: "It is just like working on a car. I find it more than meets my fullest expectations."

"I have never found anything as thoroughly adequate and easily comprehended as your course."—H. D. Haynes, Auditor of the Union Central Life Insurance Company, Cincinnati, O.

"I like the plain, simple way you have of explaining the difficult parts. The enthusiasm I have for the course I fear will bring you some new members from here."—Dr. W. J. Cameron, Des Moines, Iowa.

A young man who took my course is now running a repair shop. We have hundreds of letters from customers all over the world and we have reproduced several of them in our Free Pamphlet right from the originals in order to convince you.



See These Models—They Work—There are two sides to each Model and some of the parts are made of actual metal.

on your study table while you practically what we give you in our working models. You will play with these models like a boy with a toy and the more you play the clearer the subject will be to you.

In Addition we give 24 lessons, which are so interesting you will finish them all—they are illustrated with 34 large clear charts.

We Teach You everything there is to learn about the Automobile and Gasoline Engine such as valve setting, timing ignition, how the cylinders fire, construction of all forms of Magnetos and how to set them, storage batteries and all systems of wiring, and many other important subjects.

Don't you think you would become interested? Sure you would. Dyke's Course is the only course in the world which can successfully be taught by mail.

Mr. DYKE was the first Auto Supply man in America and built the fifth successful Automobile in this country. His experience is embodied in this course. Mr. Dyke made a special trip to Europe to secure additional matter for this great Course. The working models were designed and are made in Europe by a leading mechanical artist.

No matter how much you would pay you could not possibly get a course equal to this one.

SPECIAL TRIAL OFFER. Send us \$5 Cash and your promise to pay the other \$5 in 30 days. We will then send you the Course and will give you two days' time for inspection and if you don't like it return.

FREE INSTRUCTIVE PAMPHLET SEND FOR IT TODAY

CLASS BUTTON and DIPLOMA with each course.

DYKE'S COR'S P SCHOOL MOTORING
1300 New Bank Commerce Bldg., ST. LOUIS

MEN WANTED

MEN WANTED EVERYWHERE TO SECURE SUBSCRIPTIONS FOR A MONTHLY JOURNAL OF MACHINERY AND MACHINE TOOLS.

MODERN MACHINERY

IS THE ONLY JOURNAL OF ITS KIND PUBLISHED IN THE WEST. IT'S A LIVE WIRE. PRICE \$1.00 PER YEAR.

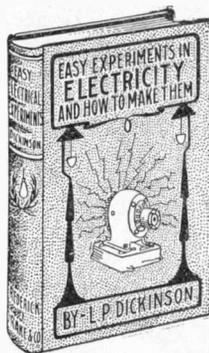
We offer very liberal terms to solicitors. Write us.

Modern Machinery

961 MONADNOCK BLK.,

CHICAGO

FOR THE AMATEUR OR PRACTICAL ELECTRICIAN



This is one of the most valuable works ever published.

Written in simple, easily understood language, fully illustrated with cuts and working drawings.

Presents a wonderfully interesting and entertaining series of electrical experiments, giving full directions for constructing apparatus required with inexpensive materials and tools easily obtained.

Shows you how to make all kinds of batteries, electric bells, rheostats, condensers, large and small induction coils, an electro-phorus, an automatic circuit closer; how to construct and use telegraph and telephone instruments, measure electrical resistance and pressure and make and use galvanometers and voltmeters.

Gives detailed directions for building a 1-20 horse power motor, explaining exactly how to make each of the various parts and assemble them correctly. Shows you how to do electro-plating at home, design a small dynamo, build an electric engine, an electric locomotive, a model fire alarm telegraph, make simple arc lamps, and light lamps by electricity. Also how to make an electric bomb, electric gyroscope and other electrical toys, etc., etc.

204 pages. Handsomely stamped cloth covers.

Price—postpaid—\$1.00

FREE for two paid annual subscriptions to POPULAR ELECTRICITY.

POPULAR ELECTRICITY BOOK DEPT.

Monadnock Block, CHICAGO, ILL.

We Have Furnished—On Credit— Over Half a Million Homes

Our Spring Furniture Catalog—picturing 3,000 new style things for the home—comes out on New Year's Day. Write today for one of the first copies printed. Both the book and the mailing are Free.

3,000 Bargains

This book shows an endless variety of everything used in the home. It shows more kinds of housefurnishings than you could find in the largest store in America.

And every one of these things is a bargain. We guarantee that no other house—either cash or credit—sells any one of these articles as low as we quote. We send all goods on approval, so you may return them if you find that this claim is not true.

We can make this guarantee because we buy up entire factory outputs, and close to actual cost. Our combined capital is \$7,000,000, so makers who need large sums of money naturally come to us. And, as we supply 500,000 customers, our output is almost unlimited. It is larger than the combined output of all other concerns in our line.

Our selling expense is a trifle, and we keep our net profit under ten per cent. Thus it is utterly impossible for other concerns to compete with us.

Over a Year to Pay

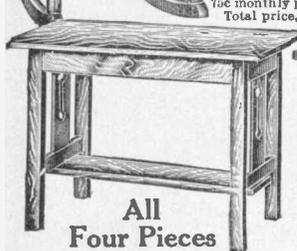
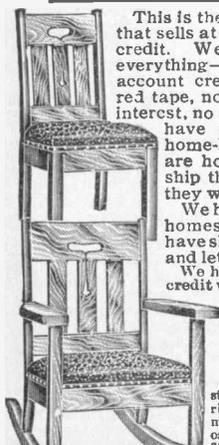
This is the only concern that sells at cash prices on credit. We do that on everything—on our open account credit plan. No red tape, no publicity, no interest, no security. We have proved that home-loving people are honest, and we ship them whatever they want.

We have furnished on credit over 500,000 homes, scattered all over America. We have shipped them whatever they wanted, and let them pay a little each month.

We have allowed them from 8 to 14 months' credit without a penny additional price. You can have the same easy terms on what you select from the thousands of things in our catalog.

K-5501—Four-piece English Mission Set.

Finely finished and constructed in mission style. Chairs are upholstered in genuine fabric leather. Every piece made of selected kiln-dried oak. \$1.50 first payment, 75c monthly payments. Total price, \$11.75.



All Four Pieces

\$11.75

30 Days' Trial

We will send anything you want on approval, and you may use it a month before even deciding to keep it. If it is not satisfactory—in price, style and quality—you may return it and we'll pay the freight both ways. The transaction will not cost you a penny.

Furnishings at Factory Cash Prices On Credit

- Furniture Silverware
- Carpets Chinaware
- Rugs Graphophones
- Draperies Washing Machines
- Stoves Sewing Machines
- Ranges Baby Cabs
- Pianos Lamps and Clocks

All Sent on Approval

You risk nothing whatever. You need keep nothing we send you unless we give you more than the same price will buy anywhere else in America.

Four Free Catalogs

Our General Catalog pictures and describes 3,000 things for the home—Furniture, Carpets, Draperies, China, etc.

Our Stove Catalog shows 70 styles of Empire Stoves and Ranges, from 89c up. These are the famous fuel-saving stoves.

Our Piano Catalog quotes a saving of from \$100 to \$150 on many styles of pianos.

Our Talking Machine Catalog shows Columbia Graphophones and the new disc records.

Cut out this coupon and state in it which catalog you want. Mail it to us before you forget it, and see what amazing offers you get.

Cut Out This Coupon

Spiegel, May, Stern Co.

802 34th Street, Chicago [24]

Mail me your _____ catalogs.

Name _____

Address _____

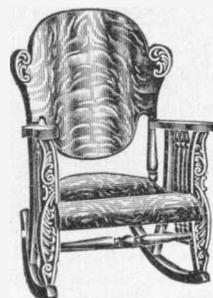
State _____



\$8.95

K-8018—Park Folding Go-Cart.

With entire steel running gear. Has cane seat and English leather hood, cloth lined. \$1.50 first payment, 75 cents monthly payments. Total price, \$8.95.



\$4.35

K-5472—Quarter-sawed Oak Roll Seat Rocker.

Has shaped back and front posts. Full roll quarter-sawed oak seat. Decorated with handsome carving. 75c first payment, 50c monthly payments. Total price, \$4.35.

SPIEGEL, MAY, STERN CO., 802 34th Street, Chicago, Ill.

POPULAR ELECTRICITY

The Electric Journal

AN ILLUSTRATED MONTHLY MAGAZINE
ON PRACTICAL ELECTRICITY

WRITTEN BY MEN WHO KNOW

If you want to really know the inner workings of electrical apparatus, you will wish to study the subject and learn for yourself how to operate electric machinery, how to locate and remedy difficulties, how to wind dynamos, etc.

FOR THE STUDENT

The electrical student will find THE ELECTRIC JOURNAL filled with up-to-date articles on electrical subjects, written by some of the most prominent engineers in America.

THE JOURNAL QUESTION BOX

Something out of the ordinary. Our Question Box Department will give you answers to practical problems you are unable to solve, furnished by the largest staff of expert contributors of any technical publication.

THE LATEST DEVELOPMENTS

If you want to keep in touch with the latest developments in electrical engineering, you cannot afford to be without THE ELECTRIC JOURNAL.

Enter your subscription now to begin with the January issue and thus have a complete 1910 volume.

Subscription price \$1.50 per year. Sample copy and list of recent articles on application.

The Electric Journal

P. O. Box 911

Pittsburg, Pa.

Not so long ago good lighting was a subject that most any "handy man" could install and "get away with it."

Nowadays, however, the ordinary all-around Jack-of-all-trades is lost in the shuffle of competition with the man who thoroughly embraces all the various phases of lighting, as an up-to-date commercial science and art.

THE ILLUMINATING ENGINEER is the only publication which thoroughly covers this field, and a year's subscription is worth more than its cost ten times over to anyone who wants really good results. Subscribe now—\$2.00 a year—20c a copy.

THE ILLUMINATING ENGINEER
36 West 39th Street, New York

BE HEALTHY AND STRONG

Something Absolutely New

Let us tell you how you can cure yourself in your own home (without Drugs) of Rheumatism, Neuralgia, Headache, Indigestion or any disease due to weak nerves, or poor circulation, and what speedy relief can be obtained by

THE WIZARD WIRELESS

It offers the safest, most complete and satisfactory method of home treatment known.

We Will Send Free an intensely interesting book telling how you can quickly and positively relieve chronic diseased conditions, and at a very small cost. Write now.

Genesee Sales Company
211 Lake Street
Chicago, Ill.

Central Electric Co.
36 Adelaide St. West,
Toronto,
Canada

COUPON
I am interested in the Wizard Wireless and would like your book "Electricity as a Remedy."
Name.....
Town.....
State.....
E-1

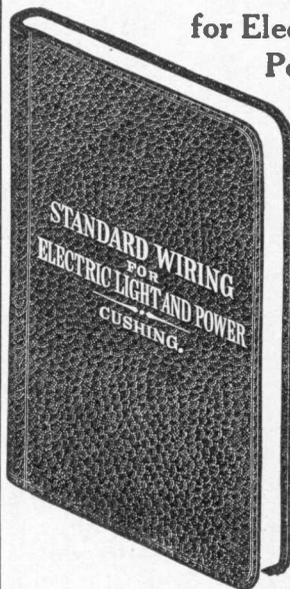
\$1.00 1909 Edition \$1.00

Standard Wiring

for Electric Light and

Power as adopted
by

the Fire
Underwriters
of the
United States



Containing the National Electric Code, explained with numerous illustrations, together with the necessary tables and formulae for outside and inside wiring and construction for all systems. Handy size for the pocket. Black limp leather binding — gilt embossed.

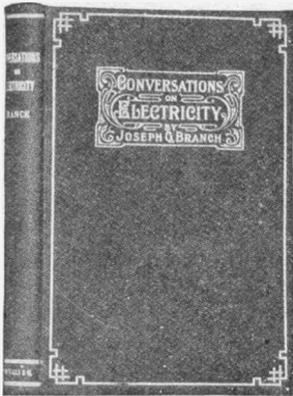
Price prepaid

\$1.00

Free for 2 paid
yearly
subscriptions
to
Popular
Electricity

POPULAR ELECTRICITY BOOK DEPT.
Monadnock Block, CHICAGO, ILL.

SPECIAL SALE



Conversations in Electricity

By JOSEPH G. BRANCH, B. S., M. E.

The author deals with the subject of electricity in a clear and *elementary* way, in order to familiarize the student with the *Principles* of electricity before attempting to show how these principles are applied in practical work.

The book is written in dialogue form, thus giving a vivid idea of the subject and leaving a strong impression on the mind of the reader.

Special attention is paid to the alternating current, its generation and application, owing to its daily increasing use.

The book contains 282 pages, with 105 illustrations, and is strongly and handsomely bound in green cloth, gilt embossed.

A valuable addition to any library. Your list of electrical books is not complete without this volume.

Regular Price - - - - \$2.00

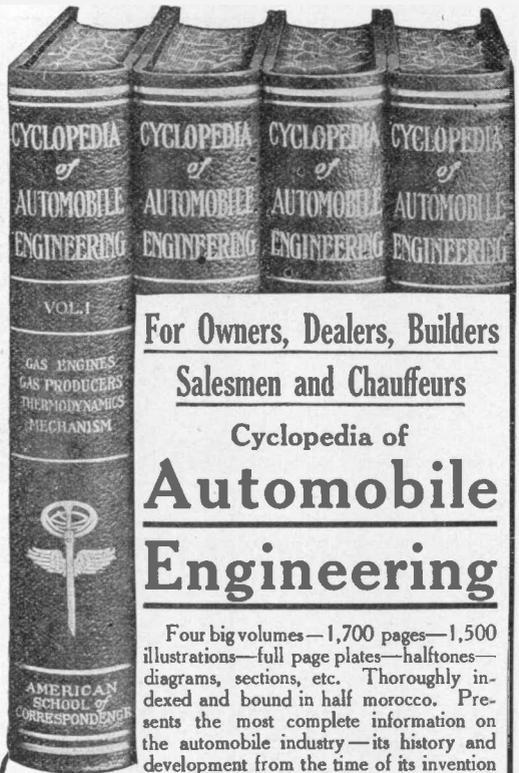
Special, one month only, **\$1.75**

Don't miss this offer.

Popular Electricity Pub. Co.

Book Dept.

Monadnock Bldg., Chicago



For Owners, Dealers, Builders
Salesmen and Chauffeurs

Cyclopedia of Automobile Engineering

Four big volumes—1,700 pages—1,500 illustrations—full page plates—halftones—diagrams, sections, etc. Thoroughly indexed and bound in half morocco. Presents the most complete information on the automobile industry—its history and development from the time of its invention up to its present state. Describes all makes of machines—mechanisms, care of auto, art of driving—a practical guide for information regarding construction, maintenance and operation. Contains complete instruction on repairing. Written by experts.

Examine the Books at Our Expense

We will send you a complete set by prepaid express upon receipt of coupon. Keep them five days—give them a thorough and careful examination. If you do not wish to keep books advise us and we will have them returned at our expense. If you keep the books send us \$2.00 in five days and \$2.00 a month until special introductory price of \$12.80 has been paid. Regular list price \$24.00.

PARTIAL LIST OF CONTENTS

Automobile Operation—Care—Trouble—Breakdown—Repairs—Automobile Power Plants—Cooling and Oiling Systems—Ignition Systems—Spark Coils—Buying a Motor Car—Gasoline, Electric and Steam Cars—Tires—Puncture—Accessories—Driving—Motorcycles—Gas and Oil Engines—Fuels—Care of Gas Engines—Electricity—Storage Batteries—Direct Current Motors—Mercury Vapor Converter—Primary Batteries—Steam Engines and Boilers—Valve Gears—Indicators, etc.

Order promptly and we will include FREE for one year, as a monthly supplement, the TECHNICAL WORLD MAGAZINE, a regular \$1.50 monthly, full of interesting scientific topics written in popular form.

FREE OFFER COUPON

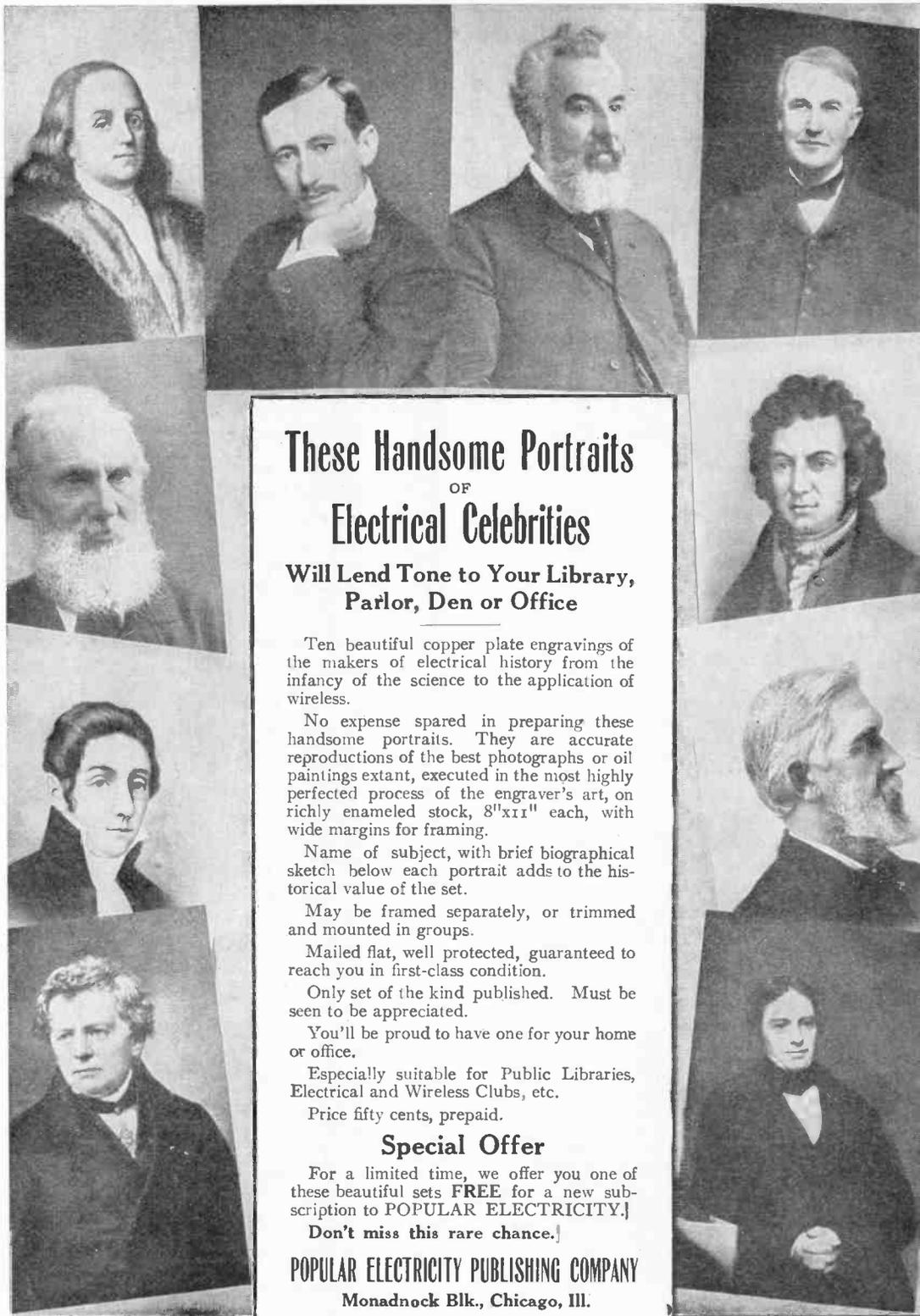
American School of Correspondence,
Chicago, U. S. A.

Please send set Cyclopedia of Automobile Engineering for 5 days' free examination; also Technical World for 1 year. I will send \$2.00 within 5 days and \$2.00 per month until I have paid \$12.80; otherwise I will notify you and hold the books subject to your order. Title not to pass until fully paid.

Name.....
Address.....
Occupation.....
Employer.....

Pop. Electricity 2-'10

POPULAR ELECTRICITY



These Handsome Portraits
OF
Electrical Celebrities

**Will Lend Tone to Your Library,
Parlor, Den or Office**

Ten beautiful copper plate engravings of the makers of electrical history from the infancy of the science to the application of wireless.

No expense spared in preparing these handsome portraits. They are accurate reproductions of the best photographs or oil paintings extant, executed in the most highly perfected process of the engraver's art, on richly enameled stock, 8"x11" each, with wide margins for framing.

Name of subject, with brief biographical sketch below each portrait adds to the historical value of the set.

May be framed separately, or trimmed and mounted in groups.

Mailed flat, well protected, guaranteed to reach you in first-class condition.

Only set of the kind published. Must be seen to be appreciated.

You'll be proud to have one for your home or office.

Especially suitable for Public Libraries, Electrical and Wireless Clubs, etc.

Price fifty cents, prepaid.

Special Offer

For a limited time, we offer you one of these beautiful sets **FREE** for a new subscription to **POPULAR ELECTRICITY.** **Don't miss this rare chance.**

POPULAR ELECTRICITY PUBLISHING COMPANY
Monadnock Blk., Chicago, Ill.

For our Mutual Advantage mention Popular Electricity when writing to Advertisers.

POPULAR ELECTRICITY

WHY NOT BE AN ARTIST?

Our Graduates are filling High Salaried Positions. Good artists

EARN \$25 TO \$100 PER WEEK and upwards, in easy, fascinating work. Our courses of Personal Home Instruction by correspondence, are complete, practical. Twelve years' successful teaching. Expert instructors. Superior equipment. Positions ready for competent workers.

Write for valuable Art Book, Free.

SCHOOL OF APPLIED ART
(Founded 1899)

70 Fine Art Building
BATTLE CREEK, MICHIGAN



OUR OWN FIREPROOF BUILDING

Price \$12.00 AT FACTORY

SAVE ROOM

Most convenient and practical low-priced Typewriter Stand on the market. Made of selected Oak, fine golden finish, 44 in. long, 24 in. wide; Pedestal 30 in. high; 3 drawers and extension slide; Paper Cabinet with shelves 14 1/2 in.; Cabinet has roll curtain front and copy holder. Order from dealer if he has it or will get it; otherwise from us. Do not accept a substitute; no other Typewriter Stand is "just as good."

Ask for Catalog by Number Only.

We also make School, Church and Opera Seats, Lodge Furniture.

No. 219—Office Desks, Chairs, Files, Book Cases, etc.
No. 418—Mission Furn. Rockers, Davenport, Couches, Settees.

E. H. STAFFORD MFG. CO., 243 Adams St., Chicago, Ill.



Quality Excellent

TURN your spare time into cash. No matter where you are employed, you can make easy money and lots of it working for **POPULAR ELECTRICITY**. Our salary plan is the most liberal ever offered. Send stamp for particulars.

POPULAR ELECTRICITY PUB. CO.
Circulation Department
Monadnock Block **CHICAGO, ILL.**

Electrician and Mechanic

is a practical magazine for everyone who wants to learn about electricity, or who uses tools. Its articles tell you how to make dynamos, engines, wireless telegraph apparatus, furniture, models, etc. The only magazine in the world of its kind.

Features for 1910

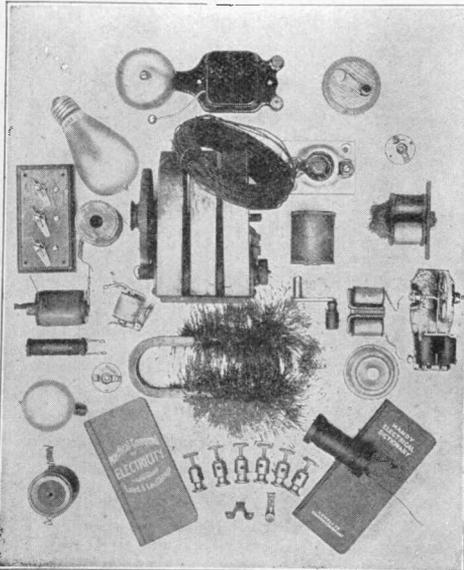
WE have in preparation or now running articles on a practical wireless set working up to 1000 miles, an induction motor, a wireless telephone that will work, an aeroplane, how to run automobiles, forging and tool-making, and others too numerous to mention.

Special Offer: We have 300 sets of the last 6 numbers of **ELECTRICIAN AND MECHANIC**. Send us \$1.00 for a year's subscription (within 30 days) and we will send the 6 back numbers **FREE**.

SAMPSON PUBLISHING CO.
1140 Beacon Building : **BOSTON, MASS.**

STUDY ELECTRICITY FREE

THIS COMPLETE EXPERIMENTAL OUTFIT WITH INSTRUCTION BOOKS WILL HELP YOU



THIS IS THE OUTFIT. START NOW

- Magneto Generator-Motor, weight 6 1/2 pounds, will light incandescent lamps, excite coils, operate as a motor from batteries. Machine has bronze bearings, oil cups, brass gears, and is provided with hand crank or pulley.
- Two pair silk wound Electro-Magnets, worth \$2.
- One fine permanent Magnet.
- Six twenty cent Binding Posts.
- One Push Button.
- One Switch.
- One box Iron Filings.
- Two Miniature Incandescent Lamps, 55 volts, 4 c. p.
- Two Lamp Sockets.
- One Coil Wire.
- One Electric Bell.
- One Laboratory Test Lamp and Socket.
- One Solenoid.
- One package miscellaneous (500) Machine and Wood Screws, all sizes and lengths.

Also all goods given with free coupon providing coupon is sent with order.

Free Coupon: Send in this coupon with your remittance of five dollars, and we will send you in addition to the generator dynamo and the twenty one pieces of experimental apparatus a complete electrical dictionary and 250 page book of electrical diagrams and instruction. Mark your letter with a cross.

Name.....

Address.....P.E.

WESTERN ELECTRIC SALVAGE CO., 1224 So. Washtenaw Ave., Chicago, Ill.

For our Mutual Advantage mention Popular Electricity when writing to Advertisers.

POPULAR ELECTRICITY

\$20 to \$50 and EXPENSES WEEKLY



At home or traveling, all or spare time. Easily learned.

GET MONEY—I DID—GOT \$301.27

worth of plating in two weeks, writes M. L. Smith, of Pa. (used small outfit.)

George P. Crawford writes:—"Made \$7.00 a day." J. J. S. Mills, a farmer, writes:—"Can easily make \$5.00 a day plating." Thos. Parker, school teacher, 21 years writes:—"I made \$9.80 profit one day, \$9.35 another." Others making money—you can do the same.



Costs Nothing to Investigate.

WRITE TODAY

LET US START YOU in the Gold, Silver, Nickel and Metal Plating business. \$5.00 to \$15.00 a day can be made doing plating with Prof. Gray's new line of guaranteed Plating Outfits. Unequaled for plating watches, jewelry, tableware, bicycles, all metal goods. Heavy plate. **Warranted. No experience required.** We do plating ourselves. Have years of experience. Use same materials we sell. Materials cost about 10c to do \$1.00 worth of plating. Manufacture the only practical outfits, including all the tools, lathes, and materials. All sizes complete. Ready for work when received. **Guaranteed. WE TEACH YOU the art, furnish recipes, formula and trade secrets FREE. THE ROYAL, Prof. Gray's New Immersion Process. Quick. Easy. Latest method.** Goods dipped in melted metal, taken out instantly with fine, brilliant, beautiful plate, ready to deliver. Thick plate every time. **Guaranteed from 5 to 10 years. A boy plates from 100 to 200 pieces tableware daily, \$10 to \$30 worth of goods. No polishing, grinding or electricity necessary. DEMAND FOR PLATING IS ENORMOUS.** Every family, hotel and restaurant have goods plated instead of buying new. It's cheaper and better. Every store, jeweler, shop, factory, has goods needing plating. Agents have all the work they can do. People bring it. You can hire boys cheap to do your plating, the same as we, and solicitors to gather work for a small per cent. Replating is honest and legitimate. Customers delighted. **WE ARE AN OLD ESTABLISHED FIRM.** Been in business for years. Capital, \$100,000.00. Know what is required. Our customers have the benefit of our experience, so that failure is next to impossible. **WE ARE RESPONSIBLE and guarantee everything.** Reader, here is a chance of a lifetime to own and boss a business of your own. **WE START YOU.** Now is the time to make money. **CALL OR WRITE TODAY.** Our new plan. Samples of plating, testimonials and circulars FREE. Don't wait. Send us your address anyway.

GRAY & CO. PLATING WORKS, 114 GRAY BUILDING, CINCINNATI, OHIO

**A PENNY PAYS FOR
The Washing
When You Have An
ELMO**



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

The Elmo power washer has a great many features which are decided improvements over other types, one of these advantages is the improved lid which permits machines to be opened without turning off the power, as the gears become disconnected automatically. Another good feature is that all the gears and working parts are shielded so that there is no such thing as torn clothes or crushed fingers.

The reversible wringer is the greatest labor and time-saving feature of the Elmo Power Machine, as it can be run either forward or back by the simple shifting of a lever on the side of the machine, therefore the trouble of napkins, handkerchiefs and other small pieces of clothing never become tangled and torn in the rollers.

The entire secret of this washing machine is the "Back-gear" which is used by no other washing machine on the market. A postal card will bring to you our circular "A Penny Pays for the Washing" which you should have before purchasing. Write today for full particulars.

THOMPSON BROS CO. Dept. 25 Grinnell, Ia.

The "IMPERIAL"

A Portable Vacuum Cleaning Machine combining efficiency, practicability and economy. Can be attached to any electric light socket.



"The Only High-Grade, Efficient Machine on the Market." Guaranteed

A LABOR SAVER FOR THE HOME

Growing concerns and responsible parties wanted as agents. Exclusive territory given. Send for Catalogue and Particulars.

Price \$1.00, Complete

EMPIRE VACUUM COMPANY
112 West 30th Street, New York

Summer Comforts of the Ocean
In the Smallest Home

COLONIAL

8 IN. UNIVERSAL D. C. DESK FAN

Can be used on Desk, Table or for Side
Wall Suspension

Consumes little more than half the current taken by an
incandescent Lamp

Large Wind Out-Put

HAND-
SOMELY
FINISHED



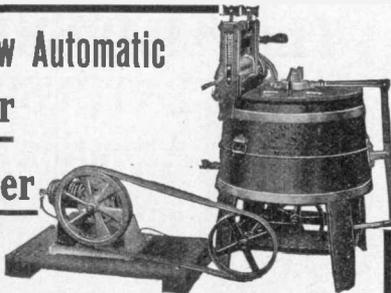
SOLID
BRASS
GUARDS
AND
BLADES

Do not buy until you have seen
This Perfection of Fan Making

If your dealer does not have one
Write us direct

THE COLONIAL FAN & MOTOR CO.
WARREN, O.

The New Automatic Power Washer



"The Automatic Power Washer" is specially adapted to be driven by a gasoline engine, counter shafting or motor which can be fastened to either the wall, floor, or any convenient out-of-the-way place, so that your washing is done automatically.

These machines are manufactured in two different types—"A" and "B." Type "B" is our latest type and is equipt with all of our latest improvements, including our reversible wringer which eliminates your clothes from becoming torn by the wringer rollers.

Write today for descriptive matter and prices.

Automatic Electric Washer Co.
NEWTON, IOWA

Speed the Work on Washday!

Use the 1900 Motor Washer
a Month—at Our Expense!

The Washday "bugbear"—**DRUDGERY**—has been cornered, captured, **routed!** It has worried women since they first bent their backs to the task of washing clothes. And women still toil like galley slaves, fighting the demon of **Dirt.**

Six Minutes to Wash
a Tubful!



Now comes the new way—the swift, efficient, smooth-working 1900 Motor Washer—a marvelous machine that lifts the entire burden from the shoulders of womankind!

Just a "twist of the wrist" and presto! the washer starts! In 6 MINUTES—or less—your tubful of clothes is **CLEAN.** The 1900 Motor Washer does **BOTH WASHING AND WRINGING**—quicker, better, cheaper than it was ever done before. A fine wringer goes with the outfit.

1900 Motor Washer (Electric or Water Power)

Runs for 2c a Week

Two cents a week pays for Power to run either the Electric or the Water Motor Washer. We have both styles. If your house is wired for electric light or supplied with running water you should accept our remarkable offer of an outfit on

30 Days' FREE Trial

The test will prove this the greatest Washer in all the world. It not only does washing and wringing, but

Motors Run Other Machines
The Portable Electric Motor will operate mangle, sewing machine, grindstone, vacuum cleaner, ice cream freezer, fan, polishing machine, etc. The Water Motor will do the same if pressure is sufficient.

Get One On Trial!

See the clothes made spotlessly clean in six minutes! See the wringing done! Try the Motors for running various light machines. Remember—

at our expense and risk! Easy payments if you decide to keep it.

Free Book Tells the Whole Story!

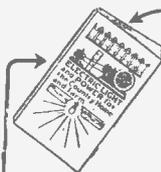
Write for Book and Free Trial Offer before laying this magazine aside. We can't begin to give all the vitally important facts in this advertisement. Write us today—sure. Address (36)

1900 WASHER CO., 3469 Henry St., Binghamton, N. Y.

If you live in Canada, Address

Canadian 1900 Washer Co., 355 Yonge St., Toronto, Can.

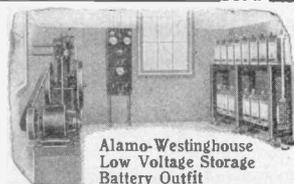
POPULAR ELECTRICITY



Do You Want Electric Light or Power for Your Country Home or Farm?

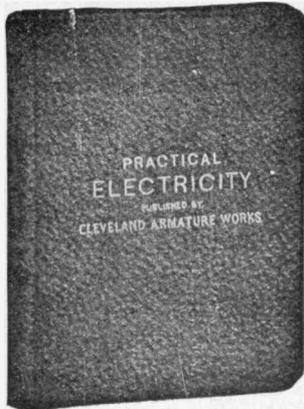
If you are out of reach of central station current and wish to install a gas engine electric outfit, either with or without storage battery, write for our Handbook, here illustrated. Alamo Electric outfits are standard. Our prices are as low as consistent with high-grade machines suitable for permanent installations. Investigate our proposition, it places you under no obligation.

The Alamo Manufacturing Co., 73 South St., Hillsdale, Mich.



Alamo-Westinghouse
Low Voltage Storage
Battery Outfit

A School Within Itself



There are XX chapters in all, XIX carrying you from the fundamental principles of electricity on through the various branches to a point where the careful student comprehends the complete designing, care and operation of a dynamo or motor, and I chapter on electric automobiles, outlining their construction, care and operation, and all about storage batteries and how to handle them. Each subject is carefully written and to the point. After a student studies a subject, he is questioned on that subject in such a manner as to bring clearly to his mind the points he needs to know regarding same. A DICTIONARY in back of book will enable him to learn the meaning of any electrical word, term or phrase used in this book, as well as hundreds of others in common use. All required tables necessary in the study are in it.

TABLE OF SUBJECTS:

<p>Chapter</p> <p>I—Wiring.</p> <p>II—Electric Batteries, Electro Plating.</p> <p>III—Magnetism.</p> <p>IV—The Magnetic Circuit.</p> <p>V—Magnetic Traction.</p> <p>VI—Magnetic Leakage.</p> <p>VII—Energy in Electric Circuit.</p> <p>VIII—Calculation of Size of Wire for Magnetizing Coils.</p> <p>IX—Calculation of EMF's in Electric Machines.</p> <p>X—Counter EMF.</p> <p>XI—Hysteresis and Eddy Currents.</p>	<p>Chapter</p> <p>XII—Armature Reaction.</p> <p>XIII—Sparking.</p> <p>XIV—Winding of Dynamos and Motors.</p> <p>XV—Proper Method of Connecting Dynamos and Motors—Self Excitation.</p> <p>XVI—Diseases of Dynamos and Motors, their symptoms and how to Cure Them.</p> <p>XVII—Arc and Incandescent Lamps.</p> <p>XVIII—Measuring Instruments.</p> <p>XIX—Alternating Current.</p> <p>XX—Automobiles.</p>
--	--

A Dictionary of over 1500 Electrical Words, Terms and Phrases, giving a brief meaning of all which are in common use.

\$2.00 PER COPY—FIFTH EDITION—24,000 COPIES SOLD

The offer we make of refunding money if book is not satisfactory upon examination is an UNUSUAL ONE in connection with the sale of a book. But we have no fear of its return. Your decision will be what thousands of others have been. Money would not buy it if it could not be duplicated. We could print testimonials by the hundreds. It is best to order and be your own judge of its merits.

CLEVELAND ARMATURE WORKS, 4730 St. Clair Ave., Cleveland, Ohio.

Armatures and Fields Wound, Commutators Filled
AMERICA'S GREATEST REPAIR WORKS

What Have You to Sell?

Let us outline a combined advertising and selling plan. One which will appeal differently to those thousands of possible customers you have failed to secure. Let us prepare new advertising copy—the kind that will attract—interest—convince. We have done this for others.—We are still doing it for them. Let us do it for you.

Wm. D. McJunkin
Advertising Agency

167 Dearborn St., Chicago

Will You Accept This Business Book if We Send it Free?

Sign and mail the coupon below. Send no money! Take no risk!

One hundred and twelve of the world's master business men have written ten books—2,070 pages—1,497 vital business secrets, ideas, methods. In them is the best of all that they know about

- | | | |
|----------------|---|---|
| —Purchasing | —Salesmanship | —Position—Getting |
| —Credits | —Advertising | —Position—Holding |
| —Collections | —Correspondence | —Man—Handling |
| —Accounting | —Selling Plans | —Man—Training |
| —Cost-keeping | —Handling Customers | —Business Generalship |
| —Organization | —Office Systems | —Competition Fighting |
| —Retailing | —Short Cuts and Methods for every line and department | and hundreds and hundreds of other vital business subjects. |
| —Wholesaling | | |
| —Manufacturing | | |

A 9,059-word booklet has been published describing, explaining, picturing the work. Pages 2 and 3 tell about managing businesses great and small; pages 4 and 5 deal with credits, collections and with rock-bottom purchasing; pages 6 and 7 with handling and training men; pages 7 to 12 with salesmanship; with advertising, with the marketing of goods through salesmen, dealers and by mail; pages 12 to 15 with the great problem of securing the highest market price for your services—no matter what your line; and the last page tells how you may get a complete set—bound in handsome half morocco, contents in colors—for less than your daily smoke or shave, almost as little as your daily newspaper.

*Will you read the book if we send it free?
Send no money. Simply sign the coupon.*

The System Co., 151-153 Wabash Ave., Chicago
If there are, in your books, any new ways to increase my business or my salary, I should like to know them. So send on your 16-page free descriptive booklet. I'll read it.

178-2-10

Name _____
Address _____
Business _____
Position _____

For our Mutual Advantage mention Popular Electricity when writing to Advertisers.

VITAL POWER

You get the enjoyment out of Life that nature intended you should have, if health prevails.

The Swedish Electric Vibrator



Swedish Electric Vibrator No. 5

Operates on any electric light current, anywhere, direct or alternating.

The only massage Vibrator that gives the **TRUE** Swedish rotary movement, fast, medium or slow. Noiseless in its operation, mechanically perfect and with ordinary care will last a lifetime.

\$25.00

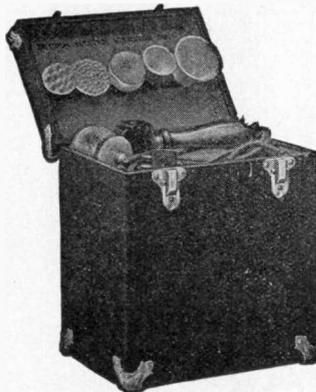
and impure matter that **CLOG UP** the capillaries. These impurities are poisoning and weakening your system and need only to be **RATTLED LOOSE**, combined with blood so that it can and will be **TAKEN OUT OF THE BODY** through the excretory organs.

It takes a big, illustrated book, with charts and diagrams and instructions in **PLAIN ENGLISH** to **SHOW** and **TELL HOW OUR VIBRATOR** will cure any ailment, correct any physical condition. We will send it to you **FREE**. Our Great Expert will write you a special letter of advice on **ANY** male or female disorder, disease, or condition, **FREE** of charge, if you will write us a history of **YOUR** or **YOUR FRIEND'S** case. Don't neglect to write us today.

Our Vibrator runs with batteries or any electric light current; works in the farm home as well as where they have electric lights, comes in an elegant, portable case, including six cells of powerful electric batteries, and all the different applicators. Full and complete instructions accompany each outfit. So simple, a child can safely operate it. Electric shock absolutely impossible. Write now for the big, **FREE** book. We pay all express charges on Vibrators.

will cultivate your system up to the top notch standard; it will **CURE** nearly every ailment; it will give you **VITAL POWER**; it will throb and thrill you into a tireless human engine with **POWER** to think **TWICE AS CLEARLY** and **DO** twice as **MUCH**. When you come in from a hard day's work, it will **SOOTHE**, **REST** and **REVITALIZE** you from head to foot; it will cause your blood to go **LEAPING** and **BOUNDING** through your veins and arteries; cause the flow of nerve fluids to saturate the innermost nerve. You can actually feel disease and weakness being driven from you and **NEW LIFE** and power being generated.

The 50,000 penetrating, revitalizing strokes per minute convey to the flesh a very peculiar vibration, unlike any sensation you ever realized. It **SETS LOOSE** in the blood and lymphatic vessels all stray



Swedish Electric Vibrator No. 2

Operated by its own powerful dry batteries, equally as effective as the No. 5, but for the use of those not having access to the electric light current.

\$15.00

Swedish Electric Vibrator Company

611-621 Farragut Avenue

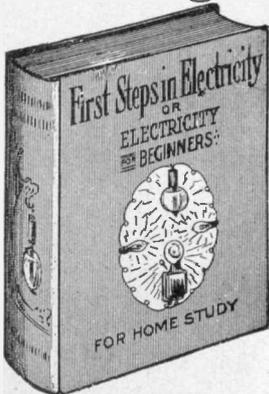
CHICAGO, ILL.

Electrical Contractors and Central Stations

If you read ELECTRORAFT MAGAZINE it will lead you unerringly along the straight and narrow path of rectitude, because it is the only publication which deals with electrical construction problems exclusively in accordance with National Code principles. Sample copy if you request it.

Electrocraft Publishing Company
Detroit, Michigan
Agents wanted everywhere.

For Beginners in Electricity



this is considered one of the best books published. Contains three carefully written volumes in one, including "First Steps in Electricity," "First Steps in Magnetism," and "First Steps in Voltaic Electricity."

The first volume takes up the development of electricity, theory and laws regarding it, the electroscope, electrophorus, electrical machines, the Leyden jar, etc.

Volume Two treats of magnetism and magnets, both natural and artificial.

Volume Three treats of Voltaic Electricity and its connection with Chemistry.

Each volume covers its respective subject thoroughly, explaining same in a clear, simple manner, illustrating the principles presented with simple entertaining experiments and showing how such experiments may be easily performed at home with little expense.

283 pages, fully illustrated. Strong cloth covers.

Price, postpaid, \$1.00.

FREE—For two paid yearly subscriptions to POPULAR ELECTRICITY.

POPULAR ELECTRICITY BOOK DEPT.
Monadnock Block, Chicago, Ill.



Free Home Study Courses

are furnished to members of The American Woman's League and their dependent children, as one of the many valuable rights of membership.

Membership in the League for life may be secured by any person (of the white race) in a few days' or a week's time without the expenditure of a single dollar. The co-operative plan of this great national organization makes this possible and easy.

No young man or young woman who is anxious to increase his or her earning power, or father or mother with boys and girls to educate, can afford to overlook the splendid opportunities provided by the League. Millions of money and the best brains and talent in the world, back of it!

Courses in

Drawing and Painting; Sculpture and Design; Applied Arts, and Arts and Crafts; Ceramics, including China Decoration; Music; Dressmaking; Kindergarten, Physical Culture; Home Economics (Homemaking); Agriculture; Civil Service; Teaching; College Preparatory; Stenography and Typewriting; Bookkeeping and Office Methods; Penmanship; etc., are being taught to thousands of Students by mail in their spare moments.

Fill out coupon below or send a post card, today, for full particulars concerning any Course in which you may be interested, and convincing, detailed information about the League plan.

Address

The American Woman's League
7153 Delmar Boulevard, University City
ST. LOUIS, MO.

THE AMERICAN WOMAN'S LEAGUE
7153 Delmar Boulevard, University City
ST. LOUIS, MO.

Please send me, without obligation on my part, full information about the League and Course I marked.

Course _____

Name _____

St. & No. _____

P. O. & State _____

A COMPLETE Electrical Workers' Library

By HENRY C. HORSTMANN and VICTOR H. TOUSLEY

Positively up-to-date and written
for the men who do the work

We defy any publisher in the world to produce a more practical collection of books for the electrical worker than this series. The immense sale of these popular books since date of publication has been greater than any electrical books ever sold to working electricians.

The Reason?

They are *practical* and do not confuse the worker. They also have the *highest endorsement* of the *International Brotherhood of Electrical Workers*.

To substantiate this claim we offer the sum of *One Hundred Dollars* to any publisher who will produce a sworn statement showing a greater sale of any similar book or books treating on the subject matter that these do, for the length of time they have been on the market.

As to our reputation for keeping business promises, we will refer you to any bank or business house in Chicago.

For the next ninety days we are making a special introductory offer of the complete set of four volumes, neatly cased (regular price \$6.00).

Our special introductory price to electrical workers \$5.00, prepaid to any address upon receipt of price. To all persons ordering this set prior to Jan. 1st we will present, free of charge, our *Handy Electrical Dictionary* for the Vest Pocket, bound in red Russia Leather, gold edges, indexed, 224 pages, illustrated. If the books ordered are not found entirely satisfactory in every way, they may be returned and your money will be cheerfully refunded. To electrical workers already having any of the below enumerated volumes, we will supply single copies of any one or more books at \$1.50 each, postpaid to any address in the world.



Electrical Wiring and Construction Tables	120 pages 70 diagrams
Modern Electrical Construction	340 pages 173 diagrams
Modern Wiring Diagrams and Descriptions	250 pages 200 diagrams
Practical Armature and Magnet Winding	232 pages 128 diagrams

Each volume is substantially bound in full Persian Seal Grain Morocco Leather, stamped on the outside covers in genuine gold leaf, round corners, red edges, pocket size, printed on super-calendered book paper.

Address all orders to the Publishers

Frederick J. Drake & Company
222 Fisher Bldg., CHICAGO, U. S. A.

OUR NEW ILLUSTRATED BOOK CATALOG

JUST OUT

Will Interest You

Tells you all about just the books you need to increase your knowledge of Electricity, assist you in your studies and experiments and advance you in Electrical Work. Send 2c. stamp for a copy with particulars regarding our

SPECIAL OFFER

"An Electrical Library" FREE!

Tear Off and Mail Coupon Today

Popular Electricity Publishing Co.
MONADNOCK BLOCK, CHICAGO

Gentlemen:—Enclosed find 2c. stamp. Please send me your Illustrated Book Catalog with full particulars regarding your special offer, "An Electrical Library Free."

Name _____

Address _____

Town _____

State _____

We Install

Power Plants

Let Us

Figure —

on all your Electrical Work. Some of the largest contracts on Electrical work in the country have been performed by us.

WE INSTALL

Power and Light Plants. Generators and Motors, Electric Light and Power Wiring for Factories, Churches, Schools, Colleges, Theatres, Office, Store and Residence Buildings.

Estimates cheerfully furnished for this class of work in any part of the U.S.

WE MANUFACTURE

Switchboards, Panelboards, Steel Cutout Cabinets, Junction Boxes, Service Switch Boxes, Theatre Stage Plugs, Experimental Switchboards and Appliances for High Schools and Colleges. Newgard receptacles and other electrical specialties.

All Electrical work at the Chicago Electrical Show installed by us.

Manufacturers of the Famous "Newgard" Waterproof Receptacle and Globe.

Henry Newgard & Co. CHICAGO, ILL.



SCHAUM BUILDING

THE HOME OF HALFTONES, ZINC ETCHINGS AND WOOD CUTS OF MERIT

RETOUCHING OF PHOTOGRAPHS AND CLASSY DESIGNS
HIGH GRADE PRINTING OF ANY NATURE

SEE OUR SAMPLES

GET OUR PRICES

Schaum Engraving and Printing Co.

Milwaukee,

Wisconsin

\$90.00 SAVED

**IN HOUSEHOLD
EXPENSES EVERY YEAR.**

IF your home is wired for electricity, you can save \$90.00 every year with a **Steiner Family Motor Outfit**. It performs all of the most difficult Housework by electricity, thus greatly reducing the cost of servant hire, and lightening the burdens of the housewife.

☑ **Best by every test.** Sold under an **absolute guarantee** of satisfaction or your money refunded.

☑ Use it **30 days free** in your own home. Never before has so **liberal an offer** been made.

☑ No letter necessary, just sign and mail us the coupon at the bottom of this ad. today and we will send you complete booklet telling all about the **Steiner Family Motor Outfit** and how you can save \$90.00 every year. Also all about our **wonderful free offer.**

STEINER MFG. CO.

14th and Warren St.

**ST. LOUIS
MO.**

STEINER MFG. CO. 14th and Warren St. ST. LOUIS MO.
Without any obligations on my part please send me prepaid your free
Book telling all about the Steiner Family Motor Outfit and how to
save \$90.00 every year in household expenses, also your won-
derful free offer.

Name _____
Address _____
No letter nec-
essary coupon
will do.

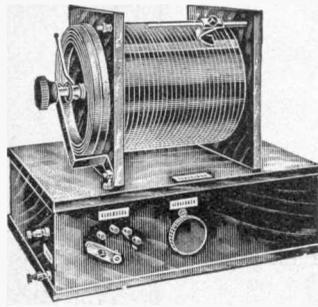
POPULAR ELECTRICITY

HIGH GRADE WIRELESS EQUIPMENT FOR PRIVATE INSTALLATION

This cut shows our 1-4 K. W. complete transmitting outfit, with all the instruments mounted in a beautiful mahogany cabinet. This is our smallest high grade outfit designed for efficient, high class work. All the instruments are connected and ready for use. The sets complete, with 1-4 K. W. Transformer, Special High Potential Condenser, Spark Gap, Oscillation Transformer and Transmitting Key, with all necessary binding posts, switches, etc. It unquestionably is the finest and most reasonable priced high grade 1-4 K. W. set offered to the public.

All the instruments are of proven worth and absolutely guaranteed, and must not be confounded with experimental instruments. They are designed and constructed for efficient and reliable work, and are made with the same thoroughness and care, and are of the same relative efficiency as the transmitting sets we furnish for Government and commercial use. Do not allow a few dollars to stand in the way of your possessing a set of instruments of absolute reliability, and with a responsible guarantee back of them. We now have practi-

Price above set \$75.00. Price above set with 1 instrument separately announced \$85.00



J. J. DUCK, 428 St. Clair St., Toledo, O.

cally no competition in the wireless field for high grade equipment for private installation, and never had any legitimate competition in price. The range of this set is from 30 to 200 miles, depending upon geographical conditions, aerial, etc.

1-2 K.W. set complete, with 1-2 K.W. Instruments mounted in mahogany cabinet... \$115
 1 K.W. set complete, with 1 K.W. Instruments mounted in mahogany cabinet... \$165
 1-2 K.W. set complete, with instruments separately mounted... \$85
 1 K.W. set complete, with instruments separately mounted... \$135
 2 K.W. set complete, with instruments separately mounted... \$270
 Prices on larger equipments on request. All our transmitting and receiving instruments are, of course, sold separately. Send 3c. stamp or coin (not sent otherwise) for our New Big Catalog on anything Electrical or Wireless. Over 40 large pages devoted to wireless instruments, for private installation and for the experimenter. As an encyclopedia of wireless it is invaluable.

\$100 For this high grade DETECTOR

Guaranteed to give perfect satisfaction. Easiest detector for the amateur to get results with, requires NO battery or potentiometer, works best without either. Nothing cheap about it but the price. FREE, with each detector, a Crystal holder (regular price 50c) and 25c lump of Silicon, also our 25c book, "How to Construct a Practical Wireless Telegraph", with fine wiring diagrams (N.C. BLUEPRINTS) and unusually fine, large Code Sheet containing Morse and Continental Codes, suitable for framing. You get \$2.00 worth of goods for \$1.00; postage 8c. This offer positively limited to the next 30 days.



CHICAGO WIRELESS SUPPLY CO.
 52 X Auditorium Office Building, CHICAGO, ILL.

WIRELESS FIENDS

This month only. 1 1/4-in. spark coil, \$5.00. 2 1/2-in. spark coil, \$9.00. 3/4-in. spark coil, \$3.75. Aluminum wire 65 cents a pound postpaid. .75 meter tuning coil, double slide, \$1.50. Carbon Detector, the only detector for short distance, 50c postpaid. Send stamp for circular.

Enamel wire No. 24 at 90c a pound.

Kenwood Wireless Supply Co.
 812 E. 46th Street, Chicago

"WIRELESS"

3/4 K.W. Transformer worth \$7.50 for \$6.50, in parts for \$6.00. 2000 Ohm Receivers with adjustable headband for \$6.00, in parts for \$5.50.

Read our adv in last month's issue.

Just Out a Wireless Book. Every wireless experimenter should have a book worth ten times its value now selling at 15c., send coin only. We give a correspondence course in wireless telegraphy, send 5c. in coin for our famous catalogue.

We sell all parts separate, Ball Bearing Sliders at 15c., each rod to fit same at 20c. per foot. Wollaston wire, Silicon, Copper Pyrites, Zincite, Detectors, Potentiometers, Condensers at 75c. and up. "Call at our store and convince yourself." We sell everything in the wireless and electrical novelty line.

Sending Helix worth \$5.00 for \$3.00, in parts, \$2.50. Act quick. Write for all information, send 5c. in coin for our catalogue. IT WILL PAY YOU. Send now all orders to

THE BROOKLYN WIRELESS CO., 595c Broadway, Brooklyn, N. Y.

WIRELESS OPERATORS Important Announcement

We have purchased the laboratory equipment of the Stone Telegraph & Telephone Co. and will offer at one half values or less a limited number of receiving sets and parts.

Send at once for a list of this well known apparatus. It is so much underpriced that your prompt action will be absolutely necessary to secure a full selection.

Watch for a still more important announcement which we will make next month.

KERMEL APPARATUS CO.

107 Brighton Ave., Allston Station, BOSTON, MASS.
 Manufacturers of Kermel Wireless Sets. 1 Kilowatt and upwards

WIRELESS TELEGRAPHY

TO INTRODUCE our new Wireless Instruments we are offering special prices for a limited time only. Send stamp today for printed matter, just off the press and of interest to all Wireless Enthusiasts.

Address nearest office.

International Wireless Co.

Lima, Ohio. Los Angeles, Calif. Univ. Sta.

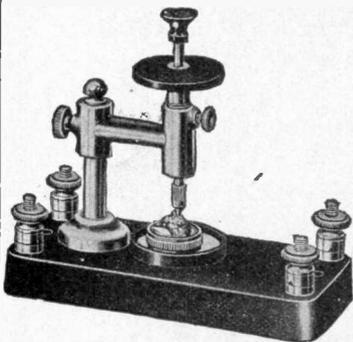
MURDOCK

Silicon - DETECTORS - MOLYBDENITE

We take great pleasure in announcing as notable additions to our steadily increasing lines of reliable wireless apparatus, two absolutely guaranteed forms of the well known SILICON and MOLYBDENITE detectors. Under license of the owners of patents covering the use of these two elements as etheric oscillation receptors we are manufacturing and offering the new MURDOCK detectors, for the use of amateurs, experimenters and owners of private installations, at prices which we believe are within the reach of those who really want the best.

Silicon Detector, \$15.00 Molybdenite Detector, \$10.00
 EVERYTHING FOR WIRELESS

WM. J. MURDOCK CO., 50 Carter St., Chelsea, Mass.
 824 Folsom St., San Francisco 824 Dearborn St., Chicago



For our Mutual Advantage mention Popular Electricity when writing to Advertisers.

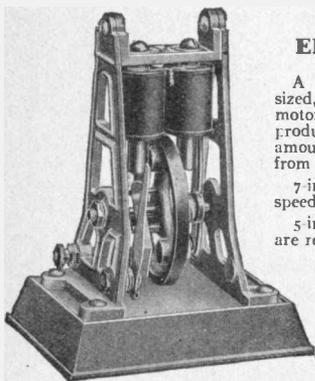


SAVE 60 to 70%

in your Electric Light bill—by using Thordarson's Multiple Lighting Transformers in connection with the new Low-Voltage Tungsten Lamps for alternating current only.

Write for full particulars.

**THORDARSON
ELECTRIC MFG. CO.**
220 Jefferson St. Chicago, Ill.



Reversible Electric Motor

A perfect model of full sized, vertical type, electric motor, mechanical perfect, producing the greatest amount of power possible from the ordinary battery.

7-inch motor, with two speed gearing. Price, \$2.00

5-inch motor, (both sizes are reversible). Price, \$1.00

Send your dealer's name, for complete list of electrical toys.

**[THE H.-K. ELECTRIC
TOY CO.]**
Indianapolis, Ind.

WIRELESS TELEGRAPH APPARATUS

SPECIAL OFFER of a limited number of 6 inch spark Induction Coils, at \$30.00 each. Have mica condensers and self starting mechanical vibrator. Run on about 8 volts; also 110 volts with suitable rheostat. Good workmanship.

Send 6 cents in stamps and we will mail our new Morse and Continental Code Chart and illustrated Catalogue of our complete line of Transmitting and Receiving Apparatus.

O. T. LOUIS COMPANY
Specialists in Scientific Apparatus
59 Fifth Ave. NEW YORK

YOUR wants for ELECTRICAL NOVELTIES

will be satisfied by us at lowest cost and most satisfactorily—a trial will convince you. Do not overlook these unusual offers.



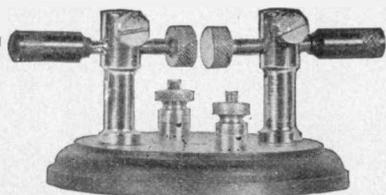
New \$1.25 Flashlight with 4 C. P. Tungsten lamp, 1500 flashes, now postpaid, 75c; with extra battery \$1. Send stamp today for our new Illustrated Catalog for complete list of

Electric Flashlights.....	33c and up
" Scarf Pins.....	38c "
" Engines.....	47c "
Rechargeable Batteries, 3 volts.....	15c "
Miniature Lamps.....	9c "
" Tungsten Lamps.....	27c "
All Metal Box Telephones, one station.....	\$1.65 "
Cigar Lighters.....	30c "
Medical Coils.....	78c "
Miniature Transformers for Reducing 110v.....	\$3.75 "

DEALERS: Write for our favorable terms and big discounts on quantity order.

ELECTRIC NOVELTY CO.

Manufacturers and Importers 246 Third Ave., PITTSBURG, PA.



Improved Wireless Universal Detector

¶ The above illustration is about one-half the actual size and possesses the best materials with workmanship which is unsurpassable.

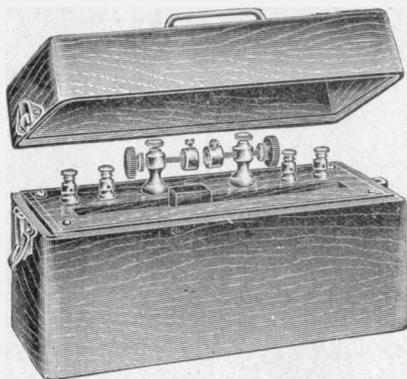
¶ The detector adjusters are insulated with highly polished hard rubber knobs. The adjuster stands are equipped with set screw which makes the adjustment rigid, and all the metal parts are highly nickel plated. Mounted on a solid mahogany basis, make a very beautiful, as well as compact instrument.

¶ Sent prepaid by mail for \$1.00.

¶ Write today for particulars, it will be profitable to you.

Elyria Wireless Supply Co.
ELYRIA, OHIO

WIRELESS RECEIVING OUTFIT



TYPE A

Consists of detector stand, tuning coil, 75 Ohm receiver with cord, and one dry battery, all in polished oak case. Will receive up to 100 miles.

PRICE ONLY \$7.75

Same instruments not mounted in case, only \$5.25. Order quick. Only a few sets left. Get our catalog of novelties.

TREMBLY ELECTRIC CO.
CENTERVILLE, IOWA

Farm Land the Basis of Value

In making investments the first consideration should always be the character of the security. Every investor to whom income is important should learn the facts about Irrigation bonds. They form, in our estimation, the safest way to earn 6 per cent.

Secured by a Thousand Farms

Irrigation bonds are secured by first liens on good farm land—sometimes a thousand farms. The farms are worth usually at least four times the loan.

The farms are exceedingly fertile, and are not subject to crop failures. Any one season's earnings are generally sufficient to repay the whole loan.

The bonds are additionally secured by a first mortgage on an irrigation system, in which the investment is often twice the bond issue.

Some Irrigation bonds are municipal securities, which form—as do School bonds—a tax lien on the district. Some are issued under the "Carey Act," where the State supervises the project.

They are issued in denominations of \$100, \$500 and \$1,000, so one may invest either little or much. All are serial bonds, part of which are paid annually, so one may make long-time or short-time investments.

78 Issues Sold

In the past 16 years we have sold 78 separate issues of Reclamation bonds, all based on farm liens. Not a dollar of loss has resulted to any investor.

Our dominant place now gives us the pick of these projects. They are passed on by our own engineers and attorneys. And an officer of our Company constantly resides in the irrigated sections, watching the projects we finance.

We have issued a book based on all this experience—a book which every investor should read. Please cut out this coupon as a reminder to send for it. (16)

Trowbridge & Niven Co.

First National Bank Building, Chicago 111 Broadway, New York
50 Congress St., Boston First National Bank Bldg., San Francisco

Please send your free book on Irrigation Bonds.

Name.....

City.....

State..... (831)

If the man behind the counter

of the corner cigar store were to say to you: "Buy this box of cigars—smoke ten of them, and if you don't like them bring back the remaining cigars and get all your money—and no charge for the ten smoked," you'd be pretty well convinced of his faith in the cigars he was selling and you'd probably buy.

But the man in the corner store doesn't do business that way.

Now, I want to make you that very offer—with this exception—that I don't want you to pay for the cigars until after you've smoked the ten. *Here is my offer in full as I've stated it for seven years:*

I will, upon request, send fifty Shivers' Panatelas, on approval, to a reader of Popular Electricity, express prepaid. He may smoke ten cigars and return the remaining forty at my expense, and no charge for the ten smoked, if he is not pleased with them; if he is pleased, and keeps them, he agrees to remit the price, \$2.50, within ten days.

On that offer I have built a large business extending into every State and Territory of the Union. My business grows by reason of repeat orders—eighty-five per cent. of the cigars I sell are shipped on repeat orders.

Every cigar is made right here in my own factory (and it is not a small affair, but a full-size business building in the business heart of Philadelphia), and I know that the filler is *all* clean, straight, long Havana, grown on the Island of Cuba, and the wrapper genuine Sumatra. The cigars are hand-made, by skilled workmen, in a clean, sanitary factory. That's why I know that my cigars will stand this offer.

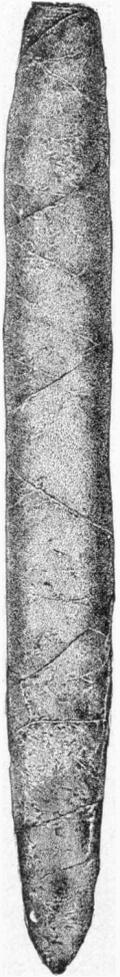
In ordering, please enclose business card or send personal references, and state which you prefer—light, medium or dark cigars.

MY BOOK FREE—It tells a lot of things about tobacco, cigars and smoking in general that every man should know. Write for it.

HERBERT D. SHIVERS

913 Filbert Street

Philadelphia, Pa.



SHIVERS' PANATELA EXACT SIZE AND SHAPE

POPULAR ELECTRICITY

TEN THOUSAND TELEGRAPHERS WANTED

by railroads, commercial companies and Wireless Companies. Only schools in America teaching

WIRELESS TELEGRAPHY

We operate fifteen Wireless Stations. Main Line R. R. Wires in each of our Institutes. Supervised by R. R. Officials. Write for prospectus.

NATIONAL TELEGRAPH INSTITUTE

CINCINNATI, OHIO PHILADELPHIA, PA. MEMPHIS, TENN. DAYENPORT, IOWA PORTLAND, ORE. COLUMBIA, S. C.



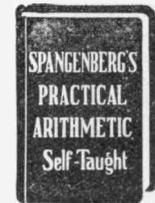
Home Study Courses
 Over one hundred Home Study Courses under professors in Harvard, Brown, Cornell and leading colleges.
 Academic and Preparatory, Agricultural, Commercial, Normal and Civil Service Departments.
 Preparation for Colleges, Teachers' and Civil Service Examinations.
 250 page catalog free. Write to-day.
THE HOME CORRESPONDENCE SCHOOL
 Dept. 100, Springfield, Mass.

Do You Like to Draw?

Sketch this face and draw a face on it
 Many people have a natural talent for drawing, but few realize the actual value of it. This school will develop your talent in the most practical way so you can sell your work, and cartoonists are well paid. Students of this school take no financial risk. Enclose 6c. for a portfolio of cartoons and sample lesson plate.
THE W. L. EVANS SCHOOL OF CARTOONING
 225 Kinmore Bldg., Cleveland, Ohio



Selling Electricity **The Magazine of Electrical Progress**
 A Text Book for the Electric Light and Power Solicitor.
 The Clearing House of New Ideas—Where to Look for Business—How to Get it—Ways to Hold it—Who has Done it. \$1.00 per year.
SELLING ELECTRICITY
 74 Cortlandt Street - - New York City



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 **60 Cents**, little book sent postpaid for (stamps accepted) leather binding, \$1.
GEO. A. ZELLER BOOK CO., Est. 1870.
 4464 W. Belle Place, St. Louis, MO.



COPY THIS SKETCH
 and let me see what you can do with it. You can earn \$20.00 to \$125.00 or more, per week as illustrator or cartoonist.
 My practical system of personal individual lessons by mail will develop your talent. Fifteen years successful work for newspapers and magazines qualifies me to teach you.
 Send me your sketch of President Taft with 6c in stamps and I will send you a test lesson plate, also collection of drawings showing possibilities for you.
THE LANDON SCHOOL of Illustrating and Cartooning
 1451 Schofield Bldg., Cleveland, O.



LEARN CHIROPRACTIC
 The new method of drugless healing **EARN \$50 TO \$100 PER WEEK**
 Our free book tells how you can learn to detect disease and remove the cause by Howard's method of Spinal Adjustment. Positively the most simple, direct, advanced and scientific method of drugless healing. Based on unerring natural laws. Anyone can understand it; learned in spare time. Improve your social prominence and financial standing. Start now on the road to honor and success. Write for free book and special scholarship offer.
NATIONAL SCHOOL OF CHIROPRACTIC
 1732 W. Congress St., Dept. 8 Chicago, Ill.

ELECTRICITY PRACTICALLY AND INDIVIDUALLY TAUGHT
 Through the medium of tools and machinery. You are qualified in a few months under the guidance of skilled instructors in the largest and best equipped electrical school in the U. S. to occupy a responsible position in the electrical field or to enter into an electrical contracting business of your own. Write or call for Prospectus.
NEW YORK ELECTRICAL SCHOOL
 40 West 17th Street New York City



Salesmen Wanted
 Traveling Salesmen earn from \$1,000 to \$25,000 a year and expenses. Over 800,000 employed in the United States and Canada. The demand for good Salesmen always exceeds the supply. We will teach you to be one by mail and assist you to get a good position. We maintain the largest **FREE EMPLOYMENT BUREAU** in the world and receive calls for thousands of Salesmen. We have assisted thousands of other men to secure good positions and better salaries and we can help you. Hundreds of our graduates who formerly earned \$25 to \$75 a month have since earned from \$100 to as high as \$1,000 a month and expenses. Thousands of positions now open. If you want to secure one of them and increase your earnings, our free book "A Knight of the Grip" will show you how. Write (or call) for it today. Address nearest office
Dept. 423 National Salesmen's Training Association
 Chicago, New York, Kansas City, Minneapolis, San Francisco, Atlanta

HOW YOU CAN EARN \$300 OR MORE A MONTH
 One box ball alley costing \$150, took in \$513 the first fifty-one days at Sullivan, Indiana. Two other alleys costing \$365, took in \$1,372.95 in five months. Four large alleys costing \$840, took in \$1,845.20 in fifty-nine days, more than \$900 a month. Why not start in this business in your own town? Both men and women go wild with enthusiasm; bring their friends, form clubs and play for hours. Players set pins with lever—no pin boy to employ. Alleys can be set up or taken down quickly. Write for illustrated booklet explaining **EASY PAYMENT PLAN.** Send for it today.
AMERICAN BOX BALL CO., 1903 Van Buren Street, Indianapolis, Indiana

For our Mutual Advantage mention Popular Electricity when writing to Advertisers.

PATENTS THAT PROTECT and PAY

Send for FREE 85-page book. Advice free. Terms reasonable. Highest references. Best results.

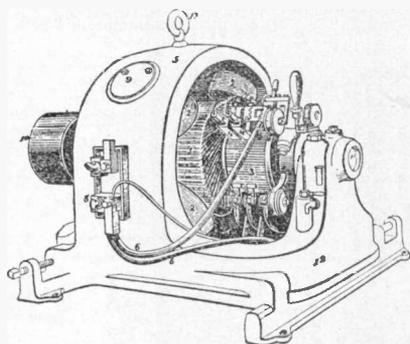
Recommended Patent Lawyer in the Bankers' Register and special list of selected lawyers. Also in Martindale's Law Directory, Sharp & Alleman's Directory of Lawyers, The Gast-Paul Directory of Lawyers, and Kime's International Law Directory.

ALL BUSINESS GIVEN PROMPT AND PROPER ATTENTION

Member of the Bar of the United States Supreme Court and all of the other Courts in the District of Columbia

A large list of strong recommendations furnished free.

WATSON E. COLEMAN, Patent Lawyer, 612 F St., N. W., Washington, D. C.



Most Unique Book of the Kind THE DYNAMO

Its Growth and Construction Simply Explained

By JOSEPH G. BRANCH, B. S., M. E.

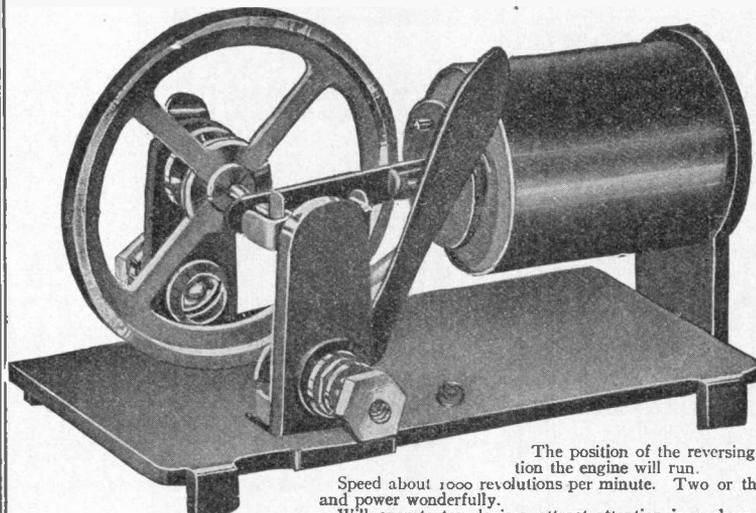
The author is one of the best known, practical writers of the day and this little work is his master-piece. It is written in the simplest and clearest language, contains no mathematics and yet is so practical and thorough that it will start you right in your work as a practical electrician. Every part of the dynamo is shown in nine full-page, beautifully colored illustrations, each part being numbered with full explanatory text in connection, so that the complete anatomy of the machine can be seen at a glance.

30 pages, 6½x9½ inches. Price, postpaid, strong paper covers, 50c. Cloth, 75c.

POPULAR ELECTRICITY BOOK DEPT.

Monadnock Block, - - - - CHICAGO, ILL.

SPECIAL OFFER



SPECIAL LOW PRICE ON THIS POWERFUL Solenoid Electric Engine

Runs like Lightning.

THIS engine is made to run for a long time on one cell of dry battery. This without doubt the best made electric engine for its size on earth.

The base and frame are made from cold rolled steel;—the coil is hollow, thereby allowing the driving shaft to be operated on the solenoid principle.

The position of the reversing lever controls the speed and direction the engine will run.

Speed about 1000 revolutions per minute. Two or three cells of battery increases speed and power wonderfully.

Will operate toy devices, attract attention in a show window, run a small fan, and is a source of endless amusement and instruction. Batteries can be purchased anywhere for 15 to 20c. each.

Finish of frame, fine black enamel, large brass fly wheel is bright dipped cylinder of coil casing in English vermilion red, which makes this also the finest finished and appearing engine.

Every engine comes in an individual box with complete directions for operating. Delivered, charges prepaid, to any address in the United States, on receipt of

50 CENTS EACH. CANADA 75 CENTS EACH.

SWEDISH AMERICAN ELECTRIC CO., 1755 Berwyn Ave., Chicago, Ill.

POPULAR ELECTRICITY



PATENTS
PATENT ATTORNEYS



CRD BY
NEW YORK EDI-DN CO 1904

PATENTS Secured Promptly and with special regard to the legal protection of the invention
HAND BOOK FOR INVENTORS AND MANUFACTURERS SENT FREE UPON REQUEST
C. L. PARKER, Patent Lawyer
Patents, Caveats, Trade Marks, Copyrights, Reports as to Patentability, Validity and Infringement.
Patent Suits Conducted in all States.

REFERENCES: American Tire Co., Automatic Vending Machine Co., Lippincott Pencil Co., International Ore Treating Machinery Co., Globe Machine and Stamping Co., Metal Manufacturing Co., Builders Iron Foundry, Morgan Machine and Engineering Co., Berkshire Specialty Co., Stewart Window Shade Co., Macon Shear Co., Acme Canopy Co., Oaks Manufacturing Co., Cox Implement Co., Columbus Buggy Co., National Index Co., Handy Box Co., Iron-Ola Co., By-Products Chemical Co., Alabama Brewing Co., National Offset Co., Antiseptic Supply Co., Floor Clean Co., Fat Products Refining Co., Richmond Electric Co., Railway Surface Contact Supplies Co., National Electric Works, Modern Electric Co.

Mr. Parker on November 1, 1903, after having been a member of the Examining Corps of the U. S. Patent Office for over five years resigned his position to take up the practice of patent law.
Address 12 MCGILL BUILDING - - - WASHINGTON, D. C.

PATENTS that PROTECT

Our 3 books for inventors mailed on receipt of 6 cts. stamps.
E. S. & A. B. LAOEY, Washington, D. C., Dept. 55 Est. 1869

Samuel G. McMeen Kempster B. Miller

McMeen & Miller

Patent Solicitors and Patent Experts

In connection with our telephone engineering practice we make a specialty of securing electrical patents for inventors, and of giving expert advice in patent matters. We also have facilities for marketing meritorious electrical inventions.

1456 Monadnock Block CHICAGO 333 Grant Ave. SAN FRANCISCO

PATENTS

*Difficult and Rejected Cases Solicited.
No attorney's fee until Patent is allowed. Experienced Personal Service.
Book Free.*

OBED C. BILLMAN, MAIN OFFICE CLEVELAND, OHIO

HAVE YOU AN IDEA? If so, write for our Books:

"Why Patents Pay," "What to Invent," "100 Mechanical Movements" and a Treatise on Perpetual Motions—50 Illustrations. All mailed free.

F. G. DIETERICH & CO.

PATENT LAWYERS AND EXPERTS

603 OURAY BUILDING, WASHINGTON, D. C.

PATENTS

TRADE MARKS AND COPYRIGHTS

SECURED OR FEE RETURNED

Send model or sketch and description of your invention for free search of the U. S. Patent Office Records.

Our Four Books mailed Free to any address. Send for these books; the finest publications ever issued for free distribution.

HOW TO OBTAIN A PATENT

Our Illustrated 80 page Guide Book is an invaluable book of reference for inventors and contains 100 mechanical movements illustrated and described.

FORTUNES IN PATENTS

Tells how to invent for profit and gives history of successful inventions.

WHAT TO INVENT

Contains a valuable list of inventions wanted and suggestions concerning profitable fields of invention. Also information regarding prizes offered for inventions, among which is a

PRIZE OF ONE MILLION DOLLARS

offered for one invention and \$10,000 for others.

PATENTS THAT PAY

Contains fac-similes of unsolicited letters from our clients who have built up profitable enterprises founded upon patents procured by us. Also endorsements from prominent inventors, manufacturers, Senators, Congressmen, Governors, etc.

WE ADVERTISE OUR CLIENTS' INVENTIONS FREE

in a list of Sunday Newspapers with two million circulation and in the *World's Progress*. Sample Copy Free.

ELECTRICAL CASES A SPECIALTY

We have secured many important electrical patents.

VICTOR J. EVANS & CO.

(Formerly Evans, Wilkens & Co.)

Main Offices, 615 "F" Street, N. W., Washington, D. C.

EUGENE C. BROWN, Victor Bldg. Washington, D. C.

Electrical Engineer and Patent Lawyer

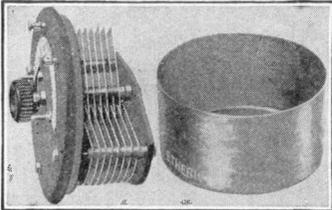
Member Bar U. S. Supreme Court and Patent Bar Association.

Mr. Brown is especially fitted for prosecuting Electrical Cases in the Patent Office and Suits in the Courts on Electrical patents, having graduated as an Electrical Engineer from Lehigh University, and for seven years was an Examiner in the Electrical Division of the U. S. Patent Office.

For our Mutual Advantage mention Popular Electricity when writing to Advertisers.

POPULAR ELECTRICITY

WIRELESS APPARATUS



Our improved type Variable condensers will measure the range of your receiving station 50 per cent.

Price \$5.00

Send 2 cent stamp for our Wireless Catalogue.

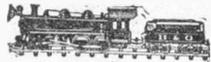
Etheric Electric Co. 71 Barclay Street New York

ELECTRICITY
VOLTAMP

The most wonderful and fascinating scientific study of the age. Every Boy, Girl and Grown-up should know about it. The new "VOLTAMP" ELECTRICAL PRODUCTS—

our 112 Page Catalog now ready, the most complete and interesting book ever issued—is full of illustrations and descriptions of the latest VOLTAMP Electrical Novelties—Motors, Dynamos, Toys, Machine Models, Telegraph and "Wireless" Instruments, Ruhmkorff Coils, Spark Coils, Geissler Tubes, Switches, Meters, Lamps, Flashlights, Transformers, Tools, etc. The greatest line of Miniature Electric Railways ever shown. Anything Electrical for Anybody. Prices consistently low.

Send for this Catalog—6 cents in stamps or coin, which will be refunded on first order of 50 cents or over. No postals answered.



VOLTAMP ELECTRIC MFG. CO., Park Bldg., Baltimore, Md.

Memory the Basis of All Knowledge
Stop Forgetting
THE KEY TO SUCCESS

How to Remember
You are no greater intellectually than your memory. Easy, inexpensive. Increases income; gives ready memory for faces, names, business details, studies, conversation; develops WRITE TO-DAY will, public speaking, writing, personality.
Dickson Memory School, 929 Auditorium Bldg., Chicago

FOOT AND ELECTRICAL DRIVEN
Power and Turret Lathes, Planers, Sharpners, and Drill Presses.
Write today for our Complete Catalog.
Shepard Lathe Co.
B. 131 W. 2nd St., Cincinnati, Ohio

EVERY BOY HIS OWN TOYMAKER
Greatest boys' book ever written. Tells how to make a Steam Engine, Camera, Windmill, Microscope, Electric Telegraph, Telephone, Magic Lantern. Boats of every kind, kites, balloons, toys, wagons, bows and arrows, stilt, animal traps, etc. Over 200 pictures. This book and catalogue only 10c. postpaid.
Commercial Electric Co.
Dept. 5, Kewanee, Ill.

Teach Yourself Arithmetic
With a set of Arithmetic Help. Any and all examples and problems in arithmetic, from the easiest to the hardest, are worked out and explained so anyone can understand. For the student or business man. Easy and simple. Two volumes; 630 pages; over 200 illustrations and color plates. Bound in red silk cloth. Most complete ever published. \$2 will bring a set prepaid anywhere. Send for a set. If not pleased, return at our expense and get your money back. Order Today.
STANDARD SALES CO., 28 Fifth Av., CHICAGO

HORN VIBRATORS
HAIR DRYERS
SMALL MOTORS
Run on both 110 volts direct current and 60 cycle alternating current. Best Machines on the market for a moderate price.
Send for a catalogue
Horn Electric Co.
36 S. Canal St. Chicago

GOVERNMENT POSITIONS
A Civil Service Manual by Ewart, Field and Morrison prepares for the examinations. Adopted by over 500 Business Colleges, Y. M. C. A.'s, and Public Evening Schools.
Three volumes with maps, \$2.50 postpaid
250 page Home Study catalog free. Write to-day.
THE HOME CORRESPONDENCE SCHOOL
Dept. 129, Springfield, Mass.

Mr. Field

Learn Telegraphy
MORSE and WIRELESS
At My Practical School. Demand for operators from Railroads and Wireless Co's greater than supply. Graduates assisted. We occupy our own large modern building, R. R. train wire and complete wireless station. Endorsed by Railroad and Western Union Officials. Teachers are practical experts. Living expenses earned. Easy payments. Correspondence courses if desired. Catalogs Free. **GEORGE M. DOHGE, Pres., Dodge's Institute, 21st Street, Valparaiso, Indiana. Established 1874.**

ROTH. ELECTRIC MOTORS
POLISHING LATHES
FORGE BLOWERS
SPECIAL MACHINERY
ROTH BROS. & CO.
1358 W. Adams St. Chicago, Ill. 136 Liberty St. New York City

IF YOU STAMMER
Attend no other school until you hear from me. Largest stammering school in the world curing by the improved natural method. No singing or time-beating methods. Beautiful 88 page book and special rates sent free.
Lee Wells Millard, President, NORTH-WESTERN SCHOOL FOR STAMMERS, Inc., 919 First St., Milwaukee, Wis.

TELEGRAPHY TAUGHT
in the shortest possible time. The Omnigraph Automatic Transmitter combined with standard key and sounder. Sends you telegraph messages at any speed just as an expert operator would. Five styles, \$2 up; circular free.
OMNIGRAPH MFG. CO.
H Corlandt Street New York

ELECTRIC GOODS FOR EVERYBODY
World's Headquarters for Dynamos, Motors, Fans, Toys, Batteries, Belts, Bells, Pocket Lamps, Toy Railways, Books, etc. We undersell All. Fortune for Agents. If it's electric we have it. Big Cat. 3 cts.
OHIO ELECTRICAL WORKS, CLEVELAND, OHIO

I TEACH BY MAIL.
WRITE FOR MY FREE BOOK
"How to Become a Good Penman" and beautiful specimens Your name elegantly written on a card if you enclose stamp. Write today. Address **F. W. TAMBLYN, 419 Meyer Building, Kansas City, Mo.**

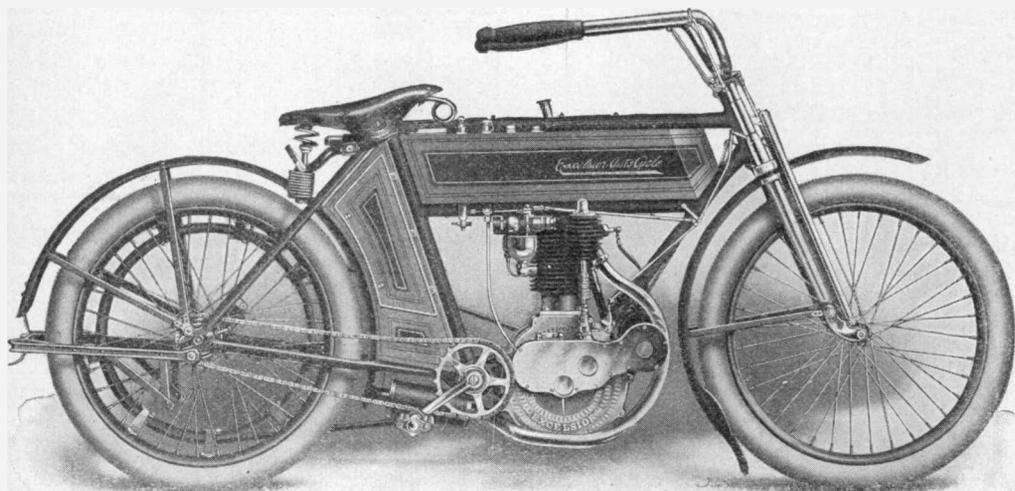
"How to Construct a Practical Wireless Telegraph"
With illustrations, diagrams, and fine copy of the Codes, 25c. A 20 stamp brings our bulletin of wireless supplies.
CHICAGO WIRELESS SUPPLY CO.
Room 520, Auditorium Office Bldg. Chicago, Ill.
For our Mutual Advantage mention Popular Electricity when writing to Advertisers.

AGENTS' PORTRAITS 35c. FRAMES 15c. SHEET PICTURES 1c. 30 Days' Credit. Samples and Catalogue Free.
CONSOLIDATED PORTRAIT, Dept. 1401, 1027 W. Adams St., Chicago
MAGIC TRICK FREE BOOK
Dept D. 3148 State St. Chicago, Ill.

POPULAR ELECTRICITY

EXCELSIOR AUTO-CYCLE

BETTER THAN EVER FOR 1910



No Product of human skill and ingenuity has ever exceeded the record of the

EXCELSIOR AUTO-CYCLE

Designed and built by men who know, thoroughly tried and proven before being offered to the public, it **made good** and has become universally recognized as **the leader of American motorcycles.**

No changes in the 1909 model were found necessary and but few advisable, but we have added such refinements as mechanical force feed oiling system, valve silencer and the lowest saddle position ever attained in a road machine.

Our advance catalog H 10 tells all about this and the new **Excelsior Twin** that will excel all other motorcycles as the **Excelsior 30-50** excels all other single cylinders.

EXCELSIOR SUPPLY COMPANY

Established 1876

233-237 Randolph St., Chicago, Ill

For our Mutual Advantage mention Popular Electricity when writing to Advertisers.



Which Will You Choose?

Will it be "Just a Common Job" at small pay or one of the well paid positions which the American School of Correspondence can train you to fill?

Many poorly paid but ambitious men have over-come greater obstacles than those which confront you—have been trained by the American School to fill a good position at big pay.

It is easy to acquire training. Choose the position you desire to hold by marking and mailing the coupon below. Let us send you a complete solution of your problem.

The American School is the *greatest practical training school* in the world. It will come to you no matter where you live and train you in your spare time—in your own home.

Make your choice today by filling in and mailing the coupon. There is no obligation. The American School sends complete information quietly and promptly by mail—not by an agent to bother you in your home or at your work. We will tell you frankly and honestly just how we can help you.

Mail the free information coupon today

American School of Correspondence
CHICAGO, U. S. A.

FREE INFORMATION COUPON

American School of Correspondence:

Please send me your Bulletin and advise me how I can qualify for position marked "X."

- | | |
|---------------------------|--------------------------|
| ... Book-keeper | ... Draftsman |
| ... Stenographer | ... Architect |
| ... Accountant | ... Civil Engineer |
| ... Cost Accountant | ... Electrical Engineer |
| ... Systematizer | ... Mechanical Engineer |
| ... Cert'f'd Public Acc't | ... Sanitary Engineer |
| ... Auditor | ... Steam Engineer |
| ... Business Manager | ... Fire Insurance Eng'r |
| ... Commercial Law | ... College Preparatory |

NAME

ADDRESS

OCCUPATION

Pop. Elect. 2-10

Bus.

\$ 665

Buys the Material Needed to Build This Home!



OUR HOUSE DESIGN No. 126

This beautiful little house is a great favorite with those who like the old English style of architecture. There are three rooms, hallway and pantry on the first floor with four comfortable chambers and bath room on the second floor. Though of moderate size, it is compact and delightfully cozy. In design it shows a happy blending of the useful with the ornamental. Its cost is scarcely more than a cottage and its value more than a house double its size.

Price includes Blue Prints, Architect's Specifications; Full Details; Working Plans and Itemized List of Material. This is the greatest bargain offer ever advertised.

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. We also have Machinery, Hardware, Furniture, Household Goods, Office Fixtures, Wire Fencing—in fact, anything required to build or equip. Everything for the Home, the Office, the Factory or the Field. 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 Cottages, Bungalows, Barns, Houses, 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.

High Grade Bathroom Outfits!



Price of this Bathroom Outfit, \$37.50

Strictly new and as good as anyone sells. We have everything needed in Plumbing Material. Our prices mean a saving to you of 30 to 60 per cent. We can easily prove it if you will give us a chance. 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. This is a positive fact. It's only one of ten other complete outfits that we are offering at prices ranging from \$25.00 to \$100.00. Our catalog describes them in detail. You need the book if you want to keep posted on up-to-date business methods. Get our prices on Pipe and Fittings. Write us today.

Hot Water Heating Plants!

We furnish new complete hot water heating outfits at half the retail prices. Our proposition includes all necessary plans, specifications, blue prints and detailed instructions; so that any ordinary mechanic handy with the use of tools can easily install it. You can't go wrong when you deal with us. We stand back of every sale. You send us today a sketch of your building and we will make you a proposition to furnish you a complete steam or hot water heating outfit. We also have hot air furnaces. Our booklet on heating plants tells every feature of the heating question. We can quote radiators and heaters separately. Whether you buy from us or not it is a valuable book for you to own. Write us today.



Send Us This Coupon

Chicago House Wrecking Co.
I saw this ad. in Popular Electricity.
I am interested in _____
Name _____
Town _____
Co. _____ State _____

Free Publications!

Fill in the coupon to the left and we will send you such literature as best suits your needs. We publish a 500 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. 891. Our book on Plumbing and Heating Apparatus contains 150 pages of useful information. Our free "Book of Plans" is described elsewhere in this advertisement.

Water Supply Outfits!

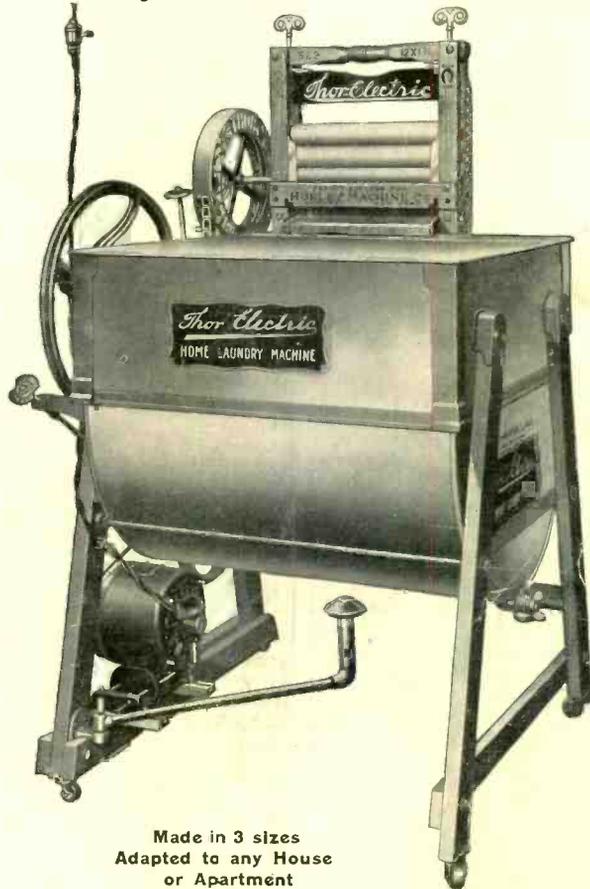
Modern Air Pressure Water Supply Systems at prices ranging from \$18.00 to \$200.00. They are strictly new, first-class and complete in every detail. It makes no difference whether you live in the country, you can enjoy every city comfort at little expense. Why not investigate this! We are ready to furnish 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.

Chicago House Wrecking Co., 35th & Iron Sts., Chicago.

9000 Homes Are Now Using

"Thor-Electric"

Home Laundry Machines—Why Not Yours?



Made in 3 sizes
Adapted to any House
or Apartment

The Cylinder Principle of Washing Clothes is Recognized by Everybody to be the Only Perfect Way

The "THOR" Electric Three-Roll Wringer wrings the clothes from either side of machine. The "THOR" washes and wrings clothes at the same time.

Our Guarantee

We guarantee that the "THOR" Electric Home Laundry Machine will wash and wring perfectly, the washing of an average family of six persons in 90 minutes at an expense of 3 cents for electricity. No one can afford to be without one of these modern, up-to-date machines in their home. Pays for itself in a few months.

Dealers and Agents Wanted Everywhere

HURLEY MACHINE COMPANY

General Office: 32 S. Clinton St., Chicago

1012 Flatiron Bldg., New York

71 First St., San Francisco