

N. S. E.

Price, 10 Cents

May, 1909

ELECTRICIAN & MECHANIC

**Forging for Amateurs
Electric Wave Telegraphy
Illuminating the Country Home
Metal Surface Finishing
Balanced Tuned Circuit Receiver
China Rivetting and Repairing
A Small Caloric Engine
Home-made Electric Heater
A Mission Tabourette
Muffler for Spark Gaps
A Simple Table**

**PUBLISHED MONTHLY BY
SAMPSON PUBLISHING CO.
6 BEACON STREET, BOSTON, MASS.**

STANLEY

BAILEY ADJUSTABLE IRON PLANES

These Planes have had many important changes, some of which are here shown:



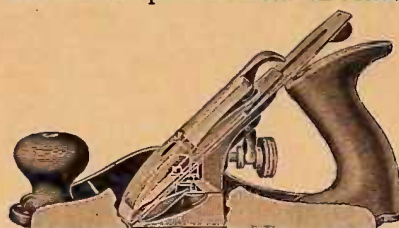
The cutter rests on the Iron Frog, being supported clear down to the heel of the Bevel, and very close to the cutting edge.

The front support being close to the mouth makes a solid bedding for frog and cutter.

The rear support being deep, greatly strengthens the sides and bottom of the Plane.



The frog screws, being located between the two supports, correctly distribute the pressure between them.



The screw bosses being deep, enable a great number of screw threads to engage, thus securely holding the frog in place and preventing any possibility of the Plane being drawn out of true when face of frog is screwed up hard.

No.			Each
1	Smooth,	5½ inches in Length, 1¼ inch Cutter,	\$1.65
2	Smooth,	7 inches in Length, 1½ inch Cutter,	2.05
3	Smooth,	8 inches in Length, 1¾ inch Cutter,	2.20
4	Smooth,	9 inches in Length, 2 inch Cutter,	2.40
4½	Smooth,	10 inches in Length, 2¼ inch Cutter,	2.75
5	Jack,	14 inches in Length, 2 inch Cutter,	2.75
5½	Jack,	15 inches in Length, 2¼ inch Cutter,	3.15
6	Fore,	18 inches in Length, 2½ inch Cutter,	3.50
7	Jointer,	22 inches in Length, 2¾ inch Cutter,	4.00
8	Jointer,	24 inches in Length, 2¾ inch Cutter,	4.80

Write for Catalogue

THE STANLEY RULE AND LEVEL CO.
NEW BRITAIN, CONN., U.S.A.

B
A
I
L
E
Y

P
L
A
N
E
S

Refinish a Piece of YOUR Furniture at OUR Expense

Let us send the Materials Free



WE WANT a sample of wood-finishing done with our preparations in your home. We will send the materials to do the work.

Here they are:

A bottle of Johnson's Electric Solvo to quickly remove the old finish—

A bottle of Johnson's Wood Dye (you to choose the color from our 14 different shades) to color the wood—

A sample of Johnson's Prepared Wax to give that beautiful "hand-rubbed" effect—

And our illustrated guide book for home beautifying which includes complete color card and tells how to finish and refinish wood—

No doubt you have some piece of furniture that you prize highly, yet do not use on account of the worn condition of its finish, or because it does not harmonize with other furniture or decorations.

Use this outfit, which we want to send you free, for refinishing it, and you will be surprised to learn how easily the work is done and the beauty of the result.

May we send you these three packages and the valuable six-color book, free at once? Learn from the test the beautiful effect obtained from the use of

Johnson's Wood Dye

It is not a mere stain. It is a deep seated dye—sinking into the pores of the wood and bringing out the beauty of the grain. When finished with Johnson's Prepared Wax you have a permanent finish of real beauty and most artistic effect. We want to give you these three packages at once—absolutely free. You can either send us your name and address on a postal or in a letter requesting them, or use coupon below printed for your convenience.

Johnson's Wood Dye comes in 14 Standard shades:

- | | |
|------------------------|-----------------------------|
| No. 126 Light Oak | No. 130 Weathered Oak |
| No. 123 Dark Oak | No. 131 Brown Weathered Oak |
| No. 125 Mission Oak | No. 132 Green Weathered Oak |
| No. 140 Manilla Oak | No. 121 Moss Green |
| No. 110 Bog Oak | No. 122 Forest Green |
| No. 128 Light Mahogany | No. 172 Flemish Oak |
| No. 129 Dark Mahogany | No. 178 Brown Flemish Oak |

Half-pints, 30c; pints, 50c. Johnson's Prepared

Wax 10c and 25c packages. Also sold in large sizes. For sale by all leading paint dealers.

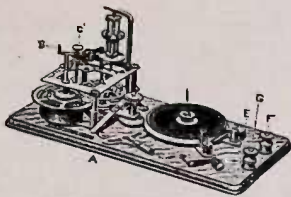
Send coupon today to

S. C. Johnson & Son, Racine, Wis.

"The Wood Finishing Authorities"

Please Use This FREE COUPON
I accept your offer of Free Booklet Edition EM-5, one sample bottle of Johnson's Wood Dye shade No. _____, one bottle of Johnson's Electric Solvo, and a sample of Johnson's Prepared Wax.

Name _____ Address _____
Name _____ Address _____

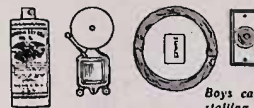


TELEGRAPHY TAUGHT

in the shortest possible time. The Omniograph 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.
41 Cortlandt St., NEW YORK

Electric Door Bell should be in Every Home.



Outfit complete like illustration **\$1.00**

We send free our printed diagram and plain instructions how to install.

Boys can start a profitable business installing our **ELECTRIC BELLS** for their friends and neighbors.

WOODS ELECTRIC WORKS, Bay City, Mich.

A School Within Itself

of a dynamo or motor, and 1 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.

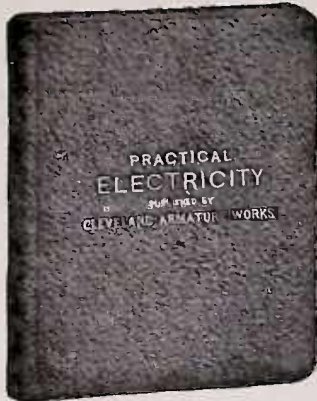


TABLE OF SUBJECTS

Chapter

- I. Wiring
- II. Electric Batteries, Electro-Plating
- III. Magnetism
- IV. The Magnetic Circuit
- V. Magnetic Traction
- VI. Magnetic Leakage
- VII. Energy in Electric Circuit
- VIII. Calculation of Size of Wire for Magnetizing Coils
- IX. Calculation of E.M.F.'s in Electric Machines
- X. Counter E. M. F.
- XI. Hysteresis and Eddy Currents

Chapter

- XII. Armature Reaction
- XIII. Sparking
- XIV. Winding of Dynamos and Motors
- XV. Proper Method of Connecting Dynamos and Motors — Self-Excitation
- XVI. Diseases of Dynamos and Motors, their Symptoms and How to Cure Them
- XVII. Arc and Incandescent Lamps
- XVIII. Measuring Instruments
- XIX. Alternating Current
- XX. Automobiles

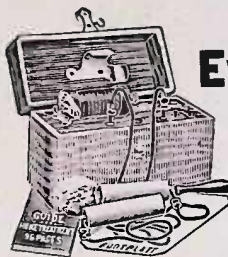
\$2.00 PER COPY — FOURTH EDITION — 20,000 COPIES SOLD

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 has 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, Cleveland, Ohio

AMERICA'S GREATEST REPAIR WORKS
Armatures and Fields wound — Commutators filed

"Something Electrical For Everybody"



Catalogue 24M, 184 pages,
1000 Illustrations, with Net
Prices on application

**Anti-Doc. Medical
Battery, \$2.00**

III UP DRY BATTERY "A" 2 1/2 x 6 3/4	\$0.25
GUARANTEED FOR "B" 3 x 7 1/2	.50
IGNITION WORK "C" 3 1/2 x 8 1/2	.60
D. P. Pony Telephone Receiver for Wireless, 1,000 ohms,	2.50
No. 4465 Hand band and one receiver, 1000 ohms	3.50
No. 1465 " " " two " " "	6.00
Eureka Telegraph Instrument	1.15
Magneto Telephone No. 1511 for long lines, each	5.50
Battery Call Telephone, for short lines, each	2.50
Mesio Electric Engines, three sizes.	\$0.75, \$1.00, 1.25
Trouble Lamps for Autos, Motor Boats, etc.	1.25
Elite Battery Ammeters	2.00
Call Bell Outfits	.60
Floor Tread for Servant's Call	.75
Battery Rheostats, 20 ohms,	.65
Electric Vibrators (3 styles)	\$5.00, \$10.00 and \$15.00

MANHATTAN ELECTRICAL SUPPLY CO.

NEW YORK
17 PARK PLACE

CH CAGO
188 FIFTH AVE.

Hotel Cumberland

New York

S. W. Cor. Broadway at 54th Street

Near 50th St. Subway Station, 53d St. Elevated and
all surface lines



Ideal Location.
Near Theatres, Shops,
and Central Park.

New and Fireproof

**Strictly First Class.
Rates Reasonable.**

All Hardwood Floors
and Oriental Rugs.

10 minutes walk to
Twenty Theatres.

Transient Rates, \$2.50 with bath, and up.
Excellent Restaurant. Prices Moderate.

Send for Booklet.

Harry P. Stimson

Formerly with Hotel Imperial.

R. J. Bingham

Formerly with Hotel Woodward.

Wireless Telegraphy and Telephony Popularly Explained

By **WALTER W. MASSIE**
(President and General Manager
Massie Wireless Telegraph Co.)

and **CHARLES R. UNDERHILL**

With Special Article by Nikola Tesla

¶ In this book the authors use simple expressions, so that all may obtain a clear idea of the inception and development of this much-talked-of art.

¶ They describe the substance through which signals are sent, the theory of the propagation of waves, method of generating and receiving the waves, the apparatus used, and, finally, the uses, limitations, and possibilities of wireless telegraphy, both commercially and financially.

Sent post-paid on receipt of One Dollar

WILLIAM R. ARNOLD, Jr.

4 MARKET SQUARE PROVIDENCE, R. I.

Holtzer-Cabot



Wireless Operator's Head Receivers

Double head band, leather covered and padded—pneumatic air cushions, complete with cord:

500 ohms,	\$10.00
1000 "	11.00
1500 "	12.00
2000 "	13.00

A recent purchaser says of this receiver:

THE HOLTZER-CABOT ELECTRIC CO.

Gentlemen:—Enclosed please find check for which please ship me by express, one pair wireless receivers, wound to 2000 ohms complete with headband, cord, ear cushions, etc.

I received the pair I ordered about the first of March, and am pleased to say that they give entire satisfaction, and after trying them out, I find they are extremely sensitive. I am carrying on quite extensive experiments in wireless telegraphy and telephony and will need another pair the duplicate of the ones I received. Yours truly,

B. ANDERSON.

Send to nearest office for BULLETIN NO. 2082 and Discount.

THE HOLTZER-CABOT ELECTRIC CO.
Boston (Brookline) Mass.

Western Office;—395 Dearborn St., Chicago, Ill.

STYLE
ECONOMY



FIT
COMFORT

The All-Round Collar

LITHOLIN WATERPROOFED LINEN COLLARS

are ready for wear, fresh and neat, at any moment. Suitable for all men and all occasions,—hard work, rough sport or dainty dress. Can be wiped white as new with a damp cloth. Save time, annoyance, and money. Won't wilt or fray. You can get them in any style and size.

COLLARS 25c. CUFFS 50c

Always sold from a RED box.

Avoid Substitution.

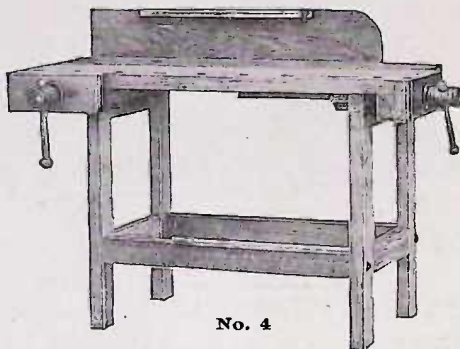
If not at your dealer's, send, giving styles, size, how many, with remittance, and we will mail, post-paid.

THE FIBERLOID COMPANY

Dept. 56 7 Waverly Place, New York



Own a Home Bench



No. 4

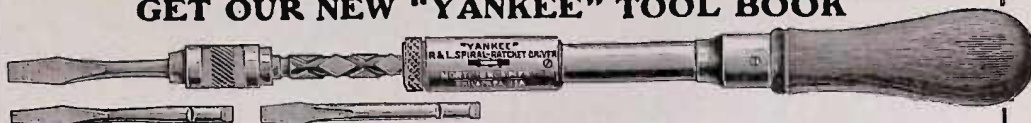
It pays to own a home work bench. It pays for itself in a short time, because it furnishes a convenient place to do all the little repair jobs needed about every home, and which you usually turn over to a carpenter. Do them yourself, using a home work bench. Then, too, it will provide fun and healthy exercise for that lusty boy of yours. Let him work off surplus energy in a wholesome manner.

Our bench catalog will be gladly sent on request..... Write today

Grand Rapids Hand Screw Co.
930 Jefferson Ave., Grand Rapids, Mich.

Are Fine Tools Your Hobby?

GET OUR NEW "YANKEE" TOOL BOOK



A book full of new time and labor-saving **"YANKEE" TOOLS** for all classes of mechanics. Tools that interest every man who ever has occasion to use tools of any kind. The book is the embodiment of Yankee ingenuity, illustrated with photographic reproductions of the tools in use. It's worth having. Send to-day. A postal brings it if you mention "Elect. & Mech."

Ask your dealer for **"YANKEE" TOOLS.**

NORTH BROS. MFG. CO.

Philadelphia, Pa.

Telephone, 2689 Oxford

C. E. ROGERS' BRASS FOUNDRY

Brass, Bronze, Aluminum & Composition Castings
OF EVERY DESCRIPTION

We make Parson's Manganese Bronze, White Brass for Auto Castings, and White Nickel Bronze. Special High-speed Bearing Metal. Special attention given to Fine Castings.

34 BEACH STREET

BOSTON

MASSACHUSETTS

Patents Secured or no attorney's fee charged

CALL OR WRITE

ELMER C. RICHARDSON

Room 6, 37 Tremont Street BOSTON, MASS.

Associated with a Reliable Washington Patent Attorney



WIRELESS RECEIVERS

An adjustable head band with ball and socket fittings give a comfortable and snug fitting effect. Weight, complete with cord, only 15 ounces. Cords join at the breast.

PRICE LIST

Complete with 7 foot Cord
1500 ohms - - \$ 9.00
2000 " - - 9.50
3000 " - - 10.00
4000 " - - 10.50

Special prices in quantities.
Soft Rubber Ear Cushions supplied at 50 cents per pair.

S. H. COUCH CO., Inc.

Telephone Manuf's
156 PURCHASE STREET
(Wireless Dept.)
BOSTON MASS.

The only "Fool-Proof" Detector TYPE I-P-81.



"You can't wear it out; burn it out; nor throw it out!"

The Improved Silicon Detector

This Detector is of an entirely new construction, and has the extremely high efficiency and artistic appearance so greatly desired by wireless experimenters. No platinum wires to lose; no acid to corrode the metal; and no battery nor potentiometer required.

This is covered by U. S. Patents Nos. 836,531, 877,451, 888,191, 904,222, and 912,613.

Certain irresponsible firms now selling so-called "silicon" or "thermal" detectors will be prosecuted to the full extent of law. Send for Descriptive Circulars and Price List.

W. C. GETZ,

345 N. Charles St.

645 N. Fulton Ave.

BALTIMORE, MD.

PATENT SPECIALIST That's ME

FREE, prompt and cheerful answers to questions.

FREE Preliminary search and honest opinion.

FREE Mechanical and protectional assistance.

FREE "Patent Pointers" & "Money Getting."

STERLING P. BUCK, 509 No. 2 St., Washington, D. C.

LOOK HERE

5 Miniature sockets, 7 cents

1 Miniature 4 1-2 volt lamps, 14 cents

2 Alcohol blow torch, 55 cents

SEND STAMP FOR LARGE CATALOGUES

Dept. 9

KETTEMAN ELECTRIC CO., Toledo, Ohio, U.S.A.



We Want You to Become Familiar With

The Reece Threading Tools

Including SCREW PLATES, TAPS, DIES, etc.



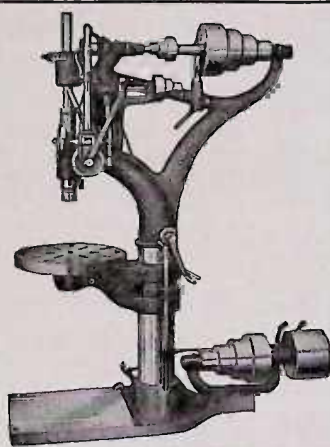
SPECIAL TRIAL OFFER

"Reece Premier" No. 1 T Tap Wrench and one each No. 2-56, 3-13, 4-36, 6-32, 8-32, 10-24, 12-24 and 14-20 "Hercules" Machine Screw Taps. Sent post-paid to any address on receipt of \$1.25

84-Page Catalogue Free

E. F. REECE CO.

Greenfield, Mass.



**YOU
ALWAYS
NEED A
20 in.
DRILL**

¶ We furnish them with any arrangement of feed, and with or without back gears. Just right for your repair shop or tool room. Do you want a circular of the

Rockford 20 in.

ROCKFORD DRILLING MACHINE CO.

ROCKFORD, ILL., U. S. A.

Here's Something New Designed for YOU!



Fig. 1.



Fig. 2.



Fig. 3.

Very often you have "Things to Fasten" to Brick, Stone, Concrete, Marble, Tile or Slate. Such fastenings are made quickly, cleanly and securely nowadays by using

Star Expansion Bolts

Drill Hole. Insert Anchor Shield (Fig. 2) put screw (Fig. 1) through attachment into the inserted shield (Fig. 2) and fasten tight (Fig. 3).

QUICK - SECURE - SIGHTLY

We make a very wide range of styles and sizes and can fit you up with an Expansion Shield for use with anything, from a No. 5 screw to a big burly bolt up to 2 in. diameter.

There's a dealer in your section who carries Star Goods. You tell us your requirements. We'll tell you where to fill them promptly.

Star Expansion Bolt Co.
147 Cedar Street New York City

*Quality
Sells*

When Henry Disston was asked: "What do you put in your saws?"
He replied: "Good steel and honest work."

**UPON THIS FOUNDATION IS BUILT
DISSTON QUALITY**



"If you want a saw, it is best to get one with a name on it that has a reputation. A man who has made a reputation for his goods knows its value as well as its cost and will maintain it."

HENRY DISSTON & SONS, Inc.

KEYSTONE SAW, TOOL, STEEL, AND FILE WORKS
PHILADELPHIA, PA.



Faucet Water Motors, \$1.00 UP

These Motors have emery-wheel and pulley to run sewing-machines, fans, etc. Sample Motor free to Agents in sections where we have no representative.

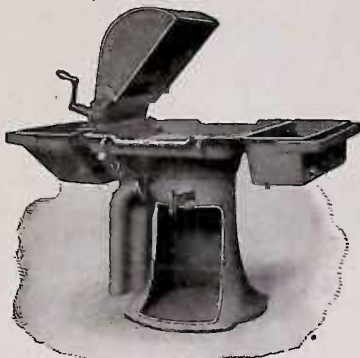
ENGINE INDICATORS

Reducing Wheels, and Planimeters for Engineers
ALCOHOL Stoves, Lamps, Flat-irons

Send for Catalogue

Lippincott M. & A. U. Dept., Newark, N.J.

STURTEVANT FORGES



Require a minimum of repairs.

Made in ten styles and all sizes, for bench work, manual-training schools, locomotive-shop and shipyard service.

SEND FOR BULLETIN 158

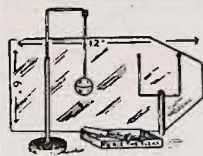
B. F. STURTEVANT CO.

GENERAL OFFICE AND WORKS

HYDE PARK

MASSACHUSETTS

705

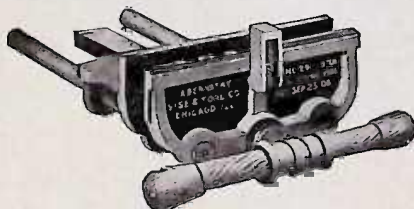


Wonderful 12 x 6 inches ELECTROPHOROUS AND APPARATUS.

Two rubs gives a stinging 3 in. spark, 6 in. to a metal conductor. Charges Leyden Jar, Lifts and Holds Up a 9 in. 4 oz. tin pie plate. \$1.25

Send for our great catalogue.

HERTZIAN ELECTRIC CO., 1009 E. 42d St., Brooklyn, N.Y.



Would You Like to Own A GOOD RELIABLE Reece Screw Plate

Genuine Reece Screw Plate
Cutting Machine Screw
Sizes, Nos. 4-36, 6-32, 8-32,

10-24, 12-24, with 5 adjustable dies 13-16 diam., 5 Taps, 1 Die Stock, 7 in. long and Tap Wrench Die complete in polished case with velvet-lined cover. Sent post-paid to any address on receipt of

\$2.95

E. F. REECE CO., Greenfield, Mass.

Wireless Apparatus



ADJUSTABLE SPARK GAP. PRICE \$5.00

Has polished Italian marble base, screw adjustment, hard rubber posts and metal parts are of lacquered brass. The spark points are of a special alloy, having several unique qualities, which are described in detail in our illustrated catalogue, devoted entirely to wireless apparatus, a copy of which will be mailed upon request.

CLAPP-EASTHAM CO.,

729 BOYLSTON STREET,

BOSTON, MASS.



"This is ACCURATE" ECLIPSE

Battery Ammeter

0 to 30 Amperes

Tells EXACT condition of your dry batteries, and indicates current in EITHER direction.

\$3.00

ELDREDGE ELECTRIC MFG. CO.
12 P. O. Square, Springfield, Mass.

ABERNATHY RAPID ACTING VISES

ARE PARTICULARLY RECOMMENDED FOR

MANUAL TRAINING SCHOOL EQUIPMENTS and for all classes of wood-workers. Seven Sizes, Styles, and Prices to select from.

Please state your requirements and write for particulars.

THE ABERNATHY VISE & TOOL CO.

329 Englewood Avenue

CHICAGO, ILL.

ELECTRICIAN AND MECHANIC

INCORPORATING

Bubier's Popular Electrician
Amateur Work
Building Craft

Established 1890
Established 1901
Established 1908

PUBLISHED MONTHLY BY

SAMPSON PUBLISHING CO.

BOSTON, MASS.

F. R. FRAPRIE, M. Sc. Chem. }
 A. E. WATSON, E. E. Ph.D. } *Editors*
 M. O. SAMPSON }

SUBSCRIPTION, IN ADVANCE, \$1.00 PER YEAR

In the United States and dependencies, and Mexico. In Canada, \$1.25. Other countries, \$1.50.

Subscribers wishing to have their addresses changed must give both old and new addresses. Notice of change of address must reach us by the 1st of the month to affect the number for the month following.

SINGLE COPY, 10 CENTS

Advertising Rates on Application

Forms close on the 1st of the month preceding date of publication.

Contributions on any branch of electrical or mechanical science, especially practical working directions with drawings or photographs are solicited. No manuscripts returned unless postage is enclosed.

All communications should be addressed

SAMPSON PUBLISHING COMPANY

6 Beacon Street, Boston, Mass.

ELECTRICIAN AND MECHANIC may be obtained from all newsdealers and branches of the American News Co.

NORTHEASTERN REPRESENTATIVE—F. W. Putnam, Durham, New Hampshire.

FOREIGN AGENTS—Arthur F. Bird, 22 Bedford Street, Strand, London.

Ramlot Frères et Sœurs, 26 Rue Grétry, Brussels, Belgium.

Copyright 1908, by the SAMPSON PUBLISHING COMPANY

Entered as Second-Class Matter July 13, 1906, at the Post Office at Boston, Mass., under the Act of Congress of March 3, 1879.

VOL. XIX.

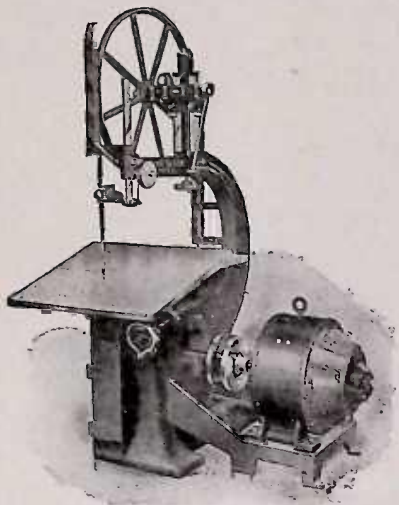
MAY, 1909

No. 11

TABLE OF CONTENTS

Forging for Amateurs. Part VI	<i>F. W. Putnam</i>	449
Recent Contribution to Electric Wave Telegraphy	<i>Prof. J. A. Fleming</i>	455
Illuminating the Country Home	<i>A. Cressy Morrison</i>	462
Metal Surface Finishing	<i>M. Cole</i>	464
A Balanced Tuned Circuit Receiver	<i>W. C. Getz</i>	469
China Rivetting and Repairing		471
A Small Caloric Engine	<i>Alfred P. Morgan</i>	473
Home-Made Electric Heater	<i>P. J. O'Gara</i>	476
A Mission Tabourette	<i>Ralph A. Windoes</i>	478
A Simply Made Muffler for Spark Gaps	<i>John H. White</i>	480
To Fix Chisel Blades in their Handles	<i>H. S. Izzard</i>	481
A Simple Table	<i>Herman A. Fasel</i>	482
The Problem of Policing the Air		483
An Electric Safety Valve		484
Questions and Answers		486
Wireless Club		489
Trade Notes		491

"OLIVER" MACHINERY COMPANY



OLIVER "C" BAND SAW
MOTOR DRIVEN

MOTOR HEAD SPEED LATHES
A SPECIALTY

Nos. 10 to 20 Clancy Street

GRAND RAPIDS, MICH., U. S. A.

MAKERS OF

Machinery and Small Tools

FOR

MANUAL TRAINING

Special Catalogue in Preparation

EVERYTHING HIGH GRADE

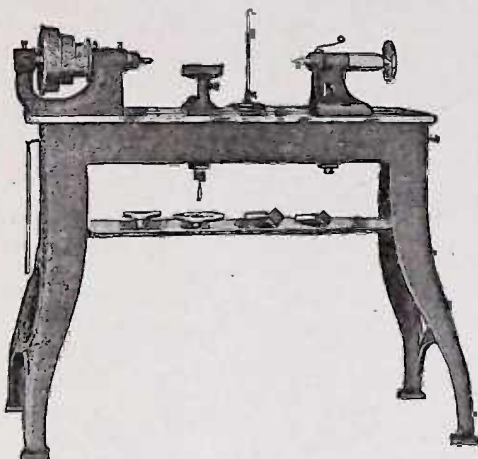
Write us for Machinery, Benches, Vises, Clamps,
Planes, Chisels, Saws, Grinders, etc., etc.

We have them.

BRANCH OFFICES

OLIVER MACHINERY CO., Hudson Terminal,
50 Church Street, New York
OLIVER MACHINERY CO., First Nat'l Bank Bldg., Chicago
OLIVER MACHINERY CO., Pacific Bldg., Seattle

— NEW — 12" MANUAL TRAINING LATHE



Retains all the good
points of our well-known

10"

but designed for larger
work

REED QUALITY and WORKMANSHIP

WRITE US BEFORE DECIDING ON YOUR NEW EQUIPMENT

F. E. REED COMPANY : Worcester, Mass.

Electrician and Mechanic

VOLUME XIX

MAY, 1909

NUMBER II

FORGING FOR AMATEURS—Part VI

F. W. PUTNAM, B. S.

EXERCISE No. 10. A LAP WELD

For our first exercise in welding, I will explain the operations gone through with in the welding of two flat bars of iron. The lap weld, which we will use for this exercise is the weld ordinarily used for joining flat pieces of iron together. To prepare two surfaces for welding, proceed as follows:

Upset the ends as shown in Fig. 70. When the bar is heated for upsetting, only one end should be heated as shown in Fig. 69, the shaded part indicating the heated metal. Only the end of the bar should be placed in the fire in order to prevent the heat from running back too far. The heated end should then be upset, until it is about the shape as shown in Fig. 70. The end which has been upset must next be shaped or scarfed as shown in Fig. 72. This scarfing should be started by means of the round or pean end of the hammer. The blows must not come directly down on the bar, but at an angle of about forty-five degrees, the object being to force the metal back toward the base as is shown in Fig. 71. This method will result in driving the metal back and thus making a kind of heavy ridge at the beginning of the scarf. When this scarf is nearly finished, the flat face of the hammer should be used as indicated in Fig. 72. The bar should be brought to the extreme end of the anvil, so that a hard, quick blow may be struck without hitting the anvil rather than the bar. The scarfs when completed should look as indicated in Fig. 73, the scarfed surfaces being quite convex and not concave as is shown in Fig. 74. The reason for this is obvious. If the scarfed ends were concave instead of convex, there would be a small pocket left between the two pieces when they were put together later for welding and the scarfs would touch only along the edges. Now, when

the weld is hammered together, the edges which are in contact will naturally weld first and the pocket will then be sealed up. The surface of the scarf is usually covered with melted scale and other impurities, and as some of this will be held in the pocket there will naturally be a bad place in the weld.

Now, if the scarfs are made convex, the metal will first stick in the very centre of the point, and as the two surfaces are hammered together, the scale will be squeezed out before the sides of the joint are welded. The length of the scarf should not be less than $1\frac{1}{2}$ times the thickness of the bar. The width of the end A, Fig. 73, should preferably be less than the real width of the bar B. When welding is to be done, the fire, as I explained in the last article, should be perfectly clean and free from clinkers. Great care must be taken to bring both pieces to the same temperature of heat at the same time. It sometimes happens that one piece will heat faster than the other, in which case it should be taken from the fire and allowed to cool until the other piece becomes heated to a like temperature. It requires considerable practice to so place the pieces in the fire so that they will be heated uniformly and the same amount. The tips of the scarfs are naturally thin and so must be especially watched. It is sometimes necessary to cool these tips slightly from time to time by dipping them in so as to prevent these extreme ends from actually burning off. Better results will be obtained by heating the pieces slowly, as then the bar will be of very nearly even heat all the way through. Just before the pieces are taken from the fire turn them so that both pieces will be placed scarf side down, in this way making sure that the surfaces forming the joint will be at a welding heat. Just before the welding heat is reached, more blast

should be used, thus giving more oxygen to the fire.

Now, the only way to find out just how this heat is coming on is to take the pieces from the fire and look at them. It will be found that the color will grow lighter as the temperature increases, and finally when the welding heat is reached, the iron will seem almost white. In the last article I stated that when the welding heat was reached little scintillating sparks would come from the fire, showing that some of the iron has been heated enough so as to be melted off in small particles and is nearly burning. This will serve as a fair indication that the iron is almost at welding heat, but must not be relied on entirely, since the condition of the fire will have much to do with the appearance of the scarfed pieces. When ready for welding the two pieces together, place the first piece scarf side up on the anvil and the second piece on top of the first piece with the scarf side down, so that the thin edges of the second piece will lap over the thick ridge C, Fig. 73, on the first piece. This is clearly shown in Fig. 75. If the pieces to be welded are small, then the operator must learn to handle both pieces alone. It is rather hard to lay the second piece directly on top of the first piece and succeed in getting it in just the right position, so it is usually better to rest the second piece on the corner of the anvil as shown at A, Fig. 76, and then guide it quickly into the proper position. If the two pieces have been brought to the proper welding heat, there will be time enough for the operator, when taking the two pieces from the fire, to rap them smartly over the edge of the anvil before placing them in position for welding. This will get rid of considerable of the scale which forms on the scarfed surfaces. The first blow struck should be directly down on the middle of the weld, and then the blows should be taken so as to work toward the ends where the tips are. Usually three or four blows at the most will close a small weld. After the weld is made, there will usually be sufficient heat still left in the bar so that it can be hammered into shape.

For the first exercise in welding, the amateur should use preferably Norway iron, and take two bars both long enough so that no tongs will be necessary in

taking the pieces from the fire. When tongs are used, they must be carefully fitted to the bars so that the bars will have a bearing surface all along the stock. A weld to be sound, must, like everything else, be made according to sound common sense. The theory of welding is simple enough to understand. It only requires a little thought to make it easy to put into practice. Let me repeat in substance what I said in the last article regarding the three things to guard against in order to get a sound weld. First, the air, second, scale and third, dirt. I have just explained the first when I said that if the scarfed surfaces were concaved when the two pieces were put together, they would meet all around the edges. This would simply form a hollow pocket enclosing a certain amount of air and also whatever amount of dirt or scale that would lap upon the surfaces, thus making a sound weld impossible to obtain. I have said that the length of the scarf should be at least one and one-half times the width of the bar. A beginner is quite apt to make the scarf too short, the result being that blows of the hammer upon the top piece will act to force it down and thus sliding it off the lower piece. The scarf must be sufficiently larger than the finished size to permit the weld to be full size after welding. Thick pieces must not be heated too quickly, else the interior metal will not be brought up to the required heat. They should be frequently turned in the fire, so as to insure uniform temperature all through the bar and be made as hot as possible without burning them. I usually withdraw the pieces that are to be welded from the fire occasionally and sprinkle the surfaces with sand. This sand will serve to exclude the air from the surface, thus preventing oxidation and at the same time cooling the outer surface and thin edges, giving the interior metal and thicker parts time to become heated all through. The first blows of the hammer in closing the weld should be fairly light and rapid, the heavier blows following to close the edges of the scarf.

The next article will take up round lap welding, the welding of rings from round and flat stock and the making of chains.

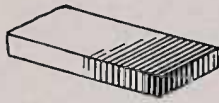


Fig. 69.

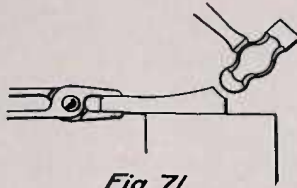


Fig. 71.



Fig. 70.

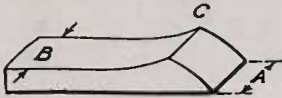


Fig. 73.

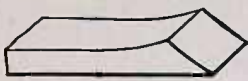


Fig. 74.

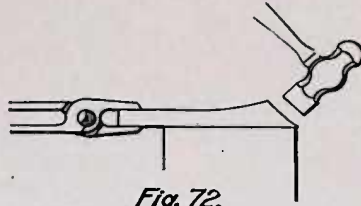


Fig. 72.

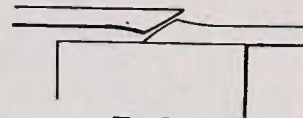


Fig. 75.

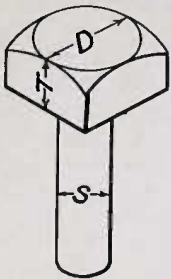


Fig. 77.

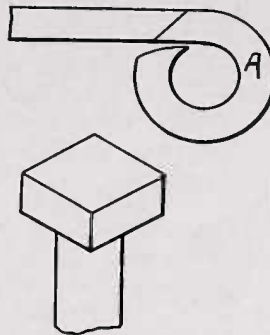
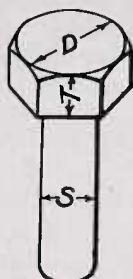


Fig. 81.

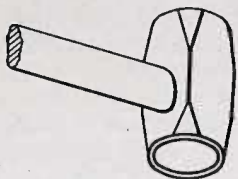
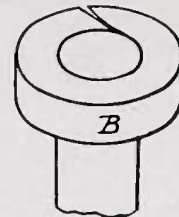


Fig. 78.

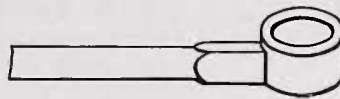


Fig. 79.

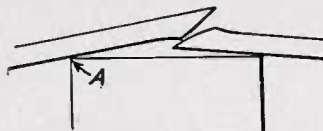


Fig. 76.

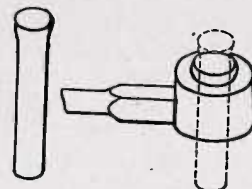


Fig. 80.

EXERCISE 11. BOLT MAKING

The making of bolts involves the up-setting of the stock sufficiently to give enough extra stock from which to form the head, or else involves the welding

of a ring of iron to the round bar, thus making the head really from the ring. The first method is the more common, particularly for small bolts where it is almost universally used. It is usually found that an upset head is stronger

than a welded one, assuming that they are both equally well made. When large quantities of bolts are to be made, the bars are heated in furnaces and heated by especial machinery. Where the work is done by hand, the tools are very simple and few in number. The header consists of a disc in which a hole has been drilled to correspond to the diameter of the bolt. A handle 12 or 15 in. in length is welded to the disc. Such a tool is shown in Fig. 79. The hole should be about 1-32 of an inch larger than the nominal size of the iron for which it is to be used. Usually the heading tool is made with one side of the head flush with the handle, the other side projecting about $\frac{3}{8}$ of an inch above it. This heading tool should always be used with the flat side on the anvil. The size of the bolt is always given as the diameter and length of the shank or stem, thus a $\frac{3}{4}$ in. bolt 4 in. long means a bolt having a shank $\frac{3}{4}$ of an inch in diameter and 4 in. long from the under side of the head to the end. All dimensions of bolt heads are determined from the diameter of the shank and are nearly always the same size for the same diameter, thus being independent of the length. To form the head of an ordinary bolt, make the width between the parallel sides or the distance B, in Fig. 77, equal to one-half times the diameter of the bolt, plus $\frac{1}{8}$ of an inch. The depth of the head T is equal to $\frac{1}{2}$ of the width of the head. This is the dimension for a head of a $\frac{3}{4}$ in. bolt or .75 times $1\frac{1}{2}$ plus .125 equals $1\frac{1}{4}$ in. for the length of the side and $\frac{1}{4}$ divided by 2 equals $\frac{3}{8}$ of an inch for the depth of the head. The cubic contents of such a head will be .625 times 1.25 times 1.25 equals .9776 cubic inches. As the area of a $\frac{3}{4}$ in. round bar is about .44 of a square inch, it follows that the length to be allowed for upsetting the head is .9766 divided by .44 equals about $2\frac{1}{4}$ in. These are the dimensions for the rough or unfinished head, as the dimension of a finished head is 1-16 in. less than the same dimension of the rough head. Bolts usually have the top corners of the head round or chamfered off as shown in Fig. 77. This may be easily done by a hand hammer, or with what is known as a cupping tool, Fig. 78, this being simply a set hammer with the face hollowed out into a bowl or cup

shape. To make a bolt with the heading tool, we proceed as follows:

First cut off the iron to the required length. Then heat the end to a high heat and strike the end with a hammer or against the anvil, so as to upset it. Next place the whole of the header on the anvil directly over the square hardy hole and drop the cold end of the bolt through. The stem of the bolt will then project down through the heading tool and hardy hole, while the head is being forged on the bolt. Strike the projecting portion of the bar and upset it until the requisite thickness of head is obtained. This will probably leave a head of curved but irregular outline. Remove the bolt from the header and square up the head just upset on the face of the anvil. This will of course thicken the head. Having heated the head again, drop the cold end of the bolt through the header again and strike the head until it is reduced to the proper thickness, after which, once more square up the edges on the face of the anvil. In doing this work, the header should be held in the left hand of the workman. Fig. 80 shows the upset rod and the rod placed in the heading tool.

BOLT HEADS MADE BY WELDING

A welded head is made by welding a ring of square iron around the shank of the bolt to form the head, this being afterwards shaped in a heading tool, the same as an upset head. A piece of square iron of the proper size is bent into a ring but not welded. A very easy way to do this is to take a bar several feet long and bend the ring on the end, cutting it off as shown in Fig. 81, A. This ring should be made just large enough when the ends are slightly separated to slip readily over the shank. The shank is then heated up to a welding head, the ring being slowly cooled and put together as shown at B, Fig. 81. The head is then brought to a welding head and sealed by quick, sharp blows of the hammer. When the head is welded to the bolt, it should be hammered square at first and not pounded or hammered round and round. It will be found that a perfect weld can be gotten very much easier by forging this head square. Great care must be taken when hitting the bolt to make sure that the whole bolt has been heated through evenly. This of course, can only be done

by heating the metal slowly. If this is not done, the outside of the ring will probably be burned before the shank is hot enough to stick. Sometimes it becomes necessary, when heating the bolt head for welding, to cool the outside ring a little, so as to prevent its burning before the shank has been heated enough. To do this, the bolt should be put in water sideways just enough to cool the outside edge of the ring and still leave the centre part of the shank hot.

IRON FORGING

What is the use of sprinkling sand on forgings? Ans. To keep the air from the surface and prevent rusting.

What is the use of sprinkling water on forgings? Ans. The sudden forming of steam removes the rust.

What are the ordinary operations of forging? Ans. Drawing down or reducing the size; upsetting or thickening and shortening; and welding or building up.

What allowance should be made for these? Ans. Upsetting shortens the work. Drawing down lengthens it. Twisting and bending also shorten.

What attention should be paid to form? Ans. There should be no sudden change of size. Sharp angles should be avoided and thick parts joined to thin ones by curves.

Why should the desired form be given as quickly as possible? Ans. Re-heating and re-working injures the iron if done too often.

Why should hammering at low heats be avoided? Ans. The iron may crack.

What is the effect of heat too quickly applied? Ans. The outside may separate from the rest of the metal.

Why does a forging require heavier blows as the work cools? Ans. The metal becomes harder as it cools.

What is drop forging? Ans. Forging done by power or when the iron is shaped by dies.

WELDING

What is welding? Ans. Joining two pieces of metal by heat and hammering.

What is its most general use? Ans. Joining two pieces of wrought iron.

On what does the process depend? Ans. It remains soft during various

degrees of heat. At a white heat, two pieces free from rust will stick together if allowed to touch.

What will prevent welding? Ans. Cinders or rust on the surface.

What care must be taken to insure a good weld? Ans. A sudden sharp blow will detach cinders and rust can be prevented by using a flux.

Why are sulphur and other foreign substances injurious? Ans. Because they combine with iron when heated.

What is used as a flux and how does it act? Ans. Sand or salt. Sand will stick to the iron at white heat and at a higher degree of heat will melt and cover it like liquid glass.

What are the signs of a welding heat? Ans. Iron is white hot and sparks and crackles.

What is the effect of exceeding this heat? Ans. The iron is burned.

What damage is done by a high heat and little work? Ans. Iron heated to white heat and not hammered is weakened.

What are the principal requirements of welding? Ans. Fire must be clean and both pieces of metal must be of the same degree of heat.

Why is a uniform heat necessary? Ans. The pieces do not join at centre, otherwise.

What is the cause of this? Ans. Only the surface is hot.

Why are a few heavy blows better than lighter ones? Ans. The light blows affect only the surface. The heavy ones affect it all through.

How is this best illustrated? Ans. In upsetting the end of a bar with a light hammer, the upset is all at the end; with a heavy hammer it goes further up the bar.

Where should a weld be placed? Ans. In the straight parts of the work, as it is difficult to hammer properly on a curve.

How should the welding heat be reached and used? Ans. Not heated too quickly, to have heat same throughout, and when proper heat is reached pieces should be joined at once.

What should be done with work after welding? Ans. All parts brought to same heat and well hammered and allowed to cool.

Why should this be done? Ans. Different degrees of heat injure the work.

What are the most common forms of weld? Ans. The butt weld; the lap weld; the scarf weld; and the split weld.

Why should the faces be jogged? Ans. To prevent slipping.

What is a test of the soundness of a weld? Ans. Sharp blow on an anvil.

Can a weld be as strong as the bar? Ans. Not if the weld is same size as the rest of the bar, unless very well done.

What is a fair allowance for the strength of a weld? Ans. It is about four-fifths as strong. If very well made it is equally as strong.

Is iron as strong when hot as when cold? Ans. At black heat it is, but at red heat it loses one fourth of its strength.

Improvements in Clocks

Two important improvements recently made in the construction of the clocks of precision used by astronomers and physicists are described in the *Revue Scientifique*, of Paris. The first is the use of pendulums made of nickel-steel, and the second is the application of electromagnetic induction to the maintenance and registration of the oscillations. Says the paper just named:

"The employment of 'invar' (36 per cent. nickel-steel, discovered by Mr. Guillaume) whose expansion may easily be made lower than 1-15 that of steel, has made easier and more exact the compensation for variations in the length of the pendulum, due to temperature. This compensation is obtained simply by the upward expansion of the steel bob, which is attached to the stem by its lower edge.

"Such a clock placed in a case at constant pressure and in a place where the temperature varies little, should vary by only an insignificant fraction of a second daily. Unfortunately, the devices for maintaining and registering the motion introduce perturbations, owing to the necessary friction, which, feeble though they may be, are irregular and cause the length of the oscillation to vary.

"An attempt has been made, though for some time with little success, to use electricity to actuate or connect the various mechanisms. In general the device used was an electromagnet which, being excited at each oscillation, re-

turned to the clock, either directly or not, its lost energy. For this it was necessary to make contact with the clock itself, and this gave rise to friction. Mr. Fery showed this in a very curious way by placing in the circuit a telephone in which the noise of the contact could be clearly recognized. Now, however, by very delicate special devices, it has been possible to abolish friction altogether, and thus to obtain clocks that keep time to about one-tenth second per day. The most recent system devised by Mr. Fery does away altogether with any material connection with pendulum, except, of course, the suspension, for which a thin, flat piece of flexible metal is used. The stem is of 'invar' and supports a horizontal horseshoe magnet as well as an additional mass serving for regulation. At each oscillation, one of the branches of the magnet enters a bobbin connected with battery, while the other enters a copper ring suspended by a wire and constituting a pendulum of the same period of oscillation. The ring is carried along by the magnet by the action of the currents induced in it by the latter, but is always a quarter of an oscillation behind it. This second pendulum makes the contact closing the circuit between the battery and the bobbin that attracts the magnet.

"This clock starts as soon as the battery circuit is closed, and assumes without regulation a steadiness of oscillation that seems never to have been reached before."

In a recent article by Dr. Louis Bell in the *Electrical World*, attention is called to the lighting systems of Europe as compared with American street lighting. According to Dr. Bell, European streets are far better lighted than our own, but not because electricity is cheaper abroad than here; for London pays over \$100 per arc per year, Paris \$166, and Berlin nearly \$120. The difference seems to be that in this country we attempt to light all of the streets fairly well, while abroad particular attention is paid to the more prominent streets.

The best way to cultivate an appetite is to cultivate a field, and then you will have both an appetite and the wherewithal to appease it.

RECENT CONTRIBUTIONS TO ELECTRIC WAVE TELEGRAPHY

PROF. J. A. FLEMING, M.A., D.SC., F.R.S., M.R.I.

*Pender Professor of Electrical Engineering in the University of London**(Continued from page 418)*

The oscillation valve is capable of giving very remarkable effects when used as a receiver with a transmitter producing undamped waves. The reason for this is obvious. The valve passes all the unidirectional currents in the attached secondary circuit. If, then, these are intermittent damped trains, say having a frequency of 100,000, and 50 trains of 20 oscillations per second, the total time during which electric current is passing is only one-thousandth of the whole time. Accordingly if we, so to speak, fill up the gaps between the trains of oscillations with other oscillations, and generate a continuous train, we greatly increase the quantity of electricity passing and repassing any point in the secondary circuit, and the indications on a galvanometer in circuit with the valve are enormously increased. A true comparison between the two cases of damped and undamped waves involves many factors, and is not fair unless we compare together transmitters taking the same mean power. Generally speaking, however, we may say that not only this glow-lamp detector, but all forms of thermal detector, give greatly increased effects when employing undamped oscillations. I find, for instance, that if undamped oscillations are created in a closed wire circuit which forms part of a circuit containing capacity and inductance shunted across a Poulsen arc, I can induce powerful secondary oscillations in a similar closed and syntonic secondary circuit at a considerable distance, and detect these by the use of my oscillation valve and a galvanometer placed. In fact, the use of undamped oscillations in a closed primary circuit, and this oscillation valve used with a telephone in a closed secondary circuit, brings to the front again the possibility of making use of so-called wireless telegraphy by electro-magnetic induction over very large distances. The old form of electro-magnetic induction telegraphy as practiced by Trowbridge, Preece, Lodge, and others made use of low-frequency alternating currents (50 to 100) in a closed

primary circuit, and employed a telephone in a distant closed secondary circuit to detect the magnetic field so produced, signals being made by interrupting the primary current. I have, however, found a means of greatly improving this form of wireless telegraphy. In a closed primary circuit I establish continuous undamped oscillations of, say, a quarter of a million frequency by the arc method. At a distance I place a syntonic secondary circuit containing my oscillation valve as a detector, a telephone being used with it connected between the middle plate and negative filament terminal. Both the primary circuit and secondary circuit are connected to earth at some point. The signals are made by breaking and making the earth connection of the transmitter in accordance with Morse code. When the earth connection is made at both ends a sound is heard in the telephone, but not when it is broken. This seems to depend upon the fact that the oscillations produced by the arc method are not absolutely continuous, but cut up into groups, as already proved by the experiment with the rapidly moving neon tube and helix.

I have found that it is not necessary to employ a high-voltage carbon filament, a small lamp with 4-volt filament, taking about one ampere, works quite as well as a wireless telegraph receiver as a 112 or 100 volt lamp. The filament has, however, to be at a certain critical temperature to obtain the best result; the vacuum also has to be extremely good. There are, no doubt, many possible variations of the above-mentioned type of oscillation valve wave detector. Every glass vessel containing rarefied gases or mercury vapor having electrodes of different sizes or shapes or temperatures, has some degree of unilateral conductivity, and can be used in the above manner to separate out the two constituent currents of an electrical oscillation, and make them detectable by an ordinary galvanometer or telephone. I have also tried with some success a flame in which two platinum wires are immersed, one of which carries a

bead of potassium sulphate as a means of rectifying oscillations of high frequency. It is well known that negative ions are then liberated in the flame, and negative electricity can pass over more freely from the electrode which carries the bead of salt to the other than in the opposite direction. I have not, however, found anything as simple and useful as the above-described low-voltage carbon filament glow lamp. Moreover, other inventors have indorsed its utility by granting it the compliment of imitation. In October, 1906, Doctor de Forest described to the American Institute of Electrical Engineers an appliance he called an "audion," which is merely a replica of my oscillation valve, described to the Royal Society eighteen months previously and to the Physical Society of London six months before, particularly with reference to its use as a wireless telegraph receiver. Apart from the name the only difference introduced by him was to substitute a telephone and battery in series connected between the middle plate and positive terminal of the filament, for the galvanometer used by me connected between the middle plate and the negative terminal. As Mr. Marconi had before that time used my oscillation valve with a telephone with it for long distance work, and M. Tissot has found a galvanometer, used as I described it, effective up to 50 kilometers, the modification made by Doctor de Forest does not make any fundamental difference in the operation of the device as a wave detector.*

Very closely connected with the question of the production of continuous or undamped electric waves is that of the electrical transmission of speech through space without wires; in other words, wireless telephony. Some considerable progress has already been made in this direction. Any complete treatment would require a lecture in itself. If, however, we pass by the investigations of Bell with the photophone, Simon, Ruhmer, and others with apparatus employing the resistance variation of selenium by projected beams of powerful light, and also those of Preece, Gavey,

*In a private letter M. C. Tissot has already acknowledged gracefully my priority of invention in this matter, although he himself was independently working in the same direction.

and others with electro-magnetic induction, we may say that at the present time the chief interest attaches to methods of wireless telephony which involve the use of undamped electric waves. The problem may then be stated to be as follows: Articulate speech made against a diaphragm at a transmitting station has to affect similarly the diaphragm of a telephone at a receiving station not connected with it by wire.

Time only permits me to give you a brief sketch of some interesting experiments which have been carried out lately by the German Wireless Telegraph Company between Berlin and their large station at Nauen, 20 miles distant. At the transmitting station they employ 12 electric arcs in series, each of which is composed of a carbon negative and a water-cooled copper positive electrode. These arcs take 4 amperes at 440 volts. (See Fig. 15.) In parallel with this series of arcs is joined a condenser and inductance, to which is inductively but loosely coupled an antenna from which undamped electric waves, 800 meters in wave length, are radiated, having a frequency, therefore, of 400,000. The oscillations set up in this antenna can be more or less enfeebled by shunting them to earth through a microphone transmitter, the resistance of which is varied by the act of speaking against it. Hence, although the wave length of the emitted electric waves is not altered, their intensity is modulated in accordance with the wave form of the sounds impressed on the transmitter diaphragm. At the receiving station there is a receiving antenna tuned to the wave length used, having a quantitative electrolytic detector in connection with a telephone coupled inductively to the antenna circuit. Hence the vibrations of the transmitter diaphragm vary the intensity of the radiated electric waves but not their wave length. These waves travel through space, fall on the receiving antenna and affect the resistance of the electrolytic detector in proportion to their intensity. Hence the receiving telephone repeats the sounds or articulations made against the transmitting microphone and reproduces speech. The German experimentalists say that a satisfactory wireless transmission of speech can be made in this manner, 20 kilo-

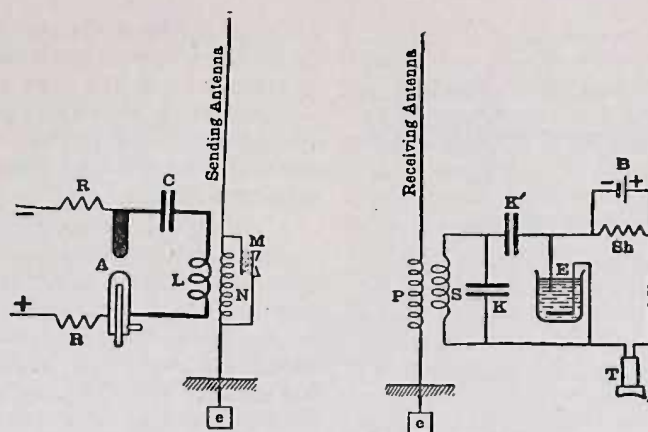


FIG. 15 — Wireless telephony by electric waves

meters or 12 miles over water, with antennae 25 meters or about 80 feet high.

Ruhmer has recently described in the *Elektrotechnische Zeitschrift* some similar experiments made with a 220-volt Poulsen arc. In this case the necessary modulation was impressed upon the radiated electric waves by inserting the primary circuit of an induction coil in the continuous current arc circuit and closing its secondary through a microphone transmitter and working battery. The receiving arrangement involved an electrolytic receiver as just described. Professor Fessenden has recently described very similar arrangements for electric wave wireless telephony.* We can, however, say that something more than a beginning has been made in the art of the wireless transmission of human speech to a distance. The energy expenditure is at present considerable, and much will have to be done before telephony without wires can be looked upon as coming within the range of commercial work. Nevertheless, having regard to the enormous improvements in wireless telegraphy in the last seven years, it is quite within the bounds of possibility we may soon be able to speak across the English Channel without a wire, and not scientifically impossible for the sounds of the human voice to be some day transmitted from the shores of England or the United States to an Atlantic liner in mid-ocean.

We may consider in the next place another problem of great practical impor-

*See *The Electrician*, Vol. LVIII, p. 710, 1907.

tance, toward the solution of which some considerable progress has been made, viz.: that of locating the direction of the sending station and giving direction to the emitted radiation sent out from it. The early attempts to do this depended upon the use of parabolic mirrors, or some arrangement of vertical rods equivalent to it. But although comparatively short electric waves of a few feet in wave length can be directed in this manner in the form of a beam, it is out of the question for electric waves hundreds of feet in length, because reflection can only take place when the dimensions of the mirror are at least comparable with that of the wave length.

The ordinary vertical antenna, of course, radiates equally in all directions, and when it is so far off as to be below the horizon a corresponding receiving antenna may respond to it, but can not locate the position of the sending station.

It seems to have been noticed by several persons that if the antenna is not vertical, it radiates rather more in one direction than another, and the same for a nonvertical receiving antenna. It is more receptive to waves coming from one direction than another. Various observations on the operation of nonvertical, looped, or duplex antennae have from time to time been made by Ze-neck, Sigsfeld, Strecker, Slaby, and DeForest, whilst methods for locating the sending station or directing the transmitted waves were described in patent specifications by De Forest, Garcia, and Stone. Although claims were made for arrangements said to be effective, these various

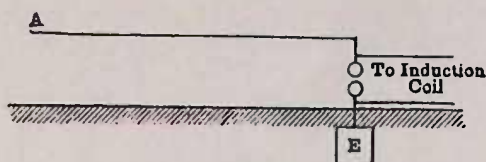


FIG. 16.—Marconi bent antenna

researches were not pressed to such logical issue as to disclose any definite general scientific principle, whilst in some cases the results said to have been obtained are clearly in contradiction to well ascertained facts.

Time will not permit further reference to these early and inconclusive observations.

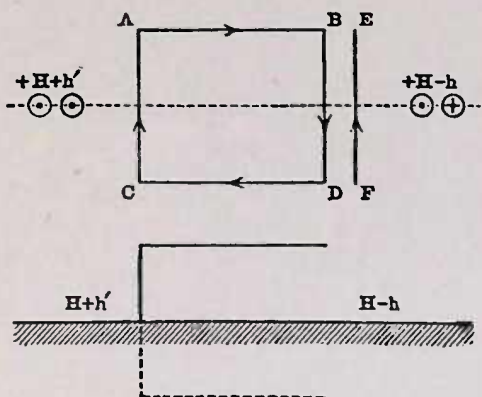


FIG. 17.—Theory of Marconi bent antenna

In March last year Mr. Marconi communicated to the Royal Society a paper on the radiation from an antenna having a short part of its length vertical and the greater part horizontal, and on the receptive powers of a similar antenna in various azimuths. (See Fig. 16.) He found that such a bent antenna emits a less intense radiation at any given distance in the direction in which the free end points than in the opposite direction. Also, since the law of exchanges holds good for electric radiators, a similar form of antenna receives or absorbs best electric waves which reach it from a direction opposite to that to which the free end points.* Hence two similar bent antennae, when set up back to back, that is,

*This is an extension to electric radiation of the principle known as Prevost's Theory of Exchanges, as amplified by Balfour, Stewart and Kirchhoff, which forms the basis

with their free ends pointing away from each other, form a system of radiator and receiver which has greater range in that position than in any other for the same distance, and hence has directive qualities not possessed by the ordinary vertical antennae.

Although I have given the mathematical explanation of the reasons for this in another place,† it is not difficult to translate the common sense of it into nonsymbolic language. Imagine a square circuit of wire half buried vertically in the earth. (See Fig. 17.) Let a current be supposed to flow round it, in clockwise direction. Then it creates a magnetic field, the direction of which along the surface of the earth in a direction at right angles to the plane of the circuit, and at equal distances from the centre, is toward the spectator on both sides. Suppose, then, that a wire equal in length to one side of the square is placed in contiguity to one vertical side, and that it carries a current opposite in direction to that in the side of the square (say, the right-hand side) to which it is in proximity. Then the magnetic field of this straight current is from the spectator at the right-hand side and to the spectator on the left-hand side. Accordingly, the total field on the right-hand side, due to the currents in the closed and open circuits together, is less than that on the left, because the individual fields are added on one side and subtracted on the other. Since the two oppositely directed currents in the adjacent wires may be imagined to come so close as to annul each other, and since the parts of the remainder below ground may be considered to be removed without affecting the field above ground, we arrive at the conclusion that an antenna partly vertical and partly horizontal radiates most strongly in the direction opposite to that in which the free end points.

Mr. Marconi discovered this fact experimentally, and made measurements of the currents induced in receiving antenna placed at equal distances round this bent transmitter, and plotted the of spectrum analysis laid down by Stokes, Kirchhoff, Bunsen, and others.

† See "A Note on the Theory of Directive Antennae," Proc. Roy. Soc. Lond., Vol. LXXVIIIa, 1906, p. 1.

results in the form of a polar curve. (See Fig. 18.) As a quantitative receiv-

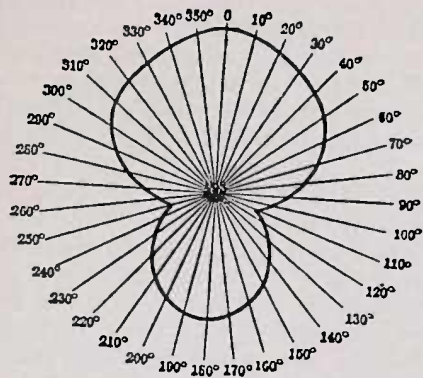


FIG. 18.—Radiation in various azimuths from Marconi bent antenna.

ing detector he made use of a Duddell's thermal ammeter. In repeating and confirming these experiments on a smaller scale last summer in the grass quadrangle of University College, I employed a form of thermal ammeter of my own design, made as follows: A vacuum vessel made like those which Sir James Dewar devised for storing

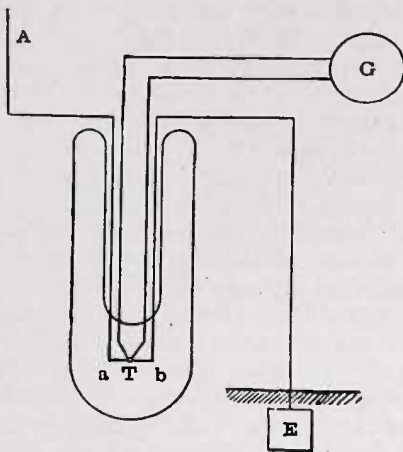


FIG. 19.—Thermal detector

liquid gases has four platinum wires sealed through the bottom of the inner test tube. One pair of these is connected in the vacuous space by an extremely fine constantin wire and the other pair by a fine tellurium-bismuth thermo-junction with the junction resting on the fine wire. (See Fig. 19.) When a galvanometer of suitable resistance is connected to the terminals of the thermo-

junction and the constantin wire inserted in the circuit of the receiving antenna we have an arrangement which enables us to measure as well as detect the intensity of the electric waves incident on the antenna. This detector, skilfully made by my assistant, Mr. Dyke, proved very useful. I was thus able to confirm Mr. Marconi's observations and my own theory of them, and furthermore noticed that when the nonvertical part of the transmitting antenna was bent so that it was not horizontal but pointed downwards, a very remarkable nonsymmetry of radiation occurred, quite, however, accounted for by theory. (See Fig. 20.)

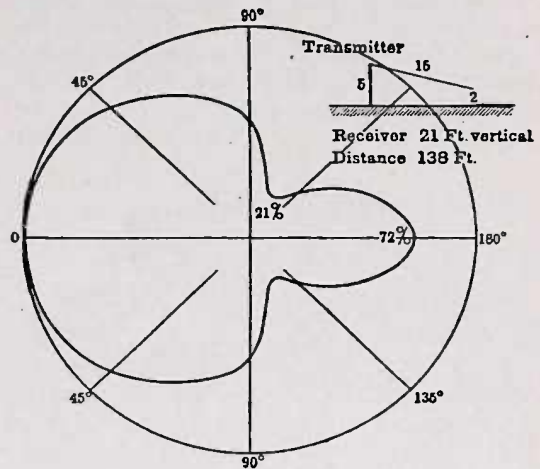


FIG. 20.

Mr. Marconi has made very effective practical use of the bent receiving antenna to locate the position of a ship or station sending out electric-wave messages when so far off as to be below the horizon.

In this case he arranges the receiving antenna so that a very short part is vertical and the greater part horizontal, and furthermore permits the horizontal part to be swiveled round the vertical part as a centre. In the vertical portion he places his magnetic or some other detector. If, then, there be a distant station in correspondence with this receiver the direction in which the transmitter lies can be determined within a few degrees by swiveling round the receiving antenna and noting the position in which it picks up signals or picks them up best from this transmitter. The transmitter then lies in the direction

opposite to that in which the free end of the receiver wire points. If it is not convenient to swivel round the horizontal portion, then Marconi arranges a number of horizontal receiving antennae like the spokes of a wheel, all having a common shorter vertical part as their centre. (See Fig. 21.) In the vertical

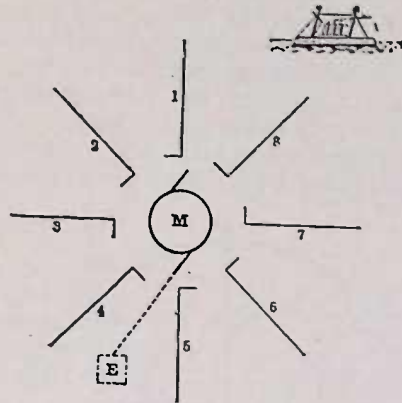


FIG. 21.—Marconi localizing antenna

part a magnetic detector is inserted, and by means of a switch any one of the horizontal radial antennae can be put in connection with it. By finding which radial gives the strongest signals, the direction of the sending station is easily located. It will be seen, therefore, that two well-defined principles had been arrived at by Marconi. First, that the nonsymmetry of the radiation and reception depends upon the employment of antennae having their horizontal portions large compared with the vertical, and secondly, that the maximum radiation is in the direction opposite to that in which the free end of the horizontal part points. These observed effects rest on a sound scientific basis, and, as I have shown, are immediately derivable from first principles.

Previously to Marconi's experiments no definite guiding principles as to directive telegraphy had been published, but a number of unconnected observations made, not always correctly interpreted or even described, and in any case with limited application.

Meanwhile, however, Prof. F. Braun, of Strassburg, had been engaged on a different plan for directing the radiation from antenna. Briefly stated, his method is as follows: He erects three vertical

antennae at the corners of an equilateral triangle, or four at the corners of a square, the sides of which are about equal to the height of the antennae, and he creates in them electrical oscillations which have a defined and constant difference of phase by methods contrived by him, Doctors Papalini and Mandelstam, not yet fully described. It is found that the waves sent off from these three antennae interfere with each other in an optical sense, exalting each other in some directions and nullifying each other in other directions, in accordance with their relative amplitude and phase difference. The resultant effect can be so arranged that the radiation is extremely unsymmetrical, being much more toward one side than the other. The intensity in various azimuths may be represented by the *radii vectores* of a sort of oval or heart-shaped curve, the triple transmitter occupying a position on the cusp or apex of the curve. (See Fig. 22.) It will be seen, therefore, that popular notions on the subject of directive telegraphy are wide of the mark. Whilst we can not yet project a narrow beam of long-wave electric radiation in any required direction, or focus it entirely on a given receiving station at a great distance, much can be done to prevent radiation being sent out from transmitters in directions in which it is of no use or not desired.

At coast stations communicating with ships at sea something has already been done to achieve this result. Mr. Marconi has for some time past employed such directive antennae at his large power stations at Poldhu and elsewhere.

These, then, are a few of the contributions which have recently been made by practitioners and theorists to this fascinating and progressive subject. But whilst we may congratulate ourselves that progress continues to be made, there are still large districts of it in which our knowledge is most incomplete. One matter having a very practical bearing is the necessity for systematic study of the causes which vary the transparency of space to long electric waves. You will continually see references in the daily papers to isolated feats of communication between ship and ship, or ship and shore, over unusually large distances. Ships equipped with what

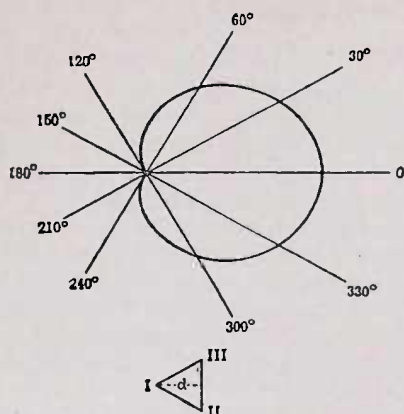


FIG. 22.—Polar diagram for Braun's triple directive antenna

is called short-distance apparatus, that is intended to send and receive over 200 miles or so, are able occasionally to communicate with others 600, 800, or even 1,000 miles away. This is not altogether a matter of personal skill or of apparatus. Our terrestrial atmosphere varies from day to day and hour to hour in its transparency to long telegraphic electric waves, just as it does to the short light waves. One reason, and probably a valid one, which has been advanced for this is the ionization of the atmosphere by sunlight, radio-active matter, or matter electrically charged reaching our earth from the sun or cosmical space. These ions or electrically charged particles suspended in the air are set in motion by the electric force of long electric waves passing through the region. This, however, involves energy which must be taken from the wave, and hence the wave passes on so much the weaker. This effect is altogether different from the disturbing effects of atmospheric electricity on the receiving antenna. As first noticed by Mr. Marconi on one of his Atlantic voyages, the atmospheric transparency for long electric waves is decreased by daylight, and this reducing effect of light on the wave energy takes place chiefly near the transmitting antenna where the electric force is largest. It fluctuates from hour to hour and month to month according to laws as yet undetermined, and has no doubt secular and irregular fluctuations superposed on its regular variations. The subject of long-distance wireless

telegraphy is yet too young to provide observations for any safe generalizations on this matter, but doubtless these will be accumulated in course of time.

Wireless telegraphy has now reached a position of such importance, especially in connection with supermarine communication, that scientific research for its advancement should have the utmost possible encouragement, subject, of course, to the consideration that there is only one ether for us all. Whilst we derive satisfaction from the thought that so much valuable discovery and invention has already rewarded the labors of workers in many lands, we have but to glance around us to see in all directions, in connection with it, unsolved problems, untrodden paths, wide fields of knowledge ripe for harvest, in which the sickle of the reaper has never yet been moved.

The well known experiments of Professor Zickler with ultra-violet light have recently been extended by J. Kohler, at Oggersheim. He makes use of the fact that if the two poles of an electrical machine are connected respectively to two sharp points, the electricity generated will pass from one point to the other noiselessly and practically invisibly. On alternately illuminating the points with ultra-violet light, a telephone in the circuit can be made to emit sounds that correspond to the illumination. The transmitter is a rectangular wooden box, in which a stroboscope disc of pasteboard is arranged so as to be readily set rotating by hand. A sheet metal tube in front of the box is used as a reflector. The receiver comprises an influence machine and a small induction coil with the spark gap to be acted upon by the ultra-violet light. Magnesium light was used for producing ultra-violet rays. The transmitter and receiver were installed at a short distance apart, and the light rays reached the receiver after traversing a round hole in the disk. When the disc was rotated a sound whose pitch depended on the speed of rotation was heard in the telephone. By alternately illuminating and screening the receiver, Mr. Kohler succeeded in telegraphing first letters, then words, and finally whole sentences.

ILLUMINATING THE COUNTRY HOME

A. CRESSY MORRISON in *The Illuminating Engineer*

The question of the source of illumination for the country home is usually limited by the location, so that neither electricity nor city gas can be given consideration. The usual method of illumination is, of course, kerosene. Candles still survive for minor uses, but the serious installation of a lighting system involves several interesting questions.

It is necessary above all things that the illuminant selected shall be safe. It must also be economical, healthful and reasonable in cost of installation. The illuminant selected should also be adequate in candle power, convenient and the quality of the light should be agreeable to the eye, cleanly and instantly available.

Acetylene seems to answer these requirements in every respect. The safety of the modern acetylene system of illumination has been demonstrated by the adoption of new rules and regulations by the National Board of Fire Underwriters, which permit the inside installation of acetylene generators. The new rules were based upon the investigation of the Board of Engineers of the National Board of Fire Underwriters, who reported to the Executive Committee that acetylene, as installed under the rules and regulations of the National Board, was safer than illuminants which it replaced.

Acetylene has advantages of safety which are not considered from an insurance standpoint. City gas practice is used in piping, and the heat generated by the small acetylene flame is but little more than one-tenth the heat generated by ordinary city gas, and in about the same ratio of one-tenth in comparison with kerosene. Kerosene, of course, is a movable unit, as are candles, so that danger to life from the upsetting of movable units is in the case of acetylene eliminated.

Acetylene has no poisonous quality whatever, and there is absolutely no danger from asphyxiation, no case of this kind having occurred throughout the world. The quantity of acetylene escaping into a room through a $\frac{1}{2}$ -ft. burner is so small that danger from explosion from this cause is eliminated, and the perfection of the acetylene generator as

now constructed under the direction of the Board of Engineers of the National Board of Fire Underwriters, is acknowledged to be such that it is mechanically safe and practically fool proof.

Calcium carbide is not a hazard, whereas liquid hydrocarbons are a source of constant danger. Hence the question of safety is well settled by the expression of the most authoritative body that could be called upon to consider the subject.

The very small flame of acetylene and its extremely high candle power in proportion to the consumption of oxygen makes acetylene the most healthful of illuminants, with the possible exception of electricity. In this respect there is no comparison with kerosene, gasoline, candles or city gas, as acetylene is far and away the most hygienic.

A $\frac{1}{2}$ -ft. burner of acetylene gives approximately 25 candle power of illumination. Acetylene has all the conveniences of city gas, and methods of ignition which are adapted to city gas can be applied with equal facility to acetylene.

The question of the cost of illumination is settled by the fact that it compares favorably with city gas burned in an open flame burner at \$1 per 1000 cubic feet. The basis of this estimated cost is plain. One hundred pounds of calcium carbide cost \$3.75. Allowing 25 cents for freight, this leaves calcium carbide 4c per pound. While calcium carbide will yield 5 cu. ft. of gas per pound under laboratory conditions, the Government guarantee is that it shall yield at least $4\frac{1}{2}$ cu. ft. in a generator. Estimating that only 4 cu. ft. are yielded, the cost per 1000 cu. ft. would be \$10.00. Professor Pond, in his recent work on acetylene, credits it with $12\frac{1}{2}$ times the illuminating power of city gas. It is, therefore, seen that there is a wide margin allowed, both in yield of carbide and in the yield of illumination, when the claim is made that it equals city gas at \$1 a 1000. It compares favorably, candle power for candle power and cost for cost, with kerosene, as acetylene in a clean burner is always burned under the best conditions, whereas kerosene is seldom burned in a perfectly trimmed

lamp. Therefore, acetylene is economical for the country home.

Questions arise as to the use of acetylene for cooking. When compared with city gas in the city, burned in an ideal gas stove, it costs considerably more, but in the country home the convenience of acetylene for use in the gas stove, especially in summer, and the fact that all the arguments in favor of the city gas stove, as regards waste of coal, cost of kindling, which make the city stoves of such marvelous advantage economically, apply, so that the use of acetylene for cooking as an adjunct to the main system and as an adjunct to the country home is unequaled.

The cost of the installation of acetylene here becomes of a great deal of interest. Taking an average country home of from seven to ten rooms, furnished with carefully designed and well polished gas fixtures, the cost of installing acetylene would be about as follows: A 25-light generator, and by this is meant a generator capable of producing, with one charge, sufficient acetylene to burn 25 lights, giving approximately 25 candle power for ten consecutive hours, would cost \$120.00. The burners would cost \$5.00; the fixtures, including glass ware, \$35.00; the piping, \$30.00; freight, drayage and incidentals, \$10.00. A generator of double capacity—that is, a 50-light generator, has many distinct advantages, in that it will generate sufficient acetylene so that the question of recharging will occur at double the intervals, and, further than that, should it ever occur that all the lights were lit at once, there would be no danger of the supply of acetylene being exhausted. Such a generator would cost \$50.00 more—that is, \$170.00—making the total cost of an acetylene plant of the highest quality for a country home \$250.00.

The figures given above are based on the assumption that very artistic fixtures and good glass ware will be adopted for the better rooms, and that simple but artistic fixtures and first-class glass ware shall be used throughout the rest of the house. The piping is ordinary city gas piping.

The installation of the piping and fixtures can be accomplished by an ordinary, careful workman, and can be done

in from three to five days and in such a manner that the piping is not visible, nor will the introduction of an acetylene system inconvenience the family.

The acetylene generator is shipped completely set up and has no intricate parts to be adjusted. It can be placed in the basement or in a separate building if so desired. Generators are usually accompanied by complete instructions, which are so simple that they can be followed by any ordinary workman without difficulty.

It has been found in actual experience that a house which is equipped with 25 burners will not burn on an average more than two burners at a time, and according to the season will use these burners for only a few hours each day. A 25-light machine has therefore practically 250 light hours, and should last without recharging for ten days or two weeks, and often longer.

A larger capacity machine, such as is described as a 50-light machine, would probably need recharging, under ordinary conditions, about once a month.

The recharging is accomplished by very simple means, and the residue from the generator is merely slacked lime. This has been found useful for all the ordinary purposes for which lime is used, including that of fertilization, and in this direction has proved very valuable for the garden.

It is, therefore, possible by the use of acetylene to have a complete individual lighting plant always ready for instant use. In the country all the conveniences of city gas, with many advantages over city gas, can be had by the country dweller today in acetylene illumination, the nearest approximation to sunlight yet devised in artificial illumination, with a distinct advantage as regards safety, at a moderate cost and to his infinite satisfaction.

Some 150,000 installations in country homes throughout the United States are a demonstration of the appreciation with which these facts have been received, and it is notable that wherever acetylene has been introduced into a community, the neighbors and residents who can afford a private installation have hastened to secure the advantages which each initial unit so clearly demonstrates.

METAL SURFACE FINISHING

M. COLE

Cast metal comes up rough from the sand of the mould, brass being rougher than cast iron, as the iron is more fluid when melted and expands a little just before setting, so takes a finer surface from the mould. Wrought iron usually has a scale on it from the forge fire, even articles of sheet brass get rough in the process of working. When starting to clean up cast metal, the loose sand usually adhering to the surface should be removed with a brush of steel wire before using a file; with wrought iron the scale should be scraped off with the edge of an old half round file.

REMOVING THE OUTER SKIN

Castings have always parts left on them where the metal has been poured, or vented. These would usually take too long to cut away with files only. When dealing with small work these can be ground off with an emery wheel; where this is not to hand, or in larger work, they must be cut away with a chisel. The skin of cast iron is very hard, and spoils a file quickly, so if not chipped away, it is removed with old files that are useless for other purposes or by immersion in acid (pickle), which eats away the surface so as to give the files a fair chance.

TRUING UP THE SURFACE

A true surface plate is required if the work is to be exact, but much can be done with a single straight-edge if the edge be true. The straight-edge if applied in all directions across the surface soon shows any inequality. With surface plate a little coloring should be used. Dry Venetian red mixed with machine oil to a thin paint is painted over its surface, the work being placed upon it; red marks show where the high parts touch the surface plate, thus showing where the metal is to be removed. When metal has been brought to fairly good surface by filing, the next step is *draw-filing* or scraping with the file in one direction only.

THE FILE AND HOW TO USE IT

Files are of various degrees of roughness. The principal ones are: 1—

Rough, 2—Bastard, 3—Second Cut, 4—Smooth, 5—Dead Smooth. They vary in fineness with their length, for example: a bastard file of 4 in. length is twice as fine as one 16 in. long. For most work 8 in. files will be found most suitable, unless there is a special reason for using longer or shorter ones. All flat files purchased should have a safe edge, that is, one of the edges not roughened, so as to allow it to press on a shoulder or against the end of a hand-vice, which guides the file without being cut by it. To do good work the file must be used slowly. If a lot of metal has to be removed, it will be found better to use a long file slowly than a short one quickly. Put pressure on the file during the forward stroke only, on the return stroke use just enough to prevent the file leaving the work; all pressure more than this is not waste of energy, but spoils the file by breaking the teeth. The work must be firmly fixed, if small, in a vice; if larger, bolted down to something firm and solid as a work bench. If not perfectly rigid it is impossible to work with any exactness. Stand in front of the vice, left leg forward, hold handle of file in right hand, end of the file in the left work steadily, being particularly careful that the file does not travel in a curve as most beginners do, but *keeping it level through the whole of the stroke*. The harder the metal, the finer the file required. Brass and copper require a sharper file than steel or wrought iron, in fact a file that is used up for brass is in good condition for wrought iron, and after that for steel. Old files should be kept for removing the skin of cast iron, as it spoils a good file. In truing up a flat surface, do not use the file in one direction only, but go in all directions over the surface, end to end, side to side, then diagonally from corner to corner, *using the whole length of the file, not the middle only*. In using a round or half-round file, a screwing motion must be given to it during the cut, this enables it to be used with much greater accuracy than otherwise. Have a handle for each file in use; handles are cheap and it is very bad practice to remove them from one file to another.

CLEANING FILES

It is important that files should be frequently cleaned, especially those used for brass and soft metals. Solder and lead in particular soon fill the spaces between the teeth and if not removed render the file useless, grease and dirt also clog. To clean, if greasy, put the file for a few minutes in strong, hot lye, or in hot water in which plenty of washing soda has been dissolved. This softens the grease, and it can then be easily washed out with a brush made by tacking a bit of card cloth (a brush-like cloth with wire in place of bristles) on a bit of wood, or with the end of a bit of brass tube strike the surface of the file in the direction of the cuts. If a file is clogged with soft metal, it must be removed with a steel point, scraping along each cut of the file—tedious work, but the only way. Although this takes time it is really quicker than working with a dirty file. Keeping the file oiled or chalked often prevents the teeth filling.

Files for ordinary use are double cut, that is, the grooves run diagonally across the tool and others across them, thus giving a raised point at each intersection of the cuts.

Saw files are single cut, the result being ridges diagonally across the file and no points. These are not so useful for getting up a surface, but are easier to keep clean, and can be used when double cut are not at hand.

DRAW-FILING

In draw-filing, the handle of the file should be removed, the file grasped with both hands, one at each end and held parallel to the chest, so that the sides of the teeth are used. Lay the file flat on the work and press on it only during the stroke *from* the body, pressure to be removed during the return stroke to the body. Always use short strokes in draw-filing. The filing is done at right angles to the length of the file. See that the file used is quite flat and not warped. The object of draw-filing is to remove the marks left by using the file in the ordinary way.

SCRAPING

When the surface is as good as filing and draw-filing can make it, scraping is the next process. The work is applied to

the painted surface plate frequently, and where the two touch, the red marks on the work show where the scraper is to be used, removing only very little at the time. Scraping and testing is continued until the work when applied to the surface plate shows an even coat of color all over. Where absolute accuracy is not required, the scraping process may be omitted. The shapes and correct way of using the scrapers are shown in the diagrams. The plain ended one is all that is required for most jobs, and is made from an old file by grinding to shape on a grindstone, and on which it must be sharpened as often as is required, as a dull scraper is useless. The other shape of scraper with turned up end is useful for getting at awkward places which do not permit the use of the ordinary shape. In grinding care must be used that the end is ground quite straight: if it is curved it will produce inequalities instead of removing them. When no surface plate is at hand a piece of plate glass will be found a good substitute.

Very useful scrapers can be made from old three-cornered files by grinding away all the roughness on a grindstone.

POLISHING

When a high finish is more necessary than accurate surfacing, the work is next polished, first with emery cloth. Lap the cloth *once* round a flat stick and use like a file. If lapped several times round it does not have a flat surface. It is best to glue the cloth to a piece of flat wood a shade larger than cloth: this is very little trouble to do and will well repay the extra time spent upon it. Having gone over the whole surface with a steady even pressure, working from end to end, then across. Repeat with a finer grade emery cloth. This will give a good polish which may, if required, be improved by using tripoli powder and water. Finish off if desired with putty powder applied dry with the hand, rubbing with the natural pad at the base of the thumb. This gives the finest polish known, though such extreme delicacy is seldom required. The work has now the best finish that can be got by abrasion.

Small articles can be polished with the lathe. A disc of leather or thick felt is run at a good speed and fed with fine emery or with fine lime powder, or a

number of circular pieces of calico are fixed between cheeks extending to half their width: the edges of the cloth give a good polish to work held against them.

A very good polishing material is the dust from grindstones, or for fine work from oilstones; both of these have great cutting power. A slip of fine oilstone used with oil or water is very useful for small work and is much used by watch-makers. The slips can be had $\frac{1}{4}$ in. wide.

BURNISHING

All metals are naturally crystalline, as may be seen by examining a bit of broken metal. Alloys, as brass, etc., are also mostly crystalline, while wrought iron is practically a bundle of rods or wires according to the quality; but all have naturally minute hollows all over the surface even after all that can be done by abrasion (filing, etc.). This is seen also in electrically deposited metals, as silver or nickel plated goods. To get a bright surface these hollows must be filled by the metal of the surrounding higher parts being forced into them by pressure with a smooth tool of much harder material, steel or blood-stone being generally used. This is called burnishing and produces the high polish seen on new electro-plated goods, which, however, soon disappears through the surface, being worn away by the whiting or plate-powder used to clean it. To preserve the bright polish it must be lacquered.

FIGURING OR CURLING

Large surfaces of burnished or even polished brass are not always pleasing to the eye, besides showing the slightest scratch or finger mark, so that figuring or curling is usually done on a surface that has to be handled. The work having been brought to a high degree of polish, a stick of charcoal is rubbed on the surface so as to produce the required designs; a little practice is required to do this well, and it should first be tried on a piece of waste brass plate. A slate pencil is often used for the purpose. The size of the pattern must be in proportion to the size of the surface worked upon. Some workers prefer to use the finger tip, dipped in powdered charcoal or fine pumice powder, though putty powder is much better; others use a leather dab-

ber, but in all cases the work must be kept well wetted.

LACQUERING

is really French polishing applied to metal work, by which a transparent coat of *Lac* protects the finely polished surface from the air and from handling; but it will not stand moisture, so that lacquered goods must be kept dry. To apply the lacquer: heat the work in an oven or over a gas flame free from smoke till too hot to handle comfortably (the lacquer should give off a little vapor when applied if the heat is correct), paint on a coat of the lacquer with a camel hair brush as large as convenient and having the end of the hair cut level, use the tip of the brush and have a bit of wire across the lacquer pot to wipe off the excess of lacquer so as not to have too much on the brush. Paint over, using the brush in one direction only, from end to end, taking great care that the coat is even all over and without streaks. The work is then re-heated and allowed to cool. Avoid too thick a coat or the effect is like gum, or too thin a coat which will cause it to have a lot of colors. See that the work is free from grease and do not touch it with the fingers, but with a clean cloth or with wire hooks or tongs.

CURVED AND IRREGULAR SURFACE

When the surfaces to be worked are not flat, the procedure must be modified to suit the shapes and curves, but it follows on the same lines as already given. Round or half-round files must be used, and emery cloth or powder on sticks of suitable shapes. Water is better than oil for this purpose, as the oil is apt to clog the powder, though paraffin oil is a good medium. In getting up irregular surfaces, scratch brushes of various shapes will be found useful; they can be used with soapy water, but they are only for getting up a finish, not for removing metal.

THE CHIPPING CHISEL

The method of using the chipping chisel will be better understood from the diagrams than by any description. The chisel must be of good steel, sharp, and the proper shape for the job. If used correctly it quickly removes a lot of metal, if wrongly used it only gashes the

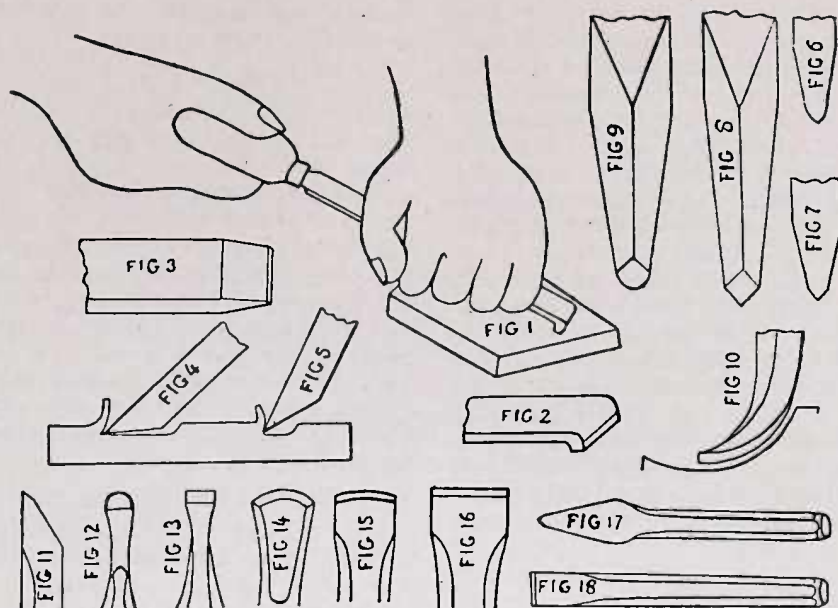


Fig. 1—Shows Scraper in use, the work being done in pushing the scraper, which is held in right hand, pressure being put on it with left.
 Fig. 2—Enlarged View of End of Scraper.
 Fig. 3—Ordinary shape of Scraper made from a File.
 Fig. 4—Shows angle at which a Chisel will cut.
 Fig. 5—Bad angle, the Chisel sinks into the work instead of cutting.
 Fig. 6—Chisel has been ground at cutting edge only until it is round ended.
 Fig. 7—Correct Shape of Chisel End.
 Fig. 8—Diamond Pointed Chisel of square section at top end.
 Fig. 9—Round do. do. do.

Fig. 10—Curved Chisel for cutting round inside of curved surface.
 Fig. 11 and those shown as 4 and 6 are easy to make as they can be shaped on grindstone from bar steel without forging.
 Fig. 12—Round Nosed Chisel for cutting deep groove or slot.
 Fig. 13—Flat do. do.
 Fig. 14—Round Ended Chisel suitable for small curved slot.
 Fig. 15—Curved do. one of the most useful shapes.
 Fig. 16—Square do. the shape in most general use.
 Fig. 17—Usual shape of Narrow Slotting Chisel made from octagon steel.
 Fig. 18—The Ordinary Chipping Chisel, made from octagon steel.

work. *Dull chisels don't cut.* It even pays to use an oilstone to get a good edge, though a fine grain grindstone is the proper thing for edging a chisel. An emery wheel is excellent for the purpose, but great care must be used or the edge of the chisel will be burned. See that the chisel edge is not too wide, $\frac{3}{4}$ in. wide takes twice as much force to cut as $\frac{3}{8}$ in., so that the smaller will take a heavy cut while the larger one takes only a light cut. The hammer should be as heavy as can be comfortably used, if too heavy for the user there is no gain over a lighter one.

Chisels must be made from the best tool steel, common stuff will not do and is no economy. They may at a pinch be made from old files. Those used for brass may be tempered harder than those for iron, and the former may also have a more acute angle at the cutting edge.

BURNISHING TOOLS AND HOW TO USE THEM

Burnishers are of steel or bloodstone, shaped according to the work they have to do. The stone burnishers are small and set at the end of a long handle: these

are used nearly upright, being grasped near the stone end with the fist. Steel burnishers are much longer and set in shorter handles. The method of using is the same in each case. First go over the work with a steel burnisher, keeping it well moistened with soap suds made from burnishing soap, grasp the tool firmly and using as much pressure as is required to get the bright effect, run it to and fro so that the burnisher glides over the surface in a straight line, then repeat so that the bright lines touch each other, thus forming a continuous bright surface. For gold or silver, stone tools must be used after the steel ones to get the best effect, but for brass, etc., steel tools will do all that is required and are much cheaper than stone tools. Some shapes of steel burnishers can be used like draw-filing, or the free end passed under a loop on the bench so that great pressure can be put on the work, the tool being moved by the handle so that it makes a curve, the work under the tool being slowly revolved so as to present fresh surfaces to the burnisher. A tool shaped like a hammer face is useful for large surfaces, or one with a handle at

each end and curved at the working part. In any case it must be remembered that *burnishing is producing a series of lines in which the metal has been brought to a very smooth surface by great pressure of a very smooth tool much harder than the work, and kept wetted with the suds of a special soap.* Work required to be dead true must *not* be burnished, and great care taken in preparing the work so that there are no deep scratches, as they are more noticeable on a burnished than on a dull surface. Everything depends on the surface of the burnisher being clean and smooth. To keep it so, it must be from time to time got up by rubbing with pressure on a polisher of good leather, mounted on a board and fed with fine putty powder. Steel burnishers when not in use must be carefully protected from rust.

Although a bloodstone burnisher will last longest, those made of agate stone answer the purpose very well and are much cheaper. For small jobs a bit of agate from an old fashioned brooch can be used; it is easily mounted, and the old brooches can be bought very cheaply.

RE-LACQUERING OLD WORK

Old or spoiled lacquer can be washed off with methylated spirits, or immersed in a bath of caustic soda dissolved in water, for about twelve hours, or wash well with soft soap and water to remove grease, then boil in strong lye for half-hour (pearlashes and water answer well), dip at once in cold water and rinse well; the work can then be lacquered as before directed.

Vulcanized indiarubber, or any substance containing sulphur, will rapidly spoil a finished brass surface and even make thin brass quite rotten; this, however, can sometimes be turned to advantage. Clean brass and clean rubber soon cement themselves together as in fittings of rubber hose. Gas fittings are so much affected by the sulphur from burned gas that chains of chandeliers, etc., require renewing at times.

PICKLE FOR IRON

A mixture of equal parts of sulphuric acid (vitriol) and water; immerse the casting for two days, the acid will remove the outer skin. **CAUTION**—*The acid must be poured slowly into the water, NOT the water into the acid, as that*

would cause an explosion. Acids should be mixed in the open air.

PICKLE FOR BRASS

may be used instead of burnishing, before lacquering. One part of nitric acid (aqua fortis) to four of water. Dip the work a few seconds, then rinse well with plenty of water and dry without touching the work with the hand. Hot sawdust is excellent for drying purposes, but it must be boxwood or other wood free from resin. Another pickle giving good effects is: one part each—nitric acid, sulphuric acid, and water; add the sulphuric acid to the water, then the nitric slowly. Lacquer at once after washing and drying.

MAKING LACQUER

This should be bought ready made. It can be had in many shades, from quite clear for silver, to deep gold color for brass. To make pale gold color: dissolve one ounce seed lac in sixteen ounces methylated spirits, add a little each of tumeric, gamboge and saffron. If for deeper color, add also a little dragon's blood. The proportion of coloring matter depends on the tint desired and the color of the metal; tin may be lacquered to resemble deep gold colored brass.

COLOR DIPS FOR BRASS

Orange.—Dissolve acetate of copper in water, add potash till the solution is neutral, dip the work a few seconds, then rinse with clean water, and dry.

Green.—Sulphate of copper dissolved in water; dip the work till the required color. Nitrate of copper gives a better effect, make a strong solution and boil the work a few minutes in it.

Gold.—A strong solution of oxalic acid gives a good shade.

Violet.—A hot solution of chloride of antimony; heat the metal and dip.

Moire.—A pretty effect is got by boiling the brass for some minutes in a strong solution of sulphate of copper to which a few drops of sulphuric acid are added, say half-ounce acid to two pints.

Antique Green.—Effects like ancient bronze. Dip in dilute acetic acid, then expose to the fumes of ammonia; repeat this process as required.

Steel Grey.—Make a weak solution of

chloride of arsenic, and boil the work a few seconds.

Blue.—Brass obtains a blue tint by steeping in a hot solution of hyposulphite of soda.

Copper color or zinc or iron is produced by making the work quite free from grease, and dipping in a strong solution of sulphate of copper.

Gold color on tin or white metal can be got by the following lacquer: 1 lb. shellac, $\frac{1}{4}$ oz. tumeric, 4 oz. dragon's blood, with enough spirits to make a thin lacquer. The work must be heated. The proportions of coloring matter vary with the shade required. An easier method is to color a clear lacquer with yellow analine dye. Any color can be had this way, but it is not as permanent as the other recipes given above.

Bronze color on brass is produced by

boiling in water in which sulphate of copper, alum, and verdigris have been dissolved. The work may be left dull or lacquered.

Colorless Lacquer.—Bleached lac dissolved in methylated spirits.

Lye for removing old lacquer.—Half-pound potash to one gallon of water; boil the work twenty minutes. Two or three minutes in this will remove grease from work.

One of the best colorless lacquers is collodion; this must be kept away from any flame whilst applying, as it is highly inflammable. It is very suitable for silver or plated goods.

Vaseline is a safe and easily applied protection for both brass and iron surfaces, protecting the latter from rust. Thin rubber solution may also be used for iron.

A BALANCED TUNED CIRCUIT RECEIVER

W. C. GETZ

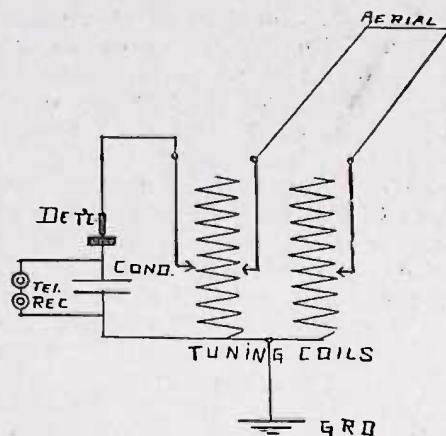
The recent return of the Fleet, together with the action of certain members of Congress in preparing a bill to compel the use of wireless on all ocean going vessels, has created a renewed interest in this hobby, that by far surpasses the interest displayed heretofore.

Experimenters in all walks of life—young and old, rich and poor, the highly educated and the purely practical—have shown an adaption to grasping the principles of this branch of science that is little less than marvelous. When it is recalled that about one year has elapsed since the first authentic articles on tuned circuit apparatus were published, and that in this year, the experimenter has passed through the stages of coherer, and relay, steel and carbon, electrolytic, carborundum, silicon, and finally completes the cycle of the "fever" with the latter detector, and tuning devices, who can doubt that the year we are now on will end with the wireless telephone in common use.

However, to get to the subject, it is my intention to show in this issue the connections of a tuned receiving circuit that is by far the best that I have so far tested. Referring to the accompanying sketch, we have the design of a circuit.

which at first glance will seem like the ordinary Hertzian Loop "hook-ups" that we have often tried out, and which have given very good results.

In this diagram, we use two tuning coils, a fixed condenser, a pair of high resistance receivers, and a thermal detector. The latter is preferably of the silicon type (made by the owners of silicon patents) which if purchased from reliable concerns, is far better than a home made one.



The aerial, as shown, is of the Loop type. It can be made with a single loop, bringing in the two ends as in the

sketch, or it may be made as described in the June, 1908, issue. Either plan will work well.

The tuning coils are made as per the instructions in the July, 1908, issue, or they may be purchased from supply dealers. I use my standard No. 101 coil, which gives excellent results.

The condenser shown should be of the new No. 120 or No. 121 type, which have a capacity of .002 M.F. per unit. The No. 120 condenser is of the single unit type; while the No. 121 condenser is provided with two units, and a Series Multiple switch, whereby three ranges of capacity may be instantly varied, the values being .001, .002 and .004 M.F. respectively. With this connection, an adjustable condenser of sliding or rotary type is not as efficient as the single or multiple unit condenser.

The High Resistance receivers are of the No. 108 type, which when fitted with the new "Gold" diaphragm is extremely sensitive. Rewound receivers may also be efficiently used, as well as other reliable makes. The experimenter should see that his receiver is properly wound, as the majority of cases of bad results can be directly traced to inefficient receivers, probably wound by inexperienced parties, and having a resistance by far out of proportion with the number of ampere turns.

With the apparatus as near to that described above as is possible or convenient to obtain, we connect it in as follows: One side or end of the aerial goes direct to the slide on the right hand tuner. Only one slide of this tuner is used, the other slide being unnecessary. The other end of the aerial goes to the right hand slide of the left tuning coil; the left hand slide of this coil going to the detector, and thence through condenser to ground. Now the important feature in this diagram is that the telephones are bridged across the condenser, instead of across the detector. This allows a much more sensitive adjustment than the other way, and the results to be obtained are extremely gratifying.

Using a Perikon detector, a pair of No. 108 receivers, and the Condenser and Tuners as shown, during the week that the Fleet was nearing Hampton Roads, I successfully picked up all stations from Brooklyn Navy Yard to Charleston, S. C., with a 30-foot aerial

on my testing station in Baltimore. As I am located at a point where it is hard to obtain a good ground, the results attained show the value of this diagram. Of course, other things were in my favor, as during that week all the stations were using all of the available supply of energy, and everything was worked to the highest point.

"I have an idea, a glorious idea!" cried the inventor's wife. "One of those simple little ideas wherein millions lie." "Yes?" said he, tossing the long white hair back from his ears. "Proceed." "It is a two-pointed pen!" cried the lady. "A reversible pen." "Excellent, but—" "I should say it was excellent. For the same money, out of the same quantity of material, two pens instead of one. Where are your patent-application papers, James?" The old inventor smiled sadly. "Jenny," he said, "that idea of yours for a pen point at both ends was patented all over the world in 1869. The pen appeared on the market in 1870. A failure, it was withdrawn. But pen-makers and the patent people tell me that never a year goes by without the arrival of a hundred or so of excited letters from people, who, like you, think that they have hit on an epoch-making idea, a two-pointed pen."

There are two methods of heating turpentine without danger. When an open pan is used it is made with a jacket—that is, there are two pans, an outer and an inner one, with a space between; superheated steam from a boiler is passed into the space and is allowed to escape through a waste steam valve at the bottom; a safety valve at the side of the pan allows the steam to blow off if the temperature rises too high. Turpentine boils vigorously at a temperature of about 338 degrees F.—much higher than the boiling point of water—hence the steam at ordinary pressure would not cause turpentine to boil, says *The Modern Painter*. Turpentine can be heated to boiling point over a burner or fire, provided it is contained in a still, which is closed with the exception of one tube leading to a condensing coil kept cool by being placed in a tub, through which a current of cold water is caused to flow; any turpentine which may be vaporized is condensed in the worm and recovered, and no vapor can pass into the outer air

CHINA RIVETTING AND REPAIRING

Besides the advantages of doing our own work, china-rivetting and repairing would, for a careful worker, be likely to command a certain income. Not only have we the opportunity of exercising judgment in the disposal of the rivets, arranging them to appear as inconspicuous as possible, but also using just as many as are absolutely necessary to hold the parts together, instead of heaping them together all over the white surface.

The amateur repairer's outfit consists of a file, a pair of cutting-pliers, some soft brass or copper wire, a small hammer, an old file with the end broken off, and lastly, the most important implement, the drill. The drill usually employed by china rivetters has a diamond point, which is a great advantage, though not a necessity. These points, or "sparks" are not expensive. They are sold for the purpose by most wholesale lapidaries, and cost from a quarter upwards. A drill working on the principle shown in the accompanying cut could be made by most of our readers with little trouble.

The upright A is a metal rod, $\frac{1}{4}$ in. diameter and about 12 in. in height. About 2 in. from the top is a hole B. The other end tapers, centrally correct, starting $\frac{1}{2}$ in. from bottom to about 1-16 in., and contains a bore for the reception of a small tin tube C. D is a piece of hard wood, shaped as shown, and having in the centre a hole through which the rod passes freely, besides holes E E on either side. F is a piece of catgut or pliant leather, which passes through the hole B, and those at E E, where it is knotted underneath. G is a lump of lead, or heavy wood, and is to give the weight required to steady the drill whilst working. The tin tube C contains a small cavity in which to fix the spark. The diamond should be set end-on, not flatwise, and does not necessarily require soldering, but merely placed and given a light tap with the hammer, as the metal will, during the actual drilling, work itself over the stone, leaving only the cutting edge visible. Those readers who do not care to undertake the actual setting could employ the services of a working jewel-

ler, who could easily make them a contrivance similar to a small watch-key, which would answer the purpose better and last longer than the tin tube. Some rivetters prefer to fix the stone with solder, but as it occasionally has to be reset, and the method described is generally satisfactory, it is hardly necessary.

The drill works in the following manner. Holding it upright in the hand, with a thumb and finger on the crosspiece on either side of the steel rod, the former is revolved a few turns to coil the strap round the rod. If the crosspiece is then pressed lightly down, the strap will coil itself of its own accord round the rod in a contrary direction, and so by moving it lightly up and down the metal rod is rapidly revolved. A diamond drill is not absolutely essential for the work, although preferable. A well-tempered steel bit, of the shape shown (enlarged) might be fixed in the contrivance described, or an ordinary Archimedean drill, the inconvenience being that two hands are required to work it, while with the former one hand is at liberty to guide its progress and hold the article.

The principle of the rivet is shown in Fig. 3. The holes are bored at an acute angle towards the broken edge, and as the rivet ends underset the hole, it is quite impossible for it to work out. Having our tools and materials ready, we take the pieces of the article to be repaired, and mark on each the places where the rivets are to come, then with the corner of a broken file a nick is made at each one, as a start for the drill. The article, during the process, may be either laid on some solid support, or held in the hand, so as to tell more easily when the drilling approaches the other side. The drilling may be assisted with a little sweet oil, but should not be carried more than half-way through the china.

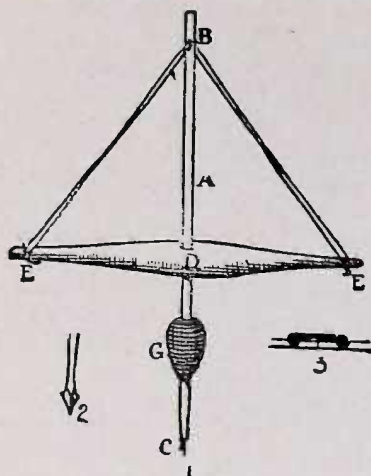
The wire employed for the rivets can be either soft brass or copper, and should be the thickness to fit the hole made by the drill, and in proportion to the article being repaired, a thin delicately formed cream-jug not requiring the same size rivet that would be necessary to hold together a wash-basin. It should be

formed into the shape shown, and filed flat on both sides. After it has been correctly measured to the length required and the ends bent inward, they should have just enough "give" to allow their passing the edges of the holes and closing in afterwards, thus holding the pieces tightly together. White lead is afterwards used to plug, if necessary.

Before rivetting an article it is often desirable, especially if it is in small pieces, to cement it together in the first place. There are many cements on the market prepared ready for use, but a home-made one composed of isinglass and vinegar will be found as efficient as any. The parts should be joined some time previous to the rivetting and should be warmed to receive the cement which can be done safely by dipping in

liable to rough usage, employ marine glue, which is a mixture of indiarubber and shellac. The surfaces should be heated as before, enough to melt the glue on being applied, and smeared over them. It is so strong that articles cemented with it will give way in any other parts than those joined.

To make a cement that will keep, suitable for anything, dissolve mastic in methylated spirit to form a saturated solution, then soak isinglass in water, until soft, the superfluous water being poured off and methylated spirit added. Then over a slow fire mix the whole together and allow to simmer until thoroughly amalgamated. It should be kept in a well-corked bottle, and when required set in hot water.—*Hobbies*.



OUTFIT FOR CHINA RIVETTING.

hot water and drying on removal. The mixture should be laid on thinly, and the pieces at once pressed tightly together.

For glass rivetting a diamond drill is almost essential, and great care is required on account of its brittleness. Stems of wine-glasses and small pieces of ornamental glass-ware may be joined by fusing over a gas-jet and pressing together when plastic, care being taken in doing so to avoid a sudden draught. For cementing glass use Canada balsam, a transparent turpentine. It should be poured into a saucer and allowed to partially evaporate, the remaining liquor being brushed over clean and warm surfaces.

For marble, alabaster and such-like

The highest telephone line in Europe which runs to the Regina Margherita Meteorological Observatory on Mount Rosa, at an altitude of 14,958 ft., is nearing completion. It was found impossible to run this line on poles, owing to the high winds and bad storms which prevail at these altitudes. It was also thought to be impracticable to lay an insulated cable, as it would gradually sink into the ice and would make repairs impossible. The final solution of the problem was to lay a bare wire across the glaciers, and depend upon the insulating qualities of the snow and ice.

In an oil refinery at Langelshheim, Germany, linseed oil is bleached by a process in which uviol lamps are employed, and which has been patented by Dr. A. Centhe. The uviol lamp is a mercury vapor lamp which produces ultraviolet rays in abundance, and is made by a special glass which transmits waves as short as 253 millionths of a millimeter. Twenty uviol lamps are immersed in a tank containing one ton of crude linseed oil, heated to 176 degrees F., into which air is simultaneously introduced in fine bubbles. Under the influence of the ultraviolet rays the oil absorbs 1-20 of its weight of oxygen and becomes colorless, brilliant and limpid. The expenditure of energy is 60 kilowatt hours per ton of oil. The air is forced through the oil by a pressure equivalent to 10 feet of water.

A SMALL CALORIC ENGINE

ALFRED P. MORGAN

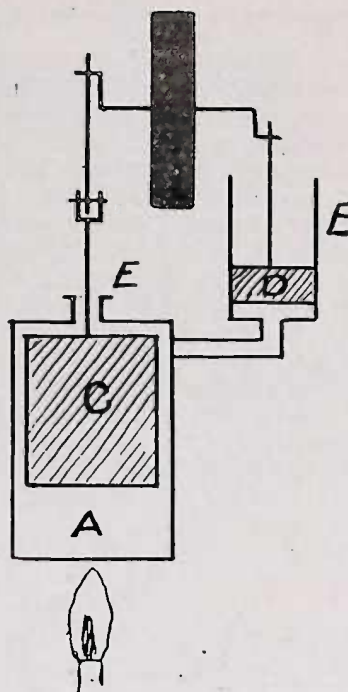
Papers devoted to the interests of amateur mechanics published from time to time articles dealing with small gas engines, steam engines and turbines, but they rarely touch upon the hot air engine.

An attempt is made in this article to explain the construction of such an engine. It may be made from old pipe and fittings and requires only that the piston and crank pins be machined. The rest of the parts may be easily made with a hack saw, breast drill, file and taps.

A little motor of this kind is very valuable in a laboratory as a source of power for agitators, circuit breakers, etc. It is very cheap to run and does not require the attention or care of an electric motor or steam engine, as once started it will continue to run until the source of heat is removed.

The type here described was invented by Stirling and is now represented by the "Rider Engine." It is known as the "closed cycle" because it contains no valves and does not exhaust but uses the same air over and over again. While not quite as efficient as the "open cycle" it possesses the advantages of being much simpler and by being able to utilize a higher pressure it may be made much smaller and more compact. Furthermore it runs with a cool power cylinder which renders lubrication much easier.

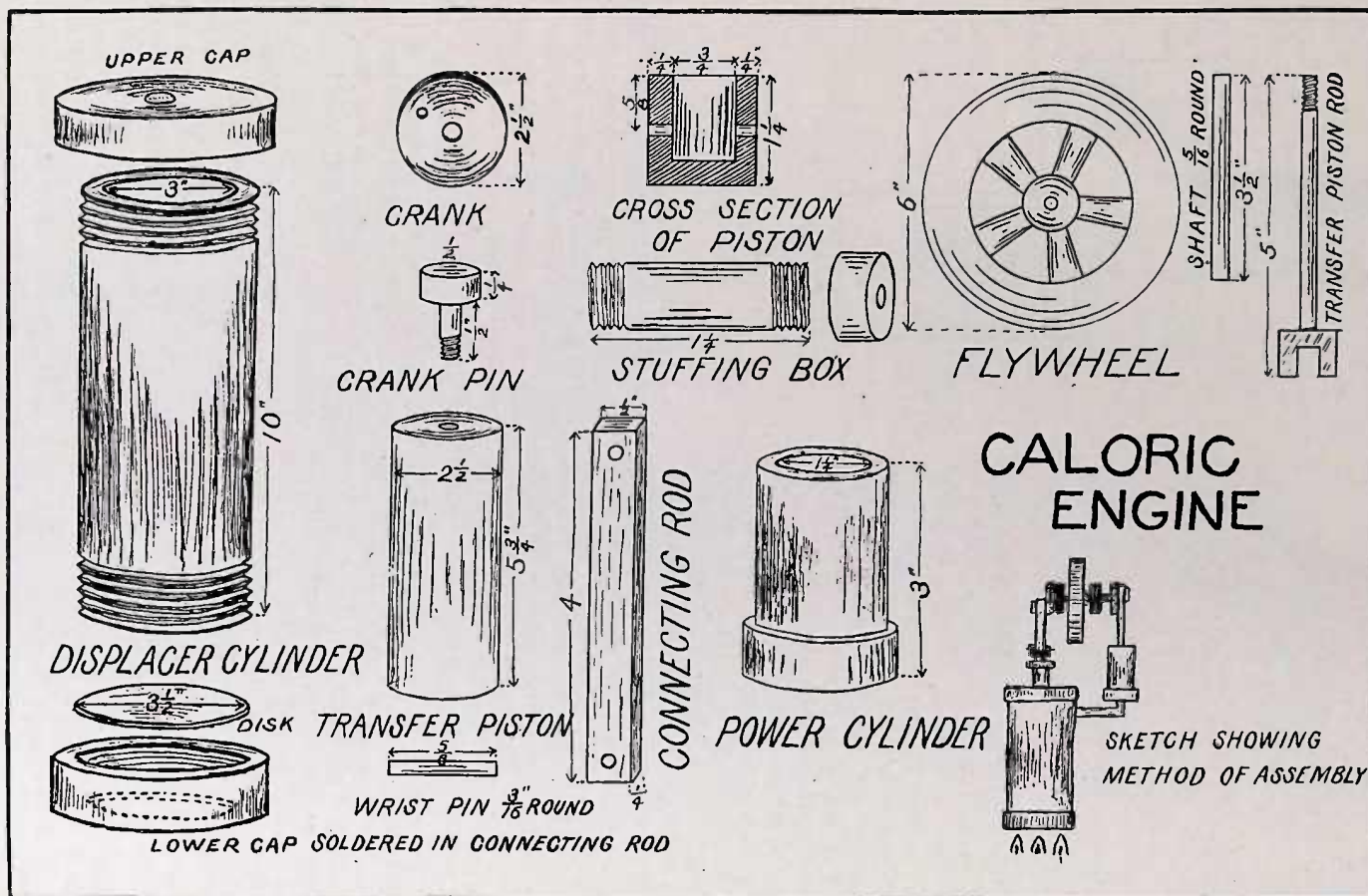
The principle of operation is as follows. See Figure 1. The cylinder A, called the "displacer cylinder" contains a shorter loosely fitting cylinder C, hollow and closed at both ends. This "transfer piston" as it is called is connected with one of the engine cranks by means of a piston rod passing through a stuffing box E in the upper end of the displacer cylinder. The power cylinder B communicates with the upper end of the "displacer" cylinder. The lower end of the cylinder A is kept heated. When the fly wheel is given a turn by hand the transfer piston is drawn to the top of the cylinder, forcing the air down into the hot part where it is expanded and enough pressure created to drive the piston forward. The momentum



of the fly wheel carries the piston beyond the end of the stroke and the "transfer" piston pushes the air to the top of the cylinder where it is colder and the pressure reduced. Thus the operation is continued and the engine will run and furnish power as long as the heat is supplied. It seems incredible that the alternate heating and cooling of the air, with consequent expansion and contraction, could take place quickly enough, but such is the case and the engine runs at 500-800 revolutions per minute.

DISPLACER CYLINDER

The displacer cylinder is made of a piece of iron or brass pipe 10 inches long and having an internal diameter of 3 inches. The ends are threaded and the upper end fitted with a cap, in the centre of which a hole has been bored and tapped to receive a stuffing box made of $\frac{1}{4}$ in. brass tubing E. The lower end of the cylinder is ground perfectly flat and square, so as to make an air tight joint with a disc of 1-16 sheet brass about $3\frac{1}{2}$ in. in diameter. The disc is held firmly in place by a cap screwed



over the end of the pipe. The cap has had a $2\frac{3}{4}$ in. hole cut in the centre, leaving a flange which serves to secure the disc. It is absolutely necessary that the cylinder and all connections be made air tight or else a great loss of power will result.

THE TRANSFER PISTON

This is made from a piece of tubing having an external diameter of $2\frac{1}{2}$ - $2\frac{3}{4}$ in. and $5\frac{3}{4}$ in. long. A plug is fitted in each end and the centre of one plug drilled and tapped to receive the piston rod which is $\frac{1}{4}$ in. tool steel 5 in. long.

THE POWER CYLINDER

The power cylinder is a piece of brass tubing 3 in. long and having an internal diameter of $1\frac{1}{4}$ in. The lower end is threaded and fitted with a cap. This end communicates with the upper end of the power cylinder through a piece of $\frac{1}{4}$ in. tubing or pipe. The cylinder is placed in a lathe chuck and a light cut is taken off the inside so as to insure perfect shape and smoothness.

THE POWER PISTON

The piston is $1\frac{1}{4}$ in. in diameter and $1\frac{1}{4}$ in. long. It is made hollow by boring a $\frac{3}{4}$ in. hole inside 1 in. deep. A 3-16 in. hole is bored at right angles to the axis and $\frac{5}{8}$ in. from the open end, to receive the wrist pin of the connecting rod. The piston is placed inside of the cylinder with a little finely powdered emery and oil, it is thus worked back and forth with a twisting motion for a while. When the piston is removed and the emery carefully cleaned out, the cylinder and piston should make a snug fit. The piston may be fitted with rings if desired.

CONNECTING ROD, CRANKS AND CRANK PINS

The connecting rod is made from a piece of brass $\frac{1}{4}$ in. x $\frac{1}{2}$ in. x 4 in. It has a 3-16 in. hole bored 5-16 in. from each end to receive the crank pin and wrist pin. The crank pin is shown in the drawing. One end is threaded to fit a hole in the crank. The crank is a disc of $\frac{1}{4}$ in. brass or iron $2\frac{1}{2}$ in. in diameter. It is bored and threaded to fit a 5-16 in. tool steel shaft $3\frac{1}{2}$ in. long. The stroke is $1\frac{3}{4}$ in.

THE FLYWHEEL

The flywheel should be about 6 in. in diameter and have a $\frac{5}{8}$ in. face. A

pattern may be made and a casting procured or an old sewing machine balance wheel may be adapted.

SETTING UP

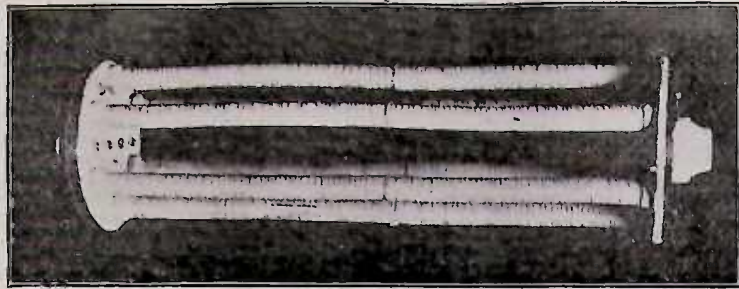
No attempt will be made to give specific directions and dimensions for mounting the engine, but the maker may suit himself. The base and bearing blocks may be of wood with babbitt bearings or special castings may be made. It may be that the maker may wish to make the engine larger or smaller, then the same proportions may be kept with good results. Those who wish may make patterns and procure castings which will make a good substantial engine. All moving parts should work freely without friction, so that when one or two bunsen burners are placed beneath the lower end of the cylinder and the flywheel given a twist by hand the engine will start without any trouble. Most cases of failure are due to leaks or too much friction.

The Skyscraper an American Type

Whether the American city has been justified in permitting the skyscraper to flourish, or whether the American investor in the end will find the lofty tower and the huge office building a useful and profitable investment, time only can tell, but that the American architect and engineer have been able to meet the opportunity which has given rise to these structures admits of no discussion. Not only has a type of building based on pure utility and special conditions been evolved, but an artistic design and treatment has resulted that today justly earns the admiration of European critics. And in actual construction no less than in design have American ingenuity and engineering skill been manifest. Structural materials—especially steel, terra cotta, and concrete—have been improved, and their use has been developed along scientific lines, so that due regard to all elements of safety can be carried on with a skill and certainty not excelled in any form of structural engineering. And with the experience of large fires and an earthquake to test his work, the engineer of the modern skyscraper surely can say that he, like his building, stands on a firm and safe foundation.—*American Review of Reviews.*

HOME-MADE ELECTRIC HEATER

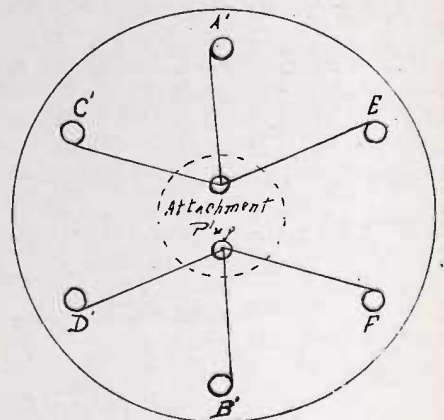
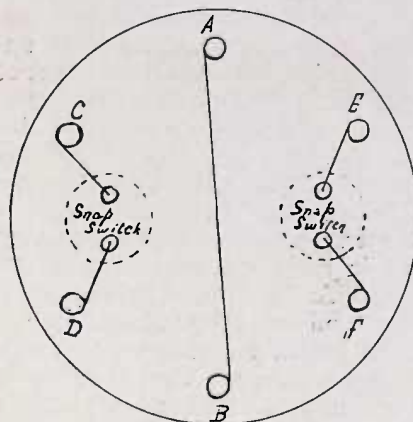
P. J. O'GARA



A home-made heater, which is just as efficient as any factory made heater, may be constructed by any ingenious boy. The material necessary for its construction is not expensive and only a few tools are needed.

Procure six porcelain bushings 18 in. by 13-16 in. and wind each one with 25 ft. of No. 26 "Climax" resistance wire. The turns should not be allowed to touch each other, and may be kept apart by putting on a thin coat of plaster of Paris on the side; it is not necessary to cover the wires with it. Cut out two discs of tin or other thin sheet metal 6 in. in diameter, and punch six 5-16 in. holes at equal distances and within $\frac{3}{4}$ in. of the outside edge. Also punch holes through which to lead out the wires, as well as others for the attachment of the plug and snap-switches. Then cut out two discs of asbestos the same as the metal discs. The diagram of these discs is shown in Figs. 1 and 2. Cut off six lengths of 5-16 in. rod iron 20 in. long and thread these lengths at both ends for about one inch. Then assemble the parts as shown

in the photograph. The attachment plug is shown at the right, while the two snap-switches are at the left. The terminals of the three upper coils should now be brought out and fastened under the upper contact of the plug; and the three lower terminals should in like manner be brought out to the lower contact screw. The upper and lower coils should have their other terminals connected together right across the end. The nearest pair of coils should now have their left hand terminals connected to the snap-switch; and the farther pair should in like manner be connected to the other snap-switch. With this arrangement three heats may be obtained by turning the snap-switches on or off. After the plug and snap-switches have been connected with the coils, two thin discs the same diameter as the other discs are fitted over the ends and held in place by small machine screws. These are not absolutely necessary, but they cover up nuts which hold the parts together, making the apparatus have a more finished appearance. Cut a piece



Wiring Connections

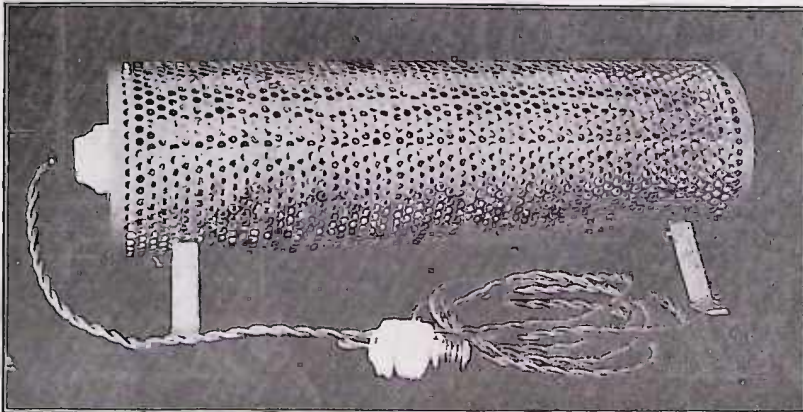


of asbestos just long enough to fit in between the two heads, and wide enough to just cover the three lower coils. This is necessary in order to protect the floor from excessive heat, since the heater rests in a horizontal position. As shown in the photograph, a protective covering made of a piece of perforated sheet metal $20\frac{1}{2}$ in. long and $19\frac{1}{4}$ in. wide is now fitted over the coils, and held in place by the bolts which also attach the legs to the heater. The legs are made of $\frac{1}{8}$ in. strap iron bent into the form shown in the photograph. Since the bolts which attach the legs to the cover also pass through the bottom sheet of asbestos there is no chance for the coils to slip out. In case the perforated sheet metal cannot be obtained at a hardware

store, there are always discarded sheets to be found at a flour mill, where perforated zinc screens are used for milling purposes.

This heater is constructed for a voltage of from 110 to 120, which is the ordinary voltage of most incandescent lighting circuits. When turned on full the heater consumes about 600 watts. With two snap-switches turned off, it takes about 200 watts, or one-third the total capacity. Attachment is made to the ordinary lamp socket by means of a piece of lamp cord and a plug.

In case that it is desired to wind the heater for 220 volts, each coil should be wound with No. 29 "Climax" resistance wire, having the same length as the one described.



A MISSION TABOURETTE

RALPH A. WINDOES

Good tabourettes have come to have a place in every home, not only for their utility but for their appearance as well, and the one here shown has proven itself capable of fulfilling both these requirements. With an ordinary amount of skill nearly any one can construct one,

to use and should be ordered as follows:

1 pc. 16 in. x 16 in. x $\frac{7}{8}$ in.

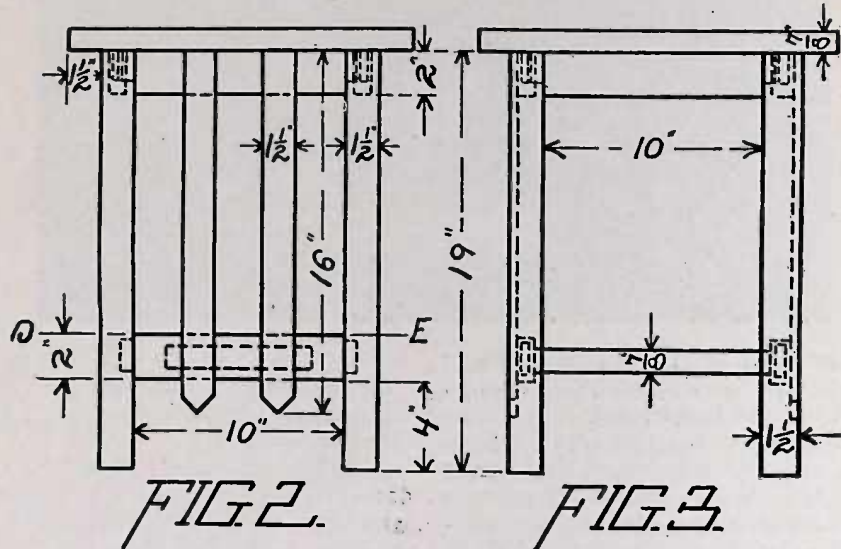
1 pc. 7 in. x $10\frac{3}{8}$ in. x $\frac{7}{8}$ in.

4 pcs. $1\frac{1}{2}$ in. x 19 in. x $1\frac{1}{2}$ in.

4 pcs. $1\frac{1}{2}$ in. x 16 in. x $\frac{1}{4}$ in.

6 pcs. 2 in. x 11 in. x $\frac{7}{8}$ in.

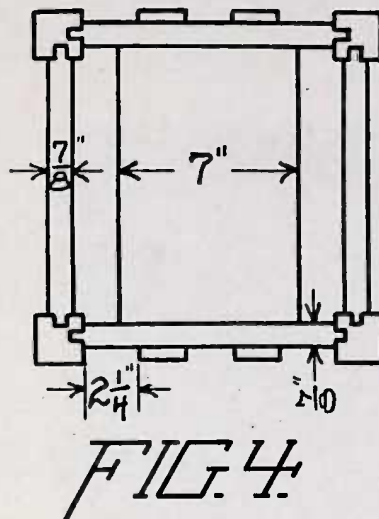
Have it sawed and planed to the right



and as the cost for the material is very small, he will feel himself well repaid for the time and money expended.

Fig. 1 gives a perspective view of the finished tabourette, but its beauty of outline cannot be brought out in any drawing. Quarter sawed oak is the best wood

dimensions at the mill and then cut your mortise and tenon joints. Be sure that the joints fit tightly, then glue and clamp the parts together that are jointed and fasten the others with screws. The shelf can be fastened with flat head screws, as the slats will cover the heads.



The slats can be glued or fastened with round head blue steel screws, the latter method being preferable. The top can be held in place by screws put in at an angle from the inside and running through the top strips.

Fig. 2 is a side elevation and Fig. 3 is an end elevation with the top in place. Fig. 4 is a plan with the top removed and

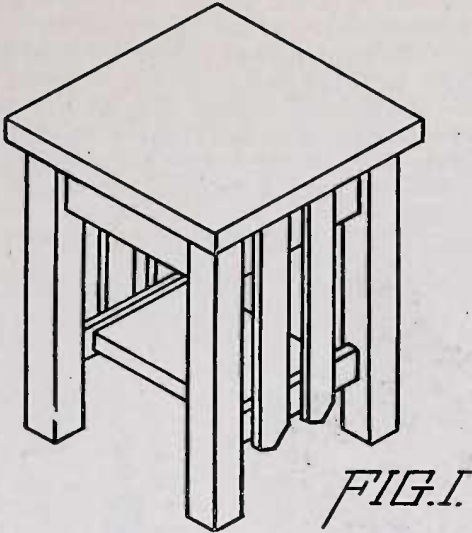
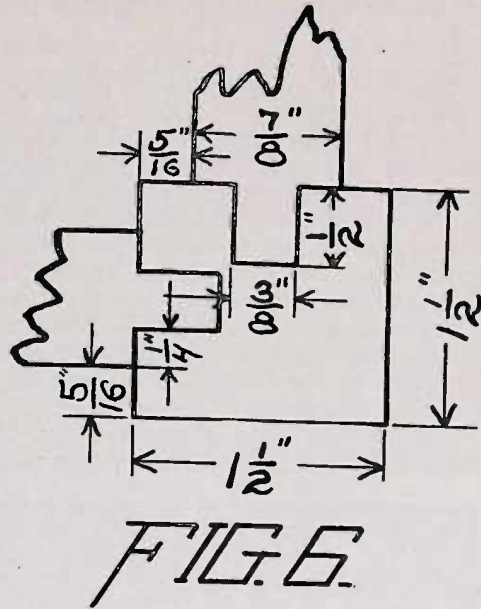


Fig. 5 is a section on line DE. A detail of the mortised corner is shown in Fig. 6.

The next thing to consider is the finish. This can be decided by the builder and should be of a color to match the other furnishings of the room in which it is to be used.

If these instructions are faithfully carried out, and an ordinary amount of care is used, you will have a piece of furniture substantial enough for the nursery and dainty enough for the parlor.

With photographs from airships people here have been familiar for some time, but snapshots taken by an automatic microapparatus attached to carrier pigeons are new on this side. It is a German, Dr. Neubronner, who, according to the *Umschau*, has just obtained a patent on an invention which at first was treated with scant respect by the German Patent Office. But on proofs being submitted of its workability its strategic value was immediately recog-



nized by the German War Office, where it is believed that especially by a besieging army photographing pigeons could be used with much advantage.

The tiny camera weighs only a little over $2\frac{1}{2}$ ounces, which is supposed to be the maximum weight a pigeon is able to carry for a flight of say 100 miles. A pigeon camera can take as many as thirty snapshots; the automatic exposure can be regulated to a nicety, so that it can be exactly calculated that the object aimed at will be duly taken. Objects can thus be photographed with relative safety from a height of from 150 to 300 feet, which would be a next to impossible task in war time for an airship to accomplish.

The military pigeon service is a highly organized branch of the intelligence department of the German army. In addition to the various Government lofts in the fortresses and at important strategic points, most of the homing clubs place their birds in case of need at the disposition of the State, and in return for this the same protection is afforded to their pigeons as to those which are the property of the Government.

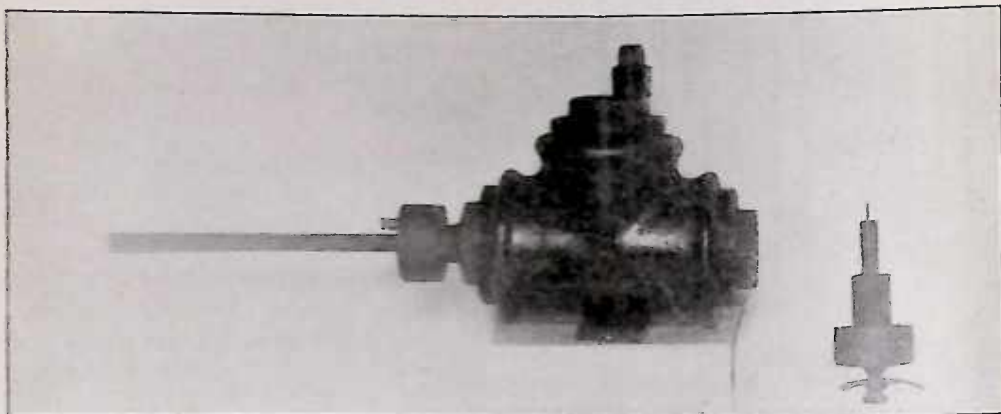
There are, the *Umschau* learns, already in existence several military vans equipped with pigeon lofts and dark rooms.

A SIMPLY MADE MUFFLER FOR SPARK GAPS

JOHN H. WHITE

One of the most annoying things encountered when working with high power wireless apparatus was the noise made by the spark jumping across the spark gap. In my experiments I used a 1 k.w. 20,000 volt, closed core transformer, which, when used with suitable condenser, gave me a spark about 1 in. long and which seemed to be at least $\frac{3}{8}$ in. in diameter. The noise from this spark was very loud and disturbed everyone in the house. I made a muffler out of a piece of glass tubing, but owing to the heat generated by the spark it had a habit of breaking when

could be screwed into it. Through the centre of these plugs I bored a hole with a No. 29 twist drill and threaded the holes with 8-32 in. threads. I cut the 5-32 in. brass rod into two pieces, one 3-14 in. and the other $1\frac{3}{4}$ in. long, and threaded them for their entire length with an 8-32 in. thread. These pieces of threaded brass rod were then screwed into the hard rubber plugs. A hole was made with the No. 29 drill in one end of the $\frac{3}{8}$ in. hard rubber rod, and it was threaded with a 8-32 in. thread and screwed on to the longer piece of brass rod serving as a handle by which it



the current was turned off especially if the air was at all chilly. I made a muffler that was in every way satisfactory as follows:

From a supply house I obtained what is known as a 2 in. T, such as is used by steam fitters 3 2 in. x $\frac{1}{2}$ in. bushings and one $\frac{1}{2}$ in. plug. I also bought 4 in. of $1\frac{1}{2}$ in. hard rubber rod, 6 in. of $\frac{3}{8}$ in. hard rubber rod, 5 in. of 5-32 in. brass rod, 2 in. of $\frac{1}{4}$ in. brass rod, one large and one small binding post and 2 in. of No. 14 platinum wire.

To assemble I screwed the bushings into the three openings of the "T" reducing the holes to about $\frac{3}{4}$ in. in diameter, taking care to fill the threads with "red lead" so as to make them air tight. I had a machinist turn two plugs from the $1\frac{1}{2}$ in. hard rubber rod, which were about $1\frac{3}{4}$ in. long, and had a thread which corresponded with the thread in the bushing, so that they

could be turned. To the outer end of the other brass rod was screwed an ordinary binding post. The $\frac{1}{4}$ in. brass rod was cut into two pieces 1 in. long and one end of each was bored and threaded with a 8-32 in. thread. Selecting a drill a little smaller in diameter than the platinum wire I drilled a hole in the other ends of the two pieces of brass rod, about $\frac{1}{2}$ in. deep and forced the platinum wire which had been cut into two pieces, 1 in. long, into them. The outer ends of the platinum wire were then held in the flame of an electric arc and slowly turned until a small ball about $\frac{1}{8}$ in. diameter had been formed on each. I then fastened the smaller binding post to the side of the hard rubber plug into which was screwed the longer piece of brass rod and made connection between it and the rod with a short piece of sheet brass.

When in use screw the $\frac{1}{2}$ in. plug into

the opening on the top and the noise made by the spark is practically nothing provided, of course, that everything is air tight. I had some trouble with the oxides of nitrogen formed, as they formed a coating over the hard rubber and short circuited the apparatus. To prevent this I screwed a "pet cock" into the opening at the top and by means of an aspirator exhausted the air from the spark chamber. Closing the cock I made some pure nitrogen by burning phosphorous under a bell jar and connecting the chamber to the bell jar with a piece of rubber tubing and opening the "pet cock," I filled the spark chamber with nitrogen. When once filled I had no trouble for several weeks, and upon exhausting and refilling with nitrogen the apparatus was as good as before. I also used carbon dioxide gas under slight pressure with good results.

By properly adjusting the hard rubber handle on the long rod so that when the platinum balls are touching inside the end of the handle is snug up against the hard rubber plug, then the distance the end of the hard rubber handle is from the plug is the distance the terminals are separated, enabling one to make careful adjustment without trouble.

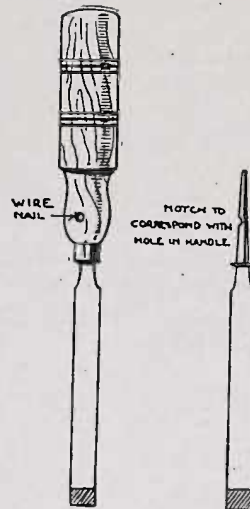
The tests of Prof. Majorana's wireless telephone which are being carried on in the Italian navy have proved entirely successful and it is very probable that the system will be soon adopted on all war vessels. The last trial was made a few days ago between the wireless station of Monte Mario at Rome and the torpedo destroyer Lanciere off the coast of Sicily near Trapani, a distance of over 500 kilometers. The naval officers at each end not only heard distinctly every word spoken but could even recognize the voice of the speaker.

The Minister of Marine is enthusiastic over the invention, which he hopes is capable of further improvements so that it can be used over longer distances. Even in its present state it is invaluable for naval squadrons. The details of the invention are kept secret, but it is known that the system is mainly based on a special microphone through which passes a continual jet of water.

To Fix Chisel Blades in Their Handles

H. S. IZZARD

How much annoyance is caused by the parting of chisel blades from their handles; especially in the case of the firm, which, with the amateur, often have to serve as mortise chisels. This difficulty can be easily overcome and a permanent fixture made by following out these simple instructions.



Remove the blade and mark on the handle where the centre of the tang falls. Drill a hole through the handle a little to one side of the mark, and so that when the blade is replaced the centre of the hole drilled shall be on the edge of the tang. Replace blade, and through the hole in the handle make a mark on the tang, with a steel point or a lead pencil. Remove blade, and where the mark falls file a notch to correspond with the hole on the handle.

Then replace blade, and through the hole drive a wire nail which fits tightly. Cut off projecting part of nail, allowing about 1-16 in. to project, burr over the end with a hammer to form a rivet, and the result will be a real permanent fixture.

In an address delivered before the Electrical Club of Chicago on the subject of the electrification of steam railroads, F. A. Sager stated that the railroads will have to spend approximately \$5,000,000,000 within a few years to keep up with the increase of traffic. By electrifying their lines at a cost of \$4,000,000,000, they would increase their capacity to such an extent that no new trackage would be needed.

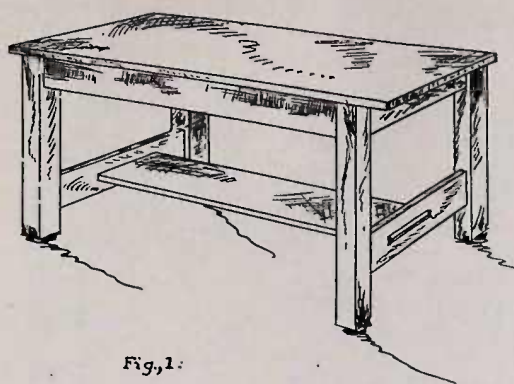


Fig. 1.

A SIMPLE TABLE

HERMAN A. FASEL

Fig. 1 is a perspective drawing of a mission table which is very easily made, and is equally adaptable to the library, sitting room or parlor.

Fig. 2 gives all the dimensions, excepting the rails which are one inch thick.

If the top rails are to be tenon and mortise the rails must be made three inches longer to allow for the tenon on each end; if dowels are used the maker can use the exact dimensions as given.

In Fig. 3 we have the dimensions for the ends; if dowels are used, the details given in the drawing can be used; but if tenon and mortise is used, the top and bottom rails must be made three inches longer to allow $1\frac{1}{2}$ in. for each tenon, the same as on the side rails.

The bottom shelf can be made wider than the plan calls for, to suit the maker's taste.

It can be put in place by first cutting

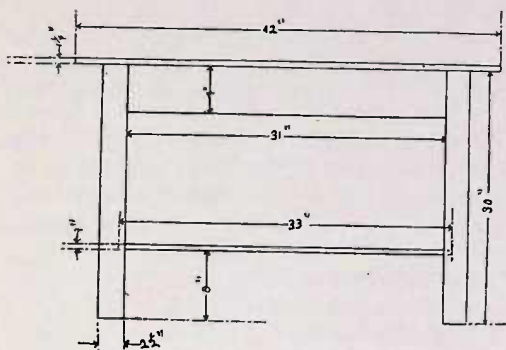


Fig. 2.

it to the proper length, and fastening by three screws through the bottom rails

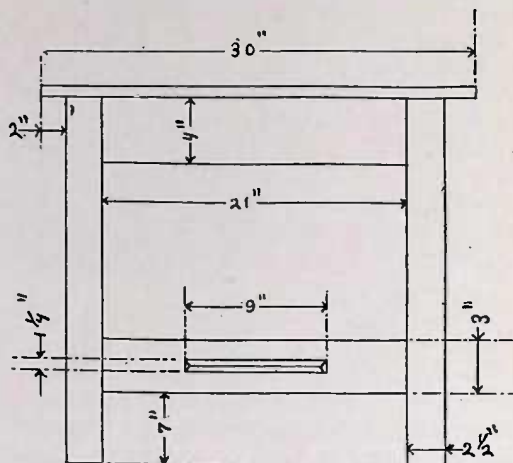


Fig. 3.

into the shelf. Then by gluing a V-shaped strip of wood over the screws, it will look as though the shelf was run through the rails.

The top may be held in place by gluing cleats one inch square on the inside of the top rails and running screws through these into the top.

Quarter-sawed oak which can be got at any planing mill is the most suitable wood. Finish with a mission stain that can be bought at any hardware store.

You can not always gauge the importance of a man by the angle at which he wears his hat.

THE PROBLEM OF POLICING THE AIR

Major Baden-Powell, the British authority in aeronautics, believes that the time is ripe for legislation governing the use of airships. In a letter to the *London Times* he says:

"Every judicious politician must look to the future rather than to the present. Changes in the laws of the country cannot be carried into effect in a moment, and what has to be considered is the state of affairs which will exist when such new laws become effective. So, too, in contemplating what the future may bring, it is desirable that legislators should devise laws applicable to the impending situation.

"We are now confronted with a most intricate and difficult question of international politics, one which in the future is bound to lead to complications and controversies. Already, it is said, the French government is considering the matter.

"It has been clearly demonstrated that apparatus can now be made—whether dependent on displacement or dynamic power—which can carry men through the air in a practical manner; and there seems to be every probability that within the next few years many machines will be constructed capable of travelling hundreds of miles through the air, swiftly, surely, and safely. Such vessels, moving independently of fixed tracks and regardless of boundaries such as we respect today, must be of great military value; they will certainly be much used for sport and pastime, and will in all probability soon be employed for such purposes as postal delivery, transport of light goods, and conveyance of express passengers.

"If then, such machines are to become at all common, it is very evident that laws must be made and modified to meet the new circumstances. The first and one of the most important questions calling for solution is that regarding international frontiers, seeing that neither walls nor fences, mountains nor rivers, not even seas, offer insurmountable barriers. Are these airships to be allowed to traverse frontiers freely, regardless of passports, independent of customs duties, defiant of bans of exile and laws of immigration? Are

they at liberty to hover over fortifications, arsenals and dockyards?

"Secondly, there is the very serious question of private boundaries. Are these 'air hogs' (as they are sure to be dubbed) to be allowed to pass over our private property? May they glide over our chimney tops, or skim close above our lawns and flower beds? The law of trespass is intricate as it is, and if proof of damage to property is its mainstay it seems wholly inapplicable to air craft. Damage due to accidental landings, as well as from articles dropped from above, is another matter. Then there must be consideration for enclosures where sporting and other events take place, and where entrance money is collected. In a few years we shall have the course at Epsom darkened by a vast flock of human vultures vying for places over the winning post! Even if flyers are to be allowed to cross high up in the sky, how can we limit the exact height at which they may travel?

"If definite laws are adopted controlling such matters, we then get to the still more perplexing problem of how to police these realms of blue. It is all very well to dictate regulations for aerial traffic, but how is the law to be maintained? Machines travelling at a speed of thirty or forty yards a second get such a start that they cannot easily be followed, and, unconfined to definite tracks, the transgressors cannot be detained on arrival at their destination. If all machines are to bear registered numbers or means of identification, there must be some international understanding about it; for in time we may have, for instance, thousands of Germans migrating over our heads to America! All this may read as a huge joke, but who can deny that such problems may demand our most earnest attention in the near future? And they must be considered while there is yet time.

"One of the first matters to decide upon is as to who is to be considered the responsible head in such affairs. Are these questions for the Home Office, or is the Board of Trade to have control? The Foreign Office and the Defence Committee will also want to have their say. Then how are such difficult issues

to be decided when we have no experts with any experience of aerial navigation (beyond a few trials in very primitive apparatus)? The council of the Aeronautical Society of Great Britain is now considering the various points of importance and may be able to lay valuable suggestions before such a body as is finally appointed to control those going up in the air in ships. Probably the Aero Club, too, and other bodies may be able to offer good advice. But such institutions cannot make the laws."

An Electrical Safety-valve

A device that acts toward a high-tension electric current precisely as an ordinary safety-valve does toward a steam-boiler is now in successful use on many electric systems. It depends on the formation of an insulating layer on certain metals, which disappears when the tension rises above a limit, just as the safety-valve opens when the steam pressure exceeds a specified amount. In these "electrolytic-valves," as they are called, magnesium and aluminum are two of the metals most commonly used. In *La Nature* a writer describes how such a "valve" is made and how it acts when formed of aluminum. He writes: "Aluminum possesses, from an electrical point of view, a very curious property. If we immerse two aluminum electrodes in certain appropriate conducting liquids, and pass a current through the circuit thus formed, we find that it stops almost instantly, so long as the pressure is below 400 volts. The two plates of aluminum become covered with a layer of non-conducting oxide, which resists the passage of the current. If we increase the electric tension, always provided it is still below 400 volts, the current passes again for a few seconds, and then disappears again almost instantly, and the thickness of the insulating layer increases. But when we exceed the tension of 400 volts, which is called the 'critical tension' for aluminum, the layer of oxide becomes permanently broken up and the current passes freely. If the tension falls below the critical value, the layer forms again

and the current is arrested. Thus, automatically, this simple arrangement of two aluminum plates will stop any current of less than 400 volts and allow currents of higher tension to pass.

"We may easily imagine applications: in a system of electric distribution, for example, if we connect one of the aluminum electrodes to a transmission wire and the other to earth, it may be seen that, automatically, so long as the tension on the line exceeds 400 volts, all or part of the current will pass between the aluminum plates and thence to earth. Suppose that 400 volts has been decided upon as the highest tension admissible on the line, we see that this arrangement will act as an electric safety-valve, working precisely like the valve of a steam-engine, when it opens and allows the steam to escape, whenever the pressure in the boiler exceeds the danger-point.

"In reality, the tension allowed on electric systems is usually much above 400 volts. But it is sufficient to arrange in series a sufficient number of aluminum electrodes, separated from each other by a layer of the liquid, to give the 'valve' any desired degree of resistance. Thus, with eleven elements in series, the 'valve' will not open unless the tension exceeds 4000 volts. Electricians are very hopeful of results from this system of protection. We know that long transmission lines, with which our industrial districts are now covered, are exposed to great dangers. One of the most serious of these is excessive tension, which many causes may bring about. It may, for instance, be caused by the unskilful or too sudden manipulation of apparatus connected with the line, or by lightning. The consequences may be most serious to the machinery and to the line itself; and consumers are at the mercy of such accidents. It may be easily understood that the arrangement of aluminum plates described above may relieve such excessive tension. In the United States it has given excellent results, and it is now being tried in France on the lines of the Mediterranean Coast Electric Company. It should be noted that if the use of these devices becomes general a new outlet will be created for the aluminum industry, which has grown so important recently in France."

QUESTIONS AND ANSWERS

Questions on electrical and mechanical subjects of general interest will be answered, as far as possible, in this department free of charge. The writer must give his name and address, and the answer will be published under his initials and town; but if he so requests, anything which may identify him will be withheld. Questions must be written only on one side of the sheet, on a sheet of paper separate from all other contents of letter, and only three questions may be sent in at one time. No attention will be given to questions which do not follow these rules.

Owing to the large number of questions received, it is rarely that a reply can be given in the first issue after receipt. Questions for which a speedy reply is desired will be answered by mail if fifty cents is enclosed. This amount is not to be considered as payment for reply, but is simply to cover clerical expenses, postage, and cost of letter writing. As the time required to get a question satisfactorily answered varies, we cannot guarantee to answer within a definite time.

If a question entails an inordinate amount of research or calculation, a special charge of one dollar or more will be made, depending on the amount of labor required. Readers will in every case be notified if such a charge must be made, and the work will not be done unless desired and paid for.

981. **Wireless Telegraphy.** L. R. G., Holden, Mo., asks: (1) When will the Kansas City and St. Louis wireless stations be in operation? I see by list in September issue they are not in operation. (2) What is the lowest resistance of receiver that will be required to hear the first named station, which is 50 miles distant, in connection with tuned set as described in July issue last? The antennæ is about 40 ft. high and the same length. Ans.—(1) Write to United Wireless Telegraph Co., No 42 Broadway, New York, N.Y., for this information. (2) You should at least get 1000 ohm receivers, and it would really be worth the difference to get a high grade pair of 1,500 ohm receivers.

982. **Management of Dynamos.** A. D., Jackman, Me., asks for information on caring for the electrical equipment of a moving picture show. Ans.—Get Crocker and Wheeler's Practical Management of Dynamos and Motors, price \$1.00. We will be pleased to supply it.

983. **Miniature Mercury Vapor Lamps.** G. A. S., So. Prairie, Wis., asks if such are made? He thinks they are advertised. Ans.—We fail to find them mentioned in the advertising columns of the leading electrical magazines, and would advise you be cautious about putting out any money on some freak. The regular lamps cost \$25.00 or more. Address Jaeger & Co., Bible House, New York, makers of miniature lamps and various novelties.

984. **Small Power Transmission.** J. V., Tower Springs, Idaho, has plenty of water power near a mine, and wishes to know if he can operate one or two stamp mills by electric motors? Ans.—While we have no exact idea of your conditions, the proposition appears practicable. Electric power is often the only means of driving such milling machinery. The case is one you should take up with some manufacturer of electrical machinery, or some consulting electrical engineer. The Allis-Chalmers Co., Milwaukee, is your nearest manufacturer.

985. **Copper Fuses.** C. B., Pittsburg, Pa., asks: (1) What is the approximate size of copper wire that 1 amp. will fuse, and if there is any rule for finding the proper diameter for any current? (2) What size of wire and core will be necessary for a transformer to change $\frac{3}{4}$ amp. at 100 volts to the equivalent amount of energy at 25 volts? (3) In the

equation for finding the electromotive force of a dynamo does the number of lines of force per square inch times the area of the coil mean the same thing as the useful flux per pole?

Ans.—(1) The melting point of a fuse is quite indeterminate unless you impose definite conditions. The size and materials of the clamp, the length of the wire, the presence or absence of a protecting tube, the length of time the current is flowing, etc., all have direct influence on the rate at which heat could be radiated, hence upon the melting point. Copper wire fuses are not approved for the reason that a relatively high temperature is required for their melting and therefore introduce an unnecessary fire risk. (2) If you make the cross section of the sheet iron core of the transformer, over which the wire is wound, $1\frac{1}{2}$ in. x $1\frac{1}{2}$ in., the outer portion forming an ordinary closed circuit, and put 600 turns of No. 20 wire in primary, 150 in secondary, you will get about the desired results. Or you can increase the section of iron, and reduce the number of turns in about the same proportion. (3) Yes.

986. **Door-bell Battery.** F. D. H., Stoneham, Mass., states that crystals have formed on the carbon of his Fuller battery, and although he has thoroughly cleaned all the parts, there is not current enough to ring the bell. What is the trouble? Ans.—The cell has simply run down, and the crystals are a mixture of chloride of zinc and sal-ammoniac. You will need to soak the carbon in warm water, put in a new zinc and fresh sal ammoniac. You meant Leclanché, not Fuller, did you not?

987. **Three-prong Armature Motors.** G. G. A., Merrill, Iowa, asks for rules for determining the field and armature windings for such common "battery" motors, and also for armatures of more than three prongs. He proposes one having an armature diameter of $1\frac{1}{2}$ in. and axial length of $\frac{1}{2}$ in. of laminated iron. Field is in the form of a U. Ans.—Such armature construction is poor, and no more work is required to construct a really good machine. The lamination feature will reduce the heat in the armature itself, but the pole pieces will still have wasteful eddy currents inducted in them, and the brushes will spark. Better use an ordinary toothed drum armature, say in small sizes, with 12 slots. If core is 2 in. in diameter, you can readily make the slots $\frac{1}{4}$ in. x $\frac{1}{4}$ in. Your design of

field magnet is faulty in that there is unnecessary difficulty imposed in putting the wire on the U portion. Put the entire quantity on the straight limbs. To answer your original question, you can put No. 23 wire on armature, No. 20 on field, all there is room for on the former, about $\frac{1}{4}$ lb. on latter. For designing excellent dynamos, even of small size you will find useful directions in Watson's series of dynamo books.

988. **Fan Motor used as Generator.** J. A. S., Allegheny, Pa., asks: (1) Can such a motor, marked 115 volts, .75 amp., 1800 rev., 1-12 h.p., having a ring armature and 12 commutator segments, be used as a generator for 50 volts and 1 amp., or 25 volts and 2 amp., without rewinding? There is a 3-speed switch, which first puts the two field coils in series, then in parallel, then cuts out one coil altogether. (2) What might the probable resistance of armature and series field be? (3) How is the formula for the electromotive force of a dynamo having a ring armature interpreted in comparison with that for a drum? Ans.—(1) With the present armature winding you should not try to draw more than the rated current. By using the parallel connection of the two field coils, you need wind the armature only. Use wire of twice the cross section, i.e. three sizes larger. $1\frac{1}{2}$ amp. will then be allowable. (2) This means only guesswork, but the armature may have 15 ohms, and each field coil 10 ohms. In the series and parallel cases, this would give working resistance of field as 20 ohms and 5 ohms, respectively. (3) Instead of considering, in either case, the area embraced by the coil, count all the wires on the outside of the armature,—counting all the layers, call this the number of *conductors*. Multiply this number by the useful flux passing through any one pole, and by the number of revolutions per second, and divide by 100,000,000, and the quotient will be the number of volts. If you estimate *turns* of wire on the armature, you must recognize that, in case of a ring armature, one turn gives one conductor, while the drum gives two. As just stated, the formula becomes at once applicable to dynamos with either type of armature, so long as it is lap wound, and to a machine with any number of field poles. For a two-pole field, lap and wave windings mean the same thing. A ring armature, except for the Brush arc dynamo, is inherently lap wound. If a drum armature is wave (series) wound, the electromotive force as determined by the simple formula must be multiplied by the number of pairs of poles.

989. **Dynamo Connections.** C. W. M., Trenton, N. J., asks: (1) Is it important whether the shunt field of a generator is connected on one side or the other of the series field winding? (2) Does it make any difference whether the equalizing connection of compound wound generators, adapted for operating in parallel, is placed on positive or negative side? (3) For what purpose are the cross connections on the back of commutator of a 400 k.w. Bullock generator? Ans.—(1) Undoubtedly you have in mind what is denoted "long" and "short" shunt field connections. It really makes little difference which

method is adopted. Possibly the latter is more common, but the same results can ordinarily be obtained by adjusting the series coils themselves. Of course the voltage is a trifle higher across the brushes of a compound wound machine than across the main terminals, by the amount of the ohmic drop in the series coils. By connecting the shunt winding directly to the brushes, a little stronger current in that circuit will result than if connected the other way. (2) No, so long as all the machines are alike. You can readily see that if the equalizer was on the positive side, and all was working well, and then if the polarity of all was reversed, the operation would be quite as good as before, but the equalizer would now be on the negative side. (3) They are the equalizer connections for the armature winding, so as to distribute the current properly to all the sets of brushes. The equivalent was described in Chapter V. of the recent series of engineering articles.

990. **Small Armature Punchings.** W. T. W., Potosi, Mo., asks where such can be obtained? Ans.—We think you can get them from the Carlisle & Finch Co., Cincinnati, O.

991. **Voltmeter Indication.** W. P., Chicago, Ill., asks if a voltmeter connected to any incandescent lamp circuit will show a proper reading, even if no lamps are burning? Ans.—Yes, and the reading will be higher, if anything, than when the lamps are on.

992. **Lamp Current.** E. G., Edinburg, N. D., asks what is the common size of incandescent lamps used for residence lighting, and what current will 16 c.p. size take, for 35 and 60 volt circuits? Ans.—10 and 16 c.p., mostly the latter. The voltages you specify are not standard, and you would have to get them made specially. 50 and 52 volts were formerly standard, along with 110 volts, but the low voltages are not now often called for. At 35 volts a 16 c. p. lamp with carbon filament could be expected to require about $1\frac{1}{2}$ amp., while at 60 volts about .9 amp. would suffice. A 50-volt lamp takes about 1 amp., a 110-volt about .5 amp.

993. **Size of Wire.** P. S., Pontiac, Mich., asks that of the sample sent. Ans.—No. 22.

994. **Sizes of Wire.** N. E. G., Ceresco, Mich., sends several samples with the same enquiry. Ans.—They are Nos. 13, 14, 17, 20 and 21.

995. **Sizes of Wire.** W. R., Kansas City, Mo., makes a similar request. Ans.—They are Nos. 16, 24, 29, 34 and 34—two smallest ones alike.

996. **Small Four-pole Dynamo.** F. R. F., Phil., Pa., asks if it is practicable to use a four-pole field with an armature $2\frac{3}{4}$ in. in diameter? Latter works well in a two-pole field. Ans.—No, you are getting the best results now. You would need to rewind armature, and then with brushes 90 degrees apart, there would be too few commutator segments to run sparklessly.

997. S. D. S., Lowell, Mass., wishes to build a $\frac{1}{8}$ h.p. motor, and using four field poles and formed coils on armature. He asks what would be the proper size of wire and number of turns for an armature core $3\frac{3}{4}$ in. diameter and 2 in. in length axially, and allow

for use on a 110 volt circuit? Ans.—For the reasons just given to F. R. F., above, you will find it quite impracticable to use more than two poles in so small a machine. You could hardly have more than 20 commutator segments, and then with brushes in four places, or, at any rate at only a quarter of the circumference apart you would have only about four insulations to withstand a difference of potential of 110 volts. Ten volts between segments is a good limit, though small and cheap motors often infringe that rule. A 110 volt motor should not have four poles if less than for 1 h.p. For 500 volts, the most cautious manufacturers draw the line at 5 h.p.

998. **Induction Coil.** A. H. A., New York, City, proposes to make one for giving 4 in. sparks, and asks if his design is good? Ans.—We cannot do better than refer you to the excellent article published by us in the July, 1907, and again in the April, 1908, numbers of this magazine. You must realize that from the same data one builder will secure the desired results, while another, with too much haste, and too little attention to apparently unimportant details, will meet with quite opposite results.

999. W. R., Kansas City, Mo., asks if a 1-10 h.p. steam engine will operate an 8-volt Midget dynamo at a speed, say, of 3000 revolutions? Ans.—Yes.

1000. **Enamelled Wire.** B. F., Washington, D. C., asks: Where can I get magnet spools wound with enamelled wire as described in March E. & M. Ans.—Try W. C. Getz, of Baltimore, Md.

1001. **Aerials.** A. T., Boston, asks: (1) I am making a wireless receiving outfit from plans in July E. & M., how high should the aerial pole be? (2) What is the length of the 4 wires shown in cut? (3) Should there be a magnet on top of pole, and if so, should it be connected with the aerial wire? (4) What pound copper wire should I use for aerial wire? (5) What number wire have I got to use in connecting up all of the instruments? Ans.—(1) From 30 to 70 feet according to your circumstances. (2) This varies with the span desired. A 50 or 60 ft. span may be used with a 30 ft. mast. (3) No, a magnet is not used. (4) A cable made of 7 strand No. 21 B. & S. gauge tinned copper wire will be found most efficient. (5) For a neat appearance, green silk flexible cord, such as is used by electricians, is very good.

1002. **Electrolytic Rectifier.** R. C. N., Chicago, asks (1) How thick are the aluminum plates in the electrolytic rectifier described in Nov. E. & M. and are they same size, width and length as the lead ones? (2) What size German silver wire should be used for a rheostat using 10 volts 5 amp. Ans.—(1) Thickness 1-16 in. (2) No. 18 B. & S. gauge, 18 per cent. alloy, G. S. wire should be used. This averages .12 ohms per foot.

1003. **Wireless Telegraphy.** A. H. P., Arlington Heights, Mass., asks: (1) Please make a diagram showing where to start winding the tuning coil and where the binding posts are placed, in making the wireless receiver described in July E. & M. (2) Where can I obtain the brass required in the conden-

ser and tuning coil and potentiometer, and what is cost of same? (3) Is the Electro Importing Co. a good place to buy? (4) Will the telephone receiver described on page 25, No. 1, 025, price \$1.00, be suitable for the wireless described in the June E. & M.? If not, where can I obtain one for that purpose? Ans.—Start the winding about $\frac{1}{8}$ in. from end of mandrel, and wind up to within $\frac{1}{8}$ in. of other ends. The July issue is very specific on this point. (2) Brass may be obtained through W. C. Getz, of Baltimore, Md. (3) As far as we know the firm is reliable; however, for better information, we refer you to Dun's or Bradstreet's commercial agencies. (4) To what receiver do you refer? If you desire to obtain receivers especially for wireless work, you might write to Mr. W. C. Getz of Baltimore, Md., who makes this branch of wireless a specialty.

1004. **Wireless Telegraphy.** G. F. C., asks: (1) With an electrolytic tuned system detector and aerial 75 ft. above the top of a hill how far ought my receiving radius to be? (2) Will a $1\frac{1}{2}$ inch spark coil transmit over a mile, aerials being unclipped by buildings? (3) Will 75 ohm receivers with electrolytic detector respond over this distance (1 mile) and if not what resistance should they be? Ans.—(1) Using 1,500 ohm receivers, the receiving radius would be about 150 to 300 miles, under favorable conditions, providing a good ground is obtainable, and a sensitive detector used. (2) Yes. (3) This is doubtful, as the resistance of the detector should be balanced by the resistance of the receivers. A pair of high efficiency receivers, of about 1,500 ohms each, should be used.

1005. **Wireless Telegraphy.** F. W. I., Brooklyn, asks: (1) How far my radius in receiving wireless messages should be with the following apparatus: Tuning coil, silicon and electrolytic detectors, adjustable condenser, pair of 1,500 ohm receivers, three dry batteries, potentiometer, and 200 ft. double-strand antenna, 70 ft. above ground at highest point; (2) double strand 130 ft. antenna, 60 ft. above ground; tuning coil, silicon detector, pair of 75 ohm receivers, and adjustable condenser? (3) How can the inductance and capacity of a tuned circuit wireless receiving and transmitting system be calculated? Ans.—(1) With this set you should be able to receive from 250 to 500 miles. (2) Using the low resistance receivers, you may be able to receive from one to ten miles. (3) This is very thoroughly treated in the December, 1908, issue of this publication, in article entitled "Calculation of Wave Length of a Tuned Circuit Wireless Telegraph Transmitter."

1006. **Wireless Telegraphy.** C. N., Dorchester, Mass., asks: (1) What is a retardation coil used in the telephone circuit for? (2) How would I connect the following articles to my tuning coil with double slide contacts: telephone receivers, glass plate condenser, silicon detector, antenna and ground? (3) Would you please tell me how to make a sending helix? Ans.—(1) To prevent the voice currents from entering the transmitter. Only the battery current is desired through

the transmitter circuit, as when the voice or alternating currents leak through, it lowers the efficiency of the receiving side. (2) The article in the July, 1908, issue gives full information and diagrams for connecting in the various receiving apparatus. See also article in April, 1909, issue, by W. C. Getz. (3) This is treated in August, 1908, issue, in article on construction of transmitting apparatus.

1007. **Aerial.** O. H., Fairmount, Ind., asks: (1) How high above the high tension wires would the aerial of a wireless telegraph have to be raised to be out of their influence? They are right in front of my house and are 60 ft. high. (2) What are the spark balls inside the sending station tuning coil for? (3) How would a lightning arrestor be made to protect wireless instruments from lightning? Ans.—(1) At least 5 ft., and you will then have considerable induction. (2) This is usually the way of mounting the spark gap, as it is convenient and makes a good appearance. (3) You cannot make a good arrestor for this purpose. Better lower your aerial when not in use.

1008. **Tantalum Detector.** D. D., Horicon, Wis., asks: (1) With the tantalum detector as described in the February issue of E. & M., a 50-ft. aerial, which is about 100 to 200 ft. long and is composed of two galvanized wires, a New England $\frac{1}{2}$ to $\frac{3}{4}$ in. spark coil for wireless work, a tuning coil, a potentiometer, a \$2 New England head receiver, and a coherer, how far would the sending and receiving radius be? (2) Is the coherer which is made of filings of silver and nickel suitable for my wireless set? (3) I have an ordinary electric light bulb, and would like to know whether the filament is tantalum or not? Ans.—(1) Probably 30 to 50 miles for receiving and 5 to 10 miles for sending. (2) No. (3) Chances are it is a regular carbon filament lamp.

1009. **Ruhmkorf Induction Coil.** R. J. D., Roxbury, Mass., asks: I have a $\frac{1}{2}$ in. Ruhmkorf induction coil that will spark only for a second and then it will not work for two or three minutes. What is the trouble? Ans.—Trouble may be in three places: Secondary jumps to primary; caused by breakdown of insulation between primary or secondary. Interrupter points dirty or welded. Not enough primary condenser around break.

1010. **Silicon Detector.** C. O., St. Louis, asks: Which is the most sensitive detector? Ans.—The new silicon detector, which will be shortly placed on the market by owners of the silicon patents. For experimenters, it is claimed to be the most sensitive in use, outside of the "Perikon" detector. The latter type of detector is owned by the same concern, and is sold to government and commercial companies. No battery nor potentiometer is needed with either of these types, thus doing away with cumbersome and troublesome apparatus.

1011. **Magnets.** O. F., New Castle, Pa., asks: (1) Does the north or positive pole of a magnet point north? I have a common horseshoe magnet and when I suspend it by a fine silk thread the pole marked N points north. I should think that the south pole of

a magnet should point north. (2) Which way does the magneto motive force flow in a magnet and from which end does it recede when the current is broken in an electro-magnet? (3) Would the shock from a 1 in. jump spark coil kill a man? Ans.—(1) Some magnets are marked N on the end which seeks the north, others the reverse way. (2) Magnetism does not flow in the sense that water does, hence your question cannot be answered. (3) No.

1012. **Silver Lacquer.** R. R. E., Clinton, N. Y., asks: (1) What is the formula for the transparent lacquer used on silver ware to prevent tarnishing? Ans.—One formula is—coat surface with solution of collodion diluted with alcohol; another, dissolve bleached shellac in pure alcohol, make it very thin. Let settle and decant. This makes a colorless lacquer.

1013. **Wire.** H. H. B., Jersey City, N. J., asks: Would you kindly inform me as to whether there was an advertisement in one of the numbers of the E. & M. concerning some new wire for contacts better than platinum, and extremely cheaper? If so, I would consider it a great favor if you would let me know the name and address of this firm. Ans.—Do not know of any such. The wire must be practically infusible, and platinum answers this requirement better than any other metal or alloy.

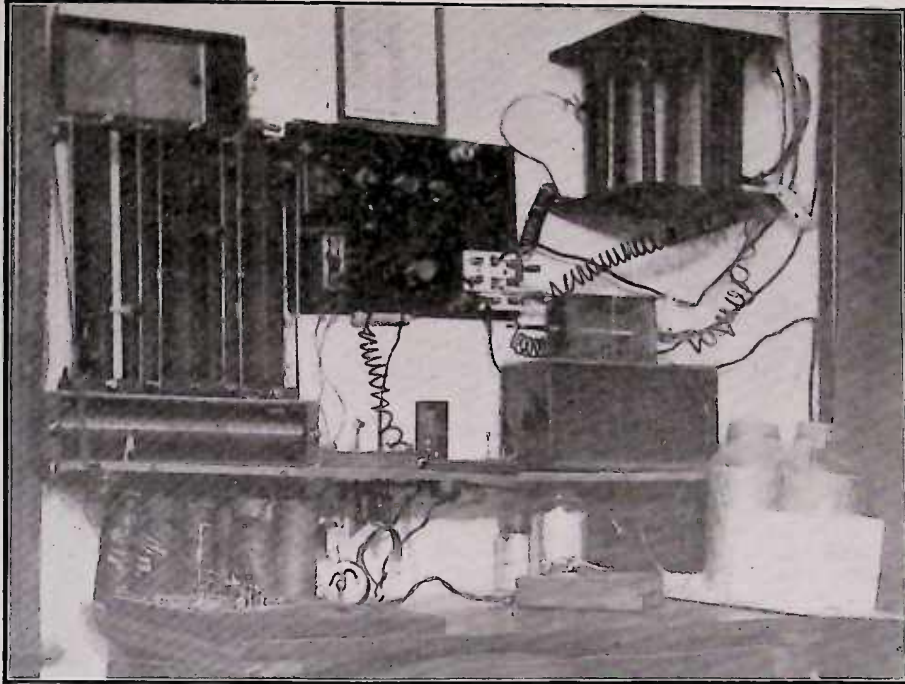
1014. E. T., Seward, Alaska, asks: I have read in your February issue, page 346, an article "How to rebuild dry batteries." Will you please inform me how to determine the parts in the formula, by weight or measure? Ans.—Determine the parts by weight.

1015. **Gas Engine. Dry Batteries.** I. D. P., Steinbach, Man., Can., asks: (1) How can a gas engine that is fired by a magnet sparker be started without turning by hand? (2) Is there any kind of dry batteries or storage batteries made strong enough to spark and start an engine a couple of times a day and at the same time a lot cheaper than this kind of batteries for firing an engine steady? Ans.—(1) By the use of compressed air. A tank can be arranged for storage of compressed air produced by a small air pump working with the engine, or a small hand pump may be used to fill the tank. This device is used in engines of large sizes, but would be rather expensive to install for use with a very small gas engine. (2) The ordinary Mesco or Columbia dry battery is strong enough to spark and start an engine twice a day and are very reasonable in price. A dry cell of the above type will "recuperate" rapidly after moderate use, while a special dry battery, or preferably a storage battery, giving even delivery of current is necessary for firing an engine steadily.

1016. **Lineman's Detector.** F. D., Cincinnati, asks: In making a lineman's detector, as described in December issue, could I not use B. S. gauge wire instead of S. W. G. D. C. wire? Will it work on 110 volts? Ans.—Yes; by referring to a table of equivalents for wire gauges, you can find the nearest wire size in B. & S. gauge to the given sizes in S. W. G. Not unless you have resistance such as a lamp in series.

WIRELESS CLUB

This department is devoted to the Club members and those interested in Wireless Telegraphy. We will publish experiences, discoveries, and suggestions, which may be helpful to all interested.



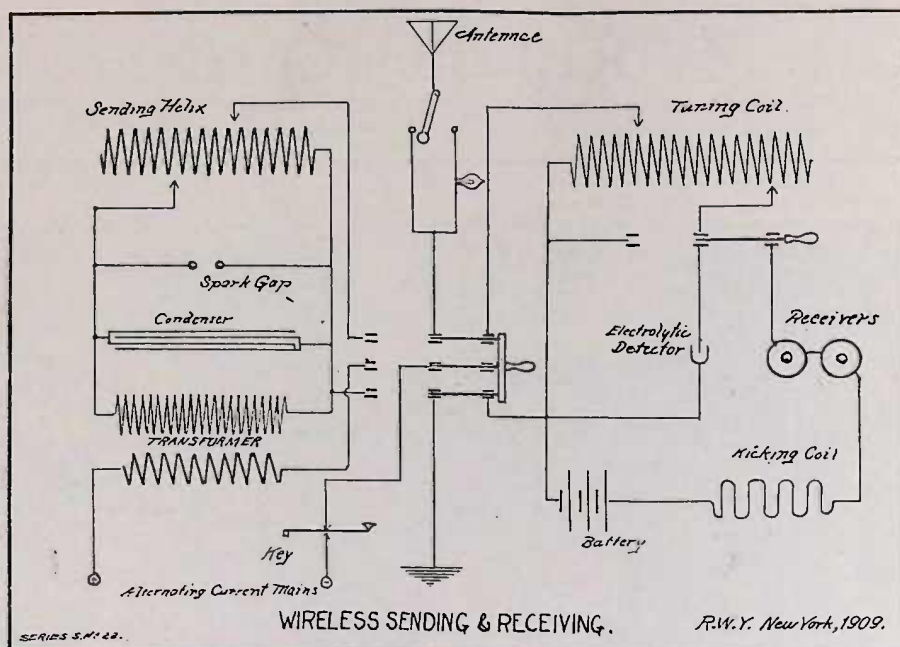
No. 143

E. Swartz, Fresno, Calif.

I am enclosing herewith a photograph of my wireless station. In the photograph the transmitting side of my station is on the right, on the wall in the centre the switch board and on the left the receiving side. The transmitter consists of the Morse key, the coil built on the transformer plan which is run by the 110 volt alternating current through a variable impedance coil, a condenser being connected across the posts of the key to keep down sparking at the key contacts. The zinc spark gap is enclosed in a box, a glass sight in front to observe and muffle the spark. The leyden jars used for a condenser are connected in series multiple, and the sending inductance consists of a number of turns of hard draw brass wire No. 16 wound on a wooden frame. The leads were made from sheet brass connected to ordinary paper clips which make excellent contacts, the connections of the transmitting system being the same as the DeForest. On the wall in the centre of the photograph is the switch board. Here are located the switches and fuse controlling the alternating current for the transmitter as well as the D.P.D.T. switch for the hertzian loop antenna; immediately below the antenna switch is the S.P.D.T. switch for the ground. In the upper

left hand corner of the board a grounded buzzer is located which is used to tune the detectors. On the right is the receiving side composed of a variable condenser consisting of two brass discs separated by glass and sliding over each other, seen directly above the tuners. Three tuners in parallel are connected in a hertzian loop according to the DeForest method. Each coil has a tuning length of 140 meters, and they are of the double slide pattern. Below the tuners is the potentiometer of the slide pattern. No. 28 bare German silver wire was wound on a wooden mandrel, each winding having a thread separating it from its neighbor. Below the potentiometer are the dry batteries to work the receiver and in front of them the detector board and shunt across the head phones which are of high resistance. A carborundum detector is connected in circuit in the photograph, being adapted to local work. However, any of the three detectors, silicon, electrolytic, or microphone, shown on the shelf below the switch board, may readily be connected when required. My wave length is about 200 meters. My call letter is F. W. Transformer is of about a fourth ($\frac{1}{4}$) k.w.

E. Swartz, Fresno, Calif.



Sending and Receiving

Having used practically every combination of wiring of the apparatus used in Wireless Telegraphy, I have concluded that the drawing above represents as good a circuit for the experimenter as can be found.

In using these connections, I make use of several instruments that, while they are all, except the sending key, the common type, I have altered in small details.

The spark-gap is made of zinc, $\frac{1}{4}$ inch rods, pointed on the ends: one electrode fixed, the other governed by a spiral spring and adjusting screw, so that the gap can be lengthened or shortened by merely turning a thumb-screw.

The receiver is wound to 4000 ohms, and enclosed in a sort of sounding box, which is connected with the operator's ears by a rubber tube.

Aluminum is used in every possible place, making the outfit exceedingly light. The aerial is also of aluminum.

My tuning coil is shaped like an unwound clock-spring. I use this mostly for a sending helix, as its length is too short for receiving long waves.

The sending key is of the magnetic blow-out type, and with a certain double-break, will stand fifteen amperes at 110 volts. I can send 40 words a minute with six amperes.

Instead of a hot-wire ammeter for tuning the open and closed oscillatory circuits, I use a small incandescent bulb, as shown in diagram: the size depending on the size spark.

In concluding, I will say that large wire (14 to 10 B. & S.) gives better results when used for connecting instruments, than ordinary bell wire, which is commonly used.

R. W. Y.

A Good Aerial

Herein is an experiment which I have tried and it has worked so well that I feel confident that it will be welcomed by members of the wireless club and all having wireless stations.

Procure two good ten pin cross arms from your local telephone or electric light company, and have two sets of irons made to hold the cross arms about one foot or higher, as desired, above the ridgepole of the house.

Now get eight good heavy insulators (the petticoat insulator having three or four deep grooves on the under side of the insulator is best) and place four on each arm, placing the insulators on the two outside pins, and then on the fourth pin from each end.

This will give an excellent support for the aerial wires, and, unlike the pole aerial, this type will give the best support, and better results can be gotten, as the insulation on this type is as nearly perfect as can be gotten (although if you are using a very heavy sending current, insulators such as are used for 100,000 volt high tension lines may be used).

The wiring of this aerial is the same as the ordinary four wire aerial, and nearly any combination in wiring may be used.

Now for the wires leading to instruments: Use the two wire lead, that is, have two wires coming from aerial to instruments, and place each through a helix similar to a sending helix, except that a helix is connected to each wire and they are variable in order to change your own wave length.

Each of these should be wound with No. 18 bare copper wire to any desired length, to get the required length of aerial.

I have had a duplicate of the above working for about two weeks and have found it to be as good as the pole aerial if not better in some cases.

GLENN C. SABIN.

TRADE NOTES

From March 10, 1909, the firm formerly known as the Western Electrical Company, 411 South 10th St., Omaha, Neb., will do business under the name Johnston Electric Company. This change is made because of the establishment of a Omaha Branch by the Western Electric Company of Chicago.

* * *

The business done in the past by the Chicago Coil Company, Chicago, Ill., will be continued under the name of the Cartridge Coil Company, LaFayette, Ind., as an Indiana corporation.

* * *

The Norman W. Henley Publishing Company, 132 Nassau St., New York, has just published a new catalogue of practical books for practical men, which will be sent free upon application.

* * *

The D'Olier Engineering Company of Philadelphia have issued their 1909 catalogue T of horizontal centrifugal pumps. This is an excellent piece of bookmaking, describing their line in full detail and gives much valuable information to all users of pumping machinery.

* * *

The L. S. Starrett Company, Athol, Mass., issue a special catalogue of steel measuring tapes, which can be had upon application by any interested reader. This shows the various styles of tapes which they manufacture with both English and metric measurements.

* * *

Fan Motors for 1909 is the subject of a catalogue just issued by the General Electric Company. This catalogue contains illustrations, descriptive matter and prices of the entire line of General Electric Fan Motors for the coming season. The line embraces motors for both alternating and direct current, in desk, bracket, ceiling, floor column and counter-column types of standard sizes. It lists also ventilating motors and miscellaneous small power motors for alternating and direct current, as well as various supply parts of the standard fan motors. The catalogue, No. 4632, is attractively printed in colors, and will be furnished on application to the nearest sales office or to the Publication Bureau, Schenectady, N.Y.

* * *

A handsome publication devoted to the Curtis Steam Turbine-Generator has recently been issued by the General Electric Company under the number 4653. This bulletin is quite elaborate so far as details of construction are concerned, containing interior views and cross-sections of various parts of turbine and generator. It describes large and small turbines of vertical and horizontal types, and contains illustrations of numerous representative Curtis Turbine installations. The bulletin will be found to contain much of interest to the central station manager.

* * *

The New York Trade School in New York City sends us its catalogue for 1908-9. This institution, now in its 28th year, has both day and evening classes in almost all the important trades, including bricklaying, plastering,

plumbing, electrical work, pattern making, painting, steam fitting, blacksmithing, printing and sheet metal work. The system of instruction includes practical work as well as theoretical study and the students are fully fitted to pursue their trades.

* * *

William J. Murdock and Company of Chelsea, Mass., have placed upon the market a most excellent circuit detector of varied application which every electrician needs. They also furnish two styles of telephone receivers for wireless telegraphy which give complete satisfaction. Write for their catalogue.

* * *

"Oliver" Quick Acting Vises, Nos. 150 to 153 inclusive, are bound to succeed because of their quality of finish and cheapness of price. They are powerful and well adapted for educational institutions, pattern shops and woodworkers in general.

The screw is steel $1\frac{1}{8}$ in. in diameter, and has buttress thread which makes it a smooth acting vise. The guides are $\frac{3}{4}$ in. diameter steel. The nut is solid bronze. The handle tee (T) is malleable iron. All of the other parts are iron.

The back jaw is screwed to the bench and supports from its farthest end, all of the remaining parts of the vise on 5-16 in. steel trunnions. The bronze nut is underneath the screw and is supported in a pocket cast under the back jaw. To get the quick action it is only necessary to lift up the screw, and it will be free from contact with the nut. Then the front jaw may be pushed in or out with the greatest ease. At any position the front jaw may be let go and the screw at once drops down into the nut and is engaged for screwing any distance. This vise is easy to operate, exceptionally powerful, and will not give any trouble.

WIRELESS TELEPHONE RECEIVERS

In purchasing wireless telephone receivers the important points to be considered are first, their sensitiveness; second, the degree of comfort with which they can be worn; third, their permanence of adjustment and construction.

There are many points in the design of receivers which affect their sensitiveness. The coils must be wound so as to give the greatest possible number of turns with the least resistance. Many people assume that high resistance means great sensitiveness. This is not necessarily the case. The most efficient winding is the one having the greatest number of turns of wire nearest the cores for a given ohmic resistance. It would be possible, for instance, to wind the cores with german silver wire and get a very high resistance, but it would give a very poor receiver. The amount of iron in the cores and the quality of the iron are also important factors.

The diameter and thickness of the diaphragm and the quality of the iron from which it is made, also greatly affect the sensitiveness.

Another feature that must be watched is the strength of the permanent magnets. These must be just the right strength to give the best results with the cores and diaphragms with which they are used. Permanence of adjustment can be secured only by mounting all the parts mentioned on some material which will be unaffected by heat or moisture.



The Wireless Operators' Head Receivers made by the Holtzer-Cabot Electric Co. of Brookline, Mass., have been designed with all of the above points in view. The windings are all made with silk covered copper wire. The magnets are made from a special quality of steel and are of the proper strength to give best results with the diaphragms used. The spools and magnets are mounted in a metal cup which supports the diaphragm. The cores are ground to a proper height so that the adjustment is permanent. The metal cup is enclosed in a hard rubber shell. The two receivers are mounted on an adjustable leather covered head band. There are no nuts or screws to work loose on this band, and nothing to catch the hair. Large pneumatic rubber cushions are provided with each set, which not only shut out extraneous noises but also make the set more comfortable. These cushions are readily detachable. A six foot two conductor green silk tinsel cord is supplied with each set also.

These sets may be wound to resistances up to 4,000 ohms.

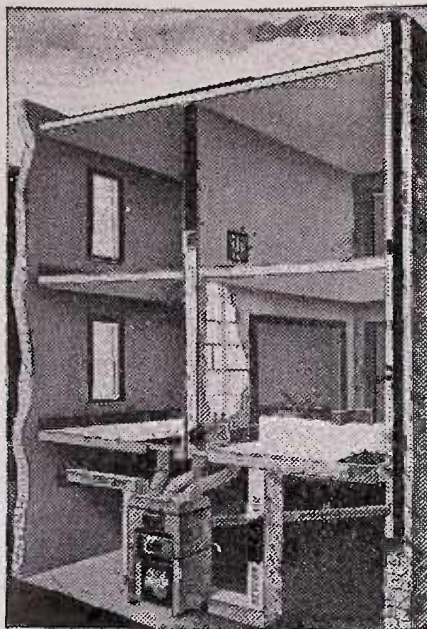
ECONOMIC HEATING

Probably no field of human endeavor has been given closer study or passed through more experiment than that of heating. Like every other problem having to do with the betterment of living conditions, there have been many fads and failures, while successes have been few.

The road from the open fireplace of "ye olden days" to the modern method of heating the home, covers generations of experiment and embraces the expenditure of countless millions of dollars in arriving at the present perfected methods of warm air heating.

For either the farm or city home, time has demonstrated that warm air—not super-

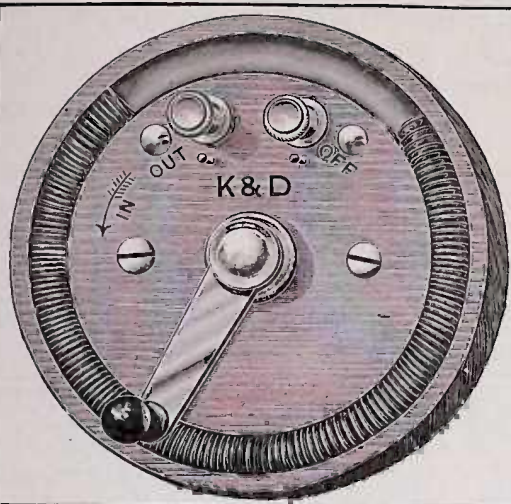
heated air—is the best, and in fact the only safe and sane system embracing all these necessary essentials, viz., health, comfort and economy. In this connection the wonderful record, established during the past twenty years, by what is known as the Hess Method of Warm Air Heating, is worthy of close investigation by readers of the Electrician and Mechanic.



In another place in this issue will be found an advertisement setting forth the remarkable offer which the Hess Warming and Ventilating Company is making in connection with the sale of their furnaces and furnace supplies. Being manufacturers, they sell direct from their own factory at factory prices and ask no pay until the heating outfit they sell is installed and has proven to be satisfactory in every way. They "have to make good" and the purchaser of the Hess Furnace runs no risk in accepting their proposition. By furnishing them with a rough sketch of any building to be heated they will send free a simple, clear plan, which can be easily understood, showing every detail of the furnace, pipes, registers, etc., in their proper places, with the exact cost to you of the complete outfit. This does not obligate you in any way to buy of them.

Another special feature of their selling plan is the great co-operative offer whereby every person buying their furnace can get his or her money back from additional sales that may be made without doing any canvassing or soliciting. This plan is fully explained with every estimate. The Hess Warming and Ventilating Company, 908 Tacoma Building, Chicago, is a reliable, long established house and thoroughly responsible.

Write for their free booklets, "Modern Furnace Heating" and "These Bear Witness."



K. & D. Improved Rheostat and Switch

No. 23

Resistance 10 Ohms. Continuous Capacity
2 Amperes.

SUITABLE for regulating miniature lamps, the speed of small motors, and a great variety of service which it would be impossible to mention in detail.

Owing to the peculiar construction of this rheostat, the change of resistance takes place very gradually on movement of the lever, and not by sudden jumps as in the ordinary construction.

The resistance coil has approximately 160 convolutions, and as the rate of change in the resistance on movement of the lever is by single convolutions, it will be seen to admit of very fine adjustment.

The coil is made of a special high-resistance wire, which is very strong, and will not corrode; no soldered connections with the resistance coil.

The coil is air-cooled, and works on our maximum rated capacity at a remarkably low temperature. Experimenters, dentists, surgeons, dermatologists, and all artisans and scientists will find this a most satisfactory and efficient small rheostat and switch.

The workmanship and finish is first class. Metal parts nickel plated. Hard rubber handles. Bases of seasoned wood, polished. Dimensions: $3\frac{1}{4}$ inches diameter; total thickness, including rubber handle, $1\frac{1}{2}$ inches.

DIRECTIONS

When the lever rests on the button marked "out," the coil is cut out, but the circuit is unbroken. To introduce resistance, move the lever in the direction shown by arrow, and vice versa. When lever rests on the button marked "off," the circuit is open.

—PRICE 75 CENTS—

Manufactured by KENDRICK & DAVIS, LEBANON, N. H.

M. M. MOTOR CYCLES

MORE THAN 1200 DELIVERIES

As a matter of fact we have delivered more 1909 models than all other manufacturers combined.

More than 1200 of the 1909 models in actual daily use on the streets and roads of this country.

Ask any owner, he'll tell you what the M. M. will do.

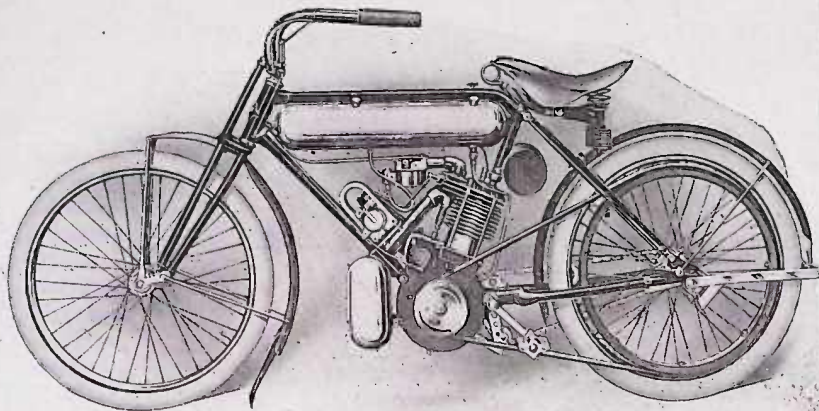
We are willing to stand by what the users say.

WE STILL HAVE M. M. MOTOR CYCLES TO SELL and can give immediate deliveries.

Catalog
and
proposition

**American
Motor
Company**

712 CENTRE ST.
BROCKTON
MASS.



PATENTS

SECURED PROMPTLY

 And with Special Regard to the
Legal Protection of the Invention

Handbook for Inventors and Manufacturers Sent Free upon Request

 Consultation Free. No charge for opinion as to the Patentability and Commercial Value of
Inventors' Ideas. Highest References from Prominent Manufacturers.

C. L. PARKER, Patent Lawyer

 Patents, Caveats, Trade-marks, Copyrights, Reports as to Patentability, Validity, and Infringe-
ment. Patent Suits conducted in all States.

 REFERENCES:—Globe Machine and Stamping Co., Murray Engineering Co., Morgan Machine and Engi-
neering Co., Berkshire Specialty Co., Stewart Window Shade Co., Macon Shear Co., Acme Canopy Co.,
Lippencott Pencil Co., Salisbury Tire Association of America, Inventors' and Investors' Corporation,
Oakes Manufacturing Co., Cox Implement Co., Columbus Buggy Co., National Index Co., By-Products
Co., Alabama Brewing Co., National Offset Co., Antiseptic Supply Co., Richmond Electric Co., Railway
Surface Contact Supplies Co., National Electric Works.

 Mr. Parker, on November 1st, 1903, after having been a member of the Examining Corps of the U. S. Patent Office for
over five years, resigned his position as Examiner to take up the practice of patent law.

Address, 52 McGill Building, Washington, D. C.

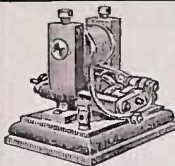
 ONLY a few complete sets of Volume XVII, containing
the first 12 installments of Dr. Watson's articles on elec-
trical engineering, and many other interesting and valuable
articles, remain unsold. The price at present is:

 Vol. XVII, bound in Red Buckram . . \$5.00
Vol. XVIII, unbound, in numbers . . . 1.25
Bound, 2.00

If interested, send 2c. stamp for index to this volume.

PATENTS THAT PROTECT AND PAY

 Advice and Books Free. Rates Reasonable. Highest
References. Best Services.

WATSON E. COLEMAN, Patent Lawyer
612 F ST. N. W., WASHINGTON, D. C


AMATEURS

 Let us send you a set of our No. 1
PARTS and build a motor having
a laminated drum armature, self-
adjusting brushes, and whose rota-
tion on 3 cells can hardly be
stopped.

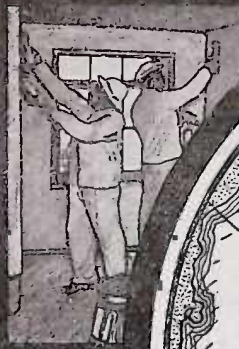
**H. W. PETERS MINIATURE
MOTOR WORKS,**

Price \$1.75. 21 Illinois St. BUFFALO, N. Y.

PATENTS SECURED

 OR FEE RETURNED. Send Sketch for FREE RE-
PORT as to Patentability. GUIDE BOOK and WHAT
TO INVENT, with valuable List of Inventions Wanted,
SENT FREE. One Million Dollars offered for one
invention; \$16,000 for others. Patents secured by us
advertised free in World's Progress; Sample Free.

EVANS, WILKENS & CO.
100 F Street Washington, D. C.




IN ALL THE WORLD

NO TRADES PAY MORE THAN

THOSE OF THE

ELECTRICIAN

PLUMBER AND BRICKLAYER

These are the trades that we teach by practical and indi-
vidual instruction under actual working conditions and
enable you in two to three months to accept a position
paying \$5 a day and over. Tools take the place of books;
we have no classes; it depends entirely upon yourself.
We can teach you the *Plumbing, Bricklaying, or*
Electrical trades, and assist you to a position
upon graduation. Write to-day for free catalogue
and information.

—COYNE—

NATIONAL TRADE SCHOOLS
238 Tenth Avenue
NEW YORK
850 N. Ashland Ave.
CHICAGO, ILL.




\$



\$

LEARN HOW TO INVENT

Our scientific lessons and problems teach the art by correspondence. Write for free booklet
SCIENTIFIC SCHOOL OF INVENTION PROVIDENCE, R. I.

60 YEARS' EXPERIENCE

PATENTS

TRADE MARKS
DESIGNS
COPYRIGHTS & C.

Anyone sending a sketch and description may quickly ascertain our opinion free whether an invention is probably patentable. Communications strictly confidential. HANDBOOK on Patents sent free. Oldest agency for securing patents. Patents taken through Munn & Co. receive special notice, without charge, in the

Scientific American.

A handsomely illustrated weekly. Largest circulation of any scientific journal. Terms, \$3 a year; four months, \$1. Sold by all newsdealers.
MUNN & Co. 361 Broadway, New York
 Branch Office, 625 F St., Washington, D. C.

"MARRIAGE GUIDE"

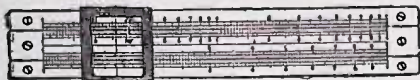
(Special Value and Price. Unusually Instructive.) For those contemplating marriage or already married: and a complete description of human system, male and female, by a prominent M. D. A mine of information. 276 octavo pages, illus'd. Also large Portfolio of nature art plates, all described. Special Price, postpaid \$1. (Table of contents free.) Send stamps, M. O., money or check to E. M. Stevens Pub. Co., 123 N. Broad, Suite 301, Philadelphia, Pa.

Blue Process Paper

Blue Printing

Drawing Materials

Chas. E. Moss 38 BROAD STREET
 BOSTON, MASS.

Fits in the Pocket

Our Vest Pocket Slide Rule complete with instructions specially prepared for students. Sent by mail post-paid—

\$1.80

Catalogue of Drawing Materials, etc., on application.

KOLESCH & CO.

138 Fulton Street (Est. 1885) New York

Samson Batteries



Strength
Long Life
Uniformity

20 Years the Standard

Why not insure correct operation of your apparatus by using this cell?

Ask for booklet and price list. For sale by all jobbers.

Electric Goods Mfg. Co.

**Battery, Telephone, Annunciator,
 and Motor Boat Ignition Specialists**

144E Pearl Street - Boston, Mass.

**Benches, Tools & Supplies**

Lowest Prices. Headquarters. Send for Catalogue.
 Special discount for Schools and Classes.

CHANDLER & BARBER

122 Summer Street - Boston, Mass.



BE A TRAVELING SALESMAN

We have trained hundreds of men to be high-grade Traveling Salesmen, and assisted them to secure positions with reliable firms. We will do the same for you. Our course in **Practical Salesmanship** is endorsed by sales-managers of leading firms everywhere. We also maintain the largest and best equipped **Free Employment Bureau** in the world, with offices in five cities, and have more calls for salesmen than we can fill from the best firms in the United States and Canada. Our graduates earn big money because they get results. Salesmanship is the Universal Science; no matter what your business is, the knowledge of real salesmanship we give you will increase your earning power. If you want to enter the most pleasant, best paid profession on earth, write for our **Free Book**, "A Knight of the Grip." Address nearest office.
 Dept. 350 **NATIONAL SALESMEN'S TRAINING ASSOCIATION**
 New York Chicago Kansas City Minneapolis San Francisco

FLYING MACHINES—Past, Present and Future

A popular account of flying machines, dirigible balloons and aeroplanes—by Alfred W. Marshall and Henry Greenly. This work was written with a view to presenting a popular exhibition of this intensely interesting subject. 12 mo.—134 pages—fully illustrated. Price, 50 cents, postpaid.
SAMPSON PUBLISHING CO. 6 Beacon St., Boston, Mass.

Catch the News While It is Hot

Get a receiving set that will take important messages without interference from experimenters. The Associated Press news of the wreck of the White Star Steamship

REPUBLIC

was received in Cambridge, Mass., more than 100 miles from the wreck, and sent to New York, over the long distance telephone. It was taken on a

TYPE "B" \$25.00 RECEIVER

taken from our stock, and this low-priced instrument received without interruption from 4 A.M. to 7.30 P.M. on Sunday, January 24th. Messages were taken from the "Gresham," "Baltic," Cape Cod and Wellfleet.

TYPE "B" RECEIVING TUNER

Complete with Double Head Telephones, Detector, and wired

—————\$25.00—————

The RECEIVING TUNER is of the loosely coupled type, and has two separate circuits inductively connected, thereby giving maximum SELECTIVITY. The primary and secondary coils are wound on separate tubes and the secondary coil being movable with respect to the primary, permits a change in the coupling between the primary and the secondary circuits without change in wave length thus giving maximum SELECTIVITY.

The primary coil is fitted with our special "inner spring" variable contact for a variation of the inductance. There is a fixed condenser in the primary circuit with a switch for short-circuiting it when not in use. This condenser enables the operator to receive long wave lengths and also to "STIFFEN" the circuit if interference is present.

The secondary coil is also wound on a tube and so arranged that it may be adjusted to give as close or as loose coupling as desired. It is fitted with our special contact, thus allowing for a variation of its inductance. There is a fixed condenser in this circuit, which has been adjusted to the correct value for the range of wave lengths of 200 to 1800 meters.

The woodwork is selected mahogany, highly finished, and all the metal parts are brass, nickel-plated and polished. It is a handsome piece of apparatus, which must be seen to be appreciated.

Have YOU received a copy of our 1909 illustrated catalogue? If not, write for ONE

Acme Wireless Construction Co.

18 WESTERN AVENUE

CAMBRIDGE, MASS.



WE have now succeeded in manufacturing a Spark Coil which is specially adapted for **WIRELESS WORK**. It is not an X-Ray Coil, but it is a Wireless Coil, and is made in all sizes. Special

this month only, our one-inch Spark Coil, \$4.50. Regular price \$6.00. Larger Coils, quotations upon application.

A. B. C. WIRELESS SPECIALTY CO.
TOWER, TRINITY BLDG.
111 BROADWAY - - NEW YORK

The Inventor's Universal Educator

TELLS ALL ABOUT PATENTS,
HOW TO SECURE THEM. HAS

**600 MECHANICAL MOVEMENTS, also
50 PERPETUAL MOTIONS**

Every inventor should have a copy. Price, \$1.00 by mail.
—ADDRESS—

F. G. DIETERICH, Ourey Bldg., Washington, D. C.

MODEL STEAM ENGINES

Vertical, high-speed, double-action, model steam engines and boilers. These engines and boilers make ideal power plants for running small dynamos, model boats, etc. They are well designed and finely enameled and polished. Price:—

1-18 h. p. engine, 3-4 inch bore, 1 inch stroke,	\$3.50
Brass boiler,	3.00
1-10 h. p. engine, 1 inch bore, 1 1-4 inch stroke,	4.50
Brass boiler,	4.00
1-6 h. p. engine, 1 1-4 inch bore, 1 3-4 inch stroke,	6.50
Brass boiler,	5.00

Prices are for finished engines ready to run.

D. L. JONES, 3213 E. 12 Street, Kansas City, Mo.



Miniature Electric Rail- way Motor—

Working Drawings and Full Instructions for Making it.....**25c.**
Empire Elec. Works, 730 Bridgeport, Ct.



VOLTS, AMPERES, RESISTANCES

Measured by our 3-in-1 volt-ammeter. Just what you want. Send for complete catalog of our accurate, compact and inexpensive volt-meters, ammeters, and volt-ammeters.

L. M. PICNOLET
84 Cortlandt Street New York



BUILD YOUR OWN SMALL ENGINE

We sell sets of castings up to 2 horse power. Also boilers, locomotives, gas engines, etc. 32-page catalogue for 10c. in stamps. This amount refunded on order amounting to \$1.00 or over. Contractors for light machinery of every description.

Sipp Electric and Machine Company
River Street, Paterson, N. J.

HOROLOGICAL DEPARTMENT

BRADLEY POLYTECHNIC INSTITUTE
Formerly Parsons Horological
Institute

PEORIA, ILLINOIS
LARGEST and BEST WATCH
SCHOOL IN AMERICA

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



THE CYCLOPEDIA OF Applied Electricity

is a storage battery of electrical knowledge. It is charged right up to the minute with reliable information—it is the *real head of the department* because it contains the work and knowledge of over thirty practical electrical engineers, experts and teachers. This work contains a complete record of their experiments, discoveries and observations. Just the information that the head of any electrical department should have at his finger tips for ready reference.

**You Can Add This Knowledge to Yours
At Half Price If You Order Promptly**

To introduce this great work, we will fill orders for the next thirty days at \$18.60 per set, payable \$2.00 after examination and \$2.00 per month. The regular price is \$36.00. Order promptly. The half price edition is limited.

Examination Free! It won't cost you a dollar to examine the books. Just fill in the coupon. The books will be sent to you absolutely FREE of charge. You can return them at our expense if not satisfactory.

These six big volumes contain 2,896 pages, covering 4,000 different topics. Hundreds of special photographs, diagrams, sections, condensed tables and formulas. Page size 7x10 inches. Printed in large, clear type on special paper, substantially bound in half red morocco.

IMPORTANT SUBJECTS COVERED

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

With this special offer we will also include free as a monthly supplement, a year's subscription to the

TECHNICAL WORLD MAGAZINE

This is a regular \$1.50 monthly, covering present day scientific facts and inventions. An ideal magazine for the home because it is just enough different from the others to make it interesting. Fill in the coupon today—don't wait for tomorrow.

American School of Correspondence, Chicago, U.S.A.

FREE OFFER COUPON

American School of Correspondence:

Please send Cyclopaedia of Applied Electricity for Free examination, also Technical World for 1 year. I will send \$2.00 within five days and \$2.00 a month until I have paid \$18.60; otherwise I will notify you and hold the books subject to your order. Title not to pass until fully paid.

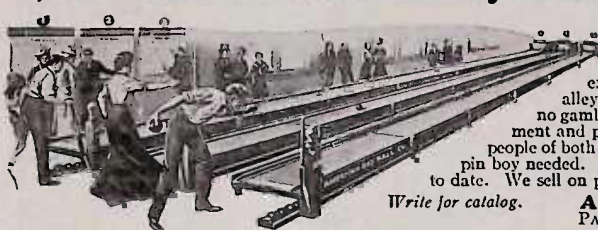
NAME

ADDRESS

OCCUPATION.....EMPLOYER.....

Elect. & Mech. 5-10

\$513 Clear Profit in 51 Days from an Investment of \$150



Write for catalog.

Is the result from the operation of one American Box Ball Alley in Sullivan, Ind. Why not go into this business yourself? It is the most practical and popular bowling game in existence. It will make big money in any town. These alleys pay from \$25.00 to \$85.00 each, per week. This is no gambling device, but a splendid bowling game for amusement and physical exercise. Liberally patronized by the best people of both sexes. Quickly installed, conveniently portable. No pin boy needed. Receipts are nearly all profit. Nearly 5,000 sold to date. We sell on payments and our catalog is free.

AMERICAN BOX BALL COMPANY
PATENTEES, 1570 Van Buren St., Indianapolis, Ind.



WE SHIP ON APPROVAL

without a cent deposit, prepay the freight and allow 10 DAYS FREE TRIAL.

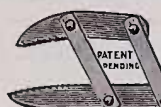
IT ONLY COSTS one cent to learn our unheard of prices and marvelous offers on highest grade 1909 model bicycles.

FACTORY PRICES Do not buy a pair of tires from anyone at any price until you write for our large Art Catalog and learn our wonderful proposition on first sample bicycle going to your town.

RIDER AGENTS everywhere are making big money exhibiting and selling our bicycles. We sell cheaper than any other factory.

Tires, Coaster-Brakes, single wheels, parts, repairs and sundries at half usual prices. Do Not Wait; write today for our special offer.
MEAD CYCLE CO., Dept. K 250 CHICAGO

THE LAKE SUPERIOR WRENCH



NO ADJUSTING NECESSARY

The Illustration Shows How

The harder you pull the tighter it grips

For shop, farm, household, automobile, gas engines. For everything and everybody. Works equally well on pipe or nuts of any kind or shapes. Ask your dealer or send \$1.00 for prepaid 12 inch sample and terms To-Day. Big Money for Agents.

LAKE SUPERIOR WRENCH COMPANY,

130 Maple Street,

Sault Ste. Marie, Mich.

LEARN TO SHAVE

SAVES MONEY AND TROUBLE.

Our free book tells how, also gives lowest prices on shaving outfits. Send for it.

LOVEL & Co., Dept. E. M., Amsterdam, N. Y.



Electric Power Motor

Sample prepaid **35c.** Agents Wanted
Empire Elec. Works, 730 Bridgeport, Ct.

\$2.50 FOR \$1.25

One year's subscription to **POPULAR ELECTRICITY** the wonderful new magazine IN PLAIN ENGLISH on Electricity... **\$1.00**

"Practical Lessons in Electricity," the most complete and concise book on Electricity ever published.... **\$1.50**

Every Electrician and Student Should Have Both

All for \$1.25 if sent with this advertisement. (Add 50 cents for Canada and foreign countries.) Act now.

Last Chance at This Price

Popular Electricity Publishing Co.
1252 Monadnock Block, Chicago, Illinois

WE HEAR THE QUESTION
EVERY DAY—

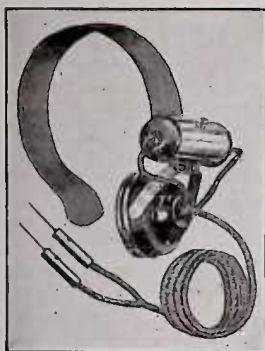
What is the Best Book on Wireless Telegraphy?

There are several good books, but if you want to know how to construct and use the latest apparatus, you cannot get better information for the money than by buying the back numbers of

Electrician and Mechanic.

Every one has one or several practical articles. We will sell you

14 Back Numbers, Jan., 1908— \$1.00
Feb., 1909, WHILE THEY LAST



PAT. APPLIED FOR

WIRELESS EXPERIMENTERS ATTENTION

OUR CIRCUIT DETECTOR

will be a most valuable addition to your equipment. Just the instrument for testing your apparatus and connections. Detects all circuit and connection troubles.

Makes an Ideal and Reliable Wireless Operator's Head Receiver.

COMPLETE—With high grade receiver, leather covered head band, battery and 5 foot green cord. **Prepaid to any part of the U. S. or Canada on receipt of \$2.50**

Our watch case style "W" telephone receiver sent **POSTPAID** on receipt of 80 cents. Three foot cords for same 20 cents.

WE ARE THE MANUFACTURERS. SEND US YOUR ORDERS.

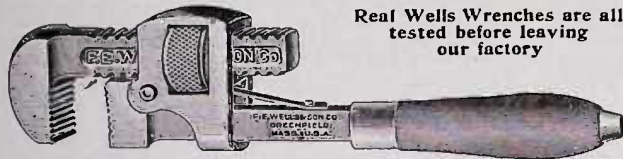
WM. J. MURDOCK & CO., Carter St., CHELSEA, Mass. Sales Dept.



STYLE "W"

WELLS PIPE TOOLS

Special Offer



Real Wells Wrenches are all tested before leaving our factory

To introduce our tools to the readers of this magazine we will send prepaid any of the following **GUARANTEED TOOLS**

No. A WELLS PIPE TOOL SET

- 1 Set STOCKS, eight pieces, $\frac{1}{8}$ in. to 1 in.
- 1 14 in. PIPE WRENCH, $\frac{1}{8}$ in. to $1\frac{1}{2}$ in.
- 1 No. 1 ROLLER PIPE CUTTER, $\frac{1}{8}$ in. to $1\frac{1}{4}$ in.
- 1 No. 1 HINGED PIPE VISE, $\frac{1}{8}$ in. to $2\frac{1}{2}$ in.
- 1 OIL CAN
- 1 lb. Can PIPE JOINT CEMENT

Packed in Nicely Finished Hinged Chest

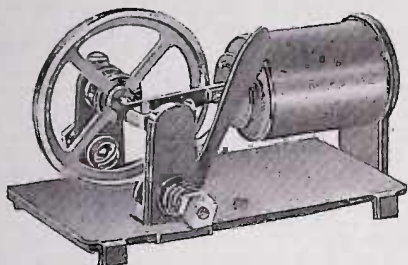
PRICE \$9.00

WELLS PIPE WRENCHES

1 8 in. WRENCH, $\frac{1}{8}$ in. to $\frac{3}{4}$ in. PIPE,	\$0.67
1 10 in. " $\frac{1}{4}$ in. to 1 in. "	0.75
1 14 in. " $\frac{1}{2}$ in. to $1\frac{1}{2}$ in. "	1.00

F. E. WELLS & SON CO.
GREENFIELD, MASS.

SOLENOID ELECTRIC ENGINE



Will run a long time on one cell of wet or dry battery. 1000 REVOLUTIONS A MINUTE. Has reversing cam controlling speed and direction. A marvel of skilled workmanship.

HANDY ELECTRICAL DICTIONARY

Vest Pocket Size

A compact, reliable reference, invaluable to the student, amateur, practical electrician or the expert.

224 pages—Plain English definitions of over 4,800 electrical terms and phrases—7 pages of diagrams. Handsome red leather binding—gilt edges—margin index.

No one Interested in Electricity should be without it.



POPULAR ELECTRICITY

IN PLAIN ENGLISH

An up-to-date electrical magazine for everybody. Non-technical, profusely illustrated, intensely interesting and instructive. Posts you on electricity in all its branches.

Ten cents a copy. One dollar a year

(Canada \$1.35, Foreign \$1.50)

Including **ELECTRIC ENGINE** or **ELECTRICAL DICTIONARY** illustrated.

Subscribe for 2 years and get both premiums

*
POPULAR ELECTRICITY PUBLISHING CO.
Monadnock Bldg.
Chicago.

CUT OUT—MAIL TO-DAY

Enclosed find \$ for years subscription to Popular Electricity in Plain English and Electric Engine—Electrical Dictionary (Show which) as advertised in Electrician and Mechanic for May, 1909.

Name

St. and No.

Town

State

SALE AND EXCHANGE

Advertisements under this heading, without display, 3 cents per word, cash with order, minimum, 75 cents. Black-faced type, 4 cents a word, minimum, \$1.

WIRELESS TELEGRAPHY

INSTRUCTION IN WIRELESS TELEGRAPHY.—Send 25 cents in coin for the best wireless instruction book published. Everybody can understand it. Make your own wireless outfits. All kinds of wireless apparatus at low prices. Send stamps for catalogue. **THE ELECTRICAL EXPERIMENTERS' SUPPLY CO.**, Room 502, 622 Wells Street, Chicago, Ill. (8)

WIRELESS OUTFITS for ship and shore stations from $\frac{1}{4}$ k.w. up. Portable outfits a specialty, write for prices. Long distance portable receiving outfit No. 24 B mounted on heavy mahogany base to withstand the roughest usage, complete with 3,000 ohm head phones \$28.00. **HAROLD P. DONLE**, 9 Phillips St., Providence, R.I.

1000 OHM DOUBLE POLE TELEPHONE RECEIVERS—\$1.75, very sensitive. Zincite and chalcopyrite 35c or free with every two receivers bought before the twentieth. Everything for wireless. **ALDEN WIRELESS CO.**, 1210 Montello St., Campello, Mass.

FOR SALE OR EXCHANGE—\$17.00 dash coil in oak box, without top, otherwise in perfect condition, giving a good fat spark, \$6.50. **STAFFORD HENDRIX**, Rye, N.Y.

ENAMELED WIRE FOR TUNING COILS—300 ft. No. 28 for 25c; 125 ft. No. 24 for 25c. Rewind your own receivers. 1000 ft. (1000 ohms) of number 40 enameled wire for same 50c. Large Cardboard Tubing. 4 and 3 $\frac{1}{2}$ in. diameter for "loose coupled" receiving. One foot of each size 25c. Postpaid. **MIDDLESEX WIRELESS SUPPLY CO.**, 94 Antrim St., Cambridge, Mass.

SPECIAL PRICES—1000 ohm single pole wireless receiver, \$1.35; double pole, special thin diaphragm, \$1.75. Leather covered head bands, single, 50c; double, 90c; "Eclipse" 12 in. double slide tuning coil, \$2.00. Blueprint showing Morse, Continental and Navy Codes, 10c. Diagrams and complete instructions for making Marconi Magnetic Detector, 25c. Receivers and Head Bands postpaid. **WATERHOUSE BROS.**, 5 Main St., Bourne, Mass.

LEFT OVER FROM A CONTRACT AND FOR SALE CHEAP—A numbers of tested wireless receiving sets, consisting of tuning coils, silicon detectors and condensers. New and in perfect condition all ready for use. Experimental work by experienced workmen. Low price on application to **JEROME REDDING & CO.**, 40 Hanover St., Boston, Mass.

SEND FOR MY BLUE PRINTS of 1 k.w., 20,000 volt Transformer. Can be built for \$20.00. Blue prints of $\frac{1}{4}$ k.w. transformer, price to build \$12.00. Either set sent for fifty cents. What you don't know about wireless ask me, no charge. **J. H. WHITE**, Ross, Calif.

EXCHANGE OR SALE—12 microphones detectors, several electrolytic detectors, a few linemen's galvanometers, hot wire meters (for wireless), 6 carbon cups for detectors complete wireless receiving stations (tuned circuits) all sizes up to 4 in. steam turbine vane wheels, several spark gaps. Will exchange or sell; write for prices. What have you? or what do you want? Write me; all letters answered. **JAMES W. PRYER**, Rusk, Texas.

BOOK OF LIFE

BIG VALUE for \$1.00 (4 Parts in ONE BOOK \$1.00) postpaid.

I.—SEX and LIFE. Mysteries of Nature.
II.—TOKOLOGY, LOVE, MARRIAGE, Etc.
III.—HEALTH, School of Medical Science. Home Treatments.
IV.—DISEASES. Ounce of Prevention cures. Male and female.
You would not be without the knowledge for many times its price. Exceedingly valuable and intensely interesting work on Sex, Health, Love, Mutual Relations, Diseases. What Determines Sex. Contains 512 octavo pages, profusely ILLUSTRATED; always a work of reference. Plainly sealed postpaid, \$1.00 complete. Strong light cover. Confidence respected. Remit by M. O., check, registered letter, stamps or coin at our risk.
E. M. STEVENS PUB. CO., Suite 303, 123 N. Broad St. Phila., Pa., U. S.

ELECTRICAL

BLAKE'S ELECTRICAL CONNECTING CORDS meet want of ready means of connecting apparatus using moderate currents. Indispensable to electrical workers. Soft, flexible, different colors for easy tracing, spring-clip attachments. In 20, 30, 40 in. lengths. Prices 10c, 15c, 20c each. **W. BLAKE**, 253 Blake St., New Haven, Conn.

FOR SALE—Two 5-bar magnetos, \$1.75 each, 1 dynamo-motor 18 volts, 1 ampere, \$2.00. About 5 lbs. of magnet wire, different sizes, \$1.50. One hammerblow vibrator 60c P.P. Electric bells and also other goods. **THEO. J. TRYKE**, R-4, Annandale, Minn.

READ THIS—200-watt dynamo, rough castings, \$4; blueprints 50c. It castings are ordered within 30 days after prints, price of prints refunded. Photo for 2c stamp. 100 watt dynamo, blueprints 50c. $\frac{1}{4}$ or $\frac{1}{2}$ h.p. water motor, blueprints 25c. **LEE, HARRIS & CO.**, Dept. C., Box 414, Jamestown, N.Y.

ONE AND ONE HALF H.P. MOTOR for sale cheap. **GEO. A. WILSON, Jr.**, 20 St. Stephen St., Boston, Mass.

FOR SALE OR EXCHANGE—One $\frac{1}{4}$ h.p. Emerson Motor for 52 volts and 60 cycles, now wound for 104 volts; 28 German silver wire; magnet wire; one telegraph sounder. One telephone ringer. Send at once to **ROBERT H. CLARKE**, 920 Arthington, Nashville, Tenn.

EXCHANGE OR SALE—Fine 4x5 camera and outfit, almost new; Blickenderfer typewriter in first class condition; one 9 in. battery fan motor complete; one 220 volt D.C. $\frac{1}{4}$ h.p. Lundell motor; one Manchester type dynamo suitable for charging storage batteries or plating. Takes about $\frac{1}{4}$ h.p.; filing coherer with decoherer; several fine telegraph instruments and keys; good violin, bow and case; new medical battery; small spark coil for demonstrating wireless; Hopkins' Experimental Science; several lbs. No. 36 S.S. magnet wire. Wanted—Good wireless apparatus. No playing. Or one h.p. 220 volt 3 phase 60 cycle motor. Or what you have. Letters with stamps answered. **C. N. SANDBECK**, Wankon, Ia.

MACHINERY AND TOOLS

CASTINGS OR FINISHED PARTS for Commercial Motors 1-12 to 1-2 h.p. Dynamos 2 to 10 lights. Complete finished machines at low prices. Armature discs 2 to 6 in. diameter. Commutators 7-8 to 3 in. diameter. 12 to 48 bars. Two cent stamp for circular. **F. E. AVERILL**, 367 7th St., Buffalo, N.Y.

FOR SALE—Complete set of castings, with blueprints of $\frac{1}{4}$ h.p. gasoline stationary engine; includes governor and timer, screws, etc., \$10. **COMET MOTOR WORKS**, 17 W. Madison Street, Chicago, Ill. (8)

FOR SALE—One $\frac{1}{4}$ h.p. 4-cycle stationary gasoline engine in A1 condition. One 22-caliber repeating Savage Rifle, in A1 condition, write for particulars. **LEONARD JOHNSON**, Box 33, Springdale, Ark.

FOR EXCHANGE—Elgin miniature 40-watt steam engine and automatic flash boiler, all complete. Never used, cost \$25.00, for a 2 in. spark coil or what? **STROBEL**, 6833 Champlain Ave., Chicago, Ills.

GAS MACHINE WITH PIPES AND FIXTURES—Will light 4-story house. Will exchange for 40-light dynamo or storage batteries. Inquire of **E. CANTRELL**, Huntington, N.Y.

FOR SALE—2 small Engine Lathes, 10 in. and 12 in. fine condition, bargain. **ACME VISE CO.**, South Bend, Ind. East Side.

PATENTS

PATENTS.—**H. W. T. JENNER**, patent attorney and mechanical expert, 608 F Street, Washington, D.C. Established 1883. I make an investigation and report if patent can be had, and the exact cost. Send for full information. Trade-marks registered.

Everything for Furnace Work

**On Free Trial At Our
Expense**
Until Jan. 1st, 1910

Our story is quickly told. We will send you a Hess Steel Furnace and complete heating outfit, including pipes, registers, fittings and everything needed, for from \$25 to \$100 less than you can buy from dealers, and deliver it at your station, freight prepaid. You may place the purchase price in the hands of your local banker who will hold the money until Jan., 1st, 1910, while you test the heater.

If the test is not satisfactory to you in every way, you may return the goods at our expense and have your money back, we to pay cost of removal and freight charges both ways. Ask us more about it. There's money in it for you. Our great co-operative plan makes you a partner in our success. We explain this with every estimate. This offer also applies to heating equipments for all buildings. We manufacture and sell from our Factory direct to you.

Heating Plans Free! Write for Booklets!

Send us a rough sketch of any building that you wish to heat and—without any charge or obligation on your part, we will have our experts prepare a simple, clear plan, which you can easily understand, showing every detail of the furnace, pipes, registers, etc., in their proper places,, with the exact cost to you of the complete equipment.

The Hess Furnace will burn any fuel. Besides any kind of coal, or wood,—chips, twisted straw, corn cobs or any other waste fuel can be utilized and money saved.

Our free booklets, "Modern Furnace Heating" and "These Bear Witness," give valuable information about heating any building perfectly and economically. Write today for these booklets.

Hess Warming & Ventilating Co.,
908 Tacoma Bldg., Chicago



No 45
**"Leader" Steel
Furnace**

Price \$49 Pipes and
Registers Extra
Delivered any station east of Omaha
and north of the Ohio River.

These
Important
Heating
Books
FREE



ELECTRICITY Girdles the Globe

It is the giant force of the Century. Electricity offers larger rewards to PRACTICALLY trained followers than any of the other professions.

Learn it and you have mastered the most fascinating and BEST PAID calling of to-day.

Our school, the most thoroughly equipped in the United States, teaches PRACTICAL ELECTRICITY in all its branches, and nothing else. Individual instruction, day or evening by skilled teachers.

Write for 64 p. illustrated book. It's free.

The New York Electrical Trade School
39½ West 17th Street, New York
No connection with any other School or Institute.

WIRELESS

The Study With a Future

No line of work offers so brilliant prospects to electrical enthusiasts. Equip yourself for the pleasure of it or for a profitable livelihood.

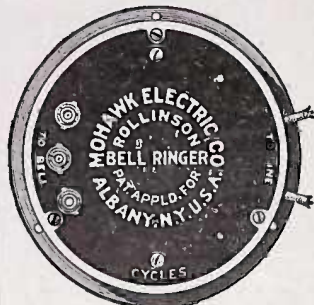
WE HAVE A DEPARTMENT DEVOTED EXCLUSIVELY TO THE DESIGN AND MANUFACTURE OF WIRELESS APPARATUS.

Our receiving outfits are of original design, made by the best instrument makers in this country. Special compact apparatus for the amateur.

Write to us for prices and detailed information.

PRAGUE ELECTRIC CO.
107 Westminster St., Providence, R. I.

Be MODERN as the TIMES



Stop using
BATTERIES

Approved by under-
writer. List Price

\$4 and Up

Will REPLACE
BATTERIES any
number.
No System of
Bell too large

Write for Catalogue 28 M.

Mohawk Electric Co.

PRINTING

BUSINESS CARDS, 250 for 75 cents with case; 100 white envelopes printed for 45 cents; 100 note heads for 50 cents; 100 letterheads for 65 cents; postpaid. **RICHARD D. ELLIOTT**, 1010 Olive St., Louis, Mo. (tf)

MISCELLANEOUS

YOUNG MEN—Latest Parisian novelty sheath gown watch fob, all the rage, 20c silver. **FOB SALES CO.**, 16 Meadow St., So. Norwalk, Conn.

STEAM CAR OWNERS, subscribe now for steam Motor Journal, monthly, devoted to steam cars. 1409 Welton St., Denver, Colo. Price 15c copy; \$1.00 year.(tf)

YOUR BUSINESS SOLD QUICKLY FOR CASH. Send price and description. Terms free. Address **FRANK P. CLEVELAND**, 1210 Adams Express Building, Chicago, Ill.

MAKE YOUR OWN FURNITURE, using our full-size, new plan patterns. Send 20c for patterns of hall seat or flower stand. Money back, guarantees satisfaction. Get handsome illustrated free catalogue. **HOME FURNITURE PATTERN COMPANY**, 2017 First National Bank Bldg., Birmingham, Ala.

BOOKS

BOOKS.—Trigonometry Simplified, 50 cents; Lettering, 25 cents; Electrical Dictionary, 25 cents; Lutes and Cements, 10 cents; Catalogue free. **NATIONAL BOOK CO.**, Cleveland, Ohio. (tf)

HELP WANTED

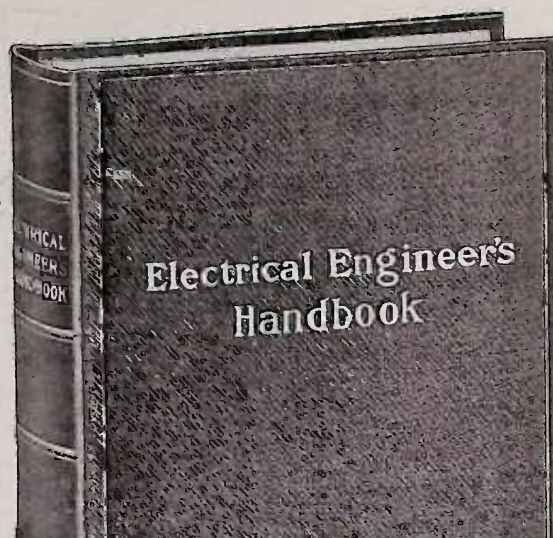
AGENTS, MACHINISTS, TOOLMAKERS, DRAFTSMEN, attention! New and revised edition Saunders' "Hand Book of Practical Mechanics," now ready. Machinists say, "Can't get along without it." Best in the land. Shop kinks, secrets from note-books, rules, formulas, most complete reference tables, tough problems figured by simple arithmetic. Valuable information condensed in pocket size. Price, post-paid, \$1. cloth; \$1.25, leather with flap. Agents make big profits. Send for list of books. **E. H. SAUNDERS**, 216 Purchase Street, Boston, Mass.

PHOTOGRAPHY

KODAKS, CAMERAS, LENSES, EVERYTHING PHOTOGRAPHIC.—We sell and exchange. Get our latest bargain list; save money. **C. G. WILLOUGHBY**, 814 Broadway, N.Y. (tf)

NATURE.—Art Portfolio 15x11 of 7 handsome reproductions and 6 full descriptions. Also Zugassentism Pt. 2, folder, just out; also 2 fine natural reps. of "WOMAN BEAUTIFUL" and a choice set for framing, all for simply \$1.00 postpaid; (or 50c. for portfolio alone.)

MARRIAGE GUIDE for those contemplating marriage or already married, and a complete description of human system, male and female, by well known M. D. author. A mine of information. 276 oct. pp. Special price, postpaid, with large bound set of assorted nature art plates, \$1. Table of contents free. Send stamps, M. O. money or check. (Unusually instructive.) **COMBINATION OFFER** combination Price for the two complete \$1.00 offers, prepaid simply \$1.45. Address **E. M. Stevens Pub. Co.**, Suite 303, Odd Fellows Temple, Phila., Pa.



Special Offer

This little book contains more knowledge about the electrical engineering and allied trades than any other book of its size in existence. It is compiled from the Courses of the International Correspondence Schools and can be readily understood by men having no knowledge of higher mathematics. The description of dynamos and motors, their faults, method of locating faults and remedying them, is clear and practical. Of much importance are the sections on alternators, alternating-current motors, diagram of connections, and tables. Information is included on the speed control of electric cars and multiple-unit trains, storage batteries, electricity and magnetism, direct-current dynamos and motors, electric batteries, AC wattmeter measurements, etc.

SPECIAL OFFER.—To those sending us the coupon below we will send this book containing 420 pages, 262 illustrations, bound in cloth, with gilt top and title, printed on high-grade paper in clear type, regularly sold at \$1.25, for

50^c

International Textbook Company

Box No. 930-P, Scranton, Pa.

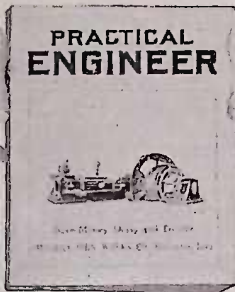
I enclose 50 cents which with this coupon entitles me to one copy of your Electrical Engineer's Handbook

Name _____

St. & No. _____

City _____ State _____

GOOD FOR 75^c



9 x 12 Inches, 132 Pages

YOURS 2 YEARS FOR \$1.50 AND YOU GET THIS VALUABLE TOOL FREE!

PRACTICAL ENGINEER is the paper all engineers like. From cover to cover it is packed with good, live engineering information, interesting illustrated articles, snappy, helpful editorials, experiences and anecdotes of engineers, and the latest and most useful facts about power plant operation and machinery. It gives plain, practical instruction and information adapted to the needs of the man-on-the-job and every word is to the point, presented in clear, forcible, down-on-the-earth style easily understood by every engineer.

It is a Journal you need. It will make your work easier and help to you do it better by pointing the way to better methods and quicker results. In fact, you can get from each issue of **PRACTICAL ENGINEER** more

good, practical suggestions for improving your work, lessening labor and cutting cost than from any other source. **Only \$1.50**, and **PRACTICAL ENGINEER** will be sent to you each month for two whole years, and you will also receive this **6-inch Polished Steel Combination Square**, the handiest tool you ever owned, and you'll get it

absolutely

FREE



THIS
STEEL
COMBINATION
SQUARE FREE

It is made of polished steel with engraved figures, and takes the place of a whole set of try-squares. You can adjust it to any point within its length and it combines in one compact tool an adjustable square (accurate to a hair's breadth), a miter, depth gauge, level and a handy little scratch awl on the bottom. It is just the thing for the engineer. You'll find use for it constantly. And it's yours free for two years' subscription to **Practical Engineer**. Simply send us your personal check, money order, or \$1.50 cash. The Square and Current Number will be sent you by return mail. If, after receiving them, you do not think you have your money's worth, or if you are dissatisfied in any way, simply return the square, and your money will be refunded at once.

PRACTICAL ENGINEER

THE POPULAR POWER PLANT MONTHLY

365 Dearborn Street, Chicago, Ill.

Canadian Subscribers send \$1.00 extra for postage.



Promoted!

Don't you worry about the boss not having his eye on you and noticing the improvement in your work. Remember that he is human — he is on the look-out for good men — his own success and the firm's depends on his ability to select the right man.

If you are a little better than the other man — if you know more about your work than he does, do you suppose the boss will pass you by and boost the other fellow?

You wish you had a better job. You wish you knew more, then you could do more and earn more. Fill in the blank form below and let us tell you how your wishes can be realized. Our advice, based upon the experiences of our successful students and graduates, will cost you nothing. It may start you right and change your whole future.

The American School is an educational institution. We employ no agents or collectors. Our reputation and the merit of our work makes this unnecessary. Advice regarding the work you want to take up and our complete bulletin will be sent for the coupon — be sure and mail it to-day.

We Help Men Help Themselves

Free Information Coupon

American School of Correspondence, Chicago, Ill.

Please send me your free Bulletin of Engineering Information and advise me how I can qualify for position marked "X."

..... Electrical Engineer	 Telephone Engineer
..... Draftsman	 Heating and Vent. Engr.
..... Mechanical Engr.	 Architect
..... Stationary Engr.	 Hydraulic Engineer
..... Structural Engr.	 Textile Boss
..... Municipal Engineer	 Sh. Metal Pat. Draftsman
..... Railroad Engineer	 College Prep. Course
..... Structural D'ftsman	 Sanitary Engineer

Name

Address

Occupation

Elect. and Mech. 5-09

IGNITION

"AMERICAN" Coils for all types
of gas and gasoline engines

Dash board motor car Coils with
removable units

Motor cycle and Motor boat Coils

"AMERICAN" Spark Plugs
with patent double mica core

"AMERICAN" Timers with
roller contact, aluminum case

THE AMERICAN COIL CO., INC.
FOXBORO, MASS.

Induction Coils and Wireless Receivers WOUND TO SPECIFICATION

Anything appertaining to high frequency
apparatus is our specialty
Write for our prices

AJAX ELECTRIC MFG. CO.
96 ESSEX STREET, BOSTON, MASS.

MYBOOK
FREE

Memory the Basis of All Knowledge

Stop Forgetting THE KEY TO SUCCESS
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, 920 Auditorium Bldg., Chicago



MACK & CO., 18 Brown's Race, Rochester, N.Y.
Manufacturers of the **FAMOUS D. R. BARTON**
TOOLS, the most complete line of superior edge tools for
Training Schools in the United States. Wood Planes, Chisels,
(all kinds), Addis Pattern Carving Tools, etc. Catalogues Free.

GEM MOTOR 75c.

Practical and substantial; will run small
mechanical toys on one cell dry battery.
Has adjustable brushes and extra large
field coil. Best on market

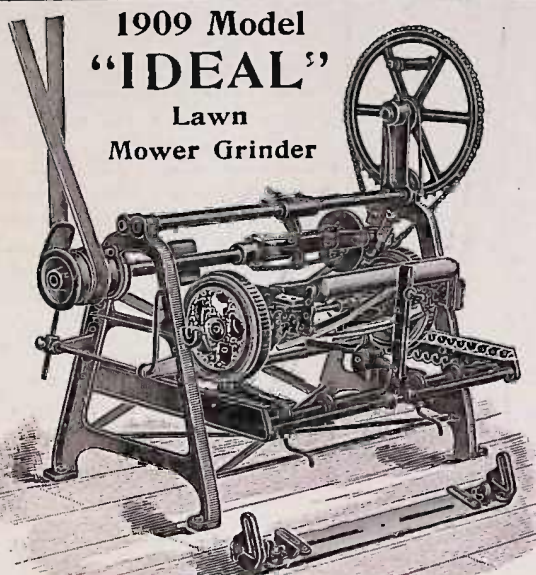
Only 75 cts. Postage 15 cts.
TREMBLY ELECTRIC CO.
CENTERVILLE, IOWA.



ALL SAFETY RAZOR BLADES 2½c

KEENEDGE CO., 169 Congress Street, Boston, Mass., and 169 Keenedge Bldg., Chicago.

We **RESHARPEN** Double edge and other safety blades for only 2½c
each. You can't afford to throw away old blades when we will sterilize, re-
sharpen and make them better than new at this trifling price. We return your own partic-
ular blades. State number and make of blades and we will send a convenient mailing
package free. **WRITE NOW.**



**1909 Model
"IDEAL"
Lawn
Mower Grinder**

"You Grind it as you find it"

The 1909 Model of the **"IDEAL" Lawn Mower Grinder**

grinds the **REEL KNIVES** to fit the
straight blade even if the latter is bent
and out of shape—something never
done before, and the most important
feature of Lawn Mower sharpening.
Has 5 in. ball bearing grinding wheel,
babbitted bearings, **Twice as Easy
Running as Any Other.**

Grinds either right or left hand Mowers per-
fectly in 15 minutes, without removing ratchets
or wheels. We are the originators, and six
years' experience has shown us how to make
them perfect.

Send for circular giving full information and prices. Write
to-day.

The HEATH FOUNDRY & MFG. Co.
(Successors to The Root Bros. Co.)
PLYMOUTH, OHIO.

Electrician and Mechanic PATENT BUREAU

United States and Foreign Patents Obtained

Owing to the large number of inquiries we are constantly receiving from inventors, we have established a bureau for the convenience of our readers, through which they will be enabled to secure patents on their inventions at the lowest cost consistent with the work performed. We have retained a firm of skilful patent attorneys of Washington, D. C., with a branch office in Boston, who will have charge of this bureau, and who will pay special attention to the legality of patents secured.

If you have made an invention and contemplate applying for a patent, the first step is to learn whether your idea is patentable. Do not depend on the fact that you or your friends have never seen anything of the kind.

Send us a pencilled sketch, showing plainly your invention, and write out a brief description of its construction and operation as well as you can. If you have a model send this also, express prepaid. We will give you our opinion as to the patentability of your invention based on years of experience, and you will get honest advice as to the probable value of your invention.

By having our report as to the patentability of your invention, you will have documentary evidence that at the date of such report you were in possession of the invention referred to therein, and thus be assisted in establishing invention should it ever be necessary to prove that you were the prior inventor.

With the report of reputable and experienced patent attorneys showing that your ideas are new and practicable, you may be able to interest capital in your invention, and thus provide for expenses incidental to the patent, etc.

If you have been working on an invention that is not new, or for which there is no demand, we will so inform you, and you can drop it without further trouble or expense.

DON'T DELAY

Procrastination has cost inventors more money and resulted in the loss of more patents to bona-fide inventors than all other causes combined.

An inventor, in order to protect his ideas, should not postpone applying for a patent.

Fill out the coupon below and forward, together with the description, sketch and model if you have one, as above directed, to this bureau and our attorneys will immediately take up the case.

Inventor (Name in full).....

Residence (Street and No.).....

City or Town.....

Attach above to description of patent and forward by mail to address as follows:—

Electrician and Mechanic Patent Bureau

6 BEACON STREET

BOSTON, MASSACHUSETTS

K. & D. Juno Motor

THE JUNO is a battery motor, of superior design both electrically and mechanically.

It is sufficiently powerful to operate slot machines, photographic apparatus, sign flashers, etc. It is of the iron-clad type, with exposed commutator. This feature adds greatly to convenience; the commutator may be readily inspected or cleaned. The field is cast in one piece, of special metal. Field coils are form wound. Armature is of the drum type, built up of finest charcoal iron laminations; slot wound. The commutator segments are of hard copper, *mica insulated*.—The K. & D. system of making small commutators with mica insulation is quite unique, and the product is decidedly of high quality.—K. & D. dependable, self-adjusting brushes of the radial type. Steel armature shaft, with two speed grooved pulley. Finely finished in black enamel and nickel.



Standard battery winding: 4 volts, 1.5 amperes, 2000 R. P. M., with average load. Occupies space, 3 1-2 x 3 1-2 x 3 1-2 inches. Weight, 2 pounds. Price\$5.00

Specially wound to run in series with 16 c. p. lamp on 110-volt DIRECT current circuit. Price.....\$6.50

Unless otherwise specified, regular battery winding will be sent.

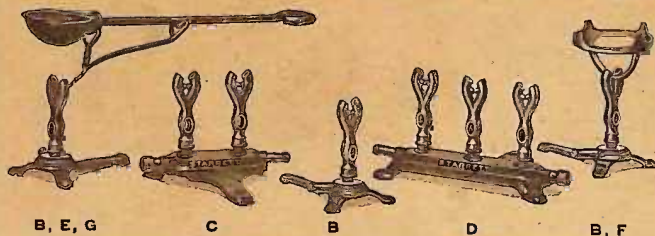
MANUFACTURED BY

KENDRICK & DAVIS

Lebanon, New Hampshire

STARRETT GAS HEATER

More heat—less gas



FOR
Mechanics, House-keepers, Plumbers, Electricians, Dentists, Jewelers, Tin-smiths, Barbers

These patented Double Tube Gas Heaters with nickel plated burners and japanned bases, are so made as to cause the gas and air to become thoroughly mixed for perfect combustion while passing through deflectors in base of tubes. The tubes are so formed as to cause the flames to penetrate each other at cross angles, producing a clean, intense heat, free from smoke and with no waste of gas. The heater will be found very useful in the machine shop, as it is convenient for tempering small tools, melting lead, babbitt, etc., and as a forge for light work. For laboratory and household use it has no equal. Over it a quart of water will boil in six minutes. Soldering irons with short handles can be used with this heater, without fear of heating the handle. The two and three burner heaters are made with a graduated adjusting tube on the end to supply the gas to one or more burners as desired.

Ask for free Catalog No. 18 W of Fine Mechanical Tools

THE L. S. STARRETT COMPANY

ATHOL, MASSACHUSETTS

U. S. A.