

ELECTRICIAN & MECHANIC

Armature Windings

Forging for Amateurs

Insulation of Spark Coils

**Construction of Electrolytic
Rectifier**

Furniture Building

Home-made Jewelry

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

STANLEY

B
A
I
L
E
Y

P
L
A
N
E
S

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, 5 $\frac{1}{4}$ inches in Length, 1 $\frac{1}{4}$ inch Cutter,	\$1.65
2	Smooth, 7 inches in Length, 1 $\frac{3}{8}$ inch Cutter,	2.05
3	Smooth, 8 inches in Length, 1 $\frac{1}{2}$ inch Cutter,	2.20
4	Smooth, 9 inches in Length, 2 inch Cutter,	2.40
4 $\frac{1}{2}$	Smooth, 10 inches in Length, 2 $\frac{1}{8}$ inch Cutter,	2.75
5	Jack, 14 inches in Length, 2 inch Cutter,	2.75
5 $\frac{1}{2}$	Jack, 15 inches in Length, 2 $\frac{1}{4}$ inch Cutter,	3.15
6	Fore, 18 inches in Length, 2 $\frac{3}{8}$ inch Cutter,	3.50
7	Jointer, 22 inches in Length, 2 $\frac{3}{8}$ inch Cutter,	4.00
8	Jointer, 24 inches in Length, 2 $\frac{3}{8}$ inch Cutter,	4.80

Write for Catalogue

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

A \$175 Wireless Set Free

☞ The publishers of ELECTRICIAN AND MECHANIC will give absolutely FREE, on February 1, 1909, a set of Wireless Telegraph Sending and Receiving Instruments worth \$175 to the reader who obtains the largest number of subscriptions to the magazine before that time. As we will pay a liberal commission on all subscriptions obtained by those who do not win this valuable outfit, we hope every reader will try for the prize. ☞ This set is made by the Clapp-Eastham Co. of Boston, may be seen at their warerooms, and the specifications are as follows:

☞ This installation is a complete model of a modern commercial station, and is thoroughly up to date, having tuned sending and receiving sets. The entire outfit is mounted in two solid mahogany cabinets, one containing the receiving and the other the transmitting apparatus, all finished in the best possible manner. The set is designed to operate on 110 volt alternating current, and takes about 2½ amperes at its maximum point, having a multiple switch so that the current may be varied in several steps downwards from this point. If desired, it will be furnished wound for 220 volts. Where direct current only is available, a one-half horse power rotary converter may be installed at small cost, to change the current from direct to alternating. If it is desired to operate the set from batteries an independent interrupter may be used.

☞ The receiving set consists of a receiving transformer, "Ferron" detector, tubular condenser, pair of telephone head receivers wound to 1000 ohms resistance to each ear, potentiometer and dry battery. As previously stated, these are mounted complete in a mahogany cabinet and are equal in appearance and sensitiveness and permit of as fine tuning as most commercial stations. Using a 100 ft. aerial, messages should be readily received from high power stations at distances of several hundred to a thousand miles.

☞ The sending set consists of a 250 Watt transformer, glass plate condenser, adjustable spark-gap (composed of Ceco alloy, which will not corrode and wear down, as do the usual zinc or brass gaps), oscillation transformer, having variable inductance in primary and secondary, and key.

☞ Used with a suitable aerial 80 or 100 ft. in height, this sending set will operate for twenty miles under average conditions, and under the best conditions, such as over water at night, this distance should be materially increased up to 100 or 150 miles.

☞ Every reader of ELECTRICIAN AND MECHANIC may try for the prize. Your own subscription for any period up to five years may be reckoned, and every year's subscription at \$1.00 which you send in will count as one toward the prize. Full particulars of the commission we will pay you will be sent on application. Write us to-day. You will find it easy to get subscriptions, and if you win the set you will get a valuable prize indeed.

SAMPSON PUBLISHING CO.

6 BEACON STREET

BOSTON, 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 Infringement. Patent Suits conducted in all States.

REFERENCES:—Globe Machine and Stamping Co., Murray Engineering Co., Morgan Machine and Engineering 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.

PATENT WHAT YOU INVENT



Our Three Books Mailed Free.
"U. S. LETTERS PATENT" gives full information in patent matters.
"THOUGHTS THAT PAY" gives list of what to invent.
"THOUGHTS THAT HAVE PAID" gives history of successful inventions.

Write for them.
No charge for opinion as to patentability; send sketch or model.
Patent obtained or fee returned.

Patents advertised for sale free.

WOODWARD & CHANDLEE, Patent Attorneys
1282 F Street, WASHINGTON, D. C.

PATENTS

Send Sketch or Model for FREE Examination and Report as to Patentability. Patents promptly secured. ADVICE FREE; Rates Reasonable; highest references and best services. WRITE FOR FREE BOOKS.

WATSON E. COLEMAN,
Registered Patent Attorney, Washington, D. C.

PATENTS SECURED

OR FEE RETURNED. Send Sketch for FREE REPORT 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.

A PLACE FOR TOOLS



No. 101

☐ A Bench 6½ feet long, 25 inches wide, with 14-inch glued-up Maple top. Cabinet has roomy drawers and cupboard.

☐ Just the thing for combined Bench and Tool Cabinet. Saves room and is much superior to the cheap tool-chest for storing tools.

☐ Drawers and cupboard have locks insuring safety.

Write for Home Bench Catalogue

GRAND RAPIDS HAND SCREW CO.

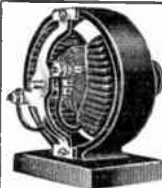
930 Jefferson Ave., GRAND RAPIDS, MICH.

Largest Bench Manufacturers in the world

Patents

Valuable Book on Patents FREE. Tells how to secure them at low cost. How to Sell a Patent and What to Invent for Profit. Gives Mechanical Movements invaluable to Inventors. Full of Money-making Patent Information. New Book FREE to all who write.

O'MEARA & BROCK, PATENT ATT'YS
1038 F Street WASHINGTON, D. C.



DYNAMO-MOTOR, \$3.85

(A Dynamo and Motor in One)
As a dynamo, it will develop 40 c.p. easily; operate induction coils; charge storage batteries; decompose water, electroplate, etc. As a motor, will operate sewing machine, jewelers' lathe, emery wheel, circular saw, advertising devices, and other useful appliances. Send stamp for catalog Nos. 9 and 10 of new things electrical.

ARROW ELECTRIC COMPANY
105 South Canal Street Chicago, Ill.

A WICKS ENGINE

IS A TWENTIETH CENTURY PRODUCTION

Why not build one? Castings, materials, and blue-prints, for building the Wicks ¾ x ¾, high speed, vertical single-acting center crank, steam engine (gas engine type), are now ready.

Complete outfit of castings, materials, and blue-print working drawings, \$2.75

Complete set of blue-print working drawings, without castings, 6 sheets 10 x 12, 50 cents, silver or money order. This amount refunded on first order for castings if within thirty days after drawings are ordered.

Three sheets of construction blue-prints and photographs, 10 cents, silver. This amount refunded on order amounting to 50 cents or more.

B. R. WICKS, Bridgeport, Conn.

FREE
TWO BOOKS
84-Page
"Inventor's Guide"
—AND—
"Fortunes in Patents"
"What and How to Invent"

PATENTS THAT PAY
Protect Your Idea
SPECIAL OFFER: Send sketches or model and description of invention for FREE SEARCH of Patent Office Records and Report as to patentability. You will save TIME and MONEY. *Highest References.*
E. E. VROOMAN, Regis't'd Patent Attorney
1160 F St., Wash., D.C.

REFERENCES:
American National Bank
Washington, D. C.
Little Giant Hay Press Co.
Dallas, Texas
Gray Lithograph Co.
New York City, N. Y.
Farmer- Manufacturing Co.
Norfolk, Va.

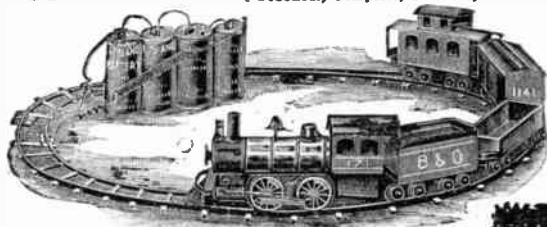
THE AMERICAN INDUSTRIAL PUBLISHING CO.
Established 1865 **PUBLISHERS** by Frederick Keppy
of Books Relating to Steam, The Steam Engine, Mechan-
ics, Machinery, Engineering, Electricity, Steam and
Hot Water Heating, Ice Making and Refrigerating,
etc. Send for Catalogue.
BOX E BRIDGEPORT, CONN., U. S. A.

PATENTS
WRITE FOR
"PATENT PARTICULARS"
S. P. BUCK, 315 Dillon St., Balto., Md.



Here's the Railroad that Runs to Boyville!

SOME CHRISTMAS SUGGESTIONS { Scientific ELECTRICAL Novelties
{ Practical, Complete, Durable, Harmless

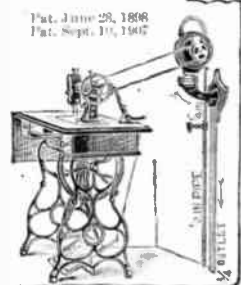


EVERY boy in the country can easily own a railroad. Costs little and pays big dividends in fun. Our Models of Locomotives, Trains, Trolley Cars, Dynamos, Lamps, etc., are practical and durable inventions. Equipped with dry batteries, no acids or liquids used, perfectly safe and harmless. Electrical toys instruct as well as amuse.

Catalog B, fully illustrated, quoting low prices—SENT FREE
THE CARLISLE & FINCH COMPANY
248 E. Clifton Ave., Cincinnati, Ohio
Largest Manufacturers Electrical Novelties in the World.



Water is in every home



By attaching an adjustable Water Motor and Water Fan to your water pipes, you can make your life more comfortable without expense.

Send 10c. for copyrighted Booklet and write for

cash discount to Fan Department.

The A. Rosenberg Motor & Mfg. Co.

Baltimore, Md.
U. S. A.

Manufacturers of Water Motors and Fans adjustable every way while running



Adjustable every way while running

STYLE ECONOMY **LITHOLIN** Fit COMFORT
WATERPROOFED LINEN COLLARS & CUFFS.



MAKE the DUST FLY

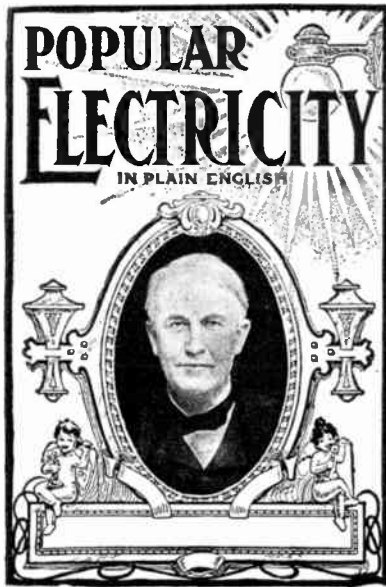
The first and only satisfactory permanent linen-wear

Litholin Waterproofed Linen Collars & Cuffs

They weather all weathers—hot, cold, wet or dry they keep their shape, and being linen, look linen—not celluloid or rubber. In every fashionable cut and style. When soiled they wipe white as new with a damp cloth. Wear them and bank your savings. **Collars 25c. Cuffs 50c.**

If not at your dealers, send giving style, size, number wanted, with remittance, and we will mail, post-paid, booklet of styles on request.
THE FIBERLOID CO.
Dept. 56 7 Waverly Pl., N.Y.





ONE-NINTH ACTUAL SIZE

NEW MAGAZINE ON ELECTRICITY

POPULAR Electricity presents the wonders of Electricity in "Plain English." It is non-technical, and so plain that all may understand. It is the first medium to bring the general public in familiar touch with the most wonderful force the world has ever known.

POPULAR ELECTRICITY IN PLAIN ENGLISH

became a necessity; because electricity is now a part of the everyday life of the Twentieth Century and it is no longer possible to transact business without a fairly extended knowledge of its principles, applications and phraseology.

You realize this. You are interested. But before this you never had a medium through which you could become familiar with this wonderful power.

NOW YOU HAVE it in Popular Electricity.

The subscription price is *only one dollar a year.*

The magazine is bright and snappy; handsomely illustrated; contains serials by well known writers; Junior Department; Household Department; Questions and Answers—best of all, everything is written up in an entertaining style absolutely non-technical.

Until the supply is exhausted we can furnish May, June, and July issues, so send in your subscription now and get the volume complete from No. 1. Simply fill in the attached coupon and mail to us with \$1.00 and you will get the "Livest" wire in the electrical field.

You can make money taking subscriptions for Popular Electricity—Lots of it. Write for Particulars.

Popular Electricity Pub. Co.

1252 Monadnock Block

CHICAGO, ILL.

E. M.
Oct.

Enclosed please find \$1.00 for one year's subscription to Popular Electricity beginning..... issue.

Name.....

City.....

Street No.....

State.....

A Book Worth Having—it's FREE



"YANKEE TOOLS"

A book packed full of new ideas in labor-saving "YANKEE TOOLS" for all classes of Mechanics. Tools that appeal to any man, no matter what his profession or calling. The book is the embodiment of Yankee ingenuity and invention, illustrated with photographic reproductions of the Tools in use.

A postal brings it if you say "Electrician and Mechanic" Your dealer sells "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

Adjustable head band with ball and socket fittings give a comfortable and snug fitting effect. Weight, complete with cord, only 16 ounces. Cords join at the breast.

PRIOR LIST

Complete with 7' high Cord	\$ 9.00
1500 ohms	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.

Wireless Telegraph Experimenters

The Excellent Results that many of my customers have had by using my No. 101 Tuning Coil justifies this advertisement being exclusively devoted to its description. The Core consists of a Well-seasoned, Accurately Turned Wooden Cylinder, having a Winding Space of 10 inches. The Winding is of No. 24 Gauge, Black Enamelled Wire, the Winding Diameter being 5 Centimeters. The Ends are finished with Natural Wood Stains, and present an exceedingly artistic appearance. This Coil has Double Sliding Contacts, and can therefore be used with Adjustable Condensers for All Wave Lengths.

THE PRICE IS BUT \$3.00

W. C. GETZ

845 N. Fulton Ave. Baltimore, Md.

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

ELECTRIC

SUPPLIES—TELEPHONES—NOVELTIES

Catalogue of 200 Free

If it's Electric we have it. Big Catalogue 4 cents

**OHIO ELECTRIC WORKS
CLEVELAND, OHIO**

The World's Headquarters for Dynamos, Motors, Fans, Toys, Batteries, Belts, Bells, Lamps, Books

We undersell all Want Agents



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, 4-31, 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.

"OLIVER" MACHINERY COMPANY

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.

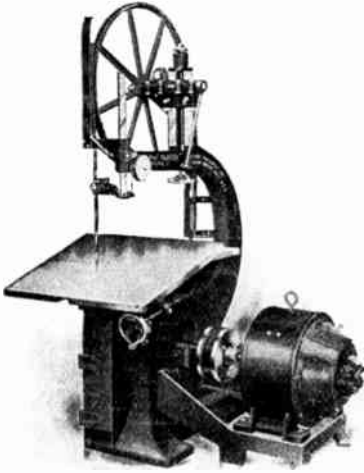
BRANCH OFFICES

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



OLIVER "C" BAND SAW
MOTOR DRIVEN

MOTOR HEAD SPEED LATHES
A SPECIALTY

Receiver's Sale

A \$56.00 Library For Only \$24.50

Wonderful opportunity to get these fifteen magnificent bound volumes, comprising the Library of Universal History for less than half value. The publishers have failed. We, as receiver, must dispose of enough sets to pay the obligations of the publisher. For a limited time we will send a set for free examination without asking you to pay one cent down.

Here is Our Offer: Send us your name and address on the coupon or a postal dress on the coupon and we will send them to you, charges prepaid. Look over these books for a week and then if you decide that you do not want them *send them back at our expense*. If you wish to keep this superb work send only 50c and then \$2.00 a month for twelve months — only \$24.50 for this \$56.00 library.

The Library of Universal History is a complete history of the whole world written by America's greatest historians and endorsed by America's greatest scholars. There are over 5,000 pages, 100 finely engraved maps and 700 large full page illustrations.

Write to us at once, just put your name on the coupon. Without obligation or expense we want you to examine this grand work in your home for a week before deciding.

15 Massive Vols.

Each vol. 7 in. wide;
10 in. high; wt.
bxd., nearly

75
lbs



F. W.
FREE
COUPON

American
Underwriters
Corporation,

Department D. 7

240 Wabash, Chicago

Without expense or obligation to purchase, I would like to examine the Library of Universal History in my home free for a week.

Name

Address

Gas Review

A Magazine for the
Gasoline Engine User

Gas Review will bring into your home—place on your library table—the wisdom, the knowledge, and the experience of the foremost experts on gas and gasoline engine.

A lesson on gas engine operation appears in each issue. Compression, ignition, mixture, battery troubles, fuel consumption, the exhaust, insulation, lubrication, wiring, electricity, and, in fact, every feature in the construction and care of gas and gasoline engines is covered fully yet in a simple, easily understood way.

Think of getting a complete course in gasoline engineering—one not only equal to but far superior to the average gasoline engine course costing from thirty to fifty dollars, all for

50 CENTS PER YEAR
Sample Copies on Request

GAS REVIEW

14 Cantwell Building

Madison

Wisconsin

TABLE OF CONTENTS

Armature Windings. Chapter II. Drum Armatures for Direct Currents	A. F. Watson	185
How to make a Miniature Clock	R. N.	192
Forging for Amateurs. Part I	F. W. Putnam, B. S.	193
The Insulation of Spark Coils and Other Electrical Apparatus.	Zodiac	200
The Construction of an Electrolytic Rectifier	W. C. Getz	204
Camp Building. Part V. Furnishing the Dining Room and Kitchen	Mabel V. H. Hunt	209
Wireless Telegraphing to a Balloon	Norbert Carolin	214
Gasoline Engine Troubles Classified	Howard W. Riley	216
Christy's Freak Automobile		218
Home-made Jewelry. Part III	Charles B. Dyer	219
Count Zeppelin's Airship		221
A Few Drafting Room Notes	I. G. B.	222
An Improved Method of Making Spiral Coils	Notege	223
Editorial		224
Wireless Club		225
Questions and Answers		226
Trade Notes		230
Book Reviews		230

WIRELESS TELEGRAPHY

The continued demand on the part of our readers for wireless information already published has led us to compile the following list of articles on **Wireless Telegraphy** recently published in **ELECTRICIAN & MECHANIC**. Copies of any of these numbers may still be had at 10 cents each. As the supply of the earlier numbers is very limited, we suggest immediate application for numbers wanted.

A Portable Wireless Telegraph Apparatus	October, 1907	Wireless Telegraph Stations in Baltimore. I	July, 1908
Automatic Calling Device for Wireless Telegraphy	October, 1907	A Practical System of Wireless Telephony	July, 1908
A Portable Wireless Outfit	(Out of Print) Nov., 1907	Construction of a Silicon Detector	July, 1908
Wireless Telegraph Distances	(Out of Print) Nov., 1907	Construction of Tuned Circuit Receiving Instruments: Tuning Coil, Potentiometer, Condenser	July, 1908
How to make a Polarized Relay	December, 1907	The Transformer as a Source of Wireless Current	August, 1908
Development of the Wireless Telephone	January, 1908	Construction of a 500-watt Transformer Coil	August, 1908
The Wireless Telegraph on the Lusitania	February, 1908	Construction of Tuned Circuit Transmitting Apparatus: Condenser, Spark-gap, Sending Helix or Inductance	August, 1908
Wireless Troubles and how to overcome Them	February, 1908	Testing and Operating of Tuned Circuit Instruments	September, 1908
Wireless Telephones in the American Navy	April, 1908	List of Wireless Stations and Calls	September, 1908
The Construction of a Magnetic Detector	April, 1908	Geographical Membership List of the Wireless Club	September, 1908
Construction of an Independent Interrupter	April, 1908	Wireless Systems of To-day. 1. The Massie System	September, 1908
An In-lor Wireless	April, 1908	Practical Hints on Insulating Induction Coils	October, 1908
The Construction of a 4-inch Spark Coil	April, 1908	Induction Coils for Wireless Telegraphy	October, 1908
The Proper Adjustment of Wireless Telegraph Detectors when used on Tuned Circuits	April, 1908		
A Compact Tesla Coil	May, 1908		
How to build Aerials for Wireless Telegraph Systems	June, 1908		
Alternating Currents of High Frequency	July, 1908		
How to make a Wireless Telephone	July, 1908		

ANY NUMBER MENTIONED ABOVE, 10 CENTS, POST-PAID

SAMPSON PUBLISHING CO. 6 Beacon Street BOSTON, MASS.

Engraved, Printed, and Bound by the Sparrell Print, Boston



STEP OUT Of the Dinner-Pail Class

This applies to **YOU**. You may not carry a dinner-pail, but if you are poorly paid and dissatisfied, you are no better off than the man who does. **STEP OUT!**

Here's your chance to step out of the dinner-pail class forever—a chance to move higher—to become an expert—to succeed in life. Mark the coupon opposite the occupation you prefer and have the I. C. S. advise you. There's no charge for this information.

Men who were no better situated than you are; men with little schooling; men in "dollar-a-day" positions; men with no hope of anything better—thousands of such men have, through the help of the International Correspondence Schools, advanced to better positions, higher salaries and more hopeful lives. **But, they first of all marked the coupon.**

The I. C. S. offers you the same chance. All that is required of you is the ability to read and write. You can qualify in your spare time, without leaving home or losing a day's work—no matter what you do or where you live.

During March and April 573 students voluntarily reported salary increases and promotions secured wholly through I. C. S. training.

This is your chance to rise—take full advantage of it by marking the coupon **NOW**.

International Correspondence Schools,
Box 930, SCRANTON, PA.

Please explain, without further obligation on my part, how I can qualify for a larger salary in the position before which I have marked X

Bookkeeper
Stenographer
Advertisement Writer
Show Card Writer
Window Trimmer
Commercial Law
Illustrator
Civil Service
Chemist
Textile Mill Supt.
Electrician
Elec. Engineer

Mechanical Draftsman
Telephone Engineer
Elec. Lighting Supt.
Mechan. Engineer
Pumbers & Steam Fitter
Stationary Engineer
Civil Engineer
Building Contractor
Architect
Architect Draftsman
Structural Engineer
Banking Engineer
Mining Engineer

Name _____
Street and No. _____
City _____ State _____

Electrician and Mechanic

Incorporating

Bubier's Popular Electrician, Established 1890

Amateur Work, Established 1901

VOLUME XIX

NOVEMBER, 1908

NUMBER 5

ARMATURE WINDINGS — Chapter II DRUM ARMATURES FOR DIRECT CURRENTS

A. E. WATSON, EE. PH.D.

DIAGRAMS representing drum windings lack the clearness of those readily drawn for the ring type. The numerous crossing of the wires makes the appearance confusing to a beginner, and even to the expert some difficulty is often presented in following the intricate circuits. In many text-books attempts toward simplification are made by showing single layer drum windings, and while such constructions have actually been

practical means were not known for adapting the drum winding to fit the conditions. The introduction of toothed armatures and invention of "formed" coils, soon after 1890, solved the difficulty, and the general adoption of this type of winding testifies to its excellence. Indeed, it is hard to conceive that better methods are likely to be invented.

To consider the subject in a progressive manner, let reference be given to Fig. 9,

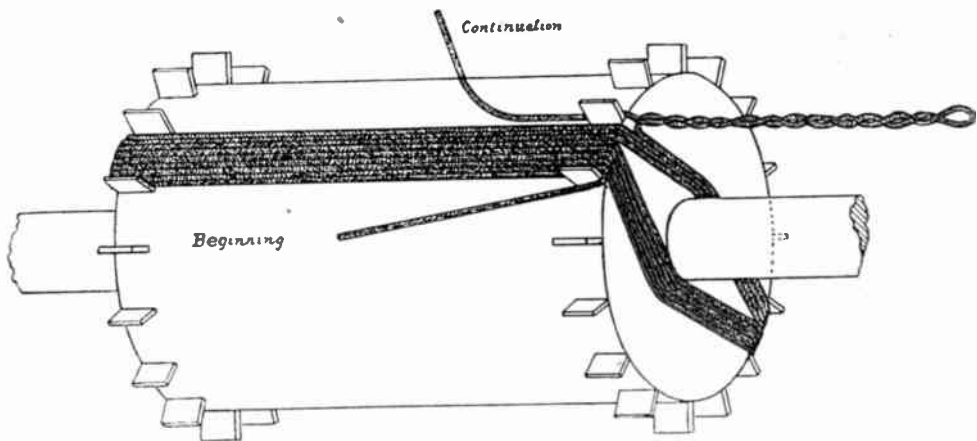


Fig. 9. First Coil of a Siemen's Drum Armature, adapted for Two-pole Field-magnet

made, they are not now common, and in this article special emphasis will be laid on the common practice of employing and recognizing the two layer principle.

For nearly twenty years after the invention of the drum winding it was limited to use with field-magnets of only two poles, while the ring form was with considerable success readily employed with multipolar designs. The reason lay in the fact that

showing in perspective a drum armature core with one coil consisting of nine turns in a single layer in place. For convenience in winding, the shaft may rest between lathe centers, or better, — for a lathe is usually lacking in cleanliness and has too many sharp corners for scraping the insulation off the wire, — on some sort of a wooden fixture on a table, and as the wire is passed around the ends, the core is rocked back

and forth through half a turn, whereby the wire is readily kept in view. With fine wires sufficient tension can be exerted to make them lie straight, but with larger ones, a counter bend can be put in with the thumb, so as to make the straight portion hug

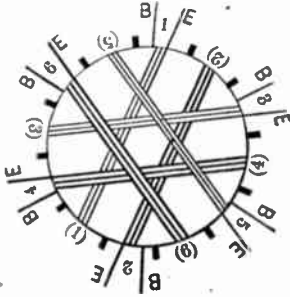


Fig. 10. Method of Winding Drum Armature with Separate Coils, and Fitting a Two-pole Magnet

closely to the core. At the ends, the first turns must pass at a sufficient distance from the shaft to allow the rest to fill in with the successive passages, else there will be an undue piling and bad appearance.

In case of a smooth surface armature like that shown in the figure, retaining pegs of fiber are driven into saw cuts made in the brass heads before the core is assembled. In addition to holding the wires in place during the winding, they are also of value in driving the conductors through the field of magnetic force when the machine is running. In case of a toothed armature, far better mechanical strength is obviously secured.

A given element of the winding may consist of more than one layer, but of course the difficulty of holding the wires in place on a smooth core is then increased; with the toothed sort, numerous layers are possible and advisable. For the single layer just described, a loop is twisted in the wire, and a similar coil wound in the next space and its opposite. That is, for a 16 coil armature, coil 1 can be placed in spaces 1 and 9, while the next will go in 2 and 10; then a second loop is made and a coil wound in 3 and 11; and so on until spaces 8 and 16 are occupied and a seventh loop is secured. The entire surface of the core will then be covered with a single layer, but only enough connections will be left out for one half the commutator segments, and these will be in a semicircle. To provide the rest of the connections, and to make the winding of

the closed circuit order, it will be necessary to continue the procedure directly on top the existing wire, that on top of the first coil providing a loop next to the last one, and opposite to the beginning of the first coil. Since the full difference of potential, in case of a two-pole machine, is existent between the opposite brushes, to which these overlapping coils connect, there will always be a pressure striving to break down the insulation between the windings. This is the only serious defect of the drum winding, but with good insulation, voltages in direct current armatures of 500, and in case of alternators, of 2000, are practicable. No such high values as are possible with ring armatures are attempted with drum windings. This defect is, however, not serious, for in case of direct current armatures, limits of commutation are met before those of puncturing insulation, and with alternators, other types of winding are readily substituted.

That these halves exist is of fundamental importance in considering drum armatures, and in the example being considered, when the second part has been completed on top the first, the very end of the wire is to be twisted to the beginning, thereby making the sixteenth loop, and the whole commutator is provided with connections. Such a winding is the simplest to grasp, and is readily accomplished by a beginner, without much opportunity for mistake. It is possible, however, to wind both layers in spaces 1 and 9, then leave out a loop, skip spaces 2 and 10, and wind two layers in spaces 3 and 11, then in 5 and 13, and so on.

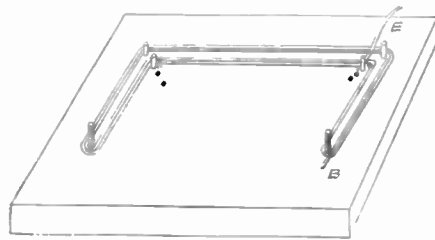


Fig. 11. Simple Form for Winding Drum Coils of Few Turns for Use with Multipolar Field-magnet

while on the second half 10 and 2 are filled, etc. The result is that only eight loops will be provided, and an 8 segment commutator needed. In general there should be a large number of segments, and in case of toothed armatures there may often be two

or three times as many segments as slots. Such a winding as the one described leaves no chance of error in making the commutator connections, but it is faulty in the respect that any one coil is considerably spread out over the surface, and that most of the time the two circuits which are in parallel with each other do not have the same length of wire and, consequently, not the same resistance. Unequal currents will therefore circulate in them. The coil can be narrowed, therefore improving commutation, and the circuits more nearly evened in length, by winding the halves side by side rather than one on top the other. This involves cutting off enough wire for each coil, leaving out plenty of ends for scratching the hands and for confusing the mind. For large armatures, however, such as were used in the standard Edison and Thomson-Houston bipolar dynamos, consisting of only one or two turns per coil, and of relatively large wire, or of a bundle of smaller wires, this is the only practicable method.

For illustration of this method, let the surface of the core be divided into twice as many spaces as there are segments, say, in 12 spaces, as shown in Fig. 10. All the turns belonging to one coil are wound in a given space and the one just short of opposite; let this be called coil 1, with its beginning and end marked B and E. Now wind coil 2 parallel to 1, but with its beginning and end on the opposite side of core. The B and E of each may be twisted together, but only loosely, for the union is for convenience during the winding only, and other combinations are needed for final connections. The pair of coils numbered 3 and 4 can next be wound, finally 5 and 6. After the binding wires are wrapped around the armature for holding these conducting wires firmly in place, the various ends are to be untwisted, and the B of one coil is to be joined to the E of the *next* coil, and to one commutator segment; in the case given there will be six such junctions, therefore opportunity for six segments. In its ultimate arrangement, the winding is seen to be the equivalent of the one first described. In that, too, the end of one coil formed the beginning of the next.

In a more useful form this second method, denoted as the "radial," as distinguished from the first or "circumferential," well fits the conditions found in toothed armature cores. In each of the slots there would be placed two separate troughs of the insu-

lating material, and halves of the winding confined to their own compartments. A few turns would be put on belonging to one coil, then a few for the other, and so on, until both places were full, and no danger incurred of breaking down the walls between or of confusing the orderly arrangement of the wires. Successive pairs of coils would cross the preceding ones at about right angles or at 45° .

When a four-pole field-magnet is considered, in which opposite poles are, of course, of the same polarity, a diametrically wound armature such as has just been described would be quite inoperative. Electromotive forces just equal and opposite to each other would be induced in the wires of each and every turn, hence there would be no exter-

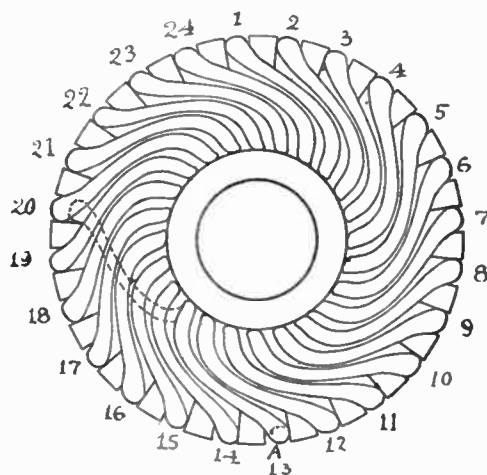


Fig. 12. End View of Scheme of Form-wound Armature for Use with a Four-pole Field-magnet

nal force whatever. The conditions illustrated in Figs. 2 and 3 of Chapter I must be fulfilled: that is, ends b and d may be attached to each other, and add their electromotive forces, while ends a and c lead to appropriate commutator segments. Just which segments are the appropriate ones demands careful consideration, and will be made clearer as the explanation is developed.

As for the actual method of winding an armature for four poles, one of the smooth core type would be quite inconvenient. Each turn, instead of passing along a diameter, must go across a chord and reach a location only one quarter of the circumference distant; to hold the wires in place against

the smooth surface would clearly be difficult. Even when toothed cores are used, the wires would be disorderly, and worse than that, those passing from one slot to the one 90° distant would obstruct the entrance to adjacent slots. In addition to this there would be the further mechanical objection that the first coils would be shorter than the others, therefore lighter in weight, and leave the armature out of balance.

While some early armatures were wound in tedious manner by hand to avoid these difficulties, ideal conditions were lacking until "form" wound coils were made, the shape being such that no interference was involved nor was there lack of perfect electrical and mechanical balance. The precursor of this realization lay in the invention by Eickemeyer, in 1888. This, however, was designed for two-pole field-magnets only, and even now is practically applied to such only with considerable difficulty. The reason is that all the coils have to be placed on the coil simultaneously. Applied to multipolar field-magnets, the scheme is the only one now considered or used by any manufacturer.

Many ingenious forms have been devised for getting the coils in just the right shape, some of them only partly giving the required shape during the winding, the final bending being a separate operation, others aiming to accomplish it while in one form. Figure 11 gives an idea of a simple device available for any amateur builder, especially if only one machine is under construction. The base-board has iron or wooden pins at proper points; those at the two loops may well be threaded and fitted with washers and thumb nuts, for securely holding the wires in proper order; at the inner corners rows of holes are provided, so as to allow for the successive turns, as they are put one within the other. First, the beginning of the wire is to be fastened under some sort of a clamp near B, and then the turns looped on, the pins being moved step by step to their inner location. If the board is mounted upon a vertical pivot, say by use of a piece of gas pipe and a floor flange, and a handle be placed upright at B, some celerity can be acquired in winding the coils. Before removing from the form, sheet lead or copper strips should be bent around the wires in a few places, so that during the winding with tape that follows, the shape may not be lost. The two loops may then be held in a wooden vise, and of the two straight horizontal portions,

one may be brought toward the person, the other carried away, until they are distant from each other by an amount equal to one quarter of the circumference of the armature. When placed in the slots, one portion should be one quarter way around from the other.

If an armature of this sort is to be designed, care must be given to a consideration of the space near the shaft, to see if there will be room. The shape of coil from slots to the inner space will take an involute curve, and the builder should make an accurate drawing to predetermine as many of the factors as possible, then wind some sample coils to see if his predictions are correct. Only by actually putting the coils in place on the core will the builder fully see the method. With the four-pole machine here being considered, about one half the entire number of coils must be started before any one of them reaches its final position; for the portion that is to occupy the upper space in a slot cannot be inserted until the portion of another coil that is to fill the bottom space of the same slot is in place. A completed winding, showing how every coil is finally locked in by its neighbors, is shown in Fig. 12. A sample coil, marked A, is visible for one half its involute curve, then its other half passes beneath six other coils out of the total twenty-four, until it reaches the bottom of its appropriate slot.

To remove a coil is quite as much of an undertaking as to put one in, and makes a person eye with some suspicion the broad claims of superiority of the formed winding over any other. First the commutator connections for about one half the winding must be removed, then interfering coils bent up out of the way, when finally the desired coil may be withdrawn, as seen in Fig. 13. It is obvious that in the winding reverse steps are necessary.

When insufficient space can be found for the bunching of the loops near the shaft, the expedient now common with all builders of using "straight-out" coils is available, resulting in a "barrel" shape of winding. Of especial value is this shape in large armatures, such as was given in Fig. 21 of Chapter V in the Engineering series, for by it there is allowance for the most rigid mechanical construction. Copper bars of rectangular section are then employed, but the essential condition is merely attained, — namely, of having a given bar that passes under on

pole electrically joined to a similar bar that lies under the next pole.

Without further attempting to describe the forms, it may be well to show an assemblage of wire-wound coils, really triple in its make-up, as largely used on railway motors. This

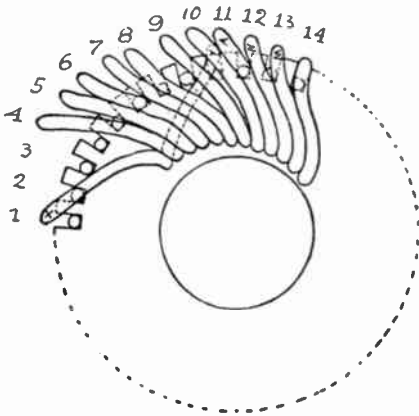


Fig. 13. Method of Removing a Coil from such an Armature shown in Fig. 12

is given in Fig. 14. Three coils, each consisting of three turns, are grouped and held under one taping. The ordinary cotton covering on the wire may be all that separates the several coils, or, in addition, there may be oiled linen between them. The outer taping is thicker, and, besides, there is the usual mica insulation in the armature slots. Such armatures must occupy the least possible space, and the device of allotting three coils per slot, with relatively large slots, reduces the diameter of the core by several inches over that required when each coil has its own slot. The full number of commutator segments is retained, with resulting good commutation at the brushes, but a great deal of slot insulation is saved.

In connecting such a winding to the commutator segments, first, all the wires from the bottoms would be soldered in, ends 1, 2, 3, of coil 1 leading to the first three segments, then similar ends of the second coil to the next three segments, and so on, until there was one wire in every segment. Ordinarily, these ends would not lead straight to the segments, but all would slant to the left at an angle of about 45° . Then end 1', bent an equal angle in the other direction, would be joined to the segment most nearly opposite 1; similarly, until all the ends were attached, there would be two wires in every

segment, and each would represent the end of one coil and the beginning of the next. Figure 15 shows a G. E. 57 armature with this sort of coils partly connected.

As will be imagined, this type of winding is of the series order, as was explained in Chapter V of the Engineering series, — though in that article the two diagrams were unfortunately exchanged, — in which a given coil connects to segments as nearly opposite as an odd number will allow. The correct diagram shows a sample coil extending from segment d to e, and to accommodate this requirement the ends of coils shown in Fig. 14 properly bend each way by the 45° angle. For clearness, the diagrams are here reproduced, with correct designation.

When the multiple-wound armature is desired, the same forms can be used, but the ends must be left out at one of the end loops rather than at the corners, whereby the essential condition may be readily given of attaching them to *adjacent* rather than to *opposite* segments. That is, referring to Fig. 14, all the wires should be included under the taping until they emerge at A.

For a series-wound armature and a four-

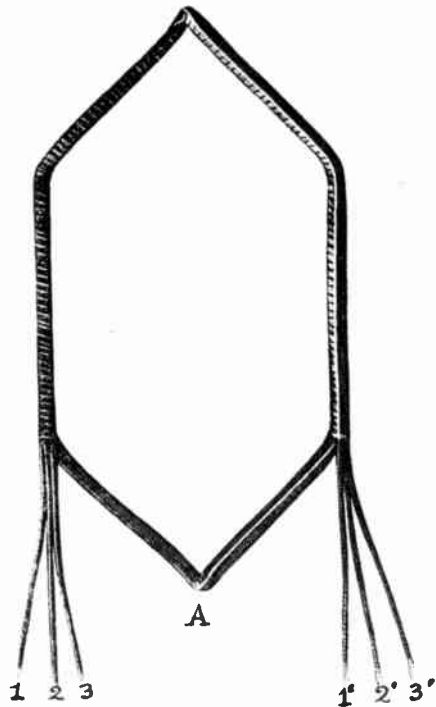


Fig. 14. Three-turn Three-coil per Slot Grouping as Largely used on Recent Railway Motor Armatures

pole field, an odd number of coils and commutator segments is imperative. The famous G. E. 800 railway motor had one hundred and seventeen, while the later types employ thirty-nine slots, with coils as shown in Fig. 14, giving the same total number of one

connected in series order 500 volts will be secured; again, by winding two wires in parallel, and using parallel connections at the commutator, 125 volts will as easily be obtained. Thus economy in the number of forms is permissible. Except for this feature, the ability of the series-wound armature to dispense with brushes at other than two places on the commutator is its chief asset. For railway motors and others, in which accessibility is at best limited to one half the machine, the ability to put all needed brushes on one side of commutator, for a four-pole machine, 90° apart, is worth seeking.

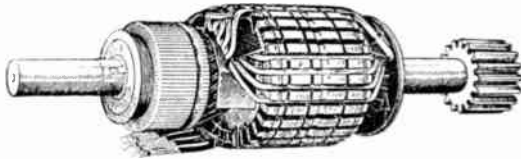


Fig. 15. General Electric No. 57 Railway Armature employing Coils as shown in Fig. 14

hundred and seventeen. With more numerous poles, the proper succession may be found with both odd and even numbers, but not all numbers are possible. The builder needs to look very carefully into the theory of such windings and to compute from Arnold's formula what the possibilities really are.

For multiple windings greater latitude is allowed, and while an odd number is permissible, as shown by the nine coils and segments of the diagram from i to h, in Fig. 17, an even number, divisible by the number of poles, is preferable.

The entire distinction between the usefulness of the series or parallel method of connecting the drum coils usually lies in the matter of number of brushes required. Sometimes a given shape of coil and particular size of wire with multiple connections will give a desired 250-volt winding, while

Additional brushes are often placed on the other neutral points of an accessible generator with series-wound armatures, the reason being that the commutators are usually very short, and one set of brushes only would give insufficient current-carrying capacity. That the presence of these additional brushes does not constitute a short circuit sometimes puzzles an observer, but reference to the diagram in Fig. 16 will show that, while brushes are properly placed on segments e and g only, another positive one could be placed near segment a, and a negative one similarly near c; these two extra brushes would apparently be bridging the insulation between the segments, but in an actual machine the segments would be sufficiently numerous as to allow the usual contact. Between one positive brush and the next there would really intervene one armature coil, but in consequence of its being in

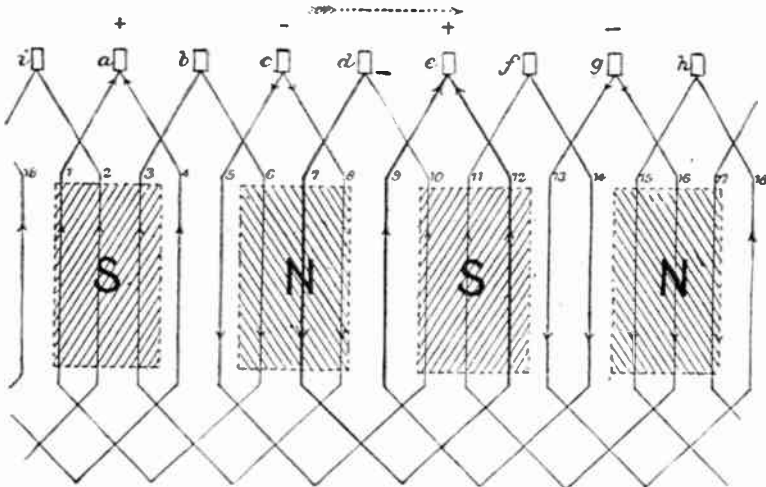


Fig. 16. Development of Multipole (Lap) Wound Drum Armature for Four-pole Field-magn.

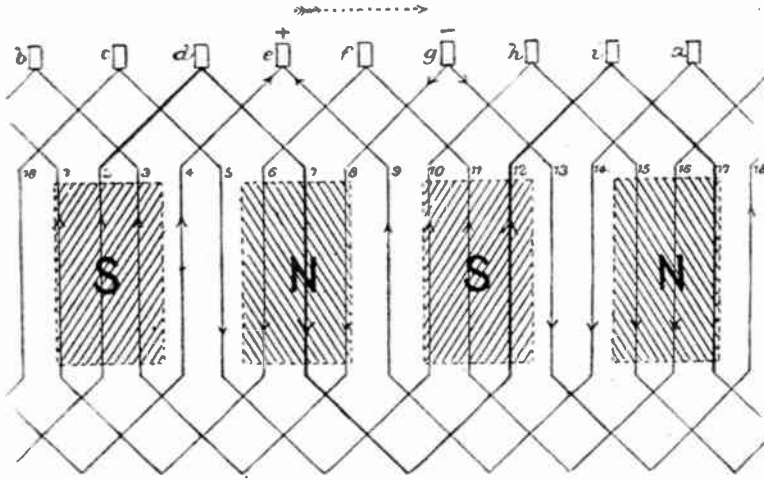


Fig. 17. Development of Series (Wave) Wound Drum Armature for Four-pole Field-magnet

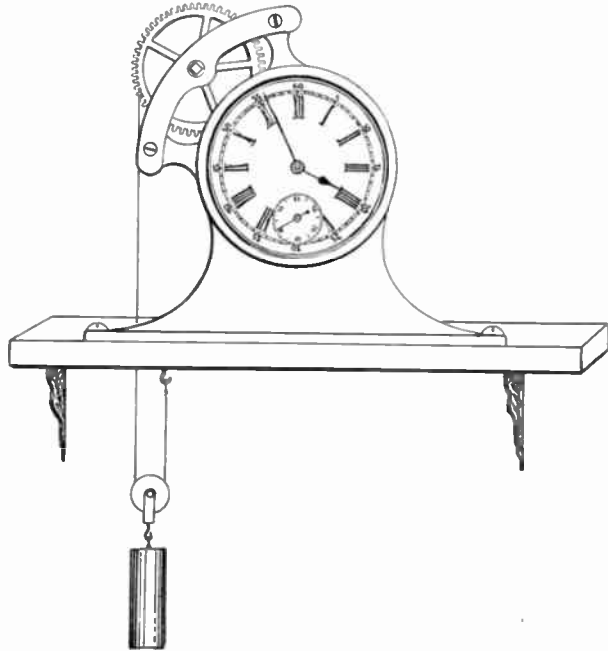
the neutral portion of the field and therefore no electromotive force developed in it, no untoward results would be experienced. With multiple windings, brushes must be used in all the possible places, as shown in Fig. 17, else complete portions of the winding will be successively unused.

Thus far it has been assumed that the coils followed exact geometrical locations on the core. It is not imperative, however, in case of two poles, that the wire pass diametrically across the ends, nor in the multipolar designs that the coils extend across

just one quarter, one sixth, or one eighth of the circumference. If they do, they are denoted as "pitch" windings; if with slightly different spacing, and denoted as "chord" or "fractional-pitch" windings, some advantages can be realized, principally in reduction of sparking, though with narrowing of the neutral position for the brushes. Such refinement will not necessarily be discussed here, but the reader will properly expect to find such a possibility recognized. It is often attention to minor details of this sort that gives distinction to a particular machine.

THE Midland Railway Company have now begun to work one of their branch lines by electric traction on a system which is absolutely new so far as England is concerned and is in use to only a limited extent abroad. The line in question unites Heysham, Morecambe, and Lancaster, and is some nine miles long. The equipment has been installed by the Railway Company for experimental purposes, and it may, if successful, be the forerunner of a much wider scheme of electrification. In the case of all electric railways and tramways now working in England the electric energy is used in the form of continuous current. Alternating current is largely used for electric lighting and on the Morecambe railway it is adopted for the first time in England for traction. The great feature to the observer is the range of poles along each side of the railway, united transversely by horizontal beams or gantries.

From the latter are hung the overhead wires which are the working conductors. Instead of the 500 volts pressure used on tramway overhead wires, these conductors are worked at a pressure of no less than 6600 volts, which makes the transmission of the power very economical. In order to avoid risk from falling wires carrying such a dangerous pressure, and also because the district is much exposed to violent storms, the poles, gantries, wires, and attachments are of great strength. The cars collect the current from the overhead wires by a bow contact, and a transformer on the car reduces the pressure to a working level before it reaches the motors. Every possible precaution has been used for the safety of the public and of the railway employees, and this, of course, is much more necessary than in the case of railways working with continuous current at low pressure.



HOW TO MAKE A MINIATURE CLOCK

R. N.

A VERY ingeniously constructed miniature clock, made some time ago by B. F. Giddens, Lynchburg, Va., is illustrated herewith. The clock always excites the curiosity and wonder of the beholder, notwithstanding its extreme simplicity. Mr. Giddens made use of an eighteen-size movement casing in which he placed an eighteen-size watch movement. A brass stand for the casing was then constructed, both being soldered together, and the whole screwed on a small, neatly made shelf. The mainspring and winding attachment were removed from the movement, and in their stead there was attached a wheel with the same gearing, $1\frac{1}{2}$ inches in diameter, to the mainspring barrel on a shafting, which acts on just about the same principle as does a weight clock.

The movement of this unique clock is operated by means of the attachment of this wheel, the power being obtained, of course, from the weight. This clock can be made to keep unusually accurate time, and can be so arranged as to run from thirty to ninety days with one winding. It is advisable, of course, to cover the clock with a glass in order to protect the movement from dust.

Any type of watch movement may be used to make this miniature clock, but the key winding movements are more economical. One need not take out the winding attachment, but only the mainspring. The so-called old English movements, having what is known as a fusee wheel, can be most readily transformed into a weight clock. In order to arrange such a movement, it is only necessary to take out the chain and adjust upon the winding arbor a drum which carries the string and the weight. When the weight is sufficiently heavy to equalize the force of the spring, the change made in the movement will rather add to its perfect time-keeping qualities. First, because there is no difference in power when the watch is entirely wound up or nearly run down, and second, because the movement is not exposed to the many different motions of the average person who wears a watch. The wheel mentioned above need not be exactly $1\frac{1}{2}$ inches in diameter. It can be almost any size desired. Moreover, a mainspring barrel with the same gearing will do. The drum, over which the weight winds, has a diameter about the same as that of the barrel.

FORGING FOR AMATEURS

F. W. PUTNAM, B.S.

I REALIZE, at the start, the difficulty of teaching even the elements of a trade on paper; but I hope, by the aid of numerous illustrations, to show clearly to the reader all the operations which enter into the work of the ordinary blacksmith.

While it is true that a man may work all his life at a blacksmith's forge and still have more to learn about the trade, it is also true that the real essentials of the trade are made up of a comparatively few simple operations, which may be learned thoroughly by any man who has some mechanical ability, and who is willing to give a fair amount of time and effort to the work. After this is done, skill will come with practice.

I wish, at this point, to thank the following firms who have so generously loaned me cuts to illustrate these articles: B. F. Sturtevant Co., Boston, Mass.; Allen Randall Co., Springfield, Mass.; The Atha Tool Co., Newark, N. J.

A forge may be made of brick or iron, or, in case of very heavy work, a basin of sand

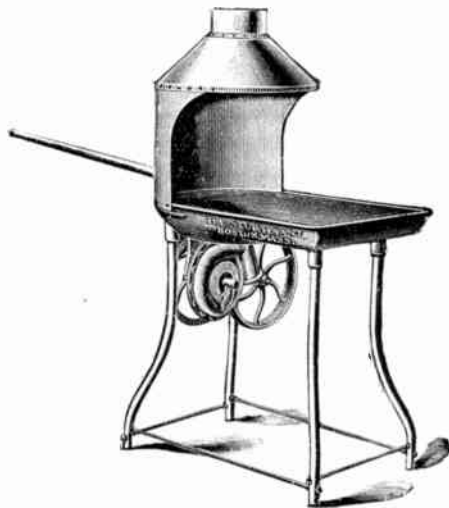


Fig. 1

on the ground. The ordinary blacksmith forge is of brick, 24 x 26 inches high, usually built into the base of a chimney. Iron forges

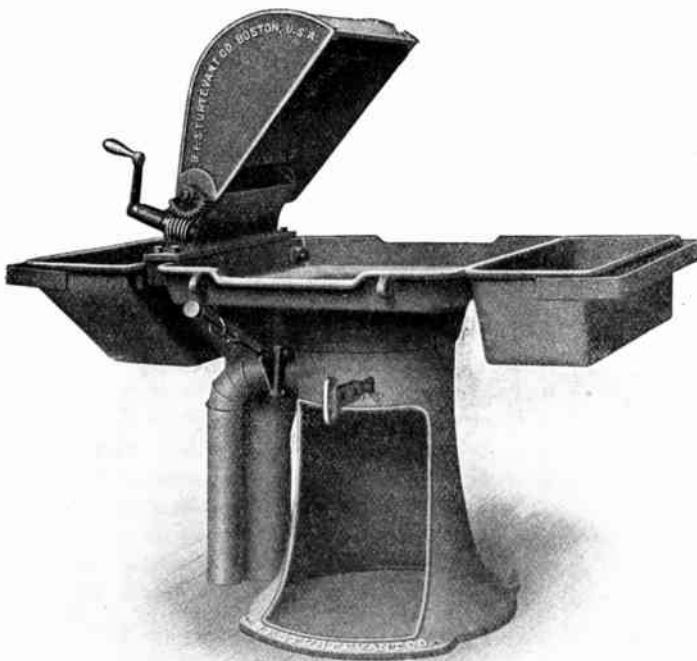


Fig. 2

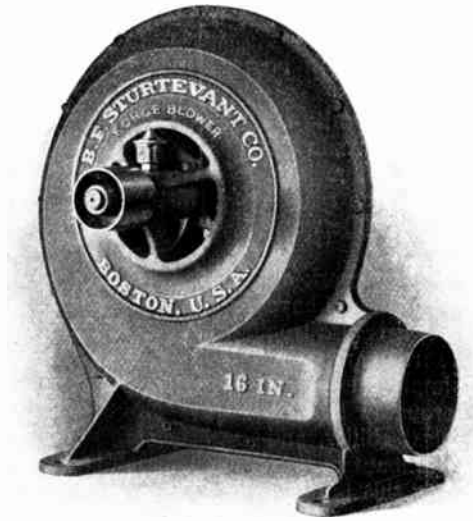


FIG. 3

consist of a cast-iron basin supported on legs or pedestals.

A tuyere (pronounced tuer) is the opening through which the blast enters the forge, and is placed in the bottom of the basin. There are various forms, from the plain, barred grate to the cone device used in the Sturtevant forges.

It is generally a cast-iron shell, with a hole through the bottom connecting with the blast pipe. In this pipe, or at the under side of the tuyere, is a shutter for regulating the air supply, which is called a gate. Besides this there is a hole in the bottom that may be opened to drop the ashes out of the tuyere into a pit below.

There are excellent portable forges now on the market, which may be bought at a very reasonable price. Figure 1 shows a portable forge having a steel plate hood, a strong running gear, and fitted with a steel pressure blower.

BLAST

The blast is produced by a rotary blower or a pair of bellows. The bellows are an old-fashioned method, and consist of two parts, the lower and the upper. They are separated by a partition, and the air from the lower half is forced through the valves in the partition into the upper chamber, where it is stored for use. They are hung from the center piece by pins in the sides. As the lower board is forced up, the air is pressed through the valves into the upper

chamber, inflating it and raising the top board. As the bottom board descends, the valves close, and openings in the lower board open, air flowing into the lower chamber. The blast for the fire is taken from the upper chamber, and is at nearly constant pressure.

The rotary blower has a number of blades set nearly radially on a shaft and placed within an iron casting. The inlet for the air is around the shaft, and the outlet for the delivery pipe is taken from the periphery of the casting. A blast is usually 4 to 6 ounces to the square inch.

The object of the blast is to supply more air for the fire. The air contains oxygen. Oxygen is a strong supporter of combustion, consequently there is more rapid combustion and a much hotter fire. Without draft it would be impossible to get a heat above red. It is possible to supply too much air and blow the fire out.

If an excess of oxygen is supplied to the fire, some of it will combine with the hot surface of the iron, forming iron oxide; such a fire is called an oxidizing fire. If the oxygen is all used up and there is an excess of carbon, it is called a reducing fire.

There are three general systems in use in forge shops for exhausting the smoke from the forges and supplying them with the blast. In one the exhaust and blast pipes are overhead; in the second, the exhaust pipes are overhead and the blast pipes underground; in the third, both exhaust and blast pipes

are underground. In this latter system, the ducts or trenches through which the smoke is forced are made generally of brick, set in cement, sometimes of cement only, and large enough to contain the blast pipes also.

Figure 2 shows an up-to-date forge with down draft. These are also made double. Figure 3 shows a power blower for use with either an overhead or down draft system for draft.



Fig. 4

A nest of tuyeres is shown in Fig. 4, air being delivered through a slot measuring $\frac{1}{2} \times 1\frac{3}{8}$ inches. An adjustable tuyere is shown in Fig. 5, and is provided with a rod ending in a tapering key, which regulates the width of opening for discharge of air to the fire.

Figure 6 shows an oil-burning tuyere, and is a cast-iron pot designed to be supported beneath the forge and lined with fire clay and brick. A dumping tuyere is shown in Fig. 7.



Fig. 6



Fig. 5



Fig. 7

For fuel, charcoal, coke, coal, oil, and gas are used. Charcoal is the best, as it is the purest. Coke is good if free from sulphur, and phosphorus sulphur makes the iron brittle when hot. Phosphorus makes it brittle when cold. Sulphur, lead, bronze, brass, Babbitt metal, etc., must never be allowed to get into fuel or fire where iron and steel are to be welded. I use Cumberland coal. It is bituminous, and contains many impurities, sulphur and phosphorus principally. The sulphur soon burns out, and this may be hastened by sprinkling water over the coal when burning. Never put the iron into the fire until combustion is well started.

Good coal has a bright, shining surface, a dull surface indicating slate. One may easily get coal so full of impurities that welding is impossible; the only remedy is to send it back and try again.

When starting a fire, clean out the ashes over the tuyere and put in a handful of shavings; after lighting, put on a little draft. When the fire is well started, draw the coke around the edges, piling it over the shavings, covering all but a small space in the center, until ignition begins; then cover all over and put on fresh coal. If the fire smokes badly, make an opening in the cover of fuel with a poker. Be very careful to distinguish between coal and coke when cleaning out.

The anvil is usually made of wrought iron, with a steel face welded on. Solid steel anvils are old-fashioned, and can be recognized by a ringing that can be heard long distances. This is the objection to steel. Some are made of cast iron with steel face. They are serviceable where light work is to be done.

An average anvil weighs from 150 to 200 pounds. It is placed at such a height that, when standing beside it, the knuckles will just touch the top surface. The horn is on the left side and the front of the anvil is opposite the workman.

In selecting an anvil, be sure that the face is flat and straight, and that the vertical surfaces adjoining the face are at right angles to it. The hole for bottom tools should be 1 inch square, straight, and at right angles to the face. The horn should be slim and quite pointed. Have about 4 inches of the front and back edges of the horn made rounding, so that you can remain on one side of the anvil all the time.

The hardie hole is square and holds the cutting and forming tools.

The pritchel hole is round and used when punching to drive the core through. Hand hammers are ball, straight, or cross peen. A $1\frac{1}{2}$ -pound ball peen hammer is convenient for ordinary use. The eye is made narrow



Fig. 8

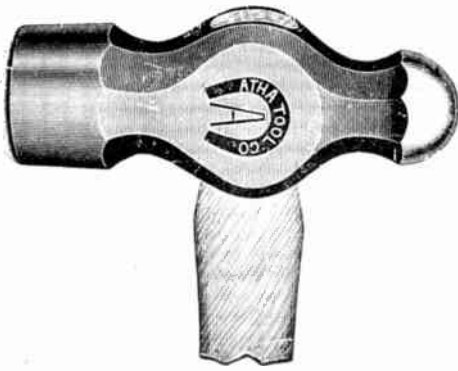


Fig. 9

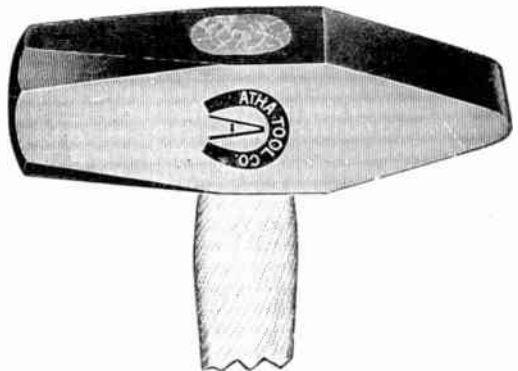


Fig. 10

at the middle, being larger at both ends. When properly wedged, the head cannot work either front or back. See that the wedges are always tight. Loose heads are extremely dangerous. A ball peen hammer has a head shaped like a ball and is used for riveting, or when it is required to stretch

bringing it farther away as heavier blows are wanted.

Swing sledges weigh from 8 to 20 pounds and have long handles. They are held with both hands near the end of the handle and given a full arm swing.

Figure 11 shows a cross peen blacksmith's sledge.

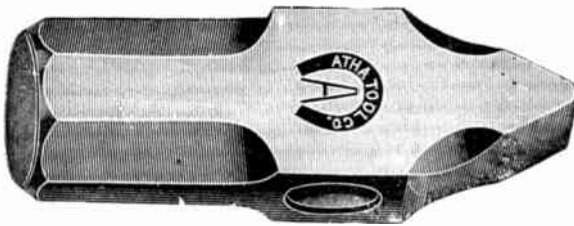


Fig. 11

Figure 12 shows a double-face blacksmith's sledge.

A horse-shoer's turning sledge is shown in Fig. 13.

Tongs are made of mild steel or Norway iron. The jaws hold the stock. The reins are the handles. Various kinds are named as follows: —

the metal in length and width for working a hollow.

The cross peen, with the peen at right angles to the handle, is used to stretch the metal lengthwise.

The straight peen, the peen being in line with the handle, is used to stretch the metal crosswise.

Figure 8 shows an adze farrier's hammer with an octagon poll.

Figure 9 shows a machinist's ball peen hammer, sometimes used by blacksmiths for light work.

A blacksmith's hand hammer, with a cross peen, is shown in Fig. 10.

The hand sledge weighs from 5 to 8 pounds, and is used by the helper. When striking, it is held in both hands, and a shoulder blow is struck without slipping the hands. Slipping the hand makes the blow inaccurate. One hand is held at or near the end of the handle; when light blows are wanted, hold the other hand nearer the head.

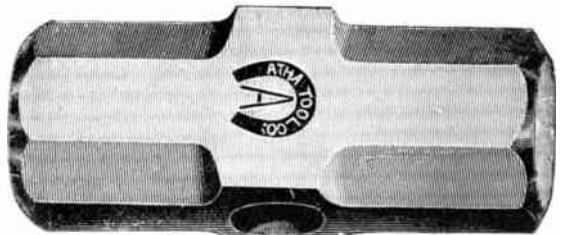


Fig. 12

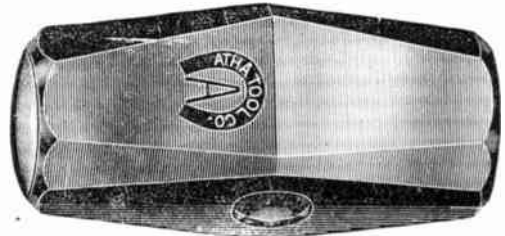


Fig. 13

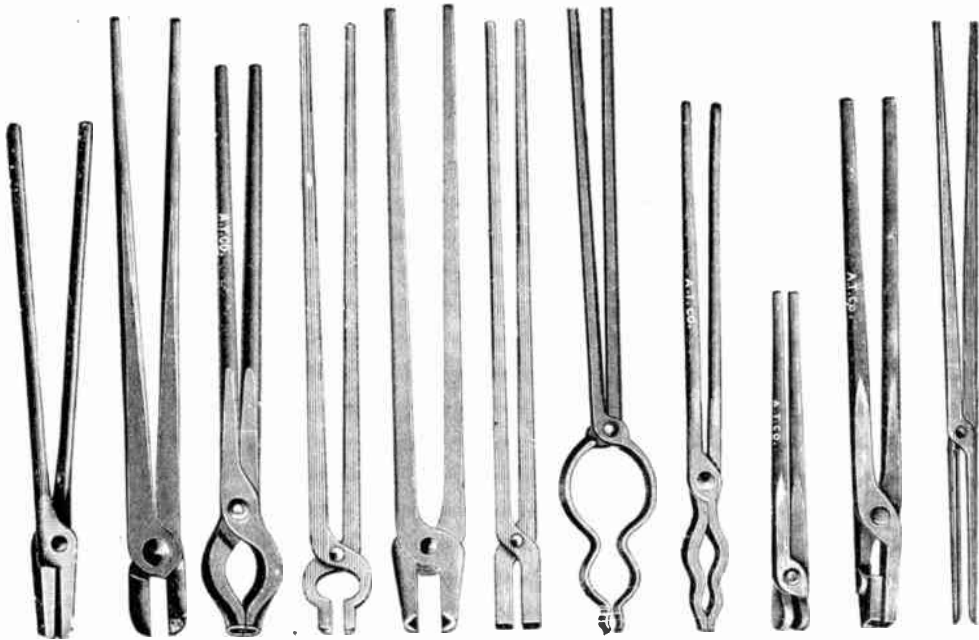


Fig. 14

Flat tongs are for holding flat iron. Gad tongs are for handling wedge-shaped stock. Curved tongs are for holding bent pieces. V tongs are for holding round or square stock. Bolt tongs are for holding pieces with a head. Pick-up tongs are for picking up small pieces or holding small pieces when tempering. Tool tongs are for holding lathe tools when making or dressing over.

A number of various styles are shown in Fig. 14 as follows, from left to right: Straight lip tongs; horse-shoe tongs; curved lip, fluted jaw tongs; curved lip tongs, to hold round stock; V-tongs; brazing tongs; two styles of

double pick-up tongs; short horse-shoer's tongs; lathe tool tongs; heating tongs, used for heating bolts and tools of all kinds, such as reamers, taps, drills, etc.

Tongs should not be left in the fire, as they will bend out of shape and have to be hammered back or cooled, and the cooling makes them brittle and soon spoils them.

Do not work on a piece of stock unless the tongs hold it firmly. A coupler is a link put over the handles to keep the jaws tight on the stock and relieve the handle of the strain. It is used only on heavy work.

The set hammer has a face about $1\frac{1}{4}$ inches square. It is used to square up corners, or, when it is desired, to localize the effect of the blow. It has a handle, and is held by the smith while the helper strikes it with the sledge. (Fig. 15.)

The flatter is similar to a set hammer, but has a large face. It is used to smooth up surfaces. (Fig. 16.)

The fuller is used for spreading out iron, or making depressions in hollowing out work, or forming a shoulder before drawing out.

The swage is used for rounding stock, each being made for a certain rise. They are slightly crowned in the middle.

Fullers and swages that have handles are

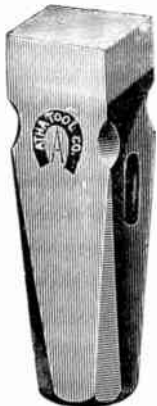


Fig. 15



Fig. 16



Fig. 17



Fig. 18

called top tools and are struck with a sledge. (Figs. 17 and 18.)

Bottom fullers and swages are held in the hardie hole. (Figs. 19 and 20.)

Punches are of various forms according to the requirements. They are tapering, being small at the point. The hole is punched by driving the punch down into the stock on the face of the anvil. If it is desired to make a hole through, the stock is turned over the pritchel hole, or other form, and the core driven out by driving the punch through from this side. If the punch is driven well into



Fig. 19

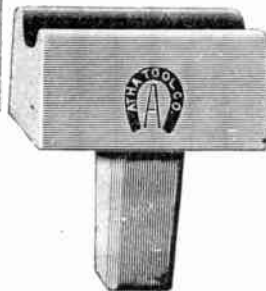


Fig. 20

the first side, a spot is easily seen on the other side, on which to place the punch for driving through. When punching a deep hole or large one, cool the punch occasionally, and drop some fine coal dust into the hole

before retaining the punch, to prevent sticking. The hole is stretched to the desired size by driving the punch deeper.

A blacksmith's square punch is shown in Fig. 21, and a round punch is shown in Fig. 22. A pritchel is shown in Fig. 23.

The hot cutter is drawn out thin and sharp and used for cutting hot metal. Keep well cooled and lift out of the cut after each blow is delivered. (Fig. 24.)

The cold cutter is heavier and stronger and ground to a blunt angle or edge. It is used to mark iron all around, so that it can be broken. (Fig. 25.)

Both chisels are usually tempered alike. The cold chisel holds its temper; but, from



Fig. 21



Fig. 22

contact with hot metal, the hot chisel soon has its cutting edge softened. For these reasons, the two chisels should never be used in place of each other, for by using the cold chisel on hot work the temper is drawn and the edge left too soft for cutting cold metal while the hot chisel soon becomes so soft that, if used in place of the cold chisel, it will have its edge turned and ruined.

Hardies are used in the hardie hole and are hot and cold, being used same as hot and cold cutters. (Fig. 26.)

The heading tool is used for forming heads on the ends of rods. A tool is required for



Fig. 23



Fig. 24



Fig. 25



Fig. 26



Fig. 29

each size of stock. The hole is usually tapering and the stock is put through the small side. The tool is faced with steel and the small end of the hole is in the steel. (Fig. 27.)

Dies are forms hollowed out of steel, into which the metal is forced to take the form of the hole. Usually they are used under power hammers or hydraulic press.

Swage blocks have various shaped grooves and holes cut into them and are used like a swage heading tool. They may be rectangular or circular.

Cones, or tapered mandrels, are made of soft iron and are used for rounding up vari-

ous sizes of rings. They have a groove running the whole length, to allow for tongs or links of chains that may be on the rings.



Fig. 28

Figure 28 shows a tool known as a creaser, and Fig. 29 shows a die used for toe calk welding.



Fig. 27

Wood Staining

WHEN carefully treated, birch gives a very clever imitation of mahogany, a fact well known to the craft. But the wood should possess suitable grain. Logwood gives a very good stain for this purpose; boil together equal parts of logwood chips and water, boiling the mass for about three

hours. Then add sufficient chloride of tin to give the shade of color desired; add the chloride while the mass is hot. Apply the stain only after it has become cool, and as many coats as may be required to give the depth of shade desired. The filler may be made with raw or burnt sienna and umber. Finish in any way desired.

THE INSULATION OF SPARK COILS AND OTHER ELECTRICAL APPARATUS

"ZODIAC"

OWING to the exceedingly high voltage to which the insulation of spark coils, Tesla coils, etc., is subjected, careful insulation is absolutely essential, and nothing can be more disheartening to the amateur than the laborious unwinding of a spark coil that has proved a failure, owing to defective or wrongly applied insulation. In this article it is proposed to deal with the various insulation materials and point out their properties and the care that must be taken to avoid spoiling their insulating qualities. Quite recently the writer had an 8-inch coil submitted to him by a reader, in which the defect was clearly due to the paraffin wax having been overheated and ruined during the winding; while a Wimshurst machine with ebonite plates failed because of the employment of a black varnish in which lead driers had been employed.

Insulation Resistance and Dielectric Strength. — All insulators are in reality very poor conductors, that is to say, their specific resistance is enormous as compared with that of, say, copper or silver. For instance, the specific resistance of shellac is several billion times as great as that of silver. But specific resistance must not be confused with dielectric strength. For example, air has a very high specific resistance indeed, but not very much dielectric strength, being easily broken down by a spark. On the other hand, glass has a large dielectric strength, but not nearly as high a specific resistance as air. The *specific resistance* determines the amount of current (negligibly small, of course, in the case of a good insulator) that can flow through the insulator and thus leak away, while the *dielectric strength* is the ability of the material to stand the mechanical and electrical stresses due to the voltages to which it is subjected. Then we have *surface leakage*, owing to which the current leaks over the surface of the insulator without passing through the material. Paraffin wax has a larger surface insulation than glass, but not so high a specific resistance as good crystal glass. Hence the reason for coating Leyden jars, etc., with paraffin wax or with shellac varnish. Placing the materials in the order of their specific resistances, we get: dry air, crystal glass, paraffin wax, ebonite, shellac,

gutta percha, and mica. As regards dielectric strength, however, as seen from Fig. 1, mica easily stands first, while air is the worst of all. Hence the importance in spark coil construction of filling in the spaces between the windings with wax and excluding air as far as possible.

Sparkling Distance in Air. — Different experimenters give varying results for the dielectric strength of air due probably to variations as regards shape of electrodes, etc. The American Institute tests, using sharp needle points and sine wave alternating current, are given below: —

Spark Length in millimeters.	Disruptive Voltage
180 (= 7.1 in.)	80,000
5.7	5,000
25.4 (= 1.0 in.)	20,000
62.2	40,000
301	120,000
380 (= 15 in.)	150,000

A. Siemens, using a point and plane with alternating current, obtained the values 10,000 volts for 5.78 millimeters (0.228 inch) and 25,000 volts for 22 millimeters (0.866 inch).

Sir W. Preece states that a voltage of 300 to 400 volts is necessary to start a spark in air at all, however short the spark-gap may be. Once a spark has passed, it is easier for a second to follow; the first spark probably produces chemical dissociations in its path which do not instantly pass away. The arrangement of the coil electrodes so that the spark-gap cannot be increased beyond the limit of the coil's capacity, is a very great safeguard against breakdown. A perfect vacuum has infinite dielectric strength; no spark can cross it. Increase of air pressure also raises the resistance to the passage of a spark. Cailletet compressed dry air to 40 or 50 atmospheres (about 700 pounds per square inch) and was unable to spark across a 0.05 centimeter gap (0.0196 inch, or approximately $\frac{1}{4}$ inch), although using a very powerful induction coil.

A Wimshurst machine, when enclosed and worked in compressed air at even low pressures of 15 to 20 pounds per square inch, will give nearly double the length of spark that

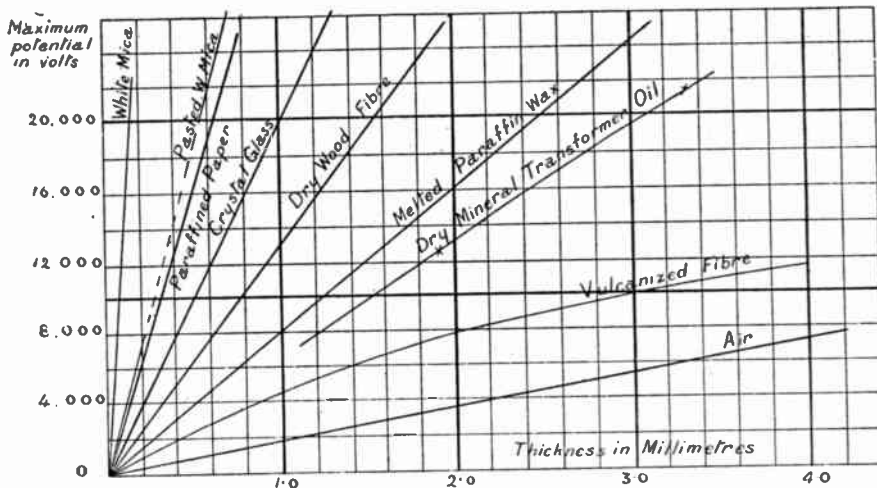


Fig. 1. Distributive Strength of Various Insulating Materials

it will yield when worked in the open, the sparking balls being of course brought outside the case.

Figure 1 shows the dielectric strength of various materials, the voltages being the maximum values. From this curve it is evident that mica easily stands first, while paraffined paper comes very near to it.

Steinmetz gives the following disruptive or dielectric strengths for various materials at a thickness of 0.05 millimeter:—

Material	Disruptive Strength in Max. Volts per Mm.	Remarks
Air	1,670	
Mica	320,000	
Vulcanized fiber	5,200 (red)	slightly damp
Dry wood fiber	13,000	
Paraffined paper	33,900	
Melted paraffin	8,100	65° C.
Boiled linseed oil	8,000	21° C.
Turpentine oil	6,400	
Copal varnish	3,000	
Ebonite (1 mm. thick)	53,000	T. Gray's result

The striking distance depends upon the maximum potential, and is therefore approximately the same for an alternating voltage (R.M.S. or effective or virtual value) as it is for a continuous voltage 1.41 times as great. This is, however, not strictly true in the case of solid insulation, due to the fact that an alternating current heats up the insulation. White glass, for instance, 0.3 millimeter thick, will resist 20,000 to 25,000 volts D.C. pressure, and is only pierced when subjected to an oscillating condenser discharge. Professor Elihu Thomson found that oil is not so good an insulator for low as for high frequencies, hence the success of oil as an insulator for Tesla coils. With 100 cycles one third the thickness of air

was found to withstand the voltage, while with 50,000 to 100,000 cycles from 1-20th to 1-60th was a sufficient barrier.

Thickness of Dielectric.—The breakdown strength per unit of thickness is generally (but not always) greater as the thickness of insulation is decreased. An infinitely small thickness of some insulators may thus have a very high disruptive strength per millimeter. The disruptive strength of melted paraffin, paraffined paper, dry air for thicknesses exceeding 10 millimeters, and mica for thicknesses exceeding about 0.75 millimeter, obeys a straight line law, *i.e.*, the disruptive strength varies directly as the thickness.

It is therefore evident that a coil wound in, say, 40 sections, will be much better insulated than one wound in 20 sections with double the insulation between each section.

Specific Inductive Capacity.—For a given condenser (with fixed size of plates and distance apart), the capacity is dependent upon the nature of the dielectric between the plates, *i.e.*, proportional to the specific inductive capacity of the dielectric. It will be presently shown that this inductive capacity has a very important bearing on the insulation question. The specific inductive capacity of the various insulators is given below:—

Dry air	1
Glass	6 to 10
Solid paraffin wax	2.29 to 1.97
Paraffin oil	1.92
Shellac	2.95 to 3.15

Ebonite	2.21 to 3.15
Mica.....	5 to 6.64
Sulphur	3.97
Petroleum oil	2.03 to 2.07
Turpentine (commercial)	2.16 to 2.23
Resin.....	2.55
Gutta percha.....	3.84
Pitch	1.8
Ozokerit oil	2.16

From the above the advantage of glass as a condenser dielectric is obvious, and also the advantage of thoroughly excluding air by soaking a spark coil condenser in melted paraffin, its capacity being by this means nearly doubled. Immersion in oil would, of course, have a similar effect.

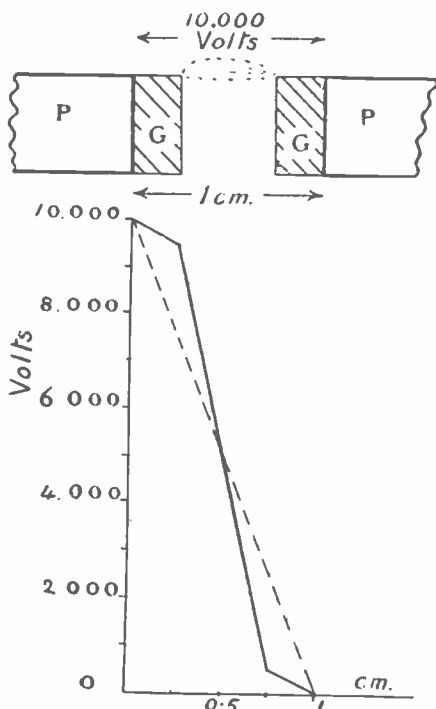


FIG. 2.

Fessenden's and Tesla's Experiment.— Suppose we take two plates, P P in Fig. 2, 1 centimeter apart, and connect them to the terminals of a 10,000-volt alternator. We then get a potential gradient across the 1 centimeter air gap of 10,000 volts per centimeter, as represented by the dotted line. Suppose the dielectric air to withstand fifty per cent more than this pressure, for an indefinite time. If now two plates of glass G G, be introduced, each 0.25 centimeter

thick, and having a specific inductive capacity eight times as great as air, the insulation breaks down, although the glass is more volt-resisting than the air. *The voltage divides itself up inversely as the inductive capacity*, so that the fall of volts across each glass slab is 500 volts, while that across the air gap (now reduced to 0.5 centimeter) is 9000 volts, or at the rate of 18,000 volts, per centimeter. Now, as the air can only support 15,000 volts per centimeter, the potential gradient in the air gap as shown by the solid line is too steep, and the spark can jump the air gap. At every alternation a spark will jump across which will quickly heat up the glass, so that this will give way and the whole insulation be thus broken down. Hence, unless the whole space is filled up, the introduction of a good insulator may actually weaken the insulation as a whole. This weakening is not always apparent at once, as the spark takes some time to eat its way through the dielectric, hence the reason why induction coils very often give way after a few years in use. The foregoing experiment was wrongly taken by Tesla to show that ebonite and glass, etc., were less insulating than is generally assumed; it is, however, of the greatest importance, for it clearly shows that in spark coil insulation we must observe the following rules:—

(1) The dielectric should be homogeneous throughout as regards its specific inductive capacity; the impregnating oil or wax having approximately the same specific capacity as the paper.

(2) Air-bubbles in the insulation should be very carefully avoided. The more completely air can be excluded from between the layers of paper, etc., the better.

For further details as to the "grading" of insulation so as to obtain specially high dielectric strength near the wire (where it is most wanted), the reader should refer to a very interesting paper by O'Gorman in the *Journal of Electrical Engineers*, Vol. XXX, 1901, page 608, *et seq.*

Heating of Dielectric.— When an insulator is subjected to a high alternating potential a certain amount of heat is generated in the dielectric itself, due to (1st) current that manages to get through the insulator; (2d) dielectric hysteresis, owing to the alternation in the electrical stress. If this heat is not dissipated as fast as it is generated, then the insulation heats up and ultimately breaks down. This heating-up may be very rapid, especially with high tension apparatus, or

where large capacity is present, the center portion being badly charred before the outside shows any visible heating effects. The amount of heat so generated in a dielectric increases at least as fast as the square of the voltage. Increase in temperature rapidly lowers the dielectric strength of an insulator; for instance, even mineral insulators become fairly good conductors when raised to high temperatures, as seen in the Nernst lamp. The insulation of a spark coil may thus be easily ruined if worked for lengthy periods off a high-voltage circuit with an electrolytic interrupter, owing to the exceedingly high periodicity (some 1500 to 2000 per second) produced by this form of interrupter.

Effect of Heat on Insulation. — Providing that no moisture is present (in which case, of course, heating would improve the insulation by drying out the moisture), increase of temperature lowers the dielectric strength; in some cases enormously so. Overheating may permanently ruin the dielectric strength; paraffin wax is turned from a white to a yellowish color, and ruined if heated much above 100° C. (212° F.), and should not be kept heated up even to this temperature longer than necessary, or its insulation qualities will be permanently affected. Nor is there any reason to heat it up to this temperature, seeing that paraffin wax has a melting point of 46° C. (114° F.). It should always be melted over a water bath, glue-pot fashion, care being taken that no steam can reach any part of the insulation material. Bee's-wax melts at 150° F. or 65° C.

Cotton-covered wire gradually deteriorates if subjected to even 100° C. (212° F.) for any great length of time, while above this temperature the cotton turns brown and becomes carbonized pretty rapidly. The practice of passing the wire over a Bunsen burner in order to melt the wax when coil winding, is a bad one, as the excessive temperature is almost certain to seriously affect the insulation. By far the better plan is to run the wire through the hot wax and then straight on to the winding former.

Moisture has always a very bad influence on the dielectric strength, and should therefore be entirely removed from the cotton or silk, wood, etc., preferably by vacuum drying, of which more will be said later on. Few people realize that the atmosphere usually contains at ordinary temperatures from forty to sixty-five per cent of the maximum moisture the air can take up (*i. e.*, saturation point); that perfectly dry (vacuum-dried).

wood, will, under quite ordinary climatic conditions, reabsorb fifteen per cent at least of its own weight in moisture within forty-eight hours; and that most paper contains at least five to ten per cent by weight of water.

Oil is very seriously affected by moisture (even the moisture of saturation), 0.01 per cent (one-hundredth of one per cent) being sufficient to lower the disruptive strength of a perfectly dry oil from 24,000 to 12,000 volts, while one-tenth of one (0.10) per cent will lower it to about 1800 volts; hence the need for carefully boiling and keeping Tesla transformer oil quite free from moisture. To simply soak, say, ordinary undried wood or paper in melted wax merely imprisons the moisture within the material, while if the temperature is raised above the boiling point of water (212° F., or 100° C.) so as to expel the moisture, the insulating qualities of the paraffin wax are ruined in the process.

Vacuum Drying. — The writer strongly favors the vacuum drying of all paper, wood, etc., before waxing, while for his large coils he always again soaks the secondary, after winding, in melted paraffin wax in vacuum, thus expelling any air-bubbles. After half an hour's vacuum waxing, the pan is opened, and when the wax is just on the point of setting, the coil is removed. Of course, the coil must be so built that the sections are well supported by the paper disks and cannot be displaced even when the wax is all melted. With a 28-inch vacuum the boiling point of water is reduced to 38° C. (100° F.), while with a 29-inch vacuum it is only 25° C. (77° F.).

As the pressure is only approximately 15 pounds per square inch, the construction of a small vacuum pan for coil work does not present any difficulty, while a simple Grove single valve type air pump with vertical barrel (the top of the piston-rod and plunger being kept tight by a layer of very thick cylinder oil) will readily give the desired vacuum. A reasonably well-fitting lid clamped on with a ring of oiled brown paper packing will be quite air-tight and readily renewed. The writer's vacuum pan was made from a worn-out float type steam trap picked up from the scrap heap. The thermometer tube is brought out through an asbestos-packed stuffing box. To build any coil above 4-inch spark without such a vacuum pan is false economy. As regards the insulation materials themselves, it will be better to deal with them under their various headings.

THE CONSTRUCTION OF AN ELECTROLYTIC RECTIFIER

W. C. GETZ

THERE are many people, outside of electrical experimenters, who require a cheap yet efficient method of changing alternating current to direct current. While the experimenter is the most interested in any apparatus of this kind, there are numerous owners of storage batteries who have access to an alternating current lighting circuit, but still have no means of converting same to a suitable current for battery charging. In fact, the majority of automobiles and power boats run by gasoline engines use the storage battery for ignition, and a majority of the owners pay exorbitant prices to have the batteries recharged.

There are several ways of changing alternating current to direct. The most efficient way is the use of the motor-generator, or rotary converter. As the efficiency of either of these types is not good on small outfits, considering their high initial cost, it is therefore unnecessary to discuss same.

The next type of apparatus to commend itself favorably is the mercury arc rectifier. The cost of this is also prohibitive to the average experimenter.

A less efficient means of making this change is with the electrolytic rectifier. When properly made, its efficiency may not exceed fifty-four per cent, but its cost is a trifle compared to the cost of even a small dynamo. Although this rectifier has been on the market for several years under various names, it has only recently come into general use.

The principle of this rectifier is based on the fact that when an aluminum plate is submerged in a suitable solution, together with another plate of a different metal, a current of electricity can be passed from the other metal to the aluminum, but no current will pass from the aluminum to the other plate.

Thus it is seen that the aluminum plate acts in a manner similar to a check valve—permitting a flow of current in one direction, but stopping it in the other. If an alternating current circuit should be connected to the two plates, during the half cycle that the current was positive to the other plate but negative to the aluminum, there would be a flow of current through the circuit. but when the cycle changed over to make the aluminum plate on the positive side, the current would not pass from the aluminum

to the other plate, and hence there would be no current flow in the circuit.

The other elements used in these rectifiers have been usually lead or iron for the metal plate or negative pole, while various mixtures of water and ammonium carbonate, ammonium oxalate, ammonium nitrate, ammonium phosphate, sodium sulphate, or sodium phosphate have been used in the solution.

The sodium phosphate solution with lead plates gives about the best results, although the other mixtures are also very efficient. As we are not particular from the strict scientific standpoint, we will therefore use a solution of 10 ounces of sodium phosphate to about $7\frac{1}{2}$ pints of water. If battery jars, 6 inches in diameter by 8 inches deep are used, the water should be within $1\frac{1}{2}$ inches of the top to have the right proportion.

As the best results are obtained with lead plates, we will specify 1-16th inch sheet lead, which may be purchased at any metal supply house.

There are numerous ways of connecting up these rectifiers. Figure 1 shows a method of connecting a single jar rectifier, having one lead and one aluminum plate. As this type only utilizes one half of the alternating current cycle, it is not very efficient.

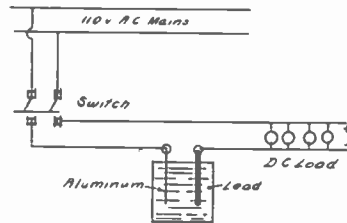


Fig 1

Figure 2 shows a single jar rectifier with two aluminum plates and one of lead plate. It is necessary to place an auto-transformer or reactance coil with neutral tap across the circuit, as shown, the lead plates and the tap from winding going to the direct current load.

Figure 3 shows the most economical arrangement possible with the electrolytic rectifier, where it is desired to use a low-voltage

direct current for battery charging, and yet have little loss in bringing it down from 110 volts alternating current. Where with Fig. 2 the reactance in the circuit reduced the voltage to a suitable point, the loss due to this reactance was also very great. Now in Fig. 3 the primary of a small static transformer is connected to the 110 volt alternating current circuit, and the secondary of

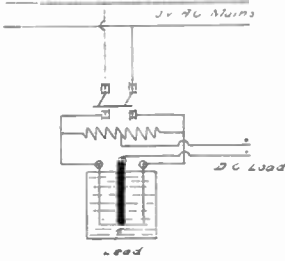


Fig. 12 w.c.o.

the transformer is so proportioned to reduce this high voltage to about 20 volts across the outside terminals, or 10 volts on each side of the winding, from the center tap. Thus, from A to C the voltage is 20, but from A to B, or B to C, the voltage is only 10. If the primary of this transformer is designed to carry 2 amperes, which a 1-5th kilowatt transformer will easily do, the secondary can produce a current of 10 amperes under an

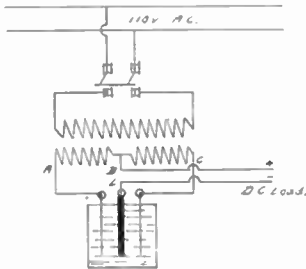


Fig. 13

e. m. f. of 20 volts without heating. Now by connecting A and C to each outside aluminum plate, and connecting B and the lead plate L to the direct current load, a current of from 1 to 10 amperes under an e. m. f. of from 8 to 10 volts will flow from the terminal B, which is positive, to the plate L, or negative terminal, thus being a direct current.

By connecting the positive pole of a 6-volt

storage battery to B, and the negative pole to L, as shown on Fig. 4, with a low reading voltmeter and ammeter connected properly, the charging of the battery can be accomplished with ease, and is thus under constant observation. A small battery rheostat, R, should be inserted in the circuit between B and the battery, so that the normal charging rate of the battery may be maintained constant, thereby compensating for any change in voltage.

This transformer can be made by any electrical experimenter at a very low price. The cost of the materials will not exceed \$6. Complete data and dimensions of this transformer may be found in the "Series E" Construction Drawings of Electrical Apparatus, the same retailing at a very reasonable price.

While it is desired to use the 110-volt alternating circuit current without the trans-

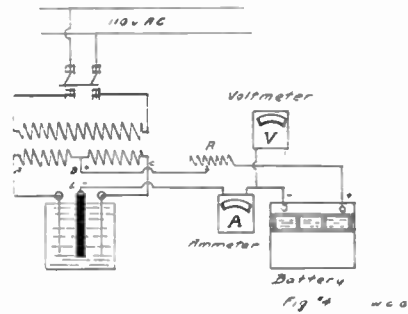


Fig. 14 w.c.o.

former, the three-jar rectifier shown in Fig. 5 is serviceable. Two of these jars have an aluminum and lead plate only, but the center jar has two aluminum and one lead plate. Trouble is often experienced with overheating of this center jar when used continuously. For charging storage batteries, it is necessary to put a bank of 6-32d c. p. 110-volt lamps in circuit as shown. This allows a direct current flow of about 4 amperes. If lamps are not available, a non-inductive resistance of 15 ohms may be used. This resistance must be made of wire heavy enough to carry a current of 10 amperes without undue heating.

To overcome the difficulties of the three-jar rectifier, the plan shown in Fig. 6 is excellent. In this case, four jars are used, each jar having one aluminum and one lead plate. The method of connecting, while seemingly complex, is really very simple. It greatly resembles the wheatstone bridge, the

direct current load being in the place of the galvanometer circuit, while the alternating current feed occupies the position of the battery circuit on the bridge.

As in the case of the three-jar rectifier, if it is desired to be used for battery charging, a bank of 6-32 c. p. lamps should be used, or a non-inductive resistance inserted. Without this lamp bank or resistance, if a low resistance is placed across the direct current

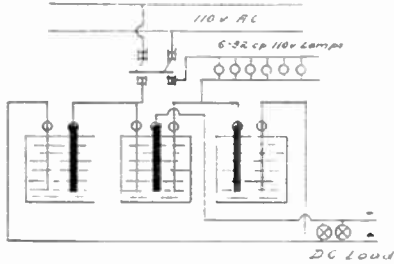


Fig. 5

side, the rush of current will be sufficient to burn out the wires, if the alternating current side is not fused or equipped with circuit breakers. A low-resistance path on the direct current side is just as dangerous as a dead short-circuit on the alternating current side, if there is no means of controlling the current flowing into the jars.

However, when the lamp bank is inserted as shown, no matter how low the path on the direct current side may be, the only current to flow through will be that allowed to pass by the resistance. Thus, where a short circuit might cause a momentary flow of 100 amperes on the main circuit, when a resistance of 10 ohms is placed in series and the short occurs at a point beyond the resistance from the supply source, the largest current flow in the circuit under an e. m. f. of 110 volts, could not exceed 11 amperes.

Another very important point to be observed is, if a low reading voltmeter is used when charging a storage battery with a rectifier that is connected other than shown in Figs. 3 or 4 (where the alternating current is first reduced to low voltage through transformer), the voltmeter should never be connected to the direct current terminals of the rectifier unless the battery is first connected, and the voltmeter should always be disconnected before the battery circuit is broken. This is because that, although the direct

circuit current cannot exceed the current flowing through the lamp bank, the direct current voltage is but a little less than the alternating current voltage. As in the case of charging storage batteries from a 110-volt direct current circuit, when the battery is connected on through lamp resistance, a voltmeter reading will show but a drop of, say, 6 volts; but if the circuit be opened, there will be the 110 volts potential difference, and the low reading voltmeter would be ruined outright, or very badly injured.

When the battery is placed in the circuit, the drop in voltage across the terminals should be but little more than the voltage of the battery, and within the range of a low-reading meter. The battery being disconnected, allows the direct current voltage to rise to about 106 volts, there being a loss of several volts in the rectifier.

Figure 7 shows the dimensions of the plates for all of the types of rectifiers whose connections have been given in the various drawings. If an ordinary Fuller battery jar is used, which is 6 x 8 inches, the plates are 4 x 6 inches, as shown, with an ear in one corner $1\frac{1}{2} \times 1$ inch. This ear is drilled with a $\frac{1}{8}$ -inch drill, and is then bent over at right angles on the dotted line.

Wooden tops can then be made for the jars. These are constructed as shown in Fig. 8. The holes shown are drilled $\frac{1}{8}$ inch

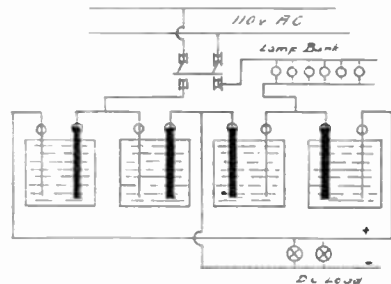


Fig. 6

for binding post screws, and the plates must be fastened in the positions indicated by the dotted lines. If two plates are used, space as shown on A; if three plates are used, take dimensions given on B.

The solution used for all these types is 10 ounces of sodium phosphate to $7\frac{1}{2}$ pints of water. This solution will last for about fifty hours' continuous service on 3-ampere load. Loss of solution from

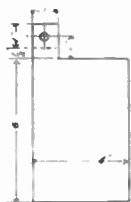
Thickness = $\frac{1}{16}$ "

Fig. 7. w.c.o.

evaporation, due to heating, should be replaced at intervals, with water. The wooden tops should be thoroughly boiled out in hot paraffine wax, and then covered with a coating of insulating paint, to prevent any leakage from the absorption of moisture. "P. B.," or "Mica Insulator Compound," are well adapted for this purpose, though dipping the tops in hot asphaltum will also do.

In charging storage batteries, be sure that the positive pole of the battery is connected to the positive pole of the rectifier. This can be found by putting a voltmeter first across the battery and then across the rectifier. (In last case, high reading scale should be used, if rectifier is not used with transformer.)

After noting the deflections, connect so that the deflections of each one will be in the same direction — that is, the terminal of the battery that gave a deflection to the right with a certain voltmeter lead on it should be connected to the terminal of the rectifier giving a deflection in the same direction with the same voltmeter terminal on it. As the lead plate is always the negative terminal, this is unnecessary with the single-jar rectifier.

Another easy way to tell is to put the terminals of the battery in a glass of water containing a slight trace of acid. The negative pole will then give off much more gas bubbles than the positive. This polarity should be carefully ascertained before connecting the battery, as a reversal of the charging current from the proper direction would ruin the battery.

The ammeter should be connected only in series with a storage battery, and load when discharging, and in the circuit between the battery and rectifier when charging. Never place the ammeter directly across the battery terminals. This does not give a true read-

ing of the amount of charge in the battery, and it is liable to burn out the ammeter, or cause the battery plates to "buckle." Any person who wilfully places a direct short circuit on a storage battery displays ignorance equal to that of a man who will tie down the safety valve of a boiler to see what pressure it will stand.

In charging, use sufficient resistance on the alternating current side of the rectifier, so that the normal rate of charge may be maintained. To this end, the lamp bank is to be preferred, as lamps may be turned on one at a time until the proper value is reached. If the battery is of the 6-volt, 20-ampere hour type, the normal rate would be about 2 amperes for twelve hours. Thus, with the ammeter in series, adjust the lamp resistance until the reading shows a flow of 2 amperes. The voltmeter should show a charging e. m. f. of from 1.8 to 2.5 volts per cell according to the degree of charge. When fully charged, the voltmeter will be about 2.5 volts per cell, and the specific gravity will be about 1.21. The battery will be gassing freely, the electrolyte assuming a milky-white appearance. A battery should never be discharged below 1.8 volts per cell. After completion of charge, the voltage will slowly drop from 2.5 to 2 volts per cell within an hour or so, and the voltage will remain at this point until the discharge begins.

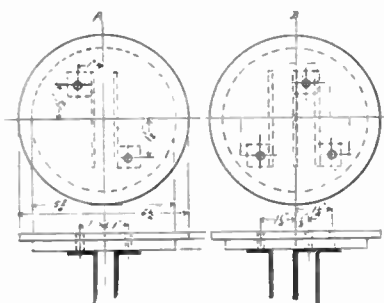
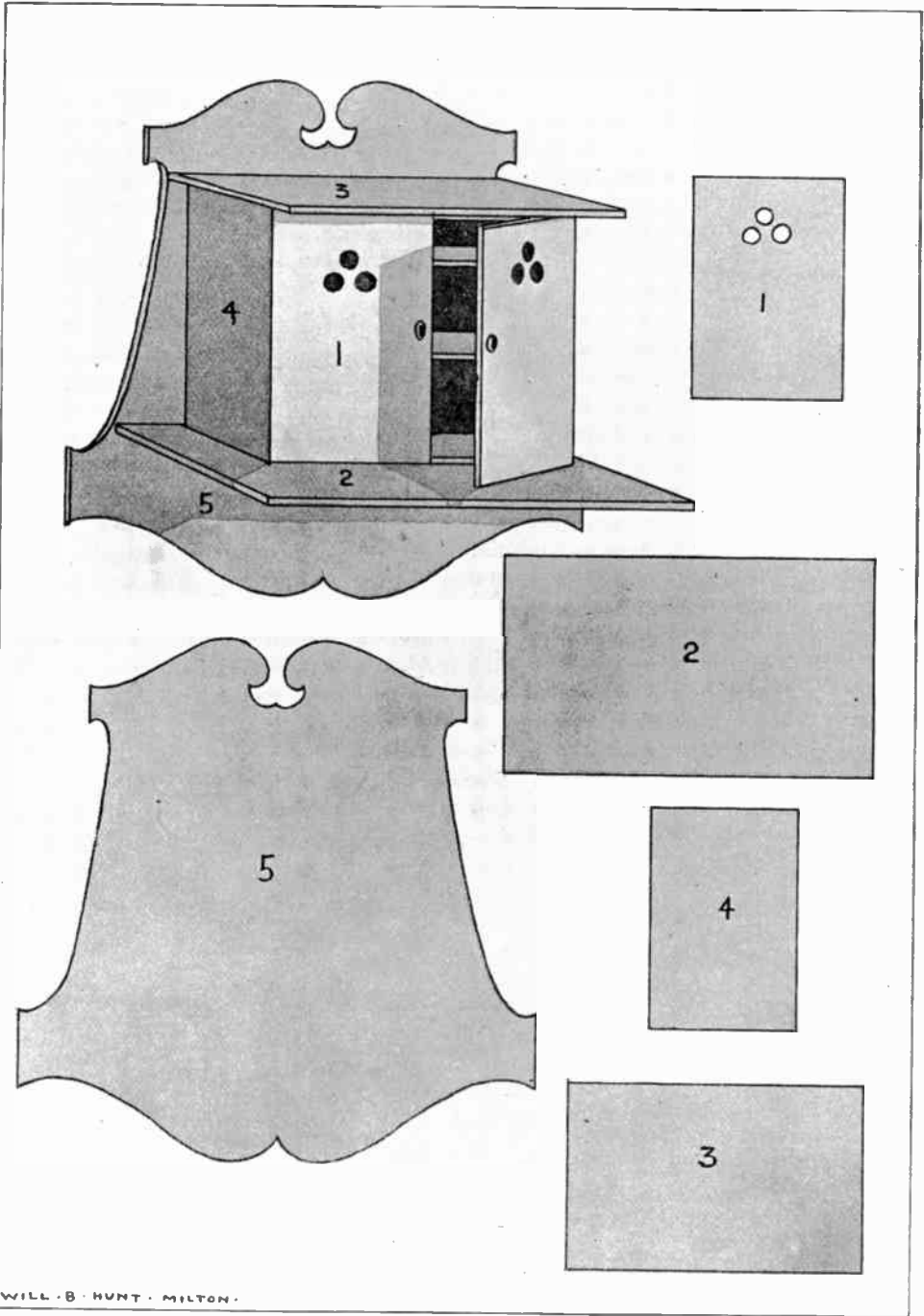


Fig. 8. w.c.o.

The other uses to which the electrolytic rectifier may be put are numerous. For running motors, bells, electric trains, and toys, etc., they are much cheaper than batteries. For use with induction coils on stationary gas engine ignition, they effect a great saving. Altogether, they form a valuable asset in any experimental or electrical "den" where alternating current is available.



MISSION MEDICINE CLOSET

BUILDING CRAFT

A DEPARTMENT FOR WOOD WORKERS

Devoted to the interest of Home Furnishers

FURNISHING THE DINING ROOM AND
KITCHEN—Part V

MABEL V. H. HUNT

THE dining room needs no burlap on the walls, which should be of matched boards, stained green. Red is often chosen for the dining room walls, but it is a scientific fact that red is a color which greatly stimulates the nerves, and unless the shade selected be a deep, dull tone, it is unadvisable for this room, which is one where considerable time is spent.

The table should be in Mission style, square, solid, and firm; the sideboard should be small and simple, without silver, which is not suitable for a summer cottage. Designs and descriptions of table and sideboard will appear in a later number of the *ELECTRICIAN AND MECHANIC*.

We are showing this month a sketch of a china closet, which may be built at home. When fastened to the wall of the dining room, it forms a convenient place for dishes, and is a thing one needs, since there is no closet shown in the plan.

This room has four windows, and since it is open directly into the living room, it is a good plan to have the draperies match those of that room.

It is unnecessary to provide any floor covering, it being much easier to care for the smooth surface; and for wall decorations, a few simple photos and a clock. There are many odd styles of timepieces to be found in the shops, one which is suitable for this room being in the form of a frying pan. Next issue of this magazine will contain a design for a tall wall clock.

The chairs should match the table in color, at least, and if one does not care to buy or make Mission chairs, ordinary leather-seated ones, stained dark, may be used instead.

The dishes need not be expensive; any of the pretty dinner sets from \$15 upwards will

do. The chief thing to avoid in getting it is an overabundance of decoration. The prettiest, by far, have merely a narrow band of some color, or a fine design along the edges of the different pieces.

Be sure to provide plenty of drinking glasses, summer time being the season when tea, coffee, and cocoa are often frowned upon when served hot. Several glass fruit dishes are needed, fruit being a natural dish,—home-picked berries taste so much better than boughten ones.

To save laundry work, why not patronize the crêpe paper manufacturers? Table cloths and doilies and napkins come in many attractive styles, and though they are not durable, they are not expensive, and it is easy to keep the table always looking fresh and clean.

It is not often that a regular meal has to be eaten in summer by artificial light, but in case of a late meal, something must be provided. Some people like a lamp in the center of the table, in which case the one described in this number will do. Oftener, however, a hanging lamp is more to be preferred. One of dull black iron, with a good oil tank and fairly large chimney, is suitable. It may be provided with a fancy shade.

When not in use, decorate the center of the table with a jar of wild flowers, fresh every day.

In the kitchen there should be a range (a No. 7 is usually large enough), with six holes and a good oven. The chimney may be of galvanized iron, connected directly with the funnel and projecting through the roof.

If near the salt water, do not attempt to keep the stove blacked with polish, but grease it with lard or tallow every day, to prevent rusting. There are ranges made especially for country houses, with a tank

holding five or ten gallons of water attached to the back, thus providing continuous hot water, as long as there is a fire, without plumbing.

There are also cook stoves built expressly for wood burning; these are very convenient where coal is scarce.

In case neither of these is desired, a blue-flame oil range is very satisfactory.

It is not supposed that there will be running water in the house. If there is, so much the better; but in either case there should be a sink built under the window for convenience to the stove and to secure plenty of light. The drain may be an ordinary pipe leading out into the yard.

The back door should be provided with screen, and it would be pleasant to have an awning over the top of the steps. An inexpensive one may be made from burlap, stretched over a home-made wooden frame.

Against the wall of the bedroom a good-sized wooden table with one large drawer may be placed. The drawer is to hold knives and forks, aprons, towels, etc.

Over the table hooks may be screwed to the walls, and on them should hang pots, pans, kettles, egg beater, molding board, rolling pin, bread and cake pans, cream whips, strainers, sieves, and other kitchen utensils. A closet may be improvised from a tall, narrow packing case, with shelves built in, and with a door made of wire netting on a frame.

A food closet of this kind is a very convenient article for the keeping of cooked stuff which may not need to go into the ice chest. It, as well as the refrigerator, may be provided with keys and kept locked, so that they may stand out of doors, — on the platform.

For the pantry, one must use his own discretion in stocking, much depending upon the length of stay and the distance from the stores. Of course, every one knows that it is cheaper to buy in quantity, and having things on hand often prevents much worry in case of sudden advent of guests or failure of goods to arrive from the stores when ordered.

Washtubs should be kept outside the house, on a bench made for them.

PORCH SETTLE

In this number there is given a design for a graceful settle, which may be made to exactly fit into the space between the right-hand pillar and the corner of the house.

This settle has curves which give it an artistic effect, yet it is not difficult to build from the given plans.

Porch blinds are suggested for the screening of the sunlight. These may be bought from a Japanese dealer, or made from burlap. Two or three lengths, stitched together and decorated with stenciling, make a very pretty, simple, and serviceable blind.

The settle may be furnished with bright red cushions or pillows.

FURNISHINGS FOR LIVING ROOM

Somewhere, upon the wall of the living room, because of its accessibility, should be hung a medicine chest, made from the model shown in the July number of the *ELECTRICIAN AND MECHANIC*. This should be kept well stocked with ordinary family remedies. It is very important to keep a good supply of these, for as a general thing a camp is at some distance from doctors and druggists, and a simple drug immediately used will often prevent a severe illness.

For the living room we are showing a Mission lamp-stand, made from smooth $\frac{1}{2}$ -inch stock and stained to suit the taste. The opening in the top is of a size to hold an ordinary quart, glass kitchen lamp, which is hidden by the frame, thus making a very handsome lamp at an extremely low price.

The shade is made from cardboard, mortised, with the openings filled in with crêpe paper. This paper comes in so many colors and combinations, and is so inexpensive, that it is possible to have numerous shades, which are easily replaced when torn or faded.

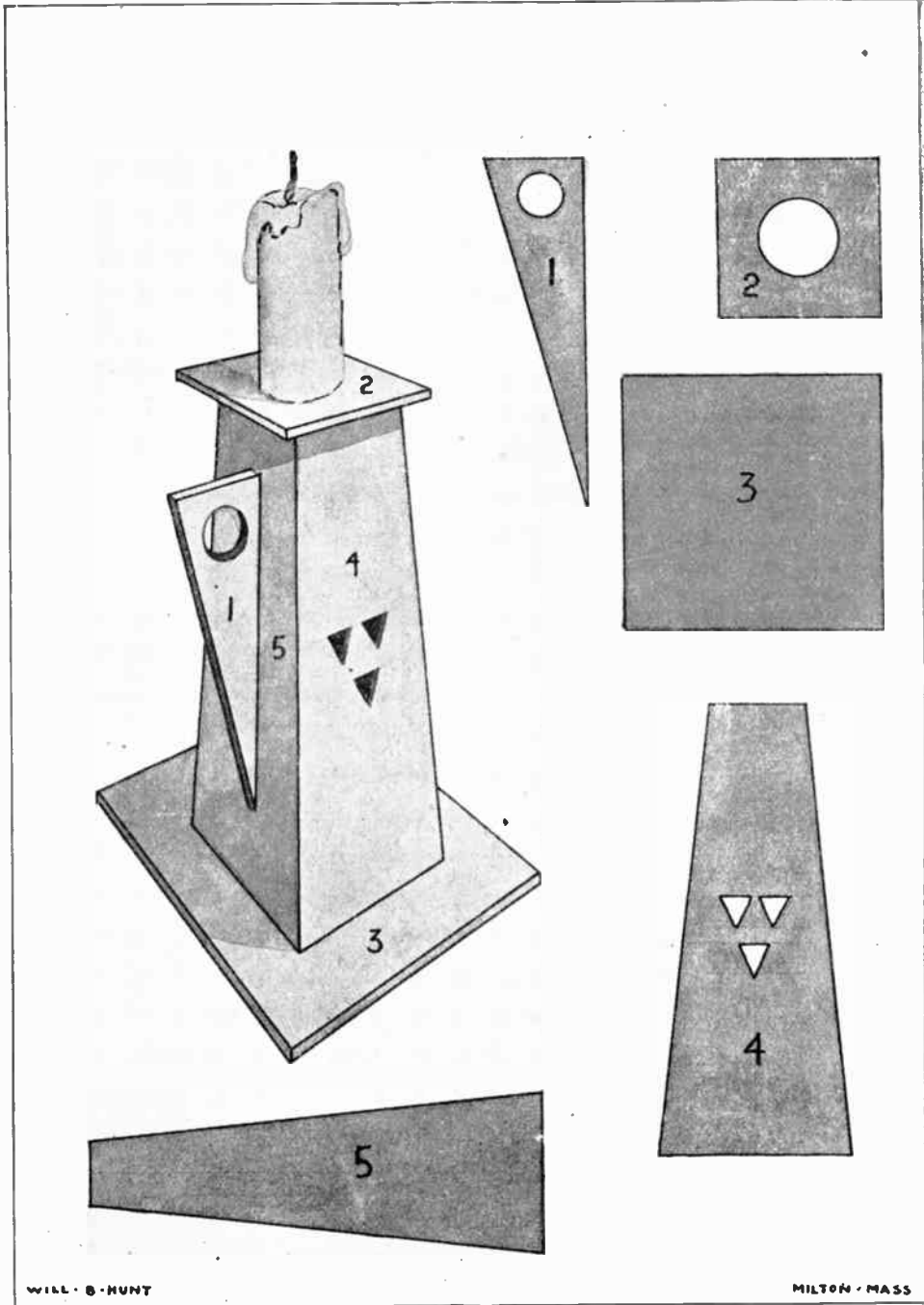
FURNISHING THE SLEEPING ROOMS

Now that the living room is completed, we turn our attention to the bed chambers of the bungalow.

Let us suppose the one next the kitchen to have a northerly exposure, with but little sunlight. This, while making the room delightfully cool for summer time, necessitates some touch of warm color to make it cheerful for the early fall days, which are invariably chilly.

The walls of this room, unless left bare, should be of golden brown burlap to the wainscoting, or the entire height of the walls if desired. It is much prettier to have the burlap extend but part way from the top, the remainder of the walls being of matched boards, shellacked.

At the joining, a shelf about 5 inches wide makes a convenient rest for an occasional



WILL · B · HUNT

MILTON · MASS

MISSION CANDLESTICK

photo or knickknack; but, above all things, avoid an overcrowded appearance. A sleeping room should be restful and harmonious, which it cannot be, filled with numerous articles of various sorts.

A Fisher or Wenzel sketch or two, and a sepia print of some country scene, such as a group of birches, *passee-partout* in brown, with a lighter brown mat, will help to make the room cozy, and yet will not detract from the quietness.

Since this is a rather dark side of the house, it will be well to have the dresser and other furnishings in white enameled wood. A dresser with a good smooth mirror and with two small and two large drawers is the most serviceable. One standard chair and one rocker, cane seated, cushioned if desired, and white enameled, are also suggested.

Built-in closets are not specified in the plan, though they may be added at the builder's discretion; but in case of their not being built, it is well to arrange something for the hanging of clothing.

This may be done in at least two ways. A corner of the room may be fitted with a triangular shelf at a height of 7 feet from the floor, another shelf placed a foot beneath it, thus forming a resting place for hats. Hooks may be screwed into a cleat joining the lower shelf, and the whole may be hidden from view by drapery attached to the upper shelf either by brass tacks or strung on wire.

In place of a washstand, a similar shelf may be arranged in another corner, placing the board lower, and hanging the valance from it to the floor.

The other way is to build a portable closet of boards or from a packing case, fit it with hooks, and drape the opening. This has the advantage of utilizing space other than corners, but the outside of the box must be stained, or, in this case, painted white to correspond with the furniture. A clothes-tree is useful, but is not an actual necessity.

The bright tones of the color scheme may be further carried out by means of bureau and commode covers and bed spreads made from cretonne, having a white background, with a delicate yellow vine for its design. Ruffled muslin window draperies, with a straight valance and side curtains of thin yellow silk, give a good effect.

Two long rugs of green or brown filling for the bedsides, and two smaller ones for before the bureau and commode, form the floor covering.

Just a word concerning the beds. Have them all of heavy iron tubing, without any brass knobs or trimmings,—they wear so much better than the others. Also get the best of springs and good-quality mattresses and pillows—it pays in the end. Should white spreads be preferred, it would be a good idea to have an extra puff at the foot of each bed, embodying the color scheme of the room.

A full toilet set should be supplied for each room, and hospital ware is suggested as a substitute for china; it is unbreakable, and comes in white and colors.

The middle sleeping room will look well done in pink and green, with oak or white furnishings. Have green burlap on the walls, oak dresser, commode, and clothes-tree, one oak chair and one green wicker chair, green rugs, and hangings of cretonne with rose pattern.

In the front chamber a departure from the burlap walls is shown, as this is to be a blue room. It has a south exposure, and needs no warm color to brighten it. Delft blue denim will make a good wall covering, and a Mission-style dresser in Flemish oak finish is to be preferred to white, here.

The draperies may be of sateen or cretonne, having white background, with decorations in Dutch blue.

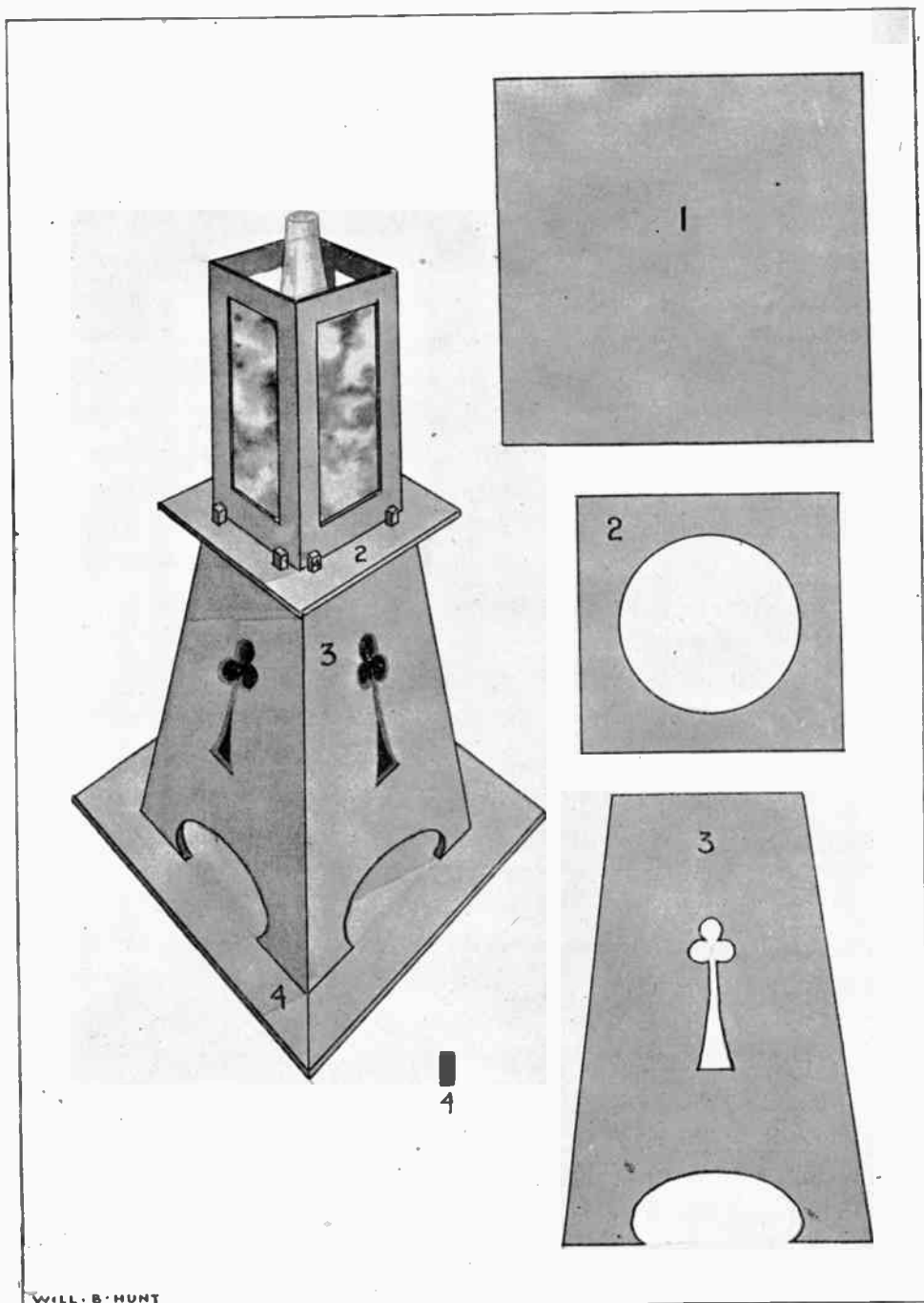
If one is fortunate enough to possess one of the old blue and white spreads, so much the better, as it will harmonize nicely with the wall tones.

The draperies for the windows of this room should be of one piece, and hang straight down from the rod, with little or no fulness,—the style known as the *Bonne Femme* curtain. Rugs, blue and white.

A *passee-partout* picture, representing a sunset scene in rich red tones, will give character to this room.

It is a good plan to provide a utility box to stand at the foot of each bed, and, owing to the vogue of the one-piece dress, the original shirt-waist box would better be displaced by one as long as the width of the bed, 12 inches wide and 16 inches high. This should be covered with upholstery like that on the walls of the room it is to occupy. Not only will this be found useful to hold clothing, but it will also serve as a seat, so that one chair instead of two may be used.

On each dresser should be placed a china pin-tray and a rack for receiving the mail of the occupant, also a jar for odds and ends.



MISSION TABLE LAMP

It is a good idea to screw a bracket lamp to the wall at the side of each dressing case, for, in the absence of electricity and gas, it is necessary to have some way of throwing a good light on to the mirror. And don't forget the match safes, — two in each room, one fastened beneath the lamp, the other at the head of the bed, on a little candle shelf.

We are showing design for Mission candlestick, simple and in keeping with the cottage. For the yellow and blue rooms, smooth wood treated with black oak finish and pro-

vided with white and gold candles is suggested. For the other room, green stain rubbed off before it is quite dry and fitted with a pink candle is suitable.

During the day these candles may be kept in a row in the living room, the idea being for each one on retiring to select his own, and carry it, lighted, into the room reserved for him, thus avoiding any inconvenience which may be attendant on entering a dark room, especially if it be unfamiliar to him.

WIRELESS TELEGRAPHING TO A BALLOON

NORBERT CAROLIN

A WIRELESS telegraph receiving station could be easily installed in a balloon. A transmitting station, however, would be too heavy and the spark might ignite the gas. A telegraph station would be better than a telephone, for it could receive messages from greater distances.

The antenna might be insulated, stranded, copper wire braided into the valve rope its full length, without interfering in the least with the operation of the valve. The same length of wire could be braided into the guide rope as "ground." The length of the wave used should be twice the total length of the two wires. Where the two wires meet in the basket there should be inserted a variable inductance in series with a detector of the barretter type; as the electrolytic type might freeze, the coherer will not stand jarring, and the magnetic is too heavy. Shunting the detector, there should be a variable mica condenser and a high-inductance telephone receiver, supplied with headgear, in series with a few dry cells.

The total weight would be less than 25 pounds and the cost less than \$20.

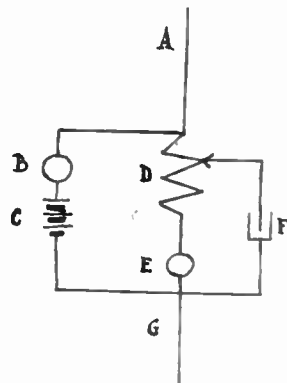
The shortness of the wave length, occasioned by the short distance between the basket and the valve, would not make much difference, as there would be no obstructions for the waves to encounter.

A transmitting station already established would probably consent to send the messages.

It might be better to use aluminum throughout, instead of copper, because, weight for weight, it is more conductive, but takes up more space.

A wireless outfit might be dangerous in a thunder storm.

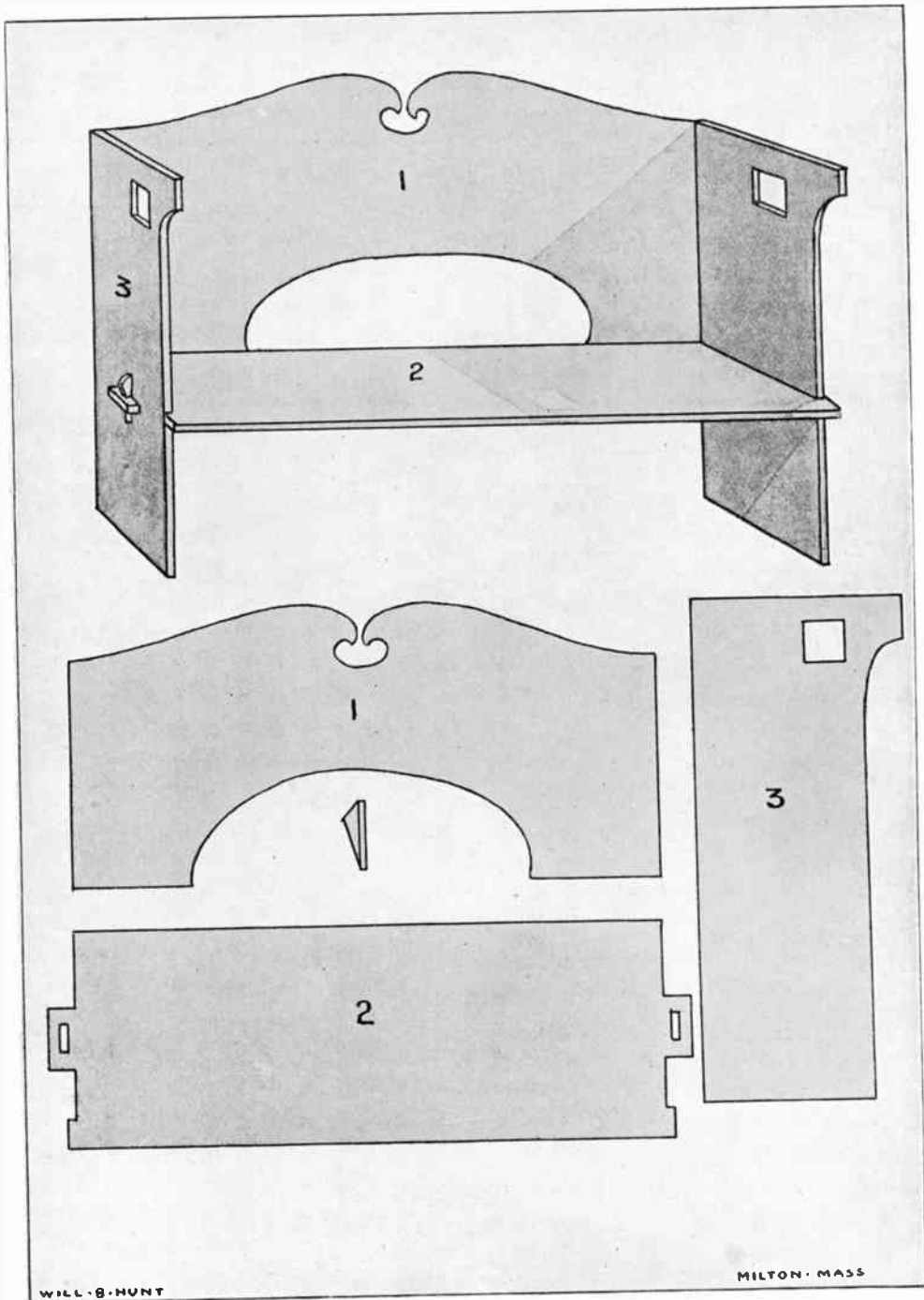
DIAGRAM OF CIRCUIT



- A = antenna
- B = receiver
- C = battery
- D = variable inductance
- E = barretter
- F = variable condenser
- G = "ground"

Wireless waves might be used to control balloons or airships containing no passengers, in the same manner that torpedoes are now controlled.

One of the first dirigibles was propelled by electricity, and now that the storage battery has been reduced to less than 70 pounds h. p. per hour, it might be worth while trying again with a specially designed motor. — *Aeronautics*.



PIAZZA SETTLE

GASOLINE ENGINE TROUBLES CLASSIFIED

HOWARD W. RILEY

THERE frequently come times when the gas engine bucks and we are at the moment unable to remember just the particular rule that applies, and so fail to get the engine to start. At such times we all of us feel the need of a classified list of gasoline engine troubles, both great and small.

The purpose of this article, then, is not to furnish anything new in regard to gasoline engine difficulties, says *Gas Review*, nor to supply detailed information as to the exact nature of any specific cause of difficulty, but simply to gather together a list of the different causes of trouble and to properly classify them under the various symptoms which they may produce in the engine.

Just a word of warning, however, before we go farther. Always study and follow the directions sent out by the manufacturers with their engines. Remember that the makers know their engines better than any one else, that they know the troubles to which they are most subject, that they are vitally interested in having their engines give satisfaction, and that they therefore take special care to have their directions correct. If, however, these directions do not give the information required, then turn to the following list:—

SYMPTOMS OF TROUBLE

- I. Difficult starting.
- II. Lack of power.
- III. Pounding.
- IV. Poor speed regulation.
- V. Excessive fuel consumption.
- VI. Back-firing.
- VII. Heavy explosions at exhaust.
- VIII. Smoke.

CAUSES OF TROUBLE

I. DIFFICULT STARTING.

- I. Lack of fuel.
 - a. Main valve or carburetor needle valve closed.
 - b. Supply tank empty.
 - c. Supply pipes or carburetor openings clogged.
 - d. Gasoline pump out of order.
 - e. Gasoline suction pipe leaking or too long.
 - f. Gasoline check valve reversed.

2. Defective ignition.
 - a. Main switch not closed.
 - b. Engine switch or timer not making good contact.
 - c. Wire disconnected, loose at binding post, or broken.
 - d. Batteries too weak.
 - e. Wiring or coil terminals short-circuited.
 - f. Wiring incorrect.
 - Make-and-break System.*
 - g. Sparking points not making contact because of dirt.
 - h. Sparking points not making contact because engine sparking mechanism out of adjustment.
 - i. Sparking points short-circuited by dirt.
 - j. Arm of moving point loose on shaft.
 - k. Speed of break too slow.
 - l. Coil defective.
 - Jump Spark System.*
 - m. Spark plug points more than 1-32 inch apart.
 - n. Spark plug points short-circuited.
 - o. Vibrator of induction coil out of adjustment.
 - p. Vibrator terminals not making contact.
 - q. Coil defective.
3. Cold engine and gasoline.
 - a. Air intake pipe too cold.
 - b. Jacket water turned on too soon or too freely.
 - c. Gasoline for first charges too cold.
4. Incorrect mixture.
 - a. Engine cylinder or air intake not primed.
 - b. Engine cylinder or air intake primed too freely.
 - c. Mixture too weak, causing snapping at carburetor, back firing (VI, 1 a) and muffler explosions (VII, 1).
 - d. Mixture too rich, causing black smoke at exhaust (VIII, 1, a).

5. Water in gasoline or cylinder.
 - a. Gasoline carelessly handled and unstrained.
 - b. Cylinder gaskets blown out or leaky.
 - c. Cylinder or cylinder head castings defective.
6. Incorrect setting of engine mechanism.
 - a. Spark out of time.
 - b. Make and break spark points not touching.
 - c. Exhaust valve out of time.
 - d. Exhaust valve not allowed to close.
 - e. Exhaust valve not fully opened.
 - f. Governor mechanism out of adjustment.

II. LACK OF POWER.

1. Lack of fuel.
See I, 1.
2. Defective ignition.
 - a. See I, 2.
 - b. Cells really worn out but strong at starting.
3. Incorrect mixture.
See I, 4, c and d.
4. Overheating and friction of engine parts.
 - a. Insufficient cooling water.
 - b. Insufficient lubrication.
 - c. Lubricants of poor quality.
 - d. Bearings bolted up too tightly.
 - e. Piston heated by pre-ignition.
 - f. Piston heated by escaping gases. See II, 5, b-e.
5. Leaks in compression chamber.
 - a. Valves not seating.
 - b. Piston rings not coated sufficiently with oil.
 - c. Piston rings sticking in grooves.
 - d. Piston rings set with all breaks in line.
 - e. Piston rings not truly circular.
 - f. Valve stems worn, bent, or binding.
 - g. Valve springs weak, loosened, or broken.
 - h. Valve cages not properly packed or ground into place.

- i. Igniter mechanism leaking.
 - j. Cylinder gaskets defective.
 - k. Sand holes in piston.
6. Constricted valve openings and air passages.
 - a. Carburetor clogged by dust and dirt.
 - b. Air passages clogged by dust and dirt.
 - c. Valve stems or operating levers bent, binding, or loose.
 - d. Exhaust pipe too long, too small, or with too many turns.
 - e. Carburetor clogged by frost.
 - f. Admission valve spring too strong.
 - g. Original design at fault.
 7. Overload on engine.
 - a. Overheating and friction of working parts. See II, 4.
 - b. Outside load too great.

III. POUNDING.

1. Pre-ignition.
 - a. Spark too early.
 - b. Cylinder and piston overheated. See II, 4.
 - c. Glowing carbon or metal points in cylinder.
 - d. Ignition uncertain. See I, 2, c and j.
2. Leaks in compression chamber.
See II, 5, a-g.
3. Looseness in some parts of engine.
 - a. Connecting-rod bearings loose.
 - b. Main shaft bearings loose.
 - c. Fly-wheel loose on shaft.
 - d. Fly-wheel cracked in hub, spoke, or rim.
 - e. Lost motion in any other part.
4. Moving parts of engine striking some obstruction.
 - a. Must be determined by inspection.

IV. POOR SPEED REGULATION.

1. Defective ignition.
See I, 2.

2. Governor out of adjustment.
 - a. Lost motion in moving parts.
 - b. Detent lever with too much clearance.
 - c. Moving parts gummed and binding.
 - d. Lack of lubrication.
3. Incorrect mixture.
See I, 4, c and d.

V. EXCESSIVE FUEL CONSUMPTION.

1. Leaks in gasoline tank or piping.
2. Incorrect mixture.
See I, 4, c and d.
3. Defective ignition.
See I, 2.
4. Leaks in compression chamber.
See II, 5.
5. Engine run too cold.
6. Engine run too fast at light loads.
7. Fuel of poor quality.
8. Engine parts heating and binding.

VI. BACK FIRING.

1. Delayed burning of previous charge.
 - a. Mixture too weak.
 - b. Spark too late.
2. Glowing points in compression chamber.
 - a. Carbon.
 - b. Metal.

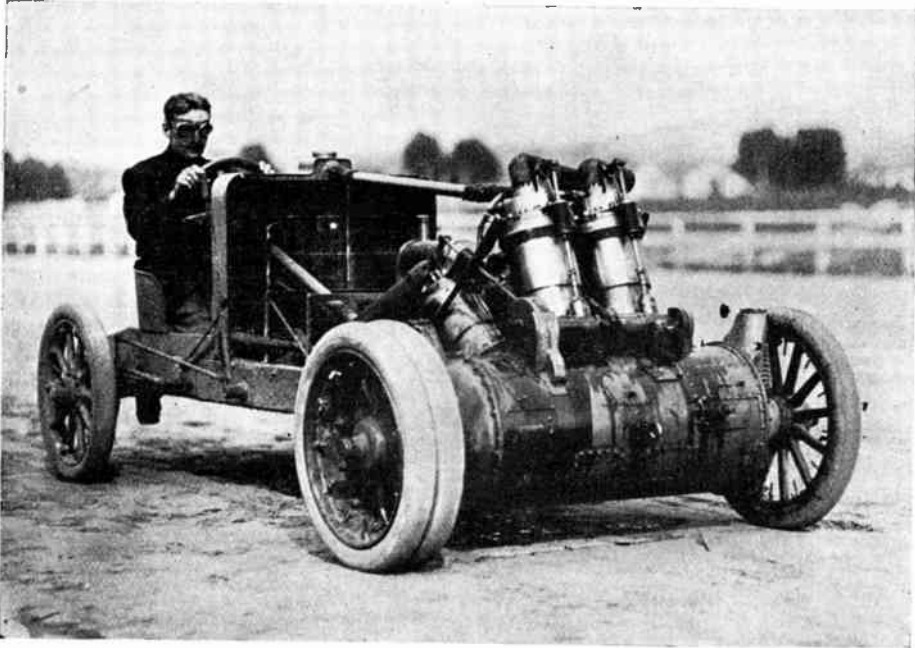
VII. HEAVY EXPLOSIONS AT END OF EXHAUST PIPE.

1. Defective ignition.
See I, 2.
2. Mixture too weak.

VIII. SMOKE.

1. At end of exhaust pipe.
 - a. Mixture too rich, gives black smoke.
 - b. Excessive cylinder lubrication gives blue smoke.
2. At open end of cylinder.
 - a. Leak past piston rings.
See II, 5, b-e.
 - b. Sand hole in piston.

—Gas Review.



FREAK AUTOMOBILE

The fastest thing in the automobile line ever built is capable of traveling at a rate of 2 miles per minute on a straight-away track. It is the invention of Mr. Walter Christy, wealthy New Yorker, who has spent years developing the "freak automobile," as it is known. Unlike any other automobile this machine develops all its power over the front axle, where all the mechanism is located and the power applied. The horse power of this machine is estimated at 130 and it is built for racing exclusively. Mr. Christy races this machine for pleasure and recreation. He has nothing for sale and does not advertise anything.

HOME-MADE JEWELRY

CHARLES B. DYER

In the very start the workers must fix this fact well in mind: Without a proper sense of fitness and a feeling for good design, no jeweler can produce good work. The design is the first and most important part, and should, therefore, be given great care and thought. Some have the mistaken idea that the more elaborate the design, the better it is, when in fact the simple straight-line designs are infinitely better and more pleasing. A good design may be easily spoiled by over-elaboration. Well-wrought simplicity is the most enduring and admirable.

Although there are as many bad as good designs in old work, it can be taken as a rule that the best inspiration may be received from old work. A careful study of the great variety of results obtained by simple means, a personal interpretation, and expression of individuality are bound to produce fresh and satisfactory work. It must be remembered that art is not a mere copy of nature either, as nature is not art. It is only when nature is interpreted by the artist that it becomes art. A slavish copy of nature is mechanical, not artistic. The worker must keep these facts in mind when starting his design, and if he desires to represent nature, let him do so, but by translating it, remembering at all times the limitations of his materials and color schemes.

For the first piece of work, we will undertake a small bar pin, such as ladies wear for collar or belt pin. This piece will teach the use of the saw and some of the tools most often used. Design some piece with straight lines, and make a drawing on tracing paper the exact size and shape desired. Take a piece of silver or copper large enough to receive the design and heavy enough to be substantial after the pin is done. Be sure and do not try to make small pins of light metal, as they bend too easily. Gauge 18 to 16 are best for small pieces.

After the design has been drawn on tracing paper just as you want it, use a piece of carbon paper, and transfer it to the metal. Go over the design now on the metal with the steel pencil, and straighten it up, marking just deep enough to prevent its being rubbed off during the process of work.

In the designs shown in Fig. 2, the shaded places may be either cut through (and show as holes in the metal) or they may be depressed and show dark when oxidized.

If you wish to saw through, take a small pointed punch, and put a good deep punch mark in the middle of each dark place. This should be done by resting the metal on the steel block, to prevent its bending under the stroke. Now, with the pump drill, put holes through all the punch marks. Do not rest the metal on the steel block during this operation, however.

The pump drill will need to be experimented with for a while to get the right swing. After the cord has been tied to each end of the cross bar and run through the end of the drill shaft, the cross bar should come down almost to the balance or fly-wheel. The drill of the proper size having been adjusted, grasp the cross bar with the fingers on top, with two on each side of the drill

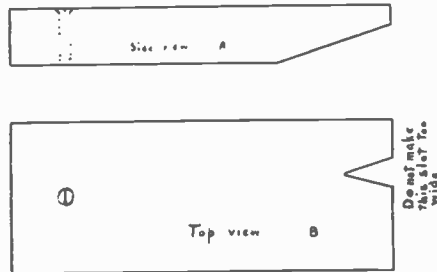


Fig. 1

shaft. Turn the fly-wheel with the thumb until the cord winds clear up around the shaft. When wound tight, press down on the bar with the finger, but release the pressure in time to allow the cord to rewind on the continued swing. Continue this pumping motion rapidly, but evenly, until the drill goes through the metal.

A saw block should now be made for the bench. Take a piece of hard wood, 2 inches wide by 5 inches long, and cut it like Fig. 1, a and b. Screw it to the bench, with about 3 inches protruding. The V-shaped slot allows you to run the saw and still have the material well back on the block. Adjust the saw frame to the length of the saw. Rest the top of the saw frame against the front of the saw block and the handle against the breast. Put in the saw, with the teeth on the top side pointing toward the body. Tighten up the top screw first. Press slightly on the handle while tightening the lower screw, so that the frame, when released, will spring enough to make the saw

tight. Use No. 1 saws for all but very heavy or very light and close work. If the design is to be cut out inside, it is best to do that part first, as the large piece of metal is more easily held.

Do not grip either the saw handle or the metal too tightly, as this is unnecessary and will be very tiring.

Run the saw straight up and down slowly until you learn its use. Never try to force the saw along or bear heavily upon it, and, if caught, never twist it to get it loose, but work it up and down carefully.

Be sure to keep the saw straight up and down, as a slant in either direction will leave the edges of the metal with an objectionable bevel.

Having fastened in the saw through one of the drilled holes (with the design on top, of course), place the metal on the block. Saw as closely to the line as possible, being careful not to go over the line on the side to be preserved. Of course, as a rule, the line may be straightened up with a file, but that is extra work, and the worker should learn to saw right to the line just as soon as possible.

Remember that the saw is wider than it is thick, so you cannot turn sharp corners or short curves by simply turning the saw. Saw along the line clear up to the corner to be turned; then pulling the saw back a short ways, make the cut a little wider by sawing a little more off the side away from the design. Make this widened place large enough to allow the saw to turn readily, and then continue along the new line.

After all the inside holes have been cut as desired, saw around the outline of the pin. If necessary, clean and straighten the lines with a fine file.

If you desire to give the surface the appearance of having been hammered, take a piece of emery and clean off all the steel pencil marks, and make the face as smooth as possible. Place the piece on the polished steel block, and hold it with the little finger of the left hand. Grasp a rather large round-faced punch with the thumb and first finger of the left hand, holding the punch just a little off the metal. Strike it with the hammer. Do not strike it too hard until you see the effect you have produced, and then regulate your stroke to obtain the desired depth of mark.

By moving the punch over the entire surface and leaving no smooth places between the marks, the work will assume the hammered effect.

This same effect may be obtained by striking the surface with a round-faced hammer, and this is the best process on large pieces, but on small work the punch may be more easily managed.

We are now ready to solder on the catch and joint to make the pin. Joints and catches may be secured from your jobber. Be sure to get the kind for hard solder, and in the German silver. The soft solder ones may be used if the patches are cut off.

Make a thick cream of borax by rubbing your borax (having added a little water) in borax block. Turn the pin upside down on the charcoal. Cut your solder into small squares about twice the size of a pinhead. Heat the work just a little, and then, having wet the joint and catch with the borax, place them in the position desired, — the joint on the right end and the catch on the left. Have the open side of the catch toward you. Wet pieces of solder with the borax, and put them at the base of the joint and catch.

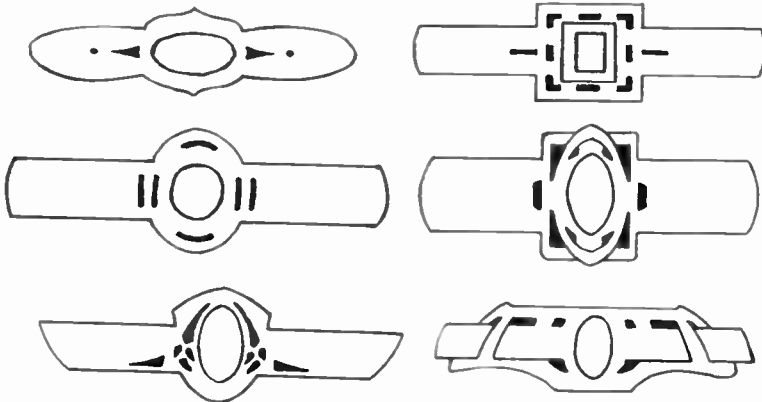


Fig. 2

The use of the blow-pipe will take some time to master, but the worker should practice its use on a scrap piece of material before he starts to solder. Remember the blue flame is the hot one, and the yellow only blackens the work and cannot be made to solder. In practice, move the blow-pipe back and forth through the flame, until you find how to make the blue flame and how to make the yellow flame. Do not blow from the lungs or cheeks, and do not try to blow a steady blast. Blow with even, intermittent blasts from the throat, breathing through the nose.

No difference what the size of the piece you are soldering, the whole piece must be heated almost red hot first. After the whole piece has been heated, direct the flames to the place to be heated, until the solder flows and you can see a clean, bright streak. A blue needle-point flame is large enough to flow the solder if the whole piece has been well heated first.

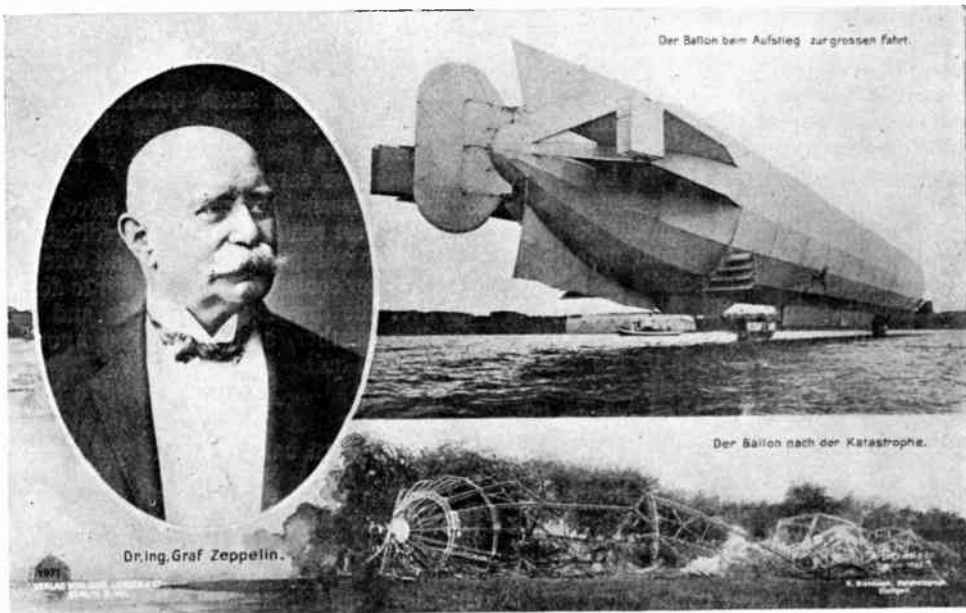
Now, either drop the piece in pickle while it is hot, or, with a small copper pan, boil it in pickle and wash in soda (common cooking

soda). Remember and do not put steel tweezers in the pickle.

Cut the pin tongue the right length, and sharpen it. Polish the point well with fine emery, and burnish to keep it from catching in the cloth. File a piece of German silver wire to a long taper point. Put the pin tongue head into the joint, and insert the tapered piece from right to left. Run it up on the taper as far as it will go, and then cut off the wire close up on each side of the joint. With the steel block and hammer, rivet down the left side. You put the rivet in from right to left, because that is the rule in the trade, so if the pin should break and another worker should want to put in a new pin, he would know how to remove the old rivet with the least trouble.

Oxidize the piece by either dipping or painting with a soft brush. Rub off with soda or pumicestone to the shade desired. Wash with clean water, dry in sawdust, and the piece is done.

Use the soda or pumice on the ball of the thumb, so you will rub the oxidizing from the high lights only.



The picture above gives a view of the great Zeppelin airship rising from the waters of Lake Constance for its last great flight. Below is a photograph of its ruins as they lay in the field at Echterdiugen. On the left is a portrait of the builder, Count Zeppelin, who is now building a fleet of aerial warships for Germany, one of which is almost ready to fly, and four more of which will be delivered next year.

A FEW DRAFTING ROOM NOTES

I. G. B.

A MAGAZINE recently published an article, covering no less than two pages, giving an account of an unfortunate young man, who had evidently gained the displeasure of the writer by marching all around the drafting room to find an oil can with which to oil his instruments.

He was at last quietly shown the simple, well-known manner of using a soft lead pencil instead.

I labored through the article to find out what was in it, and came to the end with no other reward than the above information, and when, in the course of a few weeks, I saw the same article copied by other magazines, I thought, if the readers can be burdened in this manner, there is no reason why the public should not do the same by me.

As a matter of fact, this young man, whoever he may be, was perfectly right in choosing an oil can in preference to the untidy practice of rubbing a soft lead pencil across the pen screw or any other screw belonging to a draftsman's kit; his only trouble seems to have been that he had not one of his own. Without being a dude, or girlish in his manner, it is a draftsman's duty to be neat in his appearance and his work. A slovenly kept table, instruments, and person usually go together.

On arriving at the office, the board and surroundings should be first dusted thoroughly. A general survey should be made of the tools, etc., and a mental note taken of their location. The pencils should be given decent points, and the memoranda books be in a convenient place, in case a sudden call is made for them by the man in charge or the manager himself.

I have seen draftsmen hand out an ink-eraser when a pencil rubber had been called for, and a pair of spacing dividers with the business ends more like pin heads than needle points, which had to be returned in disgust, and certainly mistrust. Nothing can be more annoying to an industrious manager than such apparent trifles.

Much-used tables or data sheets should be mounted on cards, and hung upon the walls in a handy location for quick service. Occasionally wash the dirt off the scales, and see how much better the graduations can be read.

Be obliging, and covet tact as you would success.

If the manager comes into the office with another man, see that each has a stool offered to him, if they are likely to remain at your board.

Attend strictly to all that is said, and be ready at a moment's notice to hand out what is called for, or answer any questions regarding the work.

Many a man has gotten himself into favor by being able to supply information foreign to his particular work, such as the accurate time, the latest time tables of the various railroads, and other information of a general character.

How often have I seen a whole office of men unable to supply a two-cent stamp or a postal card.

Unless there happen to be a lady typewriter in the offices, I question very much if a man could get a needle, much less some thread, should he unfortunately lose a trouser button.

In conclusion, be persevering and conscientious. Commence work on time, and quit on time, and work straight through the day, wet or shine.

Time will pass much quicker, you will learn much better, and at the close of the day will have the satisfaction of knowing that you have earned your pay.

From personal experience, I have found that the best remedy for an exceedingly hot day is not walking backwards and forwards to the water cooler, or ice filter, but to double up over the drawing board, grin and bear the hot weather, and before you know it, it's time to quit.

Can carry an Army

GERMAN army officers seem greatly perturbed over the possibilities of the "Lusitania" and her sister ship, the "Mauretania," as army transports. The two ships, they say, could transport an army of 20,000 men from England to the continent in very short order, if the necessity should arise. The officers and crews are members of the British naval reserves, and the vessels could be turned over to the admiralty with but very little preparation.

AN IMPROVED METHOD OF MAKING SPIRAL COILS

"NOLEGE"

THE following method of making spiral coils for springs or resistances has several advantages over the usual method of coiling the wire, which is kept under tension on a long, circular rod. The chief are — the length of the coil is unlimited, the pitch or number of turns per inch can be made to suit, and the internal diameter of the coil constant.

Figure 1 is the mandrel. This is best made of silver steel; the amount of taper depends on amount of spring in the wire — the greater the spring the greater the amount of taper, which should be recorded for reference when making other size mandrels.

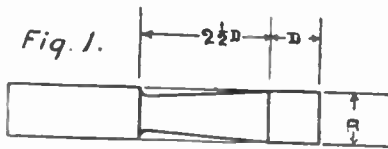


Fig. 1.

Fig. 2.



Fig. 2a

Figure 2 is the spacing and forming tool, which is made of mild steel. The spacing of the holes is equal to the required pitch of the coils, which are drilled 4-1000ths or 5-1000ths inch larger than the diameter of the wire to be used. The dotted portion is then cut away, leaving half the holes, which act as guides for the coils. The first hole should be given a good lead for the wire (Fig 2 a).

Figure 3 shows a coil in the making. A start is made by putting a few turns on by hand, which are placed in the recesses of the former. The former is then pressed fairly tight up to the mandrel, and all is ready for turning off the desired coil.— *Model Engineer and Electrician.*

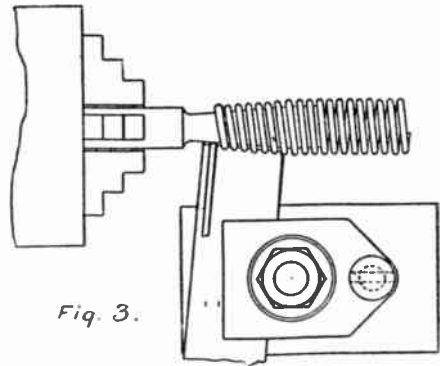


Fig. 3.

Some Details of the Proposed Equitable Building

SOME idea of the magnitude of the proposed 62-story structure which the Equitable Life Assurance Society is to erect upon the present site of the old structure at Broadway, Nassau, Pine, and Cedar streets, Borough of Manhattan, N. Y., at a cost of approximately \$10,000,000, may be gathered from the statement that the building will contain all told 40 acres of floor space, 5200 windows, 4800 radiators, 25,000 electric lights, 38 electric elevators, about 3600 offices accommodating between 20,000 and 21,000 people, two acres of eight-inch thick granite, and 1,750,000,000 brick, making 4,375,000 tons, or 8,750,000,000 pounds of brick.

The two 22-story terminal buildings of the Hudson and Manhattan Railroad, in Church Street (taken together), the largest office building in the world, occupy 70,000 square feet of ground. The cubic area is 14,500,000 feet above ground and 3,650,000 cubic feet below ground, comprising a total of 18,150,000 cubic feet. There are 5200 doors, 5000 windows, 120,000 square feet of glass, and 39 elevators in the two buildings.

The City Investing Building, 33 stories high and immediately adjoining the Singer Building, contains 12 acres of rentable space 11,000,000 cubic feet, 500,000 square feet of floor space, 21 elevators, 2260 radiators, represents an outlay of \$10,000,000, and accommodates 10,000 tenants.— *Carpentry and Building.*

Electrician and Mechanic

Incorporating

Bubier's Popular Electrician.....Established 1890
Amateur Work.....Established 1901
Building Craft.....Established 1908
The American Inventor.....Established 1892

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 the Boston Postal District and 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 15th of the month to affect the number for the month following.

SINGLE COPY, 10 CENTS

Advertising Rates on Application

Forms close on the 5th of the month preceding date of publication.

Contributions on any branch of electrical or mechanical science, especially practical working directions with drawings or photographs, solicited, and if accepted, paid for on publication. 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, N. H.

FOREIGN AGENTS—Arthur F. Bird, 22 Bedford Street, Strand, London.
 Ramlot Frères et Soeurs, 25, Rue Grétry, Brussels, Belgium.
 G. G. Turri & Co., 150 Queen Street, Melbourne, Victoria, Australia.

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. NOVEMBER, 1908 No. 5

EDITORIALS

We have in preparation, and will be ready to mail to our readers within the next month, a premium list containing a description of a number of most valuable electrical and mechanical premiums which we are prepared to give to those of our readers who are willing to obtain one or more new subscribers to **ELECTRICIAN AND MECHANIC**. This list will not contain any cheap or second-class articles, but tools and electrical goods manufactured by the foremost manufacturers in the United States, and in every case their best products. We shall be glad to forward this list when it is ready to any of our readers who are interested.

We also have in preparation a list of club-

bing offers on magazines. We shall be able to offer you subscriptions to all of the important mechanical and popular magazines, either alone or in conjunction with **ELECTRICIAN AND MECHANIC**, which will be well worth waiting for. In the meantime, if any of our readers have made up their minds what magazines they would like to take next year and will send us the list, we will name them a price which will be as low as any price which they can get from any other subscription agency or news dealer. Send in your name at once for these two lists when they are issued.

* * *

ON recent trips on Atlantic steamers, during which we had good opportunities for inspecting the Marconi installations, we were surprised to find how inefficient was the service on Atlantic steamers of the first class. Although these vessels are fitted with very large induction coils and should theoretically be able to communicate up to two hundred miles with little difficulty, this seems to be exceptional, and it is rather the exception than the rule that the smaller steamers can get into communication with vessels in their vicinity. The station at Cape Race, which is officially designated by the Marconi Company as ultra-potent, and which has a sending capacity of at least a thousand miles, sends news messages every night, which are supposed to be taken by all ships in the eastern half of the Atlantic Ocean. As a matter of fact, however, on the writer's trip from England this message was received on only one occasion, and communication was established with only a half-dozen steamers, although by the Marconi October communication chart we should have been in touch with nearly fifty. Either the Marconi apparatus on most Atlantic steamers is extremely inefficient or the operators are incompetent.

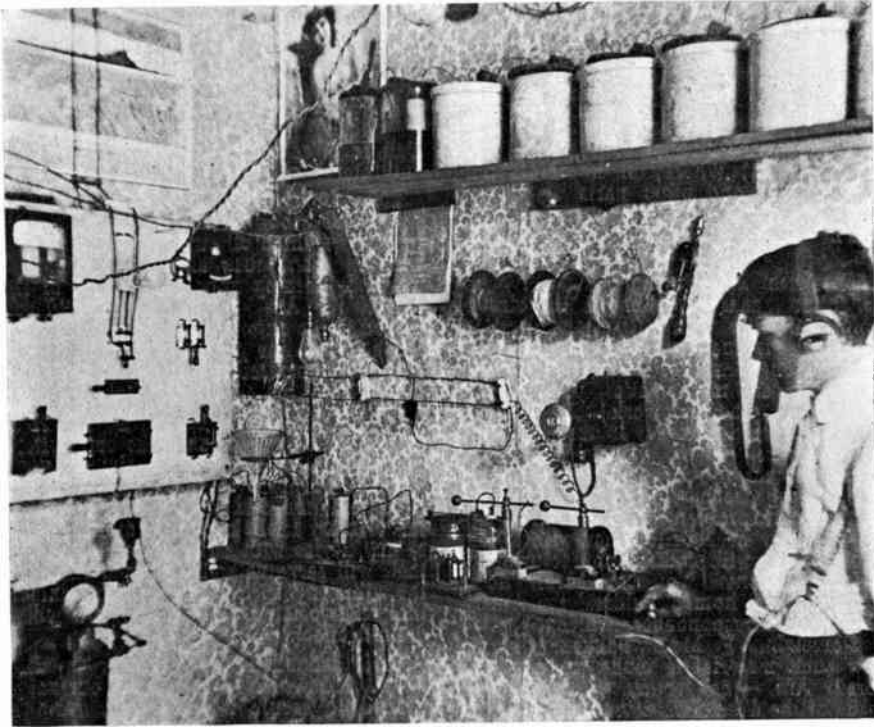
* * *

THE U. S. Civil Service Commission announces an examination on November 23, 24, 25, to fill position of Electrical Engineer and Draftsman in the office of the Supervising Architect Treasury Department, Washington, D. C., at \$1200 per annum.

For full information apply at once, either to U. S. Civil Service Commission, Washington, D. C., or to the Secretary of the Board of Examiners, at cities where examinations are to be held.

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.



Wireless Station of P. E. W.

WE give above a picture of a station constructed by one of our readers, which is being very satisfactorily operated in the South. We hope to receive other pictures of stations and workshops for publication.

WE would like to hear from all our Wireless members, and ask that the call numbers of stations be sent at once. Also any information which might be of interest to us in making further plans for our Club. If any local Clubs have been formed, would also like to be advised.

SAMPSON PUBLISHING Co.:—

WE have equipped, since April of this year, the following boats with our system: The "Pennsylvania," "Yucatan," "Northwestern," "Santa Clara," "Victoria," "Chicago," "Bertha," "Portland,"

"Chippewa," "Iroquois," "Hilonian," "Enterprise," "Buckman," "Watson," "Porter," "Barge 95," "Col. E. S. Drake," all working every day.

WE also have in operation and *working every day* the following land stations: San Diego, Los Angeles, San Francisco, and Eureka, Cal.; Astoria and Portland, Ore.; Seattle, Tacoma, Westport, Aberdeen, Wash.; North Vancouver, B. C.; Kattalla and Cordova, Alaska, and our station at Victoria, B. C., is now being installed and will be in operation before you receive this letter. We have also signed contracts for the installation of a station at Vancouver, B. C., in a hotel, and at Bellingham, Wash., in a hotel. The Dominion Government on this coast have already installed and working every day in British Columbia five Shoemaker sets, which, as you know, are now our patents.—UNITED WIRELESS TELEGRAPH COMPANY.

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 the 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.

804. D'Arsonval Galvanometer. E. S., Clinton, Iowa, asks (1) Where can he obtain mirrors, suspensions, and other parts of such a galvanometer, also standard resistance coils? Ans. — The Leeds and Northup Co., Philadelphia, Pa.

805. Electrical Engineering. J. L. T., Anandale, Minn., asks (1) What is the size of the sample of wire sent? (2) Can electrical engineering be learned at home? Ans. — (1) No. 36. (2) The branches involved in electrical engineering are mathematics, physics, mechanics, drawing, and shopwork. By as much as you can acquire proficiency in these lines, at home or otherwise, you are well on the road to the professional career you have in mind. Help from experienced teachers and opportunity to work out specific problems with electrical apparatus are surely needed, together with a year or two of service with some manufacturing or engineering company. You can surely do a part of the work at home. Address the American School of Correspondence, Chicago.

806. Porcelain. P. M. E., Salisbury, N. C., asks how such material is made for electrical insulators? Ans. — See article in the March, 1908, issue of the *General Electrical Review*, published in Schenectady, N. Y., price, 20 cents per copy.

807. Induction Coil. J. A. C., Seattle, Wash., asks (1) Is it practical to use a 115-volt 60-cycle alternating current on an ordinary induction coil, the usual interrupter being retained? (2) Can the current be also used for electroplating, by inserting a rectifier? Ans. — (1) You will find it rather unsatisfactory and uneconomical. Use considerable resistance in circuit, either by use of a bank of incandescent lamps, or by reactive coils. (2) The rectifiers are expensive, not readily under control for variable currents, and few men are acquainted with methods of repairing them. We would advise you to use a motor-generator set for both purposes.

808. Water-wheel. W. R. E., New Orleans, La., asks various questions about the power available from an impulse wheel 12 inches in diameter under the action of water at 40 pounds pressure from various sizes of nozzles. Ans. — Power for anything other than momentary use is altogether too expensive from the source you have in mind. For 1 h. p. you will need about 3000 gallons of water per hour. If you will send to the Pelton Water Wheel Co., San Francisco,

Cal., for a catalogue, you will get some reliable and interesting data.

809. Lubricator. A. E. W., New York City, asks what method of suspension is used for the weighted oil cup often seen on the overhanging crank disk of a large steam-engine? There is nothing opposite the end of the shaft to hold it. Ans. — A sufficiently stiff rod is attached to the outer end of the crank-pin, and extends to the line of the axis. Sometimes valve rods are operated from a similarly arranged device, only the end is set slightly off center.

810. Induction Coil. A. H. W., New York City, asks how to arrange the connections so as to get what is called the primary current for medical purposes? Ans. — All that is meant is the reaction due to the makes and breaks of the primary itself, and an ordinary electric bell, or any device with a rapid make-and-break contact, will serve as well. Attach the handles to the vibrating spring and to the contact screw that is associated with it and you will get the desired effect.

811. Induction Coil. R. P. G., Ellenville, N. Y., asks what voltage and current will be needed to secure 2-inch sparks from a properly made coil? Ans. — The volume of the discharge enters the consideration, for a large coil actuated by considerable battery power may be cut down to sparks of that length. We should advise you to count on using not less than 8 volts and 4 or 5 amperes.

812. Rewinding Dynamo. J. H., Sterling, Col., has burned out his 1902 Midget dynamo, and asks what sizes of wire to use to adapt it for 10 volts, with a shunt field? Ans. — You should have given some of the dimensions of the machine, and sizes of wire originally employed. You cannot expect us to have samples of all the makes of dynamos in stock for determination of such details. We think No. 21 wire on armature and No. 24 on field, — all you can get on, — will give good results.

813. Model Electric Boats. V. G., Willowdale, Ont., asks (1) Is there any book treating on this subject? (2) Are Fuller batteries good for charging small storage cells? (3) Will a 4-volt battery run two 4-volt lamps, or should more cells be used? Ans. — (1) We do not know of any. (2) Not so good as gravity cells permanently connected to the accumulators. (3) Use 6 volts with some sort of slide wire resistance in circuit.

814. **Condenser.** A. B., asks (1) In wireless telegraphy is it necessary to have the plate glass condenser in addition to the one belonging to the primary breakpiece? (2) What is the best way to step down the 110-volt direct current to fit the 2-inch spark coil? (3) If a Wehnelt interrupter was used, will the regular vibrator be disconnected? Ans.—(1) Yes. (2) For occasional use a rheostat consisting of metal plates in a wooden pail filled with salt water will suffice. For regular use a motor-generator set would be more economical. (3) Yes, the electrolytic interrupter is sufficient,—in fact, usually too vigorous for most coils.

815. **Induction Coil Troubles.** A. F. M., New Decatur, Ala., has disastrous experiences with his coil when operating it on alternating currents, and asks how he can improve matters? Ans.—We are afraid you will not meet with gratifying success with such current. Some improvement can be made by making one or more choke coils, resembling primaries of induction coils; control will be secured by varying the position of the iron cores within the winding.

816. **Chemical Rectifiers.** S. V. T., New Westminster, B. C., asks for the addresses of manufacturers of such. Ans.—We fail to find that these devices are regarded as satisfactory. We think a motor-generator set is the only recourse.

817. **Water Power.** C. M. R., Blissfield, Mich., refers to the answer No. 670, in the July issue, and asks where the 650 comes from? Ans.—The formula is a common one found in books on mechanics, the one we often use being Molesworth's "Pocket Book." The statement is found on page 136, although we stated to divide by 650 instead of multiplying by .0015, — its equivalent.

818. **Armature Winding.** A. H., Amana, Iowa, has made an electric motor after the description given in *Scientific American Supplement*, No. 641, winding the sheet iron field with No. 16 wire. The motor will run out without any appreciable power, and he wishes now to make a cast iron six-pronged armature, in the hopes that by thus reducing the air-gap the power will be increased. He has used as many as 20 batteries. Ans.—While the large air-gap involved in the original design does seriously limit the power of the motor, perhaps you have overestimated the strength of the batteries. What sort did you use? Dry cells would not be suitable. You need 8 to 10 amperes, and only large plunge batteries, or those of the storage sort will supply such a large current. The cast iron armature you propose will be so productive of eddy currents as to be no improvement over the present one. If you do make it, wind one of the six limbs full of wire, twist a loop, wind the next one, twist a second loop, and so on until there are five in all, when by joining the end with the beginning, a sixth loop will be secured. A six-segment commutator will then be needed. No. 18 wire will be a good size. You will get the most power by use of a sheet iron armature with not less than 16 slots, — 24 will be better, and wound as an ordinary drum, such as is described in Watson's "How to Make a $\frac{1}{2}$ h. p. Dynamo."

819. **Steam Boiler and Engine.** F. P. H., Baltimore, Md., has made a model steam-engine with cylinder $1\frac{1}{8}$ inch bore and $1\frac{1}{8}$ inch stroke. The boiler is made, as we suggested, from a 5 x 12 inch mercury flask, and is heated by two gas burners. The engine runs only when there is a very high boiler pressure, and then runs at a terrific speed, but quickly stops, though there is still a good pressure of steam. On starting, a good deal of water comes out of the exhaust. Can this be prevented, and what is the trouble in general? Ans.—The boiler seems to be all right, but we think your engine has altogether too much friction. You ought to be able to turn it with ease, and that it ought to make several revolutions when given a single impulse by hand. It ought to move by blowing into the pipe. If the stuffing-box is too tight, loosen it and tolerate a little leakage there. Perhaps the stuffing-box is not axial with the cylinder. How far is the engine from boiler? It ought to be close, but if some distance is imperative, use a good size of pipe, say $\frac{3}{8}$ inch, and cover it with long strips of paper, wound on spirally. You should have cocks at both ends of cylinder for "blowing off," previous to starting. This procedure allows the iron to get well warmed, and prevents accident to the engine. Perhaps, too, you have used insufficiently large ports into the cylinder.

820. **Underwriters' Rules.** M. D. G., W. Medford, Mass., asks where a copy of the latest edition can be obtained? Consult your local insurance agent, or address The Factory Mutual Insurance Companies, 31 Milk Street, Boston.

821. **Battery Cells.** V. B., Indianapolis, Ind., states: In "Questions and Answers," No. 742, question No. 3, about "improved Fuller battery cells," I have tried every way to learn what kind of cells they are, as I have a battery cell planned, and before I go to any expense, I wish to know whether or not they are alike. Just give a short answer as to what it is made of and its output in volts and amperes, as I can tell from that what I want to know. Ans.—In the improved Fuller battery a clay porous cup and Daniel zinc goes inside of the carbon cup. The solution for this cell can be either bichromate of potash or bichromate of soda. It is claimed that the advantage of this cell over any other type lies in the fact that the cell requires absolutely no attention on open-circuit work in from two to four months. The output in volts and amperes is unknown to us. The cell can be purchased for \$1.50 from J. H. Bunnell & Co., New York City.

822. **Aeronautics.** K. M., Everett, Mass., asks: (1) How many pounds will 1 cubic foot of hydrogen gas, with a specific gravity of .005, lift in air? (2) How many pounds will that quantity of hydrogen make as light as air, — that is, float in the air? (3) Is it best to have only two blades in the air propeller? Ans.—(1) Air is 14.4 times as heavy as hydrogen, under same conditions of temperature and pressure, so with hydrogen weighing .0055 pound per cubic foot, the weight of an equal volume of air will be .079 pound. The lifting power will be the difference between these two weights, or .073 pound, or a little over an ounce. (2) We really cannot com-

prehend what you mean. Perhaps you wish to know with what particular weights equilibrium will be attained, and the balloon have no further tendency to rise. This will depend upon your particular construction, for if the envelope is not completely filled, the rising will continue until the expansion of the gas within the envelope will be balanced in space by the weight of the displaced air of reduced density. During ascent the hydrogen will expand and displace more air; and though the air is of continually lessening density, it allows the same lifting power. Just as soon as the envelope prevents further expansion of gas, the tendency to rise begins to lessen. (3) The two blades allow the greatest strength with lightest weight.

823. **Potentiometer.** C. H. P., Ridgewood, N. J., asks: (1) What is bisulphide of mercury used for? (2) Is there any substitute for the potentiometer described in the July issue? (3) What is the size and composition of the sample of wire sent? Ans. — (1) We are in doubt as to where you found the "bi" part of the name, for the common compound of mercury and sulphur is cinnabar or vermilion, and denoted by the symbol HgS. This is a familiar pigment for coloring. Formerly it was very fashionable to put it in shellac, for use in covering wire on electrical apparatus. The substance is rather expensive, and for such purposes entirely needless. (2) This is merely a rheostat with a large number of contacts; you are at liberty to vary the method of construction so long as you retain this qualification. (3) The size is No. 23, and we think the material is German silver; anyway, if you have plenty of it, use it for the resistance. If you can send a longer piece, we will measure the resistance, so you will know how much to wind on the coil.

824. **Ignite Generators.** E. S., Wilmington, Del., asks: (1) Are such machines for direct or alternating currents? (2) A 6 h. p. motor-cycle engine is on hand. Will this be suitable for driving an alternating current dynamo, for wireless telegraph use? (3) Using the transformer system, what would be the range of such a set? Ans. — (1) Although the machines have permanent magnets, and therefore resemble the familiar alternating current telephone magnetos, they really have drum armatures and commutators, and give direct currents. (2) Yes, rather more than you need. Watson's 1 kilowatt design of alternator will be of interest to you. (3) Several hundred miles. We think batteries will be all you need to cover the distance you have in mind.

825. **Wireless Telegraphy.** E. R. P., Roxbury, Mass., states he is making a spark coil that is intended to give a 1½-inch spark, and has wound the secondary in five sections with ¼ pound of No. 30 D.C.C. wire, one each section. The primary is composed of four layers of No. 14 s.c.c. wire wound over a bundle of soft iron wire ¾ inch in diameter and 11 inches long. The condenser is composed of forty sheets of tin-foil 4 x 6, placed between paraffin paper. The interrupter is the ordinary vibrating type. Fifteen dry cells are used and a spark about ½ inch jump across the gap. The insulation seems all right. Ans. — See if you have not a section reversed or "bucking" the rest of the coil. This will cut down the efficiency con-

siderably. Test each section for open circuit, as this is also liable to cause trouble. You have your sections too big. Each section should not be over ¼ inch thick. It is better to have a number of thin sections, rather than a few thick ones. Make up another primary condenser, one half the size of the one you have, and see if it makes any improvement in the operation.

826. **Wireless Telegraphy.** V. C., San Francisco, Cal., asks: (1) How far should I be able to receive with the following instruments: Sixty-five-foot aerial on house supported by 10-foot poles, electrolytic and silicon detectors, one 1000-ohm watch-case receiver, tuning coil, potentiometer, and four dry cells? (2) Are the receivers used on the ordinary telephones good to use with a wireless set? Ans. — (1) Under favorable conditions you should be able to receive up to 500 miles with the above-mentioned outfit, if connected properly. See diagram in July issue, for best form of connecting. (2) No, ordinary telephone receivers are not sensitive enough, unless rewound to a high resistance by an expert. When properly rewound, they are usually very good for experimental purposes. See July Classified Advertising Column for advertiser who makes specialty of rewinding receivers.

827. **Wireless Telegraphy.** J. A. M. K., Newport, R. I., states as follows: (1) I have an aerial brought from the two chimneys of our house, about 50 feet high. I have a pair of 75-ohm receivers, a silicon detector, tuning coil, variable condenser, and a potentiometer, which cuts down a cell of battery. How far should I be able to receive under most favorable circumstances with a powerful tuned station on the sending end? (2) If I should substitute an electrolytic detector for the silicon, raise my aerial about 10 or 15 feet, and use 1000-ohm receivers, how far should I then be able to receive from same sending station? (3) How far should I be able to send with a transformer as described on pages 55-57 of ELECTRICIAN AND MECHANIC with a tuning coil and condenser? Ans. — (1) Under favorable conditions, 70 miles. If you get a pair of 1500-ohm head receivers, the distance may be increased to 500 miles. (2) About 550 to 600 miles, using 1500-ohm receivers. (3) About 90 miles.

828. **Wireless Telegraphy.** R. McC., San Francisco, Cal., asks following questions: (1) Please state the capacity in watts, size of spark, and sending distance of the coil described below, the stations using tuned circuits and electrolytic detectors: —

Core — a bundle of annealed iron wire 1 inch diameter and 6 inches long. Primary — Three layers No. 16 B. & S. s.c.c. Secondary — Three pounds No. 30 B. & S. D.C.C., sections wound in paraffin. (2) Please give data on an open core transformer, such as described in the August, 1908, issue, by V. W. Delves-Broughton, that would be capable of transmitting 200 miles overland, tuned circuits and electrolytic detectors being used. (3) How many watts capacity would the coil in question No. 2 be, or a coil of how many watts would be required to send the above distance? Ans. — (1) It is impossible to accurately estimate the watts, spark length, etc., of your coil. It should be about 140 watts, have

a 1½-inch spark, and transmitting distance with a 50-foot aerial be about 30 miles. (2) Data is given in that article. See also Series "D" drawings of W. C. Getz, which thoroughly treat of coil design for wireless work. (3) For a distance of 220 miles, a 750 kilowatt or 750 watt coil should be used.

829. Wireless Telegraphy. W. C. B., Brighton, Mass., asks: (1) How is wireless telegraphy carried on in a balloon? (2) Where does the ground connection come in? Ans. — (1) By having a wire net on the bottom of the balloon for the artificial "ground," and a suspended vertical wire, insulated from the net, for the aerial. (2) The wire net takes place of ground.

830. Wireless Telegraphy. G. L., Detroit, Mich., asks: (1) What kind of steel do they use on the telegraphone for records? Is it the same as used for making wire nails? (2) Where can this steel be gotten in thin sheets? Ans. — (1 and 2) Cannot find any data on this.

831. Wireless Telegraphy. O. W. H., Denver, Col., asks to have explained the method of calculating the wave length when given the height of the aerial and power for transmitting. Ans. — In direct connected type of antenna, the wave length is very nearly four times the length of the antenna. This is only approximate, but will serve all practical purposes.

832. Wireless Telegraphy. J. A., Brooklyn, N. Y., states he has a 15-foot pole on the top of the house, which is about 50 feet high. About 20 yards to the west a depressed electric railway runs, and to the north and south respectively there are trolley lines two and three city blocks away. The country is flat and is covered with frame houses. He has an auto-coherer with carbon grain and a 1500 ohm telephone receiver. (1) How far ought my receiving radius to be? (2) Would a silicon or electrolytic receiver increase this? (3) Is there any formula for computing the capacity of a condenser in microfarads and the inductance of a coil in millihenrys? (4) Would No. 18 B. & S. wire do instead of 22 in Mr. Getz's tuning coil? Ans. — (1) Your receiving radius should be about 10 miles. (2) Yes, a silicon or electrolytic receiver would greatly increase this radius. (3) See Collins's "Wireless Telegraphy" for the information. (4) Yes, No. 18 B. & S. wire would do as well.

833. Wireless Telegraphy. G. B. M., Nashville, Tenn. If two poles 30 feet long were erected 20 feet apart, and wires strung across 10 inches apart, putting up, say, ten wires, horizontally, would this antenna have more or less receiving radius than a single pole, say, 80 feet high? If not as great, give dimensions for a horizontal antenna with as great, if not greater, radius than an 80-foot single pole. Ans. — A horizontal antenna cannot be made that will give a greater wave length than a vertical antenna of equal or greater height. While the efficiency of a vertical antenna may be sometimes increased by converting it into an inverted "L" shaped aerial, the fact that the capacity decreases directly as the square of the distance of the antenna from the earth, makes it impossible for a horizontal antenna of a given length to have the same efficiency of a vertical one of the same

length. To get a horizontal antenna equal to a vertical one of 80 feet, it would be necessary to have about two 80-foot poles.

834. Wireless Telegraphy. E. E. H., New York City. (1) Are there any laws governing the erection of a wireless telegraph station by amateurs? (2) How far will a 2-inch spark coil transmit messages, with other instruments properly connected? (3) According to diagram by W. C. Getz in the July issue, there is only one wire leading from D. P. D. T. switch; is this correct? (4) Does it increase the receiving radius to use more than one tuning coil? Ans. — (1) At present there is no law governing wireless, but it is a generally understood form of wireless etiquette for government and commercial wireless stations to always take precedence over the amateur stations. (2) With a tuned circuit system, and a 40-foot mast, the antenna having about a 100-foot span, the transmitting distance should be about 150 miles. (3) For receiving, the antenna is used as one straight wire, only one end being used on the instruments. In sending, the two ends of the antenna are short-circuited, and are thus used as a conductor of double the surface area, but one half the distance. (4) Not unless some balanced tuned system is used, such as the De Forest with the Hertzian loop antenna.

835. Wireless Telegraphy. E. M. V., Chicago, Ill. (1) What size is the enclosed wire? (2) Could I use it on a receiving tuning coil? (3) Would a coil work well if it had twelve sections of No. 31 B. & S. and ten sections of No. 28 B. & S. in the secondary? Ans. — (1) No. 22. (2) Yes, it can be used on a receiving tuning coil. (3) No, it would not work well.

836. Wireless Telegraphy. A. W., Gates, N. Y. I have never yet seen an article telling how many volts and amperes must be sent through primary of induction coil for wireless distances. (1) For example, 100 miles. Will the coil described by Mr. Delves-Broughton in August number of ELECTRICIAN AND MECHANIC work 100 miles with 40-foot mast? (2) Will you give primary winding for battery? (3) Could not this coil be built in sections without materially increasing its size and thus secure better insulation? Ans. — (1) Would refer you to article on "Wireless Telegraph Distances" in the November, 1907, issue of this publication. (2) Kindly make your question clearer. (3) Yes; it is not necessary to do so, however. The insulation as described is sufficient.

837. Wireless Telegraphy. A. S. T., East Orange, N. J. (1) Will the transformer described by V. W. Delves-Broughton lose any of its efficiency in not being connected to a "sending coil" as described in the article by O. Kerro Luscomb? (2) Would not the above transformer work with satisfactory results as per Fig. 1 in article by W. C. Getz? De Forest system. (3) On page 68 about opposite Fig. 1, would the transformer or induction coil hinted at as possible in a later article be any more powerful than the above, 500 watts or ½ kilowatt? Ans. — (1) Yes, to a certain extent, although it is not necessary to use such a coil. The usual helix can be used in place of this coil and good results be got from it. (2) Yes. (3) We do not think so.

TRADE NOTES

ALTHOUGH the little motor just out by Kendrick & Davis carries for its number 13, it is no hoodoo, but is up to the usual high standards of this well-known concern. We are sure many of our readers will be interested in this product, and will order at once, as the price is very reasonable.

THE firm of Smith & Frisbee, Patent Attorneys and Corporation Organizers, have issued a pamphlet entitled "Letter of Instructions," for the organization of Massachusetts corporations. This pamphlet gives practical suggestions to incorporators, and the advantage obtained by incorporating under Massachusetts laws, together with information for treasurers of Maine and other foreign corporations. This firm is also about to issue a special circular for inventors, called "Inventor's Protective Certificate," giving information how to protect their inventions before filing caveats or application for letters patent. The above are of value to any one or any firm contemplating the organization of a corporation or the procuring of or purchase of any interest in any patents.

Charles F. A. Smith and Franklin S. Frisbee, the members of this firm, are both men of long experience in the procuring of United States and foreign patents and trade-marks, and in the organization of corporations under the laws of Massachusetts and other States.

Copies of either the pamphlet or certificate will be mailed free upon request, addressed to the firm at 49 Federal Street Boston, Mass.

WE have received from W. C. Getz of Baltimore, Md., copies of his blue-print wireless diagrams, series A to G, and we can cordially recommend these as of the greatest practical value to every student and experimenter who is interested in this art. We have not space for a complete description of these various series of drawings, but can say that they cover all of the practical details of construction of tuned circuit wireless telegraph instruments in a most workmanlike and thorough manner. There is no portion of the construction or connection of a wireless set which is not covered by some one of these drawings. The prices, we understand, are moderate and will be furnished on application by Mr. Getz, whose address will be found in our advertising pages.

OUR readers who are interested in telephones may be interested to know that *Telephony* has just purchased the *American Telephone Journal*, and is now the strongest telephone magazine published in the United States. *Telephony* is a weekly, and the price is \$3 per year. If any of our readers, however, desire to subscribe before the first of next January, we shall be glad to accept subscriptions at the special price of \$2 or \$2.75 for *Telephony* and *ELECTRICIAN AND MECHANIC* together. We may mention here that we are preparing a list of magazines which we can offer at reduced prices. We can save you money on all your magazines. Write us at once.

BOOK REVIEWS

HEATING AND VENTILATION. By Charles L. Hubbard, B. S., M. E. Illustrated. Chicago American School of Correspondence, 1909. Price, \$1.50.

A working manual of approved practice in the heating and ventilating of dwellings and other buildings, with complete practical instruction in the mechanical details, operation, and care of modern heating and ventilating plants.

This volume is the latest of the series of practical working guides issued by the American School of Correspondence. It is comprised of a complete course of instruction to the man on the work, in modern heating and ventilation. It appeals not only to the technically trained expert, who may use it to great advantage as a reference, but also to the beginner and self-taught practical man. The text is clear and concise, and technical terms and the formulas of higher mathematics are avoided where possible, without materially decreasing the worth of the work. The student, the architect, the draftsman, the heating man, the engineer, and the contractor should own and read this book.

REINFORCED CONCRETE. A manual of practice by Ernest McCullough, M. W. S. E. Illustrated, 1908. The Myron C. Clark Publishing Co., New York and Chicago. Price, \$1.50.

This book, the latest addition to the ranks of authorities on reinforced concrete, attacks the problem from the right standpoint. It is a manual of practice, a handy book for the draftsman and the man on the job. It leaves higher mathematics very severely alone, yet gets at the root of the question surely and quickly.

It treats of strength of beams, formulas, definitions, stone and cinder concrete, floor slabs, loads on beams, dead and live load, deflection, shear, concentrated and distributed loads, free, tied, and cantilever beams, columns formula, strength, and stiffness, walls, tanks, and footings, design and cost, forms, the conduct of the work, and tools. The practical value of this work is very great, as it is taken largely from the author's own experience, combined with the observations of other practicing engineers.

FOUNDRY WORK. By Stimson. American School of Correspondence, Chicago, Ill., 1908. Price, \$1.

This subject is an interesting one to very many working men particularly, and the author has developed the practical side of the subject in a very satisfactory manner. The illustrations, for the most part, are excellent, and it is to be regretted that some of the simplest drawings are so crudely done as to detract from the otherwise general excellence of the book. The subject "Shop Management" deserves a more thorough treatment than the author has given, but what is presented on this subject is good. A chapter on "Casting in Aluminum" would also have been a valuable addition to this book.

Taken as a whole, this book is fully up to the high standard, and deserves a large sale.





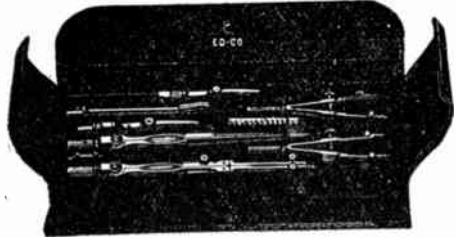
ELECTRICITY
PRACTICALLY TAUGHT
 by trained instructors in a school long established and engaged in teaching **ELECTRICITY ONLY**. Day and Evening sessions. Individual instruction. School and equipment open for inspection. Write or call for prospectus.

NEW YORK
ELECTRICAL TRADE SCHOOL
 39A West Seventeenth St.
 NEW YORK

EUGENE DIETZGEN COMPANY

214-220 E. 23d Street, NEW YORK

Chicago San Francisco New Orleans Toronto



In buying your

Drawing Materials & Drawing Instruments

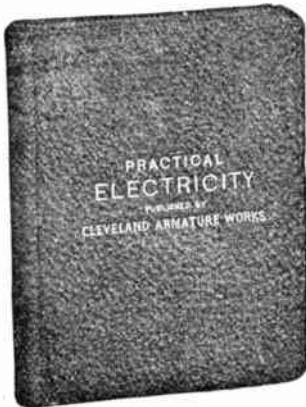
from us you have the best guarantee to obtain

THE RIGHT THING
at THE RIGHT PRICE

SEND FOR OUR CATALOGUE

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.



Chapter

- I. Wiring
- II. Electric Batteries, Electro-Plating
- III. Magnetism
- IV. The Magnetic Circuit
- V. Magnetic Tractiou
- 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

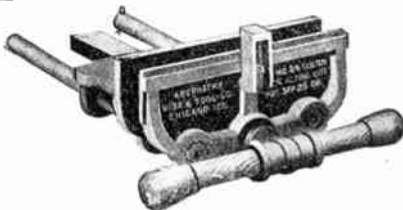
- XII. Armature Reaction
- XIII. Sparking
- XIV. Winding of Dynamos and Motors
- XV. Proper Method of Connecting Dynamos and Motors — Self-Excitation
- XVI. Diseases of Dynamos and Motors, their Symptoms and How to Cure Them
- XVII. Arc and Incandescent Lamps
- XVIII. Measuring Instruments
- XIX. Alternating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



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.



FREE STOVE and RANGE

BOOK 64 pages Free

Write for it today!

This book will save you from \$12 to \$30 when you purchase a stove or range. It explains how the best and finest stoves and ranges in the world are made, and tells you how to "know the best."

HOOSIER STOVES and RANGES FROM FACTORY TO USER

Are heavily made of highest grade selected material, beautifully finished, with all new improvements and features. "Guaranteed for Years," backed by a million dollars. "Hoosiers" are fuel savers and easy bakers. A child can operate them. Sold on 30 days free trial. No Freight to pay.

Write for Free Stove Book

AND OUR SPECIAL FREE TRIAL OFFER

HOOSIER STOVE FACTORY, 10 State St., Marion, Indiana



FOUND—A Strop that suits at a price that suits

Diamond Edge



Razor Stropps

Will put a beautiful smooth edge on your razor. Send fifty cents for one and we will refund money if not perfectly satisfied. A live man wanted in each large factory to sell on commission. Send for Circular.

THE RUSS MANUFACTURING CO.

354 Atlantic AvenueBoston, Mass.



CORNET Or Other Brass Band Instrument FREE

WE TEACH YOU TO PLAY THE CORNET OR ANY BRASS INSTRUMENT through the mail, send a beautiful instrument to learn on, and give it to you absolutely free at the end of your short course of simple lessons, easily paid for weekly. Write today for scores of testimonials from pupils all over the U. S. and Canada who earn good money through our course. No previous knowledge of music needed. Pupils all ages and far off as Alaska. Distance makes no difference.

INTERNATIONAL CORNET SCHOOL,
26 Music Hall, BOSTON, MASS.



THIS BOOK COSTS 10 CENTS

and should be the seed to a fortune to the man or woman with brains and earnestness of purpose. More individuals owe their financial success to the laws contained in this book than to any other known source

Money is the Best Partner

a man can have and the best friend a woman can have.

This Book is Plainly Written and Tells You

- How to accumulate money.
- How to earn more than savings bank interest.
- How to develop the quality essential to success.
- How to distinguish between good and bad investments
- How to improve your financial and general welfare.
- How to make money safely and judiciously, etc

You cannot afford to be without this book, as it places within your own hands the means of starting you on the road to a broader career, clean prosperity and financial independence

Regular edition, limp leather bound, silk lined, \$1.00 per copy

Fifth special pocket paper bound edition of a dollar book, 16 chapters, 104 pages, published in response to popular demand, 70,000 sold, mailed on receipt of **10 Cents,** or \$1.00 for leather bound copy) stamps or silver **SEND FOR IT NOW.**

THE FIDUCIARY CO. Publishers **487 Tacoma Building CHICAGO, ILL.**

N. B.: If you prefer, the book will be sent on 3 days approval. You can remit the 10 cents or return the book at your own discretion. The publishers know the sterling value of the book and have faith in the judgment and honesty of the average American.

Gas Engine Manual



This volume just published gives the latest and most helpful information respecting the construction, care and management of **Gas, Gasoline and Oil Engines, Marine Motors and Automobile Engines,** including chapters on Producer Gas Plants and the Alcohol Motor.

The book is a practical educator from cover to cover, and is worth many times the price to any one using a gas engine of any type or size. Contains 512 pages, 27 chapters, 156 diagrams, size 5½ x 8½ inches, weighs 2 pounds, is handsomely bound, and in every way a fine volume.

SPECIAL OFFER

The only way the practical merit of this MANUAL can be given is by an examination of the book itself, which we will submit to the readers of **ELECTRICIAN AND MECHANIC,** free for examination, to be paid for or returned, after looking it over.

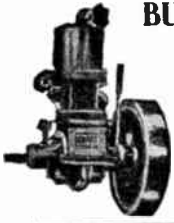
Upon receipt of the following agreement (which can be either cut out or copied), the book will be immediately forwarded.

No money in advance required, sign and return

Theo. Audel & Co., 63 Fifth Ave., New York

Kindly mail me a copy of "Audel's Gas Engine Manual," and, if found satisfactory, I will immediately remit you \$2.00, or return the book to you.

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



BUILD YOUR OWN MOTOR!

Complete sets of Castings, with blue print working drawings, for your Auto, Launch, Motor-Cycle Engine, or Workshop.

Our Remarkable Offer!
6-Actual Brake Horse Power—2 Cycle—3 Port Engine. \$100 complete with accessories. IT'S GUARANTEED! We sell Blue Print Working Drawings—2 or 4 Cycle. We have Motors complete with spark plug, from \$41.50 to \$335.00. Complete Castings for building same, from \$8.00 to \$180.00. Send stamp for Catalogue.

THE GEBHARDT MOTOR CO.
27th Street, above Dauphin, Philadelphia, Pa.

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 newdealers.

MUNN & Co. 361 Broadway, New York
Branch Office, 625 F St., Washington, D. C.

Practical Photographic Books

DARK ROOM DIME SERIES

- No. 1 Retouching for Amateurs
- " 2 Exposure Tables and Note Book
- " 3 How to Take Portraits
- " 4 Bromide Enlargements
- " 5 Manual of Photography
- " 6 Practical Development
- " 7 Popular Printing Processes
- " 8 Hints on Composition

PHOTO BEACON DIME SERIES

- No. 1 Development
- " 2 Photographic Printing Processes
- " 3 Beginner's Troubles
- " 4 The Elements of Pictorial Composition
- " 5 Isochromatic Photography

Any of the above, post-paid, 10 cents each

PHOTO BEACON EXPOSURE CARD. By F. Dundas Todd	\$0.25
FIRST STEPS IN PHOTOGRAPHY. By F. Dundas Todd	.25
SECOND STEPS IN PHOTOGRAPHY. By F. Dundas Todd	.50
ARTISTIC LIGHTING. By James Inglis	.50
PICTORIAL LANDSCAPE PHOTOGRAPHY. By John A. Hodges	.75

American Photography 6 Beacon Street
BOSTON, MASS.

WIRELESS APPARATUS

Amateur and Commercial sets, Selective System, complete or parts

\$25.00 AND UPWARDS

Apparatus repaired, adjusted, tuned, and calibrated. Curves drawn for inductance of coils and capacity of condensers.

OUR CALL F CONTINENTAL CODE . . .
SETH W. FULLER COMPANY
100 Bedford Street BOSTON, MASS.

WHY NOT BE AN ARTIST?

Our graduates are filling High Salaried Positions. Good artists

EARN \$25 TO \$100 PER WEEK

and upwards. In easy fascinating work. Our courses of Personal Home instruction by correspondence, are complete, practical. Eleven years' successful teaching. Expert instructors. Positions guaranteed competent workers. Write for Handsome Art Book, Free.

SCHOOL OF APPLIED ART (Founded 1898.)
N. 71 Gallery Fine Arts, Battle Creek, Mich.

FORTUNES ARE CARVED

CHANDLER & BARBER'S

PERFECT TOOLS

Opp. 100 TRAINING MANUAL OFFICE
Chandler & Barber, INC., 87 HARVARD ST. Boston, Mass.

ANYTHING ELECTRICAL

Our New Catalogue 100 Pages of Electricity
FLASH-LIGHTS TO DYNAMOS. CONTAINING ALSO THE LARGEST ASSORTMENT OF UNEXCELLED GERMAN TOYS
HIGHEST QUALITY LOWEST PRICES

J. J. DUCK Toledo, Ohio
Arcade Building

HIGH-TENSION TRANSFORMERS

For Wireless Telegraphy and High-frequency experiments. The 200 watt transformer will transmit over 30 miles under favorable conditions. Only \$20. We manufacture high-tension transformers, adjustable impedance coils, adjustable condensers, spark-gaps, and special instruments for high-frequency experiments.

Send for particulars, state requirements.

M. & C. TRANSFORMER COMPANY
1412 Clrard Street Los Angeles, Calif.

ELECTRIC GOODS

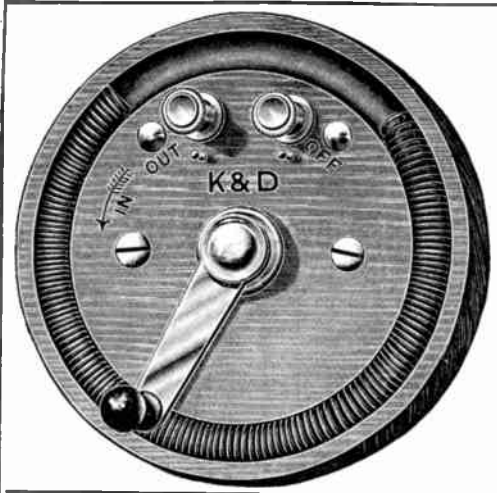
Shocking Machines, \$1.22; Geissler Tubes, 6 inch, with fluorescent liquid, 72 cents; without, 58 cents; Electric Meter, 87 cents; Blow Torch, 35 cents; Miniature Receptacles, 8 cents; Electric Top, very pretty, \$1.08; Edison Fuse Plugs, any ampere, 9 cents; Current Tap, for connecting fan, etc., without disturbing light, 48 cents; Hubbel Separable Attachment Plugs, Edison Base, 28 cents; Vest Pocket Dictionary, 24 pages, illustrated, 4000 words, terms, and phrases used in the electrical profession, 25 cents; Static Electricity, simple experiments, 73 pages, 51 illustrations, 25 cents. Above goods to any part United States and Canada prepaid. No stamps taken for these goods, send stamp for catalogue.

Ketterman Electric Co. E. ns 23d St., Toledo, Ohio

Turntables 4 Inches to 4 Feet

We can furnish motors or you can use your Fan Motor. We manufacture all kinds of Turntables for show-window work. Our new method will enable you to install a moving display at a very light expense.

The AJAX ELECTRIC MFG. CO.
96 Essex Street BOSTON, MASS.
Telephone, Oxford 1308-3



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 1/4 inches diameter; total thickness, including rubber handle, 1 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—

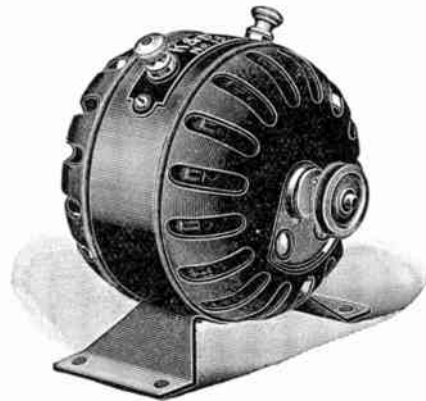
Manufactured by **KENDRICK & DAVIS, LEBANON, N. H.**

A New-comer!

K. & D. MOTOR No. 13

THIS motor is built on the lines of large machines. It stands 3 3/8 inches high. No cast iron is used in its construction. Best charcoal iron field pieces. Annular field coil, carefully taped and shellacked. The armature is laminated slot wound. Steel armature shaft, with self-lubricating bearings, so constructed as to always be in perfect alignment.

Grooved brass pulley 1/8 inch diameter. The commutator has segments of hard copper, carefully insulated with mica—a feature not found in small motors, except of our manufacture. Self-adjusting brushes. The machine is perfectly ventilated. Fields and base finished in black enamel—not paint. For its size and weight the most powerful motor manufactured.



Regularly wound as a battery motor Price, \$3.50
 Specially wound to run in series with a 16 c. p. lamp, 110 volt direct current Price, \$4.50

MANUFACTURED BY

KENDRICK & DAVIS

Lebanon, New Hampshire

INVENTIONS PROTECTED FREE

From the Day you Conceive them by using our new "Inventor's Protective Certificate" Mailed Free

SMITH & FRISBIE, PATENT ATTORNEYS
49 FEDERAL STREET, BOSTON, MASS.

Salt Mackerel



FAMILIES who are fond of Fish ought to get them direct from **GLOUCESTER**, as no dealer anywhere else could possibly be in a position to offer you goods as perfect and wholesome as we can.

We sell **ONLY** to the consumer direct, not through grocers or markets.

We want to supply **YOU**, no matter how small your requirements.

We have done a mail-order fish business for twenty-three years, sending the goods **right to our customers' homes, prepaying all delivery charges, and** guaranteeing complete satisfaction or money refunded. We want to deal with **YOU** on the same terms.

If you are interested in good fish, won't you drop us a postal that we may send you further information.

Our **SALT MACKEREL** are tender, juicy fellows—broiled for breakfast, they are delicious.

SALT CODFISH selected and prepared by our method is unexcelled.

Much of the fresh fish you buy in the market is at least several days old. Our **CANNED FISH**, being steam sterilized, is absolutely fresh.

Our **FRESH LOBSTERS**, in parchment-lined cans, go through no process except boiling (no preparation of any kind being used). Opened and packed solid in whole pieces as soon as taken from the water, they retain their crispness and natural flavor.

CRAB-MEAT, SHRIMP, and CLAMS have likewise a perfectly natural appearance and taste.

Our **SALMON, TUNNY, and IMPORTED FISH DELICACIES** are always the best produced, many being packed especially for our high-class trade.

A selection of our **FISH PRODUCTS** should always be in your store room for daily use and for the preparation at a moment's notice of dozens of dainty or substantial dishes.

Send for Descriptive Price List

FRANK E. DAVIS FISH CO.

95 Rogers Street Gloucester, Mass.



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.

SETS OF CASTINGS OF
MODEL ENGINES
SEND 10¢ FOR 126 PAGE
ILL. CATALOGUE.
ALSO TOOLS.
GEAR WHEELS & PARTS OF MODELS.
J. H. WIGHTMAN & CO.

BEWARE OF IMITATIONS

For the protection of our customers we advise that Klein's Files are being imitated, to look like Klein's. This, however, does not make them Klein's.

CAUTION—Look for this stamp, M. KLEIN & SONS, on the inside of handles—none are genuine without this stamp. Use only genuine Klein's. They are the product of years of experience and have stood the test of time.

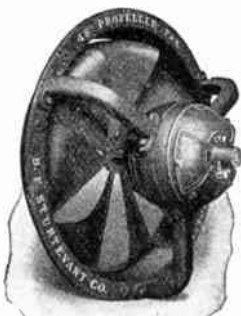
MATTHIAS KLEIN & SONS
97 W. VAN BUREN STREET CHICAGO, ILL.



BOYS--EXPERIMENTERS.



A scientifically perfect model motor, having a laminated paid drum armature, self-adjusting brushes, etc. Finished in black japan and nickel. Space occupied, $3\frac{1}{4} \times 3\frac{1}{2} \times 3\frac{1}{4}$ inches. Send stamp for catalog.
H. W. PETERS MINIATURE MOTOR WORKS.
61 Terrace. - - - Buffalo, N. Y.



COLD WEATHER FANS

The exhaust fan is as necessary in winter as in summer, for with closed windows natural ventilation is restricted. The propeller fan can be motor-driven or belted. Send for Bulletins Nos. 146 and 149.

B. F. STURTEVANT CO., Boston, Mass.

General Office and Works, Hyde Park, Mass.

NEW YORK PHILADELPHIA CHICAGO CINCINNATI LONDON

Designers and Builders of Heating, Ventilating, Drying and Mechanical Draft Apparatus; Fan Blowers and Exhaustors, Rotary Blowers and Exhaustors; Steam Engines, Electric Motors and Generating Sets; Pneumatic Separators, Fuel Economizers, Forges, Exhaust Heads, Steam Traps, Steam Turbines, etc.

Wireless Apparatus



Ceco Transformer — Closed Core Type

A 250 watt closed core transformer as powerful as the ordinary 6" spark induction coil for wireless work, and costs but \$30. It is especially adapted to tuned transmitting circuits, and can be run from any lamp socket giving alternating current. We also build larger sizes up to 10 kw. capacity at moderate prices. Complete parts for a 20 mile tuned transmitting set consisting of 250 watt transformer, large capacity glass plate condenser, oscillation transformer with adjustable primary and secondary inductances, and adjustable spark-gap making an accurate model of a modern commercial station, complete for \$60. Send for our descriptive folder of experimental apparatus for receiving and transmitting, including

- TRANSFORMERS TELEPHONE HEAD RECEIVERS
- TUNERS CONDENSERS OSCILLATION TRANSFORMERS
- DETECTORS SPARK-GAPS POTENTIOMETERS

CLAPP-EASTHAM CO.

729 Boylston Street BOSTON, MASS.

HAVE YOU SEEN THE Model Engineer and Electrician

CONTAINING SPLENDID ARTICLES ON

Electrical and Mechanical Models, Apparatus, Power Boats, Lathes, Dynamos, Steam Engines, Tools, and many other subjects, fully illustrated?

Send 8 cents for a copy

SPON & CHAMBERLAIN

Publishers of Technical Books

123 Em. Liberty St., New York

ELECTRICITY



This is the Electrical Age. Every boy and girl should experiment with the hidden mystery and learn the fundamental principles of the Earth's greatest power—ELECTRICITY. Send a 2c stamp to-day (no postals answered) for our 80 PAGE CATALOGUE "VOLTAMP ELECTRICAL PRODUCTS" Illustrates and describes Motors, Dynamos, Machine Models, Toys, Telegraph Instruments, Batteries, Meters, Coils, Geissler Tubes, Bells, Lamps, Flashlights, Telephones, "WIRELESS", Tools, etc. The greatest line of *Miniature Railways* ever shown. Ideal Christmas gifts for boys. Lowest prices for best goods. THE VOLTAMP ELECTRIC MFG. CO. Wite Building Baltimore, Md.

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.

THE LAW OF FINANCIAL SUCCESS 10^{CT}

A book of absolute necessity to every man and woman anxious to improve their circumstances financially. It tells the law clearly and teaches how to apply it. 104 pages, 16 chapters, paper bound, 65,000 sold. You cannot afford to be without it. Sent postage prepaid on receipt of 10 cents, stamps or silver. Write to-day. Fiduciary Co. 387 Tacoma Bldg. Chicago, Ill.



3-IN-1 VOLT-AMMETERS

Measure low and high voltages, besides amperes and ordinary resistances. They are inexpensive and reliable. Send for catalog of portable and switchboard voltmeters and ammeters.

L. M. PIGNOLET

84 Cortland Street New York



ELDRIDGE BATTERY VOLTMETER 0 TO 3 VOLTS DEAD BEAT

A very practical instrument for all users of batteries, either primary or storage.

WRITE FOR CIRCULAR

ELDRIDGE ELECTRIC MFG. CO.

12 Post Office Square - Springfield Mass.



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.



SALE AND EXCHANGE

Advertisements under this heading, without display, 2 cents per word, cash with order, minimum, 50 cents. Black-faced type, 4 cents a word, minimum, \$1. Exchange advertisements will be inserted for subscribers once in twelve months without charge, subsequent insertions of same copy, 1 cent a word.

ELECTRICAL MATERIAL

GRAVITY BATTERIES.—One dozen partly used 6x8 inch cells. Price, \$5.50, or 50 cents each. Blue vitriol, 5 cents per pound. For information, call or write. A. LINDAHL, 64 School Street, Waltham, Mass. (9)

CHEMICAL RECTIFIER. How to make. 25 cents. TAYLOR ELECTRIC AND MANUFACTURING COMPANY, Barker, N. Y. (11)

FOR SALE.—Small electro-magnet cores ready to wind. Right size for bells, buzzers, etc. Post-paid, 15 cents each. GEO. T. ORVIS, Caldwell, Idaho.

HOW TO RECHARGE DRY BATTERIES.—Clear and concise directions for recharging worn-out dry batteries sent for 10 cents silver. G. E. HAMILTON, 9 North Street, Danbury, Conn.

FOR SALE.—Four Gould 2-volt storage batteries; 80 ampere hours. Price, \$5 each. Address, C. S. KEACH, 80 Bower Street, Roxbury, Mass.

FOR SALE OR EXCHANGE.—Five electric bells, 2½-inch gong, 40 cents each. Five wood push-buttons, 7 cents each. One telephone instrument, receiver minus diaphragm, \$2.25; top in battered condition. Two books "Electric Lighting for Amateurs" and "Small Accumulators," 20 cents each, or both for 35 cents, post-paid. One K. & D. voltmeter, 5 to 15 volts, 75 cents. Will exchange above for a 1-inch or ¼-inch spark coil in good condition. JOHN L. TRYKE, R. 4, Annandale, Minn.

WHEATSTONE BRIDGE easily and cheaply made from our plans and instructions, complete. Set sent post-paid for 50 cents silver. GENNETH SUPPLY CO., 367 Somerville Avenue, Somerville, Mass.

WIRELESS TELEGRAPHY

VERY SENSITIVE DOUBLE HEAD RECEIVERS, 4000 ohms, \$8. Also rewinding any receiver to high resistance, and other wireless specialties. A B C WIRELESS SPECIALTY CO., 333 East 133d Street, New York City, N. Y.

SILICON FOR WIRELESS DETECTORS.—Any amateur can now make the latest and most sensitive wireless receiver. Needs no batteries. Generous piece sent post-paid, 25 cents silver. MIDDLESEX WIRELESS SUPPLY CO., 94 Antrim Street, Cambridge, Mass. (9)

ELECTRICAL EXPERIMENTERS.—You have read my article in this issue on the "Electrolytic Rectifier." Contains some good information, doesn't it? Perhaps you would like to build a transformer like the one mentioned, and experimenter can easily construct one if he has the right information at hand. The RIGHT INFORMATION consists of a series of six drawings, giving complete data and dimensions for an efficient transformer to reduce 110 volts alternating current to 10, 20, 30, or 40 volts. This set, complete, sells for 50 cents. Do you also know that my other series of drawings contain the most recent and reliable data on tuned circuit diagrams and apparatus, induction coils, step-up transformers for Wireless, and other valuable information? Better get my price lists. W. C. GETZ, 645 N. Fulton Avenue, Baltimore, Md.

We now carry in stock **STEP-DOWN TRANSFORMERS** made according to designs of W. C. Getz, consulting electrician of this company, for reducing 110 volts alternating current to 10 volts, 20 volts, 30 volts, or 40 volts for use with electrolytic rectifiers. Price, \$20. With electrolytic rectifiers, to convert the alternating current into direct current. Price, \$22.50. VOLTAMP ELECTRIC MFG. CO., Wite Building, Baltimore, Md.

"EFFICIENCY AND LOW COST," our motto. Apparatus built to order at a reasonable cost. Ideas perfected and patented. Let us know your wants. Something new. Our new model Helix, Anchor Gap, and air-cooled radiator spark gap, combined tuning coil and potentiometers a specialty. UNITED WIRELESS SUPPLY CO., 19 Beacon Avenue, Providence, R. I.

WIRELESS.—Send stamp for list of drawings used in constructing wireless apparatus. Detectors, tuning-coils, etc., for sale. Circular free. BOX 117, Byhalia, Miss.

WIRELESS EXPERIMENTERS! We can save you money, and our apparatus will give you complete satisfaction. Send for circulars to-day. NORTHWESTERN WIRELESS COMPANY, 8 Banning Building, Duluth, Minn.

WIRELESS TELEGRAPH CALLS.—Neat blue-print charts, 16x13 inches containing calls of (a) 113 Coastwise Steamships, (b) 123 Transatlantic Liners and Battleships. Ether, post-paid, 25 cents. COLMOR, 38 Dwight Street, Boston, Mass.

WIRELESS TELEGRAPH.—Complete list of "Call Letters" of the Steamships and Land Stations equipped with wireless throughout the United States; over four hundred in all. Complete list, 25 cents. W. E. BEAKES, Newburgh, N. Y.

EXCHANGE.—Set of castings for upright engine, 2½ inches bore, 3½ inches stroke; nearly finished. Back-gear foot-power lathe, 8-inch swing, 18 inches between centers, 3 inches Cushman chuck, and other articles, to exchange for small horizontal engine, boiler, shotgun, rifle, bicycle, or chic talking machine and records, or other articles. Send list of what you have. E. G. BENNETT, Sebec, Me.

PHOTOGRAPHY

KODAKS, CAMERAS, LENSES, EVERYTHING PHOTOGRAPHIC.—We sell and exchange. Get our latest bargain list; save money. C. G. WILLOUGHBY, 814 Broadway, N. Y. (1f)

FOR SALE.—8 x 10-inch improved camera outfit. Description on request. JOHN BAKE, R. 2, Bloomington, Ohio.

AMERICAN PHOTOGRAPHY succeeds "American Amateur Photographer," "Camera and Dark Room" and "Photo Beacon." The editors of each now join in making a magazine which should be in the hands of every photographer, professional or amateur. 15 cents monthly, \$1.50 per year. Three specimen copies for a quarter. AMERICAN PHOTOGRAPHY, 6 Beacon Street, Boston, Mass.

FORMULAS AND INSTRUCTIONS

MAKE YOUR OWN FURNITURE from our full-size patterns. New plan. Simple and easy. Send 10 cents for sample pattern of book-rack or candlestick, and illustrated catalogue showing other pieces. THE HOME FURNITURE PATTERN CO., 2017 First National Bank Building, Birmingham, Ala.

THREE THOUSAND FORMULAS.—My 368-page volume of recipes and trade secrets, cloth bound, only 40 cents, prepaid. Worth dollars. Satisfaction guaranteed. WILEY SANDERSON, Ypsilanti, Mich.

MACHINERY AND TOOLS

TOOLS.—The best. Many good ones listed in our new net-priced catalogue. Send name on postal for catalogue. MONTGOMERY & CO., 105 Fulton Street, New York City. (11)

MODEL ENGINE CASTINGS and blue-prints for ½, ¾, and 1 h. p. engines. JAMES BELL, 2 Van Dorn Street, Glendale, L. I.

A I H. P. GAS OR GASOLINE ENGINE, vertical type; suitable for running launch, pump, lathe, dynamo, etc. Price, including spark coil, \$40. Will send it C.O.D., if one third of price is remitted. Address, H. K., care of W. C. Getz, 645 N. Fulton Avenue, Baltimore, Md.

HOW TO MAKE an acetylene gas machine. Practical, simple, easy to build; no toy. Full instructions and blue-prints, 25 cents. A. B. ETHERIDGE, 243 Sheldon Street, Grand Rapids, Mich.

ONE HALF H. P. STEAM ENGINE, with governor, pump, and safety boiler complete, \$15. "New Watchmaker's Lathe," 14 chucks. \$12. **F. H. JACKSON**, Angelica, N. Y.

THE PERFECTION WRENCH. — The newest and best wrench made. All steel, great strength. Instantly adjusted. Easily and quickly operated. Positive grip. Immense time, trouble, and temper saver. Indispensable to automobilists. Best "all-around" tool ever offered for sale. Must be seen to be appreciated. You'll want one when you see it. For circular, address, **THE PERFECTION WRENCH CO.**, Box 426, Port Chester, N. Y.

PATENTS

MASON, FENWICK & LAWRENCE, Patent Lawyers, Box P, Washington, D. C. Established forty-seven years. Honest, careful service. Highest references. Booklet free. Write us. (2)

WANTED. — Estimates for manufacturing a patented **HOE** (No. 880,925 of March 3, 1908), which I wish to place on the market. Would also consider royalty proposition or offer for purchase of patent. Address, **MCHANIC**, 938 Washington Avenue, Racine, Wis.

BOOKS AND MAGAZINES

AGENTS, MACHINISTS, TOOLMAKERS, DRAFTSMEN, attention! New and revised edition Saunders' "Handy 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.

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; post-paid. **RICHARD D. ELLIOTT**, Box 1376, St. Louis, Mo. (tf.)

LUBRICANTS

LUBRICANTS, asbestos, graphite, and mica candles for loose pulleys and shaftings; no drip, no dirt, economical. **SWAIN LUBRICATOR CO.**, 250 E. Lake Street, Chicago, Ill. (2)

MISCELLANEOUS

START a mail order business. We furnish everything necessary; only a few dollars required; new plan, success certain. Costs nothing to investigate. **MILBURN HICKS**, Chicago, Ill. (1)

ECZEMA LOTION. — Pure white liquid, made from vegetables grown in Texas. Stops itching pain immediately and cures permanently. Sample free. **PARK CHEMICAL COMPANY**, Houston, Texas.

MECHANICS, ELECTRICIANS, send postal for list of 25-cent books. **J. H. DAWSON**, Arlington, N. J.

FOR EXCHANGE. — One Baltimore self-inking printing-press, No. 11, with type, leads, etc. Will exchange for small boiler or a dynamo. Make me an offer. **FRANK BURKHARDT**, Milbank, So. Dak.

ONE DOLLAR gets latest brand new Wellington; balance to suit. **WELLINGTON VISIBLE TYPE-WRITER CO.**, 309 Washington Street (opp. Old South), Boston, Mass.

METAL SPINNING. — **JOHN J. POLE**, Geneva, N. Y.

A FREE HOROSCOPE, with the Astrological Key to Life, as it is the key that unlocks the latest and most complete up-to-date book on the science; gives full character reading, mentality, employment, marriage, etc. Send full birth date. Price, \$2. Enclose stamp for reply. **J. D. KEIFER**, 1319 Kellam Avenue, Los Angeles, Cal.

LETTERING, ORNAMENTS, RUBBER STAMPS FOR BRONZING. Iron, tin painted work. Opaque ink for rubber stamping, tracing cloth, blue printing. Circulars free. **E. TAYLOR & CO.**, Cleveland, Ohio.

THE ONTARIO NOVELTY CO., of Lakewood, N. J., is handling the best campaign emblem ever placed upon the market. It is the head of either candidate done in sterling silver, — fobs, 25 cents; buttons, 12 cents, by mail.

The publishers of "Electrician and Mechanic" have on hand a limited number of complete

Volumes of Electrician & Mechanic FOR 1907-8

These include one copy of each of the twelve issues from July, 1907 to June, 1908, inclusive. These volumes are unbound and will be sent to any address, postage prepaid, on receipt of \$1.25.

Sampson Publishing Co., 6 Beacon St., Boston, Mass.

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 enamelled and polished. Price:—

1-16 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.

VENTRILOQUISM

Learned by any Man or Boy at Home. Small cost. Send today 2-cent stamp for particulars and proof.
O. A. SMITH, ROOM 982 — 2040 KNOXVILLE AV., PEORIA, ILL.

WIRELESS

Telegraph and Telephone sets. Transformers, speaking arcs, silicon and carborundum detectors, etc. "Wireless Telegraphy Made Simple" a new book on this subject just out; send for descriptive matter. Special discount price on all instruments for short while.

VICTOR H. LAUGHTER

Byhalia Mississippi

PATENTS

HUGHES & YOUNG

(Est. 1829)

INTERNATIONAL PATENT ATTORNEYS

55 Chancery Lane, London, England
undertake all business in relation to the Protection of Inventions and the Registration of Trade Marks and Designs. Moderate charges. Proprietors of The Inventor's Journal, "PATENTS," the oldest and most influential journal of its class published in Great Britain.

Bennett's Magazine Bargains

**Electrician & Mechanic
Success Magazine
Woman's Home Companion**

**ALL THREE
One Full Year
\$2.30**

THE periodicals in any club offer may be sent to one or to separate addresses. Join with your friends and divide the cost. The subscriptions may be new or renewals.

All Subscriptions Are for One Full Year

**Electrician & Mechanic
Review of Reviews
Or OUTING
Cosmopolitan or
SUCCESS** } **Our Price
\$3.00**
(Checks Accepted)

ELECTRICIAN & MECHANIC

- with Woman's Home Companion and American . . . \$2.30
- with Success Magazine and McClure's . . . 2.50
- with American Boy and Cosmopolitan . . . 2.30
- with Cosmopolitan and American . . . 2.30
- with World's Work and Delineator . . . 3.00
- with Everybody's and Delineator . . . 2.50
- with Everybody's and World's Work . . . 3.25
- with Scribner's Magazine . . . 3.65
- with Outing and Review of Reviews . . . 3.70
- with Field and Stream and Recreation . . . 3.35

ELECTRICIAN & MECHANIC

- with Review of Reviews and Success . . . \$3.00
- with Pearson's and Cosmopolitan . . . 2.65
- with McClure's and Woman's Home Companion . . . 2.50
- with National Sportsman . . . 1.65
- with Pearson's Magazine . . . 2.00
- with World To-day and Success . . . 2.65
- with Modern Priscilla and Ladies' World . . . 1.70
- with Woman's National Daily and Pictorial Review . . . 2.30
- with Home and Farm, Paris Modes, Poultry Success . . . 1.65
- with the Musician (or Etude) . . . 2.00

WE ALSO FURNISH AS FOLLOWS:

CLASS 13

- American Boy
- American Magazine
- American Motherhood
- Black Cat
- Book-keeper
- Children's Magazine
- Cosmopolitan Magazine
- Garden Magazine
- Harper's Bazaar
- Little Folks (new)
- Pathfinder
- National Sportsman
- Pictorial Review
- Style (including pattern)
- Success Magazine
- Sunset
- Table Talk
- Uncle Remus's Home
- Woman's Home Companion
- Woman's National Daily

Electrician & Mechanic

With Any ONE of These

\$1.65

Electrician & Mechanic

With Any TWO

\$2.30

CLASS 20

- American Photography
- Appleton's Magazine
- Breeder's Gazette
- Broadway
- Country Gentleman
- Etude (for Music Lovers)
- Field and Stream
- Musician
- National Magazine
- Pacific Monthly
- Pearson's Magazine
- Technical World
- Travel Magazine
- Van Norden Magazine
- World To-day

Electrician & Mechanic

With Any ONE of These

\$2.00

CLASS 27

- Ainslee's Magazine
- Cycle and Auto Trade Jour'n'l
- Independent
- Outing
- Putnam's Reader
- Recreation
- Review of Reviews
- Smart Set
- Suburban Life
- Toilettes

Electrician & Mechanic

With Any ONE of These and ONE of Class 13

**The THREE for
\$3.00**

**Ladies' Home Journal } OUR PRICE
Saturday Evening Post } \$3.00**

The Youth's Companion \$1.75
for 1909 including all extra numbers and calendar in thirteen colors and gold

You May Add to Your List

- Century Magazine . . \$3.85
- Harper's Magazine . . 3.50
- Harper's Weekly . . . 3.50
- St. Nicholas 2.85
- Everybody's Mag. . . \$1.50
- Delineator 1.00
- Munsey's Magazine . 1.00
- International Studio. 4.50
(For All Art Lovers)

OUR LARGE 44-PAGE CATALOGUE

Contains about 3000 publications at lowest prices. Write for it now and see how much you can save. IT'S FREE.

Our References } All Publishers
The Commercial Agencies

ADDRESS ALL ORDERS TO

Bennett's Magazine Agency 68-74 La Salle St. CHICAGO, ILL.

*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.

HOME INSTRUCTION

IN STENOGRAPHY, BOOK-
KEEPING, AND ALL CIVIL
SERVICE BRANCHES  

Send for Free Information

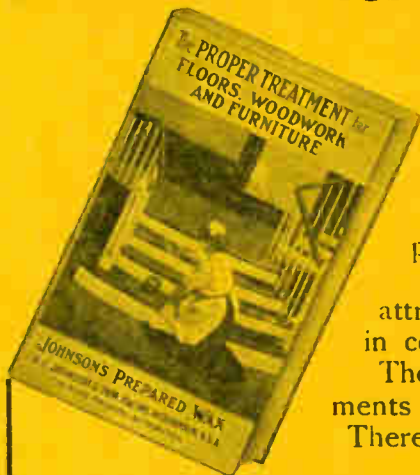
Massachusetts Correspondence Schools

194 BOYLSTON STREET

BOSTON

MASSACHUSETTS

FREE A Book of Valuable Ideas for Beautifying the Home



WE will send you *free* of charge our book "The Proper Treatment for Floors, Woodwork and Furniture," two sample bottles of Johnson's Wood Dye and a sample of Johnson's Prepared Wax.

This text book of 50 pages is very attractive—80 illustrations—44 of them in color.

The results of our expensive experiments are given therein.

There is absolutely no similarity between

JOHNSON'S WOOD DYES

and the ordinary "stain." Water "stains" and spirit "stains" raise the grain of the wood. Oil "stains" do not sink below the surface of the wood or bring out the beauty of the grain. Varnish "stains" are not stains at all. They are merely surface coatings which produce a cheap, shiny, painty finish. Johnson's Wood Dye is a dye. It penetrates the wood; does not raise the grain; retains the high lights and brings out the beauty of the wood.

For artistic coloring of all woods in the following shades:

- No. 126, Light Oak
- " 127, Dark Oak
- " 128, Mission Oak
- " 130, Weathered Oak
- " 131, Brown Weathered Oak
- " 132, Green Weathered Oak
- " 140, Marble Oak
- " 128, Light Mahogany
- " 129, Dark Mahogany
- " 110, Boer Green
- " 121, Moss Green
- " 122, Forest Green
- " 172, Flemish Oak
- " 178, Brown Flemish Oak
- " 180, Silver Gray

Johnson's Prepared Wax

will not scratch or mar. It should be applied with a cloth; dries instantly—rubbing with a dry cloth gives a velvety protecting finish of great beauty. It can be used successfully over all finishes.

We want you to try Johnson's Wood Dye and Prepared Wax at our expense. Fill out the attached coupon, being careful to specify the shades of dye wanted. We will mail you promptly the booklet and samples. Do not pass this page until you have mailed the coupon.

S. C. Johnson & Son

Racine, Wis.

"The Wood Finishing Authorities"

**FREE
Coupon
EM-11
S.C. Johnson
& Son
Racine, Wis.**

Please send me **FREE** as per your offer "The Proper Treatment for Floors, Woodwork and Furniture"—2 sample cans of Johnson's Wood Dyes, Nos. —and— and one sample can of Johnson's Prepared Wax. My dealer's

Name is

Address

My name is

Address

Oilstones

How to Select

A valuable booklet giving on the selection, use, and



Oilstones

and Use Them

a few excellent suggestions care of OILSTONES

A PRACTICAL BOOK for PRACTICAL MEN

It is bound to interest you. Written in the briefest and plainest manner possible, so that the most inexperienced person may be enabled to buy and use an oilstone.

Sent to any Address upon receipt of a two-cent stamp

DEPT. K

PIKE MFG. CO. - PIKE, N. H.

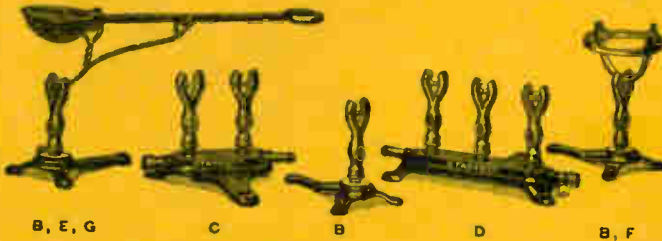
Manufacturers of

Oilstones, Razor Hones, Scythe-stones, Corundum Wheels, Emery Wheels, and Abrasives



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.