

N. S. E.

Price, 10 Cents

March, 1909

ELECTRICIAN & MECHANIC

Dynamo and Motor Design

Enameled Wire

Construction of an Electrolytic Detector

A Brooch in Silver Wire

A Model Steam Turbine

Forging for Amateurs

Electric Wave Telegraphy

A Double-acting Pump

A Revolving Bookcase

Soldering Aluminum

Modern Wood Staining

PUBLISHED MONTHLY BY

SAMPSON PUBLISHING CO.

6 BEACON STREET, BOSTON, MASS.

STANLEY

BAILEY ADJUSTABLE IRON PLANES

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



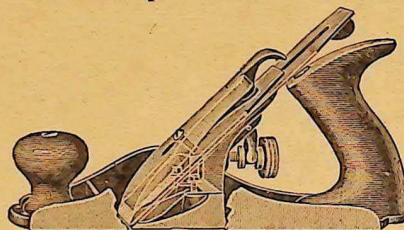
The cutter rests on the Iron Frog, being supported clear down to the heel of the Bevel, and very close to the cutting edge.

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

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



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



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

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

Write for Catalogue

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

B
A
I
L
E
Y

P
L
A
N
E
S

Technical Books

AT POPULAR PRICES

A Complete Electrical Library

These ten books by E. J. Houston and A. E. Kennelly, uniformly bound in red cloth, at \$1.00 each, or \$10.00 the set (delivered) as follows:

1. **ALTERNATING ELECTRIC CURRENTS.**
Fourth edition, 359 pages, 115 illustrations.
2. **MAGNETISM.**
Second edition, 314 pages, 97 illustrations.
3. **THE ELECTRIC MOTOR.**
Second edition, 377 pages, 112 illustrations.
4. **THE ELECTRIC TELEGRAPH.**
Second edition, 480 pages, 172 illustrations.
5. **THE ELECTRIC TELEPHONE.**
Second edition, 454 pages, 151 illustrations.
6. **ELECTRIC HEATING.**
Second edition, 298 pages, 89 illustrations.
7. **ELECTRIC ARC LIGHTING.**
Third edition, 464 pages, 173 illustrations.
8. **ELECTRIC INCANDESCENT LIGHTING.**
Third edition, 514 pages, 164 illustrations.
9. **ELECTRIC STREET RAILWAYS.**
Second edition, 373 pages, 162 illustrations.
10. **ELECTRICITY IN ELECTRO-THERAPEUTICS.**
Third edition, 467 pages, 147 illustrations.

Wireless Telegraphy

MAXWELL'S THEORY AND WIRELESS TELEGRAPHY. Part I. — "Maxwell's Theory and Hertzian Oscillations." By H. Poincaré; translated by Fred'k K. Vreeland. Part II. — "The Principles of Wireless Telegraphy." By Fred'k K. Vreeland. 250 pages, 145 illustrations. Price, \$2 net.

WIRELESS TELEGRAPHY. A book embodying a short history of Wireless Telegraphy, — its theory, experiments, and results attained. By A. Frederick Collins. 300 pages and 332 illustrations. Price, \$3 net.

We can also supply any of the remaining 25 or more books now in print on this subject

Practical 25c Books

These are Monographs, in which thoroughly practical men give definite information about the particular subject with which he is familiar. They are full of just the practical points you want to know; they are well printed and bound in handsome paper covers.

Turning and Boring Tapers. By Fred. H. Colvin, Associate Editor American Machinist. There are two ways to turn tapers. This treatise has to do with the right way; it tells you how to start the work properly, how to set the lathe, what tools to use, and how to use them. Fourth edition. Price, 25 cents.

Drafting of Cams. By Louis Rouillion. Every mechanic is interested in Cams, and this shows just how to lay them out for any kind of work you may have. Third edition. Price, 25 cents.

Threads and Thread Cutting. By Colvin-Stabel. This clears up many of the mysteries of thread cutting, such as double and triple threads, internal threads, catching threads, use of hobs, etc. Third edition. Price, 25 cents.

Commutator Construction. By William Baxter, Jr. This book goes into the designing, building, and maintenance of commutators; shows how to locate troubles and how to remedy them. Price, 25 cents.

Brazing and Soldering. By James F. Hobart. The only book that shows you just how to handle any job of brazing or soldering that comes along. Fourth edition. Price, 25 cents.

Wiring a House. By Herbert Pratt. Shows a house already built; tells just how to start about wiring it; where to begin; what wire to use; how to run it according to insurance rules. Price, 25 cents.

SPECIAL OFFER: We will send you any five of these books, if ordered at one time, on receipt of One Dollar.

At \$1.00

Drawing Instruments: Their Use and Abuse. A manual for engineers and engineering students. By Walter G. Stephan, M.E. 112 pages, 74 illustrations.

Catechism on Producer Gas. By Samuel S. Wyer, M.E. Author of "Producer Gas and Gas Producers." An elementary treatise in question and answer form, containing 287 questions and answers. 50 pages, pocket size, illustrated.

At \$1.50

Electricity made Easy by Simple Language and Copious Illustration. By Edwin J. Houston and A. E. Kennelly. 348 pages, 207 illustrations.

At \$1.50

The Motorman and His Duties. A Handbook of the Theory and Practice of Electric Railway Car Operation. By Ludwig Gutmann. Sixth edition, revised and enlarged by Lawrence E. Gould. 200 pages, 138 illustrations, 3 folding plates.

Electrical Engineering Leaflets, containing the Underlying Principles of Electricity and Magnetism. By Edwin J. Houston and A. E. Kennelly. In Three Grades, as follows: —

ELEMENTARY GRADE, suited to the study of Electrical Artisans, Wiremen, and to Elementary Students. 296 pages, 121 illustrations.

INTERMEDIATE GRADE, suited to students in High Schools or Colleges, and those beginning the study of Electrical Engineering. 300 pages, 140 illustrations.

ADVANCED GRADE, suited to students taking Technical Courses in Electrical Engineering. 296 pages, 121 illustrations.

At \$2.00

Diagrams of Electrical Connections. A collection of 130 diagrams of the most practical connections for electricians, with full explanation of each diagram. By Cecil P. Poole. 113 pages.

Induction Coils: Their Theory, Design, and Construction. By H. Armagnat; translated by Otis Allen Kenyon. 221 pages, 109 illustrations.

Keys for the Practical Electrical Worker. Electric light, power, street railway, telephone and the telegraph explained and illustrated by drawings and diagrams of connections from the latest practice. By F. J. Robinson. 193 pages, folding plates.

The Screw-cutting Lathe. How to select, set up, and operate. By James F. Hobart, M.E. 162 pages, 90 illustrations.

Electrical Catechism. A book putting into concise and accessible form reliable answers to many of the questions asked concerning the theory and application of electricity. By Geo. D. Shephardson. 422 pages, 325 illustrations. (Second edition.)

The lists mentioned on this page have been selected from our catalogue of engineering books, and are intended only to illustrate the high class of technical literature we can place before you at prices within reach of your pocketbook. If the works you want are not given space here, write us. We keep in stock the books of all publishers, and can fill orders the same day received. Catalogues and descriptive circulars sent free on request.

McGRAW PUBLISHING COMPANY 239 WEST 39th STREET
NEW YORK

DISCARD YOUR BATTERIES WITH ALL THEIR ANNOYANCE AND ADOPT THE BEACON TRANSFORMER

PERMANENT RELIABLE
ECONOMICAL

It Operates Bells, Annunciators, Gas Lighting, Engine-Ignition, etc., and is unequalled for running electric toys and miniature lamps used to illuminate Christmas trees

Send for Circular

30 DAYS FREE TRIAL

THE ELECTRIC NOVELTY CO., 6 BEACON STREET, ROOM 622, BOSTON, MASS.

A School Within Itself

There are XX chapters in all, XIX carrying you from the fundamental principles of electricity on through the various branches to a point where the careful student comprehends the complete designing, care, and operation of a dynamo or motor, and I chapter on electric automobiles, outlining their construction, care, and operation, and all about storage batteries and how to handle them. Each subject is carefully written and to the point. After a student studies a subject, he is questioned on that subject in such a manner as to bring clearly to his mind the points he needs to know regarding same. A DICTIONARY in back of book will enable him to learn the meaning of any electrical word, term, or phrase used in this book, as well as hundreds of others in common use. All required tables necessary in the study are in it.

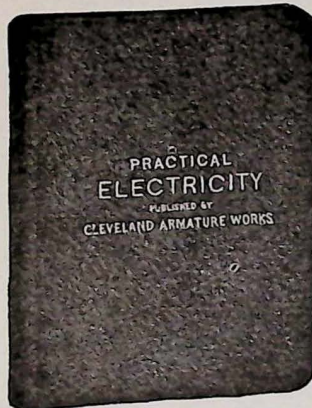


TABLE OF SUBJECTS

Chapter

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

Chapter

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

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

The offer we make of refunding money if book is not satisfactory upon examination is AN UNUSUAL ONE in connection with the sale of a book. But we have no fear of its return. Your decision will be what thousands of others has been. Money would not buy it if it could not be duplicated. We could print testimonials by the hundreds. It is best to order and be your own judge of its merits.

Cleveland Armature Works, Cleveland, Ohio

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



Electrical Supplies

This Battery is guaranteed to give satisfaction for Ignition Work.

3 SIZES PRICE

- | | | | |
|---|-------------------|----|--------|
| A | 2 1/2 x 6 3/4 in. | .. | \$0.25 |
| B | 3 x 7 1/2 in. | .. | .50 |
| C | 3 1/2 x 8 1/2 in. | .. | .60 |

Send for our Catalogue 24M "SOMETHING ELECTRICAL FOR EVERYBODY," 168 pages with net prices.

The following are a few of them

- | | |
|---|---------------|
| Red Seal Dry Battery, "A" 2 1-2 x 6 3-4 in., all kinds open circuit work..... | \$0.20 |
| Mesco Dry Battery, 2 1-2 x 6 3-4 in., Call Bells, Telephones, etc..... | .15 |
| Elite Battery Ammeter..... | 2.00 |
| Marine Weatherproof Primary Coil..... | 1.25 |
| Marine Weatherproof Jump Spark Coil..... | 4.00 |
| Ignition Switch, Removable Lever..... | .50 |
| Electric Call Bell Outfit..... | .60 |
| Burglar Alarm Trap..... | .13 |
| Floor Tread for Servant's Call..... | .75 |
| Pony Telephone Receiver..... | .38 |
| Battery Call Telephone..... | each 2.50 |
| Eureka Telegraph Instrument..... | 1.15 |
| Battery Rheostat, 20 ohms resistance..... | .65 |
| Sta There Battery Connectors..... | per dozen .36 |
| Mesco Current Tap and Socket..... | .25 |
| Electric Vibrators (3 styles) \$5.00, \$10.00, and \$15.00 | |

Manhattan Electrical Supply Co.

NEW YORK, 17 Park Place
CHICAGO, 188 Fifth Avenue

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.

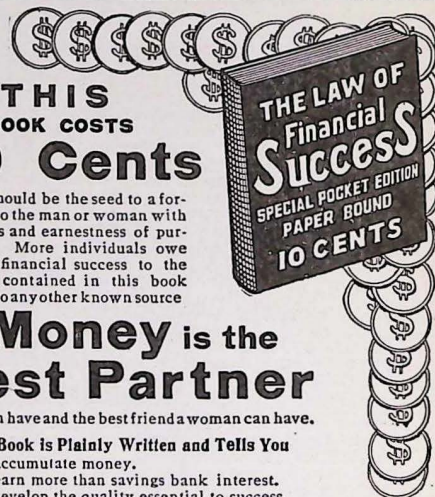
Regular edition, limp leather bound, silk lined, \$1.00 per copy.

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

787 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.



Wireless Telegraphy and Telephony Popularly Explained

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

and **CHARLES R. UNDERHILL**

With Special Article by *Nikola Tesla*

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

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

Sent post-paid on receipt of One Dollar

WILLIAM R. ARNOLD, Jr.

4 MARKET SQUARE PROVIDENCE, R. I.

Holtzer-Cabot

Wireless Operator's
Head Receivers



Double head band, leather covered and padded — pneumatic air cushions, complete with cord, \$10.00.

Send for our Bulletin No. 20 B2

**The Holtzer-Cabot
Electric Company**
Brookline, Mass.

Western Office: CHICAGO, ILL.

¶ Within ten years there will be more Flying Machines built than any other vehicle.

¶ Learn the business while it is young and you will have the best positions when it is old.

¶ You can learn more about Flying Machines in one year by reading the National Aeronautic Magazine

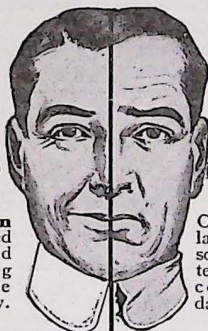
FLY

than from any other source.

Send \$1.00 for a year's subscription to

AERO PUB. CO., Betz Building, Philadelphia, Pa.

SMILE
with
the
NEW



FROWN
with
the
OLD

Litholin
Waterproofed
Collars and
Cuffs bring
comfort, style
and economy.

Ordinary Collars and Cuffs soil, wear, and tear. To first cost add 2c. daily.

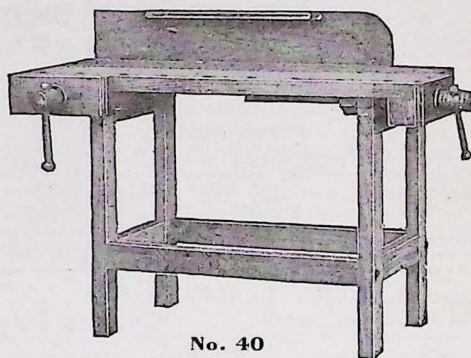
Cover one half of the above face and then the other, and you see illustrated the real comfort of **LITHOLIN** Waterproofed Linen Collars and Cuffs as compared with others. **LITHOLIN** is linen and looks it,—never wilts, cracks nor frays, and is wiped white as new with a damp cloth. Newest shapes and sizes.

COLLARS, 25c. CUFFS, 50c.

Always sold in RED boxes—avoid substitution. If not at your dealer's, send, giving styles, size, number wanted, with remittance, and we will mail, post-paid.

Booklet of styles free on request.

THE FIBERLOID COMPANY
Dept. 56, 7 Waverly Place NEW YORK



No. 40

EVERY reader of **ELECTRICIAN AND MECHANIC** should own one of our superior Home Work Benches. You are of a mechanical turn of mind and "handy with tools" or you would not take this magazine. A home work bench can be made a means of saving many dollars a year, by providing a place where you can do jobs for the house that otherwise must be sent out. It provides healthy amusements for the boys, keeps them at home, and stimulates a desire to create and make good use of their spare hours. ¶ We are the largest manufacturers of Home Benches in the world, and our catalogue contains much of interest for you. It shows our full line with descriptive matter. Send to-day. It's worth while.

GRAND RAPIDS HAND SCREW CO.

930 JEFFERSON AVENUE

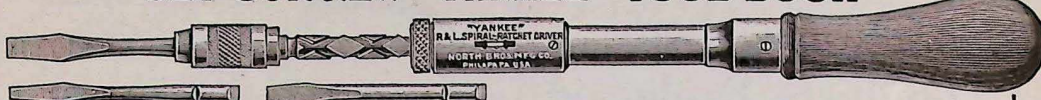
GRAND RAPIDS

::

MICHIGAN

Are Fine Tools Your Hobby?

GET OUR NEW "YANKEE" TOOL BOOK



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

Telephone, 2689 Oxford

C. E. ROGERS' BRASS FOUNDRY

Brass, Bronze, Aluminum & Composition Castings
OF EVERY DESCRIPTION

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

34 BEACH STREET

BOSTON

MASSACHUSETTS

Patents Secured

or no attorney's
fee charged

CALL OR WRITE

ELMER C. RICHARDSON

Room 6, 37 Tremont Street BOSTON, MASS.

Associated with a Reliable Washington
Patent Attorney

THE VALUE OF A HIGH RESISTANCE TELEPHONE RECEIVER MAY BE DOUBLED

if the New Gold Diaphragm is used. Being extremely thin (.0055 inch), yet stiff and rigid in construction, they respond to the weakest impulses, and can be adjusted nearer to the Pole-Pieces than the ordinary diaphragm without danger of touching. Standard Size—2 Inch Diameter—Each 50c. Fits Nos. 107 and 108 Receivers, "Solid Back," and other Types, increasing Efficiency from 50 to 100%. Special Receiver Cords for Wireless Work, 6 ft. Double Conductor—Each 40c.

W. C. GETZ

645 N. Fulton Avenue

Baltimore, Md.

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



WIRELESS RECEIVERS

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

Price List

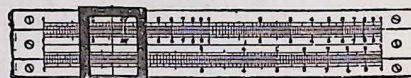
Complete with 7 foot Cord	
1500 ohms	\$ 9.00
2000 "	9.50
3000 "	10.00
4000 "	10.50

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

S. H. COUCH CO., Inc.

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

Fits in the Pocket



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

\$1.80

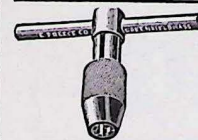
Catalogue of Drawing Materials, etc., on application.

KOLESCH & CO.

138 Fulton Street (Est. 1885) New York



We Want You to Become Familiar With
The Reece Threading Tools
Including SCREW PLATES, TAPS, DIES, etc.

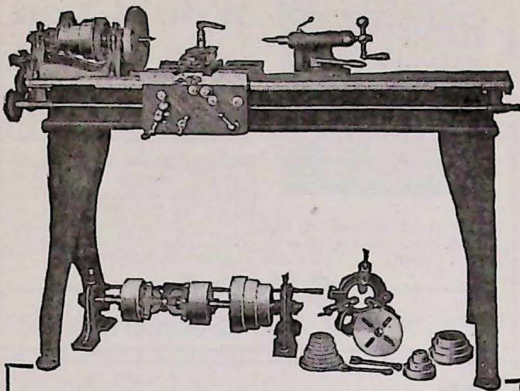


SPECIAL TRIAL OFFER

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

84-Page Catalogue Free

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



Try a Rockford Lathe

Made in two sizes, 9" and 11" swing, and for either foot or power drive.

We know these machines are right because satisfied users say they are. A catalogue will tell more about them.

**ROCKFORD
DRILLING MACHINE CO.**
ROCKFORD, ILL., U. S. A.

HOFFMAN & LAUER, Inc.
926 State Life Bldg. Indianapolis, Ind.

Manufacturers and Importers of
Tools for Hand-made Jewelry

See C. B. Dyer's Articles



VOLTS, AMPERES, RESISTANCES

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

L. M. PICNOLET
84 Cortlandt Street New York

Do you want to open a Moving Picture Parlor or are you interested in one?

All particulars are published in the *Moving Picture News*, America's Leading cinematograph weekly. Alfred H. Saunders, Editor. \$2.00 per year, 10 cents per copy. To readers of the ELECTRICIAN AND MECHANIC who send this coupon, one month's trial subscription is offered Free.

Cinematograph Publishing Co.
30 West 13th Street NEW YORK

HOW TO RUN AN AUTO



"Homans' Self Propelled Vehicles" gives full details on successful care, handling and how to locate trouble.

Beginning at the first principles necessary to be known, and then forward to the principles used in every part of a Motor Car.

It is a thorough course in the Science of Automobiles, highly approved by manufacturers, owners, operators and repairmen. Contains over 400 illustrations and diagrams, making every detail clear, written in plain language. Handsomely bound.

PRICE \$2 POSTPAID

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 for examination, to be paid for or returned,

after looking it over.

Upon receipt of the following agreement, the book will be forwarded.

No money in advance required, sign and return.

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

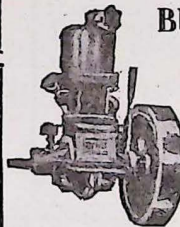
Kindly mail me copy of Homans' Automobiles, and, if found satisfactory, I will immediately remit you \$2.00, or return the book to you.

NAME _____

ADDRESS _____

VENTRILOQUISM

Learned by any Man or Boy at Home. Small cost. Send today 2-cent stamp for particulars and proof.
O. A. SMITH, ROOM 1028-2040 KNOXVILLE AV., PEORIA, ILL.



BUILD YOUR OWN MOTOR!

Complete sets of Castings, with blueprint 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 \$535.50. Complete Castings for building same, from \$8.00 to \$160.00. Send stamp for Catalogue.

THE GEBHARDT MOTOR CO.

27th Street, above Dauphin, Philadelphia, Pa.

LOOK HERE

Miniature sockets, 7 cents

Miniature 4 1-2 volt lamps, 14 cents

Alcohol blow torch, 55 cents

SEND STAMP FOR LARGE CATALOGUES

Dept. 9

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

Induction Coils and Wireless Receivers WOUND TO SPECIFICATION

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

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

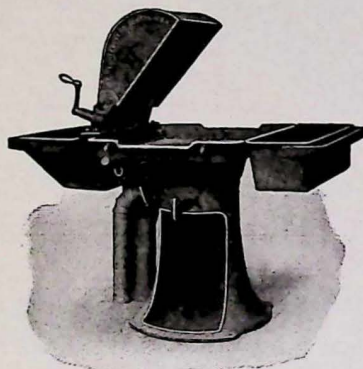
ENGINE INDICATORS

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

Send for Catalogue

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

STURTEVANT —FORGES—



Require a minimum of repairs.

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

SEND FOR BULLETIN 158

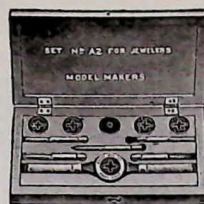
B. F. STURTEVANT CO.

GENERAL OFFICE AND WORKS

HYDE PARK

MASSACHUSETTS

705



Would You Like to Own A GOOD RELIABLE Reece Screw Plate

Genuine Reece Screw Plate Cutting Machine Screw Sizes, Nos. 4-36, 6-32, 8-32, 10-24, 12-24, with 5 adjustable dies 13-16 diam., 5 Taps, 1 Die Stock, 7 in. long and Tap Wrench Die complete in polished case with velvet-lined cover. Sent post-paid to any address on receipt of

\$2.95

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

Wireless Apparatus

SOME THINGS WE DO, AND SOME WE DON'T DO

We don't make the most extravagant claims.
We prefer results not words.

We do not try to make the cheapest.

We believe we build the best.

We do not claim to be the largest manufacturers in the world.

We do claim our apparatus to be unexcelled in quality.

We do not use enameled wire on our tuners; we have found it inferior.

We use bare copper wire wound by a unique method giving superior results.

We might also add, that we don't imitate, but have originated many novel and exclusive features.

Our transformers for use on alternating current are self-controlling in sizes of $\frac{1}{4}$, $\frac{1}{2}$, 1 and $1\frac{1}{2}$ K. W., requiring no impedance coil or rheostat. They are more efficient than induction coils, will send from fifty miles upwards, and come as low as \$30.

If you wish to improve your station, send for descriptive folder of

Transformers Telephone Head Receivers
Condensers Tuning Coils Spark Gaps Detectors
Oscillation Transformers Potentiometers

CLAPP-EASTHAM CO.

729 Boylston Street

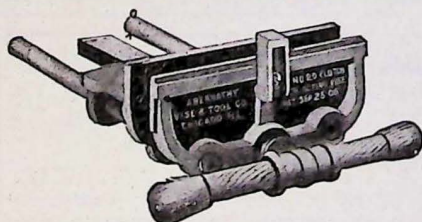
BOSTON, MASS.

WIRELESS TELEGRAPHY EASILY MASTERED

By our method of instruction we make you a skilled, practical Wireless Operator in a few months, so that you will be able to fill a good position as Wireless Telegraph Operator, or conduct a Wireless Telegraph Station of your own.

Write to-day for our 72-page "Book of Information." It contains the Morse and Continental Wireless Telegraph Codes and tells how the Wireless Telegraph is operated. Mailed to any address on receipt of 25 cts.

BOSTON SCHOOL OF TELEGRAPHY, 18 Boylston Street, Boston, Mass.



ABERNATHY RAPID ACTING VISES

ARE PARTICULARLY RECOMMENDED FOR

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

Please state your requirements and write for particulars.

THE ABERNATHY VISE & TOOL CO.

329 Englewood Avenue

CHICAGO, ILL.

TABLE OF CONTENTS

Dynamo and Motor Design	<i>Louis M. Schmidt, Ph.B.</i>	363
Enameled Wire	<i>H. M. Nichols</i>	368
The Construction of an Electrolytic Detector	<i>S. Fulton Kerr</i>	370
An Unbreakable Leyden Jar		372
A Brooch in Silver Wire		373
A Model Steam Turbine	<i>Charles Buys</i>	374
Forging for Amateurs	<i>F. W. Putnam, B. S.</i>	379
A New Aluminum Solder		379
Recent Contribution to Electric Wave Telegraphy	<i>Prof. J. A. Fleming</i>	380
Electric Wave Telegraphy		384
How to Construct a Good Double-acting Pump		386
A Revolving Bookcase		387
Soldering Aluminum	<i>H. M. Nichols</i>	389
Types of Men Who will never Succeed		390
Modern Wood Staining	<i>Edward Hurst Brown</i>	392
Editorial		395
Our Wireless Club		396
Questions and Answers		402
Book Reviews		404
Things Received		404

*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.

"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

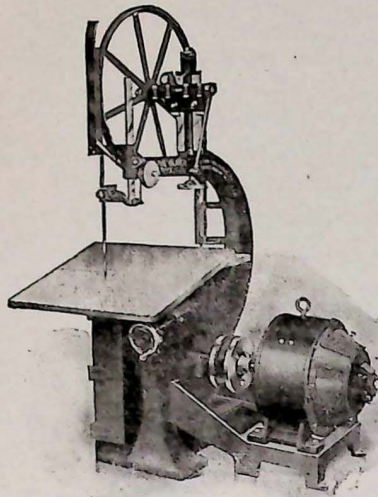
EVERYTHING HIGH GRADE

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

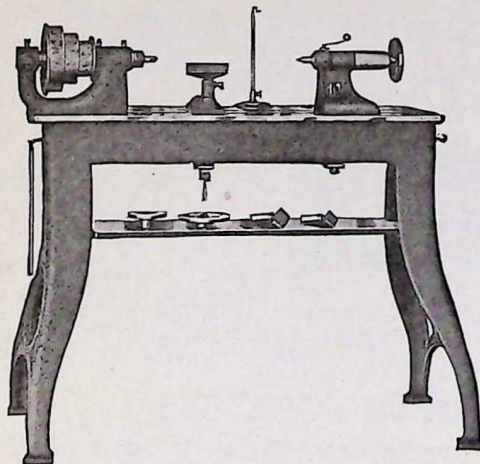


OLIVER "C" BAND SAW
MOTOR DRIVEN

**MOTOR HEAD SPEED LATHES
A SPECIALTY**

NEW

12" MANUAL TRAINING LATHE



Retains all the good
points of our well-known

10"

but designed for larger
work

**REED QUALITY and
WORKMANSHIP**

WRITE US BEFORE DECIDING ON YOUR NEW EQUIPMENT

F. E. REED COMPANY : Worcester, Mass.

Electrician and Mechanic

Incorporating

Bubier's Popular Electrician, Established 1890

Amateur Work, Established 1907

VOLUME XIX

MARCH, 1909

NUMBER 9

DYNAMO AND MOTOR DESIGN

CALCULATIONS FOR ONE-QUARTER H. P. MOTOR GENERATOR

LOUIS M. SCHMIDT, PH.B.

THERE is no feature of electrical engineering that is more valuable or helpful to the student than a knowledge of the methods and principles involved in the calculations for the design of electrical apparatus. First and foremost among such apparatus stands the electric generator and motor. Accordingly, we believe that a set of calculations for a generator or motor will be duly appreciated. It is our intention, in the present case, to cover clearly and concisely the fundamental principles involved, without an attempt to condense within a few pages the large amount of information on the subject which is contained in many volumes.

As a motor and generator are generally reversible, the principles involved in both are essentially the same. We have selected for our problem a $\frac{1}{4}$ -h. p. generator or motor. To be more precise, we will state that the design is for a $\frac{1}{4}$ -h. p. generator to operate on a 110-volt direct current circuit.

Standard practice indicates that the field should be bi-polar, that the armature should have a toothed core, and that a suitable speed is about twenty-five hundred revolutions per minute.

ARMATURE

About the first feature to be worked out is the diameter of the armature. This is determined from the speed and the practice as to peripheral speed. This latter ranges from 1500 feet per minute for small sizes to more than double this for large sizes. Using a value of 2000 feet per minute, the diameter of the armature would be determined from the following:—

$$2000 = \frac{\pi d \times 2500}{12}$$

$$d = \frac{2000 \times 12}{\pi \times 2500} = 3.06 \text{ inches.}$$

The final value to be used will be determined after consideration of the feature of the slots in the armature core.

A suitable width of slot for the size under consideration seems to be about $\frac{1}{4}$ inch. The number of slots corresponds to the number of commutator segments, and the latter is determined from the voltage and current. We shall need to determine the current.

$$\frac{1}{4} \text{ h. p.} = \frac{746}{4} = 186.5 \text{ watts.}$$

$$\text{Current} = \frac{186.5}{110} = 1.69 \text{ amperes.}$$

For this current it would be possible to run as high as 25 to 30 volts between commutator segments. It is well to use a large number of segments, if possible. At 12.5 volts between segments, the number of segments

between brushes would be $\frac{110}{12.5} = 8.8$. On this

basis, on both sides of the commutator there would be $8.8 \times 2 = 17.6$. Allowing for overlapping of brushes, it looks as if a good number to use would be 20 commutator segments.

With a corresponding number of slots $\frac{1}{4}$ inch wide in the armature core, there would be cut away $\frac{1}{4} \times 20 = 5$ inches of the circumference. Allowing an equal amount for the width of the teeth between the slots, the circumference of the armature before cutting the slots should be $5 + 5 = 10$ inches.

The diameter corresponding to a circumference of 10 inches is $3\frac{1}{16}$ inches, which is somewhat larger than the value given above. We will make the value an even $3\frac{1}{4}$ inches, without change in the slots, causing a slight increase in the width of the faces of the teeth over the $\frac{1}{4}$ inch originally allowed.

The armature conductor will next be considered. The total armature current, based on the $\frac{1}{4}$ h. p. rating, was 1.69 amperes. Allowing for current for field excitation, it will be well to allow about 1 ampere for the current in each wire of the armature. Allowing a density of about 3200 amperes per square inch of armature conductor, the

cross-section of the same would be $\frac{1}{3200} =$

.000313 square inch. Accordingly, a suitable conductor is No. 24 B. & S. (.020 inch), with a cross-section of .000317 square inch.

Allowing 1-16th inch for insulation of slots, and .004 inch for s.c.c. insulation of

the wire, there will be room for $\frac{\frac{1}{4} - 1-16th}{.024} =$

$\frac{.1875}{.024} = 7.8$ conductors per layer. Therefore

it will be safe to allow for seven turns per layer, with some space to spare for insulation.

The depth of slot depends upon the number of wires, and the latter on features of length of armature, air-gap dimensions, and flux density, which we will now consider.

The length of armature may be made from 1 to 1.5 times the diameter. We will use the 1:1 ratio, so that the length of the armature will be $3\frac{1}{4}$ inches.

The polar span might be from seventy to ninety per cent of the total. For our calculations we will assume that the poles each embrace an arc of about 120°. We will allow that one half of this is cut away at the armature surface by slotting. Accordingly, the air-gap area at the outer armature surface equals—

$$3\frac{1}{4} \times \pi \times 3\frac{1}{4} \times \frac{120}{360} \times \frac{1}{2} = 5.5 \text{ square inches.}$$

Allowing full value for the surface at the pole piece would give 11 square inches. Taking the average of these two for the mean area of the air-gap would give

$$\frac{5.5 + 11}{2} = 8.25 \text{ square inches.}$$

The flux density for the air-gap might be taken from 20,000 to 40,000 lines of force per square inch. On a basis of 25,000 lines per square inch, the total flux would be $8.25 \times 25,000 = 206,250$ lines.

The number of conductors is obtained from the formula:—

$$E = \frac{\phi N S}{10^8}, \text{ in which}$$

E = electromotive force at brushes.

ϕ = total flux of lines of force.

N = total number of armature conductors on outside of armature.

S = speed of armature in revolutions per

$$\text{second} = \frac{\text{revolutions per minute}}{60}$$

$$\text{Accordingly, } N = \frac{E \times 10^8}{\phi S}$$

$$= \frac{110 \times 60 \times 10^8}{206,000 \times 2500} \\ = 1280 \text{ conductors.}$$

$$\text{Number of conductors per slot} = \frac{1280}{20} = 64.$$

$$\text{Number of layers} = \frac{64}{7} = 9+.$$

As there are two coils per slot, it will be well to use thirty-five wires per coil for each slot, — a total of seventy wires in ten layers. Accordingly, there will be twenty coils of thirty-five turns each.

The wire will occupy $10 \times .024 = .24$ inches depth of slot. As not less than 1-16th inch should be allowed for insulation, it would be well to make the depth of slot $\frac{3}{8}$ inch. Accordingly, the slot will be $\frac{1}{4}$ inch wide and $\frac{3}{8}$ inch deep.

We can now take up the feature of resistance and weight of armature conductor. What is wanted first is the mean length of turn for the armature winding. The minimum possible length would be for the bottom of the slots. Without any allowance for insulation and thickness of wire, this value would be $(3\frac{1}{4} - (\frac{3}{8} \times 2) + 3\frac{1}{4}) \times 2 = (2\frac{1}{2} \times 3\frac{1}{4}) \times 2 = 11.5$ inches. For the top of slots, and assuming the piling up at ends to be equal to the depth of slot, we have:—

$$\text{Length of sides} = 3\frac{1}{4} + \frac{3}{8} + \frac{3}{8} = 4 \text{ inches.}$$

$$\text{" across ends} = 3\frac{1}{4} \text{ inches.}$$

$$\text{" of one side and end} = 7\frac{1}{4} \text{ inches.}$$

$$\text{Total length of turn} = 14.5 \text{ inches.}$$

Average of the two values given

$$= \frac{11.5 + 14.5}{2} = 13 \text{ inches.}$$

As some insulation will be needed at ends, and there will be some allowance to be made for unavoidable losses, we may expect that a length of 15 inches per turn will be a safe value to use.

On this basis

$$\text{The total length} = \frac{15 \times 35 \times 20}{12} = 875 \text{ feet.}$$

$$\text{Weight of wire} = \frac{875 \times 1.22}{1000} = 1.0695 \text{ lbs.}$$

$$\text{Resistance} = \frac{875 \times 25.68}{1000} = 22.5 \text{ ohms.}$$

$$\text{The resistance between brushes for the closed circuit armature} = \frac{22.5}{4} = 5.625 \text{ ohms.}$$

As a check on the armature capacity, we may use what is called the circumferential current density, which is the ratio of the total current rating for all the armature conductors around the whole surface of the armature and the core circumference.

For the total current rating we have $70 \times 1 \times 20 = 1400$ amperes. The circumference, based on the full diameter of $3\frac{1}{4}$ inches, is 10.2 inches. Accordingly, the ratio

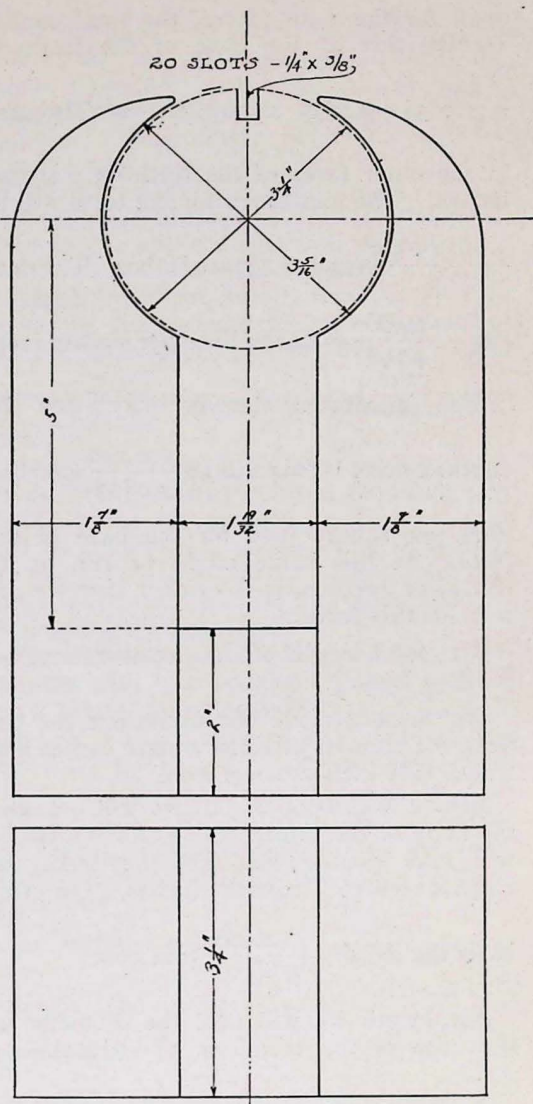
$$\text{would be } \frac{1400}{10.2} = 137 \text{ amperes per inch.}$$

As with a density of 300 the rise in temperature would be about 40°C. , it is evident that the rating for our armature is quite low.

FIELD

We can now give attention to the field. In this connection we have to determine the field excitation for the armature, the air-gaps, and the field itself.

For the air-gaps we have an area of 8.25 square inches. The depth we will take to correspond to the clearance between the outer faces of the teeth and the field bore. This we will make 1-32d inch, giving a total depth for both gaps of $1-32d + 1-32d = 1-16\text{th}$ inch. The density of magnetic flux we have taken at 25,000 lines of force per square inch for the air-gaps. Accordingly, we have to provide field excitation for air-gaps of 8.25 square inches in area, 1-16th inch in length, and 25,000 lines density.



The formula for the ampere turns is as follows:—

Ampere turns per inch = $.3133 \times B$, in which B = density per square inch. There-

$$\text{fore the ampere turns} = \frac{.3133 \times 25,000}{16} = 490$$

ampere turns.

For the armature, we have to consider the teeth and the body of the core.

The diameter at the bottom of the teeth = $3\frac{1}{4} - (\frac{3}{8} \times 2) = 2\frac{1}{2}$ inches. The circumference for this diameter = 7.85 inches. Of this, $\frac{1}{4} \times 20 = 5$ inches is cut away, leaving for the total section at the base of the teeth $7.85 - 5 = 2.85$ inches. On the basis of 120° polar

span for the pole pieces, the total section for the flux at the base of the teeth =

$$\frac{2.85}{3} \times 3\frac{1}{4} = 3.0875 \text{ square inches. The area}$$

at the outer faces of the teeth = 5.5 square inches. The mean area for the teeth will be

$$\frac{3.0875 + 5.5}{2} = 4.298 \text{ square inches. The den-}$$

$$\text{sity} = \frac{206,000}{4.298} = 48,000 \text{ lines per square inch.}$$

The maximum density may well be checked here. This will be $\frac{206,000}{3.0875} = 66,800$

lines per square inch for the base of the teeth. As this value might be run up to 80,000 or 100,000, it is evident that we are safe for this feature.

The total length of the armature teeth = $\frac{3}{8} + \frac{3}{8} = \frac{3}{4}$ inch.

We must provide for excitation for the teeth for an area of 4.298 square inches and length of $\frac{3}{4}$ inch of sheet iron.

Before working this out, we will consider the body of the armature. For the area we will take double that for the teeth, or $4.298 \times 2 = 8.596$ square inches. On this

$$\text{basis the density} = \frac{206,000}{8.596} = 24,000.$$

For length we will take the diameter at the base of the teeth, or $3\frac{1}{4} - (\frac{3}{8} \times 2) = 2.5$ inches.

We have, then, in this case, to provide for a section of 8.596 square inches and length of 2.5 inches of sheet iron at a density of 24,000 lines per square inch.

We need now to consider the characteristics of sheet iron.

An inspection of the table shows that the armature density is low for the material used, and that the excitation required is approximately 10.3 ampere turns per inch for the teeth and 3 ampere turns per inch for the body of the core. The total for these will be as follows: —

$$\begin{aligned} 10.3 \times \frac{3}{4} &= 7.82 \\ 3 \times 2\frac{1}{4} &= 8.25 \\ \text{Total} &= 16.07 \text{ ampere turns.} \end{aligned}$$

DATA ON MAGNETIZATION, INDUCTION, AND PERMEABILITY FOR SHEET IRON

<i>Magnetization.</i>	<i>Induction or Density.</i>	<i>Permeability.</i>
Ampere turns per inch.	Lines per square inch.	
5	45,000	2820
7.5	57,000	2380
10	65,000	2035
12.5	70,000	1750
15	74,000	1540
20	80,000	1250
30	87,500	913
40	92,500	725
50	95,000	597
60	99,000	516
70	101,000	450

We will now consider the excitation for the field itself. For the material we will use cast iron. The limiting density for this material is about 40,000 lines per square inch. On a basis of 35,000, we shall require an area of $\frac{206,000}{35,000} = 5.9$ square inches.

As the length is $3\frac{1}{4}$ inches, corresponding to the height of the laminations of the armature, the depth should be at least $\frac{5.9}{3.25} = 1.82$ inches, or about $1\frac{7}{8}$ inches.

We shall now consult the table for cast iron to determine the ampere turns required.

DATA ON MAGNETIZATION, INDUCTION, AND PERMEABILITY FOR CAST IRON

<i>Magnetization.</i>	<i>Induction or Density.</i>	<i>Permeability.</i>
Ampere turns per inch.	Lines per square inch.	
12.5	10,000	398
15	14,000	292
20	18,000	284
30	25,000	260
40	30,000	234
50	33,000	206
60	35,000	183
70	37,500	168
80	39,000	153
90	40,000	139

An inspection of the table shows that for a density of 35,000 an excitation of 60 ampere turns per inch will be required. We do not, however, know the total ampere turns required. We shall need to do a little

trial work before we can know this. We have already accounted for the following:—

Ampere turns for air-gaps.....	490
Ampere turns for armature core...	16
Total for air-gaps and core.....	506
Trial value for field.....	494
Total trial value.....	1000

On the basis of twelve per cent of the total armature current used for excitation, the field current would be $\frac{2 \times 12}{100} = .24$ amperes, or about $\frac{1}{4}$ ampere.

The total turns on this basis to give 1000 ampere turns would be $\frac{1000}{.25} = 4000$ turns.

At a current density one half that for the armature, or $\frac{3200}{2} = 1600$ amperes per square inch, the conductor area should be $\frac{.25}{1600} = .0001565$ square inch. Evidently No. 27 B. & S. (.014 inch) D.C.C. conductor would be suitable, which has an area of .000158 square inch.

The spread of the legs as worked out on the diagram corresponds in this case to the radius for the field bore, or 1 19-32ds inches. Allowing 19-32ds inch for the insulations and extra space between the coils, will leave 1 inch for wire, or $\frac{1}{2}$ inch for each leg. Allowing (.008 inch) for the D.C.C. insulation, there will be space for $\frac{.5}{.022} = 22.8$ layers of wire. For the turns per layer we would then have $\frac{4000}{2 \times 22} = 91$. This would require $91 \times .022 = 2$ inches, length of leg as a minimum. Add twenty-five per cent for spread of wire, makes 2.5 inches. Add $\frac{1}{2}$ inch for insulation and clearance for armature, makes a total of $3\frac{1}{2}$ inches. Adding the radius of the armature, or 1 19-32ds inches, would give 4 27-32ds inches for the approximate distance from the base of the field core to the center of axis of the armature. In the diagram this is given as 5 inches, which ought to be a safe value. The yoke is given a depth of an even 2 inches.

We can now obtain a value for the length of the magnetic circuit for the field. Across the top this would be the spread of the legs less the diameter of the field bore, or

$1\frac{7}{8} + 1$ 19-32ds — 3 5-16ths inches = 5-32ds inch. At the yoke it will equal the spread + $\frac{1}{2}$ depth $\times 2$, or $1\frac{7}{8} + 1$ 19-32ds + 1 + 1 = 5 15-32ds. Along the legs the length = $5 \times 2 = 10$. Accordingly, the total length = 5-32ds + 5 15-32ds + 10 = 15 $\frac{5}{8}$ inches. At 60 ampere turns per inch, this would call for $60 \times 15\frac{5}{8} = 936$ ampere turns. The value is close to our approximation of 1000 ampere turns. Actually a larger amount would be required by about twenty-five per cent to make up for leakage losses. This would make a total of 936 + twenty-five per cent = 1170 ampere turns, or a total of $\frac{1170}{.25} = 4700$ turns.

At 23 layers and 2350 turns per leg, there would be 102 turns per layer, requiring 2.25 inches space for minimum. It is evident that by encroaching on the extra allowances we made for insulation and clearances, that there is ample room for this wire with the dimensions we have used.

We will now consider how our field winding fits with our voltage. To do this we must first obtain the resistance of the field winding. The minimum length around the leg is $(1\frac{7}{8} + 3\frac{1}{4}) \times 2 = 10\frac{1}{4}$ inches. The maximum, $10\frac{1}{4} + (1$ 19-32ds $\times 2) = 12$ 27-32ds inches. The average, with some allowance for losses, would be about 1 foot per turn. The total length of wire would be $1 \times 4700 = 4700$ feet.

The weight would be $\frac{4700 \times .61}{1000} = 2.86$ pounds. The resistance would be $\frac{4700 \times 51.5}{1000} = 240$ ohms.

At 110 volts, the current would be $\frac{110}{240} = .46$ ampere, or nearly double the required value.

On this basis the ampere turns would be $.46 \times 4700 = 2160$, and the current density = $\frac{.46}{.000158} = 2920$.

These values are beyond the limits, so that it will be well to try the next smaller wire, No. 28 (.0126 inch):—

No. of layers	=	$\frac{.5}{.0206}$	= 24.2
No. of turns per layer	=	$\frac{2.5}{.0206}$	= 121
Total turns	=	$24 \times 120 \times 2$	= 5760
Length of wire	=	1×5760	= 5760

$$\begin{aligned}
 \text{Resistance of wire} &= \frac{5760 \times 64.9}{1000} = 374 \\
 \text{Maximum current} &= \frac{110}{374} = .294 \\
 \text{Current density} &= \frac{.294}{.0001255} = 2340 \\
 \text{Maximum ampere turns} &= .294 \times 5760 = 1690
 \end{aligned}$$

On the basis of 1170 ampere turns, the density would be $\frac{2340 \times 1170}{1690} = 1620$ amperes per square inch. Accordingly, under normal conditions this winding would seem to be about right. The reduction of the current from maximum to normal is effected by means of a rheostat inserted in the field circuit. By means of such a rheostat, the voltage may be adjusted to allow for slight deviations in speed and other features from the assumed values.

The matter of brushes is another electrical feature. Data used for these are an allowance of from 25 to 40 ampères per square inch for carbon brushes and 150 to 200 amperes per square inch for copper brushes. For ordinary service, with direction of rotation unchanged and load conditions fairly constant, copper brushes will give good results. Otherwise it may be best to use carbon brushes.

It is believed that in the above the principal features of electrical design have been covered, so that all that is necessary to make the design complete is to take care of the strictly mechanical features. While the importance of good mechanical design and construction are duly recognized, it is the electrical features that we have taken care of in the present case, that come first of all.

ENAMELED WIRE

H. M. NICHOLS

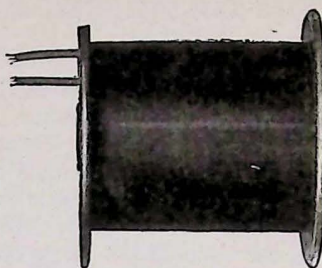
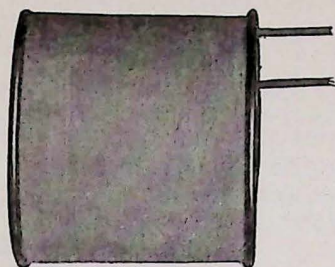
THERE has lately come into quite extensive use a new kind of magnet wire, known as enamel-covered wire. This wire is not covered with enamel, as one might suppose from its name, but with cellulose acetate, a substance which closely resembles enamel in its appearance. It differs from enamel, in that it is much more flexible and tougher, and that it will not stand nearly as high a temperature, it being charred by the flame of a match.

Numerous other substances have been tried to take the place of the cotton covering on magnet wire. Among these are collodion, albumen, glue, rubber, enamel, silk solutions, and casein. None of these substances has proved satisfactory, as they have all had some grave defect, such as brittleness, lack of mechanical strength, poor dielectric strength, etc. Out of all these substances cellulose acetate is the only one that has given satisfaction when put to the test of actual use.

The principal advantage of enameled wire over cotton-covered wire lies in the saving in weight and space. Since the covering on enameled wire is much thinner than it is on cotton-covered wire, a certain number of turns of enameled wire will go in a smaller space than will the same number of turns of cotton-covered wire. This gain is greater with the smaller sizes of wire, as the ratio

of thickness of insulation to the diameter of wire increases with the decrease in size of the wire. The accompanying illustration shows two magnet spools, one wound with 8400 turns of No. 28 B. & S. single cotton-covered magnet wire, and the other wound with 8400 turns of enameled wire. The diameter of the bare wire is .012 + inch. The thickness of the wire with cotton insulation is .0166 inch, while the thickness of that with cellulose acetate covering is only .0140 inch. The dielectric strength of the cellulose acetate covering is about twice that of the cotton covering.

There is one disadvantage that arises from the use of enameled wire, and that is that the insulation is so very thin that any little burr or sliver of metal on the wire will penetrate the covering and may short-circuit several turns. With properly manufactured wire, however, this difficulty is almost entirely removed. Another peculiarity of enameled wire, that the user of it must take account of, is the rigidity of the insulation. There is no give to the insulation, and consequently, to allow for expansion when heated, it is necessary to wind a spool of enameled wire much more loosely than is customary with cotton-covered wire. The insertion of several layers of paper in the spool will help take up this expansion and not add much to the diameter of the spool.



The flexibility of good enameled wire is high, and it will stand bending around a mandrel of five or six times its own diameter, without injury to the insulation. The wire will also stand a temperature of 100°C . without injury to the insulation. The insulation is softened by alcohol, turpentine, animal and vegetable oils, and coal tar solvents. It does not seem to be affected by pure mineral oils, such as are used in transformers, oil switches, etc. Coils wound with enamel wire do not require baking, as the coating is not affected by moisture.

The manufacture of enameled wire requires considerable engineering skill. The wire must be very carefully drawn, so that it will be true and free from burrs. The wire after being cleaned is passed through the enameling machine. This machine serves to guide the wire through the various tanks, dies, etc. The wire is first passed through a tank filled with cellulose acetate, dissolved in a coal-tar solvent. It then passes into a heated chamber, where the solvent is driven off. The wire also passes through a die, which scrapes off any surplus coating. This process is repeated a number of times, and the final result is a covering consisting of several very thin layers of cellulose acetate.

Enameled wire is used largely in the manufacture of meters, instruments, telephones, and similar lines of work where compactness and lightness are of prime importance. The wire also possesses a number of qualities which make it valuable for use in the field spools of dynamos and motors. The principal ones are that it can be run at a high temperature and that it is not affected by moisture, a very desirable quality where motors are to be used in mines and other damp places.

The illustrations loaned by the General Electric Company show two spools of the same size, each containing 8400 turns of No. 28 B. & S. copper wire. The thicker winding of single cotton-covered wire is

15-16ths inch deep and weighs 2.8 pounds. The winding of enameled wire is 9-16ths inch deep and weighs only 2.2 pounds, a saving of twenty-one per cent in weight of wire. The following table gives a comparison of diameters for several sizes of wire:—

Size B. & S.	Single Cotton Covered	Single Silk Covered	Enameled
24	.0241	.023	.022
25	.022	.021	.020
26	.020	.019	.0175
28	.0166	.0156	.0140
30	.014	.0126	.0113
32	.012	.0105	.0092
34	.0103	.0086	.0073
36	.0085	.0070	.0062
38	—	.0060	.0052
40	—	.0050	.0042

REAGENT bottles holding caustic alkalies, alkaline carbonates, etc., very frequently become fixed, and the usual method has been to tap the stopper with a wooden block, or the application of heat to the neck, or a combination of both. Results are poor in certain cases and often result in the fracture of the neck. The inverse process may be used to advantage. In other words, freeze the stopper, thus causing a contraction of the stopper from the neck. The bottles which I used for experiment had failed to open, under the heating and tapping, and were bad cases of fixed stoppers. The bottles held sodium carbonate that had formed sodium silicate, an excellent cement, and so were firmly fixed. They were inverted in a mixture of crushed ice and calcium chloride, taking care that the freezing solution did not touch the lips of the bottles. After standing twenty minutes, each stopper was removed without the slightest exertion. This is the neatest and safest way to remove stoppers from bromine bottles and other corrosive chemicals. — *Scientific American*.

THE CONSTRUCTION OF AN ELECTROLYTIC DETECTOR

S. FULTON KERR

As I have not seen any articles on the construction of an electrolytic detector in this magazine for some time, I will endeavor to describe the making of one which, if properly constructed, will give the maker the satisfaction of knowing that he has a detector as sensitive as those used in the large commercial installations.

Some experimenters claim that the silicon is the most sensitive detector, but having experimented with almost every type, I can say from experience, that in my estimation, the electrolytic is the most sensitive of them all. Moreover, it has the advantage of being easily adjusted.

From a piece of brass $\frac{1}{2}$ inch wide and $\frac{1}{16}$ inch thick, make two pieces, as shown in Fig. 4, and drill with a No. 8-32 clearance drill, according to dimensions. These are the two pieces shown in Fig. 1 as "E," and are designed to hold the carbon cup in place, and also to make electrical contact with same.

For the standard "A" get a piece of brass strip $4\frac{1}{2}$ inches long, $\frac{3}{4}$ inch wide, and $\frac{1}{8}$ inch thick, and bend into shape, as per Fig. 5. Drill a hole for a No. 8-32 screw, $\frac{1}{8}$ inch from each end. The screws are to fasten the standard to the base.

From another piece of brass cut two pieces

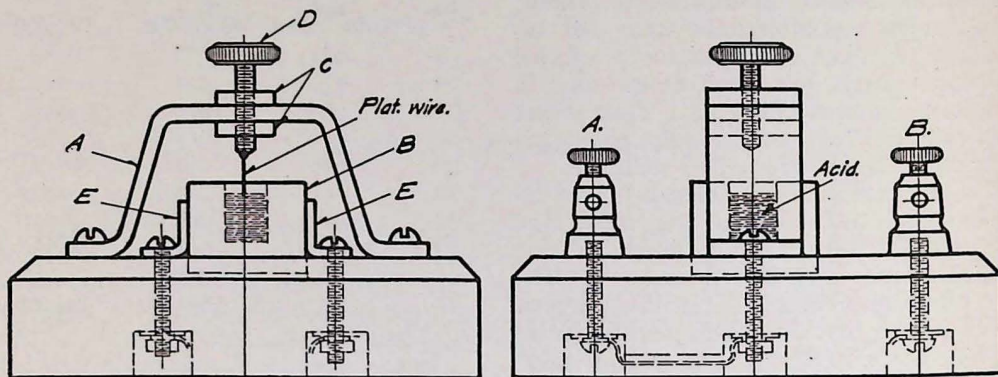


FIG. 1.

Figure 1 shows a general view of the detector when completed, and for the sake of clearness, the binding-posts are omitted from one of the views.

Procure a piece of hard wood $4 \times 4 \times 1$ inches thick, and drill 6 holes large enough to accommodate No. 8-32 screws. Counterbore these holes $\frac{3}{8}$ inch deep on the under side of the base, so as to allow for the screw heads and washers. Cut grooves for the connections about $\frac{1}{8}$ inch deep, so that the detector, when completed, will set flat on the table. Figure 2 illustrates the base very clearly.

In making this detector, the dimensions should be followed as closely as possible, in order that the parts, when completed, will fit together without any trouble.

From a carbon brush of a dynamo or motor saw a piece out $1 \times 1 \times \frac{3}{4}$ inch deep. Drill a $\frac{3}{8}$ -inch hole $\frac{1}{2}$ inch deep, as shown in Fig. 3. If graphite carbon can be obtained, it should be used. This is the cup "B" into which the small platinum wire is dipped.

$\frac{3}{4}$ inch long, $\frac{1}{2}$ inch wide, and $\frac{1}{8}$ inch thick, as shown in Fig. 6. These are to be soldered on the standard "A," one on each side, as shown in dotted lines at "C" in Fig. 5. A hole should then be drilled through the center with a No. 29 drill and tapped with a No. 8-32 tap. This makes a sort of bushing, so that when the thumb-screw "D" is screwed into it, it will have plenty of thread to turn in, and thus will not be wobbly or shaky, as it might have been had the two pieces "C" been left off.

The different parts being now constructed, we will proceed with the assembling.

The first thing to do is to screw the binding-posts on the base, then place the carbon cup in the 1 inch square hole cut in the base. Screw the two pieces "E" on each side of the carbon cup with No. 8-32 screws, shown in Fig. 1. A better idea would be to screw these two pieces on first, and then slip the carbon cup in between them. The two brass clips should have enough spring to hold the cup firmly in place, and also to make

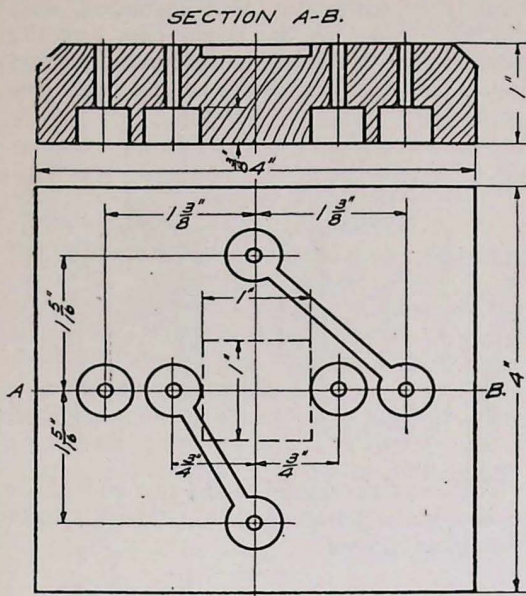


FIG. 2.

good electrical contact with it. It is also a good idea to copperplate the outside of the cup, and this should be done before the hole is drilled in it, so that the copper cannot get into it. The cup should then be connected with the binding-post "B," by fastening a wire to a screw that holds one of the clips with the binding-post.

Next fasten on the standard with two No. 8-32 screws, and connect one of these screws with the binding-post "A."

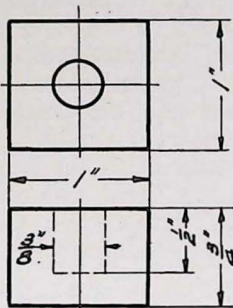


FIG. 3.

Now get a thumb-screw from a large binding-post, and as the hole in the standard is tapped with a No. 8-32 tap, the thumb-screw will necessarily have to have the same thread. A thumb-screw with a No. 8-32 thread will do for general use, but for long distance work, say for distances over 250 miles, where the adjustment must be very fine, a thumb-screw with a fine micrometric

thread should be used, as this will allow the thumb-screw to be raised or lowered the smallest fraction of an inch. A screw like this can likely be obtained at a wholesale jewelry supply concern, and the standard can also be tapped there with the correct thread. Buy a piece of platinum wire about $\frac{3}{4}$ inch long, and with a very small diameter, from .0005 inch to .0001 inch or smaller, if obtainable, and have a jeweler fuse this on the end of the thumb-screw. This wire

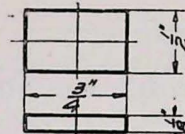


FIG. 6.

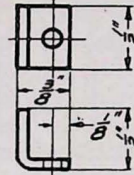


FIG. 4.

comes heavily silver plated, so that it can be handled easily. When the wire is immersed in the acid, the silver is soon eaten away, leaving the minute platinum wire exposed.

The parts being now assembled, make up a mixture of one part nitric acid and four parts water. Then with a pen dropper fill the carbon cup nearly full, and the detector is ready for use. Never leave the acid in the cup over night, as it would spoil. Draw it off with the pen dropper, and keep in a stoppered bottle, and it may then be used over and over.

Figure 7 shows an excellent system of wiring for a complete receiving station, A

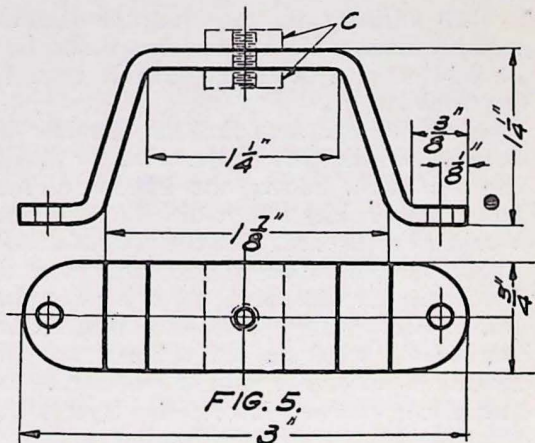
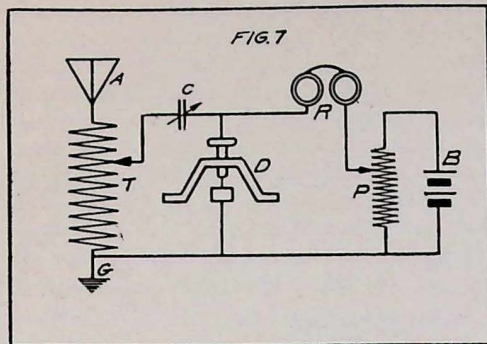


FIG. 5.



being the aerials, T, the tuning coil, C, adjustable condenser, D, the detector, R, high resistance telephone receivers, P, potentiometer, and B, the battery. In connecting up the instruments the platinum wire must be connected to the *positive* terminal of the battery. This is absolutely necessary, as the detector will not work any other way.

The battery should consist of not more than three dry cells at the most, but I prefer only two with a potentiometer of about 400 ohms bridged around them, as I find this gives the best results.

For short distance work 75-ohm telephone receivers will answer, but it is really surprising how much clearer the signals come in and how much farther the receiving radius is increased when 1000-ohm receivers are used, and for long distance work the high resistance telephones should be used if the experimenter wishes to get any satisfactory results at all.

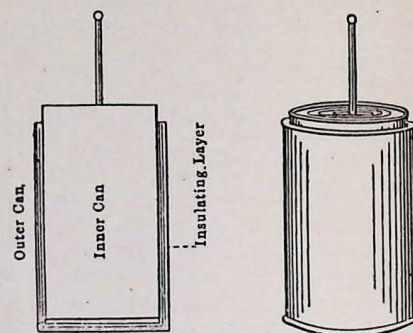
I will not attempt to describe the adjustment of the detector, as that has been fully covered by several excellent articles in this magazine lately.

AN UNBREAKABLE LEYDEN JAR

Two ordinary tin cans may be used to make a serviceable Leyden jar, which has the advantage of being unbreakable, according to Kosmos.

Select two tins such that the diameter of the one exceeds that of the other by about one half inch. Cover the bottom of the larger tin (inside) with a disk of rubber or varnished cardboard. To the bottom of the smaller tin (on the outside) solder a piece of iron or copper wire, bent into a hook at the tip, or else ending in a ball. Around the smaller tin wind an old rubber plate or several layers of silk rags or well-varnished parchment, folding this insulating layer down into the tin over the edge, an inch or more.

Place the smaller tin, thus insulated, with the edge down, in the larger can, and the Leyden jar is completed, ready to be charged from a frictional machine or an electrophorus.



The inner tin should stand out an inch or so above the outer can, to prevent sparks from passing over.

THE production of a brown color on metals is not a difficult operation, but many platers are unfamiliar with the method of accomplishing it. Many wares thus finished are now found on the market. The methods given in some of the text-books for producing a brown color, and in which the so-called "smear" operations are employed, are not satisfactory, as they are too slow.

The method of producing a brown color on metals is by the use of liver of sulphur on a bronze deposit. On copper or silver, liver of sulphur gives a black or chocolate color, but on bronze a brown color is produced.

The work to be treated must first be bronze plated. The regular bronze solution containing copper and zinc may be used, or that made of copper or tin. The effect of the liver of sulphur is the same. When a good deposit has been produced, the article is rinsed and immersed in a solution of liver of sulphur made as follows:—

Water.....	1 gallon
Liver of sulphur.....	2 oz.

This solution is used cold and the work immersed in it. When the desired color has been obtained, the article is rinsed, and then scratch-brushed. In this manner the high lights may be relieved and shaded down to a brown in the background. The whole "secret," then, of producing a brown color, is in the use of bronze instead of copper for oxidizing with liver of sulphur. — *The Brass World*.

A BROOCH IN SILVER WIRE

THE brooch illustrated at Fig. 1 is a good example of a combination of rings and beads, etc., soldered together. The work of preparing the different parts will be found very easy by those who have made the tie-pin described in our last chapter.

The length should be about $1\frac{1}{2}$ or 2 inches, with a width of from $\frac{5}{8}$ to $\frac{3}{4}$ inch, and the wire from 1-32d to 11-6th inch in diameter. It will be necessary to draw the design with ruler and compasses on a piece of paper to actual size, and then bend each piece of wire to fit the drawing. The illustrations show a $2\frac{1}{2}$ -inch brooch, but those who desire to make one only $1\frac{1}{2}$ or 2 inches long will have no difficulty in reducing the design.

Commence by making the two large curves, taking care not to indent the surface of the wire with the pliers; the joint should be soldered and the work cleaned up.

The piece should now be laid in position on the drawing, and then the square piece carefully fitted, allowing a trifle top and

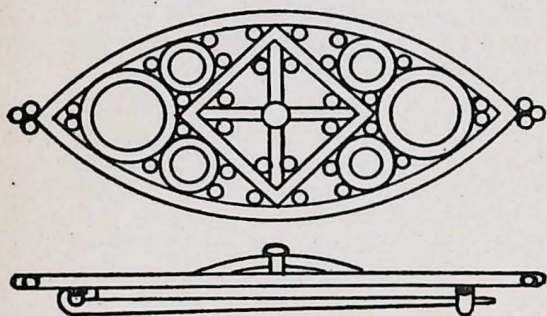


FIG. 1. BROOCH IN SILVER WIRE.
(Drawn to an enlarged scale.)

bottom for filing off to insure a hold for the solder. Solder up the join, and then prepare the raised centerpieces shown in detail without the bead at Fig. 2, and in side elevation with the bead at Fig. 1. These pieces should be carefully bent to shape and fitted tightly into the corners, and filed to a miter at the top. To prevent them moving during soldering, they should be carefully tied up with fine binding wire, after being painted with borax solution. The soldering should be carefully done to insure a perfect joint; and then the top may be filed smooth, a large bead made, filed flat underneath, and then soldered over the miter.

The centerpiece may now be fitted with the small beads as shown, and placed in position and soldered up.

We have now to construct the rings, the two large ones being made first. It will be advisable to form them a little larger than necessary in order that they may be fitted very tightly. When they have been soldered up, fit in the four smaller rings, place the beads in position, and solder up. The work should now be placed in pickle, cleaned up, and any projecting pieces of solder filed off.

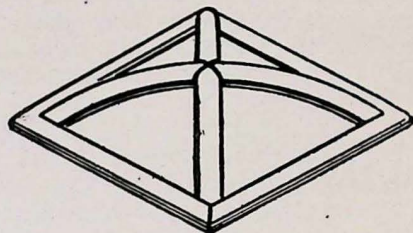


FIG. 2. DETAIL OF CENTRE, WITHOUT BEADS.
(Perspective view.)

The pin should now be fitted, the parts being shown in detail at Fig. 3—*a* the pin, *b* the hinge, and *c* the catch. The wire, as it is, will not be stiff enough to use as a pin, and to harden it a length should be planished up. For this work a small hammer and a flatiron for a stake will be the only tools required. Hit the wire, carefully turning it round and round, until it is quite stiff, and then bend the end over to form a loop, as shown at *a*, the projecting end being left a little longer in order to give a spring to the pin.

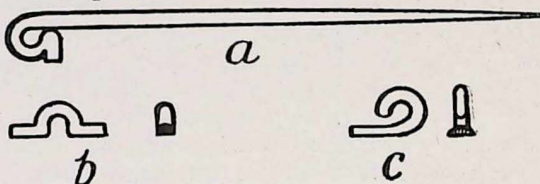


FIG. 3. DETAILS OF PIN.

The hinge should be carefully bent and the feet flattened out on the iron, so that they may be soldered tightly to the back. The catch should be bent as shown at *c*, and then laid on the iron, so that the foot may be flattened and the loop beaten the other way, to render it quite stiff, as shown in the side view at *c*.

In soldering on the hinge, so place it that when the pin is inserted the projecting end will butt against a part of the back. The end of the pin should be filed to a point, and cleaned up smooth with emery cloth and a burnisher.

A MODEL STEAM TURBINE

CHARLES BUYS

THE popularity of the steam turbine among engineers is growing day by day. They realize that for some classes of work it has no superior as a prime mover.

We will consider a model turbine powerful enough to operate a 10-20-watt dynamo or machine requiring like power.

In designing this turbine, two main points were borne in mind, — to keep down the number of castings and to allow all machine work to be done on a 5-inch hand-turning lathe.

Make the patterns of pine, $\frac{1}{8}$ inch thick. Cigar boxwood can be used. Make sure that the wood is perfectly dry and as free from knots and checks as possible. But two patterns are needed, — one (Figs. 1 and 2) the stator plates, A; and the rotor (Figs. 3 and 8), B.

Having received the castings from the foundry, make the rotor first. Take a round steel bar, 5-16ths inches in diameter and $2\frac{1}{2}$ inches long; center it in the lathe, and turn down to $\frac{1}{4}$ inch in diameter all over.

Drill a $\frac{1}{4}$ -inch hole in the rotor casting and mount it on the shaft setting, so that projection is $\frac{1}{2}$ inch from one end of shaft. Then turn shaft to dimensions given (Fig. 6). Lay off on the circumference of the rotor twenty-eight divisions equally spaced. Cut with a hack-saw slots $\frac{1}{4}$ inch deep on lines, radiating from the center at each of these divisions. Clean up with a fine file or emery all burred edges which may have been made by the sawing. Next take a strip of No. 24 gauge brass, 9-16ths inch wide and 28 inches long, and saw it up into $\frac{1}{2}$ -inch lengths. Lay these pieces on the wooden block A (Fig. 5), and curve them by striking the bar with a mallet. Solder a bucket in each of the saw cuts, and be careful to use only as much solder as is absolutely needed to hold the bucket in place. Mount the rotor in the lathe, and take a very light cut on the tops of the blades. Cut a brass strip $\frac{1}{2}$ inch wide, 24 gauge, and 12 inches long, and solder it on to the tops of the blades. Do not lap the joint, but carefully butt it, and solder the ends together.

Balance the rotor, and if it does not turn evenly, bore holes in the brass retaining strip until it rotates evenly and will stand still in any position.

Turn your attention now to the casings

or stator. Bolt them to the face plate and turn one like A, Fig. 1, and then take the other and proceed as follows: Bore into each nozzle projection to the depth of $\frac{1}{2}$ inch with a $\frac{1}{8}$ -inch drill. This may be done as shown in Fig. 7. Then drill way through with a 1-16th-inch bit, and ream out with a taper reamer from the back side. Bore the four holes for the $\frac{1}{8}$ -inch retaining bolts, and on the other casing take a cut 1-16th inch wide, 1-32d inch deep, and 2 inches from center on the inside.

Next take a strip of 24 gauge brass, $1\frac{1}{2}$ inches wide and $12\frac{1}{2}$ inches long, and set it into the cut on the casing; butt the joint where the two ends come together, and solder the joint; then solder this ring on to the casing which contains the nozzles. Bore a $\frac{1}{2}$ -inch hole in the other casing, and solder a brass tube in it for the exhaust. Bore 3-16ths-inch holes in the centers of the casings and oil holes at the bearings.

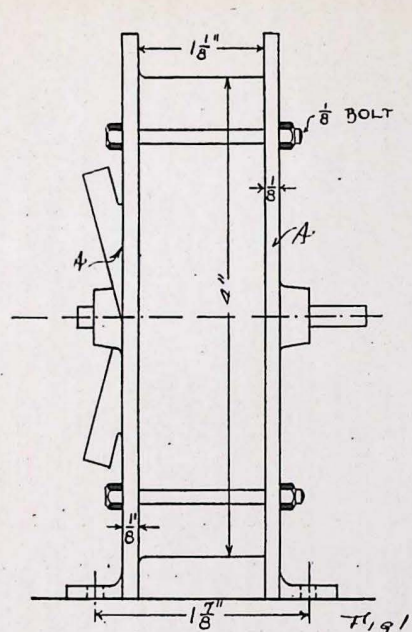
Next assemble the component parts, and it may be well to pack the joint J (Fig. 3) with cardboard or paper.

Run a $\frac{1}{4}$ -inch inside diameter brass supply pipe from your boiler to within a few inches of your turbine; then make a Y, and run a branch to each nozzle, and slip the branch on to nozzle projections, and solder. Gearing may be applied to the shaft, or you may connect it direct to the armature shaft of your dynamo.

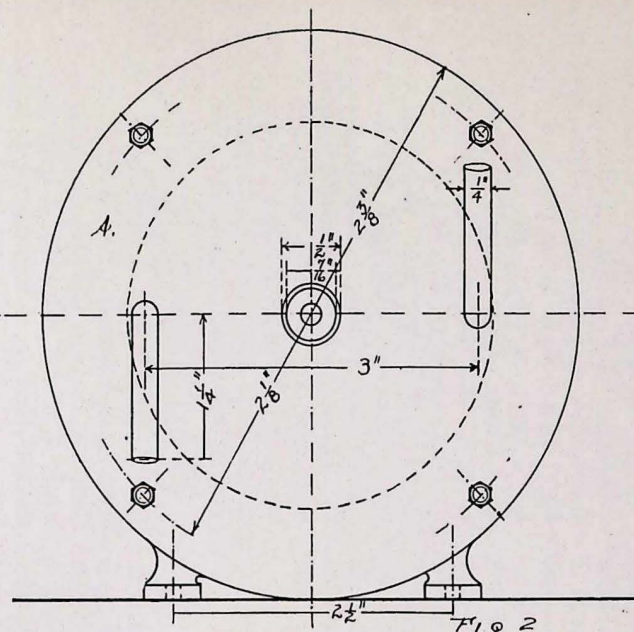
With 40 pounds steam pressure, this little turbine will run sweetly and smoothly and with considerable speed. Make everything but the shaft of brass or copper.

Largest Induction Motor

THE largest induction motor in the world was started recently at Gary, Ind., where it is installed in a large rolling mill. The motor is rated to develop 6000 h. p. It is of the three-phase 25-cycle type, and two 2000-kilowatt Curtis turbines generate the current necessary to operate it. The motor receives the current at 6600 volts. By using a step-by-step controller, starting at 1350 volts, the motor was successfully started in the proper direction, coming to full speed in 45 seconds.



END ELEVATION



SIDE ELEVATION

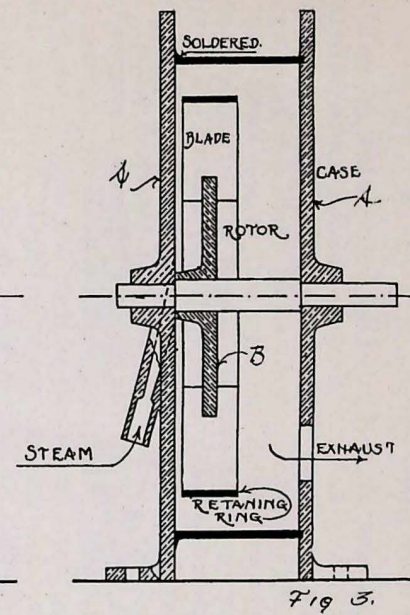
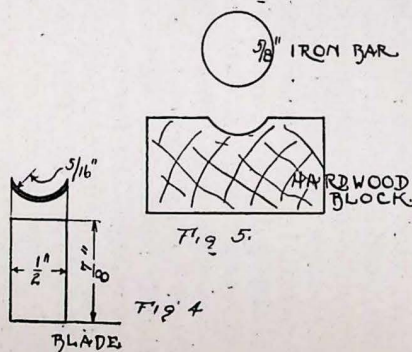


Fig. 3.

SECTION



BLADE

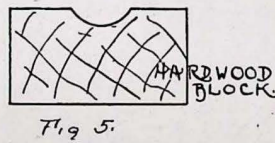


Fig. 5.

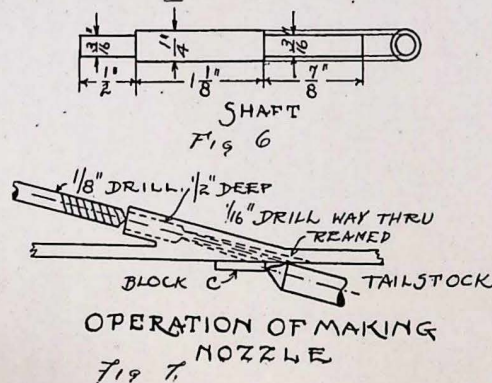


Fig. 6

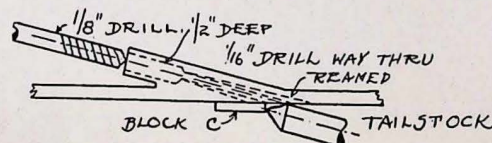
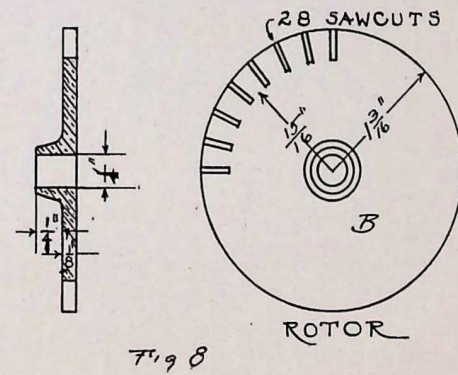
OPERATION OF MAKING
Fig. 7. NOZZLE

Fig. 8

ROTOR

FORGING FOR AMATEURS—Part IV

F. W. PUTNAM, B. S.

IN the previous exercise I explained in some detail the drawing out of a piece of metal, either by pounding or otherwise. It is frequently quite difficult to square up work readily, since the bar is apt to be forged into a diamond shape, or else one corner will project out too much. A section cut through a bar which has been drawn out in this way would appear in cross section similar to the sketches shown in Fig. 44. A bar which has been hammered into this shape can be remedied by laying the bar across the anvil and striking upon the projecting corner with the hammer, as is shown in Fig. 45, the idea being to strike a blow in such a way as to cause the extra metal to be forced back into the body of the bar, and so gradually squaring it off. The arrow indicates that the hammer, as it strikes the metal, should be given a sort of sliding motion, so as to draw the metal over in the direction desired. It is useless to attempt to square up a corner of this kind by simply striking straight down upon the work. All the hammering must be done with the idea—force the metal back into the bar and away from the projecting corner.

EXERCISE 3. A HASP

Figure 46 shows a hasp made from 3-16th-inch Norway iron. First, form the end to be slotted, and punch two $\frac{1}{4}$ inch holes $\frac{3}{4}$ inch between centers. This brings in an exercise on punching. There are two kinds of punches used for making holes in hot metal. First, a punch made from any heavy stock and provided with a handle used with a sledge hammer; and second, a straight hand punch used with a hand hammer. These punches are made of tool steel. The hand punch is usually used for punching small holes in light iron, and is simply a bar of round, or octagonal, steel, about 10 inches long, having one end forged down tapering, the extreme end being of the same shape, but slightly smaller than the hole which is to be punched. The taper should be uniform, and the extreme end should be absolutely straight across. The heavy hammer punch is shown in Fig. 47. The different views of Fig. 48 show very clearly the different steps used in punching a clean hole through a piece of hot iron. It will be

observed that the punch is first driven about halfway through the bar, with the work lying flat on the anvil. This, of course, will compress the metal which is directly underneath the punch and cause a slight bulge on the opposite side of the bar, which allows the hole to be readily located. The piece is then turned over, and the punching completed from this side, the small piece, "A," being then driven completely through. This will leave a clean hole. If the punching had been done all from one side, a considerable burr or projection would have been raised on the side where the punch came through. "D" and "E" of Fig. 48 illustrate clearly the results of proper and improper punching. If a hole is to be punched through a thick piece of stock, the punch is apt to stick before the hole has been punched deep enough. To prevent this, start the punch and then remove it. Put in a little powdered coal in the hole and then continue the punching. The coal will prevent the punch from sticking. Having punched the two holes required in the slotted end of our hasp, use a cold chisel for cutting out the iron connecting these holes. Work the cold chisel from both sides in exactly the same way as the punch was used. You will remember that the cold chisel was described in the first article. In using the cold chisel, be careful to cut tangent to both holes. It frequently happens in finishing up this slot that the outer edges of the hasp are not straight, and if the hasp is laid on its edge on the anvil and hammered to straighten out these edges, the slot will become partially filled up. To avoid this, a piece of iron, a little under $\frac{1}{4}$ inch in thickness and tapering from $\frac{1}{2}$ inch at one end to about 1 inch at the other end and 10 inches long, can be driven into the slot, thus filling up the hole, and then by hammering on the edges of the hasp, it can be easily trued up. This wedge just referred to will be found invaluable for any such work. To finish the hasp, punch the hole as indicated in the drawing, the center being $\frac{1}{2}$ inch from this end of the hasp. The corners at this end should be cut off on the hardie and then worked to a semicircle, keeping the punch in the hole. The other end is then to be rounded slightly and tipped up a trifle. Usually hasps are made of common iron,

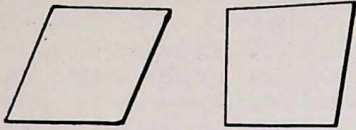


Fig. 44.

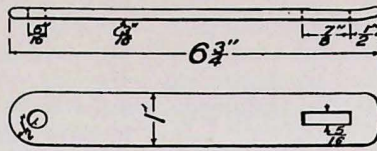


Fig. 46.

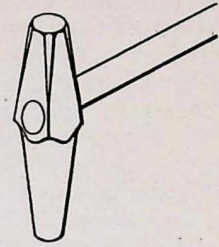


Fig. 47.

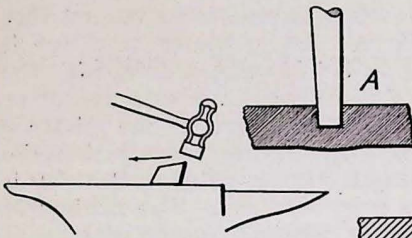


Fig. 45.

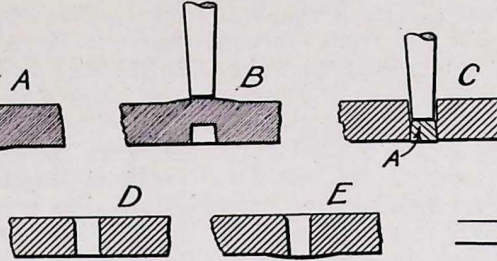


Fig. 48.

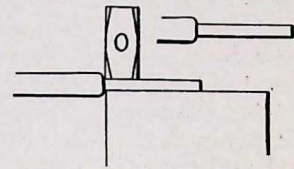


Fig. 52.

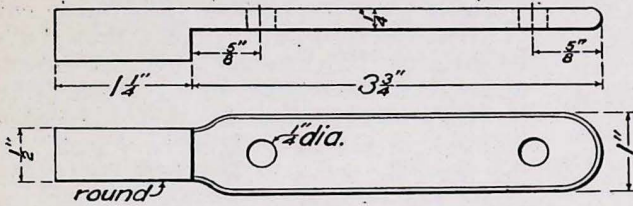


Fig. 49.

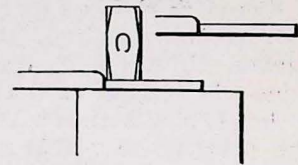


Fig. 53.

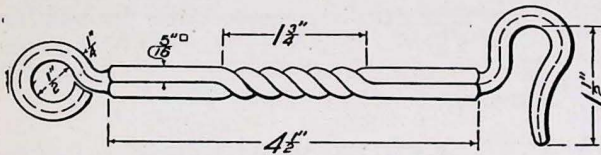


Fig. 50.

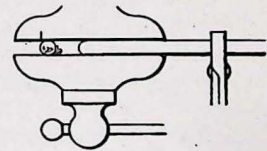


Fig. 54.

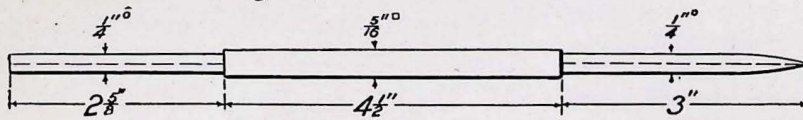


Fig. 51.

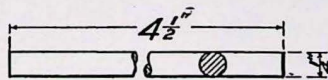


Fig. 55.

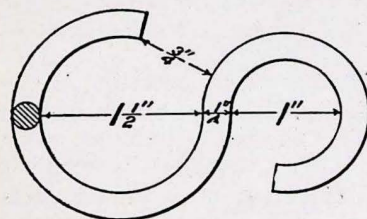


Fig. 56.

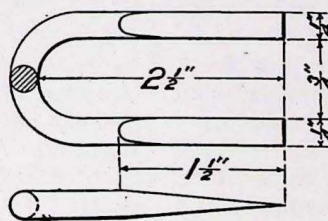


Fig. 57.



Fig. 58.

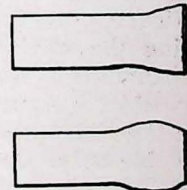


Fig. 59.

but for the beginner much better results will be obtained by the use of Norway iron, since it can be worked at a lower heat without splitting, and be reheated several times, if necessary, without any damage to the iron.

EXERCISE 4

Figure 49 shows another exercise in drawing out and punching. For this, use a bar of $\frac{1}{2}$ -inch round, common iron. First, heat the stock for about 3 inches from the end to a white heat, and shoulder in at this point, and draw out $\frac{1}{2} \times 1$ inch. Do not attempt to flatten the stock out at much under a white heat, as the end of the stock is very liable to crack. Next punch the hole farthest from the end, first holding the shouldered point down, that it may lay flat when driving the punch through the pritchel hole. Next, punch the hole next the end round the end and cut off. Cut off the stock so that it will be of the required length, as indicated in Fig. 49.

EXERCISE 5. A GATE HOOK

Figure 50 shows a gate hook to be made out of Norway iron, stock 5-16ths inch square. It will first be necessary to determine what length of stock will be required to bend up the ends after it is forged into the proper size. This can be done very easily, by laying out the work full size, and then laying a string upon the lines to be measured. The hook will require about 3 inches length of stock and the eye about 2 $\frac{3}{4}$ inches. It will be noticed that the hook and eye are to be forged round. Figure 51 shows a layout of the bar with the two ends rounded, one to form a hook and the other the eye.

Figure 52 shows the correct way of shouldering the stock, so as to get it centered. Place the piece on the anvil in such a position that the point where the shoulder is to be will come exactly on the nearest edge of the anvil. Next place the set hammer on top of the piece, as shown in Fig. 52, in such a way that its edge will come directly in line with the edge of the anvil.

Figure 53 shows the wrong way of shouldering the stock. It will be noticed that the shoulder is carried over on to the anvil instead of keeping it exactly at the edge, and the result is as shown, — a shoulder on one side only. In working this shoulder, a piece of stock would be turned continually, otherwise the shoulder will work in faster on one side than on the other. Always make

sure that the shoulder is kept exactly even with the edge of the anvil. The shoulders, when formed, are next to be bent one for the eye and the other for the hook. The twist is to be made as follows: —

First make a chalk mark on the jaws of the vise, so that the edge of the vise will be where one end of the twist is to come. When the end of the hook is even with the mark on the vise, heat the part to be twisted very carefully to an even yellow heat. Place it in the vise as quickly as possible, with the end even with the mark. Grasp the other end with the tongs, leaving the distance between the tongs and the vise equal to the required length of the twist, and twist it around one complete turn. The method of holding stock in the vise and the position of the tongs is shown in Fig. 54.

EXERCISE 6. A STAPLE

Figure 55 shows a staple to be made out of $\frac{1}{4}$ -inch round Norway iron. Draw both ends to the straight-edged taper, as shown, and bend in the middle, taking care to bring the ends even. When bending, the inside diameter of the staple is to be $\frac{3}{4}$ inch. If the curve is not a perfect half circle, the staple can be opened up by placing it on the horn of the anvil and striking a light blow with the hammer, drawing the blow in the proper direction, to cause the opening of the anvil. The curve can be best gotten by drawing it over the horn of the anvil, striking very light blows.

EXERCISE 7. A PAINT HOOK

Figure 56 shows a paint hook much used by painters for holding a paint pail to the round of a ladder. For this, use $\frac{1}{4}$ -inch round Norway iron, and take the necessary measurements for length from the directions already given for figuring out the required length for circles; the larger circles should be bent first and then the smaller circle. This iron is so light that heavy blows should be avoided, otherwise the stock will be flattened out.

UPSETTING

The operation known as upsetting is frequently used in welding two pieces of iron together. A piece is said to be upset when it is worked in such a way that its length is shortened and either or both its thickness and width increased. There are several ways of upsetting, the method naturally depending largely on the shape the work is in.

When short pieces are to be upset, the stock is usually stood on end on the anvil, and blows struck directly on the upper end. The work must always be kept straight. After a few blows have been struck, the iron usually starts to bend, and requires re-straightening before further upsetting can be done. If only one portion of a piece is to be upset, then the heat must be confined to that part, since the part of the work which is hottest will be upset the most. Figure 57 shows a common result of upsetting a short piece for its entire length. This may be due to two causes,—either the blows of the hammer were not heavy enough, or the ends were hotter than the center of the stock. In order to bring a piece of this kind to uniform size throughout, it should be heated to a much higher heat in the center, and upset with heavy blows. If the work is very short, it is not always easily possible to confine the heat to the middle part. In such case, the bar may be heated all over and then the ends cooled, one at a time, in water. If light blows are used, the effect of them fails to reach the middle of the work, and consequently the upsetting is then only on the ends.

Figure 58 shows the result of heavy blows combined with good heating. It will be noticed that the work is upset more in the middle and less on the ends. A piece of this kind may be brought to uniform size throughout by first heating one end and upsetting it, and then treating the other in the same way, in every case confining the heat as much as possible to the ends. A long bar may be upset by laying it across the face of the anvil, the heated end extending 2 or 3 inches over the edge, the upsetting being accomplished by striking against this end with the hammer or sledge. If the work is heavy, the weight should offer enough resistance to the blows to prevent the piece from sliding back too far at each blow. With lighter pieces, however, it is usually necessary to hold a sledge against the unheated end so as to prevent the bar from sliding too much. Heavy pieces are frequently upset by lifting them up and dropping or driving them down on the face of the anvil or against a heavy block of iron resting on the floor.

Figure 59 shows the effect of the blows when the end of a bar is upset. The upper view shows the effect of too light blows, and the lower view shows the bar properly heated and upset with heavy blows.

A New Aluminum Solder

THE demand for aluminum solder has increased in proportion to that of aluminum, and while many aluminum solders have been placed on the market, some of them, in fact nearly all, have failed to fill the requirements demanded for this class of work. The requirements of a good aluminum solder are that it shall actually adhere to the aluminum and produce a good joint, and, at the same time, melt at a sufficiently low temperature to avoid melting the aluminum while it is being used.

Among the aluminum solders that have lately appeared on the market, none seem to have the merit of that discovered by Dr. Otto F. Reinhold, a German chemist. For years Dr. Reinhold has made a study of soldering aluminum and has carried out a large number of experiments on the subject. The result has been the discovery of a solder for aluminum that will not only adhere, but at the same time requires no flux when it is used. So far as known, there have been no aluminum solders placed on the market having this property. On this account, the solder has been given the name of "No-Flux."

To solder aluminum with it, the parts should be well cleaned from grease with benzine, and then scoured with a steel brush, emery cloth, or other suitable material. It is just as necessary to clean the metal as in any other soldering operation. The soldering is preferably done with a blowpipe, although a soldering iron may be used if desired. In soldering any metal, a blowpipe always produces better results than a soldering iron, and should be employed wherever it is possible to use it.

The blowpipe is applied to the aluminum, and then the solder rubbed on. When the solder melts and a few drops have been allowed to fall upon the surface, they are rubbed on the point by a steel brush so that the solder spreads over the surface and produces intimate contact. A bundle of small steel wires may be used for the brush or a piece of flattened steel. It matters not as long as the solder is spread. The scraping, however, is necessary in order to remove the dross which forms. The solder will then flow and form a good joint. In soldering two pieces together, the joint should first be covered with the solder and then placed together and the blowpipe applied to produce the solid joint.

RECENT CONTRIBUTIONS TO ELECTRIC WAVE TELEGRAPHY*

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

Pender Professor of Electrical Engineering in the University of London

THE achievements and possibilities of wireless telegraphy have not yet ceased to interest the public mind. In less than ten years from the practical inception of that form of it conducted by electric waves, it has developed into an implement of immense importance in naval warfare and maneuvers. It has provided a means of communication between ship and shore which has added greatly to the safety of life and property at sea. It has so far altered the conditions of ocean travel that great passenger liners, separated by vast distances on stormy seas, speak to each other through the ether with far-reaching voices, and are never out of touch with land during the whole of their voyage from port to port.

You are doubtless aware that it is now the usual thing for an Atlantic liner, equipped with long-distance receivers, to be in communication with either the Marconi stations at Poldhu in England or Clifden in Ireland, and that at Cape Cod in the United States, throughout the voyage, and at the same time to exchange messages not only with the other shore stations when passing, but with a score or so of sister vessels during the journey.†

On board many of the Cunard liners small daily newspapers are published, containing the latest news of the day sent by wireless telegraphy from both coasts.

Every important navy in the world has now adopted it in some form as an indispensable means of communication. In our own navy, Admiral Sir Henry Jackson, to whom the country is so much indebted in this matter, informs me that every ship above the size of a torpedo boat is or will soon be fitted. Large battle ships carry fairly high-power transmitters for long-distance work. The admiralty are satisfied that this method of signaling is of the greatest utility, and

there is no need to remind you of the evidence of this furnished in the recent Russo-Japanese war. No modern liner or large passenger vessel is now complete without a wireless telegraph equipment, and an elaborately organized system of communication has been created by the Marconi Company in connection with this marine telegraphy.

Concurrently with this practical development of the art, much scientific investigation has been conducted, having for its object the elucidation and measurement of the various physical operations involved, as well as further improvement. There comes a time in the history of every applied science when the ability to measure precisely the effects concerned is a condition of further progress. It is this alone which enables us to test our theories, or hold in leash hasty opinions as to the possibilities of the invention.

In considering, then, during the present hour, some of the recent contributions to this new telegraphy, we may pay a moment's attention to the nature of the things or effects in it which can be measured. An essential element in all electric wave telegraphy is the elevated insulated wire or wires called the antenna, in which high frequency electric currents are set up, and from which the electric waves radiate. Consider a long vertical wire, insulated completely from the earth and charged with electricity. (See Fig. 1.) There must be somewhere on the surface of the earth near by a charge of opposite sign. If the wire is negatively charged, then, on its surface, there is, according to modern views, an excess of negative ions or electrons, and on the ground surface round the wire there is a deficiency, — that is, there is a positive charge. Furthermore, in the interspace around the rod there is a state of strain of some kind distributed along certain curved lines, commonly called lines of electric force. From one point of view, these lines may be regarded simply as a convenient mode of delineating the direction of the strain, having not more material reality than lines of latitude and longitude. There are, however, some reasons for considering that they *do* possess an actual physical existence, and that they are a necessary part of the mechanism of atoms

*Paper read before the Royal Institution of Great Britain at its weekly evening meeting, Friday, May 24, 1907.

†The Cunard liner "Lucania," which arrived March 18, 1907, at Liverpool from New York, reported that she was, when in mid-Atlantic, in communication by wireless telegraphy with Poldhu, in Cornwall, and Cape Cod, in the United States, at the same time. During the voyage she spoke with thirty-two North Atlantic steamers, and with twenty-four of these she had wireless communication.

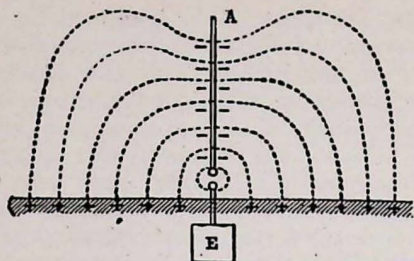


Fig. 1. Lines of Electric Force round an Antenna before Discharge

and electrons.* They have a strong resemblance in many ways to the vortices or vortex lines, which can be created in a fluid. Moreover, just as vortex lines in a fluid can be self-closed or endless, or else terminate in little whirlpools on the free surface of the liquid, so lines of electric force can form either closed loops, or else have their ends terminating on opposite charges of electricity; that is, on an electron at one end, and the positive charge of an atom, whatever that may be, at the other end. Suppose, then, that the rod is suddenly connected to the earth at the bottom end by allowing it to spark to the earth. Its electric charge rushes out; that is, the excess or deficit of electrons on its surface disappears, and this movement of electricity constitutes an electric current flowing into or out of the rod from the earth. The electrons, however, possess inertia or mass; hence, when they rush out of the rod into the earth, they not only discharge it, but overdo it, and leave the rod with a positive charge. They then rush back again, and the process repeats itself, and we thus obtain a rapid ebb and flow of electricity into and out of the wire, called a series of electric oscillations. Each rush, however, is feebler than the last, and therefore the oscillations decay away or, as it is termed, are damped. The energy represented by the initial charge is frittered away, partly owing to collisions of the electrons and atoms in the rod and spark dur-

ing the movement, and partly because the electron radiates or communicates its kinetic energy to the medium when it is accelerated or retarded.

We have next to attend to the effects taking place outside the rod or antenna. As the negative charge disappears from the rod, owing to the removal of the excess of free electrons from its surface, the ends of the lines of electric force which abut on it and stretch between it and the earth glide downwards along the rod, and end by forming a semi-loop of electric force or strain, with its ends or feet resting on the earth. (See Fig. 2.) This arises from the facts

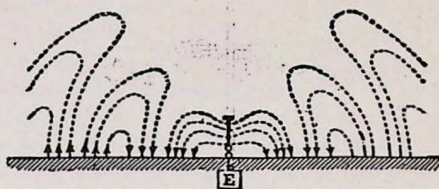


Fig. 2. Diagrammatic Representation of the Detachment of Semi-loops of Electric Strain from a Simple Marconi Antenna

that the lines of force exercise a lateral pressure on each other, whilst lengthway they are in a state of tension, and also that lines of electric strain cannot exist inside a conductor such as a spark. Hence, when the spark happens, the lines which a moment ago stretched across the spark-gap disappear. There is then an unbalanced pressure on the remaining lines, which are thus squeezed in toward the gap and deformed, so that they finally extend, not from rod to earth, but from two adjacent places on the earth, and form a semi-loop.

But, as above explained, the rod does not simply become discharged. Owing to the inertia of the electrons when they rush out, they more than discharge the rod; they overdo it and leave it positively charged. This, then, implies that a fresh system of lines of electric force grows up between the earth and the rod, and the first formed set of semi-loops is pushed outward. Then the process is repeated as the oscillations of the electrons in and out of the rod die away and in the space around we have a system of semi-loops of electric force being pushed outward in every direction, as shown in the diagram in Fig. 2.*

*Cf. Faraday. "Experimental Researches in Electricity," Vol. III, Series XXIX, 3273, 3297, and 3299. On "Physical Lines of Magnetic Force." Faraday used the expression physical line of force to denote their concrete reality as distinguished from a mere geometrical conception. Also in his paper, "Thoughts on Ray Vibrations," *Phil. Mag.*, Vol. XXVIII, Series 3, 1846, he considers that light may be a vibration propagated along lines of force. See also J. J. Thomson, "Electricity and Matter," p. 53, for an argument for the physical reality of lines of electric force drawn from the ionization of gases by Röntgen rays.

*In referring to lines or semi-loops of electric force as moving through space, we do not necessarily mean to imply that each line is ear-marked so that it preserves an individual identity. All that

There is, however, another factor involved in the process. The movement of the electrons into and out of the rod constitutes an alternating electric current, and this is accompanied by the production of an alternating magnetic field, the direction of which is represented by a system of concentric circles, with their centers on the antenna. (See Fig. 3.) When the current in the rod is reversed in direction, the field is not reversed at all parts of space instantaneously, but the reversal is propagated outward

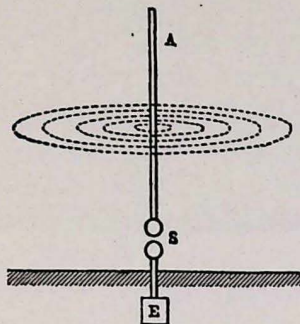


Fig. 3. Lines of Magnetic Force round an Antenna during Discharge

with the speed of light. Accordingly, the electric oscillations in the antenna create periodic variations of magnetic force and electric force in the space outside. At points near the earth's surface, some way from the rod, the magnetic force is parallel to, and the electric force perpendicular to, the surface of the earth or sea. Experience shows that electric wave telegraphy over any large distances cannot be conducted unless the antenna is so placed that the electric force is perpendicular to the surface of the earth or sea.

At any distance from the antenna, and at any one spot, the magnetic and electric forces are therefore periodically varying in magnitude, and owing to the finite rate of propagation of the forces through space, we find that at certain equispaced intervals these forces are similarly reversed in direction at the same instant.

actually happens at any point in the field is a periodic oscillation or cyclical change in the electric and magnetic force at that point. This, however, is repeated successively from point to point, and we may hence speak of the line of force as moving forward, just as we speak of a surface water wave moving forward, when in reality the only movement in the latter case is a small up-and-down motion of the water at each place, or at least a circular motion of no very great extent.

When we speak of the length of the electric waves, we mean the shortest distance which separates two adjacent places at which either the electric or magnetic force reverses direction in the same way at the same instant. In wireless telegraphy the length of waves employed may vary from 200 to 300 feet to many thousands of feet or several miles. The determination of this wave-length is a practically important matter, and accordingly instruments have been designed specially for its measurement by Dönitz, by Professor Slaby, and by me. I have ventured to name my own appliance for measuring long electric wave-lengths a *cymometer*.*

The importance of the measurement is as follows: We know that the properties of short electric waves constituting light and radiant heat depend upon their wave-length, and that some bodies are opaque to light waves, but transparent to heat waves. So, in the case of the much longer ether or electric waves used in telegraphy, the ease with which they pass through buildings, forests, and even mountains or cliffs, or round the earth's curved surface, is determined by their wave-length. Waves of 100 or 200 feet in length are considerably obstructed by the closely packed houses in a town, but much longer waves go easily through them. The measurement of the wave-length is made to depend upon the fact that there is a simple relation between the velocity of these waves (which is the same as that of light), the periodic time of the oscillations in the antenna, and the wave-length as expressed by the formula $\text{wave-length} = \text{velocity} \times \text{periodic time}$. Since the velocity is nearly 1000 million feet per second, the wave-length in feet is easily found, when we know the time period of the oscillations in the antenna. This last quantity can be found by placing near to the antenna a circuit in which secondary electric oscillations can be sympathetically induced by those in the antenna. For this purpose we must have a circuit which possesses the two qualities of capacity and inductance. This is secured by joining in series some form of Leyden jar or condenser and some form of spiral wire or inductance. Moreover, we

*See *Proc. Roy. Soc.*, Vol. LXXIV, p. 490, 1905, on an "Instrument for the Measurement of the Length of Long Electric Waves." Also *Phil. Mag.*, June, 1905, on the "Applications of the Cymometer."

must have the means of varying this capacity and inductance, so as to bring the cymometer circuit into tune, as it is called, with the antenna. Every such circuit containing capacity and inductance has a natural period of electric oscillation, resembling in this respect the time of swing of a mechanical system composed of a heavy body suspended by an elastic spring.*

In my cymometer the condenser part consists of one to four sliding tubes, each consisting of a pair of brass tubes, separated by an ebonite tube. The outer tubes can slide off the inner ones, and so vary the capacity. The inductance consists of a long spiral of copper wire, and the circuit is completed by a thick copper bar. Matters are so arranged that when the outer tubes are drawn off the inner tubes so as to vary the electrical capacity, the effective amount of the spiral included in the circuit is simultaneously varied in exactly the same proportion. To determine when the time period of the cymometer circuit is in agreement with that of the antenna, I use a neon vacuum tube. Some three years ago I found that such a tube was extremely sensitive to a high frequency electric field, being caused to glow brilliantly when subjected to its action.

You are already familiar with the beautiful method discovered by Sir James Dewar for obtaining neon from atmospheric air by the use of charcoal at very low temperatures, and tubes filled with rarefied neon prepared by his process are able, as I have shown, to serve important purposes in connection with wireless telegraphy.

In the cymometer a neon tube is connected to the opposite coatings of the condenser. If then the cymometer bar is placed near to the lower part of a transmitting antenna, and we slide along the outer condenser tube, thus varying the capacity and inductance of the instrument, provided it has a suitable range, a position will be found in which the neon tube glows brightly. The cymometer is equipped with a scale, which shows for every position of its handle the corresponding frequency or time period, and the related wave-length. Hence, the simplest operation, which a child can perform, serves to determine in one instant the frequency of the oscillations in the antenna

and the wave-length of the radiated waves. I have devised instruments of this type covering the whole range of wave-length measurement from 50 to 100 feet up to 20,000 feet or more. An instrument of the same kind, but with a more sensitive oscillation detector than a neon tube, can be used to measure the wave-length of waves being received on the antenna. The cymometer has other uses besides wave-length measurement. One of these is to draw a resonance curve and thence reduce the rate of decay of the oscillations in a train and their number. In a train of oscillations the time period occupied by each oscillation, whether of current or potential, is the same, but the amplitudes die away in geometric ratio. Hence the ratio of two successive amplitudes or oscillations is constant, and the natural logarithm of this ratio is called the *decrement*. We can determine this decrement when we know the frequency of the oscillations in the primary circuit and the current induced in any secondary oscillation circuit, placed near to the first, when the latter is in exact syntonism, and also slightly out of syntonism, with the primary. Employing a formula of Bjercknes, we can find the sum of the decrements D and d of the primary and secondary circuits by the formula

$$D + d = \pi \left(1 + \frac{n}{N} \right) \sqrt{\frac{a^2}{A^2 - a^2}}$$

where a is the current in the secondary circuit when it is tuned to a frequency n , and A is the maximum current when the secondary circuit is tuned to agree with the frequency N of the primary circuit.

For this purpose, I modified the cymometer by including in the bar two fine resistance wires, against one of which a sensitive thermo-junction of iron and bismuth is attached. This enables me to measure the value of the current in the cymometer bar. The process of measurement is then as follows: We place the cymometer alongside the antenna and slide along the handle slowly, thus altering its time period or natural frequency. We observe the current and frequency, and plot a curve called a resonance curve showing the secondary or cymometer current in terms of the frequency. (See Fig. 4.) This curve rises to a maximum value, sometimes very sharply, the maximum corresponding to the condition

*If the capacity C is reckoned as usual in microfarads, and the inductance L in centimeters, then the time period T of the oscillation is given by the formula $T = 1/\sqrt{CL} \div 5,033,000$.

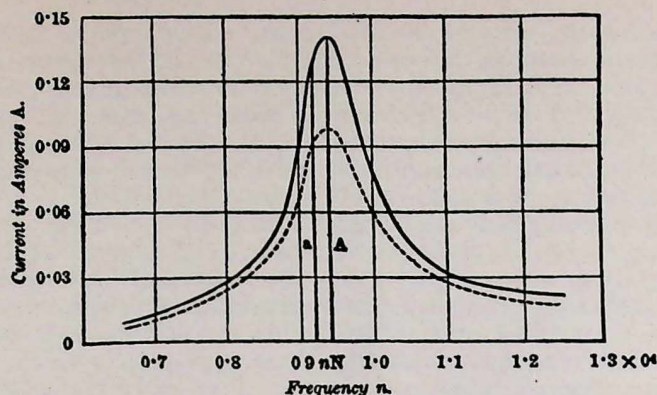


Fig. 4. Resonance Curve of Loosely Coupled Oscillatory Circuit

of exact syntonism between the antenna and cymometer circuits.*

From the curve we can determine the sum of the decrements of the cymometer and antenna. A second experiment made with a known additional resistance inserted in the cymometer bar enables us to eliminate the decrement (D) of the cymometer itself, and thus find that of the antenna alone. When this is done, we know what percentage each oscillation in the antenna is of the previous one. Suppose we agree that when the oscillations have decayed away to one per cent of their initial value, the train shall be considered to be finished; then another simple formula, $M = (4.605 + D) \div 2D$, enables us to find the number of complete oscillations M in a train when we know the decrement D.†

Electric oscillations are classified into highly damped and undamped varieties corresponding to few, many, and infinite oscillations in a train. (See Fig. 5.) In electric-wave telegraphy we have various kinds of transmitters or wave makers which are intended to create these types of oscillation. In the first case, if we set up an antenna and connect the lower end to one of the spark-balls of an induction coil, the other being to earth, we have an arrangement which produces highly damped oscillations and waves. (See Fig. 6.) This is due to the fact that since the capacity of the antenna itself is small, the energy which can be stored up in it and liberated at each spark discharge is

*If the damping of the secondary circuit is small, as it is in the case of the cymometer circuit, then the resonance curve is very sharply peaked or rises quickly to a maximum when the primary oscillations are feebly damped, provided always that the "coupling" or mutual inductance of the two connected circuits is small.

†See "The Principles of Electric Wave Telegraphy," Fleming, p. 167.

also small, at most a fraction of a foot-pound or a few foot-pounds. Hence it is rapidly frittered away by resistance and in radiation, and the oscillations are few, say half a dozen or so, and highly damped. If, however, we form an oscillation circuit consisting of a large condenser, inductance, and spark-gap, we can store up a larger amount of energy and liberate this suddenly across the spark-gap at each discharge. (See Fig. 7.) If, then, these oscillations are made to induce others in a directly or inductively connected antenna, we can liberate the energy as radiation, and having a larger store to draw upon, create longer trains, say of 20 to 100 more feebly damped oscillations.

Corresponding to these types of transmitter there are various suitable forms of receiver. With a highly damped radiator we must use some form of wave-detector, such as a coherer, which is chiefly affected by the first or maximum oscillation, and this must be inserted in a receiving circuit which is easily set in oscillation by a single, or at most a few electro-magnetic impulses. On the other hand, this renders the receiver more liable to disturbance by vagrant electric waves, due to atmospheric electricity, or other transmitters, if of sufficient strength.

If, however, we employ a feebly damped radiator emitting long trains of waves, say 20 to 50 waves, we can make use of a stiffer receiver circuit, that is, one containing a good deal of inductance, and a detector such as Marconi's magnetic detector, which operates under the action of feeble, but oft-repeated and properly timed impulses. We have then the advantage that the receiving circuit can be made far less sensible to non-syntonic or isolated impulses, unless these are of extreme violence.

Again, there are certain forms of detector — such as the thermal — and one of my

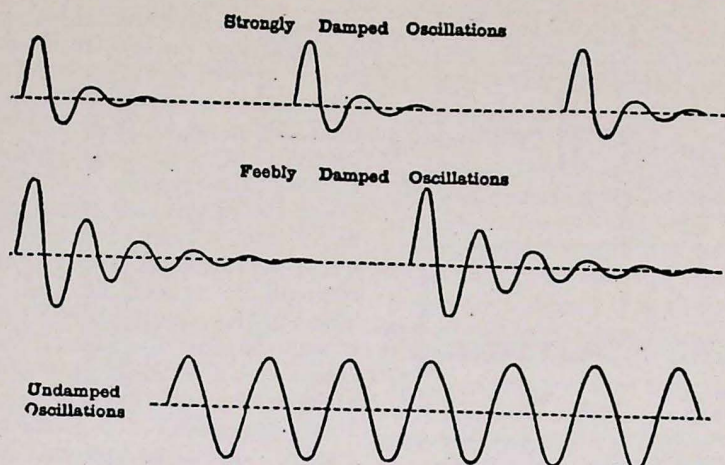


FIG. 5

own, to be described presently — which are affected by the product of the mean-square value of the oscillations during a train and by the number of trains per second. Hence, in this case the effect on such a receiver at a given distance under the same conditions, will be increased by increasing the number of trains of oscillation per second, as well as by diminishing damping in each train. It was, therefore, foreseen that we should gain some advantage by the use of undamped trains if some form of electric radiator could be found emitting waves continuously, like the steady note of an organ pipe, rather than sounds like the intermittent blast on a trumpet or blows on a drum. There are at least three ways in which these undamped oscillations can be created. The first is a mechanical method, viz., by a high frequency alternator. Assuming we possess an alternating current dynamo giving a current of a sufficiently high frequency, we can connect one terminal to earth and the other to a radiating antenna, and then on setting the machine in operation, high frequency undamped currents would be created in the antenna, and corresponding waves radiated. To secure the best results, it is necessary, however, to syntonize the free-time period of the antenna circuit and the natural frequency of the alternator. The chief difficulty, however, is to construct a machine which shall give alternating currents of sufficiently high frequency and voltage with sufficient power and current capacity. Sixteen or seventeen years ago, Prof. Elihu Thomson and M. Tesla built dynamos giving an alternating current of 10 amperes at a frequency of 10,000 to 15,000, and an output of about 1000 watts. Mr. Duddell exhibited

to the physical society, in April, 1905, an alternator capable of a frequency of 120,000, but its power output was not more than 0.2 watt. I have on the table a small alternator made by Mr. S. G. Brown, giving an alternating current having a frequency of 12,000, an e.m.f. of 20 volts, and a power of about 50 watts. Professor Fessenden has recently given a description of an alternator made for him having a frequency of 60,000, with an output of 250 watts, running at a speed of 10,000 r.p.m., and giving an e.m.f. of 60 volts. Since steam turbines of the Laval type are now made to run at 500 revolutions a second, it is not difficult to construct an inductor alternator having a frequency of 50,000 to 100,000. Such a type of alternator has, however, always a large fall in terminal potential difference if called upon to give out current. For this reason, a type of machine without iron in the armature is to be preferred, but

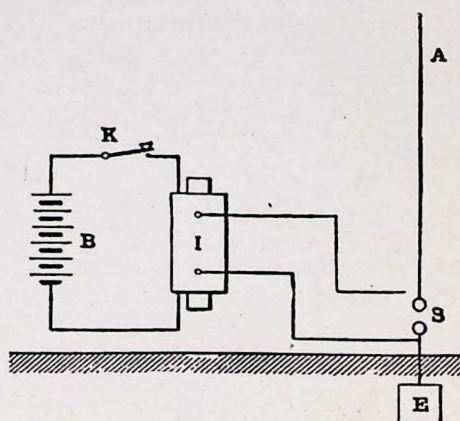


FIG. 6 — Antenna emitting strongly damped telegraphic electric waves.

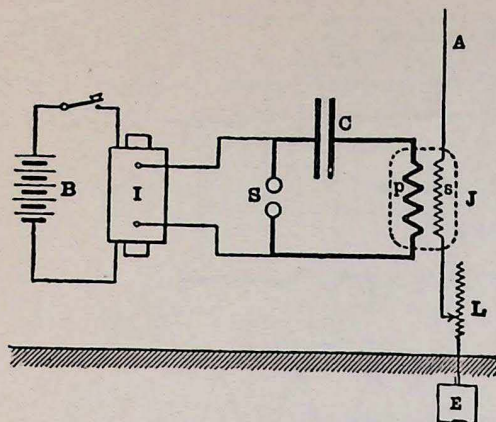


FIG. 7.—Antenna emitting feebly damped telegraphic electric waves.

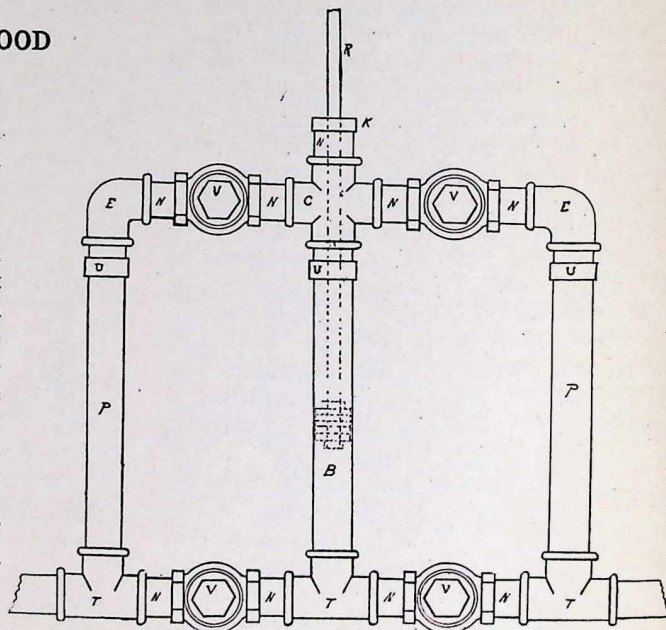
then it becomes more difficult to balance the moving parts for very high speeds. In spite of some attempts, the difficulties of making and driving a high-frequency and high-potential alternator of any considerable output, say 10 kilowatt size, have not yet been overcome. Even if we could secure a frequency of 50,000, this corresponds to a wave of four miles in length, and special antenna arrangements are necessary to radiate and receive such waves. Hence the alternator method of electric wave production will certainly not supersede the spark method, although in some cases it may be practicable and useful.

(To be continued.)

HOW TO CONSTRUCT A GOOD DOUBLE-ACTING PUMP

P. J. O'HARA

A VERY efficient double-acting force pump can be made by any one with very few tools. The material needed consists of standard pipe and pipe fittings, such as may be readily obtained at almost any hardware or farm implement house. As may be seen by the drawing, the following parts are required: One cross (C), two elbows (E), three tees (T), nine nipples (N), three unions (U), one cap (K), four check-valves (V), one brass tube for cylinder (B), two pieces of pipe the same length as the cylinder (P), one brass rod threaded at both ends (R).



The brass tube should be perfectly true inside, if it is desired to use a brass piston; however, this is not necessary even, for a good working pump. The piston may be made by clamping heavy pieces of leather between two heavy washers, or flanges, as shown in the drawing. The nipple, through which the piston rod passes, should be filled about three fourths of its length with babbitt metal, and then bored out so that the piston rod will be a good fit, but not too tight. The cap (K) should also be bored, but large enough so that the piston rod will not be cut by it. The unfilled portion of the nipple and the cap form the stuffing box.

No dimensions are given here, but any one who desires to construct a pump of this type may choose sizes of pipes and fittings to meet his requirements. The cylinder need not necessarily be the same size as the pipe and pipe fittings, but if the water is to be forced any considerable height, it is not well to have it too large. A pump of this type has been in use for over four years, and pumps water into a reservoir under a 150-foot head. The pump is bolted to a heavy plank by means of yokes, and the piston rod is made to run true by the use of a simple guide and crosshead, to which is connected the pitman. The pump is direct connected to a small overshoot wheel, which furnishes the necessary power. Any bright boy may easily construct a pump of this type, which may be operated by a wind-mill, gasoline engine, or any other source of energy.

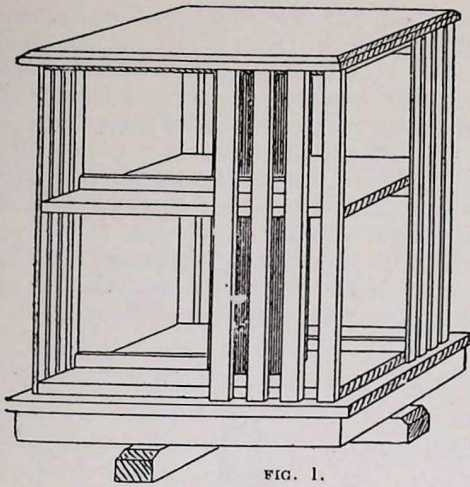


FIG. 1.

A REVOLVING BOOKCASE

A SMALL revolving bookcase is a very useful piece of furniture, and although it may appear to be somewhat difficult to make, it is comparatively an easy piece of work. We will suppose that oak is to be the timber used and we wish to have two shelves, one, the top one, for books not more than 9 inches, and the bottom shelf to take books up to 11 inches. The height from the floor will be 2 feet 4½ inches and the sides of top 1 foot 9 inches, this being a very convenient size.

The first thing will be to get out the timber, and the following shows the finished sizes:—

Top.—One piece, 1 foot 9 inches x 1 foot 9 inches x ¾ inch; one piece, 1 foot 7 inches x 1 foot 7 inches x ¾ inch.

Shelves.—Two pieces, 1 foot 7 inches x 1 foot 7 inches x ¾ inch.

Laths.—Sixteen pieces, 1 foot 10¼ inches x 1½ inches x ⅜ inch.

Box.—Two pieces, 1 foot 11 inches x 3 inches x ¾ inch; two pieces, 1 foot 11 inches x 1½ inches x ¾ inch.

Upright Post.—One piece, 1 foot 2 inches x 2 inches x 2 inches.

Plinth.—Four pieces, 1 foot 9 inches x 2½ inches x ¾ inch; four pieces, 1 foot 8½ inches x 2 inches x ¾ inch.

Crossfeet.—Two pieces, 1 foot 10 inches x 2 inches x 2 inches.

Brackets.—Four pieces, 7 inches x 2½ inches x ¾ inch.

Arms.—Twelve pieces, 10¾ inches x ¾ inch x ¾ inch.

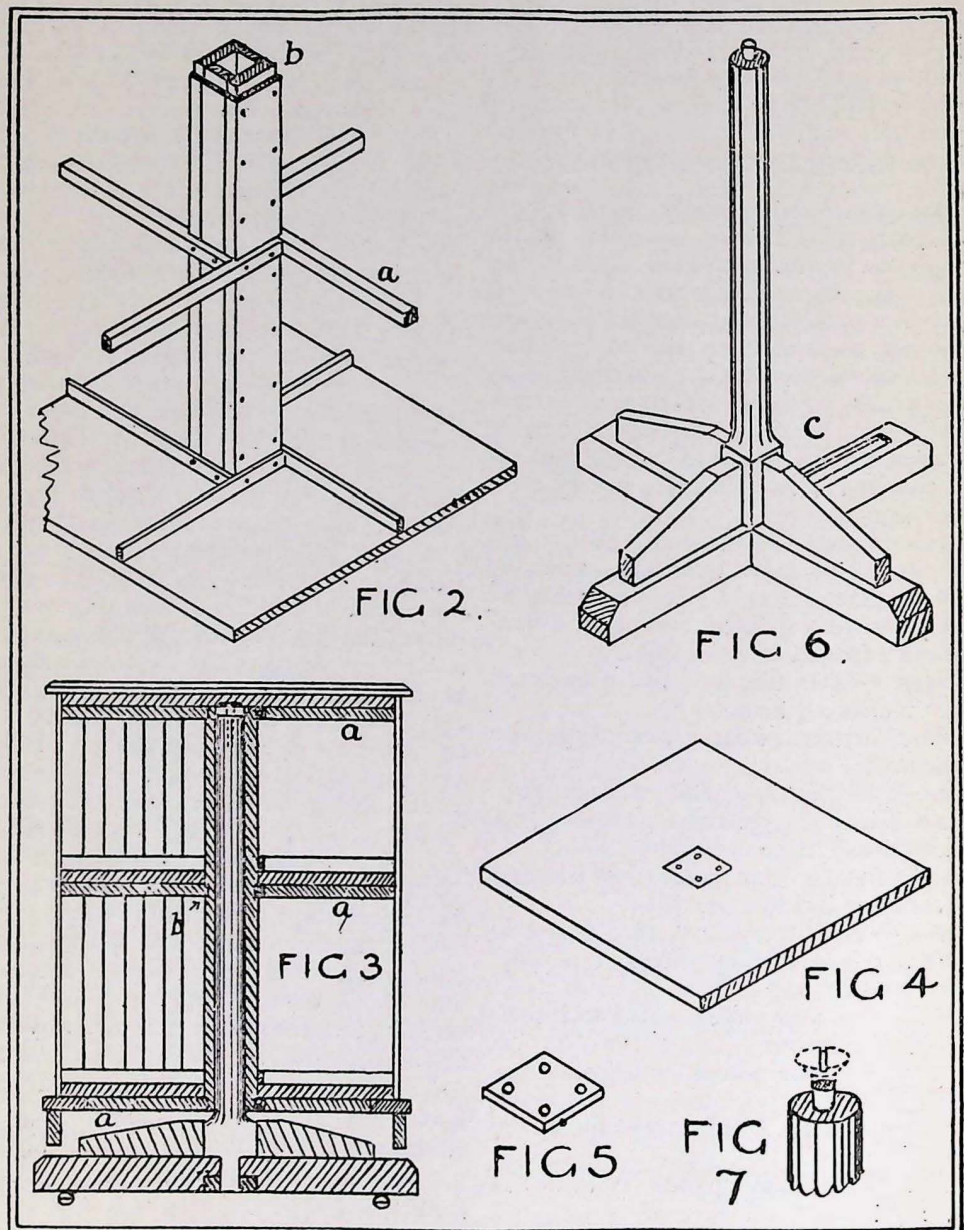
Book Stops.—Eight pieces, 11 inches x ¾ inch x ½ inch.

The above lengths may be cut from two 10½-foot lengths of 11 inches x 7½ inch oak, and 5 feet of 2½ inch x 2½ inch stuff.

Having procured the wood, the first thing will be to cut off two 1 foot 9½ inch lengths and six 1 foot 7½ inch lengths; plane these up quite true to ¾ inch thick and glue them up in pairs, one top, one under-top, and two shelves. Care must be taken that the joints for gluing are very true, and the glue used very hot, and if the glue is well rubbed out of the joints, it will not show when set. While waiting for these pieces, the box may be made; this is shown in section at Fig. 3, and in detail at Fig. 2. Inside the box is the round upright post, and to the outside is secured the arms, shown at ("a"), on which the shelves rest. Two pieces are cut off to 1 foot 11 inches and planed to 3 inches wide; another two pieces same length are cut, planed to 1½ inches wide and these pieces are glued, screwed, or nailed together, forming a hollow box, 1 foot 11 inches and 3 inches square outside. We have now to make grooves in this box, as shown at ("b"), one ¾ inch wide, ¼ inch deep, top and bottom, and another 9¾ inches away from the top. In these grooves the ¾ inch x ¾ inch arms should, later on, be screwed, each one being 10¾ inches long, with the exception of the four bottom pieces, which are only 9¾ inches long. The shelves may now be cleaned up, and the sides sawn down to bring them square, each shelf being 1 foot 7 inches x 1 foot 7 inches. Both sides should have a 3-inch slot cut in the center, and then they may be slipped in position, and the arms screwed in place, as shown at Fig. 2, also the shelves should be screwed to the arms, taking care that the screws do not come through the top of the shelf. The book stops, 11 inches x ¾ inch x 1½ inches, should now be screwed on the shelves, as shown, and against the outside of the box. At this stage it will be as well to prepare the board under-top shown at Fig. 4, and in the section (Fig. 3). This should be 1 foot 7 inches square, and in the middle a small iron plate, about 2 inches square, shown at Fig. 5, should be screwed, as shown at Fig. 4. The plate need not be more than ⅛ inch thick. When this is done, screw the board to the top arms, and then prepare the top to 1 foot 9 inches square, and chamfer the edge to ¼ inch. Glue and screw the top to the under board, but place the grain across the other, so that it will keep quite true.

We have now to place the plinth in position. Plane up four pieces to $2\frac{1}{2}$ inches x $\frac{3}{4}$ inch and miter the corners to make a frame 1 foot 9 inches outside measurement. The corners may be nailed as well as glued, but care must be taken to carefully fill up the nail holes. Underneath this frame another frame should be glued and nailed, but the wood should be upright and 1 foot $8\frac{1}{2}$ inches outside measurement, the plinth should be glued and screwed on underneath the bottom shelf, as shown in the section of Fig. 3. We

have now to nail or screw the laths, the first one flush with the corner, and the last flush with the outside edge of the book stops. These may be plain, as shown, chamfered or even beaded, but it will be more in keeping with the work to have them quite plain. This completes the bookcase, and we have now to make the stand, as shown at Fig. 6. The upright should, if possible, be turned to $1\frac{1}{2}$ inches diameter to within $4\frac{1}{2}$ inches of the end. If not, the round should be carefully worked with a spoke-shave, and plane



and finish smooth with file and glass paper. Cut a 1 inch square tenon, 2 inches long on the end, and then prepare two lengths to 2 inches square for the crossfeet, join them together with a lapped halving joint, and in the center cut a 1-inch mortise, glue up the work, chamfer the ends, and then put in the upright. In the top of the upright drive a stout screw to within $\frac{1}{2}$ inch of the top, and then file off the $\frac{1}{4}$ inch, as shown at Fig. 7. Next place the brackets, either housing them in $\frac{1}{8}$ inch, as suggested at C (Fig. 6), or nailing them straight to the angle.

The bookcase may now be slipped over the upright and the screw end will stop against the iron plate and will allow the case to be easily revolved.

To fume the oak, it will be necessary to place the case in a large packing case, and place a basin of strong ammonia inside and cover the box until the fumes have sufficiently colored the wood. A good polish may be given by rubbing in ordinary beeswax and turpentine, the first coat being applied hot with a brush.

Ball casters will be found 'most convenient, and are easily screwed on.

SOLDERING ALUMINUM

H. M. NICHOLS

WHILE it is possible to solder aluminum successfully, and it is accomplished every day in several large manufacturing establishments, in the manufacture of aluminum gear cases and automobile parts it is a difficult task, requiring much skill and patience.

There are three difficulties to be overcome in soldering aluminum.

First, the heat conductivity of aluminum is higher than the heat conductivity of the metals commonly soldered. The aluminum conducts the heat of the soldering iron or blow-torch away very quickly, and renders it difficult to obtain the requisite soldering temperature.

Secondly, solder alloys with aluminum at a temperature some 200° F. higher than the temperature at which it alloys with copper. These two factors make the use of an ordinary soldering iron almost out of the question, except when soldering very small articles. However, with a good blow-torch, a sufficiently high temperature can be reached and maintained, for the successful soldering of aluminum.

The third difficulty met with is by far the most serious. When aluminum is exposed to the air, a thin, invisible coating of oxide of aluminum instantly forms on its surface. In this respect aluminum does not differ from other metals; but while in the case of other metals there exists fluxes that will dissolve these oxides, allowing the solder to come in perfect contact with the metals, and thus uniting them to form a perfect joint, no such flux is known for aluminum, and it is this lack of a suitable flux which causes the most difficulty in soldering it. A large number of different substances have

been tried as fluxes, but not a single flux has been found that does not do more harm than good.

The only practicable way of removing the oxide from aluminum is to scrape it off with the stick of hot solder. If the work to be soldered is brought to the proper heat with a blow-torch, and a stick of solder is rubbed roughly over its surface, the oxide will be scraped off and the melting solder will alloy with the aluminum, tinning its surface in a manner similar to the way in which the surfaces of other metals are tinned. This process must be continued until the surface of the aluminum is completely tinned, as the strength and durability of the joint depends upon the thoroughness of the tinning process.

After the surfaces have been tinned in the above manner, they can be united by melting the desired quantity of solder on to them, pressing them firmly together and exposing them to the heat of the blow-torch for a short interval. Care should be taken not to move the pieces while the solder is setting.

When making a butt joint, it is necessary to put the solder just where it is wanted before the final heating, as it is hard to make solder flow into an aluminum joint.

The best solders for aluminum are composed of tin and zinc in various proportions. A very good proportion is eighty per cent tin and twenty per cent zinc. Pure block tin answers quite well by itself, without the addition of zinc. Numerous other substances have been added by various inventors, but their utility appears to be of a doubtful nature.

TYPES OF MEN WHO WILL NEVER SUCCEED

THE president of one of Chicago's largest and most modern business concerns was recently looking through some old files and came across a letter that amused him very much. It was an answer to an offer he had made a man, early in the organization of his business, when it was mostly on paper, to go into partnership with him. The letter was in part as follows:—

"I wish I had time to look in on you as requested, to-day, and talk over the partnership deal, but we've decided to move, and I must go with my wife house hunting."

The president, fifteen years older and \$1,000,000 richer than when that letter was written, smiled as he read it, yellow with age, and so plainly portraying the character of his old friend, who is still a clerk in the very establishment where he was then employed.

How perfectly that letter represents one type of man who will never get beyond a certain degree of success and whose advancement will be just so far as his ability to perform immediate duties places him. Such a man would never get out of his beaten path long enough to see his opportunities, and if they were thrust under his very nose, the slightest demand of his usual routine existence would be sufficient to turn him away from them. This type of man is held in check by the thousand invisible wires binding him tight and fast to the accepted order of his existence. Had he possessed the smallest success germ, he would have been on the spot at the appointed hour at any cost, knowing that in the line he was then pursuing he would never make a fortune, and that at least here was a possible chance of doing so. The house hunting could wait, or his wife could attend to it. All things else could wait, but see his man he must, and at the appointed hour.

What a contrast is this to the course of Mellen, of Mellen's food fame. He was working along on a good salary and had a nice little property, but he saw a fortune in Mellen's Food. He decided to dig it out. He put every cent he had in the world into the promotion of this food for babies, and finally sold his home, and moved into a cheap house, in order to raise additional funds for the enterprise. It did not distress

him nor his wife that they must suffer some discomfort and inconvenience in order to promote a great business. Can you imagine him letting Mellen's Food business wait, while he went house hunting? He let it wait for nothing; it was first, last, and all the time uppermost in his mind—and naturally he achieved his ambition. He made his fortune.

When Graham Bell was organizing his telephone company, he offered the secretaryship to a young newspaper man who was then earning \$30 a week. The young reporter merely looked at Mr. Bell and smiled a deep, knowing smile. He knew a good thing when he had it, and if any one thought he was going to give up a sure salary like that—well, he guessed not. He is still drawing his \$30 per, and Bell has the smile on his side. This man represents the type that wants an absolutely sure, gilt-edged, proved, sound proposition, before he will risk touching it. This is the type of man that would not take special training in his own line of work, unless there was a guaranteed advantage in dollars and cents attached to it. This is the type that takes no chances. He would not see the use of filing on a mining claim unless he knew positively there was gold in it in paying quantities. He would not see the use of taking up timber land unless he was absolutely sure that lumbermen would settle in that district and buy his logs. He would not invest money in advertising unless he was guaranteed big returns. Thus he would reason, and thus he would fool himself with the idea that he is a shrewd business man, when the truth is he is so short-sighted that he could never meet real success excepting by the merest chance.

The "dead sure" propositions never go begging for promoters or investors. It is the element of seeming uncertainty that gives the ordinary man his opportunity. Moneyed men are quick to gain possession of every enterprise that shows its value on the face of it; but many of the largest fortunes have been made in enterprises that the greatest capitalists refuse to touch. It remained for some progressive man with more brains and push than capital to "make it go."

The most hopeless type of failure is the man who can tell every one else just how to run his business. Such a man seldom has

a business of his own to run. He is the Jack-of-all-trades, he has a smattering of all kinds of business knowledge, and can talk fluently on any subject of a commercial nature that may arise. His friends wonder why it is that Brown never gets ahead. He is a "pleasant spoken" fellow, well versed on all timely topics, well-mannered, likable, but some way he is always shifting about from pillar to post, never advancing far beyond where he started. If you listen to him five minutes he can tell you where the most successful business men of his community make big mistakes, and how he could run the same business at a tremendous saving. The real secret of the failure of this type — and he is always a failure — is monumental conceit. Having learned a few things he fancies he knows them all. It is conceit that makes him acquire a dribbling knowledge of every line of business, so that he can appear learned in conversation. He never really masters any one thing; he never loses himself, head over ears, in his business, he is really a commercial dilettante, playing about the edges of great things.

Why, I have sat in dumb astonishment and listened to such a man who was never at his best able to command over \$75 a month, as bookkeeper, explain minutely how Marshal Field ought to run his great store. I have heard such a man discourse most wisely (?) on the mistakes of makers of huge fortunes — mistakes in system, management, methods, etc. The real creators of fortunes know full well that the management of one business needs a lifetime of study and close application, and they never pretend to understand the details of any but their own line. Nor are they certain that they have gotten to the bottom of that. The business dilettante, on the other hand, writes editorials for a country paper one summer during the absence of the editor, and forever after he can tell any aspiring young *litteratus* just how to win fame in journalism. He is bookkeeper in a bank another season, and forever after can give the most successful banker in the country pointers on how his business should be conducted. He even dabbles in art, painting a few water color sketches — and is prepared to act as high critic on the works of the masters, past, present, and to come. He can never be a success because his bump of self-appreciation is so large that he would rather pose

forever as all-knowing than do some good earnest hard hustling in order to acquire knowledge worth airing.

Another very common type of failure is he who is afraid of doing more than he is paid for. I know a young man who had been five years trying to establish himself in a certain line of business. He had not been successful. One season a friend of his connected with a well-established concern, sent for him and said: "I am going away on a three months' vacation. Now I propose that you come in here and manage my department during my absence, and at the same time establish a department in your line. We need such a department, and here is your chance. Get it going in good shape by the time I get back."

The young man readily agreed, for he needed the money badly. When his friend returned, however, he found that the new department had not been opened. He asked the man why this was. "I wasn't paid enough for that order of work," he answered, with some spirit. "That kind of work takes brains, and should command a big salary. When I saw what I was to get, I just let the whole thing slide."

His friend returned the compliment and let him "slide." He is now looking for a job.

When a man's time is all he has in the world, why should he hesitate to spend it demonstrating to ever watchful employers how well he can use it? Why should he prefer to waste the day, even though he gets nothing for it? It is at least better to give evidence of being a hustler than an idler.

If you are paid \$2 a day, do your very best work, just as if you were paid \$5 a day; and sooner or later the \$5 position will find you. The man or woman who is heart and soul interested in his or her work does not need to worry about a raise in salary. It will come quickly enough. Every man, barring accident, eventually gets out of business just what he puts into it. — *The Keystone*.

An important part in the operation of gas engines using liquid fuel is played by the mixing or carbureting device. A proper proportion of fuel oil and air is of course essential. For multiple cylinder engines the complete gassification before leaving the carbureter is certainly very desirable.

MODERN WOOD STAINING

EDWARD HURST BROWN

A FEW years ago the art of wood staining, so far as it had been developed, consisted entirely of crude attempts at imitating the more expensive woods by coloring the cheaper lumber with a thin wash of pigment mixed with oil or ground in varnish. These stains were made by the leading paint manufacturers, and were sold, as they still are, under such names as mahogany, oak, walnut or cherry oil stains, or varnish stains, as the case might be. The oil stains are intended for the use of the practical painter, while the varnish stains are made for the amateur tinkerer, and serve both as a color and as a first coat of varnish.

When used on white pine or whitewood, these stains will produce a more or less close resemblance to the color of the wood which it is desired to imitate, but the great dissimilarity in the grain markings of these woods from those of the hardwoods which they were supposed to represent, renders these stains comparatively useless except for a cheap class of work. The fact that the hardwoods could be stained to take on an additional beauty did not seem to occur to wood finishers until a very few years ago, but when the idea was once introduced, it immediately caught the popular fancy; and now decorators do not hesitate to color oak, chestnut, or other hardwoods to harmonize with the decorative scheme of the room, even though the colors employed may be entirely different from those found in any natural wood, says the *American Carpenter and Builder*.

The possibilities of this class of wood staining have been very greatly increased by the developments in the manufacture of aniline dyes. Only a few years ago, colors of this class were too fugitive to stand exposure to strong light for any length of time, and hence had little value for any purpose requiring the permanence looked for in wood finishing. But the investigations of chemists have produced aniline stains that are really almost light-proof, and which are capable of producing very beautiful effects on the various hardwoods. Moreover, a class of aniline dyes soluble in linseed oil has been produced, which has made it possible for the color and varnish manufacturers to place upon the market ready-for-use stains that produce many novel and beautiful color effects, and which are entirely free from the muddiness insepa-

rable from a pigment stain. It is true, the latter are more permanent, for absolute fastness to light does not seem to have been actually obtained in aniline colors as yet, in spite of the claims sometimes put forth concerning them. Nevertheless, they are sufficiently permanent for all practical purposes; and at the end of several years, if they begin to fade appreciably, it is possible to replace them with an entirely new color scheme.

So many beautiful stains of this character are on the market that it is scarcely worth while for the hardwood finisher to go to the trouble and expense of preparing them for himself, when the ready-to-use article will answer his purposes exactly, and will cost him little if any more than he would pay for the materials required to make his own stain.

Aniline oil stains have one disadvantage, in that they darken, because of the darkening of linseed oil when not exposed to strong light. The decorator who wishes to produce clear bright color tones will use alcohol or water stains, even though these raise the grain of the wood, necessitating subsequent sandpapering to remove the projecting fibers and a second application of the stain to cover the bare spots left by the sandpapering. An alcohol or spirit stain will penetrate deeply into the grain of the wood, acting as a dye rather than as a surface coating; and it possesses the advantage for hurried work that it dries very quickly and may be followed almost at once by a coat of shellac.

The writer has seen work that has been stained and had two coats of shellac in the same day, and in the case of repairs to stores, offices, and other places where business must not be delayed, this is a valuable consideration. For ordinary work, the shellac is usually used for a first coater after the stain, and the subsequent finishing coats are built up with light-colored varnish.

Soft woods, such as white pine, whitewood, cypress, and some other similar woods, are too spongy to use water or spirit stains upon them, for the wood will immediately suck up the stain and it will be almost impossible to avoid showing laps at each application of the brush. Oil stains are the only ones that can be applied to woods of this character. Some finishers give them a thin coat of shellac before staining, which will permit either a dye or a pigment stain to lie in a thin film on the

surface. While this gives a uniform color, it is not staining the wood in the true sense of that term.

A class of finish, entirely distinct from the old varnish stains, has been introduced within the past few years. They have been extensively advertised and have met with a large popular demand. These are made by coloring a quick drying varnish with aniline oil stains. They enable one to color and varnish a surface at the same time, thus meeting the wants of the amateur tinkerer. They are more particularly adapted for small articles, such as chairs and other pieces of furniture, or small brackets and the like. On floors they should be applied quickly along the entire length of one board. Then the next board should be coated, and so on. The reason for this is that they dry so quickly that the workman needs to be very careful in using them or he will show laps. For this reason painters find it difficult to employ them on architectural woodwork, where broad surfaces, such as door panels, wainscots, and the like must be covered.

These colored varnishes are sold under different trade names, but are practically identical in composition, no matter what they are called or by whom made.

Many very beautiful effects are obtained on oak, mahogany, and other woods containing tannic acid, by means of chemicals of an acid or alkaline nature. These chemicals, however, produce little or no effect on dry, pitchy, or sappy wood. In other words, while they may be employed to change the color of the hardwoods, they cannot be used on pine or white wood in order to make these cheaper woods imitate the more expensive ones. These chemical stains are permanent in their effect, and as they actually change the chemical nature of the wood itself, they produce clear color tones, without any of the muddiness left by pigments. They have no tendency to become lighter or fade out under exposure to the strongest light. Chemical stains are ordinarily employed by the furniture factories to produce the effects known as weathered and fumed oak, and similar changes that, as a rule, might be classed as darkening of the wood, although some of the chemicals produce an actual change of color. They are also employed by expert hardwood finishers in the highest class of architectural work, but although in theory they are very simple, they require such careful manipulation to produce the exact tone desired, that they should be handled only by experts.

The simplest of all these stains is ammonia, which may be used to darken oak or mahogany. It should be reduced with water to the desired strength and applied with a mop or fiber brush, as it will destroy hair or bristles. In this, as in all other chemical stains, it is safer to make the ammonia more dilute than necessary, and to apply successive coatings, rather than to attempt to use the full strength. As the ammonia completely evaporates, leaving no residue behind, it will not affect subsequent coats of varnish.

Another way of using ammonia is the so-called fuming process, by which effects can be produced that cannot be obtained in any other manner. It is applicable, however, only to small articles which can be enclosed in an air-tight box, on the floor of which are placed shallow porcelain or glass saucers containing 26° ammonia. The fumes rising from this produce a very even stain without raising the grain of the wood, thus avoiding any necessity for sandpapering. This process will take twelve hours or more, according to the depth of tone desired. The fuming process is difficult to use for the standing finish of a room, as it is next to impossible to close up the windows and doors so tightly as to avoid the escape of the ammonia fumes, and the quantity of ammonia required to fill a room so that it will act on the wood is so great as to be dangerous to the health of people in the house, in the event of leakage.

Lime water, made by slaking ordinary lime in sufficient water, is probably the oldest of the chemical stains, having long been employed by hardwood finishers for darkening mahogany. It is brushed over the surface and allowed to remain until it is thoroughly dry, when the powdered lime is well brushed off, and the wood is then thoroughly washed. A coat of vinegar must then be given to neutralize any alkali remaining in the wood, and which would be injurious to subsequent varnish coats.

Caustic soda and caustic potash will also produce dark stains, but are difficult to handle, and are seldom used on account of their liability to injure the after finish.

Chromate and bichromate of potash as well as permanganate of potash are used to produce the so-called golden oak, and also give an antique effect to mahogany.

A yellow effect is given to walnut by the use of picric acid, which is also employed to liven up the tone of this wood.

Where expense is no object, a very beautiful brown tone can be obtained by the use of iodine.

About one half pound green copperas dissolved in a gallon of warm water can be employed to advantage for the purpose of deepening and fixing the color of any of the above stains. Vinegar is used to neutralize alkali stains before varnishing.

Verdigris, dissolved in soft water or vinegar, will give a green satin on almost all woods.

Sulphuric acid diluted with equal parts of water will give the so-called sixteenth-century effect on oak.

Bichromate of potash dissolved in water will give to walnut an effect resembling rosewood.

A strong solution of nitrate of silver applied to any wood and exposed to sunlight will give a metallic black stain.

As many of the chemical stains mentioned above are active poisons, extreme care must be used in handling them, and as a rule it is well for the workman to protect his hands with rubber gloves.

We have been asked by a subscriber for a method of preparing stains to make yellow pine look like antique oak, mahogany, and rosewood. As we have already explained, it is impossible to make one wood look like another if the character of the grain differs materially. The grain of yellow pine is so strongly marked, and is so characteristic that no matter how closely we may make the yellow pine imitate antique oak, mahogany, or rosewood in color, we can never hope to make it look like any of them. A number of varnish and paint manufacturers make stains with which a great many beautiful effects can be obtained on yellow pine, and unless our correspondent is an expert hardwood finisher, we would advise him to buy the prepared stain and use it strictly in accordance with the directions given by the manufacturer, rather than to attempt to make his own stains. We will, however, give him formulas for making the stains desired.

An antique oak stain is made by dissolving 12 ounces of soluble Vandyke brown in a gallon of water, to which is added a pint of ammonia of a strength of 16° or 18°. This is heated, and after it is removed from the stove, a half pint of turpentine is added to prevent raising the grain of the wood.

The simplest method of producing a mahogany stain is by boiling 2 ounces of soluble Bismarck brown in 1 gallon of water until the brown has dissolved. Strain, after it has cooled. Before using, warm it and add $\frac{1}{2}$ pint ammonia and $\frac{1}{4}$ pint turpentine.

For rosewood the above stain should be

mixed with about half its volume of walnut stain, which is prepared by dissolving 2 pounds of soluble Vandyke brown in a gallon of water, by boiling, and adding, while hot, 1 gill of ammonia and 1 gill of turpentine. It should be used while warm.

Many of the odd and beautiful effects produced by the furniture manufacturers are obtained by the use of colored fillers. In other words, the paste filler which is necessarily used up in filling up the pores of any open grained wood, is mixed with enough pigment color finely ground in oil to produce the effect desired. In some cases it is merely required to accent the grain, while in other cases a contrasting color may be employed. In any case where an open grained wood has been stained, the filler should be tinted to match.

WE regret to state that the diagram on page 345 of the February issue was incorrect, as several correspondents have called to our attention. It is very evident that with the arrangement there sketched, the buzzers would be in circuit with the battery, and would ring continuously. The proper position for the battery is between the button and the buzzer.

UNITED STATES Civil Service Commission. An examination will be held on March 17 and 18, 1909, for the position of Mechanical and Electrical Engineer at \$1200 per annum. Full information may be had from the United States Civil Service Commission, Washington, D. C., or from the secretary of the local board of examiners in any large city. The commission also announce that competitive examinations will be held in the spring of 1909 for a large number of technical positions, full information in regard to which may be had on request.

IMITATION IVORY

An inventor has discovered a new method of imitating ivory, which, owing to the rapid extinction of the elephant, has become very costly. The imitation is deceptively similar to and is said to possess the same hardness as the genuine article. He uses in its production the substances of which the genuine ivory consists; namely, tribasic phosphate of lime, carbonate of lime, magnesia, alum, gelatine, and albumen.

PRACTICAL NOTES

SIR HENRY DE VILLIERS, who attended the Quebec celebration as the representative of South Africa, acquainted himself *en route* with the progress being made in cutting the big 3000 carat Cullinan diamond. He explained that the two chief gems resulting will ornament the scepter and the crown of King Edward. When it was shipped to England, it was a moot question what the quality of the diamond would be, experts being unable to tell the perfection of a stone from the rough. Now it has been found to be of superfine quality, pure white, and possessed of remarkable brilliance and luster.

The cutting will employ three artisans for nine months. One of the diamonds will weigh 425 carats and the other will be slightly smaller, but both will be immeasurably larger than the Koh-i-Nor (102 carats). The great cost of cutting will probably be met by the value of the chips which come from the two perfect gems.

* * *

CEMENT

E. VIALI

THE following cement will stick to anything:—

Clean gum arabic.....	2 ounces
Fine starch.....	1½ ounces
White sugar.....	½ ounce

Pulverize the gum arabic and dissolve it in as much water as the laundress would use for the quantity of starch indicated. Dissolve the starch and sugar in the gum arabic solution. Cook the mixture in a vessel suspended in boiling water until it becomes clear. This should be as thick as tar, and should be kept so. To keep it from spoiling, put in a small lump of camphor, or a few drops of oil of cloves or sassafras.

This cement is very strong, and will stick perfectly to glazed surfaces, and is an ideal glue for repairing broken rocks, minerals, or fossils.

* * *

WITH a view to proving it possible by modern methods to build a house in a day, finishing it ready for occupancy by the owner, W. C. Carl of East St. Louis, Ill., recently put up a substantial four-room frame cottage containing parlor, dining-room, kitchen, bedroom, and bath, doing the work with thirty men in twelve hours. To construct the building 11,000 feet of lumber were cut

and fitted; 12,000 shingles were put on the roof; 75,000 nails were driven; 6000 laths were used on the walls and ceilings, and 375 yards of plaster applied.

* * *

NEW COMPASS OF GREAT VALUE

At a recent meeting of the League of German Naval Architects, a new compass was exhibited which is revolutionary in its nature. Unlike all other compasses, it has no magnetic needle. It is in the form of a gyroscope, and when suspended in a certain way, will always adjust itself parallel to the earth's axis.

The invention is regarded by German experts as of great importance for battleships, or any type of ship of steel construction. Magnetic compass needles are frequently deflected by the steel construction of ships.

* * *

A SINGLE-PHASE electric road is about to be built, connecting Baltimore and Washington.

* * *

It is estimated the power which could be generated at Victoria Falls in South Africa exceeds 200,000 h. p.

* * *

ETCHING CRYSTALS ON GLASS

It is not generally known that most crystalline salts when allowed to crystallize on glass afford a sufficient resisting medium to allow of their beautiful form being etched into the glass by holding them in the vapor of hydrofluoric acid. The process is exceedingly simple, says *The Master Painter*. Having the glass surface covered with crystals, protect all but the part to be etched with a paper mask and expose the glass to the fumes of the acid. No artificial heat is required at ordinary temperature. About a minute will suffice for the etching, after which wash the glass promptly, and the forms of the crystals will be found permanently reproduced on the surface of the glass. Common salt is one of the best crystals to experiment with; it crystallizes very easily, and the forms it yields are varied. By reflected lamplight some of the etched crystals give a beautiful iridescence, due to interference.

Electrician and Mechanic

Incorporating

Bubier's Popular Electrician.....Established 1890
Amateur Work.....Established 1901
Building Craft.....Established 1908

PUBLISHED MONTHLY BY

SAMPSON PUBLISHING CO.

BOSTON, MASS.

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

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, New Hampshire.

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. MARCH, 1909 No. 9

EDITORIALS

THE Department of Commerce and Labor has made a report on the statistics of telephones in the continental United States, in 1902 and 1907, respectively. This report includes all commercial and mutual systems and farmer or rural lines, but not telephones operated by steam or electric railways, or isolated systems operated by commercial and manufacturing enterprises, or federal, state, and municipal governments. This report shows a most marvelous growth in five years. The number of telephones has increased from 2,371,044 to 6,118,578, an increase of 158 per cent. The Bell companies have made a gain of only about 138 per cent, while the Independents have almost tripled, their

telephones increasing from barely over one million to practically three million. The increase in switchboards and exchanges is about 50 per cent, and it is evident that the common battery system is growing relatively much faster than the magneto. Automatic exchanges have more than doubled in number, but still total only 118. The number of messages has increased about 125 per cent, and it is estimated that the number in 1907 reached the enormous total of 11,372,605,063. Estimating that there are 80,000,000 people in the United States, this would make over 140 messages during the year for every individual in the continental United States. The total par value of stock and bonds outstanding has increased 134 per cent, and is now over \$800,000,000. This large investment furnishes employment to over 144,000 people, and the reward of their employment is over \$68,000,000.

* * *

THE Bowery Mission, of 92 Bible House, New York City, sends us an appeal to set forth in our columns the urgent need of the workless men whom it is trying to help. In New York, as in every great city, those who are out of work suffer far more at this season of the year than in the summer time, and this mission endeavors to minimize the sufferings as far as possible. While the mission is always glad to receive donations of money, its present purpose is to find employment, and offers its services in this respect free of charge to both employer and employee. We trust that some of our readers may be able to offer assistance.

* * *

THE wreck of the S. S. "Republic" has afforded a striking example of the great services to humanity which wireless telegraphy may upon occasion render. The newspapers were loud in their praise of the heroism of the operator and the value of the apparatus. The immediate result has been the stimulation of experimental work in wireless telegraphy on the part of thousands who had not previously become imbued with the fascination of this scientific marvel. We regret to say, however, that many amateurs in the neighborhood of Boston were so anxious to get news that they seriously interfered with commercial and naval work. As the result of the disaster, bills have been introduced in Congress, and will undoubtedly be passed, requiring the installation of wireless apparatus on all Atlantic passenger steamers.

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.

907. Generator Design. W. R., Mosgrove, Pa., asks if it is possible to make a generator on plan shown by his drawing, and if so, what size and how much wire for fields and armature, and about what output of current would it give? Ans.—Yes; you have the correct idea of the arrangement of parts and the electrical circuits. The name "shunt" in describing the field winding is not quite correct, for plainly, the excitation must be derived from a "separate" source. The size of machine is so small, however, that it is hard to state what the output would be. We would suggest No. 20 wire for both field and armature. You would get perhaps about 10 volts and an allowable current of 1 ampere. Use 5 to 10 volts to excite the field. At eighteen hundred revolutions per minute the frequency will be 60 cycles.

908. Hydraulic Ram. M. A., Milford, Ohio, asks: (1) If a small step-down transformer is used in connection with an electrolytic rectifier, as suggested in the November number, will the load on the primary of the transformer vary directly with the load on the direct current side of the rectifier? (2) Please describe the construction and operation of a hydraulic ram. (3) What will be the speed of the small single phase induction motor when operated on a sixty cycle current, as described a few months ago; and how much power will it produce at full voltage? Ans.—(1) The efficiency at best is rather low, being possibly fifty per cent at full load. At light loads it will be still lower; but within certain limits, the increase in load after the initial losses are supplied will demand proportional energy from the supply mains. (2) An encyclopedia article, or the circulars from a manufacturing company, will be more useful to you than the brief account we can give here. In general, the principle of operation consists in allowing a body of water in a long straight pipe a momentary flow, then, by the automatic closing of the check-valve, a sufficient impact is obtained by the hammer blow of the arrested water to open a much smaller valve against the pressure of the column of water on the other side, and actually to squeeze a little past. As soon as the immediate effect of the blow is over, the pressure of the water that has been pumped, or forced, closes this small valve; then the main valve, by its weight, opens, whence a second movement of water along the main pipe follows, and the cycle of operations is repeated. Address the Niagara Hydraulic Engine Co., 140 Nassau Street, New York City. (3) About

$\frac{1}{4}$ h. p., with speed at eighteen hundred revolutions per minute.

909. Engine-Rating. R. M., Hoopeston, Ill., asks: (1) How are engines tested by a dynamometer and the horse power determined? (2) Are battery lamps as efficient as those made for regular lighting circuits? (3) What is the pitch, speed, etc., of the screw propellers of the largest ocean liners and battleships? Ans.—(1) A dynamometer is essentially a Prony brake, which operates on the rim of a wheel driven by the engine. The push downward at the end of a definite length of lever arm is measured on platform or spring scales, and the computation of the foot-pounds made. This number multiplied by the revolutions per minute, by 6.28 (the circumference of a wheel of unit radius), and then divided by 33,000, will give the effective horse power. (2) Yes, quite as good, but their operation is of course expensive. (3) There is such a variety as to preclude giving any definite data.

910. Battery Behavior. T. L., Bennettsburg, N. Y., asks: (1) What is the trouble when a Fuller battery gives only $1\frac{1}{2}$ volts and $\frac{1}{2}$ ampere, when the porous cup cracks or flakes off, and the zinc quickly loses its amalgamation? (2) What are the lengths of filaments in small battery lamps? (3) What changes should be made in a small generator that gives 3 volts and 3 amperes to make it give 8 volts and 1 ampere? Present winding is of Nos. 25 and 16 wire. Ans.—(1) The cracks in the porous cups are fatal to their usefulness; new cups must be provided. (2) We do not know, and the only way is to guess at the lengths. Of what use would the information be? You can send to the General Elec. Co., Harrison, N. J., Miniature Lamp Dept., for circulars showing the size of lamps. (3) Probably a shunt winding would be more serviceable to you than the present series. The wire on armature seems about right now, but the field-magnet must be faulty. Try No. 25 on that also, and connect it as a shunt to the armature. If the wire gets too warm, wind on more of the same size.

911. Rubber. P. M. E., Salisbury, N. C., asks: (1) What will keep rubber from solidifying after the heat for melting has been removed? (2) Where can vaseline be purchased the cheapest? Ans.—(1) The behavior of rubber seems like that of metals, which naturally solidify on cooling. You can make a solution of it in bisulphide of carbon. Caution must however be taken in using this solvent. It is very inflam-

mable and poisonous. (2) From the Chesebrough Manufacturing Company, New York City.

912. **Wireless Telegraphy.** R. E. S., Great Barrington, Mass., asks: (1) I have a double strand antenna 30 feet high at the highest point, which extends from the house to a tree about 40 feet distant. My antenna is made of galvanized iron wire. I use an electrolytic detector, tuning coil, variable condenser, potentiometer, dry cells, and two 75-ohm telephone receivers. What should my receiving radius be under favorable conditions? (2) Would a silicon or carborundum detector work as well as the electrolytic? (3) Is the galvanized iron wire all right for the antenna?

Ans. — (1) Your receiving radius should not be much over 15 miles, as you are wasting much of your aerial efficiency by using iron wire; and also, with low resistance receivers it is not possible to receive from any distance. (2) A silicon detector is as sensitive as a carborundum detector, or an electrolytic, but you must bear in mind that strong patents cover these detectors, and unless you purchase them from the owners of these patents, you render yourself liable to suit for infringement. Many cheap imitations of these detectors are now on the market, and it will only be a short while before these infringing instruments will be taken from the market. (3) You should use 7 strand No. 21 tinned copper wire, made into a cable. Iron wire is very bad.

913. **Wireless Telegraphy.** P. C., Plainfield, Ill., asks: (1) How many dry batteries are used to operate a 4-inch induction coil to be used for wireless telegraphy? (2) In the 4-inch induction coil described in the April number, could No. 34 B. & S. gauge s.s.c. copper wire be used instead of No. 36, as I want to use the coil for wireless telegraphy? (3) Would four parallel wires down each side of a roof from the ridge-pole, AB one side, B top, B' C other side, be practicable? "A" is the receiving station, 25 feet high. "B" is top of a church steeple, 100 feet high. "C" is a barn about 25 feet high. Distance from "A" to "B" is about 175 feet. Between "B" and "C" is about 160 feet. How far could I receive, using an electrolytic detector? Ans. — (1) Dry batteries are not suitable for a large induction coil. Type Q, Edison Batteries should be used. (2) Yes, No. 34 wire may be used. (3) It is not necessary, and in fact impractical, to bring your aerial down from B to C, unless you intend using some balanced or Hertzian loop system, similar to DeForest. For experimental purposes, the portion from A to B is ample.

914. **Wireless Telegraphy.** J. E. L., Fort Luscum, Alaska, asks: On a cable about 4 miles long, used both as a telephone and telegraph line, there is a 6 microfarad condenser on telephone circuit which gives fairly good satisfaction, and on telegraph circuit there is a choke coil (resistance unknown to me) which is supposed to protect telegraph instruments from interruptions from telephone sources, but does not do so. When telephone rings, it rings through relay, closing local circuit and causing such noise on local sounder that work must stop until ringing ceases. Can it be wired in such a manner that the telephone ring can be prevented from interfering with relay? The telegraph is on a closed circuit system, and grounded. Ans. —

It is evident that the choke coils used are either bad or else have not sufficient impedance to round off the waves sent out by the generator. By testing the choke coil for short circuit, comparing its resistance with another coil, or by winding a new coil and trying it in the circuit, this trouble may be determined and corrected.

915. **Wireless Telegraphy.** H. A. C., Derry, N. H., asks: (1) I live in a large valley 280 feet above sea-level. On one side there is a range of hills about a mile away. On the other side of the hills is a wireless set about 2 miles from the hills. Could I, with an 80-foot pole, telegraph to him? (2) Is there anything better than chicken wire for an antenna? (3) Is the aerial wire in the transmitting part connected to the antenna? If so, do you use a wire separate from the receiving wire to send on? Ans. — (1) You should have no difficulty in working with your friend with the aerial you describe, if you use tuned circuit apparatus. (2) The best wire for aerial work consists of 7 strands of No. 21 tinned copper wire, made into a cable. This may be obtained from wireless supply dealers. (3) The same aerial is used both for transmitting and receiving, a suitable switch being used to throw over from one set to the other, as shown in the June, July, and August issues, in articles by W. C. Getz.

916. **Wireless Telegraphy.** Bro. A., Saint Cesaire, Can., asks: How many sheets of tin-foil, and the size, are to be used for an adjustable and non-adjustable condenser? We sometimes use these kinds of condenser in some wireless receiving apparatus. Ans. — The number of metal sheets depends on the capacity desired. On the No. 120 condenser of W. C. Getz, two sheets of tin-foil 3 x 6 inches are used. This gives a capacity of about .002 m. f. For adjustable condensers, sheet brass or zinc is used.

917. **Wireless Telegraphy.** L. Q., Salem, Mass., asks: (1) How is sound reproduced by the steel wire type of telegraph, and how is record made and removed at will on the same wire? (2) Where can I obtain Wollaston wire for electrolytic detectors, and how much bare German silver wire (No. 26) would be required for a potentiometer 5 inches long and 1½ inches in diameter, wound as described in the July number; also, what would the approximate resistance be? What is the method of calculating the amount of wire needed to fill a given space? (3) Where can a condensed list and short description of each of the patents granted on wireless and allied apparatus be obtained, and does the United States government publish an up-to-date list of wireless calls and stations which may be obtained by amateurs? Ans. — (1) By passing the wire rapidly through a magnetic field, in which a telephone receiver is connected to a fine wire winding. This causes a change in the lines of force, which in turn produce electricity in the coil of wire, thus actuating the receiver. The record is destroyed by running it through an alternating current field, or by annealing, redrawing, and tempering the wire again. (2) Wollaston wire may be obtained from W. C. Getz, of Baltimore, Md. For potentiometer, use No. 30 German silver wire. About ¼ pound will be needed. The resistance should be about 200 ohms. To calculate for wire needed, multiply the diameter of mandrel by number of turns of

wire to the inch by 3.1416, and divide by 12. This will give the number of feet of wire per inch length. Find the resistance of this many feet from a wire table, and divide resistance desired by this resistance. The result will be the length of mandrel in inches. (3) A list of wireless patents can be secured from any patent attorney in Washington, D. C. For books of the government on wireless, application should be made to the superintendent of Public Documents, Government Printing Office, Washington, D. C.

918. **Wireless Telegraphy.** G. E. T., Ravenswood, Ill., asks: (1) Can you tell me name of book that explains processes of oil insulation and the vacuum drying of coil while in construction? (2) Do you need two antennas for sending and receiving, or can you use the same one for both? Ans. — (1) There is no recent book treating this subject thoroughly that we know of. (2) One aerial is sufficient for both sending and receiving, if provided with a suitable switch for changing from one set to the other. See diagram in August, 1908, issue, article by W. C. Getz.

919. **Wireless Telegraphy.** N. C., New York, asks: What is the most efficient proportion of capacity to induction in a tuned circuit? Ans. — This depends entirely on the fundamental wavelength of the aerial and the amount of energy used in the charging source; it can only be determined for a given aerial, by test, using the hot wire meter, as explained in the various articles by W. C. Getz, in recent issues of this magazine. An approximate determination can be figured out by using higher mathematics, in conjunction with the basic formula of static phenomena, but the calculation involved is too deep for the average experimenter.

920. **Wireless Telegraphy.** L. A., Newton Highlands, Mass., asks: How can I cut down the 110 lighting circuit so that I can run a $1\frac{1}{2}$ inch spark-coil? Ans. — Put a lamp-bank in series with your coil, as given in the August, 1908, issue of the ELECTRICIAN AND MECHANIC, article on "Wireless Telegraph Transmitting Apparatus," by W. C. Getz. If your lighting current is alternating, you can place an impedance coil in series; make this about 6 layers of No. 18 magnet wire, wound on an iron wire core, 2 inches in diameter, and 12 inches long; bringing out taps from each layer.

921. **Wireless Telegraphy.** R. E. J., Sonora, Cal., asks: (1) The secondary voltage of the 250-watt transformer, used for wireless work? (2) Size of wire? Ans. — (1) If the secondary voltage is from 10,000 to 40,000 it may be used for wireless work. (2) Size of secondary wire should be from No. 28 to No. 34 B. & S. gauge.

922. **Wireless Telegraphy.** J. R. F. P., Fordham, N. Y., asks: (1) What are the directions for making a 250-watt closed core type sparking transformer to be used on 110-volt alternating current? (2) What is the composition of the metal of which a sample is sent? (3) How can a 75-ohm telephone receiver be rewound so as to make it 1000 ohms, or as high as possible? Ans. — (1) This will be given in a later issue. Complete directions may be obtained from W. C. Getz, of No. 345 N. Charles Street, Baltimore, Md., for construction of this type of transformer. (2) Seems to be steel wire,

known as "piano" wire. (3) This is difficult for the experimenter to do, as it not only requires much experience, but also a knowledge of the peculiar properties of enameled wire, of which but little is known. It is cheaper to send the receiver to some reliable specialist for this work.

923. **Dynamo Winding.** C. B. H., Montreal, Can., has castings for a dynamo of the familiar Edison shape, field-magnet cores being 5 inches long and $2\frac{1}{4}$ inches in diameter; upper yoke is of $2\frac{1}{4} \times 1$ inch section. Bore is $3\frac{1}{8}$ inches in diameter and 3 inches long. Armature is laminated, and has 12 slots. He asks (1) If there is enough iron in the yoke, and (2) What winding should be used to provide for an output of 30 volts? Ans. — (1) No, this is only about one half the section of the cores; let it be of about the same dimensions, but of wrought iron. The field cores are too long, and will be improved by shortening them 1 inch. There will still be room for all the wire to bring the iron near enough to magnetic saturation. In their present shape you can make the spools about $3\frac{1}{8}$ inches in outside diameter, and wind 130 turns per layer, 14 layers of No. 20 single-covered wire; 9 pounds in all will be needed. If you shorten the cores, use larger diameter spools, so as to hold about 18 layers. If the speed is to be about 2000 revolutions per minute, you will need 80 wires per slot, 40 turns per half winding, and a 12-segment commutator. As you did not state the size of slots, we cannot tell you what size of wire will fit.

924. **Exciter.** P. R., Bentonville, Ark., asks: What size of alternating current dynamo will a 12-watt exciter fit, and where can the parts for such an alternator be secured? Ans. — Possibly a 100-watt machine, but 12 watts is such a trifle of electrical energy it is hard to be sure you have it at all. We do not know of any one selling such toys.

925. **Crude Oil Engine.** P. M. E., Salisbury, N. C., asks: (1) How many gallons of crude petroleum oil an engine will consume per horse-power hour, and (2) How many kilowatt a 10 h. p. engine will generate? Ans. — (1) What is known as "crude" oil varies largely in its chemical constitution, and no definite answer can be given. We advise you to correspond with some manufacturer of engines, say the Otto Gas Engine Works, Philadelphia, Pa. (2) About 7 kilowatts.

926. **Rewinding.** A. R. G., Telluride, Col., has a Knapp "S" dynamo rated at 6 volts and 4 amperes, speed being 3000 revolutions per minute. He asks if it can be rewound for 105 volts and 10 amperes. Ans. — Your question is ridiculous. Even the 24-watt rating is high, and the speed already difficult to care for. How could you expect 1050 watts? Such a machine would weigh 200 pounds. A new book by Watson gives full drawings and description of a dynamo of just this output, 1 kilowatt.

927. **Counter Electromotive Force.** J. E. T., Cleveland, Ohio, refers to a certain text-book in which the statement is made that the efficiency of an electric motor depends upon the value of the counter e. m. f. it generates, and that it is impossible to build a motor which does not produce this counter pressure. Is this correct? Ans. — Yes. In the motor, there are conductors cutting through the field of force exactly as in the case of

a generator, and by an inviolable law of nature an electromotive force is generated. That it acts in a direction counter to the current that produces the torque is also fundamental. A clear explanation of this action was given in the Engineering series, in Chapters VII and VIII, January and February, 1907.

928. **Twenty-light Dynamo.** C. E. K., Harrisburg, Pa., sends the following specifications for a dynamo: Winding space on field spools, $5\frac{1}{2}$ inches long, $\frac{5}{8}$ inch deep, radially; field bore, 5 inches long, $3\frac{3}{4}$ inches diameter; armature, $5\frac{1}{2}$ inches long, $3\frac{3}{4}$ inches diameter, laminated; 24 slots, $\frac{1}{2} \times \frac{1}{2}$ inch; commutator has 24 segments; field-magnet is of cast steel. He asks what should be the winding for 110 volts and capable of operating 20 16 c. p. lamps? Speed, 2500 revolutions per minute. Ans. — It is a pity that you could not afford time to make a sketch of the machine, for without it our estimate is worth very little to you. All we can do is to suggest No. 16 wire for the armature, and No. 19 or 20 for the field. We have no means of computing the number of turns requisite.

929. **Electric Power.** A. C. W., asks: What is the highest amperage and voltage he can get from a dynamo run by direct coupling to a $\frac{1}{4}$ h. p. steam-engine? Ans. — This question is very indefinite; $\frac{1}{4}$ h. p. means nearly 200 watts of electrical energy. An engine may deliver $\frac{1}{4}$ h. p. to a dynamo, but the latter has some unavoidable losses, and in small machines these may be relatively high. If you secured 150 watts, you would be doing well. There can be almost any range of the volts and amperes as long as their product did not exceed 150. It would be impracticable to try to wind for higher than 110 or lower than 5 volts. We do not have any designs for a dynamo of this size for a speed low enough to admit direct coupling. Watson's $\frac{1}{4}$ h. p. machine is an excellent one, and you can readily drive it by means of a belt. Castings for it cost \$4.

930. **Carbons.** C. S., Hamilton, Ohio, asks: (1) What is the proper size and amount of German silver wire for use as a resistance with a hand feed arc lamp that has $\frac{5}{8}$ inch diameter carbons? (2) What are the best carbons for such a lamp? (3) Where can small punchings for dynamo armatures be obtained? (4) Can we design small generators of 10 to 100 watts output, and at what price for each? (5) Where can drawings be obtained for the $\frac{1}{4}$ h. p. gas engine described two years ago? Ans. — (1) You did not state what voltage was at hand, nor how many amperes you use. Supposing the common conditions of 110 volts and 13 to 15 amperes, you will need about 7 pounds of No. 10 wire of the 18 per cent grade. It must be wound open for free ventilation. (2) The genuine imported "Electra" carbons are the best, and any dealer will supply them if you insist upon having them. Hugo Reisinger, 11 Broadway, New York City, is the general agent. (3) Carlisle & Finch Co., Cincinnati, Ohio. (4) Yes, but we would not think it worth while to design such small ones. Nothing smaller than $\frac{1}{4}$ h. p. appeals to us. About \$5 per machine for the sketches and calculations, but more if you wished working drawings. (5) From the author, William C. Houghton, Waltham, Mass.

931. **Gravity Motor.** E. C., Huntington, L. I., asks for directions for making such a con-

trivance, say by winding up a large weight, for running a small dynamo. Ans. — Such an arrangement is highly impracticable. Counting in the loss by friction, you will not get back more than one half the power required to wind it up. At best its power will be feeble and short-lived. Better use a wind-mill.

932. **Tungsten Steel.** J. E. D., Montreal, Can., refers to the Engineering article on Measuring Instruments, in which it is stated that tungsten is a desirable impurity in the magnet steel. He asks where he can get such a quality? No one in his city seems ever to have heard of it. Ans. — This grade was first made in Germany, and large quantities of it are still imported. The agents for North America are Leslie & Co., in your own city. The author of the article you mention keeps a stock of the magnets on hand, and they can be obtained from him at \$1.50 each.

933. **Wimshurst Machine.** E. K., Farmer, Ohio, asks: (1) Is it practicable to substitute copper for brass in the construction of the rods, etc., and steel for the spindles? (2) May the glass pillars be tubes, and serve also as Leyden jars, or must they be solid? Ans. — (1) The use of copper and steel, as you propose, is allowable, the only point being, for look's sake, to use materials that will keep bright. (2) The pillars can be hollow or solid, as you please, but the Leyden jars must be of thin glass, with some considerable area for the tin-foil. If you can combine these features, you will be on the safe side.

934. **Telephone Dynamo.** C. B., DeFuniak Springs, Fla., asks: (1) If it would be beneficial for the operation of a magneto from a telephone set used for a direct current machine to wind the limbs of the bars? (2) What would be the output? Armature is $1\frac{1}{4}$ inches in diameter and 3 inches long. (3) What is the size of wire sent? Ans. — (1) Yes, this is frequently done with considerable increase of power. (2) If you wind the armature with No. 25 wire and the field with No. 20, you may get 10 or 12 volts and 1 ampere. (3) No. 25.

935. **Gyroscope.** M. T., West Unity, Ohio, asks: (1) Where can such an instrument be obtained? (2) What should be the weight of a fly-wheel for a $2\frac{1}{2} \times 3$ inch steam-engine, and where can one be obtained? Ans. — (1) From the Central Scientific Company, Chicago, Ill. (2) 15 to 20 pounds. From Carlisle & Finch, Cincinnati, or from L. H. Wightman & Co., 130 State Street, Boston, Mass.

936. **Battery Motor.** F. P. H., Baltimore, Md., sends an excellent drawing of a $\frac{1}{4}$ h. p. Crocker-Wheeler 10-volt, 12-ampere battery motor, such as that firm manufactured 20 years ago. The field was wound with No. 14 wire, but that has been removed. The armature is wound with No. 17 wire, and now the desire is to rewind the field-magnet so as to allow the same armature to be used, and allow machine to serve as a generator for charging a few storage cells or for lighting miniature lamps. What winding will suffice? Ans. — The spools should be large enough to hold 60 turns per layer, and 20 layers of No. 20 single covered wire. About 5 pounds will be needed. Connect in shunt to the armature, with a rheostat that has about 15 ohms

divided into at least 16 steps; $\frac{1}{4}$ pound of No. 20 German silver wire, of 18 per cent grade, will suffice.

937. Wireless Telegraphy. H. M., New York City, N. Y., asks: (1) Which is the better, a rubber or a mica tube, to insulate primary of an induction coil from secondary? (2) What size and how many layers of wire should the primary of a coil have, whose secondary has 7 pounds of No. 34 wire wound in twenty-five sections, $\frac{3}{4}$ inch in diameter? The coil will be used with electrolytic interrupter on 110 volts. Ans. — (1) Micanite tube is the best. This may be obtained from Mica Insulator Co. of New York. (2) You have not made your secondary in the right proportions. For 110 volts, your primary should be about four layers of No. 12 d.c.c. wound on a core $1\frac{1}{4}$ inches in diameter and 15 inches long.

938. Wireless Telegraphy. C. O. S., Los Angeles, Cal., asks: I have made a three-plate rectifier, as described by Mr. Getz in November's issue. It does not work. What is the reason? The rectifier I made is illustrated in Fig. 2, page 205. I used Merck's sodium phosphate. It does not dissolve in water as I judged it should. I have made it exactly as article said. The lead plate I think is a trifle too large, being 3-32ds, but that is the closest I could get to 1-16th. I think the whole fault lies in the solution. Ans. — The sodium phosphate should dissolve in water after several hours. Probably you have reversed one of the plate connections, or are not using sufficient reactance across the terminals. This type has been successfully worked in many cases, using same proportions and sizes, and has given no trouble.

939. Wireless Telegraphy. A. H. P., Arlington Heights, Mass. (1) Where can I buy two coils 18 inches in length for a powerful wireless receiver, and what is the price? (2) Could you give me some practical hints about making a sender for a wireless set, not too powerful and not too expensive? (3) If an aerial pole is 20 feet high, how large need the cross-arm be, and how many wires of what number need to be used on the cross-arm like picture? Ans. — (1) Write to W. C. Getz, of 645 N. Fulton Avenue, Baltimore, Md., who may be able to supply you with same. (2) See articles in August issue of *ELECTRICIAN AND MECHANIC* by V. W. Delves-Broughton, O. Kerro Luscomb, and W. G. Getz. (3) Use four wires, connected as shown in June issue. Make the cross-arm 3 feet wide, spacing the four wires 1 foot apart. Use seven strands of No. 21 B. & S. gauge tinned copper wire. This may be obtained from wireless supply dealers advertising in this issue.

940. Wireless Telegraphy. E. B. P., Dorchester, Mass. Would you please consider my sketch of a receiving outfit and see if it is wired right. I made the switchboard with four binding-posts. Do you think the fourth would be necessary? Would this kind of wire do for a tuning coil? Ans. — You have shown no condenser in your receiving circuit. This should be inserted between the detector and tuning coil. The fourth binding-post, while convenient, is not essential.

941. Wireless Telegraphy. C. A., Mediopolis, Ia. (1) How high would be the aerial and how

many wires would there have to be run to it, using a coil made of 15 pounds No. 32 wire, 300 ohm receivers, electrolytic or silicon detector, to work a distance of 92 miles across country, the country being fairly level? (2) What should the length and diameter of core be on coil wound with 15 pounds of No. 32 wire? (3) How many sheets of tin-foil in the condenser? (4) How is the variable condenser in the sending and receiving set connected up? Ans. — (1) Aerial would have to have a vertical height of about 90 feet. Use four wires, as shown in the June issue of *ELECTRICIAN AND MECHANIC*, as described in article on construction of aërials, by W. C. Getz. Your 300-ohm receivers are not sensitive enough. You should have 1500-ohm receivers. You should also use tuned circuit apparatus, as, unless you do, the results obtained will be very poor. (2) Make the core 20 inches long and 2 inches in diameter. (3) This cannot be determined until after the coil is made. See answer to C. L., Menominee, Mich., in this issue. (4) The variable condenser is not used in sending set. It is used in the receiving set, in series between detector and tuning coil, as shown in July issue, article by W. C. Getz, on "Tuned Circuit receiving Instruments."

942. Wireless Telegraphy. W. B., Oak Park, Ill. Will you tell me if I can telephone 100 miles with a telephone of 75 ohms, resistance? I can take coil of any resistance outside the telephone anywhere, but I cannot take a telephone any higher than 75 ohms. I am doing a little experimenting, and would like to know if I could telephone 100 miles with a 75-ohm telephone. Ans. — If you use a telephone induction coil connected as in the regular sets, you should have little difficulty in hearing over 100 miles with a 75-ohm receiver, as this is about the standard resistance for all long-distance telephone instruments. Of course, the transmitter must be similar to the "solid" type of long-distance transmitters now in extensive use by all telephone companies.

943. Wireless Telegraphy. C. L., Menominee, Mich. (1) What amount of voltage and amperage should be used on a spark-coil (jump), primary being made of three layers of No. 12 s.c.c. copper wire, wound on a core 12 inches long and $1\frac{1}{4}$ inches in diameter? (2) How many sheets of tin-foil $3\frac{1}{2} \times 8$ inches, with two sheets of paraffined rice paper between each sheet, would be necessary for the condenser for above primary? Ans. — (1) About 20 volts direct current. If, however, alternating current is used, the coil will, no doubt, stand a voltage of 110, but this should be carefully determined by using an alternating current ammeter, so that it can be seen how much current flows through the coil. (2) Make up your condenser in units of ten sheets, each unit having five sections. In this manner you can try, say, ten units, and increase or decrease the number until it suits your coil. The condenser size depends on the coil, and varies with different conditions, so that it can rarely be determined beforehand.

944. Wireless Telegraphy. H. C. B., Norwood, Mass. Could tungsten be used in detector described on page 347 of February issue as well as tantalum? Ans. — We have never

heard of its being used. You might try it and see how it works.

945. **Wireless Telegraphy.** C. A. R., Seattle, Wash. (1) If I would change the 500-watt transformer coil in the August issue to 250 watts, to be put on the secondary and primary, what would be the length of core and width, or diameter? (2) What size spark would this coil produce, and how far would it send a message in wireless work? Ans.—(1) Use two thirds of material specified in coil in August issue. The cost would be but very little more for 500-watt type. (2) About one half of the spark of the 500-watt type. Under good conditions, would transmit 25 miles.

946. **Wireless Telegraphy.** W. C. V., Brooklyn, N. Y. Would a spark-coil made up as per following dimensions give a 2-inch spark suitable for wireless telegraphy? Secondary, No. 36, about $2\frac{1}{2}$ pounds; primary, No. 14; two layers core, 9×1 inches. Would the coil work satisfactorily if it were wound on five or six spools, and connected center to center and outer ends to outer ends? Ans.—You should use about No. 32 or No. 34 wire. No. 36 is too fine. Wind in sections $\frac{1}{8}$ inch or $3\text{--}16$ ths inch wide, and reverse every other section when assembling, thus keeping the wire always turning in same direction.

947. **Wireless Telegraphy.** M. H. S., Gloucester, Mass. Will you please tell me if this will do as a tuning coil? It was formerly used to reduce the number of volts from 110 to about 6. It has about three hundred turns of about No. 30 bare German silver resistance wire, wound on a hollow core 10 inches long and 1 inch in diameter. Ans.—It will not do. It has too much resistance, and is not big enough in diameter. Copper wire should be used, as described in article by W. C. Getz in July, 1908, issue.

948. **Wireless Telegraphy.** F. McK., Oakland, Cal., asks: (1) How is an oscillation transformer made? (2) Where and at what price can Baker's "Telegraphing through the Air" be obtained? (3) What should be the receiving radius of a wireless station having a four-wire aerial, with 3-foot spreaders, 50 feet long, and supported by two masts 45 and 30 feet long. The instruments are a tuning coil, adjustable condenser, electrolytic detector, potentiometer, and two 1000-ohm receivers, connected according to W. C. Getz's diagram in July *ELECTRICIAN AND MECHANIC*. Ans.—(1) This will be described in a later issue. As a complete description could not be given in this column, we must ask you to wait until the number containing same is issued. (2) A list of about all the books on wireless was published in our February, 1909, issue, including the most recent ones. We do not seem to know this particular one. (3) About 200 miles under favorable conditions.

949. **Wireless Telegraphy.** C. C. H., Washington, Kans. (1) Is there any wireless station nearer to me than Kansas City, and is an aerial 36 feet in height high enough, if a good tuning coil were used in connection with an auto coherer and 75-ohm telephone receiver? (2) What is the best way to recharge a dry battery? (3) How many batteries would be required to run a hand-power dynamo, No. 7, at full speed? Dynamo is offered in J. W. Scribner's cat, Tona-

wanda, N. Y. Ans.—(1) A 36-foot vertical aerial under the best conditions will only work about 150 miles. Another thing, the low resistance receivers will not give any good results. You should either have them rewound or get a new pair. (2) The best way is to get a new one, as the elements are usually so far gone that it is not worth while. However, if you wish to experiment on the subject, a very good article in the February, 1909, issue gives much valuable data on same. (3) In our opinion, Mr. Scribner must have a very remarkable cat. The best we ever got out of a cat was a small discharge of static electricity. However, this seems to be quite an improvement, and we will await with interest any further tests on the feline.

NOTE.—It is hardly possible to run a dynamo with batteries, as, although designed the same as a motor as far as the magnetic portions are concerned, the windings are often different, which would thus cut down the efficiency when run on batteries. At the most, it is an expensive proceeding.

950. **Induction Motor.** C. D. F., Salem, Ore., asks: (1) What wire gauge is used in the 25-cent book, "Small Dynamos and Motors"? (2) Is the single-phase induction motor described in *ELECTRICIAN AND MECHANIC* for May, 1908, strong enough to run a washing machine? If not, what proportions should be used? Ans.—(1) Birmingham Wire Gauge is the one principally used in England. (2) Your question is too indefinite, because a washing machine might require 1-10th h. p. or $\frac{1}{2}$. Probably this motor is not strong enough. The difficulty in making a home-made induction motor which will be at all economical is in the accurate making of the rotor and stator so that practically no air-gap exists between them. A competent designer has been working for a year or two endeavoring to plan for us an induction motor which would be within the capacity of the average amateur, and we still hope to be able to publish this article later, but progress is slow.

THINGS RECEIVED

The Garvin Machine Company, Spring and Varick streets, New York City. Illustrated catalogue, illustrating and describing profiling machines, Lincoln and Duplex milling machines, vertical spindle milling machines, universal cutter and tool grinder, vertical, horizontal, and automatic tapping machines, duplex drill lathes, and gang drills. The catalogue is printed in English, French, and German, and describes a well-planned and constructed line of machine tools.

Frictionless Metal Co., Chattanooga, Tenn. "The Tale of the Frictionless Bars." An interesting little pamphlet in colors, which is both humorous and good advertising.

N. Curtis Fletcher & Co., 24 Milk Street, Boston, Mass. Circular of financial statistics, relating to New England gas and electric light securities, giving much valuable information for investors.

Pike Manufacturing Co., Pike, N. H. "A suggestion on Progressive Methods." This booklet lists in detail the combination stock and display cabinets for oil stones and abrasive materials which are furnished by this progressive firm, and gives full particulars as to prices, etc. The book is intended only for dealers, but will undoubtedly be sent to them upon request sent in on their letter head.

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.

BOSTON, MASS., January 24, 1909.

Sirs, — In reply to Sampson Publishing Co. letter, regarding noon-time signals, as sent by wireless from this station, I submit the following report: —

The time as sent by wireless is sent by the U. S. Naval Observatory, Washington, D. C., and is Washington time. It is sent over the telegraph wires, and through the medium of a sounder, acting as a transmitting key, operates the wireless transmitter.

The signals commence at 11.55 A.M. and are sent out in dots, one for each second, except the 29th, 56th, 57th, 58th, 59th, and 60th seconds, which are omitted for the first four minutes; on the fifth and last minute, the 29th, 50th, 51st, 52d, 53d, 54th, 55th, 56th, 57th, 58th, 59th seconds are omitted, and on the 60th second a long dash is made, which signifies twelve o'clock noon.

The signals are sent every day, except Sundays and holidays; it sometimes happens that owing to some fault on the telegraph lines, the signals are not sent until the first, second, third, and sometimes the fourth minute has gone by, and occasionally not received at all, over the telegraph wires.

Equipment Officer, Very respectfully,

Navy Yard, W. V. Albert, Ch. Elect. U. S. N.
Boston, Mass. *In charge of station.*

THE following letter from one member of our Wireless Club to another may give some ideas on the building of cheap wireless apparatus. In our opinion great ingenuity is displayed in the letter.

"I wish you could come up here and I could explain this wireless receiver to you nicely. However, I'll do my best on paper. I think you'll find it a peach, for I had no trouble in receiving sixty miles with it with only a pole, the top of which was 56 feet above the ground. I obtained this elevation by means of a short pole on my roof, and the instruments were in the attic. The set has an improvement over mine in the potentiometer which makes it much more sensitive. My aerial has four parallel wires of No. 16 copper or bronze. It was, of course, carefully insulated with porcelain knobs wherever it came near the wood. My ground was on the water pipe.

"My tuning coil is simply one hundred turns of No. 17 bare copper wire wound on an old butter tub. Sliding contacts could be obtained by two leads. Tuning was accomplished by simply moving one of them up and down the coil until the signals could be heard at their loudest. A small condenser, made of four half sheets of yeast cake tin-foil and waxed paper, was used simply to prevent the batteries short-circuiting through the tuning coil. I bought two telephone receivers from the Manhattan Electric Supply Co., Cortlandt Street, New York, at 42 cents each. They were, of course, wound to 75 ohms, but I unwound them and wound on all the No. 40 wire the coils would hold. This brought them up to 350 ohms apiece and used about $\frac{1}{4}$ ounce of wire. I made a head strap of brass, for you want to use your hands for adjusting rather than holding telephones. The potentiometer con-

sists of a hard wood stick wound with about two hundred turns of bare German silver wire of a size such that the total resistance will be about 300 ohms.

"Last, but by no means least, comes the electrolytic cup. Mine consisted of a small glass jar about 1 inch diameter and 20 inches high. It was fitted with a rubber stopper through which two glass tubes were pushed. Through the bottom of one of these a piece of No. 24 platinum wire was sealed with a lead going out above.

In the bottom of the other a piece of platinum wire .001 inch was sealed, and then the end worked off flush on an oilstone. I got a contact here by filling the tube with mercury with a copper wire dipped in this. You can get this .001 wire from the Ohio Electric Co., Cleveland, Ohio, for 10 cents per inch. The glass jar was then filled above the level of the points with a 20 per cent solution of sulphuric acid and water. Now in connecting it up, I don't remember whether it is the positive or negative which is connected to the smaller point, but at any rate the one which produces the least noise in the telephone when you connect it up is the correct one. I can tell you for sure when I go home next time.

"To adjust the potentiometer, simply move your contact until no noise is heard in the telephone. You see the object is to balance the current from the batteries against that which the small cup generates. Then when a wave comes the resistance of the cup is raised, hence the balance is upset and you get a buzz in the telephone."

ONE of our Club members writes as follows: —

I have an aerial composed of six wires 50 feet long. It is supported by a 25-foot pole on the roof, and extends down the rear of the house to an extension on the third floor, where it is fastened, and led to my operating room on the same floor. With this aerial I am able to hear all commercial messages within 250 miles. The above results were under ordinary conditions.

I would be pleased to know the names and address of the members of the Wireless Club in New York City, in order that I might meet them and try to form a local meeting place. E. V. A.

THE Marconi Wireless Telegraph Company of America announce elsewhere in this issue that they are prepared to sell as souvenirs, genuine Marconi coherers which have been in use in commercial Marconi installations. For prices refer to the advertisement.

THE Clark Wireless Telegraph and Telephone Co., of Detroit, which has a practical monopoly of wireless communication on the Great Lakes, has recently installed a wireless station in the editorial offices of the *Detroit Journal*, which thus becomes the first newspaper in the United States to own a wireless equipment.

BOOK REVIEWS

DRAWING INSTRUMENTS. By Walter G. Stephan, M.E. New York, McGraw Publishing Company, 1908. Price, \$1.

The production of this excellent little manual was caused by the lack of any satisfactory book on this

subject of recent date. The book considers the various instruments which are in use by draftsmen, and gives full and explicit directions for the selection, care, and use of each, including the labor-saving devices which have been put upon the market in recent years. The book is a necessity for the library of every engineering student and draftsman.

ELECTRIC MOTORS; THEIR INSTALLATION, CONTROL, OPERATION, AND MAINTENANCE. By Norman G. Meade. New York, McGraw Publishing Company, 1908. Price, \$1.

This concise book of about 160 pages, profusely illustrated, covers very interestingly and explicitly the subject indicated by its title. The book is written practically without mathematics, the diagrams and illustrations giving full information wherever the text is not sufficient for description. The book explains the phenomena of electric motors, describes the various types which are in use, and the auxiliary apparatus used with them. Finally, there are several chapters on installation, operation, and care of motors for practical users.

THE THEORY, DESIGN, AND CONSTRUCTION OF INDUCTION COILS. By H. Armagnat. Translated and edited by Otis Allen Kenyon. New York, McGraw Publishing Company, 1908. Price, \$2.

This book fills a gap in electrical literature. The limited use of the induction coil long rendered its theory and design a neglected branch. The progress of recent years, which has made the induction coil a most potent factor in electrical work, including its applications to X-ray work, gas engine ignition, wireless telegraphy, etc., has caused considerable attention to be paid to the subject. The author has cleared up many doubtful points, and has made a long step toward rendering the calculation of induction coils as accurate as that of transformers. Much attention is given to the theory and practice of interrupters. While the book does not pretend to be one of constructional directions, it is essential to all who would thoroughly understand the manufacture or use of induction coils.

CONVERSATIONS ON ELECTRICITY. By Joseph G. Branch, B.S., M.E. An elementary work, written expressly for engineers and students. First Part, with 105 illustrations. Chicago and New York, Rand, McNally & Company. Price, \$2.

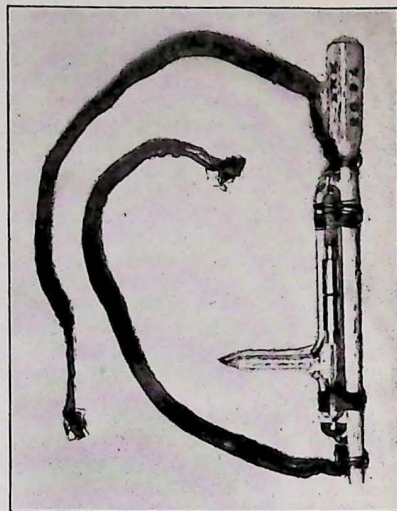
The author has endeavored in this book of nearly 300 pages to give as simple and elementary a treatment of electricity as is possible. The book is entirely free from mathematical expressions, but is well furnished with illustrations. It is written in the form of questions and answers, and the important points are distinguished by heavy type. An especially valuable feature is a very complete index.

THE MECHANICAL WORLD ELECTRICAL POCKET-BOOK FOR 1909. Manchester, Emmott & Co.

For the second year this useful little handbook comes to our desk. This contains in pocket form a large collection of the most useful information necessary in everyday electric work, compressed into some two hundred pages. Not only does it epitomize briefly but thoroughly the present status of electrical engineering work, but it contains a large number of valuable reference tables, as well as a diary for 1909.

Certainly no American publisher could produce this at anywhere near the price, which is but sixpence, or in this country 25 cents.

MARCONI COHERER

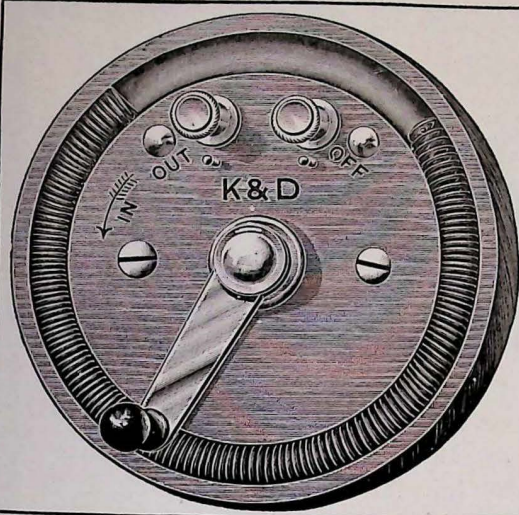


In response to many requests from all over the country, the Marconi Wireless Telegraph Company of America has decided to offer for sale (AS SOUVENIRS ONLY) a limited number of MARCONI COHERERS as illustrated above, all of which have been in service at Marconi stations.

SENT POST-PAID ON RECEIPT OF \$3.50

**Marconi Wireless Telegraph
Company of America**

**27 William Street
New York**



K. & D. Improved Rheostat and Switch

No. 23

Resistance 10 Ohms. Continuous Capacity
2 Amperes.

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

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

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

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

The coil is air-cooled, and works on our maximum rated capacity at a remarkably low temperature.

Experimenters, dentists, surgeons, dermatologists, and all artisans and scientists will find this a most satisfactory and efficient small rheostat and switch.

The workmanship and finish is *first class*. Metal parts nickel plated. Hard rubber handles. Bases of seasoned wood, polished. Dimensions: $3\frac{1}{4}$ inches diameter; total thickness, including rubber handle, $1\frac{1}{8}$ 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.

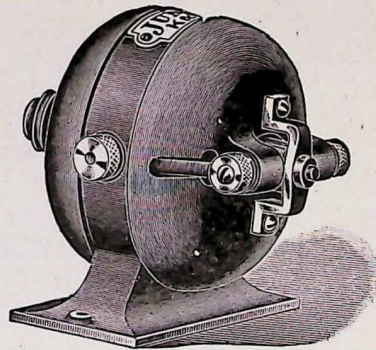
PRICE 75 CENTS

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

K. & D. Juno Motor

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

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



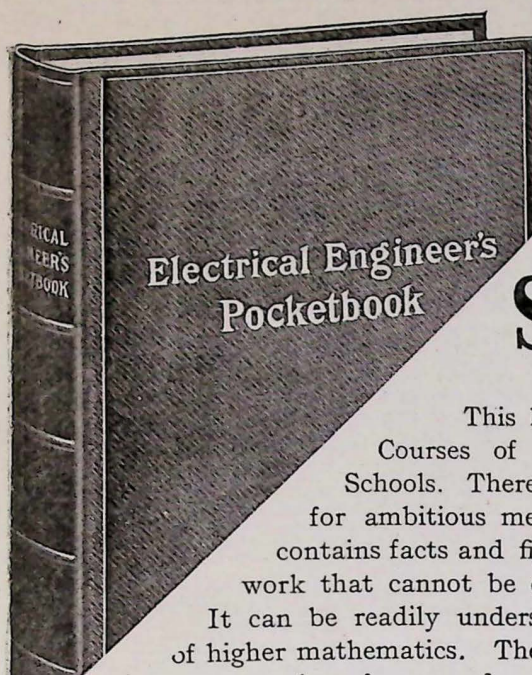
Standard battery winding: 4 volts, 1.5 amperes, 2000 R. P. M., with average load. Occupies space, $3\frac{1}{2} \times 3\frac{1}{2} \times 3\frac{1}{2}$ inches. Weight, 2 pounds.
Price.....\$5.00

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

Unless otherwise specified, regular battery winding will be sent.

MANUFACTURED BY

KENDRICK & DAVIS - Lebanon, New Hampshire



A Pocket Salary-Raiser

This little textbook is compiled from the Courses of the International Correspondence Schools. Therefore, its value as a promotion gainer for ambitious men can be readily understood. It contains facts and figures that are needed in every-day work that cannot be easily found in ordinary textbooks. It can be readily understood by men having no knowledge of higher mathematics. The book is of special value to wiremen, dynamo tenders, foremen of construction, managers, engineers, superintendents of electric lighting and electric-railway systems, superintendents of power stations, manufacturers and dealers in electrical apparatus and supplies. The description of dynamos and motors, their faults, method of locating faults and remedying them, is of great value. Of much importance are the sections on alternators, alternating-current motors, alternating-current measuring instruments, electric transmission, diagram of connections, data, tables, etc. Information is included on the speed control of electric cars and multiple-unit trains. There is also given up-to-date instruction on storage batteries that has been carefully edited by the engineers of the largest battery manufacturing concern in the country. Included in this book are sections on electricity and magnetism, direct-current dynamos and motors, electric batteries, alternating-current apparatus, A C watt-meter measurements, electric transmission, electric lamps, interior wiring, miscellaneous applications of electricity, electric-car controlling, etc. It can easily be carried in the pocket.

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

50c

International Textbook Co.

Box 930-P, Scranton, Pa.

I enclose 50 cents which together with this coupon entitles me to a copy of your Electrical Engineers' Handbook.

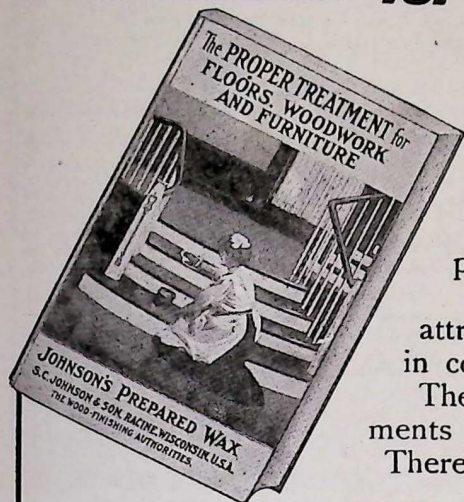
Name

Street & Number

City State

GOOD FOR 75 CENTS

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 DYE

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
- " 123, Dark Oak
- " 125, Mission Oak
- " 140, Manilla Oak
- " 110, Bog Green
- " 128, Light Mahogany
- " 129, Dark Mahogany
- " 130, Weathered Oak
- " 131, Brown Weathered Oak
- " 132, Green Weathered Oak
- " 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"

--- Please Use this FREE COUPON ---

I accept your offer of Free Booklet Edition E. M. 3 and two sample bottles of Johnson's Wood Dye. Send me shades Nos. and and one sample can of Johnson's Prepared Wax.

Name.....

Address.....

I usually buy my paint & store of

Name.....

Address.....

PATENTS

SECURED PROMPTLY

 And with Special Regard to the
Legal Protection of the Invention

Handbook for Inventors and Manufacturers Sent Free upon Request

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

C. L. PARKER, Patent Lawyer

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

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

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

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

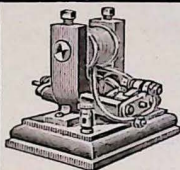
 ONLY a few complete sets of Volume XVII, containing
the first 12 instalments of Dr. Watson's articles on elec-
trical engineering, and many other interesting and valuable
articles, remain unsold. The price at present is:

Vol. XVII, bound in Red Buckram . . \$5.00

Vol. XVIII, unbound, in numbers . . . 1.25

Bound, 2.00

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



AMATEURS

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

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

Price \$1.75. 211 Illinois St. BUFFALO, N. Y.

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

EVANS, WILKENS & CO.

100 F Street Washington, D. C.

IN ALL THE WORLD

NO TRADES PAY MORE THAN

THOSE OF THE

ELECTRICIAN

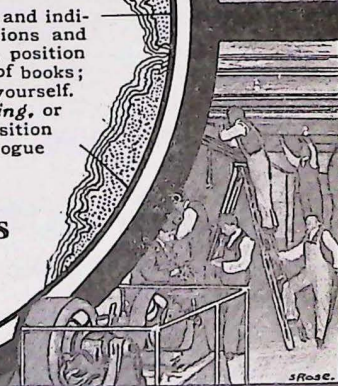
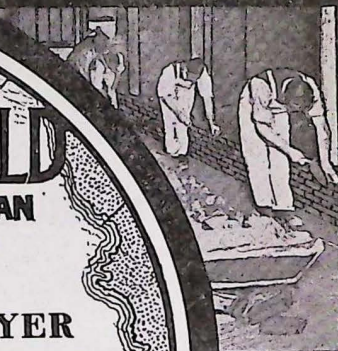
PLUMBER AND BRICKLAYER

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

COYNE

NATIONAL TRADE SCHOOLS

 238 Tenth Avenue
NEW YORK

 850 N. Ashland Ave.
CHICAGO, ILL.


The Busiest Concern Around Boston—

The SECRET SERVICE BATTERY CO.

314 Ferry Street Everett, Mass.

WE MAKE FLASHLIGHT BATTERIES OF EVERY DESCRIPTION. SAMPLE OF ANY SIZE BY MAIL, 40 CENTS. (We pay postage.)

Write for Quantity Prices

PATENTS

60 YEARS' EXPERIENCE

TRADE MARKS
DESIGNS
COPYRIGHTS & C.

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

Scientific American.

A handsomely illustrated weekly. Largest circulation of any scientific journal. Terms, \$3 a year; four months, \$1. Sold by all newsdealers.

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

Samson Batteries



Strength
Long Life
Uniformity

20 Years the Standard

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

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

Electric Goods Mfg. Co.

Battery, Telephone, Annunciator,
and Motor Boat Ignition Specialists

144E Pearl Street - Boston, Mass.

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

SEND FOR
MANUAL TRAINING
GUIDE

CHANDLER & BARBER, 100 N. 3rd St.,
HARDWARE 12th ST. BOSTON, MASS.

Blue Process Paper Blue Printing Drawing Materials

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

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.

Murdock's Circuit Detector

Patent applied for



DON'T USE A MAGNETO FOR TESTS when the quickest and most practical method is to use our DETECTOR.

Neat and compact—Can be carried in pocket.

Invaluable for electricians, armature winders, telephone wire men, coil winders, cable testers.

SPECIAL OFFER—On receipt of \$2.50 and mentioning this paper, we will send, prepaid, to any part of the U. S. or Canada one of these detectors.

Complete with Cord and Battery - - - \$2.50

Manufactured only by

WM. J. MURDOCK & CO.

Chelsea, Mass.

FLYING MACHINES—Past, Present, and Future

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

Catch the News While It is Hot

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

REPUBLIC

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

TYPE "B" \$25.00 RECEIVER

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

TYPE "B" RECEIVING TUNER

Complete with Double Head Telephones, Detector, and wired

—————\$25.00—————

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

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

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

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

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

Acme Wireless Construction Co.

18 WESTERN AVENUE

CAMBRIDGE, MASS.

ELECTRICITY

VOLTAMP

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. 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.

MODEL STEAM ENGINES

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

1-16 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.

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. AND C. TRANSFORMER COMPANY
1412 Girard Street Los Angeles, Calif.



ELDREDGE BATTERY VOLTMETER

0 TO 3 VOLTS DEAD BEAT

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

WRITE FOR CIRCULAR

ELDREDGE 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.



THE BIG THREE IN ELECTRICITY

Franklin Discovered It. Edison Developed It.
The Cyclopedia Applies It.

CYCLOPEDIA OF APPLIED ELECTRICITY

presents in compact, practical form and in non-technical language, the results of the best work of the best men in the electrical profession; it lays the foundation of electrical progress for years to come.

This Cyclopedia completely covers the whole electrical field. 2,896 pages of authoritative information; treats of 23 general subjects; its detailed index includes over 4,000 different topics. Hundreds of special photographs, diagrams, sections, tables, formulas. Pages are 7 x 10 inches in size, special paper, large, clear type, half morocco binding.

THE YOUNG MAN will find it a valuable guide to one of the greatest money-making professions of the present and future age.

THE ELECTRICAL WORKER, whether "trouble shooter" or expert, will find this Cyclopedia valuable as an index to what he knows and a ready reference to what he has forgotten.

THE BUSINESS MAN AND HOUSE OWNER can gain from it a knowledge of electricity that will save him many a dollar.

FREE FOR EXAMINATION. Fill in and mail the coupon. We will send you a set of these practical books for five days' FREE examination. Examine the books carefully. If satisfactory send \$2 within five days and \$2 per month until you have paid the special \$18.60 price. The regular list price \$36. If you don't keep the books, advise us and we will send for them. Remember! You can examine the books without expense or obligation—we pay all charges.

IMPORTANT SUBJECTS COVERED

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

FREE! IF YOU ORDER PROMPTLY

With all orders received before April 1st, we will include **FREE** for one year, as a monthly supplement, the

TECHNICAL WORLD MAGAZINE

An Ideal American family monthly—regular price, \$1.50

FREE OFFER COUPON

American School of Correspondence, Chicago, U. S. A.: Please send Cyclopedia of Applied Electricity for **FREE** examination, also Technical World for 1 year. I will send \$2.00 within five days and \$2.00 a month until I have paid \$18.60; otherwise I will notify you and hold the books subject to your order. Title not to pass until fully paid.

Name.....

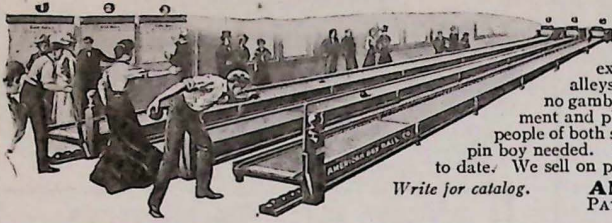
Address.....

Occupation.....

Employer.....

Elect. & Mech. 3-'09

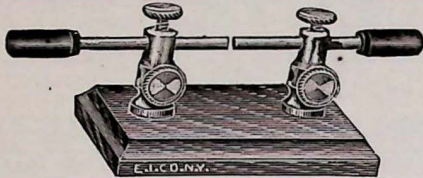
\$513 Clear Profit in 51 Days from an Investment of \$150



Write for catalog.

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

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

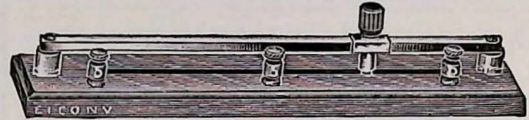


THE ELECTRO ZINC SPARK-GAP. is guaranteed to increase sending range from 25% to 50% on account of peculiar properties of zinc. Hard rubber handles used on both ends. Gap is adjustable while sending. Can also be used as Anchor gap. PRICE, 60 cents. By mail, 3 cents extra.

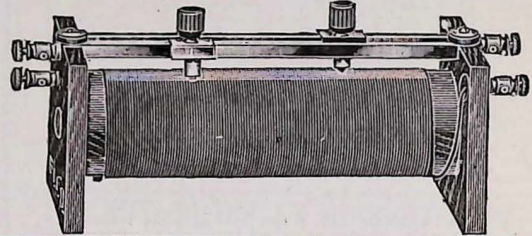
THE ELECTRO TUNER, JR. is wound with 300 turns of No. 24 Enamelled wire which cannot become loose as in other inferior makes. Our patent rolling ball slider which does not scratch wires but makes perfect contact is used on both slides. Size 8 in. long, 3 1/4 in. high, 3 1/4 in. wide. PRICE, \$2.25. By mail, 35c. extra.

Our large 114-page electrical encyclopedia containing dozens of electrical experiments, wireless diagrams, and telegraph codes will be sent to you on receipt of 2 cents for postage.

ELECTRO IMPORTING COMPANY
82 B WEST BROADWAY - - - NEW YORK CITY
"Everything for the Experimenter"



THE ELECTRO POTENTIOMETER, NON-INDUCTIVE, has been pronounced a marvel by several leading commercial wireless companies. Not a German-Silver-wire affair. High resistance GRAPHITE RODS 300 and 500 OHMS used in our instrument. Our patent rolling ball slider used. No wear on graphite rod. Wonderfully smooth adjustment. Size 10 in. long, 2 in. high, 2 in. wide. PRICE, \$1.50. By mail, 15 cents extra.



\$2.50 FOR \$1.25

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

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

**Every Electrician and Student
Should Have Both**

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

Last Chance at This Price

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

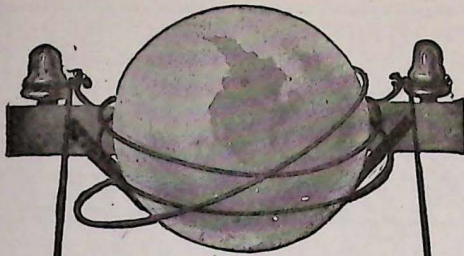
HAVE YOU SEEN THE Model Engineer and Electrician

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 Girdles the Globe

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

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

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

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

The New York Electrical Trade School
39½ West 17th Street, New York

No connection with any other School or Institute.

FOR FORTY YEARS A STANDARD PIANO.



WING PIANOS

are made by us and are sold direct from our own factory and in no other way. Dealers' and agents' profits and every unnecessary cost eliminated.

Every dollar is piano value through and through, the best that 40 years of experience can produce.

AN ABSOLUTELY FREE TRIAL

for 20 days, in your own home, no cost or obligation. ALL FREIGHTS PAID and all risks assumed by us.

Pioneers of the direct plan of piano selling, our unparalleled success has brought forth many imitators, but no competitors, either as to the excellence of our product or the integrity and economy of our methods. Forty years of daily increasing business and 45,000 satisfied buyers testify to this.

Ask a Wing customer what he thinks of Wing Pianos and Wing methods. We will send you names in your locality for the asking.

FREE "THE BOOK OF COMPLETE INFORMATION ABOUT PIANOS."

A copyrighted book of 152 pages with many illustrations. A complete reference book on the piano subject. History of the piano, descriptions of every part, how to judge good and bad materials, workmanship, etc. Teaches you how to buy intelligently. You need this book. Free for the asking from the old house of

WING & SON, 368-382 W. 13th St., New York

The School Arts Book

The best magazine for instruction in Drawing, Design, Color, and Manual work. One of the best features is the department of

Annotated Outlines

by HENRY TURNER BAILEY, which make a complete course in drawing for all grades, progressive and completely illustrated. "The Workshop" gives full details, with drawings, for making many useful and ornamental objects.

A splendid monthly for teachers, pupils, and the home. We will send a sample to any point in the United States free.

\$1.50 per year, September to June.

Send postal NOW.

The Davis Press, Publishers
37 Front St., Worcester, Mass.

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 engines.

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

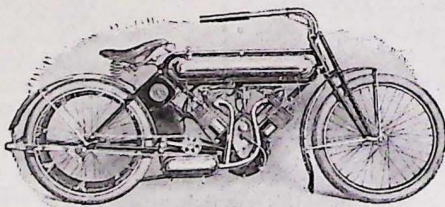
Madison

Wisconsin

What the "Horseless Age" Says

MOTORCYCLE CONSTRUCTION AS SEEN AT THE MADISON SQUARE GARDEN SHOW

¶ The number of double cylinder engines has increased, in response to a demand for greater power, but, strange to say, very little attention has been paid to the subject of proper balance. Many makers of single cylinder engines make the absurd claim that they have perfectly balanced their engines. Only two American makers have given this subject any serious attention. The new Pierce four cylinder has, of course, a good balance, but in the case of the M. M. 90 degree twin, a double cylinder engine has been produced with a better balance than a four cylinder. The placing of the cylinders in this type of engine at 42, 45, or 50 degrees produces an engine as poorly balanced as a single cylinder of the same power.



M. M. Twin Ninety Degree V Balanced Motor

AMERICAN MOTOR COMPANY
712 CENTRE STREET : : BROCKTON, MASS.

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

BIG MONEY MANUFACTURING DRY BATTERIES. MANUFACTURERS' HANDBOOK explains everything. Price, \$1, prepaid. H. MCCOY & CO., Sandusky, Ohio.

FOR EXCHANGE OR SALE.—All new, 1-pound, No. 34 s.c.c. magnetic wire, \$1.40; $\frac{1}{2}$ -inch spark-coil parts, \$3.50; pony relay, 50 ohms, \$1.50; "Excelsior" telescope, 75 cents; two telephone transmitters, 45 cents each; two 3-inch electric bells, 30 cents each. Also 3 x 4 printing press, \$1; four hundred Kirkman's soap coupons; magnet wire, pushes, switch, etc. (list for stamp). Want: volt and ammeter, good telegraph instrument, cash, or offer. A. J. MARKHAM, Summit, N. J.

LOOK! \$20 will build 20,000-volt, 1-kilowatt transformer. Blue-prints and directions for 50 cents. J. H. WHITE, Ross, Cal.

STORAGE CELL, \$1; 4-cell plunge battery, \$1.50; pair of telephones, \$3; 3-cell bicycle wet battery, 75 cents; battery motor, "Albert," 50 cents; "Type A" battery motor and shafting, \$1.50. PITHER SHARP, 26 Seneca Street, Pontiac, Mich.

FOR SALE.—One electric vulcanizer, \$8; one 75-watt dynamo, \$8; one stereoptic, with arc light burner, \$10; 36-foot, 2-inch steel track and two switches with two electric cars, \$8; one Connecticut 15-volt, 30-ampere, \$2. G. W. ANDRAE, 541 Clark Street, Stevens Point, Wis.

FOR SALE OR EXCHANGE.— $\frac{1}{2}$ R. W. transformer; also 12 pounds of No. 36 silk-covered copper wire. GEO. A. WILSON, JR., 20 St. Stephens Street, Boston, Mass.

BOYS LEARN TO MAKE dry batteries and refill old cells. Send 10 cents coin for formula and directions. ARTHUR K. WHITMER, Dept. E, 115 High Street, Canton, Ohio.

WIRELESS TELEGRAPHY

EXCHANGE.—A 75-ohm telegraph relay, 20-ohm telegraph sounder, filing coherer, and a pair of brass spark balls; all suitable for wireless telegraph; all new; cost \$6. Will exchange for 1500-ohm telephone receivers or anything electrical. MAXWELL P. HELLMAN, 20 West 83d Street, New York, N. Y.

LATEST MODELS IN WIRELESS APPARATUS.—Electrolytic detector, with extra delicate adjustment for long-distance work, \$2. Tuning coil, double-slide contacts, finely finished, will tune to all wave-lengths, \$3. Potentiometer, special high resistance, \$3. All of these have the advantage of being decidedly new, carefully and neatly made. Brass work lacquered, and polished mahogany bases. Your order will have prompt attention. HAROLD P. DONLE, 9 Phillips Street, Providence, R. I.

WIRELESS FUSED SILICON.—25 cents ounce. Send for price list of wireless apparatus. EASTERN ELECTRIC CO., 26 Orange Road, Montclair, N. J.

ENAMELED WIRE FOR TUNING COILS.—300 feet No. 28, for 25 cents; 125 feet No. 24, for 25 cents; post-paid. Tin-foil, 50 cents pound, post-paid. MIDDLESEX WIRELESS SUPPLY COMPANY, 94 Antrim Street, Cambridge, Mass.

INTENSITY COILS, 1 to 12 inches, guaranteed for one year, suitable for wireless telegraphy and experimental work. For a descriptive circular, address THE INTENSITY COIL CO., Shideler, Ind.

FOR SALE.—One 6-inch induction coil, two transformers, two interrupters, one break-in key, two helices, three spark-gaps, four receiving condensers, three receiving transformers, and two telephone receivers. Address NEWELL A. THOMPSON, JR., 31 Brook Street, Brookline, Mass.

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

MACHINERY AND TOOLS

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 N., Port Chester, N. Y. (16)

FOR SALE.— $\frac{1}{2}$ h. p. steam-engine, almost new; price, \$6. THOMAS ALCOCK, 17 Social Street, New Bedford, Mass.

FOR SALE OR EXCHANGE.—One water-cooled, horizontal, 2-cycle, $\frac{1}{2}$ h. p. gasoline engine. Complete outfit. Price, \$15. Miniature electric coal mining train; complete outfit included. Price, \$6. MAGEE ADAMS, Milford, Ohio.

FOR SALE.—Castings for $\frac{1}{2}$ h. p. horizontal, water-cooled gasoline engine, nearly finished, with carburetor, \$7. Castings for 30-watt dynamo, with wire, \$3. Two automobile instruction books, cost \$3, for \$1.50. E. ROOT, Box 412, Galva, Ill.

CASTINGS of high-speed marine or horizontal steam-engines, with slide valve, $\frac{1}{2}$ -inch bore, 1-inch stroke, best gray iron, and easily machined on 9-inch lathe, complete, with blue-print, \$1.25. Finished horizontal engine, 1-10th h. p., \$5; marine, \$6. Automatic flash boiler for these engines, with feed pump and all accessories, \$6.50. Send 3 cents for catalogue. THE MINIATURE ENGINE MANUFACTURING CO., Elgin, Ill.

FOR SALE.—Set of castings, rods, screws, etc., for horizontal steam-engine, —cylinder, 1 3-16ths x 2 inches, bored, faced, planed; wheel and eccentric turned; much other work done. Several parts are brass. Would run small dynamo. Price, \$4. A bargain. E. H. WARREN, 58 Nashua Street, Woburn, Mass.

BOOKS AND MAGAZINES

"OUR LITTLE HANDY BOOK," for 10 cents, while they last. Containing valuable information and workshop receipts, and new, useful, handy tools for any mechanic. Address HANDY TOOL CO., Bellevue, Ohio.

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.

HELP WANTED

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

PATENTS

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

PHOTOGRAPHY

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

TWELVE POST-CARDS, 10 CENTS. — Multicolored art, nature, and comic series, some embossed. LOCK BOX 43, W. Stewartstown, N. H.

MISCELLANEOUS

SHORTHAND. — The Benedict Vowel System, — easiest, cheapest, best. Send 25 cents for signs for commonest words. Reference, M. O. SAMPSON. G. BENEDICT, 43 Tremont Street, Boston, Mass.

PUZZLE. — The jackstone puzzle. A good mechanical puzzle, that is a puzzle. 10 cents, post-paid. THE CONOID BATTERY CO., Norwich, Conn.

MAKE YOUR OWN SIGNS. — New device; simple; makes perfect letters; only a dime, with directions. H. A. SAULT, Ben Lomond, Cal.

MAGIC POCKET TRICK FREE. — Catalogue included. Send 4 cents to MAGIC DEPT. 17, 270 West 39th Street, New York, N. Y.

FOR EXCHANGE. — One Meyer model flute, silver head, eight silver keys, instruction book, and music stand; one model horizontal boiler, 17 inches long x 8 inches in diameter, steam dome 5 x 5 inches, five copper guses, tested to 100 pounds C. W. P.; one Wonder dynamo motor, practically new; one Divine Red Devil motor, with buffing and emery wheels, nearly new; one new Knapp reversible battery motor; one emery grinder; one flashlight; two five-bar telephone generators; one 80-ohm extension bell; one good Winchester repeating rifle. Want metal working lathe, large induction coil, transformer, auto engine, moving picture machine, — or what have you got? E. T. SCHMUCKER, Haverdorn, Iowa.

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)

MYBOOK
FREE

Memory the Basis of All Knowledge
Stop Forgetting
THE KEY TO SUCCESS
You are no greater intellectually than your memory. Easy, inexpensive. Increases income; gives ready memory for faces, names, business details, studies, conversation; develops will, public speaking, writing, personality.
Dickson Memory School, 920 Auditorium Bldg., Chicago.



MACK & CO., 18 Brown's Race, Rochester, N.Y.

Manufacturers of the **FAMOUS D. R. BARTON TOOLS**, the most complete line of superior edge tools for Training Schools in the United States. Wood Planes, Chisels, (all kinds), Adair Pattern Carving Tools, etc. Catalogues Free.

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

361 Broadway
NEW YORK



10 DAYS FREE TRIAL

We will ship you a "RANGER" BICYCLE on approval, freight prepaid to any place in the United States without a cent deposit in advance, and allow ten days free trial from the day you receive it. If it does not suit you in every way and is not all or more than we claim for it and a better bicycle than you can get anywhere else regardless of price, or if for any reason whatever you do not wish to keep it, ship it back to us at our expense for freight and you will not be out one cent.

LOW FACTORY PRICES

We sell the highest grade bicycles direct from factory to rider at lower prices than any other house. We save you \$10 to \$25 middlemen's profit on every bicycle—highest grade models with Puncture-Proof tires, Imported Roller chains, pedals, etc., at prices no higher than cheap mail order bicycles; also reliable medium grade models at unheard of low prices.

RIDER AGENTS WANTED

in each town and district to ride and exhibit a sample 1909 Ranger Bicycle furnished by us. You will be astonished at the wonderfully low prices and the liberal propositions and special offers we will give on the first 1909 sample going to your town. Write at once for our special offer. DO NOT BUY a bicycle or a pair of tires from anyone at any price until you receive our catalogue and learn our low prices and liberal terms. BICYCLE DEALERS: you can sell our bicycles under your own name plate at double our prices. Orders filled the day received.

SECOND HAND BICYCLES—a limited number taken in trade by our Chicago retail stores will be closed out at once, at \$3 to \$8 each. Descriptive bargain list mailed free.

TIRES, COASTER BRAKES,

single wheels, inner tubes, lamps, cyclometers, parts, repairs and everything in the bicycle line at half the usual prices. DO NOT WAIT but write today for our Large Catalog beautifully illustrated and containing a great fund of interesting matter and useful information. It only costs a postal to get everything. Write it now.

MEAD CYCLE COMPANY, Dept. K250 CHICAGO, ILL.



THE CENTURY Adjustable Steel Drafting Table

The newest, best, and most reasonable good drafting table on the market. Built of stiff and unbreakable angle steel, well braced; insuring rigidity, strength, lightness, and neat appearance. Can be instantly adjusted to any position and quickly folded up for transportation. "It Don't Wobble."

\$9.25 OUTFIT FOR \$7.50



PATENT
ALLOWED

Century Leader No. B
with Tray, \$7.50
without Tray, \$6.50

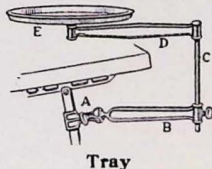
a table for the home or office. All parts nicely finished. Can be folded into a space $4\frac{1}{2} \times 27 \times 34$ inches, and weighs but 25 pounds. **TERMS:** Cash with order; f.o.b. cars, Columbus, Ohio.

Send in your order early

TRAY

For drawing instruments and material. Can be easily attached at any position on every supporting member of the table, by clamping the thumb nut at universal joint. The tray, 10 inches in diameter, swings over the top of board and is always within convenient reach.

**WE BUILD TABLES OF ANY SIZE
HUSTLING AGENTS WANTED**



Tray

THE CENTURY MFG. CO.

254 N. Front St. Columbus, Ohio

Catalogue on Request

Ring In-Ring Out! Year In-Year Out!



DO YOU lose your individuality daily with a "punch" on the time clock? Then you are known by number—not by name.

Have you ever thought of the future—what your reward will be if you continue year in and year out in the same old rut?

How are you going to rise above these conditions? The American School of Correspondence will show you the way.

The fact that you hold your present job is evidence of brains and ability. That's all you need.

Tell us what position you desire to hold. Get our free advice. Signing the coupon does not place you under any obligations. We do not employ agents or collectors. Like all strictly educational institutions, we rely, for growth, solely upon reputation, usefulness and success of our students.

This is the beginning of a new year. Let this month mark the beginning of your success—a better position, more pay and shorter hours. Fill in and send the coupon.

We help men help themselves.

FREE INFORMATION COUPON

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

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

Electrician and Mechanic, 3-'09

- | | |
|-------------------------|-------------------------------------|
| .. Electrical Engineer | .. Heating and Ventilating Engineer |
| .. Civil Engineer | .. Plumber |
| .. Draftsman | .. Architect |
| .. Mechanical Engineer | .. Hydraulic Engineer |
| .. Stationary Engineer | .. Textile Boss |
| .. Structural Engineer | .. College Prep. Course |
| .. Railroad Engineer | .. Sheet Metal Pattern Draftsman |
| .. Municipal Engineer | |
| .. Structural Draftsman | |

NAME.....

ADDRESS.....

OCCUPATION.....

A \$175 Wireless Set Free

¶ The publishers of ELECTRICIAN AND MECHANIC will give absolutely FREE, on APRIL 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 on up-to-date lines, 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 $2\frac{1}{2}$ 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.

Electrician and Mechanic PATENT BUREAU

United States and Foreign Patents Obtained

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

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

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

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

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

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

DON'T DELAY

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

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

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

Inventor (Name in full).....

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

City or Town.....

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

Electrician and Mechanic Patent Bureau

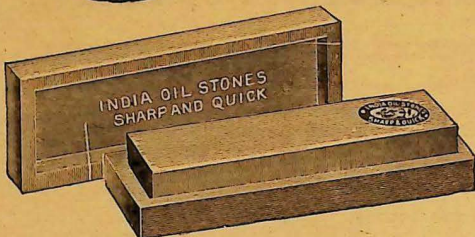
6 BEACON STREET

BOSTON, MASSACHUSETTS



INDIA OILSTONES

As a good oilstone is a very important item in every mechanic's tool kit, the question of what stone will best fill the bill should be decided only after careful inquiry and experiment.



India, mounted in Wood Box



Special India Gouge Slip

To those who have not tried the India let us say you will not find its equal in any other oilstone on the market.

It is made in 61 different shapes and sizes, and in different grades of coarseness to suit all classes of work.

Let us send you a souvenir India Stone to test, also a price list.

SOLE SELLING AGENTS

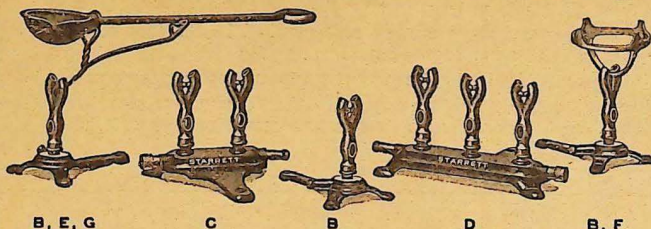
Pike Manufacturing Co.

PIKE, N. H.

Manufactured by NORTON COMPANY, Worcester, Mass.

STARRETT GAS HEATER

More heat—less gas



FOR
Mechanics, House-keepers, Plumbers, Electricians, Dentists, Jewelers, Tinsmiths, 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.