Advertisements.

Inside Page, each insertion - - - 75 cents a line.
Back Page, each insertion - - - $1.00 a line.

The above are charges per agate line—about eight words per line. This notice shows the width of the line, and is set in agate type. Engravings may head advertisements at the same rate per agate line, by measurement, as the letter press. Advertisements must be received at publication office as early as Thursday morning to appear in next issue.

Novelty Hot Air Furnaces.

Expose an Immense Heated Surface.

Extract all the Heat from the Gases. Furnish Pure Warm Air in Abundance.

Fourteen Years of Test. Universally satisfactory.

Send for "Our Furnace Book."

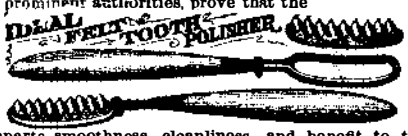
Abram Cox Stove Co.,
MANUFACTURERS,
Philadelphia and Chicago.

WOOL HAT MAKING.—FULL DEscription of the process.—Wool washing, carding and forming, settling, bumping and washing out, stretching or stumping, drying, storing and steaming, pulling out, dyeing, blocking, storing, pressing, finishing, rounding, curling and ironing, paring, trimming and shaping, velouring off. With 20 figures. Contained in SCIENTIFIC AMERICAN SUPPLEMENT, Nos. **626, 628,** and **629.** Price 10 cents each. To be had at this office and from all newsdealers.

HOME-MADE INCUBATOR.—PRACTIcal directions for the manufacture of an effective incubator that has been carefully tested and found to perform all that may be reasonably expected; with directions for operating. With 4 figures. Contained in SCIENTIFIC AMERICAN SUPPLEMENT, No. **630.** Price 10 cents. To be had at this office and from all newsdealers.

"TOOTH BRUSH REFORM."
ITS PRINCIPLES AND RESULTS.

For the harsh bristles so long in use, we offer a delicately compact serrated surface of specially prepared felt, of great polishing power and conforming after a moment's soaking, to every crevice of the teeth, reaching between, and, by its absorbent nature, removing the oils and accumulations which cause decay. Results, attested by prominent authorities, prove that the



Imparts smoothness, cleanliness, and benefit to the teeth, soothes and strengthens the gums, and avoids annoyances and positive injuries inflicted by bristles.

IS IT ECONOMICAL?

Imperishable holder costs 35c. Felt Polishers only need be renewed, 18 boxed 25c., each good for ten days' beneficial use. Test it and judge. Druggists or mailed by HORSEY MFG. CO., Utica, N. Y.
(See SCIENTIFIC AMERICAN of March 31, 1887.)

MALLEABLE AND FINE GRAY IRON ALSO STEEL CASTINGS FROM SPECIAL PATTERNS
THOMAS DEVLIN & CO. LEHIGH AVE & AMERICAN ST. PHILA.

SUN DIALS — PRACTICAL DIRECtions for laying off simple mural and portable sun dials. With 5 figures. Contained in SCIENTIFIC AMERICAN SUPPLEMENT, No. **631.** Price 10 cents. To be had at this office and from all newsdealers.

SAWS Wanted 50,000 Sawyers and Lumbermen to send us their full address for a copy of Emerson's ☞ Book of **SAWS.** We are first to introduce NATURAL GAS for heating and tempering **Saws** with wonderful effect upon improving their quality and toughness, enabling us to reduce prices. Address **SAWS**
EMERSON, SMITH & CO. (Ltd.),
Beaver Falls, Pa.

THE PHONOGRAPH.—A DETAILED description of the new and improved form of the phonograph just brought out by Edison. With 8 engravings. Contained in SCIENTIFIC AMERICAN SUPPLEMENT, No. **632.** Price 10 cents. To be had at this office and from all newsdealers.

MAGIC LANTERNS.
OUR PETROLEUM LANTERNS HAVE THE FINEST LENSES AND THE LAMPS ARE UNRIVALLED FOR POWERFUL WHITE LIGHT.
CHOICE STOCK OF VIEWS COLORED AND PLAIN
SEND FOR CATALOGUE TO
QUEEN & CO. PHILADELPHIA PA.

PATENTS.

MESSRS. MUNN & CO., in connection with the publication of the SCIENTIFIC AMERICAN, continue to examine improvements, and to act as Solicitors of Patents for Inventors.

In this line of business they have had *forty-one years' experience*, and now have *unequaled facilities* for the preparation of Patent Drawings, Specifications, and the prosecution of Applications for Patents in the United States, Canada, and Foreign Countries. Messrs Munn & Co. also attend to the preparation of Caveats, Copyrights for Books, Labels, Reissues, Assignments, and Reports on Infringements of Patents. All business intrusted to them is done with special care and promptness, on very reasonable terms

A pamphlet sent free of charge, on application, containing full information about Patents and how to procure them: directions concerning Labels, Copyrights, Designs, Patents, Appeals, Reissues, Infringements, Assignments, Rejected Cases, Hints on the Sale of Patents, etc.

We also send, *free of charge*, a Synopsis of Foreign Patent Laws, showing the cost and method of securing patents in all the principal countries of the world.

MUNN & CO., Solicitors of Patents,
361 Broadway, New York.

BRANCH OFFICES.—No. 622 and 624 F Street, Pacific Building, near 7th Street, Washington, D. C.

Samples and Illustrated Pamphlet "Steam Saving and Fire-Proof Materials" Free by Mail.

H. W. JOHNS MANUFACTURING CO.,
SOLE MANUFACTURERS OF
—W. Johns' Fire and Water-Proof Asbestos Roofing, Sheathing, Building Felt, Asbestos Steam Packings, Boiler Coverings, Roof Paints, Fire-Proof Paints, etc.
VULCABESTON, Moulded Piston-Rod Packing, Rings, Gaskets, Sheet Packing, etc.
Established 1858. 87 MAIDEN LANE, NEW YORK. CHICAGO. PHILADELPHIA. LONDON.

COPPER TUBES. SHEET BRASS BRASS WIRE. 175 177 LAKE ST. CHICAGO.

Mention this paper.

New Gas Engine "The Baldwin"

Exhibited at the late American Institute Fair, New York.

A four horse-power engine in connection with storage battery, running 84 incandescent electric lights (and without battery, 32 lights), giving a perfect light, with all the steadiness that can be obtained from the high-speed steam engines in common use for electric lighting, and permitting any number of lights to be shut off or turned on without affecting the remaining lights in the slightest degree. A marvel of beauty, perfection, and power, adapted to lighting, pumping, and all purposes where a safe and cheap power is required. Manufactured and guaranteed by

Otis Brothers & Co.,
Elevators and Hoisting Machinery,
38 PARK ROW, NEW YORK.

THE AGE OF THE STARS.—BY Prof. Janssen. History of the discoveries that have led to the introduction of the doctrine of evolution in the science of astronomy. Contained in SCIENTIFIC AMERICAN SUPPLEMENT, Nos. **630** and **631.** Price 10 cents each. To be had at this office and from all newsdealers.

STORAGE BATTERIES FOR ELECtric Locomotion.—A paper by A. Reckenzaun, offering a few facts and figures relating to the present state of the subject of the application of storage batteries to locomotive purposes. Contained in SCIENTIFIC AMERICAN SUPPLEMENT, No. **625.** Price 10 cents. To be had at this office and from all newsdealers.

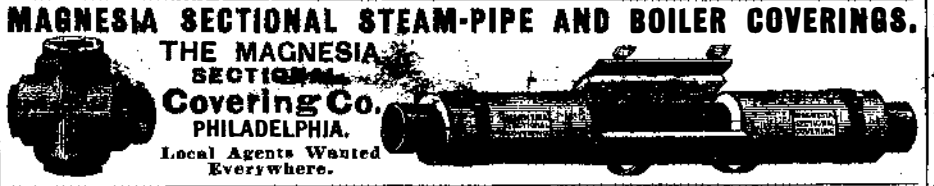
WATCHMAKERS
Before buying, send for Price List of Whitcomb Lathe, Webster Foot-Wheel and our Table of Equivalents.
American Watch Tool Co., Waltham, Mass.

THE DEVELOPMENT OF THE MERcurial Air Pump.—By Prof. Silvanus P. Thompson, D.Sc. An interesting historical paper in which the various mercurial air pumps in use from early times up to the present are classified and described. I. Upward driving pumps. II. Downward driving pumps. III. Upward and downward driving pumps. IV. Combination pumps. V. Injector pumps. VI. Mechanical mercurial pumps. With 36 engravings. Contained in SCIENTIFIC AMERICAN SUPPLEMENT, Nos. **629, 630** and **631.** Price 10 cents each. To be had at this office and from all newsdealers.

WIRE ROPE

Address JOHN A. ROEBLING'S SONS, Manufacturers, Trenton, N. J., or 117 Liberty Street, New York.
Wheels and Rope for conveying power long distances. Send for circular.

MAGNESIA SECTIONAL STEAM-PIPE AND BOILER COVERINGS.

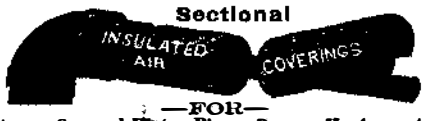


THE MAGNESIA SECTIONAL Covering Co. PHILADELPHIA.
Local Agents Wanted Everywhere.

RIDGWAY REFRIGERATOR
Refrigerators of Every Description. Send for Circular.
MANUFACTURING CO. Ltd. 815 Arch Street, Phila., Pa.

CHEMICAL AND ALLIED INDUStries.—By Watson Smith. An elaborate report upon the objects illustrative of the progress, advance, and present position of the chemical industries shown at the Manchester Royal Jubilee Exhibition. Contained in SCIENTIFIC AMERICAN SUPPLEMENT, Nos. **627, 628, 629, 630, 632.** Price 10 cents each or 50 cents for the series. To be had at this office and from all newsdealers.

SHIELDS & BROWN CO.
Manufacturers of
Sectional

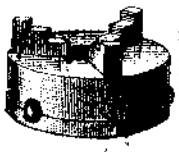


—FOR—
Steam, Gas and Water Pipes, Drums, Heaters, etc.
The Best Non-Conductor of Heat & Cold in the World.
Send for illustrated descriptive Circular, and name this paper.
143 Worth Street, NEW YORK. 240 & 242 Randolph St., CHICAGO.

USEFUL BOOKS.

Manufacturers, Agriculturists, Chemists, Engineers, Mechanics, Builders, men of leisure, and professional men, of all classes, need good books in the line of their respective callings. Our post office department permits the transmission of books through the mails at very small cost. A comprehensive catalogue of useful books by different authors, on more than fifty different subjects, has recently been published for free circulation at the office of this paper. Subjects classified with names of author. Persons desiring a copy, have only to ask for it, and it will be mailed to them. Address,

MUNN & CO., 361 Broadway, New York.



The CUSHMAN Patent 3 Pinion Geared Scroll Chucks with their latest improvements are unexcelled. Made in all sizes from 2½ inch to 12 inch diameter, and are sold by the trade all over the world.
Manufactured by
The Cushman Chuck Co., Hartford, Conn.

THE AMERICAN BELL TELEPHONE CO.
95 MILK ST. BOSTON, MASS.

This Company owns the Letters Patent granted to Alexander Graham Bell, March 7th, 1876, No. 174,465, and January 30th, 1877, No. 186,787.

The transmission of Speech by all known forms of Electric Speaking Telephones infringes the right secured to this Company by the above patents, and renders each individual user of telephones not furnished by it or its licensees responsible for such unlawful use, and all the consequences thereof, and liable to suit therefor.

COMPLETE STEAM PUMP ONLY SEVEN DOLLARS
DEMAND THE PUMP OF YOUR DEALER OR WRITE TO US FOR PRICES
VAN DUZEN & TIFT. SOLE MAKERS CINCINNATI, O.

DRY AIR REFRIGERATING MACHINE. Description of Hall's improved horizontal dry air refrigerator, designed to deliver about 10,000 cubic feet of cold air per hour, when running at a speed of 100 revolutions per minute, and capable of reducing the temperature of 90° above to 50° below zero. With five figures, showing plan and side elevation of the apparatus, and diagrams illustrative of its performance. Contained in SCIENTIFIC AMERICAN SUPPLEMENT, No. **288.** Price 10 cents. To be had at this office and from all newsdealers.

The "ALLARD" SPIRAL SCREW DRIVER. FOR LIGHT AND RAPID WORK. For Machinists, Gun and Lock Smiths, Cabinet Makers and others. The greatest labor saving tool extant. Saves its cost in a very short time. Best quality of material. Superior workmanship. No tiresome turning of the hand and twisting of the wrist. Price $2.25, postpaid. **The Alford & Berkele Co.,** Sole Agents, 77 Chambers St., N. Y.

The Original Unvulcanized Packing.
CALLED THE STANDARD—As it is the Packing by which all others are compared.
Accept no packing as JENKINS PACKING unless stamped with our "Trade Mark."
JENKINS BROS. 71 John Street, N. Y. 105 Milk Street, Boston. 18 So. Fourth St., Phila. 54 Dearborn St., Chicago.

We are prepared to furnish the finest quality of **THROUGH PUNCHES** and **DIES** for **METAL WORK**, for the manufacture of which we have unequalled facilities. Henry Disston & Sons, Incorporated, Jobbing Department, Front & Laurel Sts., Phila., Pa.

AUTOMATIC CUT OFF ENGINES PERFECTION MANUFACTURED ON SCIENTIFIC AND PRACTICAL PRINCIPLES
BALL ENGINE CO. ERIE PA.

TELESCOPES—THEIR HISTORY and the discoveries made with them.—By Prof. E. S. Holden. An interesting historical paper, discussing the development of the telescope from the time of Galileo up to the present day. Contained in SCIENTIFIC AMERICAN SUPPLEMENT, No. **629.** Price 10 cents. To be had at this office and from all newsdealers.

BRASS WORK Small Brass Work & Models A Specialty. Also Nickel Plating. T. L. McKEEN, Easton, Penn.

SYRACUSE MALLEABLE IRON WORKS
WE SUPPLY TRADE

ETIOLOGY OF SCARLET FEVER.—A lecture by Dr. E. Klein, F.R.S., on the communicability of scarlet fever through the use of milk derived from cows to which a mild form of the disease has been given by man. Contained in SCIENTIFIC AMERICAN SUPPLEMENT, No. **629.** Price 10 cents. To be had at this office and from all newsdealers.

THE FLORIDA STEAM HEATER.
Will Never Rust Out or Explode.
Sectional. Portable. Automatic. Magazine or Surface Feed. 16 sizes.
Send for Illus. Book and Estimates.
Pierce, Butler & Pierce Mfg. Co.,
West Agents. **SYRACUSE, N. Y.**

THE
Scientific American
ESTABLISHED 1846.
The Most Popular Scientific Paper in the World.

Only $3.00 a Year, including Postage. Weekly. 52 Numbers a Year.

This widely circulated and splendidly illustrated paper is published weekly. Every number contains sixteen pages of useful information and a large number of original engravings of new inventions and discoveries, representing Engineering Works, Steam Machinery, New Inventions Novelties in Mechanics, Manufactures, Chemistry, Electricity, Telegraphy, Photography, Architecture, Agriculture, Horticulture, Natural History, etc. Complete List of Patents each week.

Terms of Subscription.—One copy of the SCIENTIFIC AMERICAN will be sent for *one year*—52 numbers—postage prepaid, to any subscriber in the United States or Canada, on receipt of **three dollars** by the publishers; six months, $1.50; three months, $1.00.

Clubs.—Special rates for several names, and to Post Masters. Write for particulars.

The safest way to remit is by Postal Order, Draft, or Express Money Order. Money carefully placed inside of envelopes, securely sealed, and correctly addressed, seldom goes astray, but is at the sender's risk. Address all letters and make all orders, drafts, etc., payable to

MUNN & CO.,
361 Broadway, New York.

THE
Scientific American Supplement.

This is a separate and distinct publication from THE SCIENTIFIC AMERICAN, but is uniform therewith in size, every number containing sixteen large pages full of engravings, many of which are taken from foreign papers, and accompanied with translated descriptions. THE SCIENTIFIC AMERICAN SUPPLEMENT is published weekly, and includes a very wide range of contents. It presents the most recent papers by eminent writers in all the principal departments of Science and the Useful Arts, embracing Biology, Geology, Mineralogy, Natural History, Geography, Archæology, Astronomy, Chemistry, Electricity, Light, Heat, Mechanical Engineering, Steam and Railway Engineering, Mining, Ship Building, Marine Engineering, Photography, Technology, Manufacturing Industries, Sanitary Engineering, Agriculture, Horticulture, Domestic Economy, Biography, Medicine, etc. A vast amount of fresh and valuable information obtainable in no other publication.

The most important Engineering Works, Mechanisms, and Manufactures at home and abroad are illustrated and described in the SUPPLEMENT.

Price for the SUPPLEMENT for the United States and Canada, $5.00 a year, or one copy of the SCIENTIFIC AMERICAN and one copy of the SUPPLEMENT, both mailed for one year for $7.00. Single copies 10 cents. Address and remit by postal order, express money order, or check,

MUNN & Co., 361 Broadway, N. Y.,
Publishers SCIENTIFIC AMERICAN.

Builders Edition.

THE SCIENTIFIC AMERICAN ARCHITECTS' AND BUILDERS' EDITION is issued monthly. $2.50 a year. Single copies, 25 cents. Forty large quarto pages, equal to about two hundred ordinary book pages; forming a large and splendid **Magazine of Architecture,** richly adorned with *elegant plates in colors*, and with other fine engravings; illustrating the most interesting examples of modern Architectural Construction and allied subjects.

A special feature is the presentation in each number of a variety of the latest and best plans for private residences, city and country, including those of very moderate cost as well as the more expensive. Drawings in perspective and in color are given, together with full Plans, Specifications, Sheets of Details, Estimates, etc.

The elegance and cheapness of this magnificent work have won for it the **Largest Circulation** of any Architectural publication in the world. Sold by all newsdealers. $2.50 a year. Remit to

MUNN & CO., Publishers,
361 Broadway, New York.

PRINTING INKS.
THE "Scientific American" is printed with CHAS ENEU JOHNSON & CO.'S INK. Tenth and Lombard Sts., Phila., and 47 Rose St., opp. Duane St., N. Y.

© 1888 SCIENTIFIC AMERICAN, INC.