

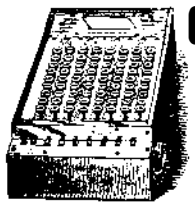
Advertisements.

Inside Page, each insertion 75 cents a line
Back Page, each insertion \$1.00 a line.
The above are charges per square line—about eight words per line.



VICTOR'S MAKE THE PACE HIGHEST GRADE CATALOGUE FREE
OVERMAN WHEEL CO., MAKERS, CHICOPEE FALLS, MASS.
GOSTON, WASHINGTON, DENVER, SAN FRANCISCO.
A. G. SPALDING & BROS. SPECIAL AGENTS. CHICAGO, NEW YORK, PHILADELPHIA.

ALUMINUM. AN INTERESTING DESCRIPTION OF THE VARIOUS METHODS OF MANUFACTURING THIS METAL, CHEMICAL AND ELECTROLYTIC, WITH SPECIAL REFERENCE TO THE HEROUIT METHOD. WITH FIGURES. CONTAINED IN SCIENTIFIC AMERICAN SUPPLEMENT, No. 753. Price 10 cents. To be had at this office and from all newsdealers.



COMPTOMETER (TRADE MARK) ALL ARITHMETICAL PROBLEMS Solved rapidly and accurately by using the COMPTOMETER. Saves 40 per cent. of time. Entire relief from mental strain. Adapted to all commercial and scientific computations. Send for circular.

FELT & TARRANT MFG. CO., 52-56 Illinois St., Chicago.

SAWS Wanted 50,000 Sawyers send us their full address for a copy of Emerson's Book of SAWS, new 1890 edition. 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 the cost. Address EMERSON, SMITH & CO. (Ltd.), Beaver Falls, Pa.

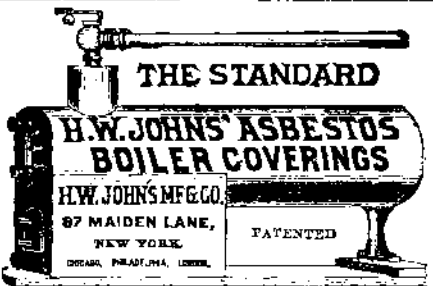
MACHINE TOOLS Engine Lathes, Planers, Shapers, Turret Lathes, etc. The Hendey Mach. Co., Torrington, Conn.

PATENT STEAM-PIPE CASING FOR Underground Steam Pipes A. WYCKOFF & SON, 116 East Chemung Place, ELMIRA, N. Y.

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

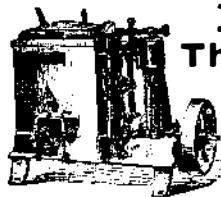
This Company owns the Letters Patent granted to Alexander Graham Bell, March 7th, 1876, No. 174,465, and January 30th, 1877, No. 186,787.

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.



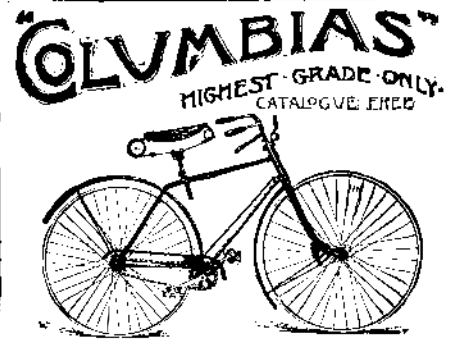
THE STANDARD H.W. JOHNS' ASBESTOS BOILER COVERINGS H.W. JOHNS MFG. CO. 87 MAIDEN LANE, NEW YORK. PATENTED. Scientific Book Catalogue RECENTLY PUBLISHED. Our new catalogue containing over 100 pages, including works on more than fifty different subjects. Will be mailed free to any address on application. MUNN & CO., Publishers Scientific American. 361 Broadway, New York.

NEW KODAKS "You press the button, we do the rest." Seven New Styles and Sizes ALL LOADED WITH Transparent Films. For sale by all Photo. Stock Dealers. THE EASTMAN COMPANY, Send for Catalogue, ROCHESTER, N. Y.



NO SKILLED ENGINEER. The Shipman Automatic Steam Engine STATIONARY AND MARINE. Petroleum, Kerosene Oil, and Natural Gas Fuel. 1, 2, 4, 6, and 8 Horse Power, Single. 8 and 22 Horse Power, Compound For Elevating Water, Creameries, and all Manufacturing Purposes. SHIPMAN ENGINE CO., 210 Summer St., BOSTON

KOCH'S DISCOVERIES.—A FULL ACCOUNT OF DR. KOCH'S REMEDY FOR TUBERCULOSIS, THE METHOD OF USING IT, ETC. WITH 18 ILLUSTRATIONS. CONTAINED IN SCIENTIFIC AMERICAN SUPPLEMENT, No. 752. Price 10 cents. To be had at this office and from all newsdealers.

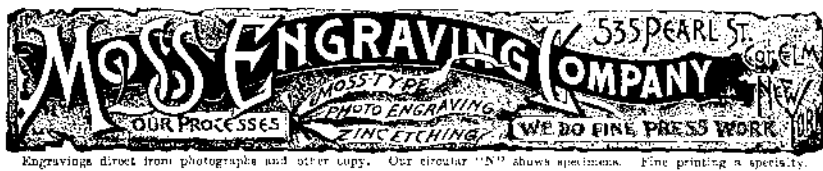


POPE MFG. CO., 77 Franklin Street, BOSTON. Branch Houses: 12 Warren St., NEW YORK, 291 Wabash Ave., CHICAGO. Factory, HARTFORD, CONN.

Motor of 19th Century Can be used Any Place, to do Any Work, and by Any One. No Boiler! No Fire! No Steam! No Ashes! No Gauges! No Engineer! A perfectly safe Motor for all places and purposes. Cost of operation about one cent an hour to each indicated horse power. For circulars, etc., address CHARTER GAS ENGINE CO., P. O. Box 145, Sterling, Ill. Economy, Reliability, Simplicity, Safety.

GATE VALVE for low pressures (below 60 lbs.) whether for Steam, Gas, Water, Oils, or Thick Fluids, investigate the "Heron" as a more compact and costs much less than any other Gate Valve. Write for Catalogue. The Lunkenheimer Brass Mfg. Co., 15-17 E. 8th St., Cincinnati, O.

WORKING MODELS and Experimental Machinery Work. New inventions worked out. Small machinery built in iron or brass. Working drawings made. Aug. Zaubits, 48 Centre St., N.Y.



THE "FISHKILL" CORLISS ENGINE COMBINING A MAXIMUM OF ECONOMY, EFFICIENCY, AND DURABILITY. Fishkill Landing Machine Co., Fishkill-on-Hudson, N. Y.

Wonderful Electrical Invention Found after years of study. A reliable battery for medical purposes. Without acids, paste, or plates. No recharging, always ready. Mild or powerful. Electricity will cure when all other remedies fail. Price, \$8.00. We want agents everywhere. A fortune in every State. Particulars and terms for stamp. C. DORAN STONE & CO., Sole Agents, CHICAGO.

THE COPYING PAD.—HOW TO MAKE and how to use; with an engraving. Practical directions how to prepare the gelatine pad, and also the aniline ink by which the copies are made; how to apply the written letter to the pad; how to take off copies of the letter. Contained in SCIENTIFIC AMERICAN SUPPLEMENT, No. 438. Price 10 cents. For sale at this office and by all newsdealers in all parts of the country.

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

2nd MACHINERY N. Y. Mach'y Depot, Bridge Store 16, Frankfort St., N. Y.

HARMON'S IMPROVED Leveling Instrument. With or without Compass. For Engineers, Contractors, and all others requiring a low price Leveling instrument for grading, measuring heights, squaring, or setting any desired angle. Illustrated circular sent on receipt of stamp. JOHN W. HARMON, 65 Haverhill St., Boston, Mass.

SEWING MACHINE MOTOR FOR AMATEURS.—By C. D. Parkhurst. Description of a very simple and effective motor, with laminated armature, of sufficient power to actuate a sewing machine. With 11 engravings. Contained in SCIENTIFIC AMERICAN SUPPLEMENT, No. 759. Price 10 cents. To be had at this office and from all newsdealers.

KEUFFEL & ESSER CO. NEW YORK. Levels, Transits, Surveyors' Compasses, Pocket and Prismatic Compasses, Hand Levels, etc. Arkie Mirrors, Plumblers, Pantographs, Engineers' Slide Rules, Leveling Rods, Poles, Chains, etc. Catalogue on application.

THE FRED'K CRANE CHEMICAL CO. SHORT HILLS, N. J.—BOX 91A—ZAPONS, BRUSH & DIP, LACQUERS, VARNISH, SHELLS, BLACKS, BRILLIANT & DEAD, JAPANS, AIR DRYING, ENAMELS, TRANSPARENT, FOR METAL AND WOOD, PROOF AGAINST ACIDS AND ALKALIES. —WRITE FOR CATALOGUE—

COPPER TUBES SHEET BRASS BRASS WIRE

PAINTROOFS WITH DIXON'S SILICA GRAPHITE PAINT Water will run from it pure and clean. It covers double the surface of any other paint, and will last four or five times longer. Equally useful for any iron work. Send for circulars. JOS. DIXON CRUCIBLE CO., Jersey City, N. J.

PATENT JACKET KETTLES Plain or Porcelain Lined. Tested to 100 lb. pressure. Send for Lists. BARROWS-SAVERY CO., 8 Front & Reed Streets, Philadelphia, Pa.

STEREOTYPING.—A VALUABLE series of lectures by Thomas Bolas, discussing the most recent methods in this branch of typography. With 23 illustrations. Contained in SCIENTIFIC AMERICAN SUPPLEMENT, Nos. 773 and 774. Price 10 cents each. To be had at this office and from all newsdealers.

ELECTRIC PERCUSSION DRILLS Marvin System of Percussion Tools. Drill contains no commutator nor moving contacts. All circuits are protected in closed metallic cases. More economical, simpler, and more easily handled than steam or air drills. Safe and reliable. Not affected by moisture, dampness, or dripping water. Weight of drill, with tripod, about 400 pounds. Speed of drilling in hard granite, 2 in. hole, 2 inches per minute. Send for descriptive pamphlet and prices. Edison General Electric Co., Edison Building, Broad St., New York.

GYMNASTICS FOR GIRLS.—AN INTERESTING account of the course of instruction given at the Berkeley Athletic Club for Ladies. With 18 illustrations. Contained in SCIENTIFIC AMERICAN SUPPLEMENT, No. 733. Price 10 cents. To be had at this office and from all newsdealers.

Otis Electric Elevator —ALSO—Manufacturers of the Standard Hydraulic Passenger and Freight, Steam and Belt ELEVATORS, Otis Brothers & Co., 38 Park Row, New York

SCIENTIFIC AMERICAN SUPPLEMENT. Any desired back number of the SCIENTIFIC AMERICAN SUPPLEMENT can be had at this office for 10 cents. Also to be had of newsdealers in all parts of the country.

GRAVES ELEVATORS. PASSENGER & FREIGHT L. S. GRAVES & SON ROCHESTER N. Y. NEW YORK, BOSTON, ST. LOUIS, CLEVELAND.

A NEW CATALOGUE OF VALUABLE PAPERS Contained in SCIENTIFIC AMERICAN SUPPLEMENT, sent free of charge to any address. MUNN & CO., 361 Broadway, New York.

WOODEN TANKS FOR RAILROADS, WATER WORKS, MILLS, FARMS, & COMPLETE STOCK OF PIPE, TUBES, & SPECIALTY. SPECIFICATIONS FURNISHED FOR FOUNDATIONS, ETC. W. E. CALDWELL & CO. No. 217 E. MAIN ST. LOUISVILLE, KY.

THE STEAM ENGINE: ITS PRINCIPLES, its development, its future and perfection—A paper by E. N. Dickerson, giving an outline of the history of the steam engine, and discussing the principles upon which it operates and which limit its capacity. With 2 figures. Contained in SCIENTIFIC AMERICAN SUPPLEMENT, No. 686. Price 10 cents. To be had at this office and from all newsdealers.

NEW MAIL New Grade, \$100. CUSHION TIRES and TANGENT SPORES. Handsomest and Best Diamond Safety. Send for Catalogue and Second-Hand List. Also Sole New England Agents for LITTLE GIANT PRICE, \$35.00. Only Boy's Safety with a Spring Fork, preventing injury to young riders from jar and vibration. 107 Washington St. WM. READ & SONS, BOSTON, MASS.

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 full 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, Canada, or Mexico, 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, Zoology, Archeology, 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, New York. Publishers SCIENTIFIC AMERICAN.

Building 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. ENOU JOHNSON & CO.'S INK, Tenth and Lombard Sts., Philadelphia, and 47 Rose St., opp. Duane, New York