

Advertisements.

Inside Page, each insertion --- 25 cents a line. Back Page, each insertion --- \$1.00 a line.

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

Victor Bicycles!



For pleasure, business, recreation, and for anything you could use a bicycle for. VICTORS ARE BEST! Send for catalogue.

Overman Wheel Co., Makers, Chicopee Falls, Mass.

THE COPYING PAD.—HOW TO MAKE and how to use; with an engraving. Practical directions how to prepare the gelatine pad, and also the antiseptic 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 newdealers in all parts of the country.

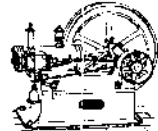
NEW KODAKS



"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, ROCHESTER, N. Y. Send for Catalogue.

2 to 40 H. P.



THE 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. Economy, Reliability, Simplicity, Safety. P. O. Box 148. Sterling, Ill.

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.

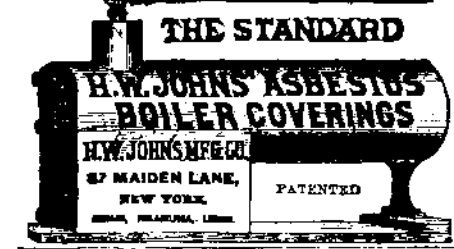
The transmission of Speech by all known forms of Electric Speaking Telephones infringes the right secured to this Company by the above patents, and renders each individual user of telephones not furnished by it or its licensees responsible for such unlawful use, and all the consequences thereof, and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



CHEMICAL ICE MACHINES

Steam and Belt Machines to make 700 Pounds Ice in Twenty-four Hours.

C. H. DE LAMATER & CO., Foot West 13th St., New York.



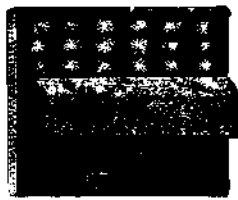
THE BEST LIME KILN KNOWN or no pay. C. D. PAGE, Rochester, N. Y.



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.

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.



Patent Riveted Monarch Rubber Belting.

BEST IN THE WORLD. THE GUTTA PERCHA AND RUBBER MFG. CO. Para Building, 35 Warren St., New York. Chicago, San Francisco, Boston, Mass.

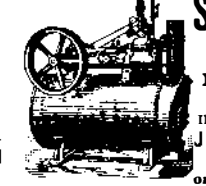


THE FRED K CRANE CHEMICAL CO. SHORT HILLS, N. J.—BOX 91A. ZAPONS, BRUSH & DIP, LACQUERS, VARNISH, SHELLAC, BLACKS, BRILLIANT, JAPANS, AIR DRYING, ENAMELS, TRANSPARENT, FOR METAL AND WOOD, PYRO, ACIDS AND ALKALIES. WRITE FOR CATALOGUE.



POP SAFETY VALVE WATER RELIEF VALVE IMPROVED STEAM GAGE STEAM ENGINE INDIOATOR

Single Bell Chime Whistle, and all Instruments used in connection with Steam, Air and Water. Sole Agents for Clark's Lumen Fire Hose. NEW YORK. LONDON. GROSBY STEAM GAGE & VALVE CO. 98 Oliver St. Boston, Mass.



STEAM ENGINES

Upright and Horizontal, Stationary, Portable and Semi-Portable. 8 to 16 Horse Power. Illustrated Pamphlet Free. Address JAMES LEFFEL & CO. SPRINGFIELD, OHIO, or 110 Liberty St. New York

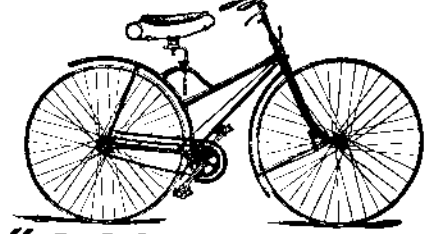
THE STEAM ENGINE: ITS PRINCIPLES, its development, its future and perfection.—A paper by E. N. Dickerson, giving an outline of the history of the steam engine, and discussing the principles upon which it operates and which limit its capacity. With 2 figures. Contained in SCIENTIFIC AMERICAN SUPPLEMENT, No. 656. Price 10 cents. To be had at this office and from all newdealers.



Hoskins' Patent Hydro-Carbon BLOW-PIPE AND ASSAY FURNACES. No dust, No ashes, Cheap, effective, economical, portable, and automatic. Send for Price List. W. Hoskins, 81 S. Clark St., Room 54, Chicago, Ill.

INVENTORS and others desiring new articles manufactured and introduced, address P. O. Box 86, Cleveland, O.

ON GAS ENGINES.—A VALUABLE paper by E. Delamare-Debutteville, touching upon the history of gas motors in general, and describing in detail the "Simplex" engine invented by the author and Mr. Ablandin. With 23 figures. Contained in SCIENTIFIC AMERICAN SUPPLEMENT, Nos. 715 and 716. Price 10 cents each. To be had at this office and from all newdealers.

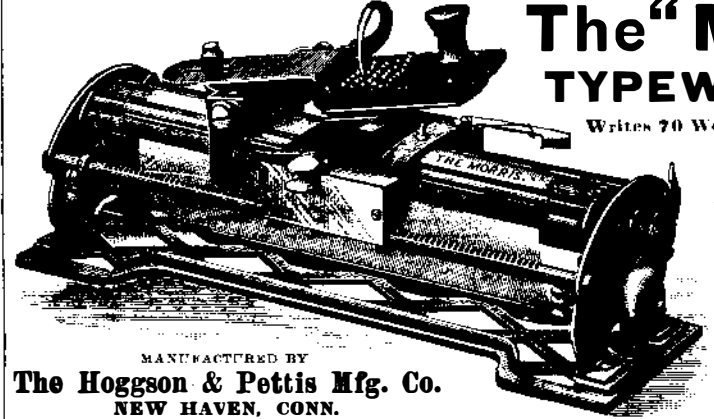


"COLUMBIAS" HIGHEST GRADE ONLY.

Catalogue Free. POPE MFG. CO. 77 Franklin St., BOSTON. BRANCH HOUSES: 12 Warren St., NEW YORK. 291 Wabash Ave., CHICAGO.

THE ONLY PRACTICAL LOW-PRICED \$15 TYPEWRITER

Catalogue free. Address Typewriter Department, POPE MFG. CO., Boston, New York, Chicago.



The "Morris" TYPEWRITER.

Writes 70 Words a Minute. Price \$15.00 Perfect Lettering. Exact Alignment. Samples of writing and 14-page illustrated catalogue cheerfully sent on application. Special inducements offered Agents to sell this machine.

NATIONAL STEEL TUBE CLEANER

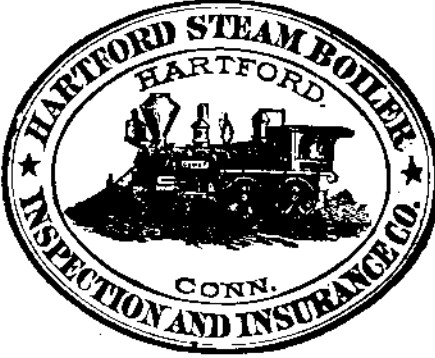


RANKS THE HIGHEST Endorsed by the best Engineers. CHALMERS-SPENCE CO. Office, 59 Liberty Street, Works, 419-425 E. Eighth St., New York

ESTABLISHED HALF A CENTURY.

MARVIN'S FIRE & BURGLAR SAFES

HAVE MANY PATENTED IMPROVEMENTS NOT FOUND IN OTHER MAKES THAT WILL WELL REPAY AN INVESTIGATION BY THOSE WHO DESIRE TO SECURE THE BEST SAFE MARVIN SAFE CO. NEW YORK, PHILADELPHIA, LONDON. ENGLAND.



SHORTHAND

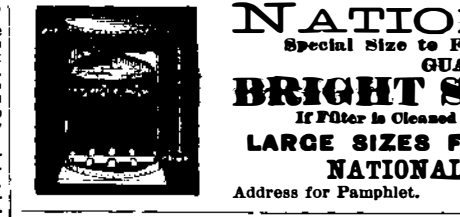
Writing thoroughly taught. Situations procured all pupils when competent. For circulars, W. G. CHAFFEE, Oswego, N. Y.

SAWS

Wanted 50,000 Sawyers and Lumbermen to send their full address for a copy of Emerson's Book of Sawing, new 1888 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 prices. Address EMERSON, SMITH & CO. (Ltd.), Beaver Falls, Pa.

TOOL AGENTS WANTED

in every SHOP in the United States. Send 10c for catalogue. THE FINEST OF MECHANICAL TOOLS A SPECIALTY. C. B. JAMES, 98 LAKE ST., CHICAGO



NATIONAL FILTER

Special Size to Filter Entire Supply of Water for House. GUARANTEED TO PRODUCE BRIGHT SPARKLING WATER. If Filter is Cleaned Once Each Day. Can be Cleaned in 10 Minutes. LARGE SIZES FOR MILLS AND WATER WORKS. NATIONAL WATER PURIFYING CO., Address for Pamphlet, 145 Broadway or 86 Liberty St., New York.



PORTER AUTOMATIC ENGINE

PORTER MFG CO LIMITED SYRACUSE N.Y. SPECIFICATIONS SOLICITED ESTIMATES GIVEN

SYRACUSE MALLEABLE IRON WORKS

OTIS ELEVATORS

THE STANDARD OF THE WORLD For all kinds of PASSENGER and FREIGHT Elevator Service. OTIS BROTHERS & CO. General Offices, NEW YORK.

GRAVES ELEVATORS.

PASSENGER-FREIGHT GRAVES & SONS ROCHESTER N.Y. NEW YORK BOSTON PHILADELPHIA

JENKINS BROS. VALVES!

JENKINS BROS., 71 John St., N. Y.; 105 Milk St., Boston; 21 North 5th St., Phila.; 54 Dearborn St., Chicago. BASE BALL—A DESCRIPTION OF the great national game of the United States, by an English writer, Jno. Newton Crane, with diagram of the field and illustrations of players. Contained in SCIENTIFIC AMERICAN SUPPLEMENT, No. 693. Price 10 cents. To be had at this office and from all newdealers.

COMPTOMETER

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.

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, Teleggraphy, 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, Geography, Archaeology, 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.

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, special feature 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 newdealers. \$2.50 a year. Remit to MUNN & CO., Publishers, 361 Broadway, New York.

PRINTING INKS.

THE "Scientific American" is printed with CHAS. T. BENO JOHNSON & CO.'S INK, Tenth and Lombard Sts., Phila., and 47 Rose St., opp. Duane St., N. Y.