

Advertisements.

Inside Page, each insertion --- 25 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.

STEREOPTICONS.

Our Petroleum Lanterns have the finest lenses and the lamps are unrivaled for powerful white light. Choice collection of views colored and plain.

Send for Catalogue to
QUEEN & CO.
PHILADELPHIA, PA.

924 Chestnut Street.

VELOCITY OF ICE BOATS. A COLLECTION of interesting letters to the editor of the SCIENTIFIC AMERICAN on the question of the speed of ice boats, demonstrating how and why it is that these craft sail faster than the wind which propels them. Illustrated with 10 explanatory diagrams. Contained in SCIENTIFIC AMERICAN SUPPLEMENT, No. 214. Price 10 cents. To be had at this office and from all newsdealers.



ASBESTOS ROOFING
FIRE AND WATER-PROOF BUILDING FELT,
FIRE-PROOF PAINTS, STEAM PACKINGS, BOILER
COVERINGS, ETC.

Samples and descriptive Price List free by mail.

E. W. JOHNS MFG CO., 87 MAIDEN LANE, N. Y.;
CHICAGO. PHILADELPHIA. LONDON.

FIRE.—A LECTURE BY J. C. HOADLEY, delivered in the Sibley College course.—The practical sources of useful artificial heat. Useful fire-sustaining substances. Carbon and hydrogen. Difference between quantity of heat and temperature. Specific heat. Waste from banked fires. Effect of nitrogen in retarding combustion. Boiler heating. Heat carried away by flue gases. Effect of boiler pressure upon quantity of heat carried away by flue gases. With numerous tables and diagrams. Contained in SCIENTIFIC AMERICAN SUPPLEMENT, No. 214. Price 10 cents. To be had at this office and from all newsdealers.

VOLNEY W. MASON & CO.,
FRICTION PULLEYS CLUTCHES and ELEVATORS
PROVIDENCE, R. I.

DRAINAGE OF PLANTATIONS.—A PAPER by D. J. Yeo, describing an inexpensive and efficient method of draining ground in sites that are to be planted with trees. With one engraving showing plan of drainage. Contained in SCIENTIFIC AMERICAN SUPPLEMENT, No. 541. Price 10 cents. To be had at this office and from all newsdealers.



THE "ACME"
Automatic Safety Engine.
1, 2, and 4 horse power. Always ready. No engineer. No dirt. No noise. Cheap, reliable, economical.

Rochester Machine Tool Works,
Rochester, New York.

ICE-HOUSE AND COLD ROOM.—BY R. G. Hatfield. With directions for construction. Four engravings. Contained in SCIENTIFIC AMERICAN SUPPLEMENT, No. 59. Price 10 cents. To be had at this office and from all newsdealers.



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.

WM. A. HARRIS,
Providence, R. I. (Park St.) Six minutes' walk from station.
Original and Only Builder of the
HARRIS-CORLISS ENGINE
With Harris' Pat. Improvements, from 1 to 1,000 H. P.
Send for copy Engineer's and Steam User's
Manual. By J. W. Hill, M.E. Price \$1.25.
MENTION THIS PAPER.

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.

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 unequalled 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 entrusted 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 value 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.



E. FABER.

Ask your stationer for **E. FABER'S Anti-nervous Rubber Penholder, No. 4262.** Price, 10 cents each.

THE BRIDGEPORT WOOD FINISHING CO
G. M. BREINIG, AGENT, PRINCIPAL OFFICE AT MANUFACTORY NEW MILFORD, CONN.
NEW YORK BUSINESS OFFICE, 95-98 MAIDEN LANE, MANUFACTURERS OF
WHEELER'S PATENT WOOD FILLER.
BREINIG'S LITHOGEN SILICATE PAINT.
LITHOGEN PRIMER, WOOD STAINS
SILEX FLINT AND FELDSPAR.
PAMPHLET GIVING DIRECTIONS FOR FINISHING HARD WOOD FREE TO ANY ADDRESS.

PATENT JACKET KETTLES,
Plain or Porcelain Lined. Tested to 100 lb. pressure. Send for Lists.
HAND, BURR & CO.
614 and 616 Market St., Philadelphia, Pa.

GOLD MEDAL, PARIS, 1878.
BAKER'S
Breakfast Cocoa.
Warranted absolutely pure Cocoa, from which the excess of Oil has been removed. It has three times the strength of Cocoa mixed with Starch, Arrowroot or Sugar, and is therefore far more economical, costing less than one cent a cup. It is delicious, nourishing, strengthening, easily digested, and admirably adapted for invalids as well as for persons in health.
Sold by Grocers everywhere.

W. BAKER & CO., Dorchester, Mass.

PRINCIPLES INVOLVED IN THE CONSTRUCTION OF HIGH SPEED ENGINES.—A lecture by C. T. Porter in the Sibley College Course. The first chapter in the history of high speed engineering in its application to stationary engines. Features of the high-speed horizontal engine; the bed plate; the crank and shaft; balancing; truth of construction. With 7 figures. Contained in SCIENTIFIC AMERICAN SUPPLEMENT, No. 546. Price 10 cents. To be had at this office and from all newsdealers.

CLARK'S NOISELESS RUBBER WHEELS
No more Splintered Floors.
Different Styles. Catalogue Free.
GEO. P. CLARK,
Box L. Windsor Locks, Ct.



JENKINS STANDARD PACKING
TRADE MARK
BARREL, KEG, Hogshead, AND STAVE MACHINERY.
Over 50 varieties manufactured by
Trass Hoop Driving. E. & B. Holmes,
BUFFALO, N. Y.

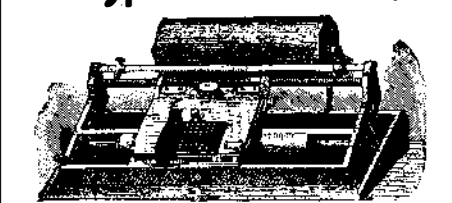
ESTABLISHED HALF A CENTURY.
MARVIN'S
FIRE & BURGLAR
SAFES
HAVE MANY PATENTED IMPROVEMENTS NOT FOUND IN OTHER MAKES
THAT WILL WELL REPAY AN INVESTIGATION BY THOSE WHO DESIRE TO SECURE THE BEST SAFE
MARVIN SAFE CO.
NEW YORK, PHILADELPHIA, LONDON, ENGLAND.

THE SEVERN TUNNEL.—A FULL DESCRIPTION of this great and difficult piece of engineering, and of the means employed to carry it out, to a successful termination. Illustrated with one plate. Contained in SCIENTIFIC AMERICAN SUPPLEMENT, No. 539. Price 10 cents. To be had at this office and from all newsdealers.

Telegraph and Electrical SUPPLIES
Medical Batteries, Inventors' Models, Experimental Work, and fine brass castings. Send for catalogue **C. E. JONES & SONS, Cincinnati, O.** It is important to us that you mention this paper.

PATENT RIVETED MONARCH RUBBER BELTING.
Best in the World.
Specially adapted for PAPER MILLS, SAW MILLS, and THRESHING MACHINES.
THE CUTTA PERCHA and RUBBER MFG. CO.,
New York, Chicago, San Francisco, Toronto.

Hall Type Writer. Price \$40



Interchangeable rubber type; 15 styles of type in English, also Greek, Italian, Norwegian, Swedish, Danish, French, Spanish, Russian, etc.
"The Hall is, in my opinion, equal to any of the writers on the market for speed, while it is simpler than all, and without a rival for distinctness."
—Jas. A. Spaulding, M.D., Portland, Me.
Send six cents in stamps for 40 page illustrated catalogue. Hall Type Writer Co., Salem, Mass.

NICKEL PLATING & POLISHING MATERIALS.
ZUCKER & LEVETT
CHEMICAL CO. NEW YORK U.S.A.
NICKEL & ELECTRO PLATING OUTFITS.

Use the **JENKINS STANDARD PACKING** in the worst joint you have, and if, after following directions, it is not what we claim, **WE WILL REFUND THE MONEY.**
Our "Trade Mark" is stamped on every sheet. None genuine unless so stamped. Send for Price List.

JENKINS BROS.,
71 John Street, N. Y. 79 Kilby Street, Boston.
13 So. Fourth Street, Phila.



INTERNATIONAL INSTITUTE FOR Liquefied Carbonic Gas.
O. BRUNLER, 857 Broadway, New York.

Barnes' Foot-Power Machinery.
Complete outfits for Actual Workshop Business. Read what a customer says: "Considering its capacity and the accuracy of your No. 4 Lathe, I do not see how it can be produced at such low cost. The velocipede foot-power is simply elegant. I can turn steadily for a whole day and at night feel as little tired as if I had been walking around." Descriptive Catalogue and Price List Free. **W. F. & JOHN BARNES** Co. Address 1999 Main St., Rockford, Ill.

TIGHT & SLACK BARREL MACHINERY
A SPECIALTY OF
JOHN GREENWOOD & CO.
ROCHESTER, N. Y.

ELECTRIC
best and most reliable Belt ever introduced. Made by
C. A. SCHIERER & CO.
47 Ferry St., New York; 416 Arch St., Philadelphia; 88 Federal Street, Boston.

THE HYDRAULIC COLLISION BUFFER.—Description of a system of buffers devised by Mr. W. F. Stanley, of London, with a view of minimizing the effects of collisions both on land and water. With 10 figures. Contained in SCIENTIFIC AMERICAN SUPPLEMENT, No. 538. Price 10 cents. To be had at this office and from all newsdealers.

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.

PULLEYS.
Order from our "Special List."
THE JOHN T. NOYE MFG. CO.,
BUFFALO, N. Y.



OF THE Scientific American
FOR 1886.

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.

All Classes of Readers find in the SCIENTIFIC AMERICAN a popular resume of the best scientific information of the day; and it is the aim of the publishers to present it in an attractive form, avoiding as much as possible abstruse terms. To every intelligent mind, this journal affords a constant supply of instructive reading. It is promotive of knowledge and progress in every community where it circulates.

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.—One extra copy of the SCIENTIFIC AMERICAN will be supplied gratis for every club of five subscribers at \$3.00 each; additional copies at same proportionate rate.

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. 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 pertaining to these and allied subjects is given, the whole profusely illustrated with engravings.

The most important Engineering Works, Mechanisms, and Manufactures at home and abroad are represented 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. Address and remit by postal order, express money order, or check.

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

To Foreign Subscribers.—Under the facilities of the Postal Union, the SCIENTIFIC AMERICAN is now sent by post direct from New York, with regularity, to subscribers in Great Britain, India, Australia, and all other British colonies; to France, Austria, Belgium, Germany, Russia, and all other European States; Japan, Brazil, Mexico, and all States of Central and South America. Terms, when sent to foreign countries, Canada excepted, \$4, gold, for SCIENTIFIC AMERICAN, one year; \$8, gold, for both SCIENTIFIC AMERICAN and SUPPLEMENT for one year. This includes postage, which we pay. Remit by postal or express money order, or draft to order of **MUNN & CO., 361 Broadway, New York.**

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