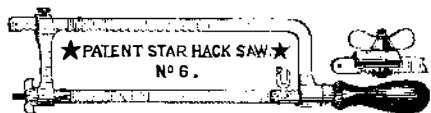


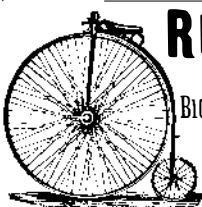
Advertisements.

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



Both the Frames and Blades of our Star Hack Saws are now as perfect as human skill can make them.

MILLERS FALLS CO., 93 Reade Street, New York.



RIDE CYCLES!

VICTORS ARE BEST! Bicycles, Tricycles, and Safeties.

CHEMISTRY OF SUBSTANCES taking part in Putrefaction and Antiseptics—Three lectures by John M. Thomson, F.R.S.E.



Hard Rubber Pump Valves

For Hot Water, Oils, and Acids, also for very high pressures.

ICE-BOATS — THEIR CONSTRUCTION and management. With working drawings, details, and directions in full.



THE RICHARDS OIL ENGINE

The Safest, Most Economical, and Most Convenient Engine. No Boiler, no Steam, no Coal, no Ashes, no Danger, no Extra Insurance, no Engineer, and next to no Attendance.

LIMITING NUMBERS OF TEETH IN Gear Wheels.—A valuable paper by George B. Grant treating of the different methods of determining the limiting numbers of teeth in gear wheels when small pinions must be used.



Shepard's New \$60 Screw-Cutting Foot Lathe

Foot and Power Lathes, Drill Presses, Scroll Saw Attachments, Chucks, Mandrels, Twist Drills, Dogs, Calipers, etc.

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

THE GENERATION OF STEAM.—A lecture by Geo. H. Babcock delivered in the Sibley College Course.



PATENTS.

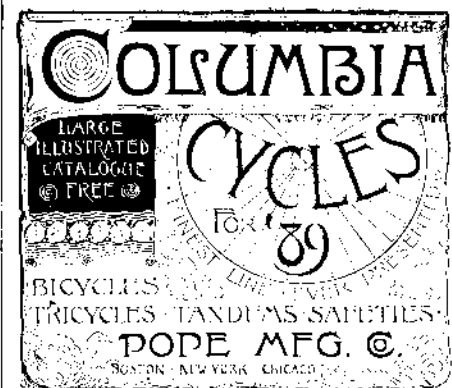
MESSRS. MUNN & CO., in connection with the publication of the SCIENTIFIC AMERICAN, continue to examine improvements, and to act as Solicitors of Patents for Inventors.



PIPE COVERINGS

Made entirely of ASBESTOS. Absolutely Fire Proof.

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.



ELECTRO MOTOR. SIMPLE. HOW TO make. By G. M. Hopkins.—Description of a small electro motor devised and constructed with a view to assisting amateurs to make a motor which might be driven with advantage by a current derived from a battery, and which would have sufficient power to operate a foot lathe or any machine requiring not over one man power.



Scientific Book Catalogue

RECENTLY PUBLISHED. Our new catalogue containing over 100 pages, including new works on more than fifty different subjects.

DELAFIELD'S PATENT SAW CLAMP.—1889 PATTERN.

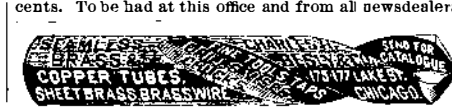


LOCOMOTIVE, ESTRADE'S HIGH-Speed.—Full description of this new engine, and a criticism of the same by Mr. Nansouty. With 1 figure. Contained in SCIENTIFIC AMERICAN SUPPLEMENT, No. 643. Price 10 cents.

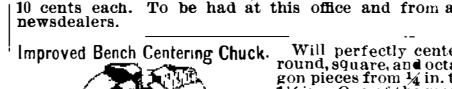
H.W. JOHNS' ASBESTOS STEAM PACKING

Boiler Coverings, Millboard, Roofing, Building Felt, Liquid Paints, Etc.

MANGANESE STEEL AND ITS PROPERTIES.—Abstract of two papers on this subject by Mr. Robert A. Hadfield, Assoc. M. Inst. C.E.



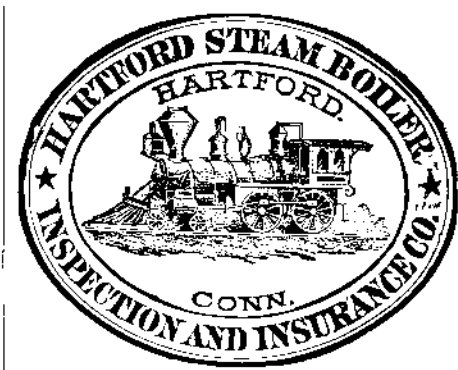
HEATING CITIES BY STEAM.—AN elaborate paper by C. E. Emory, Ph.D., discussing the general features of what is technically called a district steam system, and giving a description of the work of the New York Steam Company.



Improved Bench Centering Chuck. Will perfectly center round, square, and octagonal pieces from 1/4 in. to 1 1/2 in.

NEW YORK BELTING AND PACKING CO.

JOHN H. CHEEVER, Treas. 15 PARK ROW, New York. OLDEST and LARGEST Manufacturers in the United States of VULCANIZED RUBBER FABRICS For Mechanical Purposes.



THE MODERN ICE YACHT.—BY Geo. W. Polk. A new and valuable paper, containing full practical directions and specifications for the construction of the fastest and best kinds of Ice Yachts of the latest, most approved forms.

MICROSCOPES

Telescopes, Spectacles, Lantern Slides, Barometers, Photographic Outfits for Amateurs, Field Glasses, etc.



SECTIONAL INSULATED AIR COVERINGS FOR PIPES, BOILERS, DRUMS, AND ALL OTHER HOT SURFACES.

PNEUMATIC DYNAMITE TORPEDO

Gun.—An exhaustive account of this new weapon and of the experiments made with it; along with a description and illustration of a proposed dynamite cruiser, with 6 figures.

PATENT JACKET KETTLES

Plan or Porcelain Lined. Tested to 100 lb. pressure. Send for Lists.

A NEW CATALOGUE OF VALUABLE PAPERS

Contained in SCIENTIFIC AMERICAN SUPPLEMENT, sent free by mail to any address.

OTTO GAS ENGINES.

Over 25,000 Sold. Horizontal Otto Gas Engines, Gas Engines, Twin Cylinder, Otto Gas Engines, Combined Otto Gas Engines and Pumps, Combined Otto Gas Engines and Dynamometers.

THE GREAT TELESCOPES OF THE World.—A paper by Prof. John K. Rees, giving a popular account of all the great telescopes, their powers and limitations and method of construction.

VAN DUZEN GAS ENGINE

NO BOILER. NO COAL. NO ENGINEER. No Extra WATER RENT or INSURANCE. INSTANTLY STARTED. DURABLE, RELIABLE, SAFE and ECONOMICAL.

INFLUENCE MACHINES.

—A PAPER by James Wimshurst, giving a complete account of the recent forms of generators of static electricity. With 15 figures.



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.



THE PHONOGRAPH.—A DETAILED description of the new and improved form of the phonograph just brought out by Edison. With 8 engravings.

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.

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.

MUNN & CO., 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.

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.

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.

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

PRINTING INKS.

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