

Advertisements.

Back Page - \$1.00 a line. Inside Page - 75 cents a line. Engravings may head advertisements at the same rate per line, by measurement, as the letter press. Advertisements must be received at publication office as early as Friday morning to appear in next issue.

SCHLENKER'S Stationary-Die and Revolving-Die Bolt Cutters. THE BEST AND CHEAPEST MADE. HOWARD IRON WORKS, Buffalo, N. Y. Send for Catalogue.

FOOT LATHES-FOOT DRILL PRESSES. H. L. SHEPARD, Cincinnati, O.

STANDARD SCROLL BOOK, just out, has 200 designs and ideas invaluable to all Painters, etc. Just the thing wanted, and must be seen to be appreciated. Only \$1. Examine at any bookstore or painter's supply store. Mailed post paid on receipt of price by JESSE HANEY & CO., 119 Nassau St., N. Y.

ROGERS' TANNATE OF SODA BOILER SCALE PREVENTIVE. JOSEPH G. ROGERS & CO., Madison, Ind. Send for book on Boiler Incrustation.

\$16 Forges, FOR YOUR SHOP. Send 3c. stamp for catalogue to EMPIRE PORTABLE FORGE CO., Troy, N. Y. DOWN TO \$8.00.

The "Danbury" Drill Chuck-the "old reliable," greatly improved, now all solid cast steel, jaws strengthened 100 per cent. Always best-nov Best and Cheapest. All Hardware and Machinery Stores sell them. The HULL & BELDEN CO., Manufacturers, Danbury, Conn.

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

VELOCIPED CARRIAGES, OF LIGHT CONSTRUCTION, fast speed. Worked by hand cranks; also by foot treadles. Illustrated in SCIENTIFIC AMERICAN SUPPLEMENT No. 8. To be had at this office and of all news agents. Price 10 cents.



[ESTABLISHED 1846.]

Munn & Co.'s Patent Offices.

The Oldest Agency for Soliciting Patents in the United States.

THIRTY YEARS' EXPERIENCE.

MORE PATENTS have been secured through this agency, at home and abroad, than through any other in the world.

They employ as their assistants a corps of the most experienced men as examiners, specification writers, and draftsmen that can be found, many of whom have been selected from the ranks of the Patent Office.

SIXTY THOUSAND inventors have availed themselves of Munn & Co.'s services in examining their inventions and procuring their patents.

MUNN & CO., in connection with the publication of the SCIENTIFIC AMERICAN, continue to examine inventions, confer with inventors, prepare drawings, specifications, and assignments, attend to filing applications in the Patent Office, paying the government fees, and watch each case step by step while pending before the examiner. This is done through their branch office, corner F and 7th streets, Washington. They also prepare and file caveats, procure design patents, trademarks, and reissues, attend to rejected cases (prepared by the inventor or other attorneys), procure copyrights, attend to interferences, give written opinions on matters of infringement, furnish copies of patents, and, in fact, attend to every branch of patent business both in this and in foreign countries.

A special notice is made in the SCIENTIFIC AMERICAN of all inventions patented through this agency, with the name and residence of the patentee. Patents are often sold, in part or whole, to persons attracted to the invention by such notice.

Patents obtained in Canada, England, France, Belgium, Germany, Russia, Prussia, Spain, Portugal, the British Colonies, and all other countries where patents are granted, at prices greatly reduced from former rates. Send for pamphlet pertaining specially to foreign patents, which states the cost, time granted, and the requirements for each country.

Copies of Patents.

Persons desiring any patent issued from 1836 to November 26, 1867, can be supplied with official copies at reasonable cost, the price depending upon the extent of drawings and length of specifications.

Any patent issued since November 27, 1867, at which time the Patent Office commenced printing the drawings and specifications, may be had by remitting to this office \$1.

A copy of the claims of any patent issued since 1836 will be furnished for \$1.

When ordering copies, please to remit for the same as above, and state name of patentee, title of invention, and date of patent.

A pamphlet containing the laws and full directions for obtaining United States patents sent free. A handsomely bound Reference Book, gilt edges, contains 140 pages and many engravings and tables important to every patentee and mechanic, and is a useful handbook of reference for everybody. Price 25 cents, mailed free.

Address MUNN & CO.,

Publishers SCIENTIFIC AMERICAN,

37 Park Row, N. Y.

BRANCH OFFICE-Corner F and 7th Str ets, Wash- gton, D. C.

THE HEALD & SISCO

Patent Centrifugal Pumps.

VERTICAL & HORIZONTAL. First Premiums at New Orleans, Cincinnati, and New York. "Medal of Special Award," American Institute, 1874. Perfect satisfaction guaranteed. The cheapest, simplest, strongest, most efficient and popular Pump in use, for emptying dry-docks, Coffin-dams, etc., and for use in Paper Mills, Tanneries, and Factories. STEAM PUMPS very low, for Wrecking, Dredging, Irrigating, etc. Illustrated pamphlet, free. Nearly 1,000 references to actual customers. 31 pages first class testimony. Address HEALD, SISCO & CO. Baldwinsville, N. Y.



and Shaped Diamond Carbon Points, indispensable for Truing Emery Wheels, Grinding, Hardened Steel and Paper Calendar Rollers, Drilling, Planing, Moulding and sawing stone. J. DICKINSON, 64 Nassau St., N. Y.

Todd & Rafferty Machine Co.

MANUFACTURERS OF

The celebrated Greene Variable Cut-Off Engine, Lowe's Patent Tubular and Fine Boilers, Plain Slide Valve Stationary, Hoisting, and Portable Engines. Boilers of all kinds. Steam Pumps, Mill Gearing, Shafting, &c., Silk, Tow Oakum, Bagging, Rope, Flax, and Hemp Machinery. Agents for the New Haven Manufacturing Co.'s Machin- ist's Tools, for Judson's Governors and Stop Valves, Sturtevant Blowers, and Differential Pulley-Blocks. WAREHOUSES, 88 LIBERTY STREET, NEW YORK. WORKS, PATERSON, NEW JERSEY.

DAMPER REGULATORS BEST AND LEVER MURRELLI & KEIZER, 44 Holliday St., Balt. GAGE COCKS.

The Scientific American REFERENCE BOOK.

A Bound Book of 144 Pages, for 25c.

On receipt of 25 cents, we send by mail, post paid, a copy of a handsome little bound volume entitled the SCIENTIFIC AMERICAN REFERENCE BOOK, containing 144 pages illustrated with engravings, and forming one of the cheapest and most valuable books of condensed refer- ence ever printed. Among its contents are:

- 1. The Census of the United States, by States, Territories, and Counties, in full, showing also the area of the several States.
2. Table of Occupations.-Showing the principal occupations of the people of the United States, and the number of persons engaged in each occupation. Com- piled from the last Census.
3. The Patent Laws of the United States in full. With Directions How to Obtain Patents, Official Rules, Costs, etc.; Forms for Applications for Patents and Caveats; Forms for Assignments, in whole and part; Licenses; State, Town, County, and Shop Rights; Di- rections How to Introduce and Sell Inventions; General Principles applicable to Infringements; Synopses of the Patent Laws of Foreign Countries, Costs, Procedure, Rights of Employers and Employees in respect to In- ventions; State Laws concerning Patents.
4. United States Trade Mark Registration, show- ing the Trade Mark Law in full, with Directions for Registering Trade Marks, Costs, etc.
5. United States Copyright Law for Labels, in full. With Directions, Expenses, etc.
6. The Principal Mechanical Movements. De- scribed and illustrated by 150 small diagrams, of great value to Inventors and Designers of Mechanism.
7. Geometry, as Applied to Practical Purposes. With illustrations.
8. The Modern Steam Engine.-With engraving, showing all the parts, names, etc., and a brief history of the Invention and Progress of Steam Power.
9. Horse Power.-Simple and plain rules for Calculating the Horse Power of Steam Engines and Streams of Water.
10. Knots.-Presenting engravings of 48 different kinds of Rope Knots, with explanations as to tying.
11. Tables of Weights and Measures.-Troy Weight; Apothecaries' Weight; Avoirdupois, or Com- mercial Weight; French Weights; United States Stand- ard; Dry Measure; Land Measure; Cubic Measure; Liquid Measure; French Square Measure; French Cubic, or Solid Measure; Measuring Land by Weight, with engraving of a section of the English, and a sec- tion of the French rule, of equal length.
12. Valuable Tables:
(1) Table of the Velocity and Force of the Wind.
(2) Table of the Specific Gravity and Weight per Cubic Foot and Cubic Inch, of the principal substances used in the Arts.
(3) Table of the Heat-Conducting Power of various Metals and other Solids and Liquids.
(4) Table of the Mineral Constituents absorbed or removed from the Soil, acre, by different crops.
(5) Table of Steam Pressures and Temperatures.
(6) Table of the Effects of Heat upon various bodies, melting points, etc.
13. Miscellaneous Information.-Force of Expan- sion by Heat; small Steamboats, proper dimensions of engines, boilers, propellers, boats; Incubation, Tem- perature of; To Make racing Paper; Constituents of various Substances; Friction, how produced, and Rules for Calculation; Specific Heat Explained; Specific Gravity of Liquids, Solids, Air, and Gases; Gunpow- der-Pressure, Heat, and Horse Power of; Copying Ink, to Make; Heat, its mechanical equivalent explained; Molecules of Matter, size and motion explained; Light- ning and Lightning Rods-Construction and Information; Value of Drainage Explained; Amount of Power at present Yielded from Coal by best Engines; Sound-Its velocity and action; Liquid Gases, Recipes; Value of Brains; Properties of Charcoal; Height of Waves; Speed of Electric Spark, etc.; Valuable Recipes.

MUNN & CO., Publishers, Scientific American Office, 37 Park Row, New York

COMPRESSED AIR MOTIVE POWER.-For particulars of the most recent practice, send 20 cents for SCIENTIFIC AMERICAN SUPPLEMENT, Nos. 1 and 2, containing 5 engravings of the "Compressed Air" Locomotives now in use in St. Gothard Tunnel Works, with dimensions, etc.

PERFECT NEWSPAPER FILE.

The Koch Patent File, for preserving newspapers, magazines, and pamphlets, has been recently improved and price reduced. Subscribers to the SCIENTIFIC AMERICAN and SCIENTIFIC AMERICAN SUPPLEMENT can be supplied for the low price of \$1.50 by mail, or \$1.25 at the office of this paper. Heavy board binding. Low Price. Our new Catalogue describes these and every tool necessary for the Am- ateur or Artizan. Send for it. WM. L. CHASE & CO.

MUNN & CO., Publishers SCIENTIFIC AMERICAN.

EAGLE FOOT LATHES,

With Scroll and Circular Saw Attach- ments, Slide Rest, Tools, &c.; also Small Engine Lathes, Metal Hand Planers, &c. Neatest designs, superior finish. Low Prices. Our new Catalogue describes these and every tool necessary for the Am- ateur or Artizan. Send for it. WM. L. CHASE & CO. 95 & 97 Liberty St. New York.

Diamond Solid Emery Wheels.

PRICES-6x4, \$1.25; 8x1, \$2.25; 12x1 1/2, \$5.50; 15x2, \$12.50; 18x2, \$16.00; 24x2, \$19.50; 24x3, \$42. All other sizes at pro- portionate prices. Best cutting, free from glazing, they are the best Solid Emery Wheels. Give diam. of holes in your order for wheels. Emery Grinders unequalled by any in the world. Address AMERICAN TWIST DRILL CO., Woonsocket, R. I.



NON-COMBUSTIBLE STEAM BOILER & PIPE COVERING

WITH "AIR SPACE" IMPROVEMENT. Saves 10 to 20 per cent. CHALMERS SPENCE CO., Foot E. 9th St., N. Y.; 1302 N. 2nd St., St. Louis, Mo.

W. C. DUYCKINCK, IMPORTER, MANUFACTURER, AND DEALER IN Railway, Machinists', and En- gineers' Supplies. 50 and 52 JOHN STREET, P. O. Box 4101. NEW YORK.

Niagara Steam Pump Works ESTABLISHED 1826. CHARLES B. HARDICK, No. 23 Adams Street, BROOKLYN, N. Y.

M. SELIG JUNIOR, & CO., Importers of American Machinery, Tools, Agricultural Implements, Wholesale and Export Hardware and Machinery Merchants. Est'd 1866. 26 Queen Victoria St., LONDON, E. C., ENGLAND.

Portland and Keene's Cement. From the best London Manufacturers. For sale by JAMES BRAND, 35 Beekman St., New York. A Practical Treatise on Cement furnished for 25 cents.

WROUGHT IRON BEAMS & GIRDERS

THE UNION IRON MILLS, Pittsburgh, Pa.- The attention of Engineers and Architects is called to our improved Wrought-Iron Beams and Girders (pat- ented), in which the compound welds between the stem and flanges, which have proved so objectionable in the old mode of manufacturing, are entirely avoided. We are pre- pared to furnish all sizes at terms as favorable as can be obtained elsewhere. For descriptive literature, ad- dress Carnegie Brothers & Co., Union Iron Mills, Pittsburgh, Pa.

THE CENTENNIAL INTERNATIONAL EX- HIBITION OF 1876.-The full History and Progress of the Exhibition, maps of the grounds, engravings of the buildings, news and accounts of all the most notable objects, are given weekly in the SCIENTIFIC AMERICAN SUPPLEMENT. Terms, \$5 for the year; single co- pies 10 cts. To be had at this office, and of all news agents. All the back numbers, from the commencement on Jan- uary 1, 1876, can be had. Those who desire to possess a complete and splendid illustrated Record of the Centen- nial Exposition, should have the SCIENTIFIC AMER- ICAN SUPPLEMENT.

H. W. JOHNS, PATENT MATERIALS.

Asbestos Roofing, with the improved White Asbestos Fire Proof Coating, for steep or flat Roofs in all climates. Asbestos Roof Douring, for old Leaky Roofs. Asbestos Cement, for repairing Leaks on Roofs. Asbestos Roof Paint, for Tin Roofs, Ironwork, &c. Asbestos Paints-all colors-for structural purposes. Asbestos Fire Proof Coating, for wood work, &c. Asbestos Steam Pipe and Boiler Coverings. Asbestos Steam Packing, for old Leaky Pipes, all sizes. Sheathing Felt, Vermis-Proof Lining, &c. These articles are ready for use, and can be easily ap- plied by any one. Send for Pamphlets, Price Lists, &c. H. W. JOHNS, 87 Maiden Lane, N. Y., Patentee and Manufacturer. Established 1858.



WHIPPLE'S Patent Door Knob.

Awarded a Bronze Medal at the American Institute Fair for 1874. The Judges say: "We consider this method of fastening DOOR KNOBS a great improvement over any- thing yet invented for the purpose, as it obviates the use of side screws and washers, and can be regulated to suit any thickness of Doors." Send for Circular. THE PARKER & WHIPPLE COMPANY, West Meriden, Conn., or 97 Chambers St., N. Y.

Machinists' Tools.

NEW AND IMPROVED PATTERNS. Send for new illustrated catalogue. Lathes, Planers, Drills, &c. NEW HAVEN MANUFACTURING CO., New Haven, Conn.

Do Your Own Printing! \$3 Free for cards, labels, envelopes, etc. Larger sizes for larger work. Business Men do their printing and adver- tising, save money and increase trade. Pleasure and profit in Amateur Printing. The Girls have great fun and make money fast at Boys' printing. Send two stamps for full cat- alogue of presses, type, etc., to the Manufacturer, KELSEY & CO., Meriden, Conn.

PORTLAND CEMENT

For Walks, Cisterns, Foundations, Stables, Cellars Bridges, Reservoirs, Breweries, etc. Remit 10 cents for Practical Treatise on Cements. S. L. MERRILL & CO., 76 South St. New York

The Tanite Co., STROUDSBURG, PA. EMERY WHEELS & GRINDERS

CHICAGO OR WESTERN HEAD QUARTERS for Tanite Co.'s Emery Wheels, Grinding Machinery, &c. C. C. CHAMPLIN, 152 Lake St. Tanite Wheels delivered free of freight in any part of the West, on receipt of list price in advance.

SCREW PROPELLERS, THEIR SHAFTS AND FITTINGS. By Hamilton W. Pendred, M. E. An able treatise, showing the present practice, its advan- tages and defects. With 25 figures. Price 10 cents. Con- tinued in No. 4 of SCIENTIFIC AMERICAN SUPPLE- MENT. To be had at this office, and of all news agents.

HARTFORD STEAM BOILER Inspection & Insurance COMPANY.

W. B. FRANKLIN, V. Pres't. J. M. ALLEN, Pres't. I. B. PIERCE, Sec'y.

NOYE'S Mill Furnishing Works are the largest in the United States. They make Burr Millstones, Portable Mills, Smut Machines, Packers, Mill Picks, Water Wheels, Pulleys and Gearing, specially adapted to flour mills. Send for Catalogue. J. T. NOYE & SON, Buffalo, N. Y.

IRON BRIDGE BUILDING-A complete de- scription, with dimensions, working drawings, and perspectives of Girard Avenue Bridge, Philadelphia, Pa. With foundations of piers. Ten engravings. Price 30 cents. Contained in Nos. 1, 2, and 4 of SCIENTIFIC AMERICAN SUPPLEMENT, 10 cents per copy. To be had at this office, and of all news agents.

COLD ROLLED SHAFING

The fact that this shafting has 75 per cent greater strength, a finer finish, and is truer to gauge, than any other in use, renders it undoubtedly the most economical. We are also the sole manufacturers of the CELEBRATED COLLINS' PAT. COUPLING, and furnish Pulleys, Hangers, etc., of the most approved styles. Price list mailed on application to JONES & LAUGHLIN, 130 S. Canal Street, Chicago, Ill. Stocks of this shafting in store and for sale by FULLER, DAN, & FITZ, Boston, Mass.; GEO. PLACE & CO., 121 Chambers St., N. Y. PIERCE & WHALING, Milwaukee, Wis.



OF THE SCIENTIFIC AMERICAN, FOR 1876. THE MOST POPULAR SCIENTIFIC PAPER IN THE WORLD. THIRTY-FIRST YEAR.

VOLUME XXXIV.-NEW SERIES.

The publishers of the SCIENTIFIC AMERICAN beg to announce that on the first day of January, 1876, a new volume commenced. It will continue to be the aim of the publishers to render the con- tents of the new volume more attractive and use- ful than any of its predecessors.

To the Mechanic and Manufacturer.

No person engaged in any of the mechanical pur- suits should think of doing without the SCIENTIFIC AMERICAN. Every number contains from six to ten engravings of new machines and inven- tions which cannot be found in any other publica- tion.

The SCIENTIFIC AMERICAN is devoted to the interests of Popular Science, the Mechanic Arts, Manufactures, Inventions, Agriculture, Commerce and the industrial pursuits generally; and it is valu- able and instructive not only in the Workshop and Manufactory, but also in the Household, the Library, and the Reading Room. Each volume contains hundreds of Notes, Receipts, and Sugges- tions and Advice, by Practical Writers, for Work- ing Men and Employers, in all the various arts.

TERMS OF SUBSCRIPTION - POSTAGE PAID BY US.

One copy Scientific American, one year ..\$3.20 One copy Scientific American, six months. 1.80 One copy Scientific American, three months 1.00 One copy Scientific American and one copy Scientific American Supplement, both for one year, post-paid..... 7.00

The Scientific American Supplement

A weekly paper, uniform in size with the SCIENTIFIC AMERICAN, but a distinct publication. It contains working drawings of engineering works, and elaborate treatises on every branch of Science and Mechanics, by eminent writers, at home and abroad. An illustrated cover protects the hand- somely printed sheets. Price, \$5.00 per annum Single copies 10 cents. Remit by postal order, draft, or express. Address all letters and make all Post Office or- ders and drafts payable to

MUNN & CO. 37 PARK ROW, NEW YORK.

The "Scientific American" is printed with CHAS. ENEU JOHNSON & CO.'S "SINK, Tenth and Lombard-sts., Philadelphia, and 59 Gold-st., New-York"