

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.



A PLAIN BRACE, A KATCHET BRACE,
A DRILL BRACE, ALL IN ONE.
Material, Style, Finish, Durability, in
all respects this Brace is warranted to be
the best in any market. Sent by mail,
postage paid by us on receipt of \$3.00.
Most Hardware dealers will furnish it at
the same price. MILLERS FALLS CO.,
No. 74 Chamber St., New York.



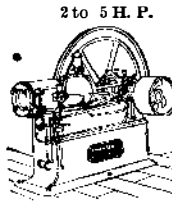
Caligraph
LIFESHORT WRITE THE WAY
Address: The American Writing
Machine Co., Hartford, Conn.,
New York Office, 237 Broadway.

**INTERNATIONAL INSTITUTE FOR
Liquefied Carbonic Gas.**
G. BRUNIER, 857 Broadway, New York.

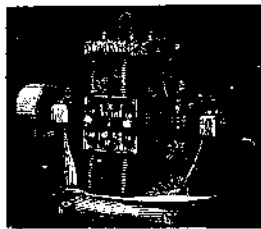


**ASBESTOS
ROOFING**
FIRE AND WATER-PROOF BUILDING FELT,
FIRE-PROOF PAINTS, STEAM PACKINGS, BOILER
COVERINGS, ETC.

Samples and descriptive Price List free by mail.
H. W. JOHNS MFG CO., 87 MAIDEN LANE, N. Y.
CHICAGO. PHILADELPHIA. LONDON.



2 to 5 H. P.
**CHARTER'S
GAS ENGINE.**
Warranted equal to any in
Power and Economy, and Superior
to all in Simplicity and com-
pactness. Gives an impulse at
every Revolution.
H. H. LATHAM,
Chicago Agent, 115 Monroe Street.
Williams & Orton Mfg. Co.,
P. O. Box 148. STERLING, ILL.



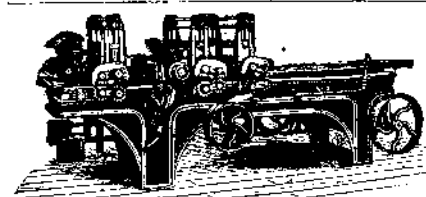
ARC LIGHTING.
The WATERHOUSE SYSTEM
SAVES POWER.
(25 to 50 per cent.)
Has a Perfect Regulator, and
Lamps entirely reliable.
Everything works in harmony
and the objections common
to other systems have
been perfected.

The Waterhouse Electric Mfg. Co., Hartford, Conn.

MILL OWNERS.

Price of Burnham's Improved Standard Turbine is cost
of manufacturing. Pamphlet free. Address York, Pa.

Mineral Lands Prospected
Artesian Wells Bored. Superior Stationary En-
gines, specially adapted to Electric Light purposes.
Built by P. A. DIAMOND DRILL CO., Birdsboro, Pa.



WITHERBY, RUGG & RICHARDSON, Manufacturers of
Patented and Working Machinery of every description.
Fits all descriptions. Send for former occupied
by R. Ball & Co., Worcester, Mass. Send for Catalogue.

WM. A. HARRIS,
Providence, R. I. (Park St.) Six minutes' walk West from station.
Original and Only Builder of the
HARRIS-CORLISS ENGINE,
With Harris' Pat. Improvements, from 10 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.

PATENTS.

MESSRS. MUNN & CO., in connection with the publi-
cation of the SCIENTIFIC AMERICAN, continue to ex-
amine 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
of 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, con-
taining full information about Patents and how to pro-
cure them; directions concerning Labels, Copyrights,
Designs, Patents, Appeals, Reissues, Infringements, As-
signments, Rejected Cases, Hints on the Sale of Pa-
tents, etc.

We also send, free of charge, a Synopsis of Foreign Pa-
tent 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, Pa-
cific Building, near 7th Street, Washington, D. C.

THE BRIDGEPORT WOOD FINISHING CO

G. M. BREINIG, AGENT, PRINCIPAL OFFICE AT MANUFACTORY, NEW MILFORD, CONN.
NEW YORK BUSINESS OFFICE, 96-98 MAIDEN LANE. MANUFACTURERS OF
WHEELERS 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.

MACHINERY List, Engines, Lathes, Planers, Drills,
New and 2d hand. C. L. JACKSON & CO., Baltimore, Md.

ELECTRIC
LEATHER BELTING
best and most reliable Belt
ever introduced. Made by
C. A. SCHIEKEN & CO.
47 Ferry St., New York; 416
Arch St., Philadelphia; 86 Federal Street, Boston.



THE BACKUS
WATER MOTOR
SUPPLIES FROM
HYDRANT PRESSURE
the cheapest power known.
Invaluable for blowing
Church Organs, running
Printing Presses, Sewing
Machines in Households,
Turning Lathes, Scroll
Saws, Grindstones, Coffee
Mills, Sausage Machines,
Feed Cutters, Electric
Lights, Elevators, etc. It
needs little room, no firing
up, fuel, ashes, repairs, en-
gineer, explosion, or delay,
no extra insurance, no coal
bills. Is noiseless, neat,
compact, steady; will work
at any pressure of water
above 15 lb.; at 40 lb. pres-
sure has 4-horse power, and
capacity up to 10-horse
power. Prices from \$15 to \$300. Send for circular to
THE BACKUS WATER MOTOR CO., Newark, N. J.

Established 1837.
Machine Knives,
L. & I. J. WHITE,
BUFFALO, N. Y.

Planing, Moulding, Shingle and
Stave, Hoop and Veneer. Plated
Stock and Blanks for Moulding Cutters. Other Machine
Cutters to Pattern. Moulding Cutters can be ordered by
number from Universal Moulding Book.

**Columbia Bicycles
and Tricycles.**
CATALOGUE SENT FREE.
The POPE MFG. CO., 597 Washington St., Boston
Branch Houses: 19 Warren St., New
York; 115 Wabash Ave., Chicago.



**JENKINS
STANDARD
PACKING**
TRADE MARK
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.

**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.

COPPER TUBES.
SHEET BRASS BRASS WIRE
Reflecting Telescopes. Equatorial Mountings, etc.
Reasonable prices. Gardam & Sons, 96 John St., N. Y.

CARY & MOEN
STEEL WIRE OF EVERY DESCRIPTION
234 W. 29 ST. EVERY STEEL SPRINGS. NEW YORK CITY

CLARK'S NOISELESS RUBBER WHEELS
No more Splintered Floors.
Different Styles. Catalogue Free.
GEO. P. CLARK,
Box 11, Windsor Locks, Ct.

BEFORE YOU BUY A BICYCLE
Of any kind, send stamp to A. W. CUMP,
Dayton, Ohio, for large Illustrated Price
List of New and Second-Hand Machines.
Second-hand BICYCLES taken in exchange.
BICYCLES Repaired and Nickel Plated.

Barnes' Foot-Power Machinery.
Complete outfits for Actual Workshop
Business. Read what a customer says:
"Considering its capacity and the ac-
curacy of your No. 4 Lathes, 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 1399 Main St., Rockford, Ill.

NEWARK FILTERING CO., NEWARK, N. J.
TRIBE BUILDING, NEW YORK.

POINTERS for Users of Steam Pumps.
Van Duzen's Patent Steam Pump
Hot or Cold. Is
Can Pump Sandy or Impure Water or Liquids. Efficient.
Has no moving parts, consequently no
wear, no repairs, no trouble. Purchasers
assume no risks, as we guarantee every
Pump. Above comparison with Jet
Pumps, Ejectors, etc., made of Iron.
Demand this Pump of your dealer and
take no cheap substitute. We make Ten
20,000 gallons per hour. State for what purpose wanted
and send for Catalogue of "Pumps."
VAN DUZEN & TIFT, Cincinnati, O.

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

HYDRAULIC FLANGED HEADS,
OF IRON OR STEEL, FOR BOILER AND TANK MAKERS.
Unequaled for Strength and Uniformity.
THE DICKSON MANUFACTURING CO.
SCRANTON, PA.
96 Lake Street, Chicago. 57 Oliver Street, Boston. 112 Liberty Street, New York.



Save postage by using Wear-
Metal Mailing Boxes and
Envelopes, Book Corner Pro-
tectors, metal, paper cover-
ed. For sending merchandise
through the U. S. and For-
eign mails. Officially approved
by F. O. Dept. Cheapest,
lightest, strongest. No lids.
No strings. 50,000 sizes. Send
10cts. for samples and in for-
mation to The Weaver Mail-
ing Envelope & Box Co., 415 Race St., Philadelphia. A.
De O. ROSSITER, Sole Lessee. Agents wanted.

RAILWAY AND STEAM FITTERS' SUPPLIES
Rue's Little Giant Injector.
SCREW JACKS, STURTEVANT BLOWERS, &c.
JOHN S. URQUHART, 46 Cortlandt St., N. Y.

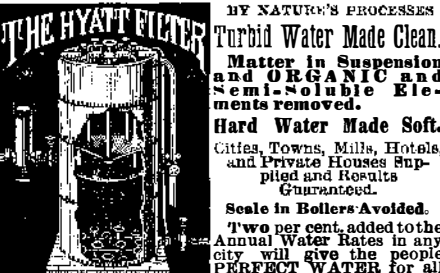
**PATENT
JACKET KETTLES,**
Plain or Porcelain Lined. Tested to 100 lb.
pressure. Send for Lists.
HAND, BURK & CO.,
614 and 616 Market St., Philadelphia, Pa.

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.

RUBBER BELTING, PACKING, HOSE,
AND ALL OTHER KINDS OF
RUBBER GOODS,
FOR
MECHANICAL AND MANUFACTURING PURPOSES.
The Largest and Most Extensive Manufacturers in America.
THE GUTTA PERCHA AND RUBBER MFG. CO.,
New York, Chicago San Francisco, Toronto.

Andrews' Office & Bank Desks
The finest work in the U. S.; kiln
dried lumber. All work guaranteed.
ORIENTAL CHAIRS, School Desks, Globes.
A. H. ANDREWS & CO., 255 Washington St.,
686 Broadway, N. Y.

AQUA PURA
BY NATURE'S PROCESSES
Turbid Water Made Clean.
Matter in Suspension
and ORGANIC and
Semi-Soluble Ele-
ments removed.
Hard Water Made Soft.
Cities, Towns, Mills, Hotels,
and Private Houses Sup-
plied and Results
Guaranteed.
Scale in Boilers Avoided.
Two per cent. added to the
Annual Water Rates in any
city will give the people
PERFECT WATER for all
time.
Send for Circulars and Estimates.



NEWARK FILTERING CO., NEWARK, N. J.
TRIBE BUILDING, NEW YORK.

POINTERS for Users of Steam Pumps.
Van Duzen's Patent Steam Pump
Hot or Cold. Is
Can Pump Sandy or Impure Water or Liquids. Efficient.
Has no moving parts, consequently no
wear, no repairs, no trouble. Purchasers
assume no risks, as we guarantee every
Pump. Above comparison with Jet
Pumps, Ejectors, etc., made of Iron.
Demand this Pump of your dealer and
take no cheap substitute. We make Ten
20,000 gallons per hour. State for what purpose wanted
and send for Catalogue of "Pumps."
VAN DUZEN & TIFT, Cincinnati, O.

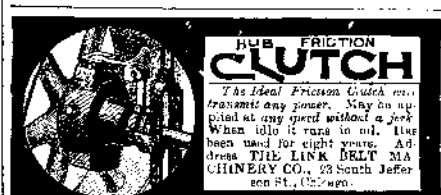
**Telegraph and Electrical
SUPPLIES**
Medical Batteries, Inventors' Models, Experi-
mental Work, and fine brass castings. Send for
catalogue C. E. JONES & BRO. Cincinnati, O.
It is important to us that you mention this paper.

HYDRAULIC FLANGED HEADS,
OF IRON OR STEEL, FOR BOILER AND TANK MAKERS.
Unequaled for Strength and Uniformity.
THE DICKSON MANUFACTURING CO.
SCRANTON, PA.
96 Lake Street, Chicago. 57 Oliver Street, Boston. 112 Liberty Street, New York.

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 in-
fringes the right secured to this Company
by the above patents, and renders each
individual user of telephones not furnish-
ed by it or its licensees responsible for such
unlawful use, and all the consequences
thereof, and liable to suit therefor.



PATENTEES and others desiring specialties
manufactured, will find uncom-
ed facilities and low estimates by applying to THE
JEWEL MANUFACTURING CO., Toledo, Ohio.



PROSPECTUS
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 six-
teen 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, Archi-
tecture, Agriculture, Horticulture, Natural History, etc.
All Classes of Readers find in the SCIENTIFIC
AMERICAN a popular resume of the best scientific in-
formation 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 pub-
lishers; six months, \$1.50; three months, \$1.00.

Clubs.—One extra copy of the SCIENTIFIC AMER-
ICAN 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. Ad-
dress all letters and make all orders, drafts, etc., pay-
able 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 Engi-
neering, Steam and Railway Engineering, Mining,
Ship building, Marine Engineering, Photography,
Technology, Manufacturing Industries, Sanitary En-
gineering, Agriculture, Horticulture, Domestic Econo-
my, 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 AM-
ERICAN 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 sub-
scribers 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; \$9, gold,
for both SCIENTIFIC AMERICAN and SUPPLEMENT for
one year. This includes postage, which we pay. Remit
by postal express money order, or draft to order of
MUNN & CO., 361 Broadway, New York.

PRINTING INKS
THE "Scientific American" is printed with CLAS-
SIC ENGLISH INK, by ENEU JOHNSON & CO.'S INK, Tenth and
Broad Sts., Phila., and 47 Rose St., opp. Duane St., N. Y.