The Electrical Age

Established 1883. An Illustrated Weekly Electrical Journal. 10 cents per copy

VOL. XXV.—No. 660. NEW YORK, JANUARY 6, 1900 Subscription, $2.50 per year. Foreign Countries, $3.50 per year.

1889.
PARIS EXPOSITION MEDAL
— FOR —
RUBBER INSULATION.

OKONITE
TRADE MARK.

1893.
WORLD'S FAIR MEDAL
— FOR —
RUBBER INSULATION.

THE STANDARD FOR RUBBER INSULATION.

OKONITE WIRES, OKONITE TAPE, MANSON TAPE, CANDEE WEATHERPROOF WIRES.

WILLARD L. CANDEE, H. DURANT CHEEVER } MANAGERS.
THE OKONITE CO., Ltd., Sole Manufacturers,
253 BROADWAY, NEW YORK.
GEO. T. MANSON, GENERAL SUPT. W. H. HODGINS, SECRETARY.

SPEER
Carbon Brushes

Are made under the direct supervision of Mr. J. S. SPEER (formerly of the Partridge Carbon Co.). This guarantees the excellency of the brushes, which are made in every type required.

NOT IN THE TRUST.

The Speer Carbon Co., ST. MARYS, Pa., U. S. A.

THE
PHOENIX GLASS CO.
MANUFACTURERS OF
Gas and Electric
Globes, Shades, Etc.

HAVE YOU A COPY OF OUR No. 8 CATALOGUE?
IF NOT, SEND FOR IT.

Pittsburgh. New York. Chicago.

Fibre Paper Rubber CABLES AND High Grade Rubber Covered and Weatherproof WIRES

Conduits and Accessories, for Telephone, Telegraph, Electric Light and Power.

STANDARD UNDERGROUND CABLE COMPANY,

Pittsburg: Westinghouse Bldg. Philadelphia: 1225 Betz Bldg.
New York: 18 Cortlandt St. Chicago: 542 The Rookery.
St. Louis: 507 Security Bldg.

Don't
Travel--
Telephone

FOR SERVICE APPLY TO
NEW YORK TELEPHONE CO.
CONTRACT OFFICES
18 Cortlandt, 15 Dey, 952 Broadway, 115 W. 38th.

ADAM E. SCHATZ,
COUNSEL IN
PATENT CAUSES, TRADE-MARKS and COPYRIGHTS
AMERICAN AND FOREIGN,
346 Broadway,
N. Y. Life Ins. Building. NEW YORK.

PATENTS. PATENT SOLICITOR AND ELECTRICAL EXPERT.

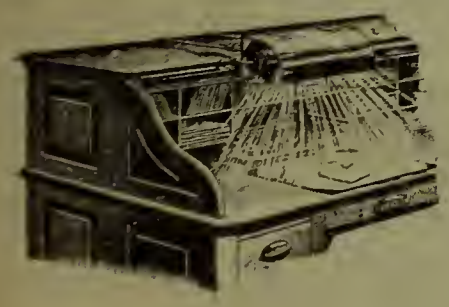
Former Manager, now successor to the Patent Business heretofore conducted by "The Electrical World."

W. A. ROSENBAUM, 177 TIMES BLDG., N. Y.

Eschwei Electric Co.,
—MANUFACTURERS OF—
ARC LIGHTS.
47-49 Centre Street,
NEW YORK.

The IMPROVED "DAYLIGHT" DESK LAMP.

PARABOLA EFFECT.



This Electric Desk Lamp is constructed upon scientific principles, and is of great value to those who are compelled to do desk work. The light is soft and abundant, and so well distributed as to leave no shadows or dark corners on the desk; yet the lamp itself is entirely shaded from the eyes, and in no way interferes with the opening or closing of a "roll top" desk.

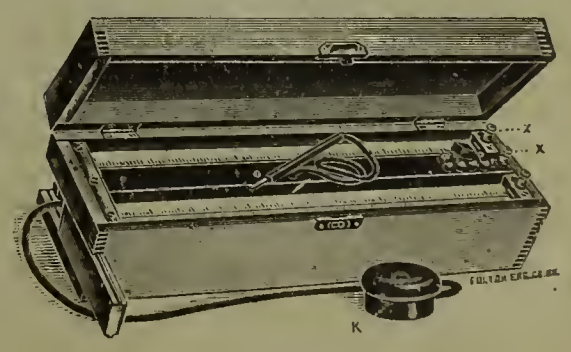
Nothing in the market compares favorably with it. It doubles the power of an incandescent lamp without bunching the light.

Adjustable "Roll Top" Desk Lamp, without socket, $3.00.

FRANK E. KINSMAN, 26 Cortlandt St., N. Y.
HAVEMEYER BUILDING.
No Special Lamp or Socket Necessary.

Direct Reading
Ohmmeters
BRUSHES.
RHEOSTATS,
Special Machinery.

AM. El. Specialty Co.,
123 Liberty St., New York.
TELEPHONE, 126 CORTLANDT.



SEE PAGE III.

BAKER & CO.,
Newark, N. J.
New York Office: 120 Liberty St.

In Sheet or Wire, any degree of hardness.

PLATINUM
FOR ALL PURPOSES.

ELECTRICAL ENGINEERS AND CONTRACTORS
RECOMMENDED BY
THE ELECTRICAL AGE.

Advertisements of 4 lines or less under this head $26 per year, additional lines at proportionate rates.

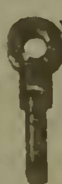
ZIMDARS & HUNT.
General Electrical Contractors. Wiring complete plants, etc. 127 Fifth Ave., New York. N. Y.

HATZEL & BUEHLER
Electrical Engineers and Contractors. 114 Fifth Avenue, New York.

J. F. BIDSTRUP & CO.
35 Frankfort Street, New York. Electrical Work of all kinds. Wiring, etc. Dynamo and Motor Repairing, Electrical Supplies

INDEX TO ADVERTISERS.

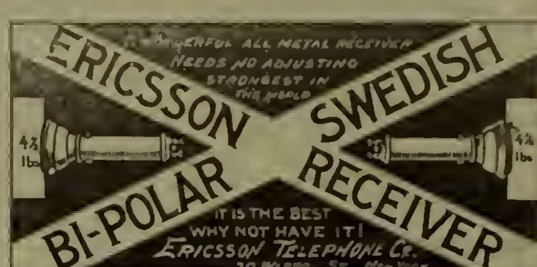
DYNAMO and ARMATURE
Rewinding Repairing and Reconstructing Armatures, Dynamos, Railway Motors, Transformers, Commutators.
Stucky & Heck Electric Mfg. Co., Ltd.,
35 N. J. R. R. Ave., Newark, N. J.



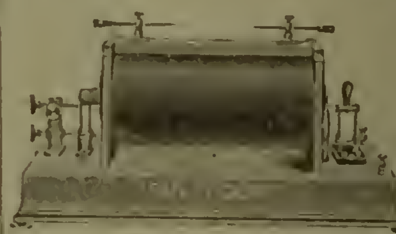
McIntire Patent Connector
AND TERMINALS.
Fuse Wire, Fuse Links and Strips.
C. McINTIRE CO.
13 Franklin St., Newark, N. J.

Motors Bought, Sold and Installed.
Motors Maintained at Reasonable Rates.

THE ELECTRIC MOTOR INSPECTION AND REPAIR CO. OF NEW YORK.
General Office ... 31 PARK ROW, NEW YORK
H. L. SMITH, Mgr. Telephone Call, 418 Cortland



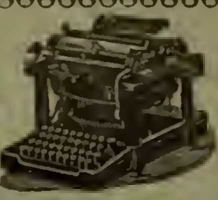
X-RAY COILS A Specialty.



Telephone and Spark Coils.

C. F. SPLITDORF, 17-27 Vandewater St., N. Y.

GORDON BATTERY COMPANY.
THE BEST PRIMARY BATTERY FOR CLOSED OR OPEN CIRCUIT WORK.
594 Broadway, . . . New York.



TYPEWRITER BARGAINS.
Practically new Remingtons, Caligraphs, Smith-Premiers, Hammonds, Yosts, Densmores, fully guaranteed, only $20 to $50—Cost $100. Good machines rented $4 monthly. *Free Handsome Colored Price List.* Also, list of Revised American Standard Pitman Shorthand Books, arranged for self-instruction. Consolidated Typewriter Exchange, 245 B'way, N. Y.

CALIFORNIA IS THE REAL WINTER RESORT

and the New York Central is the best way to reach it,—only ninety-six hours from Grand Central Station, New York to the orange groves of California.

The best is the cheapest and the New York Central has no equal.

A booklet on the "Lake Shore Limited," containing also a novel and unique descriptive time table of this wonderful train, will be sent free by addressing George H. Daniels, General Passenger Agent, Grand Central Station, New York.

50 YEARS' EXPERIENCE

PATENTS

TRADE MARKS
DESIGNS
COPYRIGHTS &c.

Anyone sending a sketch and description may quickly ascertain our opinion free whether an invention is probably patentable. Communications strictly confidential. Handbook on Patents sent free. Oldest agency for securing patents.
Patents taken through Munn & Co. receive *special notice*, without charge, in the

Scientific American.

A handsomely illustrated weekly. Largest circulation of any scientific journal. Terms, $3 a year; four months, $1. Sold by all newsdealers.
MUNN & Co. 361 Broadway, **New York**
Branch Office, 625 F St., Washington, D. C.

HOLOPHANE GLOBES.

More Light.

No Glare.

Perfect Diffusion.

Artistic Patterns.

For all kinds of electric lighting,
Send for catalogues and price lists.

HOLOPHANE GLASS CO., 1 Broadway, N. Y.

The Electrical Age

Established 1883. An Illustrated Weekly Electrical Journal. 10 cents per copy

VOL. XXV.—No. 661. NEW YORK, JANUARY 13, 1900 Subscription, $2.50 per year. Foreign Countries, $3.50 per year.

1889.
PARIS EXPOSITION MEDAL
— FOR —
RUBBER INSULATION.

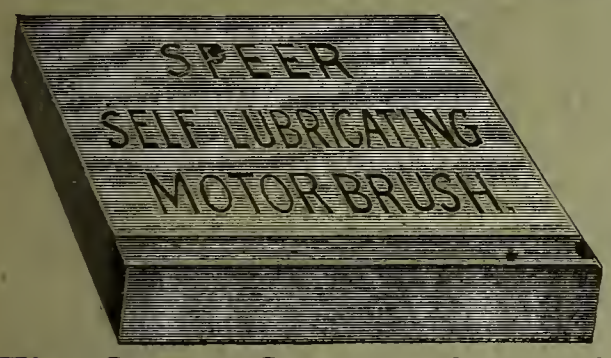
OKONITE
TRADE MARK.

1893.
WORLD'S FAIR MEDAL
— FOR —
RUBBER INSULATION.

THE STANDARD FOR RUBBER INSULATION.

OKONITE WIRES, OKONITE TAPE, MANSON TAPE, CANDEE WEATHERPROOF WIRES.

WILLARD L. CANDEE, M. DURANT CHEEVER } MANAGERS.
THE OKONITE CO., Ltd., Sole Manufacturers,
253 BROADWAY, NEW YORK.
GEO. T. MANSON, General Supt.
W. H. HODGINS, Secretary.



SPEER
Carbon Brushes

Are made under the direct supervision of Mr. J. S. SPEER (formerly of the Partridge Carbon Co.). This guarantees the excellency of the brushes, which are made in every type required.

NOT IN THE TRUST.

The Speer Carbon Co., ST. MARYS, Pa., U. S. A.

THE
PHOENIX GLASS CO.
MANUFACTURERS OF
Gas and Electric
Globes, Shades, Etc.

HAVE YOU A COPY OF OUR No. 8 CATALOGUE?
IF NOT, SEND FOR IT.

Pittsburgh. New York. Chicago.

Fibre Paper Rubber CABLES AND High Grade Rubber Covered and Weatherproof WIRES

Conduits and Accessories, for Telephone, Telegraph, Electric Light and Power.

STANDARD UNDERGROUND CABLE COMPANY,

Pittsburg: Westinghouse Bldg. Philadelphia: 1225 Betz Bldg.
New York: 18 Cortlandt St. Chicago: 542 The Rookery.
St. Louis: 507 Security Bldg.

Don't
Travel--
Telephone

FOR SERVICE APPLY TO
NEW YORK TELEPHONE CO.
CONTRACT OFFICES
18 Cortlandt, 15 Dey, 952 Broadway, 115 W. 38th.

ADAM E. SCHATZ,
COUNSEL IN
PATENT CAUSES, TRADE-MARKS and COPYRIGHTS
AMERICAN AND FOREIGN,
346 Broadway,
N. Y. Life Ins. Building. NEW YORK.

PATENTS. PATENT SOLICITOR AND ELECTRICAL EXPERT.
Former Manager, now successor to the Patent Business heretofore conducted by "The Electrical World."
W. A. ROSENBAUM, 177 TIMES BLDG., N. Y.

Eschwei Electric Co.,
—MANUFACTURERS OF—
ARC LIGHTS.
47-49 Centre Street,
NEW YORK.

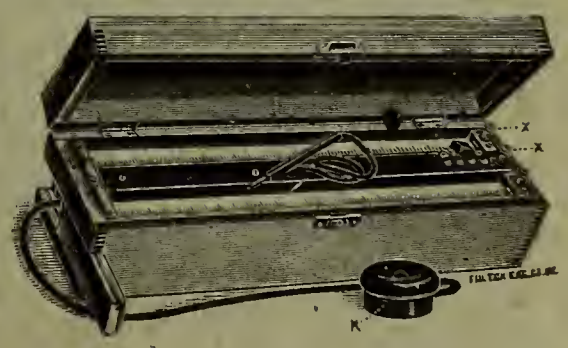
The IMPROVED "DAYLIGHT" DESK LAMP.
PARABOLA EFFECT.

This Electric Desk Lamp is constructed upon scientific principles, and is of great value to those who are compelled to do desk work. The light is soft and abundant, and so well distributed as to leave no shadows or dark corners on the desk; yet the lamp itself is entirely shaded from the eyes, and in no way interferes with the opening or closing of a "roll top" desk.

Nothing in the market compares favorably with it. It doubles the power of an incandescent lamp without bunching the light.

Adjustable "Roll Top" Desk Lamp, without socket, $3.00.
FRANK E. KINSMAN, 26 Cortlandt St., N. Y.
HAVEMEYER BUILDING.
No Special Lamp or Socket Necessary.

Direct Reading
Ohmmeters
BRUSHES,
RHEOSTATS,
Special Machinery.
AM. El. Specialty Co.,
123 Liberty St., New York.
TELEPHONE, 126 CORTLANDT.



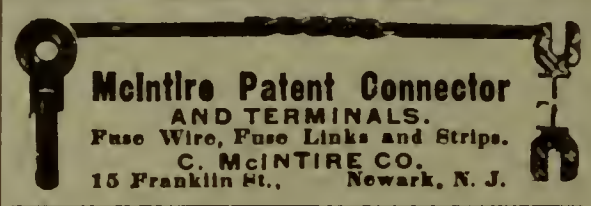
SEE PAGE III.

BAKER & CO.,
Newark, N. J.
New York Office: 120 Liberty St.

PLATINUM
In Sheet or Wire, any degree of hardness. FOR ALL PURPOSES.

INDEX TO ADVERTISERS.

DYNAMO and ARMATURE
Rewinding, Repairing and Reconstructing Armatures, Dynamos, Railway Motors, Transformers, Commutators.
Stucky & Heck Electric Mfg. Co., Ltd.,
85 N. J. R. R. Ave., Newark, N. J.


McIntire Patent Connector
AND TERMINALS.
Fuse Wire, Fuse Links and Strips.
C. McINTIRE CO.
15 Franklin St., Newark, N. J.

Motors Bought, Sold and Installed.
Motors Maintained at Reasonable Rates.
THE ELECTRIC MOTOR INSPECTION AND REPAIR CO. OF NEW YORK.
General Office.....34 PARK ROW, NEW YORK
H. L. SMITH, Mgr. Telephone Call, 418 Cortland

ELECTRICAL ENGINEERS AND CONTRACTORS
RECOMMENDED BY
THE ELECTRICAL AGE.

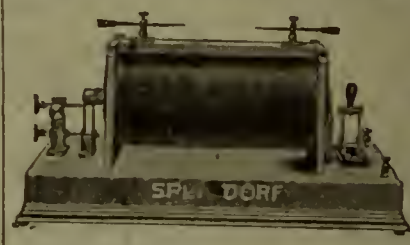
Advertisements of 4 lines or less under this head. $26 per year, additional lines at proportionate rates.

ZIMDARS & HUNT.
General Electrical Contractors. Wiring complete plants, etc. 127 Fifth Ave., New York. N. Y.

HATZEL & BUEHLER
Electrical Engineers and Contractors. 114 Fifth Avenue, New York.

J. F. BIDSTRUP & CO.
35 Frankfort Street, New York. Electrical Work of all kinds. Wiring, etc. Dynamo and Motor Repairing, Electrical Supplies.

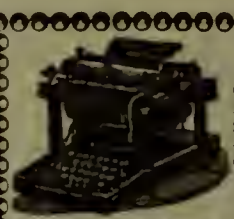
X-RAY COILS A Specialty.



Telephone and Spark Coils.

C. F. SPLITDORF, 17-27 Vandewater St., N. Y.

GORDON BATTERY COMPANY.
THE BEST PRIMARY BATTERY FOR CLOSED OR OPEN CIRCUIT WORK.
594 Broadway, . . . New York.


TYPEWRITER BARGAINS.
Practically new Remingtons, Caligraphs, Smith-Premiers, Hammonds, Yosts, Densmores, fully guaranteed, only $20 to $50—Cost $100. Good machines rented $4 monthly. *Free Handsome Colored Price List.* Also, list of Revised American Standard Pitman Shorthand Books, arranged for self-instruction. Consolidated Typewriter Exchange, 245 B'way, N. Y.

THE TRANSCONTINENTAL TRUNK LINE.

Commencing with the Canadian Pacific on the North, the Sunset Route on the South, and every line between these two extremes, offering the choice of 39,625 different routes. The New York Central is the greatest through-car line in America.

A booklet on the "Lake Shore Limited," containing also a novel and unique descriptive time table of this wonderful train, will be sent free by addressing George H. Daniels, General Passenger Agent, Grand Central Station, New York.

50 YEARS' EXPERIENCE
PATENTS
TRADE MARKS
DESIGNS
COPYRIGHTS &C.
Anyone sending a sketch and description may quickly ascertain our opinion free whether an invention is probably patentable. Communications strictly confidential. Handbook on Patents sent free. Oldest agency for securing patents.
Patents taken through Munn & Co. receive *special notice*, without charge, in the
Scientific American.
A handsomely illustrated weekly. Largest circulation of any scientific journal. Terms, $3 a year; four months, $1. Sold by all newsdealers.
MUNN & Co. 361 Broadway, New York
Branch Office, 625 F St., Washington, D. C.

HOLOPHANE GLOBES.
More Light.
No Glare.
Perfect Diffusion.
Artistic Patterns.
For all kinds of electric lighting,
Send for catalogues and price lists.
HOLOPHANE GLASS CO., 1 Broadway, N. Y.

AUTOMOBILE NUMBER.

The Electrical Age

Established 1883. An Illustrated Weekly Electrical Journal. 10 cents per copy

VOL. XXV.—No. 662. NEW YORK, JANUARY 20, 1900. Subscription, $2.50 per year. Foreign Countries, $3.50 per year.

1889.
PARIS EXPOSITION MEDAL
— FOR —
RUBBER INSULATION.

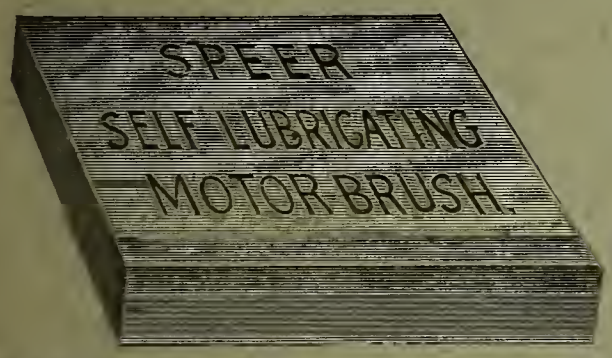
OKONITE
TRADE MARK.

1893.
WORLD'S FAIR MEDAL
— FOR —
RUBBER INSULATION.

THE STANDARD FOR RUBBER INSULATION.

OKONITE WIRES, OKONITE TAPE, MANSON TAPE, CANDEE WEATHERPROOF WIRES.

WILLARD L. CANDEE, H. DURANT CHEEVER, MANAGERS.
THE OKONITE CO., Ltd., Sole Manufacturers, 253 BROADWAY, NEW YORK.
GEO. T. MANSON, GENERAL SUPT. W. H. HODGINS, SECRETARY.



SPEER
Carbon Brushes

Are made under the direct supervision of Mr. J. S. SPEER (formerly of the Partridge Carbon Co.). This guarantees the excellency of the brushes, which are made in every type required.

NOT IN THE TRUST.

The Speer Carbon Co., ST. MARYS, Pa., U. S. A.

THE
PHOENIX GLASS CO.
MANUFACTURERS OF
Gas and Electric
Globes, Shades, Etc.

HAVE YOU A COPY OF OUR No. 8 CATALOGUE? IF NOT, SEND FOR IT.

Pittsburgh. - New York. - Chicago.

Fibre Paper Rubber CABLES AND High Grade Rubber Covered and Weatherproof WIRES

Conduits and Accessories, for Telephone, Telegraph, Electric Light and Power.

STANDARD UNDERGROUND CABLE COMPANY,

Pittsburg: Westinghouse Bldg. Philadelphia: 1225 Betz Bldg.
New York: 18 Cortlandt St. Chicago: 542 The Rookery.
St. Louis: 507 Security Bldg.

Don't
Travel--
Telephone

FOR SERVICE APPLY TO
NEW YORK TELEPHONE CO.
CONTRACT OFFICES
18 Cortlandt, 15 Dey, 952 Broadway, 115 W. 38th.

ADAM E. SCHATZ,
COUNSEL IN
PATENT CAUSES, TRADE-MARKS and COPYRIGHTS
AMERICAN AND FOREIGN,
346 Broadway,
N. Y. Life Ins. Building. NEW YORK.

PATENTS. PATENT SOLICITOR AND ELECTRICAL EXPERT.

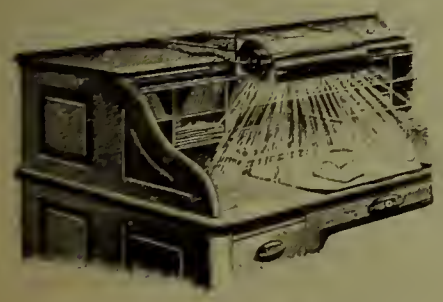
Former Manager, now successor to the Patent Business heretofore conducted by "The Electrical World."

W. A. ROSENBAUM, 177 TIMES BLDG., N. Y.

Eschwei Electric Co.,
—MANUFACTURERS OF—
ARC LIGHTS.
47-49 Centre Street,
NEW YORK.

The IMPROVED "DAYLIGHT" DESK LAMP.

PARABOLA EFFECT.



This Electric Desk Lamp is constructed upon scientific principles, and is of great value to those who are compelled to do desk work. The light is soft and abundant, and so well distributed as to leave no shadows or dark corners on the desk; yet the lamp itself is entirely shaded from the eyes, and in no way interferes with the opening or closing of a "roll top" desk.

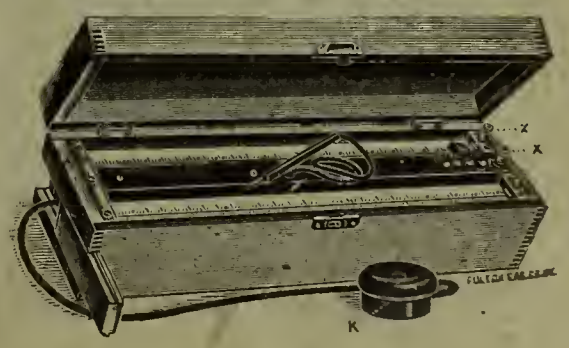
Nothing in the market compares favorably with it. It doubles the power of an incandescent lamp without bunching the light.

Adjustable "Roll Top" Desk Lamp, without socket, $3.00.

FRANK E. KINSMAN, 26 Cortlandt St., N. Y.
HAVEMEYER BUILDING.
No Special Lamp or Socket Necessary.

Direct Reading
Ohmmeters
BRUSHES.
RHEOSTATS,
Special Machinery.

AM. El. Specialty Co.,
123 Liberty St., New York.
TELEPHONE, 126 CORTLANDT.



SEE PAGE III.

BAKER & CO.,
Newark, N. J.
NEW YORK OFFICE: 120 LIBERTY ST.

PLATINUM
FOR ALL PURPOSES.

In Sheet or Wire, any degree of hardness.

INDEX TO ADVERTISERS.

DYNAMO and ARMATURE
Rewinding, Repairing and Reconstructing Armatures, Dynamos, Railway Motors, Transformers, Commutators.
Stucky & Heck Electric Mfg. Co., Ltd.,
35 N. J. R. R. Ave., Newark, N. J.

McIntire Patent Connector
AND TERMINALS.
Fuse Wire, Fuse Links and Strips.
C. McINTIRE CO.
15 Franklin St., Newark, N. J.

Motors Bought, Sold and Installed.
Motors Maintained at Reasonable Rates.
THE ELECTRIC MOTOR INSPECTION AND REPAIR CO. OF NEW YORK.
General Office.....34 PARK ROW, NEW YORK
H. L. SMITH, Mgr. Telephone Call, 418 Cortland

ELECTRICAL ENGINEERS AND CONTRACTORS
RECOMMENDED BY
THE ELECTRICAL AGE.

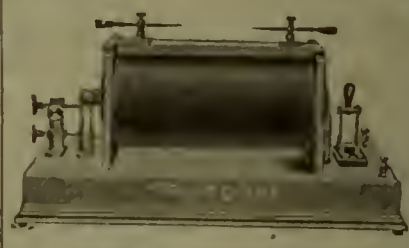
Advertisements of 4 lines or less under this head $26 per year, additional lines at proportionate rates.

ZIMDARS & HUNT.
General Electrical Contractors. Wiring complete plants, etc. 127 Fifth Ave., New York. N. Y.

HATZEL & BUEHLER
Electrical Engineers and Contractors. 114 Fifth Avenue, New York.

J. F. BIDSTRUP & CO.
35 Frankfort Street, New York. Electrical Work of all kinds. Wiring, etc. Dynamo and Motor Repairing, Electrical Supplies.

X-RAY COILS A Specialty.



Telephone and Spark Coils.

C. F. SPLITDORF, 17-27 Vandewater St., N. Y.

GORDON BATTERY COMPANY.
THE BEST PRIMARY BATTERY FOR CLOSED OR OPEN CIRCUIT WORK.
594 Broadway, . . . New York.

TYPEWRITER BARGAINS.
Practically new Remingtons, Caligraphs, Smith-Premiers, Hammonds, Yosts, Densmores, fully guaranteed, only $20 to $50—Cost $100. Good machines rented $4 monthly. *Free Handsome Colored Price List.* Also, list of Revised American Standard Pitman Shorthand Books, arranged for self-instruction. Consolidated Typewriter Exchange, 245 B'way, N. Y.

DON'T

go to Europe until you have made a trip on the New York Central's "Empire State Express" and seen Niagara Falls. Both can be accomplished in a day, and at the lowest regular rate charged on any railroad in the World,

2 CENTS PER MILE.

For a copy of the "Luxury of Modern Railway Travel" send a one-cent stamp to George H. Daniels General Passenger Agent, Grand Central Station New York.

50 YEARS' EXPERIENCE
PATENTS
TRADE MARKS
DESIGNS
COPYRIGHTS &C.

Anyone sending a sketch and description may quickly ascertain our opinion free whether an invention is probably patentable. Communications strictly confidential. Handbook on Patents sent free. Oldest agency for securing patents.
Patents taken through Munn & Co. receive *special notice*, without charge, in the

Scientific American.

A handsomely illustrated weekly. Largest circulation of any scientific journal. Terms, $3 a year; four months, $1. Sold by all newsdealers.
MUNN & Co. 361 Broadway, **New York**
Branch Office, 625 F St., Washington, D. C.

HOLOPHANE GLOBES,

More Light.

No Glare.

Perfect Diffusion.

Artistic Patterns.

For all kinds of electric lighting,
Send for catalogues and price lists.

HOLOPHANE GLASS CO., 1 Broadway, N. Y.

AUTOMOBILE NUMBER.

The Electrical Age

Established 1883. An Illustrated Weekly Electrical Journal. 10 cents per copy

VOL. XXV.—No. 663. NEW YORK, JANUARY 27, 1900. Subscription, $2.50 per year. Foreign Countries, $3.50 per year.

1889.
PARIS EXPOSITION MEDAL
— FOR —
RUBBER INSULATION.

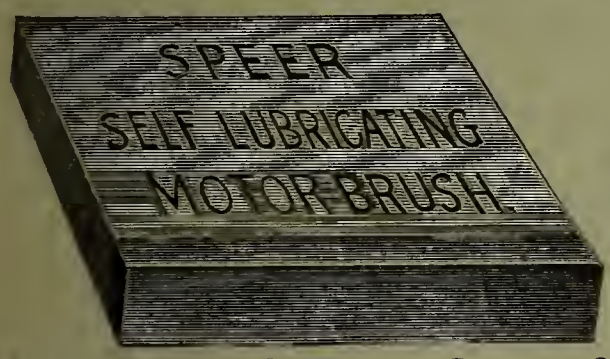
OKONITE
TRADE MARK

1893.
WORLD'S FAIR MEDAL
— FOR —
RUBBER INSULATION.

THE STANDARD FOR RUBBER INSULATION.

OKONITE WIRES, OKONITE TAPE, MANSON TAPE, CANDEE WEATHERPROOF WIRES.

WILLARD L. CANDEE, H. DURANT CHEEVER } MANAGERS.
THE OKONITE CO., Ltd., Sole Manufacturers,
253 BROADWAY, NEW YORK.
GEO. T. MANSON, General Supt.
W. H. HODGINS, Secretary.



SPEER
Carbon Brushes

Are made under the direct supervision of Mr. J. S. SPEER (formerly of the Partridge Carbon Co.). This guarantees the excellency of the brushes, which are made in every type required.

NOT IN THE TRUST.

The Speer Carbon Co., ST. MARYS, Pa., U. S. A.

Fibre Paper Rubber CABLES AND High Grade Rubber Covered and Weatherproof WIRES

Conduits and Accessories, for Telephone, Telegraph, Electric Light and Power.

STANDARD UNDERGROUND CABLE COMPANY,

Pittsburg: Westinghouse Bldg. Philadelphia: 1225 Betz Bldg.
New York: 18 Cortlandt St. Chicago: 542 The Rookery.
St. Louis: 507 Security Bldg.

ADAM E. SCHATZ,
COUNSEL IN
PATENT CAUSES, TRADE-MARKS and COPYRIGHTS
AMERICAN AND FOREIGN,
346 Broadway,
N. Y. Life Ins. Building. NEW YORK.

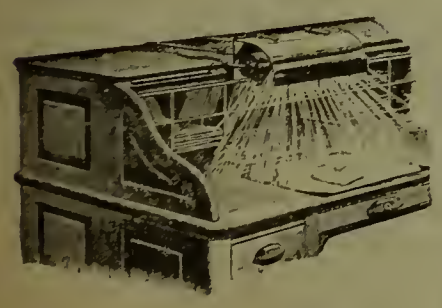
PATENTS. PATENT SOLICITOR AND ELECTRICAL EXPERT.

Former Manager, now successor to the Patent Business heretofore conducted by "The Electrical World."

W. A. ROSENBAUM, 177 TIMES BLDG., N. Y.

The IMPROVED "DAYLIGHT" DESK LAMP.

PARABOLA EFFECT.



This Electric Desk Lamp is constructed upon scientific principles, and is of great value to those who are compelled to do desk work. The light is soft and abundant, and so well distributed as to leave no shadows or dark corners on the desk; yet the lamp itself is entirely shaded from the eyes, and in no way interferes with the opening or closing of a "roll top" desk.

Nothing in the market compares favorably with it. It doubles the power of an incandescent lamp without bunching the light.

Adjustable "Roll Top" Desk Lamp, without socket, $3.00.

FRANK E. KINSMAN, 26 Cortlandt St., N. Y.
HAVEMEYER BUILDING.
No Special Lamp or Socket Necessary.

THE
PHOENIX GLASS CO.
MANUFACTURERS OF
Gas and Electric
Globes, Shades, Etc.

HAVE YOU A COPY OF OUR No. 8 CATALOGUE?
IF NOT, SEND FOR IT.

Pittsburgh. New York. Chicago.

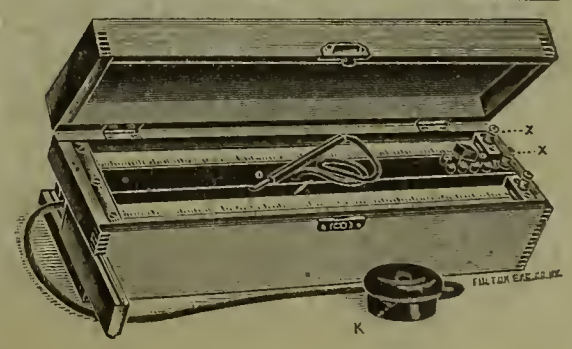
Don't
Travel--
Telephone

FOR SERVICE APPLY TO
NEW YORK TELEPHONE CO.
CONTRACT OFFICES
18 Cortlandt, 15 Dey, 952 Broadway, 115 W. 38th.

Eschwei Electric Co.,
—MANUFACTURERS OF—
ARC LIGHTS.
47-49 Centre Street,
NEW YORK.

Direct Reading
Ohmmeters
BRUSHES.
RHEOSTATS,
Special Machinery.

AM. El. Specialty Co.,
123 Liberty St., New York.
TELEPHONE, 126 CORTLANDT.



SEE PAGE III.

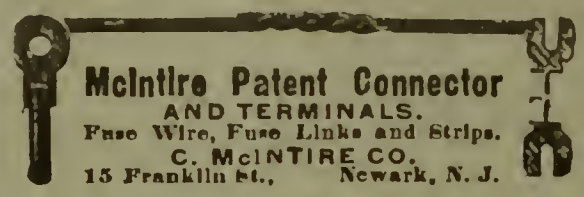
BAKER & CO.,
Newark, N. J.
NEW YORK OFFICE: 120 LIBERTY ST.

In Sheet or Wire, any degree of hardness.

PLATINUM
FOR ALL PURPOSES.

INDEX TO ADVERTISERS.

DYNAMO and ARMATURE
Rewinding Repairing and Reconstructing Armatures, Dynamos, Railway Motors, Transformers, Commutators.
Stucky & Heck Electric Mfg. Co., Ltd.,
85 N. J. R. R. Ave., Newark, N. J.


McIntire Patent Connector
AND TERMINALS.
Fuse Wire, Fuse Links and Strips.
C. McINTIRE CO.
15 Franklin St., Newark, N. J.

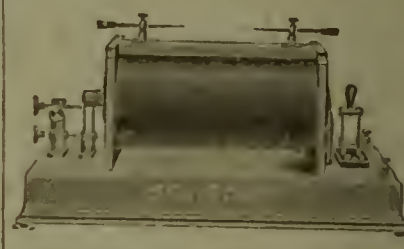
Motors Bought, Sold and Installed.
Motors Maintained at Reasonable Rates.
THE ELECTRIC MOTOR INSPECTION AND REPAIR CO. OF NEW YORK.
General Office.....34 PARK ROW, NEW YORK
H. L. SMITH, Mgr. Telephone Call, 418 Cortland

ELECTRICAL ENGINEERS AND CONTRACTORS
RECOMMENDED BY
THE ELECTRICAL AGE.
Advertisements of 4 lines or less under this head $26 per year, additional lines at proportionate rates.

ZIMDARS & HUNT.
General Electrical Contractors. Wiring complete plants, etc. 127 Fifth Ave., New York. N. Y.

HATZEL & BUEHLER
Electrical Engineers and Contractors. 114 Fifth Avenue, New York.

J. F. BIDSTRUP & CO.
35 Frankfort Street, New York. Electrical Work of all kinds. Wiring, etc. Dynamo and Motor Repairing, Electrical Supplies.

X-RAY COILS A Specialty.

Telephone and Spark Coils.
C. F. SPLITDORF, 17-27 Vandewater St., N. Y.

GORDON BATTERY COMPANY.
THE BEST PRIMARY BATTERY FOR CLOSED OR OPEN CIRCUIT WORK.
594 Broadway, . . . New York.


TYPEWRITER BARGAINS.
Practically new Remingtons, Caligraphs, Smith-Premiers, Hammonds, Yosts, Densmores, fully guaranteed, only $20 to $50—Cost $100. Good machines rented $4 monthly. *Free Handsome Colored Price List.* Also, list of Revised American Standard Pitman Shorthand Books, arranged for self-instruction. Consolidated Typewriter Exchange, 245 B'way, N. Y.

GRACEFUL CURVES AND EASY GRADES

give comfort to a journey via the New York Central Lines between Chicago, St. Louis and Cincinnati, and New York and Boston. No other line approaches the New York Central in the number, character and speed of its trains.

For a copy of the "Luxury of Modern Railway Travel" send a one-cent stamp to George H. Daniels, General Passenger Agent, Grand Central Station, New York.

50 YEARS' EXPERIENCE
PATENTS
TRADE MARKS
DESIGNS
COPYRIGHTS &C.
Anyone sending a sketch and description may quickly ascertain our opinion free whether an invention is probably patentable. Communications strictly confidential. Handbook on Patents sent free. Oldest agency for securing patents.
Patents taken through Munn & Co. receive *special notice*, without charge, in the
Scientific American.
A handsomely illustrated weekly. Largest circulation of any scientific journal. Terms, $3 a year; four months, $1. Sold by all newsdealers.
MUNN & Co. 361 Broadway, New York
Branch Office, 625 F St., Washington, D. C.


HOLOPHANE GLOBES.
More Light.
No Glare.
Perfect Diffusion.
Artistic Patterns.
For all kinds of electric lighting, Send for catalogues and price lists.
HOLOPHANE GLASS CO., 1 Broadway, N. Y.

The Electrical Age

Established 1883. An Illustrated Weekly Electrical Journal. 10 cents per copy

VOL. XXV.—No. 664. NEW YORK, FEBRUARY 3, 1900. Subscription, $2.50 per year. Foreign Countries, $3.50 per year.

1889.
PARIS EXPOSITION MEDAL
— FOR —
RUBBER INSULATION.

OKONITE
TRADE MARK.

1893.
WORLD'S FAIR MEDAL
— FOR —
RUBBER INSULATION.

THE STANDARD FOR RUBBER INSULATION.

OKONITE WIRES, OKONITE TAPE, MANSON TAPE, CANDEE WEATHERPROOF WIRES.

WILLARD L. CANDEE, H. DURANT CHEEVER } MANAGERS.
THE OKONITE CO., Ltd., Sole Manufacturers,
253 BROADWAY, NEW YORK.
GEO. T. MANSON, GENERAL SUPT.
W. H. HODGINS, SECRETARY.

SPEER
Carbon Brushes

Are made under the direct supervision of Mr. J. S. SPEER (formerly of the Partridge Carbon Co.). This guarantees the excellency of the brushes, which are made in every type required.

NOT IN THE TRUST.

The Speer Carbon Co., ST. MARYS, Pa., U. S. A.

THE
PHOENIX GLASS CO.
MANUFACTURERS OF
Gas and Electric
Globes, Shades, Etc.

HAVE YOU A COPY OF OUR No. 8 CATALOGUE?
IF NOT, SEND FOR IT.

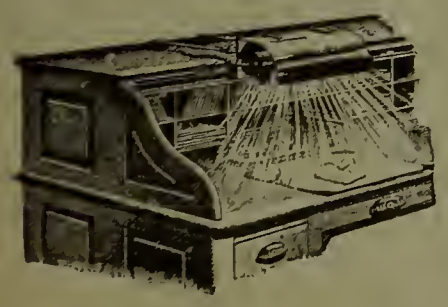
Pittsburgh. New York. Chicago.

BUY OF THE MAKER!
JOSEPH MEIER'S SONS,
291 Market Street, NEWARK, N. J.
Pure Oak Tanned
SHORT LAPPED LEATHER BELTING.

ADAM E. SCHATZ,
COUNSEL IN
PATENT CAUSES, TRADE-MARKS and COPYRIGHTS
AMERICAN AND FOREIGN,
346 Broadway,
N. Y. Life Ins. Building. NEW YORK.

PATENTS. PATENT SOLICITOR AND ELECTRICAL EXPERT.
Former Manager, now successor to the Patent Business heretofore conducted by "The Electrical World."
W. A. ROSENBAUM, 177 TIMES BLDG., N. Y.

The IMPROVED "DAYLIGHT" DESK LAMP.
PARABOLA EFFECT.



This Electric Desk Lamp is constructed upon scientific principles, and is of great value to those who are compelled to do desk work. The light is soft and abundant, and so well distributed as to leave no shadows or dark corners on the desk; yet the lamp itself is entirely shaded from the eyes, and in no way interferes with the opening or closing of a "roll top" desk.

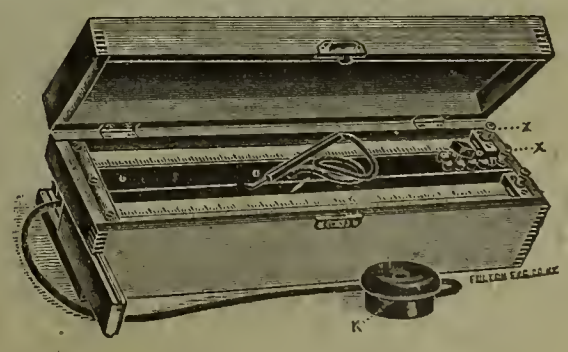
Nothing in the market compares favorably with it. It doubles the power of an incandescent lamp without bunching the light.

Adjustable "Roll Top" Desk Lamp, without socket, $3.00.
FRANK E. KINSMAN, 26 Cortlandt St., N. Y.
HAVEMEYER BUILDING.
No Special Lamp or Socket Necessary.

Don't
Travel--
Telephone
FOR SERVICE APPLY TO
NEW YORK TELEPHONE CO.
CONTRACT OFFICES
18 Cortlandt, 15 Dey, 952 Broadway, 115 W. 38th.

Fibre Paper Rubber CABLES AND High Grade Rubber Covered and Weatherproof WIRES
Conduits and Accessories, for Telephone, Telegraph, Electric Light and Power.
STANDARD UNDERGROUND CABLE COMPANY,
Pittsburg: Westinghouse Bldg. Philadelphia: 1225 Betz Bldg.
New York: 18 Cortlandt St. Chicago: 542 The Rookery.
St. Louis: 507 Security Bldg.

Direct Reading
Ohmmeters
BRUSHES.
RHEOSTATS,
Special Machinery.
AM. El. Specialty Co.,
123 Liberty St., New York.
TELEPHONE, 126 CORTLANDT.



BAKER & CO.,
Newark, N. J.
New York Office: 120 Liberty St.

PLATINUM
FOR ALL PURPOSES.

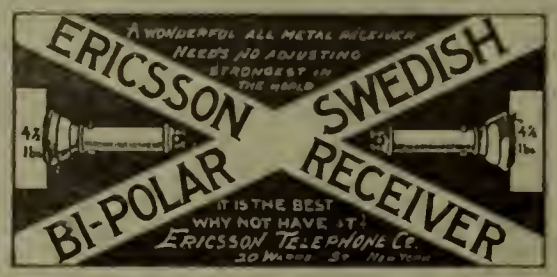
In Sheet or Wire, any degree of hardness.

INDEX TO ADVERTISERS.

DYNAMO and ARMATURE
Rewinding Repairing and Reconstructing Armatures, Dynamos, Railway Motors, Transformers, Commutators.
Stucky & Heck Electric Mfg. Co., Ltd.,
85 N. J. R. R. Ave., Newark, N. J.

McIntire Patent Connector
AND TERMINALS.
Fuse Wire, Fuse Links and Strips.
C. McINTIRE CO.
15 Franklin St., Newark, N. J.

Motors Bought, Sold and Installed.
Motors Maintained at Reasonable Rates.
THE ELECTRIC MOTOR INSPECTION AND REPAIR CO. OF NEW YORK.
General Office.....34 PARK ROW, NEW YORK
H. L. SMITH, Mgr. Telephone Call, 418 Cortland.



ELECTRICAL ENGINEERS AND CONTRACTORS
RECOMMENDED BY
THE ELECTRICAL AGE.

Advertisements of 4 lines or less under this head $26 per year, additional lines at proportionate rates.

ZIMDARS & HUNT.
General Electrical Contractors. Wiring complete plants, etc. 127 Fifth Ave., New York. N. Y.

HATZEL & BUEHLER
Electrical Engineers and Contractors. 114 Fifth Avenue, New York.

J. F. BIDSTRUP & CO.
35 Frankfort Street, New York. Electrical Work of all kinds. Wiring, etc. Dynamo and Motor Repairing, Electrical Supplies.

C. F. SPLITDORF,
MANUFACTURER OF

ELECTRO-MAGNETS and TELEPHONE BOBBINS
17-27 Vandewater St., New York.

GORDON BATTERY COMPANY.
THE BEST PRIMARY BATTERY FOR CLOSED OR OPEN CIRCUIT WORK.
594 Broadway, . . . New York.

TYPEWRITER BARGAINS.
Practically new Remingtons, Caligraphs, Smith-Premiers, Hammonds, Yosts, Densmores, fully guaranteed, only $20 to $50—Cost $100. Good machines rented $4 monthly. *Free Handsome Colored Price List.* Also, list of Revised American Standard Pitman Shorthand Books, arranged for self-instruction. Consolidated Typewriter Exchange, 245 B'way, N. Y.

LEAVE NEW YORK
5.30 P. M.
ARRIVE CHICAGO
4.30 P. M. next day,

by the New York Central's "Lake Shore Limited." The most comfortable and luxurious long distance train in the world.

1,000 MILES IN 24 HOURS.

A booklet on the "Lake Shore Limited," containing also a novel and unique descriptive time table of this wonderful train, will be sent free by addressing George H. Daniels, General Passenger Agent, Grand Central Station, New York.

50 YEARS' EXPERIENCE
PATENTS
TRADE MARKS
DESIGNS
COPYRIGHTS &C.

Anyone sending a sketch and description may quickly ascertain our opinion free whether an invention is probably patentable. Communications strictly confidential. Handbook on Patents sent free. Oldest agency for securing patents.
Patents taken through Munn & Co. receive *special notice*, without charge, in the

Scientific American.

A handsomely illustrated weekly. Largest circulation of any scientific journal. Terms, $3 a year; four months, $1. Sold by all newsdealers.
MUNN & Co. 361 Broadway, New York
Branch Office, 625 F St., Washington, D. C.

HOLOPHANE GLOBES.
More Light.
No Glare.
Perfect Diffusion.
Artistic Patterns.
For all kinds of electric lighting,
Send for catalogues and price lists.
HOLOPHANE GLASS CO., 1 Broadway, N. Y.

The Electrical Age

Established 1883. An Illustrated Weekly Electrical Journal. 10 cents per copy

VOL. XXV.—No. 665. NEW YORK, FEBRUARY 10, 1900. Subscription, $2.50 per year. Foreign Countries, $3.50 per year.

1889.

PARIS EXPOSITION MEDAL
— FOR —
RUBBER INSULATION.

OKONITE
TRADE MARK.

1893.

WORLD'S FAIR MEDAL
— FOR —
RUBBER INSULATION.

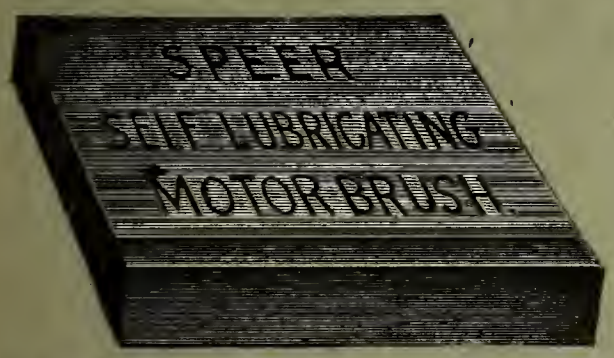
THE STANDARD FOR RUBBER INSULATION.

OKONITE WIRES, OKONITE TAPE, MANSON TAPE, CANDEE WEATHERPROOF WIRES.

WILLARD L. CANDEE, H. DURANT CHEEVER } MANAGERS.

THE OKONITE CO., Ltd., Sole Manufacturers,
253 BROADWAY, NEW YORK.

GEO. T. MANSON, General Supt.
W. H. HODGINS, Secretary.



SPEER
Carbon Brushes

Are made under the direct supervision of Mr. J. S. SPEER (formerly of the Partridge Carbon Co.). This guarantees the excellency of the brushes, which are made in every type required.

NOT IN THE TRUST.

The Speer Carbon Co., ST. MARYS, Pa., U. S. A.

BUY OF THE MAKERS.

BEST PURE OAK SHORT LAP LEATHER BELTING

JOSEPH MEIER'S SONS,

295 Market Street, NEWARK, N. J.

ADAM E. SCHATZ,
COUNSEL IN
PATENT CAUSES, TRADE-MARKS and COPYRIGHTS
AMERICAN AND FOREIGN,
346 Broadway,
N. Y. Life Ins. Building. NEW YORK.

PATENTS. PATENT SOLICITOR AND ELECTRICAL EXPERT.

Former Manager, now successor to the Patent Business heretofore conducted by "The Electrical World."

W. A. ROSENBAUM, 177 TIMES BLDG., N. Y.

The IMPROVED "DAYLIGHT" DESK LAMP.

PARABOLA EFFECT.

This Electric Desk Lamp is constructed upon scientific principles, and is of great value to those who are compelled to do desk work. The light is soft and abundant, and so well distributed as to leave no shadows or dark corners on the desk; yet the lamp itself is entirely shaded from the eyes, and in no way interferes with the opening or closing of a "roll top" desk.

Nothing in the market compares favorably with it. It doubles the power of an incandescent lamp without bunching the light.

Adjustable "Roll Top" Desk Lamp, without socket, $3.00.

FRANK E. KINSMAN, 26 Cortlandt St., N. Y.
HAVEMEYER BUILDING.
No Special Lamp or Socket Necessary.

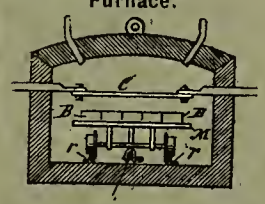
THE
PHOENIX GLASS CO.
MANUFACTURERS OF
Gas and Electric
Globes, Shades, Etc.

HAVE YOU A COPY OF OUR No. 8 CATALOGUE?
IF NOT, SEND FOR IT.

Pittsburgh. New York. Chicago.

AARON CARTER, President. C. H. WATERMAN, Treas. & M'g'r.
MAJ. W. M. COMBS, Vice-Pres. A. E. BOSSE, Secretary.
LEMUEL RUSSELL, Consulting Engineer.

Electric Enameling Furnace.



The Electric
Enameling Co.,
203 BROADWAY,
NEW YORK.

Office of Record, 188 Market St., Newark, N. J. S. J. MACDONALD Counsel.

Fibre Paper Rubber CABLES AND High Grade Rubber Covered and Weatherproof WIRES

Conduits and Accessories, for Telephone, Telegraph, Electric Light and Power.

STANDARD UNDERGROUND CABLE COMPANY,

Pittsburg: Westinghouse Bldg. Philadelphia: 1225 Betz Bldg.
New York: 18 Cortlandt St. Chicago: 542 The Rookery.
St. Louis: 507 Security Bldg.

Don't
Travel--
Telephone

FOR SERVICE APPLY TO
NEW YORK TELEPHONE CO.
CONTRACT OFFICES
18 Cortlandt, 15 Dey, 952 Broadway, 115 W. 38th.

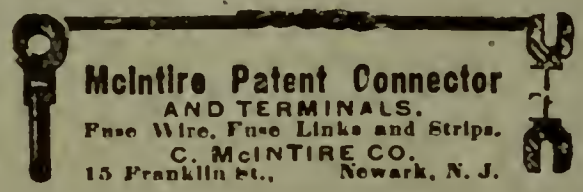
BAKER & CO.,
Newark, N. J.
New York Office: 120 Liberty St.

PLATINUM
FOR ALL PURPOSES.

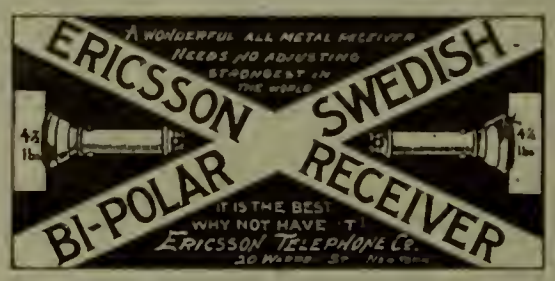
In Sheet or Wire, any degree of hardness.

INDEX TO ADVERTISERS.

DYNAMO and ARMATURE
Rewinding, Repairing and Reconstructing Armatures, Dynamos, Railway Motors, Transformers, Commutators.
Stucky & Heck Electric Mfg. Co., Ltd.,
25 N. J. R. R. Ave., Newark, N. J.


McIntire Patent Connector
AND TERMINALS.
Fuse Wire, Fuse Links and Strips.
C. McINTIRE CO.
15 Franklin St., Newark, N. J.

Motors Bought, Sold and Installed.
Motors Maintained at Reasonable Rates.
THE ELECTRIC MOTOR INSPECTION AND REPAIR CO. OF NEW YORK.
General Office.....34 PARK ROW, NEW YORK
H. L. SMITH, Mgr. Telephone Call, 418 Cortland.



ELECTRICAL ENGINEERS AND CONTRACTORS
RECOMMENDED BY
THE ELECTRICAL AGE.

Advertisements of 4 lines or less under this head $26 per year, additional lines at proportionate rates.

ZIMDARS & HUNT.
General Electrical Contractors. Wiring complete plants, etc. 127 Fifth Ave., New York. N. Y.

HATZEL & BUEHLER
Electrical Engineers and Contractors. 114 Fifth Avenue, New York.

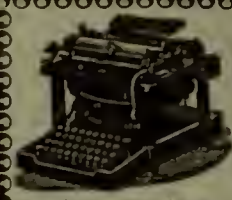
J. F. BIDSTRUP & CO.
35 Frankfort Street, New York. Electrical Work of all kinds. Wiring, etc. Dynamo and Motor Repairing, Electrical Supplies.

X-RAY COILS A Specialty.

Telephone and Spark Coils.

C. F. SPLITDORF, 17-27 Vandewater St., N. Y.

GORDON BATTERY COMPANY.
THE BEST PRIMARY BATTERY FOR CLOSED OR OPEN CIRCUIT WORK.
594 Broadway, . . . New York.


TYPEWRITER BARGAINS.
Practically new Remingtons, Caligraphs, Smith-Premiers, Hammonds, Yosts, Densmores, fully guaranteed, only $20 to $50—Cost $100. Good machines rented $4 monthly. *Free Handsome Colored Price List.* Also, list of Revised American Standard Pitman Shorthand Books, arranged for self-instruction. Consolidated Typewriter Exchange, 245 B'way, N. Y.

ENGLISH,
RUSSIAN,
FRENCH
AND GERMAN

officers from their stations in the Pacific almost invariably travel by the New York Central on their trips to and from the Fatherland, on account of the wonderful speed and comfort of its trains.

For a copy of the "Luxury of Modern Railway Travel" send a one-cent stamp to George H. Daniels, General Passenger Agent, Grand Central Station, New York.

50 YEARS' EXPERIENCE
PATENTS
TRADE MARKS
DESIGNS
COPYRIGHTS &C.
Anyone sending a sketch and description may quickly ascertain our opinion free whether an invention is probably patentable. Communications strictly confidential. Handbook on Patents sent free. Oldest agency for securing patents.
Patents taken through Munn & Co. receive *special notice*, without charge, in the
Scientific American.
A handsomely illustrated weekly. Largest circulation of any scientific journal. Terms, $3 a year; four months, $1. Sold by all newsdealers.
MUNN & Co. 361 Broadway, New York
Branch Office, 625 F St., Washington, D. C.

HOLOPHANE GLOBES.
More Light.
No Glare.
Perfect Diffusion.
Artistic Patterns.
For all kinds of electric lighting,
Send for catalogues and price lists.
HOLOPHANE GLASS CO., 1 Broadway, N. Y.

The Electrical Age

Established 1883. An Illustrated Weekly Electrical Journal. 10 cents per copy

VOL. XXV.—No. 666. NEW YORK, FEBRUARY 17, 1900. Subscription, $2.50 per year. Foreign Countries, $3.50 per year.

1889.

PARIS EXPOSITION MEDAL
— FOR —
RUBBER INSULATION.

OKONITE
TRADE MARK.

1893.

WORLD'S FAIR MEDAL
— FOR —
RUBBER INSULATION.

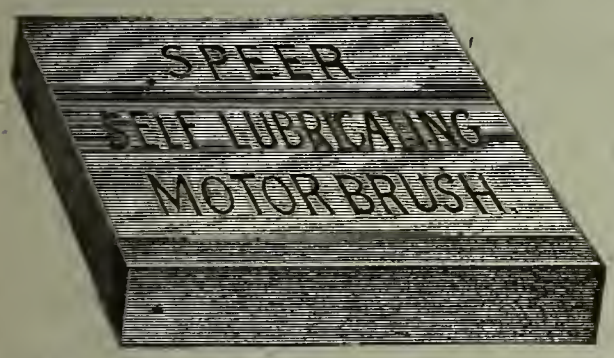
THE STANDARD FOR RUBBER INSULATION.

OKONITE WIRES, OKONITE TAPE, MANSON TAPE, CANDEE WEATHERPROOF WIRES.

WILLARD L. CANDEE, H. DURANT CHEEVER } MANAGERS.

THE OKONITE CO., Ltd., Sole Manufacturers,
253 BROADWAY, NEW YORK.

GEO. T. MANSON, GENERAL SUPT.
W. H. HODGINS, SECRETARY.



SPEER
Carbon Brushes

Are made under the direct supervision of Mr. J. S. SPEER (formerly of the Partridge Carbon Co.). This guarantees the excellency of the brushes, which are made in every type required.

NOT IN THE TRUST.

The Speer Carbon Co., ST. MARYS, Pa., U. S. A.

BUY OF THE MAKERS.

BEST PURE OAK SHORT LAP LEATHER **BELTING**

JOSEPH MEIER'S SONS,

295 Market Street, NEWARK, N. J.

ADAM E. SCHATZ,

COUNSEL IN

PATENT CAUSES, TRADE-MARKS and COPYRIGHTS

AMERICAN AND FOREIGN,

346 Broadway,

N. Y. Life Ins. Building. NEW YORK.

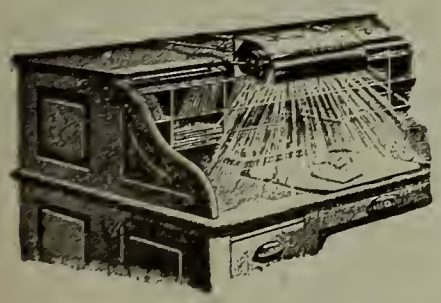
PATENTS. PATENT SOLICITOR AND ELECTRICAL EXPERT.

Former Manager, now successor to the Patent Business heretofore conducted by "The Electrical World."

W. A. ROSENBAUM, 177 TIMES BLDG., N. Y.

The IMPROVED "DAYLIGHT" DESK LAMP.

PARABOLA EFFECT.



This Electric Desk Lamp is constructed upon scientific principles, and is of great value to those who are compelled to do desk work. The light is soft and abundant, and so well distributed as to leave no shadows or dark corners on the desk; yet the lamp itself is entirely shaded from the eyes, and in no way interferes with the opening or closing of a "roll top" desk.

Nothing in the market compares favorably with it. It doubles the power of an incandescent lamp without bunching the light.

Adjustable "Roll Top" Desk Lamp, without socket, $3.00.

FRANK E. KINSMAN, 26 Cortlandt St., N. Y.
HAVEMEYER BUILDING.
No Special Lamp or Socket Necessary.

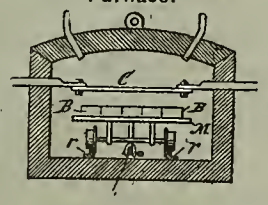
THE
PHOENIX GLASS CO.
MANUFACTURERS OF
Gas and Electric
Globes, Shades, Etc.

HAVE YOU A COPY OF OUR No. 8 CATALOGUE?
IF NOT, SEND FOR IT.

Pittsburgh. New York. Chicago.

AARON CARTER, President. C. H. WATERMAN, Treas. & M'g'r
MAJ. W. M. COMBS, Vice-Pres. A. E. BOSSE, Secretary.
LEMUEL RUSSELL, Consulting Engineer.

Electric Enameling Furnace.



The Electric Enameling Co.,
203 BROADWAY,
NEW YORK.

Office of Record, 188 Market St., Newark, N. J. S. J. MACDONALD Counsel.

Fibre Paper Rubber **CABLES AND** High Grade Rubber Covered and Weatherproof **WIRES**

Conduits and Accessories, for Telephone, Telegraph, Electric Light and Power.

STANDARD UNDERGROUND CABLE COMPANY,

Pittsburg: Westinghouse Bldg. Philadelphia: 1225 Betz Bldg.
New York: 18 Cortlandt St. Chicago: 542 The Rookery.
St. Louis: 507 Security Bldg.

Don't
Travel--
Telephone

FOR SERVICE APPLY TO
NEW YORK TELEPHONE CO.
CONTRACT OFFICES
18 Cortlandt, 15 Dey, 952 Broadway, 115 W. 38th.

BAKER & CO.,
Newark, N. J.
New York Office: 120 Liberty St.

PLATINUM
FOR ALL PURPOSES.

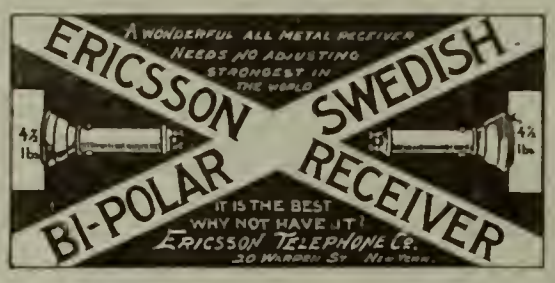
In Sheet or Wire, any degree of hardness.

INDEX TO ADVERTISERS.

DYNAMO and ARMATURE
Rewinding Repairing and Reconstructing Armatures, Dynamos, Railway Motors, Transformers, Commutators.
Stucky & Heck Electric Mfg. Co., Ltd.,
35 N. J. R. R. Ave., Newark, N. J.


McIntire Patent Connector
AND TERMINALS.
Fuse Wire, Fuse Links and Strips.
C. McINTIRE CO.
15 Franklin St., Newark, N. J.


Motors Bought, Sold and Installed.
Motors Maintained at Reasonable Rates.
THE ELECTRIC MOTOR INSPECTION AND REPAIR CO. OF NEW YORK.
General Office ..... 34 PARK ROW, NEW YORK
H. L. SMITH, Mgr. Telephone Call, 418 Cortland.



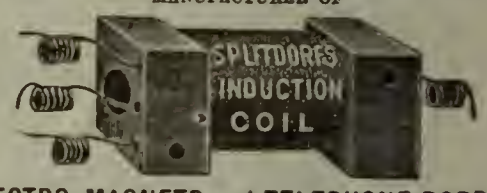
ELECTRICAL ENGINEERS AND CONTRACTORS
RECOMMENDED BY
THE ELECTRICAL AGE.

Advertisements of 4 lines or less under this head $26 per year, additional lines at proportionate rates.

ZIMDARS & HUNT.
General Electrical Contractors. Wiring complete plants, etc. 127 Fifth Ave., New York. N. Y.

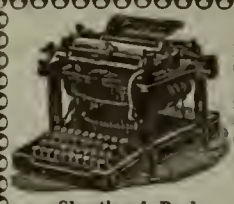
HATZEL & BUEHLER
Electrical Engineers and Contractors. 114 Fifth Avenue, New York.

J. F. BIDSTRUP & CO.
35 Frankfort Street, New York. Electrical Work of all kinds. Wiring, etc. Dynamo and Motor Repairing, Electrical Supplies.

C. F. SPLITDORF,
MANUFACTURER OF


ELECTRO-MAGNETS and TELEPHONE BOBBINS
17-27 Vandewater St., New York.

GORDON BATTERY COMPANY.
THE BEST PRIMARY BATTERY FOR CLOSED OR OPEN CIRCUIT WORK.
594 Broadway, . . . New York.


TYPEWRITER BARGAINS.
Practically new Remingtons, Caligraphs, Smith-Premiers, Hammonds, Yosts, Densmores, fully guaranteed, only $20 to $50—Cost $100. Good machines rented $4 monthly. *Free Handsome Colored Price List.* Also, list of Revised American Standard Pitman Shorthand Books, arranged for self-instruction. Consolidated Typewriter Exchange, 245 B'way, N. Y.

HOW RAILROADS AID COMMERCE.

The map in the "Round the World" folder, issued by the New York Central Lines, is an object lesson on the subject of the relations between the railroads and all other commercial interests. It marks an era in the history of the foreign commerce of the United States.

A copy will be sent free, post-paid, on receipt of three cents in stamps, by George H. Daniels, General Passenger Agent, Grand Central Station, New York.

50 YEARS' EXPERIENCE
PATENTS
TRADE MARKS
DESIGNS
COPYRIGHTS &C.
Anyone sending a sketch and description may quickly ascertain our opinion free whether an invention is probably patentable. Communications strictly confidential. Handbook on Patents sent free. Oldest agency for securing patents.
Patents taken through Munn & Co. receive *special notice*, without charge, in the
Scientific American.
A handsomely illustrated weekly. Largest circulation of any scientific journal. Terms, $3 a year; four months, $1. Sold by all newsdealers.
MUNN & Co. 361 Broadway, New York
Branch Office, 625 F St., Washington, D. C.


HOLOPHANE GLOBES.
More Light.
No Glare.
Perfect Diffusion.
Artistic Patterns.
For all kinds of electric lighting,
Send for catalogues and price lists.
HOLOPHANE GLASS CO., 1 Broadway, N. Y.

The Electrical Age

Established 1883. An Illustrated Weekly Electrical Journal. 10 cents per copy

VOL. XXV.—No. 667. NEW YORK, FEBRUARY 24, 1900. Subscription, $2.50 per year. Foreign Countries, $3.50 per year.

1889.

PARIS EXPOSITION MEDAL
— FOR —
RUBBER INSULATION.

OKONITE
TRADE MARK

1893.

WORLD'S FAIR MEDAL
— FOR —
RUBBER INSULATION.

THE STANDARD FOR RUBBER INSULATION.

OKONITE WIRES, OKONITE TAPE, MANSON TAPE, CANDEE WEATHERPROOF WIRES.

WILLARD L. CANDEE, H. DURANT CHEEVER } MANAGERS.

THE OKONITE CO., Ltd., Sole Manufacturers,
253 BROADWAY, NEW YORK.

GEO. T. MANSON, General Supt.
W. H. HODGINS, Secretary.

SPEER
Carbon Brushes

Are made under the direct supervision of Mr. J. S. SPEER (formerly of the Partridge Carbon Co.). This guarantees the excellency of the brushes, which are made in every type required.

NOT IN THE TRUST.

The Speer Carbon Co., ST. MARYS, Pa., U. S. A.

BUY OF THE MAKERS.

BEST PURE OAK SHORT LAP LEATHER BELTING

JOSEPH MEIER'S SONS,

295 Market Street, NEWARK, N. J.

PATENTS!

FREE! Valuable Book on Patents. Tells how to secure them at low cost. Gives Mechanical Movements---invaluable to Inventors and Mechanics. Full of Money-Making Patent information.

Big Book Free! O'MEARA & CO. PATENT ATTORNEYS, 903 G Street, Washington, D. C.

The IMPROVED "DAYLIGHT" DESK LAMP.

PARABOLA EFFECT.

This Electric Desk Lamp is constructed upon scientific principles, and is of great value to those who are compelled to do desk work. The light is soft and abundant, and so well distributed as to leave no shadows or dark corners on the desk; yet the lamp itself is entirely shaded from the eyes, and in no way interferes with the opening or closing of a "roll top" desk.

Nothing in the market compares favorably with it. It doubles the power of an incandescent lamp without bunching the light.

Adjustable "Roll Top" Desk Lamp, without socket, $3.00.

FRANK E. KINSMAN, 26 Cortlandt St., N. Y.
HAVEMEYER BUILDING.
No Special Lamp or Socket Necessary.

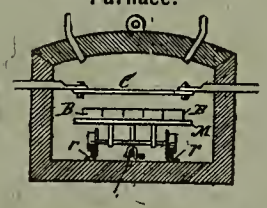
THE
PHOENIX GLASS CO.
MANUFACTURERS OF
Gas and Electric Globes, Shades, Etc.

HAVE YOU A COPY OF OUR No. 8 CATALOGUE?
IF NOT, SEND FOR IT.

Pittsburgh. New York. Chicago.

AARON CARTER, President. C. H. WATERMAN, Treas. & M'g'r.
MAJ. W. M. COMBS, Vice-Pres. A. E. BOSSE, Secretary.
LEMUEL RUSSELL, Consulting Engineer.

Electric Enameling Furnace.



The Electric Enameling Co.,
203 BROADWAY,
NEW YORK.

Office of Record, 188 Market St., Newark, N. J. S. J. MACDONALD Counsel.

PATENTS. PATENT SOLICITOR AND ELECTRICAL EXPERT.

Former Manager, now successor to the Patent Business heretofore conducted by "The Electrical World."

W. A. ROSENBAUM, 177 TIMES BLDG., N. Y.

Don't Travel-- Telephone

FOR SERVICE APPLY TO
NEW YORK TELEPHONE CO.
CONTRACT OFFICES
18 Cortlandt, 15 Dey, 952 Broadway, 115 W. 38th.

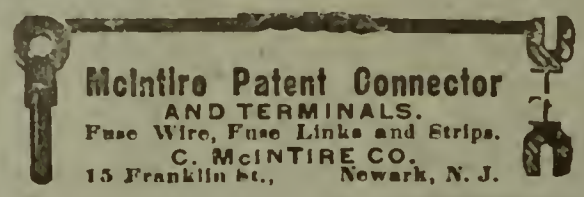
BAKER & CO.,
Newark, N. J.
NEW YORK OFFICE: 120 LIBERTY ST.

PLATINUM
FOR ALL PURPOSES.

In Sheet or Wire, any degree of hardness.

INDEX TO ADVERTISERS.

DYNAMO and ARMATURE
Rewinding Repairing and Reconstructing Armatures, Dynamos, Railway Motors, Transformers, Commutators.
Stucky & Heck Electric Mfg. Co., Ltd.,
85 N. J. R. R. Ave., Newark, N. J.


McIntire Patent Connector
AND TERMINALS.
Fuse Wire, Fuse Links and Strips.
C. McINTIRE CO.
15 Franklin St., Newark, N. J.

Motors Bought, Sold and Installed.
Motors Maintained at Reasonable Rates.
THE ELECTRIC MOTOR INSPECTION AND REPAIR CO. OF NEW YORK.
General Office ..... 34 PARK ROW, NEW YORK
H. L. SMITH, Mgr. Telephone Call, 418 Cortland.

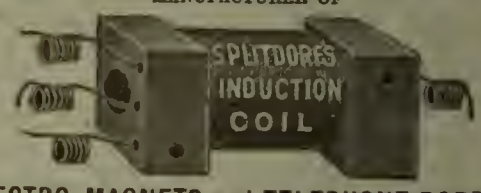
ELECTRICAL ENGINEERS AND CONTRACTORS
RECOMMENDED BY
THE ELECTRICAL AGE.

Advertisements of 4 lines or less under this head $26 per year, additional lines at proportionate rates.

ZIMDARS & HUNT.
General Electrical Contractors. Wiring complete plants, etc. 127 Fifth Ave., New York. N. Y.

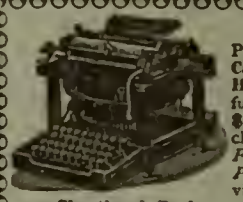
HATZEL & BUEHLER
Electrical Engineers and Contractors. 114 Fifth Avenue, New York.

J. F. BIDSTRUP & CO.
35 Frankfort Street, New York. Electrical Work of all kinds. Wiring, etc. Dynamo and Motor Repairing, Electrical Supplies.

C. F. SPLITDORF,
MANUFACTURER OF


ELECTRO-MAGNETS and TELEPHONE BOBBINS
17-27 Vandewater St., New York.

GORDON BATTERY COMPANY.
THE BEST PRIMARY BATTERY FOR CLOSED OR OPEN CIRCUIT WORK.
594 Broadway, . . . New York.


TYPEWRITER BARGAINS.
Practically new Remingtons, Caligraphs, Smith-Premiers, Hammonds, Yosts, Densmores, fully guaranteed, only $20 to $50—Cost $100. Good machines rented $4 monthly. *Free Handsome Colored Price List.* Also, list of Revised American Standard Pitman Shorthand Books, arranged for self-instruction. Consolidated Typewriter Exchange, 245 B'way, N. Y.

FROM ST. MICHAEL
TO MANILA,
11,974 MILES.

And the Stars and Stripes affording protection to American Commerce all the way.

See the new "Round the World" folder of the New York Central Lines, just out.

A copy will be sent free, post-paid, on receipt of three cents in stamps, by George H. Daniels, General Passenger Agent, Grand Central Station, New York.

50 YEARS' EXPERIENCE
PATENTS
TRADE MARKS
DESIGNS
COPYRIGHTS &C.
Anyone sending a sketch and description may quickly ascertain our opinion free whether an invention is probably patentable. Communications strictly confidential. Handbook on Patents sent free. Oldest agency for securing patents.
Patents taken through Munn & Co. receive *special notice*, without charge, in the
Scientific American.
A handsomely illustrated weekly. Largest circulation of any scientific journal. Terms, $3 a year; four months, $1. Sold by all newsdealers.
MUNN & Co. 361 Broadway, New York
Branch Office, 625 F St., Washington, D. C.


HOLOPHANE GLOBES.
More Light.
No Glare.
Perfect Diffusion.
Artistic Patterns.
For all kinds of electric lighting,
Send for catalogues and price lists.
HOLOPHANE GLASS CO., 1 Broadway, N. Y.

The Electrical Age

Established 1883. An Illustrated Weekly Electrical Journal. 10 cents per copy

VOL. XXV.—No. 668. NEW YORK, MARCH 3, 1900. Subscription, $2.50 per year. Foreign Countries, $3.50 per year.

1889.

PARIS EXPOSITION MEDAL
— FOR —
RUBBER INSULATION.

OKONITE
TRADE MARK

1893.

WORLD'S FAIR MEDAL
— FOR —
RUBBER INSULATION.

THE STANDARD FOR RUBBER INSULATION.

OKONITE WIRES, OKONITE TAPE, MANSON TAPE, CANDEE WEATHERPROOF WIRES.

WILLARD L. CANDEE, H. DURANT CHEEVER } MANAGERS.

THE OKONITE CO., Ltd., Sole Manufacturers,
253 BROADWAY, NEW YORK.

GEO. T. MANSON, General Supt.
W. H. HODGINS, Secretary.

SPEER
Carbon Brushes

Are made under the direct supervision ot Mr. J. S. SPEER (formerly of the Partridge Carbon Co.). This guarantees the excellency of the brushes, which are made in every type required.

NOT IN THE TRUST.

The Speer Carbon Co., ST. MARYS, Pa., U. S. A.

BUY OF THE MAKERS.

BEST PURE OAK SHORT LAP LEATHER BELTING

JOSEPH MEIER'S SONS,

295 Market Street, NEWARK, N. J.

PATENTS!

FREE! Valuable Book on Patents. Tells how to secure them at low cost. Gives Mechanical Movements---invaluable to Inventors and Mechanics. Full of Money-Making Patent information.

Big Book Free! O'MEARA & CO. PATENT ATTORNEYS, 903 G Street, Washington, D. C.

The IMPROVED "DAYLIGHT" DESK LAMP.

PARABOLA EFFECT.

This Electric Desk Lamp is constructed upon scientific principles, and is of great value to those who are compelled to do desk work. The light is soft and abundant, and so well distributed as to leave no shadows or dark corners on the desk; yet the lamp itself is entirely shaded from the eyes, and in no way interferes with the opening or closing of a "roll top" desk.

Nothing in the market compares favorably with it. It doubles the power of an incandescent lamp without bunching the light.

Adjustable "Roll Top" Desk Lamp, without socket, $3.00.

FRANK E. KINSMAN, 26 Cortlandt St., N. Y.
HAVEMEYER BUILDING.
No Special Lamp or Socket Necessary.

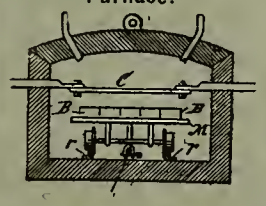
THE
PHOENIX GLASS CO.
MANUFACTURERS OF
Gas and Electric Globes, Shades, Etc.

HAVE YOU A COPY OF OUR No. 8 CATALOGUE?
IF NOT, SEND FOR IT.

Pittsburgh. New York. Chicago.

AARON CARTER, President. C. H. WATERMAN, Treas. & M'g'r.
MAJ. W. M. COMBS, Vice-Pres. A. E. BOSSE, Secretary.
LEMUEL RUSSELL, Consulting Engineer.

Electric Enameling Furnace.



The Electric Enameling Co.,
203 BROADWAY,
NEW YORK.

Office of Record, 188 Market St., Newark, N. J. S. J. MACDONALD Counsel.

PATENTS. PATENT SOLICITOR AND ELECTRICAL EXPERT.

Former Manager, now successor to the Patent Business heretofore conducted by "The Electrical World."

W. A. ROSENBAUM, 177 TIMES BLDG., N. Y.

Don't Travel-- Telephone

FOR SERVICE APPLY TO
NEW YORK TELEPHONE CO.
CONTRACT OFFICES
18 Cortlandt, 15 Dey, 952 Broadway, 115 W. 38th.

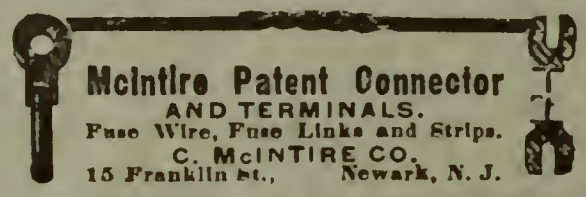
BAKER & CO.,
Newark, N. J.
NEW YORK OFFICE: 120 LIBERTY ST.

PLATINUM
FOR ALL PURPOSES.

In Sheet or Wire, any degree of hardness.

INDEX TO ADVERTISERS.

DYNAMO and ARMATURE
Rewinding, Repairing and Reconstructing Armatures, Dynamos, Railway Motors, Transformers, Commutators.
Stucky & Heck Electric Mfg. Co., Ltd.,
85 N. J. R. R. Ave., Newark, N. J.


McIntire Patent Connector
AND TERMINALS.
Fuse Wire, Fuse Links and Strips.
C. McINTIRE CO.
15 Franklin St., Newark, N. J.

Motors Bought, Sold and Installed.
Motors Maintained at Reasonable Rates.
THE ELECTRIC MOTOR INSPECTION AND REPAIR CO. OF NEW YORK.
General Office ..... 34 PARK ROW, NEW YORK
H. L. SMITH, Mgr. Telephone Call, 418 Cortland.

ELECTRICAL ENGINEERS AND CONTRACTORS
RECOMMENDED BY
THE ELECTRICAL AGE.

Advertisements of 4 lines or less under this head $26 per year, additional lines at proportionate rates.

ZIMDARS & HUNT.
General Electrical Contractors. Wiring complete plants, etc. 127 Fifth Ave., New York. N. Y.

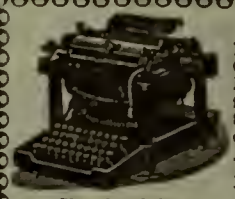
HATZEL & BUEHLER
Electrical Engineers and Contractors. 114 Fifth Avenue, New York.

J. F. BIDSTRUP & CO.
35 Frankfort Street, New York. Electrical Work of all kinds. Wiring, etc. Dynamo and Motor Repairing, Electrical Supplies.

X-RAY COILS A Specialty.

Telephone and Spark Coils.
C. F. SPLITDORF, 17-27 Vandewater St., N. Y.

GORDON BATTERY COMPANY.
THE BEST PRIMARY BATTERY FOR CLOSED OR OPEN CIRCUIT WORK.
594 Broadway, . . . New York.


TYPEWRITER BARGAINS.
Practically new Remingtons, Caligraphs, Smith-Premiers, Hammonds, Yosts, Densmores, fully guaranteed, only $20 to $50—Cost $100. Good machines rented $4 monthly. *Free Handsome Colored Price List.* Also, list of Revised American Standard Pitman Shorthand Books, arranged for self-instruction. Consolidated Typewriter Exchange, 245 B'way, N. Y.

MAP OF OUR NEW POSSESSIONS.

A document of unusual value is the "Round the World" folder just issued by the New York Central Lines, including a map of the United States, Alaska and our islands in the Atlantic and Pacific Oceans.

A copy will be sent free, post-paid, on receipt of three cents in stamps, by George H. Daniels, General Passenger Agent, Grand Central Station, New York.

50 YEARS' EXPERIENCE
PATENTS
TRADE MARKS
DESIGNS
COPYRIGHTS &C.
Anyone sending a sketch and description may quickly ascertain our opinion free whether an invention is probably patentable. Communications strictly confidential. Handbook on Patents sent free. Oldest agency for securing patents.
Patents taken through Munn & Co. receive *special notice*, without charge, in the
Scientific American.
A handsomely illustrated weekly. Largest circulation of any scientific journal. Terms, $3 a year; four months, $1. Sold by all newsdealers.
MUNN & Co. 361 Broadway, New York
Branch Office, 625 F St., Washington, D. C.


HOLOPHANE GLOBES.
More Light.
No Glare.
Perfect Diffusion.
Artistic Patterns.
For all kinds of electric lighting, Send for catalogues and price lists.
HOLOPHANE GLASS CO., 1 Broadway, N. Y.

The Electrical Age

Established 1883. An Illustrated Weekly Electrical Journal. 10 cents per copy

VOL. XXV.—No. 669. NEW YORK, MARCH 10, 1900. Subscription, $2.50 per year. Foreign Countries, $3.50 per year.

1889.
PARIS EXPOSITION MEDAL
— FOR —
RUBBER INSULATION.

OKONITE
TRADE MARK.

1893.
WORLD'S FAIR MEDAL
— FOR —
RUBBER INSULATION.

THE STANDARD FOR RUBBER INSULATION.

OKONITE WIRES, OKONITE TAPE, MANSON TAPE, CANDEE WEATHERPROOF WIRES.

WILLARD L. CANDEE, R. DURANT CHEEVER } MANAGERS.
THE OKONITE CO., Ltd., Sole Manufacturers,
253 BROADWAY, NEW YORK.
GEO. T. MANSON, General Supt.
W. H. HODGINS, Secretary.

LAVA—LAVA—LAVA

Washers Bushings Threaded Pieces

Combine high heat resistance
With best insulating quality.
SEND MODEL OR DRAWING FOR ESTIMATE.

D. M. STEWARD M'F'G. CO.
NEW YORK OFFICE 107 CHAMBERS ST.
CHATTANOOGA, TENN.

BUY OF THE MAKERS.
BEST PURE OAK SHORT LAP LEATHER BELTING
JOSEPH MEIER'S SONS,
295 Market Street, NEWARK, N. J.

PATENTS!
FREE! Valuable Book on Patents. Tells how to secure them at low cost. Gives Mechanical Movements---invaluable to Inventors and Mechanics. Full of Money-Making Patent information.
Big Book Free!
O'MEARA & CO.
PATENT ATTORNEYS,
903 G Street, Washington, D. C.

The IMPROVED "DAYLIGHT" DESK LAMP.
PARABOLA EFFECT.

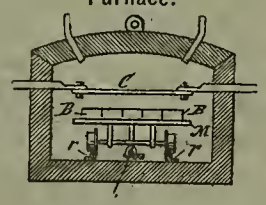
This Electric Desk Lamp is constructed upon scientific principles, and is of great value to those who are compelled to do desk work. The light is soft and abundant, and so well distributed as to leave no shadows or dark corners on the desk; yet the lamp itself is entirely shaded from the eyes, and in no way interferes with the opening or closing of a "roll top" desk.
Nothing in the market compares favorably with it. It doubles the power of an incandescent lamp without bunching the light.

Adjustable "Roll Top" Desk Lamp, without socket, $3.00.
FRANK E. KINSMAN, 26 Cortlandt St., N. Y.
HAVEMEYER BUILDING.
No Special Lamp or Socket Necessary.

THE
PHOENIX GLASS CO.
MANUFACTURERS OF
Gas and Electric Globes, Shades, Etc.
HAVE YOU A COPY OF OUR No. 8 CATALOGUE? IF NOT, SEND FOR IT.
Pittsburgh. New York. Chicago.

AARON CARTER, President. C. H. WATERMAN, Treas. & M'g'r.
MAJ. W. M. COMBS, Vice-Pres. A. E. BOSSE, Secretary.
LEMUEL RUSSELL, Consulting Engineer.

Electric Enameling Furnace.



The Electric Enameling Co.,
203 BROADWAY, NEW YORK.
Office of Record, 188 Market St., Newark, N. J. S. J. MACDONALD Counsel.

PATENTS. PATENT SOLICITOR AND ELECTRICAL EXPERT.
Former Manager, now successor to the Patent Business heretofore conducted by "The Electrical World."
W. A. ROSENBAUM, 177 TIMES BLDG., N. Y.

Don't Travel-- Telephone
FOR SERVICE APPLY TO
NEW YORK TELEPHONE CO.
CONTRACT OFFICES
18 Cortlandt, 15 Dey, 952 Broadway, 115 W. 38th.

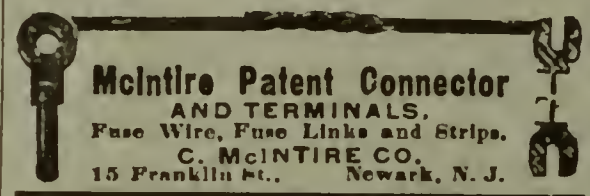
BAKER & CO.,
Newark, N. J.
New York Office: 120 Liberty St.

PLATINUM
FOR ALL PURPOSES.

In Sheet or Wire, any degree of hardness.

INDEX TO ADVERTISERS.

DYNAMO and ARMATURE
Rewinding Repairing and Reconstructing Armatures, Dynamos, Railway Motors, Transformers, Commutators.
Stucky & Heck Electric Mfg. Co., Ltd.,
35 N. J. R. R. Ave., Newark, N. J.


McIntire Patent Connector
AND TERMINALS.
Fuse Wire, Fuse Links and Strips.
C. McINTIRE CO.
15 Franklin St., Newark, N. J.

Motors Bought, Sold and Installed.
Motors Maintained at Reasonable Rates.
THE ELECTRIC MOTOR INSPECTION AND REPAIR CO. OF NEW YORK.
General Office ..... 34 PARK ROW, NEW YORK
H. L. SMITH, Mgr. Telephone Call, 418 Cortland.

ELECTRICAL ENGINEERS AND CONTRACTORS
RECOMMENDED BY
THE ELECTRICAL AGE.

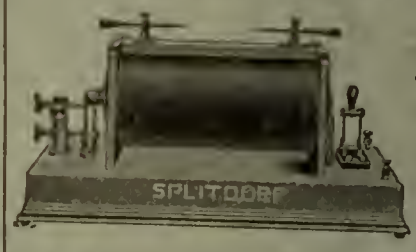
Advertisements of 4 lines or less under this head $26 per year, additional lines at proportionate rates.

ZIMDARS & HUNT.
General Electrical Contractors. Wiring complete plants, etc. 127 Fifth Ave., New York. N. Y.

HATZEL & BUEHLER
Electrical Engineers and Contractors. 114 Fifth Avenue, New York.

J. F. BIDSTRUP & CO.
35 Frankfort Street, New York. Electrical Work of all kinds. Wiring, etc. Dynamo and Motor Repairing, Electrical Supplies.

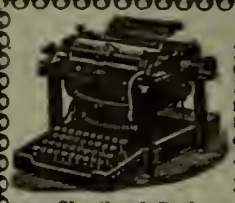
X-RAY COILS A Specialty



Telephone and Spark Coils.

C. F. SPLITDORF, 17-27 Vandewater St., N. Y

GORDON BATTERY COMPANY.
THE BEST PRIMARY BATTERY FOR CLOSED OR OPEN CIRCUIT WORK.
594 Broadway, . . . New York.


TYPEWRITER BARGAINS.
Practically new Remingtons, Caligraphs, Smith-Premiers, Hammonds, Yosts, Densmores, fully guaranteed, only $20 to $50—Cost $100. Good machines rented $4 monthly. *Free Handsome Colored Price List.* Also, list of Revised American Standard Pitman Shorthand Books, arranged for self-instruction. Consolidated Typewriter Exchange, 245 B'way, N. Y.

OUR GREAT LAKES AND OUR MOUNTAINS.

Are all shown in marvelous detail in the "Round the World" folder just issued by the New York Central Lines. Including a map of the United States, Alaska and our Islands in the Atlantic and Pacific Oceans.

A copy will be sent free, post-paid, on receipt of three cents in stamps, by George H. Daniels, General Passenger Agent, Grand Central Station, New York.

50 YEARS' EXPERIENCE
PATENTS
TRADE MARKS
DESIGNS
COPYRIGHTS &C.
Anyone sending a sketch and description may quickly ascertain our opinion free whether an invention is probably patentable. Communications strictly confidential. Handbook on Patents sent free. Oldest agency for securing patents.
Patents taken through Munn & Co. receive *special notice*, without charge, in the
Scientific American.
A handsomely illustrated weekly. Largest circulation of any scientific journal. Terms, $3 a year; four months, $1. Sold by all newsdealers.
MUNN & Co. 361 Broadway, New York
Branch Office, 625 F St., Washington, D. C.

HOLOPHANE GLOBES.
More Light.
No Glare.
Perfect Diffusion.
Artistic Patterns.
For all kinds of electric lighting,
Send for catalogues and price lists.
HOLOPHANE GLASS CO., 1 Broadway, N. Y.

The Electrical Age

Established 1883. An Illustrated Weekly Electrical Journal. 10 cents per copy

VOL. XXV.—No. 670. NEW YORK, MARCH 17, 1900. Subscription, $2.50 per year. Foreign Countries, $3.50 per year.

1889.

PARIS EXPOSITION MEDAL
— FOR —
RUBBER INSULATION.

OKONITE
TRADE MARK.

1893.

WORLD'S FAIR MEDAL
— FOR —
RUBBER INSULATION.

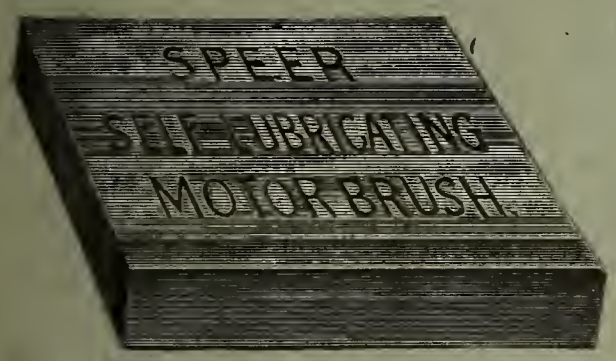
THE STANDARD FOR RUBBER INSULATION.

OKONITE WIRES, OKONITE TAPE, MANSON TAPE, CANDEE WEATHERPROOF WIRES.

WILLARD L. CANDEE, H. DURANT CHEEVER } MANAGERS.

THE OKONITE CO., Ltd., Sole Manufacturers,
253 BROADWAY, NEW YORK.

GEO. T. MANSON, General Supt.
W. H. HODGINS, Secretary.



SPEER
Carbon Brushes

Are made under the direct supervision of Mr. J. S. SPEER (formerly of the Partridge Carbon Co.). This guarantees the excellency of the brushes, which are made in every type required.

NOT IN THE TRUST.

The Speer Carbon Co., ST. MARYS, Pa., U. S. A.

BUY OF THE MAKERS

BEST PURE OAK SHORT LAP LEATHER BELTING

JOSEPH MEIER'S SONS,

295 Market Street, NEWARK, N. J.

PATENTS!

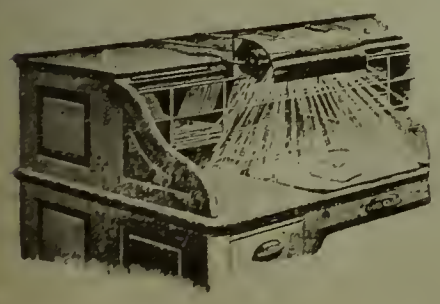
FREE! Valuable Book on Patents. Tells how to secure them at low cost. Gives Mechanical Movements---invaluable to Inventors and Mechanics. Full of Money-Making Patent information.

Big Book Free!

O'MEARA & CO.
PATENT ATTORNEYS,
903 G Street,
Washington, D. C.

The IMPROVED "DAYLIGHT" DESK LAMP.

PARABOLA EFFECT.



This Electric Desk Lamp is constructed upon scientific principles, and is of great value to those who are compelled to do desk work. The light is soft and abundant, and so well distributed as to leave no shadows or dark corners on the desk; yet the lamp itself is entirely shaded from the eyes, and in no way interferes with the opening or closing of a "roll top" desk.

Nothing in the market compares favorably with it. It doubles the power of an incandescent lamp without bunching the light.

Adjustable "Roll Top" Desk Lamp, without socket, $3.00.

FRANK E. KINSMAN, 26 Cortlandt St., N. Y.
HAVEMEYER BUILDING.
No Special Lamp or Socket Necessary.

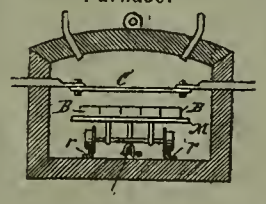
THE
PHOENIX GLASS CO.
MANUFACTURERS OF
Gas and Electric Globes, Shades, Etc.

HAVE YOU A COPY OF OUR No. 8 CATALOGUE?
IF NOT, SEND FOR IT.

Pittsburgh. New York. Chicago.

AARON CARTER, President. C. H. WATERMAN, Treas. & M'g'r
MAJ. W. M. COMBS, Vice-Pres. A. E. BOSSE, Secretary.
LEMUEL RUSSELL, Consulting Engineer.

Electric Enameling Furnace.



The Electric Enameling Co.,
203 BROADWAY,
NEW YORK.

Office of Record, 188 Market St., Newark, N. J. S. J. MACDONALD Counsel.

PATENTS. PATENT SOLICITOR AND ELECTRICAL EXPERT.

Former Manager, now successor to the Patent Business heretofore conducted by "The Electrical World."

W. A. ROSENBAUM, 177 TIMES BLDG., N. Y.

Don't Travel-- Telephone

FOR SERVICE APPLY TO
NEW YORK TELEPHONE CO.
CONTRACT OFFICES
18 Cortlandt, 15 Dey, 952 Broadway, 115 W. 38th.

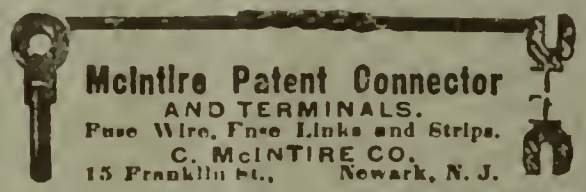
BAKER & CO.,
Newark, N. J.
New York Office: 120 Liberty St.

In Sheet or Wire, any degree of hardness.

PLATINUM
FOR ALL PURPOSES.

INDEX TO ADVERTISERS.

DYNAMO and ARMATURE
Rewinding Repairing and Reconstructing Armatures, Dynamos, Railway Motors, Transformers, Commutators.
Stucky & Heck Electric Mfg. Co., Ltd.,
35 N. J. R. R. Ave., Newark, N. J.


McIntire Patent Connector
AND TERMINALS.
Fuse Wire, Fuse Links and Strips.
C. McINTIRE CO.
15 Franklin St., Newark, N. J.

Motors Bought, Sold and Installed.
Motors Maintained at Reasonable Rates.
THE ELECTRIC MOTOR INSPECTION AND REPAIR CO. OF NEW YORK.
General Office ..... 34 PARK ROW, NEW YORK
H. L. SMITH, Mgr. Telephone Call, 418 Cortland

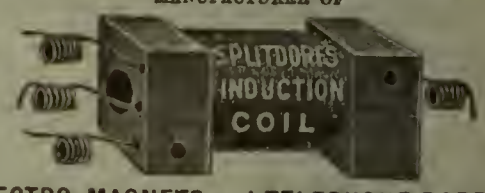
ELECTRICAL ENGINEERS AND CONTRACTORS
RECOMMENDED BY
THE ELECTRICAL AGE.

Advertisements of 4 lines or less under this head $26 per year, additional lines at proportionate rates.

ZIMDARS & HUNT.
General Electrical Contractors. Wiring complete plants, etc. 127 Fifth Ave., New York. N. Y.

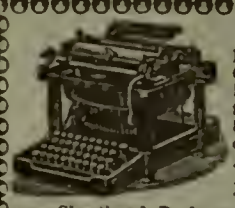
HATZEL & BUEHLER
Electrical Engineers and Contractors. 114 Fifth Avenue, New York.

J. F. BIDSTRUP & CO.
35 Frankfort Street, New York. Electrical Work of all kinds. Wiring, etc. Dynamo and Motor Repairing, Electrical Supplies

C. F. SPLITDORF,
MANUFACTURER OF


ELECTRO-MAGNETS and TELEPHONE BOBBINS
17-27 Vandewater St., New York.

GORDON BATTERY COMPANY.
THE BEST PRIMARY BATTERY FOR CLOSED OR OPEN CIRCUIT WORK.
694 Broadway, . . . New York.


TYPEWRITER BARGAINS.
Practically new Remingtons, Caligraphs, Smith-Premiers, Hammonds, Yosts, Densmores, fully guaranteed, only $20 to $50—Cost $100. Good machines rented $4 monthly. *Free Handsome Colored Price List.* Also, list of Revised American Standard Pitman Shorthand Books, arranged for self-instruction. Consolidated Typewriter Exchange, 245 B'way, N. Y.

THE PACIFIC
AND
ORIENTAL MAIL

Leaves Grand Central Station, New York, by the New York Central, every night in the year at 9.15. and the fourth night thereafter this mail is in San Francisco, ready for delivery or transfer to the steamers for Hawaii, Australia, Philippines, Japan and China.

See the new "Round the World" folder just issued by the New York Central Lines.

A copy will be sent free. post-paid. on receipt of three cents in stamps, by George H. Daniels. General Passenger Agent, Grand Central Station. New York.

50 YEARS' EXPERIENCE
PATENTS
TRADE MARKS
DESIGNS
COPYRIGHTS &C.
Anyone sending a sketch and description may quickly ascertain our opinion free whether an invention is probably patentable. Communications strictly confidential. Handbook on Patents sent free. Oldest agency for securing patents.
Patents taken through Munn & Co. receive *special notice*, without charge, in the
Scientific American.
A handsomely illustrated weekly. Largest circulation of any scientific journal. Terms, $3 a year; four months, $1. Sold by all newsdealers.
MUNN & Co. 361 Broadway, New York
Branch Office, 625 F St., Washington, D. C.


HOLOPHANE GLOBES.
More Light.
No Glare.
Perfect Diffusion.
Artistic Patterns.
For all kinds of electric lighting,
Send for catalogues and price lists.
HOLOPHANE GLASS CO., 1 Broadway, N. Y.

The Electrical Age

Established 1883. An Illustrated Weekly Electrical Journal. 10 cents per copy

VOL. XXV.—No. 671. NEW YORK, MARCH 24, 1900. Subscription, $2.50 per year. Foreign Countries, $3.50 per year.

1889.
PARIS EXPOSITION MEDAL
— FOR —
RUBBER INSULATION.

OKONITE
TRADE MARK.

1893.
WORLD'S FAIR MEDAL
— FOR —
RUBBER INSULATION.

THE STANDARD FOR RUBBER INSULATION.

OKONITE WIRES, OKONITE TAPE, MANSON TAPE, CANDEE WEATHERPROOF WIRES

WILLARD L. CANDEE, H. DURANT CHEEVER } MANAGERS.
THE OKONITE CO., Ltd., Sole Manufacturers,
253 BROADWAY, NEW YORK.
GEO. T. MANSON, General Supt.
W. H. HODGINS, Secretary.

LAVA—LAVA—LAVA

Washers Bushings Threaded Pieces

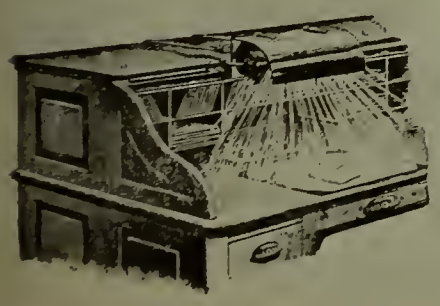
Combine high heat resistance
With best insulating quality.
SEND MODEL OR DRAWING FOR ESTIMATE.

D. M. STEWARD M'F'G. CO.
NEW YORK OFFICE 107 CHAMBERS ST.
CHATTANOOGA, TENN.

BUY OF THE MAKERS
BEST PURE OAK SHORT LAP LEATHER BELTING
JOSEPH MEIER'S SONS,
295 Market Street, NEWARK, N. J.

PATENTS!
FREE! Valuable Book on Patents. Tells how to secure them at low cost. Gives Mechanical Movements---invaluable to Inventors and Mechanics. Full of Money-Making Patent information.
Big Book Free!
O'MEARA & CO.
PATENT ATTORNEYS,
903 G Street, Washington, D. C.

The IMPROVED "DAYLIGHT" DESK LAMP.
PARABOLA EFFECT.



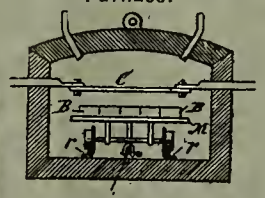
This Electric Desk Lamp is constructed upon scientific principles, and is of great value to those who are compelled to do desk work. The light is soft and abundant, and so well distributed as to leave no shadows or dark corners on the desk; yet the lamp itself is entirely shaded from the eyes, and in no way interferes with the opening or closing of a "roll top" desk.
Nothing in the market compares favorably with it. It doubles the power of an incandescent lamp without bunching the light.

Adjustable "Roll Top" Desk Lamp, without socket, $3.00.
FRANK E. KINSMAN, 26 Cortlandt St., N. Y.
HAVEMEYER BUILDING.
No Special Lamp or Socket Necessary.

THE
PHOENIX GLASS CO.
MANUFACTURERS OF
Gas and Electric Globes, Shades, Etc.
HAVE YOU A COPY OF OUR No. 8 CATALOGUE?
IF NOT, SEND FOR IT.
Pittsburgh. New York. Chicago.

AARON CARTER, President. C. H. WATERMAN, Treas. & M'g'r.
MAJ. W. M. COMBS, Vice-Pres. A. E. BOSSE, Secretary.
LEMUEL RUSSELL, Consulting Engineer.

Electric Enameling Furnace.



The Electric Enameling Co.,
203 BROADWAY, NEW YORK.
Office of Record, 188 Market St., Newark, N J. S. J. MACDONALD Counsel.

PATENTS. PATENT SOLICITOR AND ELECTRICAL EXPERT.
Former Manager, now successor to the Patent Business heretofore conducted by "The Electrical World."
W. A. ROSENBAUM, 177 TIMES BLDG., N. Y.

Don't Travel-- Telephone
FOR SERVICE APPLY TO
NEW YORK TELEPHONE CO.
CONTRACT OFFICES
18 Cortlandt, 15 Dey, 952 Broadway, 115 W. 38th.

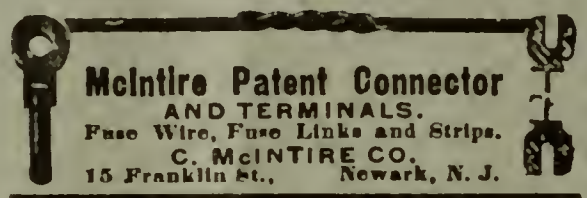
BAKER & CO.,
Newark, N. J.
New York Office: 120 Liberty St.

PLATINUM
FOR ALL PURPOSES.

In Sheet or Wire, any degree of hardness.

INDEX TO ADVERTISERS.

DYNAMO and ARMATURE
Rewinding Repairing and Reconstructing Armatures, Dynamos, Railway Motors, Transformers, Commutators.
Stucky & Heck Electric Mfg. Co., Ltd.,
35 N. J. R. R. Ave., Newark, N. J.


McIntire Patent Connector
AND TERMINALS.
Fuse Wire, Fuse Links and Strips.
C. McINTIRE CO.
15 Franklin St., Newark, N. J.

Motors Bought, Sold and Installed.
Motors Maintained at Reasonable Rates.
THE ELECTRIC MOTOR INSPECTION AND REPAIR CO. OF NEW YORK.
General Office.....34 PARK ROW, NEW YORK
H. L. SMITH, Mgr. Telephone Call. 418 Cortland.

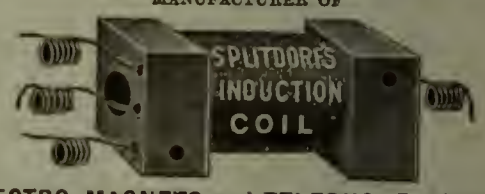
ELECTRICAL ENGINEERS AND CONTRACTORS
RECOMMENDED BY
THE ELECTRICAL AGE.

Advertisements of 4 lines or less under this head $26 per year, additional lines at proportionate rates.

ZIMDARS & HUNT.
General Electrical Contractors. Wiring complete plants, etc. 127 Fifth Ave., New York. N. Y.

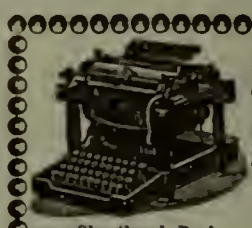
HATZEL & BUEHLER
Electrical Engineers and Contractors. 114 Fifth Avenue, New York.

J. F. BIDSTRUP & CO.
35 Frankfort Street, New York. Electrical Work of all kinds. Wiring, etc. Dynamo and Motor Repairing, Electrical Supplies

C. F. SPLITDORF,
MANUFACTURER OF


ELECTRO-MAGNETS and TELEPHONE BOBBINS
17-27 Vandewater St., New York.

GORDON BATTERY COMPANY.
THE BEST PRIMARY BATTERY FOR CLOSED OR OPEN CIRCUIT WORK.
594 Broadway, . . . New York.


TYPEWRITER BARGAINS.
Practically new Remingtons, Caligraphs, Smith-Premiers, Hammonds, Yosts, Densmores, fully guaranteed, only $20 to $50—Cost $100. Good machines rented $1 monthly. *Free Handsome Colored Price List.* Also, list of Revised American Standard Pitman Shorthand Books, arranged for self-instruction. Consolidated Typewriter Exchange, 245 B'way, N. Y.

A VALUABLE MAP.

NEW AND OLD POSSESSIONS OF THE UNITED STATES.

A new map, quite different from the old style of railroad map, is that just issued by the New York Central Lines.

Complete and accurate as to detail. Just the thing to use in studying the new geography of the United States.

A copy will be sent free, post-paid, on receipt of three cents in stamps, by George H. Daniels, General Passenger Agent, Grand Central Station, New York.

50 YEARS' EXPERIENCE
PATENTS
TRADE MARKS
DESIGNS
COPYRIGHTS &C.

Anyone sending a sketch and description may quickly ascertain our opinion free whether an invention is probably patentable. Communications strictly confidential. Handbook on Patents sent free. Oldest agency for securing patents.
Patents taken through Munn & Co. receive *special notice*, without charge, in the

Scientific American.

A handsomely illustrated weekly. Largest circulation of any scientific journal. Terms, $3 a year; four months, $1. Sold by all newsdealers.
MUNN & Co. 361 Broadway, New York
Branch Office, 625 F St., Washington, D. C.

HOLOPHANE GLOBES.
More Light.
No Glare.
Perfect Diffusion.
Artistic Patterns.
For all kinds of electric lighting,
Send for catalogues and price lists.
HOLOPHANE GLASS CO., 1 Broadway, N. Y.

The Electrical Age

Established 1883. An Illustrated Weekly Electrical Journal. 10 cents per copy

VOL. XXV.—No. 672. NEW YORK, MARCH 31, 1900. Subscription, $2.50 per year. Foreign Countries, $3.50 per year.

1889.

PARIS EXPOSITION MEDAL
— FOR —
RUBBER INSULATION.

OKONITE
TRADE MARK.

1893.

WORLD'S FAIR MEDAL
— FOR —
RUBBER INSULATION.

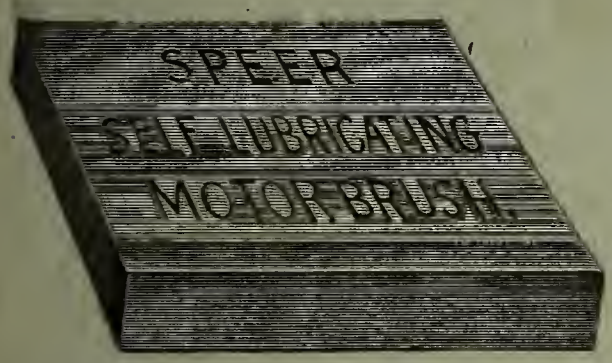
THE STANDARD FOR RUBBER INSULATION.

OKONITE WIRES, OKONITE TAPE, MANSON TAPE, CANDEE WEATHERPROOF WIRES

WILLARD L. CANDEE, H. DURANT CHEEVER } MANAGERS.

THE OKONITE CO., Ltd., Sole Manufacturers,
253 BROADWAY, NEW YORK.

GEO. T. MANSON, GENERAL SUPT.
W. H. HODGINS, SECRETARY.



SPEER
Carbon Brushes

Are made under the direct supervision of Mr. J. S. SPEER (formerly of the Partridge Carbon Co.). This guarantees the excellency of the brushes, which are made in every type required.

NOT IN THE TRUST.

The Speer Carbon Co., ST. MARYS, Pa., U. S. A.

THE
PHOENIX GLASS CO.
MANUFACTURERS OF
Gas and Electric
Globes, Shades, Etc.

HAVE YOU A COPY OF OUR No. 8 CATALOGUE?
IF NOT, SEND FOR IT.

Pittsburgh. New York. Chicago.

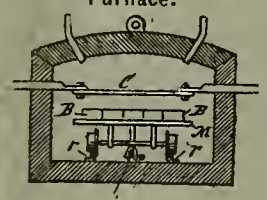
BUY OF THE MAKERS

BEST PURE OAK SHORT LAP LEATHER BELTING

JOSEPH MEIER'S SONS,
295 Market Street, NEWARK, N. J.

AARON CARTER, President. C. H. WATERMAN, Treas. & M'g'r.
MAJ. W. M. COMBS, Vice-Pres. A. E. BOSSE, Secretary.
LEMUEL RUSSELL, Consulting Engineer.

Electric Enameling Furnace.



The Electric Enameling Co.,
203 BROADWAY,
NEW YORK.

Office of Record, 188 Market St., Newark, N J. S. J. MACDONALD Counsel.

PATENTS!

FREE! Valuable Book on Patents. Tells how to secure them at low cost. Gives Mechanical Movements---invaluable to Inventors and Mechanics. Full of Money-Making Patent information.

Big Book Free!

O'MEARA & CO.
PATENT ATTORNEYS,
903 G Street,
Washington, D. C.

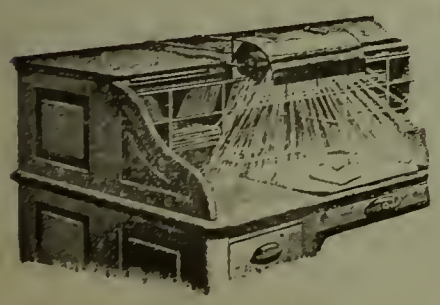
PATENTS. PATENT SOLICITOR AND ELECTRICAL EXPERT.

Former Manager, now successor to the Patent Business heretofore conducted by "The Electrical World."

W. A. ROSENBAUM, 177 TIMES BLDG., N. Y.

The IMPROVED "DAYLIGHT" DESK LAMP.

PARABOLA EFFECT.



This Electric Desk Lamp is constructed upon scientific principles, and is of great value to those who are compelled to do desk work. The light is soft and abundant, and so well distributed as to leave no shadows or dark corners on the desk; yet the lamp itself is entirely shaded from the eyes, and in no way interferes with the opening or closing of a "roll top" desk.

Nothing in the market compares favorably with it. It doubles the power of an incandescent lamp without bunching the light.

Adjustable "Roll Top" Desk Lamp, without socket, $3.00.

FRANK E. KINSMAN, 26 Cortlandt St., N. Y.
HAVEMEYER BUILDING.
No Special Lamp or Socket Necessary.

Don't
Travel--
Telephone

FOR SERVICE APPLY TO
NEW YORK TELEPHONE CO.
CONTRACT OFFICES
18 Cortlandt, 15 Dey, 952 Broadway, 115 W. 38th.

BAKER & CO.,
Newark, N. J.
New York Office: 120 Liberty St.

PLATINUM
FOR ALL PURPOSES.

In Sheet or Wire, any degree of hardness.

INDEX TO ADVERTISERS.

DYNAMO and ARMATURE
Rewinding Repairing and Reconstructing Armatures, Dynamos, Railway Motors, Transformers, Commutators.
Stucky & Heck Electric Mfg. Co., Ltd.,
35 N. J. R. R. Ave., Newark, N. J.

McIntire Patent Connector
AND TERMINALS.
Fuse Wire, Fuse Links and Strips.
C. McINTIRE CO.
15 Franklin St., Newark, N. J.

Motors Bought, Sold and Installed.
Motors Maintained at Reasonable Rates.
THE ELECTRIC MOTOR INSPECTION AND REPAIR CO. OF NEW YORK.
General Office.....34 PARK ROW, NEW YORK
H. L. SMITH, Mgr. Telephone Call, 418 Cortland.

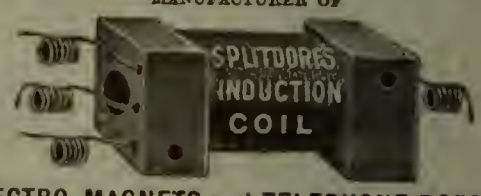
ELECTRICAL ENGINEERS AND CONTRACTORS
RECOMMENDED BY
THE ELECTRICAL AGE.

Advertisements of 4 lines or less under this head $26 per year, additional lines at proportionate rates.

ZIMDARS & HUNT.
General Electrical Contractors. Wiring complete plants, etc. 127 Fifth Ave., New York. N. Y.

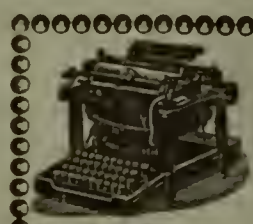
HATZEL & BUEHLER
Electrical Engineers and Contractors. 114 Fifth Avenue, New York.

J. F. BIDSTRUP & CO.
35 Frankfort Street, New York. Electrical Work of all kinds. Wiring, etc. Dynamo and Motor Repairing. Electrical Supplies

C. F. SPLITDORF,
MANUFACTURER OF


ELECTRO-MAGNETS and TELEPHONE BOBBINS
17-27 Vandewater St., New York.

GORDON BATTERY COMPANY.
THE BEST PRIMARY BATTERY FOR CLOSED OR OPEN CIRCUIT WORK.
594 Broadway, . . . New York.


TYPEWRITER BARGAINS.
Practically new Remingtons, Caligraphs, Smith-Premiers, Hammonds, Yosts, Densmores, fully guaranteed, only $20 to $50—Cost $100. Good machines rented $4 monthly. *Free Handsome Colored Price List.* Also, list of Revised American Standard Pitman Shorthand Books, arranged for self-instruction. Consolidated Typewriter Exchange, 245 B'way, N. Y.

ROUND THE WORLD.

THE route 'round the world is across the American Continent, via New York and Niagara Falls,, through the centre of the richest country on the globe.

You will be convinced of this tf you will examine the new "Round the World" folder just issued by the New York Central Lines.

A copy will be sent free, post-paid. on receipt of three cents in stamps, by George H. Daniels, General Passenger Agent, Grand Central Station, New York.

50 YEARS' EXPERIENCE
PATENTS
TRADE MARKS
DESIGNS
COPYRIGHTS &C.
Anyone sending a sketch and description may quickly ascertain our opinion free whether an invention is probably patentable. Communications strictly confidential. Handbook on Patents sent free. Oldest agency for securing patents.
Patents taken through Munn & Co. receive *special notice*, without charge, in the
Scientific American.
A handsomely illustrated weekly. Largest circulation of any scientific journal. Terms, $3 a year; four months, $1. Sold by all newsdealers.
MUNN & Co. 361 Broadway, New York
Branch Office, 625 F St., Washington, D. C.


HOLOPHANE GLOBES.
More Light.
No Glare.
Perfect Diffusion.
Artistic Patterns.
For all kinds of electric lighting,
Send for catalogues and price lists.
HOLOPHANE GLASS CO., 1 Broadway, N. Y.

The Electrical Age

Established 1883. An Illustrated Weekly Electrical Journal. 10 cents per copy

VOL. XXV.—No. 673. NEW YORK, APRIL 7, 1900. Subscription, $2.50 per year. Foreign Countries, $3.50 per year.

1889.
PARIS EXPOSITION MEDAL
— FOR —
RUBBER INSULATION.

OKONITE
TRADE MARK

1893.
WORLD'S FAIR MEDAL
— FOR —
RUBBER INSULATION.

THE STANDARD FOR RUBBER INSULATION.

OKONITE WIRES, OKONITE TAPE, MANSON TAPE, CANDEE WEATHERPROOF WIRES.

WILLARD L. CANDEE, E. DURANT CHEEVER } MANAGERS.
THE OKONITE CO., Ltd., Sole Manufacturers,
253 BROADWAY, NEW YORK.
GEO. T. MANSON, GENERAL SUPT
W. H. HODGINS, SECRETARY.

LAVA—LAVA—LAVA

Washers Bushings Threaded Pieces

Combine high heat resistance
With best insulating quality.

SEND MODEL OR DRAWING FOR ESTIMATE.

D. M. STEWARD M'F'G. CO.

NEW YORK OFFICE
107 CHAMBERS ST.

CHATTANOOGA, TENN.

THE
PHOENIX GLASS CO.
MANUFACTURERS OF
Gas and Electric Globes, Shades, Etc.

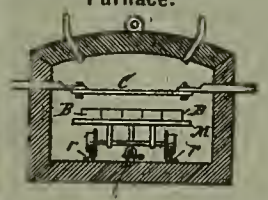
HAVE YOU A COPY OF OUR No. 8 CATALOGUE?
IF NOT, SEND FOR IT.

Pittsburgh. New York. Chicago.

BUY OF THE MAKERS
BEST PURE OAK SHORT LAP LEATHER BELTING
JOSEPH MEIER'S SONS,
295 Market Street, NEWARK, N. J.

AARON CARTER, President. C. H. WATERMAN, Treas. & M'g'r.
MAJ. W. M. COMBS, Vice-Pres. A. E. BOSSE, Secretary.
LEMUEL RUSSELL, Consulting Engineer.

Electric Enameling Furnace.

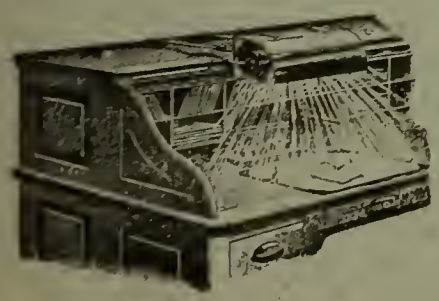


The Electric Enameling Co.,
203 BROADWAY, NEW YORK.
Office of Record, 188 Market St., Newark, N. J. S. J. MACDONALD Counsel.

PATENTS!
FREE! Valuable Book on Patents. Tells how to secure them at low cost. Gives Mechanical Movements---invaluable to Inventors and Mechanics. Full of Money-Making Patent information.
Big Book Free!
O'MEARA & CO.
PATENT ATTORNEYS,
903 G Street,
Washington, D. C.

PATENTS. PATENT SOLICITOR AND ELECTRICAL EXPERT.
Former Manager, now successor to the Patent Business heretofore conducted by "The Electrical World."
W. A. ROSENBAUM, 177 TIMES BLDG., N. Y.

The IMPROVED "DAYLIGHT" DESK LAMP.
PARABOLA EFFECT.



This Electric Desk Lamp is constructed upon scientific principles, and is of great value to those who are compelled to do desk work. The light is soft and abundant, and so well distributed as to leave no shadows or dark corners on the desk; yet the lamp itself is entirely shaded from the eyes, and in no way interferes with the opening or closing of a "roll top" desk.
Nothing in the market compares favorably with it. It doubles the power of an incandescent lamp without bunching the light.

Adjustable "Roll Top" Desk Lamp, without socket, $3.00.
FRANK E. KINSMAN, 26 Cortlandt St., N. Y.
HAVEMEYER BUILDING.
No Special Lamp or Socket Necessary.

Don't Travel-- Telephone
FOR SERVICE APPLY TO
NEW YORK TELEPHONE CO.
CONTRACT OFFICES
18 Cortlandt, 15 Dey, 952 Broadway, 115 W. 38th.

BAKER & CO.,
Newark, N. J.
New York Office: 120 Liberty St.

PLATINUM
FOR ALL PURPOSES.

In Sheet or Wire, any degree of hardness.

INDEX TO ADVERTISERS.

DYNAMO and ARMATURE
Rewinding Repairing and Reconstructing Armatures, Dynamos, Railway Motors, Transformers, Commutators.
Stucky & Heck Electric Mfg. Co., Ltd.,
85 N. J. R. R. Ave., Newark, N. J.

McIntire Patent Connector
AND TERMINALS.
Fuse Wire, Fuse Links and Strips.
C. McINTIRE CO.
15 Franklin St., Newark, N. J.

Motors Bought, Sold and Installed.
Motors Maintained at Reasonable Rates.
THE ELECTRIC MOTOR INSPECTION AND REPAIR CO. OF NEW YORK.
General Office.....34 PARK ROW, NEW YORK
H. L. SMITH, Mgr. Telephone Call, 418 Cortland.

ELECTRICAL ENGINEERS, AND CONTRACTORS
RECOMMENDED BY
THE ELECTRICAL AGE.

Advertisements of 4 lines or less under this head $26 per year, additional lines at proportionate rates.

ZIMDARS & HUNT.
General Electrical Contractors. Wiring complete plants, etc. 127 Fifth Ave., New York. N. Y.

HATZEL & BUEHLER
Electrical Engineers and Contractors. 116 Fifth Avenue, New York.

J. F. BIDSTRUP & CO.
35 Frankfort Street, New York. Electrical Work of all kinds. Wiring, etc. Dynamo and Motor Repairing, Electrical Supplies

X-RAY COILS A Specialty

Telephone and Spark Coils.

C. F. SPLITDORF, 17-27 Vandewater St., N. Y.

GORDON BATTERY COMPANY.
THE BEST PRIMARY BATTERY FOR CLOSED OR OPEN CIRCUIT WORK.
594 Broadway, . . . New York.

TYPEWRITER BARGAINS.
Practically new Remingtons, Caligraphs, Smith-Premiers, Hammonds, Yosts, Densmores, fully guaranteed, only $20 to $50—Cost $100. Good machines rented $4 monthly. *Free Handsome Colored Price List.* Also, list of Revised American Standard Pitman Shorthand Books, arranged for self-instruction. Consolidated Typewriter Exchange, 245 B'way, N. Y.

OUR NEW POSSESSIONS.

A map, valuable for its accuracy and beauty, will be found in No. 21 of the New Central's "Four-Track Series." In addition to our new possessions it correctly delineates the United States, Alaska, the Klondike Region, the Asiatic Coast and Australia.

A copy will be sent free, post-paid, on receipt of three cents in stamps, by George H. Daniels, General Passenger Agent, Grand Central Station, New York.

50 YEARS' EXPERIENCE
PATENTS
TRADE MARKS
DESIGNS
COPYRIGHTS &C.

Anyone sending a sketch and description may quickly ascertain our opinion free whether an invention is probably patentable. Communications strictly confidential. Handbook on Patents sent free. Oldest agency for securing patents.
Patents taken through Munn & Co. receive *special notice*, without charge, in the

Scientific American.

A handsomely illustrated weekly. Largest circulation of any scientific journal. Terms, $3 a year; four months, $1. Sold by all newsdealers.
MUNN & Co. 361 Broadway, New York
Branch Office, 625 F St., Washington, D. C.

HOLOPHANE GLOBES.
More Light.
No Glare.
Perfect Diffusion.
Artistic Patterns.
For all kinds of electric lighting,
Send for catalogues and price lists.
HOLOPHANE GLASS CO., 1 Broadway, N. Y.

The Electrical Age

Established 1883. An Illustrated Weekly Electrical Journal. 10 cents per copy

VOL. XXV.—No. 674. NEW YORK, APRIL 14, 1900. Subscription, $2.50 per year. Foreign Countries, $3.50 per year.

1889.
PARIS EXPOSITION MEDAL
— FOR —
RUBBER INSULATION.

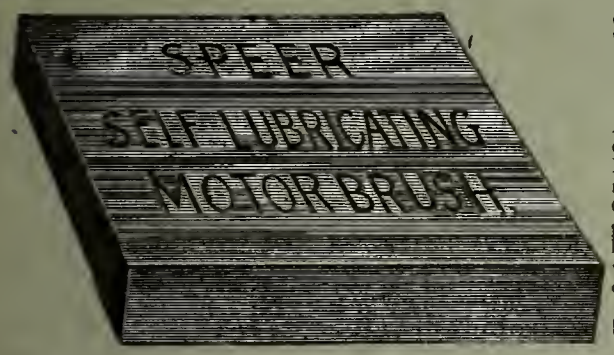
OKONITE
TRADE MARK.

1893.
WORLD'S FAIR MEDAL
— FOR —
RUBBER INSULATION.

THE STANDARD FOR RUBBER INSULATION.

OKONITE WIRES, OKONITE TAPE, MANSON TAPE, CANDEE WEATHERPROOF WIRES.

WILLARD L. CANDEE, M. DURANT CHEEVER } MANAGERS.
THE OKONITE CO., Ltd., Sole Manufacturers,
253 BROADWAY, NEW YORK.
GEO. T. MANSON, GENERAL SUPT. W. H. HODGINS, SECRETARY.



SPEER
Carbon Brushes

Are made under the direct supervision of Mr. J. S. SPEER (formerly of the Partridge Carbon Co.). This guarantees the excellency of the brushes, which are made in every type required.

NOT IN THE TRUST.

The Speer Carbon Co., ST. MARYS, Pa., U. S. A.

BUY OF THE MAKERS

BEST PURE OAK SHORT LAP LEATHER BELTING

JOSEPH MEIER'S SONS,
295 Market Street, NEWARK, N. J.

PATENTS!

FREE! Valuable Book on Patents. Tells how to secure them at low cost. Gives Mechanical Movements---invaluable to Inventors and Mechanics. Full of Money-Making Patent information.

Big Book Free!

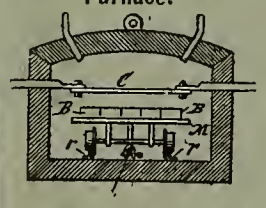
O'MEARA & CO.
PATENT ATTORNEYS,
903 G Street,
Washington, D. C.

EXTRA SOFT SMOOTH CASTINGS
LIGHT AND HEAVY.
For Electrical and Special Purposes.
AUTOMOBILE CYLINDERS.
DROP FORGINGS TO ORDER.
DIE SINKING.
Oscar Barnett Foundry Co.
NEWARK, N. J.
L. D. 'Phone, 1045.

THE
PHOENIX GLASS CO.
MANUFACTURERS OF
Gas and Electric Globes, Shades, Etc.
HAVE YOU A COPY OF OUR No. 8 CATALOGUE?
IF NOT, SEND FOR IT.
Pittsburgh. New York. Chicago.

AARON CARTER, President. C. H. WATERMAN, Treas. & M'g'r.
MAJ. W. M. COMBS, Vice-Pres. A. E. BOSSE, Secretary.
LEMUEL RUSSELL, Consulting Engineer.

Electric Enameling Furnace.



The Electric Enameling Co.,
203 BROADWAY,
NEW YORK.
Office of Record, 188 Market St., Newark, N. J. S. J. MACDONALD Counsel.

PATENTS. PATENT SOLICITOR AND ELECTRICAL EXPERT.
Former Manager, now successor to the Patent Business heretofore conducted by "The Electrical World."
W. A. ROSENBAUM, 177 TIMES BLDG., N. Y.

Don't Travel-- Telephone
FOR SERVICE APPLY TO
NEW YORK TELEPHONE CO.
CONTRACT OFFICES
18 Cortlandt, 15 Dey, 952 Broadway, 115 W. 38th.

BAKER & CO.,
Newark, N. J.
New York Office: 120 Liberty St.

In Sheet or Wire, any degree of hardness.

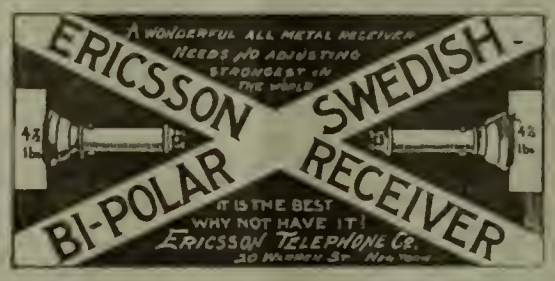
PLATINUM
FOR ALL PURPOSES.

INDEX TO ADVERTISERS.

DYNAMO and ARMATURE
Rewinding Repairing and Reconstructing Armatures, Dynamos, Railway Motors, Transformers, Commutators.
Stucky & Heck Electric Mfg. Co., Ltd.,
35 N. J. R. R. Ave., Newark, N. J.

McIntire Patent Connector
AND TERMINALS.
Fuse Wire, Fuse Links and Strips.
C. McINTIRE CO.
15 Franklin St., Newark, N. J.

Motors Bought, Sold and Installed.
Motors Maintained at Reasonable Rates.
THE ELECTRIC MOTOR INSPECTION AND REPAIR CO. OF NEW YORK.
General Office ... ...34 PARK ROW, NEW YORK
H. L. SMITH, Mgr. Telephone Call, 418 Cortland.



ELECTRICAL ENGINEERS AND CONTRACTORS
RECOMMENDED BY
THE ELECTRICAL AGE.

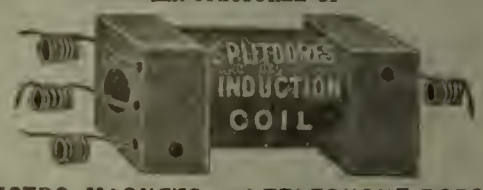
Advertisements of 4 lines or less under this head $26 per year, additional lines at proportionate rates.

ZIMDARS & HUNT.
General Electrical Contractors. Wiring complete plants, etc. 127 Fifth Ave., New York. N. Y.

HATZEL & BUEHLER
Electrical Engineers and Contractors. 116 Fifth Avenue, New York.

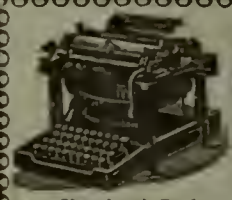
J. F. BIDSTRUP & CO.
35 Frankfort Street, New York. Electrical Work of all kinds. Wiring, etc. Dynamo and Motor Repairing, Electrical Supplies

C. F. SPLITDORF,
MANUFACTURER OF



ELECTRO-MAGNETS and TELEPHONE BOBBINS
17-27 Vandewater St., New York.

GORDON BATTERY COMPANY.
THE BEST PRIMARY BATTERY FOR CLOSED OR OPEN CIRCUIT WORK.
594 Broadway, . . . New York.



TYPEWRITER BARGAINS.
Practically new Remingtons, Caligraphs, Smith-Premiers, Hammonds, Yosts, Densmores, fully guaranteed, only $20 to $50—Cost $100. Good machines rented $4 monthly. *Free Handsome Colored Price List.* Also, list of Revised American Standard Phitman Shorthand Books, arranged for self-instruction. Consolidated Typewriter Exchange, 245 B'way, N. Y.

ACROSS THE CONTINENT.

By way of New York and Niagara Falls, through the centres of populations and the gateways of commerce, which are, of course, on or reached by the New York Central.

For particulars see the new "Round the World" folder just issued by the New York Central Line. It contains a $700.00 map.

A copy will be sent free, post-paid, on receipt of three cents in stamps, by George H. Daniels, General Passenger Agent, Grand Central Station, New York.

50 YEARS' EXPERIENCE
PATENTS
TRADE MARKS
DESIGNS
COPYRIGHTS &C.

Anyone sending a sketch and description may quickly ascertain our opinion free whether an invention is probably patentable. Communications strictly confidential. Handbook on Patents sent free. Oldest agency for securing patents.
Patents taken through Munn & Co. receive *special notice*, without charge, in the

Scientific American.

A handsomely illustrated weekly. Largest circulation of any scientific journal. Terms, $3 a year; four months, $1. Sold by all newsdealers.
MUNN & Co. 361 Broadway, New York
Branch Office, 625 F St., Washington, D. C.

HOLOPHANE GLOBES.
More Light.
No Glare.
Perfect Diffusion.
Artistic Patterns.
For all kinds of electric lighting, Send for catalogues and price lists.
HOLOPHANE GLASS CO., 1 Broadway, N. Y.

The Electrical Age

Established 1883. An Illustrated Weekly Electrical Journal. 10 cents per copy

VOL. XXV.—No. 675. NEW YORK, APRIL 21, 1900. Subscription, $2.50 per year. Foreign Countries, $3.50 per year.

1889.
PARIS EXPOSITION MEDAL
— FOR —
RUBBER INSULATION.

OKONITE
TRADE MARK.

1893.
WORLD'S FAIR MEDAL
— FOR —
RUBBER INSULATION.

THE STANDARD FOR RUBBER INSULATION.

OKONITE WIRES, OKONITE TAPE, MANSON TAPE, CANDEE WEATHERPROOF WIRES.

WILLARD L. CANDEE, H. DURANT CHEEVER } MANAGERS.
THE OKONITE CO., Ltd., Sole Manufacturers,
253 BROADWAY, NEW YORK.
GEO. T. MANSON, General Supt.
W. H. HODGINS, Secretary.

LAVA—LAVA—LAVA

Washers Bushings Threaded Pieces

Combine high heat resistance
With best insulating quality.
SEND MODEL OR DRAWING FOR ESTIMATE.

D. M. STEWARD M'F'G. CO.
NEW YORK OFFICE 107 CHAMBERS ST.
CHATTANOOGA, TENN.

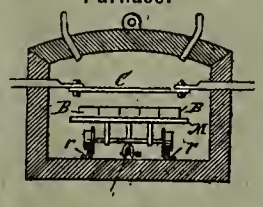
BUY OF THE MAKERS
BEST PURE OAK SHORT LAP LEATHER BELTING
JOSEPH MEIER'S SONS,
295 Market Street, NEWARK, N. J.

PATENTS!
FREE! Valuable Book on Patents. Tells how to secure them at low cost. Gives Mechanical Movements---invaluable to Inventors and Mechanics. Full of Money-Making Patent information.
Big Book Free!
O'MEARA & CO.
PATENT ATTORNEYS,
903 G Street,
Washington, D. C.

EXTRA SOFT SMOOTH CASTINGS
LIGHT AND HEAVY.
For Electrical and Special Purposes.
AUTOMOBILE CYLINDERS.
DROP FORGINGS TO ORDER.
DIE SINKING.
Oscar Barnett Foundry Co.
NEWARK, N. J.
L. D. 'Phone, 1045.

THE
PHOENIX GLASS CO.
MANUFACTURERS OF
Gas and Electric Globes, Shades, Etc.
HAVE YOU A COPY OF OUR No. 8 CATALOGUE?
IF NOT, SEND FOR IT.
Pittsburgh. New York. Chicago.

AARON CARTER, President. C. H. WATERMAN, Treas. & M'g'r.
MAJ. W. M. COMBS, Vice-Pres. A. E. BOSSE, Secretary.
LEMUEL RUSSELL, Consulting Engineer.
Electric Enameling Furnace.



The Electric Enameling Co.,
203 BROADWAY, NEW YORK.
Office of Record, 188 Market St., Newark, N. J. S. J. MACDONALD Counsel.

PATENTS. PATENT SOLICITOR AND ELECTRICAL EXPERT.
Former Manager, now successor to the Patent Business heretofore conducted by "The Electrical World."
W. A. ROSENBAUM, 177 TIMES BLDG., N. Y.

Don't Travel-- Telephone
FOR SERVICE APPLY TO
NEW YORK TELEPHONE CO.
CONTRACT OFFICES
18 Cortlandt, 15 Dey, 952 Broadway, 115 W. 38th.

BAKER & CO.,
Newark, N. J.
New York Office: 120 Liberty St.

PLATINUM
FOR ALL PURPOSES.

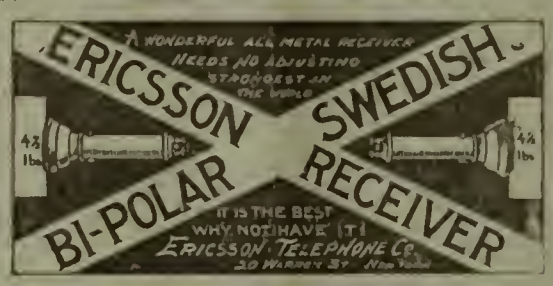
In Sheet or Wire, any degree of hardness.

INDEX TO ADVERTISERS.

DYNAMO and ARMATURE
Rewinding, Repairing and Reconstructing Armatures, Dynamos, Railway Motors, Transformers, Commutators.
Stucky & Heck Electric Mfg. Co., Ltd.,
85 N. J. R. R. Ave., Newark, N. J.

McIntire Patent Connector
AND TERMINALS.
Fuse Wire, Fuse Links and Strips.
C. McINTIRE CO.
15 Franklin St., Newark, N. J.

Motors Bought, Sold and Installed.
Motors Maintained at Reasonable Rates.
THE ELECTRIC MOTOR INSPECTION AND REPAIR CO. OF NEW YORK.
General Office ..... 34 PARK ROW, NEW YORK
H. L. SMITH, Mgr. Telephone Call, 418 Cortland.



ELECTRICAL ENGINEERS AND CONTRACTORS
RECOMMENDED BY
THE ELECTRICAL AGE.

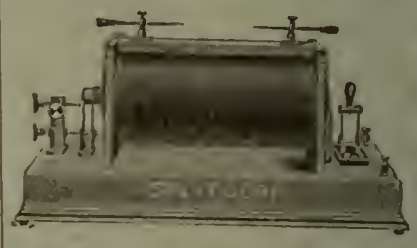
Advertisements of 4 lines or less under this head $26 per year, additional lines at proportionate rates.

ZIMDARS & HUNT.
General Electrical Contractors. Wiring complete plants, etc. 127 Fifth Ave., New York. N. Y.

HATZEL & BUEHLER
Electrical Engineers and Contractors. 114 Fifth Avenue, New York.

J. F. BIDSTRUP & CO.
35 Frankfort Street, New York. Electrical Work of all kinds. Wiring, etc. Dynamo and Motor Repairing, Electrical Supplies.

X-RAY COILS A Specialty



Telephone and Spark Coils.
C. F. SPLITDORF, 17-27 Vandewater St., N. Y.

GORDON BATTERY COMPANY.
THE BEST PRIMARY BATTERY FOR CLOSED OR OPEN CIRCUIT WORK.
594 Broadway, . . . New York.

TYPEWRITER BARGAINS.
Practically new Remingtons, Caligraphs, Smith-Premiers, Hammonds, Yosts, Densmores, fully guaranteed, only $20 to $50—Cost $100. Good machines rented $4 monthly. *Free Handsome Colored Price List.* Also, list of Revised American Standard Pitman Shorthand Books, arranged for self-instruction. Consolidated Typewriter Exchange, 245 B'way, N. Y.

HOLOPHANE GLOBES.
More Light.
No Glare.
Perfect Diffusion.
Artistic Patterns.
For all kinds of electric lighting,
Send for catalogues and price lists.
HOLOPHANE GLASS CO., 1 Broadway, N. Y.

The Electrical Age

Established 1883. An Illustrated Weekly Electrical Journal. 10 cents per copy

VOL. XXV.—No. 676. NEW YORK, APRIL 28, 1900. Subscription, $2.50 per year. Foreign Countries, $3.50 per year.

1889.
PARIS EXPOSITION MEDAL
— FOR —
RUBBER INSULATION.

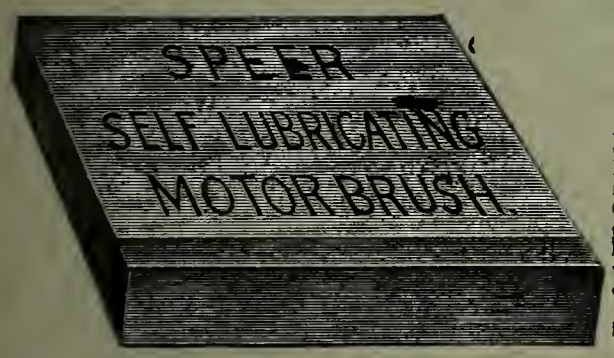
OKONITE
TRADE MARK.

1893.
WORLD'S FAIR MEDAL
— FOR —
RUBBER INSULATION.

THE STANDARD FOR RUBBER INSULATION.

OKONITE WIRES, OKONITE TAPE, MANSON TAPE, CANDEE WEATHERPROOF WIRES.

WILLARD L. CANDEE, M. DURANT CHEEVER } MANAGERS.
THE OKONITE CO., Ltd., Sole Manufacturers,
253 BROADWAY, NEW YORK.
GEO. T. MANSON, GENERAL SUPT. W. H. HODGINS, SECRETARY.



SPEER
Carbon Brushes

Are made under the direct supervision of Mr. J. S. SPEER (formerly of the Partridge Carbon Co.). This guarantees the excellency of the brushes, which are made in every type required.

NOT IN THE TRUST.

The Speer Carbon Co., ST. MARYS, Pa., U. S. A.

THE
PHOENIX GLASS CO.
MANUFACTURERS OF
Gas and Electric
Globes, Shades, Etc.

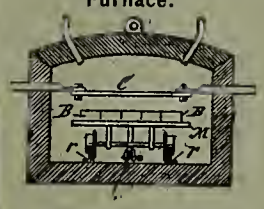
HAVE YOU A COPY OF OUR No. 8 CATALOGUE?
IF NOT, SEND FOR IT.

Pittsburgh. New York. Chicago.

BUY OF THE MAKERS
BEST PURE OAK SHORT LAP LEATHER BELTING
JOSEPH MEIER'S SONS,
295 Market Street, NEWARK, N. J.

AARON CARTER, President. C. H. WATERMAN, Treas. & M'g'r.
MAJ. W. M. COMBS, Vice-Pres. A. E. BOSSE, Secretary.
LEMUEL RUSSELL, Consulting Engineer.

Electric Enameling Furnace.



The Electric Enameling Co.,
203 BROADWAY,
NEW YORK.
Office of Record, 188 Market St., Newark, N. J. S. J. MACDONALD Counsel.

PATENTS! FREE! Valuable Book on Patents. Tells how to secure them at low cost. Gives Mechanical Movements---invaluable to Inventors and Mechanics. Full of Money-Making Patent information.

Big Book Free! O'MEARA & CO.
PATENT ATTORNEYS,
903 G Street,
Washington, D. C.

PATENTS. PATENT SOLICITOR AND ELECTRICAL EXPERT.
Former Manager, now successor to the Patent Business heretofore conducted by "The Electrical World."
W. A. ROSENBAUM, 177 TIMES BLDG., N. Y.

EXTRA SOFT SMOOTH CASTINGS
LIGHT AND HEAVY.
For Electrical and Special Purposes.
AUTOMOBILE CYLINDERS.
DROP FORGINGS TO ORDER.
DIE SINKING.
Oscar Barnett Foundry Co.
NEWARK, N. J.
L. D. 'Phone, 1045.

Don't Travel-- Telephone
FOR SERVICE APPLY TO
NEW YORK TELEPHONE CO.
CONTRACT OFFICES
18 Cortlandt, 15 Dey, 952 Broadway, 115 W. 38th.

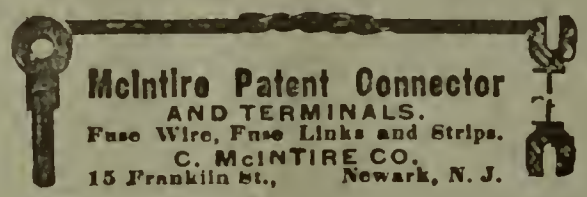
BAKER & CO.,
Newark, N. J.
New York Office: 120 Liberty St.

PLATINUM
FOR ALL PURPOSES.

In Sheet or Wire, any degree of hardness.

INDEX TO ADVERTISERS.

DYNAMO and ARMATURE
Rewinding Repairing and Reconstructing Armatures, Dynamos, Railway Motors, Transformers, Commutators.
Stucky & Heck Electric Mfg. Co., Ltd.,
35 N. J. R. R. Ave., Newark, N. J.


McIntire Patent Connector
AND TERMINALS.
Fuse Wire, Fuse Links and Strips.
C. McINTIRE CO.
15 Franklin St., Newark, N. J.

Motors Bought, Sold and Installed.
Motors Maintained at Reasonable Rates.
THE ELECTRIC MOTOR INSPECTION AND REPAIR CO. OF NEW YORK.
General Office ..... 34 PARK ROW, NEW YORK
H. L. SMITH, Mgr. Telephone Call, 418 Cortland.

ELECTRICAL ENGINEERS AND CONTRACTORS
RECOMMENDED BY
THE ELECTRICAL AGE.

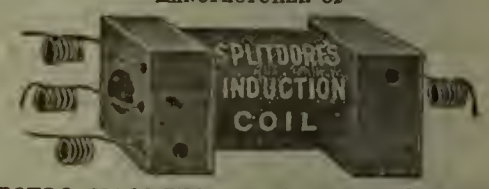
Advertisements of 4 lines or less under this head $26 per year, additional lines at proportionate rates.

ZIMDARS & HUNT.
General Electrical Contractors. Wiring complete plants, etc. 127 Fifth Ave., New York. N. Y.

HATZEL & BUEHLER
Electrical Engineers and Contractors. 114 Fifth Avenue, New York.

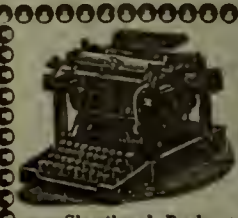
J. F. BIDSTRUP & CO.
35 Frankfort Street, New York. Electrical Work of all kinds. Wiring, etc. Dynamo and Motor Repairing, Electrical Supplies.

C. F. SPLITDORF,
MANUFACTURER OF



ELECTRO-MAGNETS and TELEPHONE BOBBINS
17-27 Vandewater St., New York.

GORDON BATTERY COMPANY.
THE BEST PRIMARY BATTERY FOR CLOSED OR OPEN CIRCUIT WORK.
594 Broadway, . . . New York.


TYPEWRITER BARGAINS.
Practically new Remingtons, Caligraphs, Smith-Premiers, Hammonds, Yosts, Densmores, fully guaranteed, only $20 to $50—Cost $100. Good machines rented $4 monthly. *Free Handsome Colored Price List.* Also, list of Revised American Standard Pitman Shorthand Books, arranged for self-instruction. Consolidated Typewriter Exchange, 245 B'way, N. Y.

HOLOPHANE GLOBES.

More Light.

No Glare.

Perfect Diffusion.

Artistic Patterns.

For all kinds of electric lighting,
Send for catalogues and price lists.

HOLOPHANE GLASS CO., 1 Broadway, N. Y.

The Electrical Age

Established 1883. An Illustrated Weekly Electrical Journal. 10 cents per copy

VOL. XXV.—No. 677. NEW YORK, MAY 5, 1900. Subscription, $2.50 per year. Foreign Countries, $3.50 per year.

1889.
PARIS EXPOSITION MEDAL
— FOR —
RUBBER INSULATION.

OKONITE
TRADE MARK

1893.
WORLD'S FAIR MEDAL
— FOR —
RUBBER INSULATION.

THE STANDARD FOR RUBBER INSULATION.

OKONITE WIRES, OKONITE TAPE, MANSON TAPE, CANDEE WEATHERPROOF WIRES.

WILLARD L. CANDEE, H. DURANT CHEEVER } MANAGERS.

THE OKONITE CO., Ltd., Sole Manufacturers,
253 BROADWAY, NEW YORK.

GEO. T. MANSON, GENERAL SUPT.
W. H. HODGINS, SECRETARY.

LAVA—LAVA—LAVA

Washers Bushings Threaded Pieces

Combine high heat resistance
With best insulating quality.

SEND MODEL OR DRAWING FOR ESTIMATE.

D. M. STEWARD M'F'G. CO.

NEW YORK OFFICE
107 CHAMBERS ST.

CHATTANOOGA,
TENN.

BUY OF THE MAKERS

BEST PURE OAK SHORT LAP LEATHER **BELTING**

JOSEPH MEIER'S SONS,

295 Market Street, NEWARK, N. J.

PATENTS!

FREE! Valuable Book on Patents. Tells how to secure them at low cost. Gives Mechanical Movements---invaluable to Inventors and Mechanics. Full of Money-Making Patent information.

Big Book Free!

O'MEARA & CO.
PATENT ATTORNEYS,
903 G Street,
Washington, D. C.

EXTRA SOFT SMOOTH CASTINGS
LIGHT AND HEAVY.

For Electrical and Special Purposes.

AUTOMOBILE CYLINDERS.

DROP FORGINGS TO ORDER.

DIE SINKING.

Oscar Barnett Foundry Co.

NEWARK, N. J.

L. D. 'Phone. 1045.

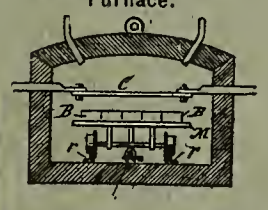
THE
PHOENIX GLASS CO.
MANUFACTURERS OF
Gas and Electric Globes, Shades, Etc.

HAVE YOU A COPY OF OUR No. 8 CATALOGUE?
IF NOT, SEND FOR IT.

Pittsburgh. New York. Chicago.

AARON CARTER, President. C. H. WATERMAN, Treas. & M'g'r.
MAJ. W. M. COMBS, Vice-Pres. A. E. BOSSE, Secretary.
LEMUEL RUSSELL, Consulting Engineer.

Electric Enameling Furnace.



The Electric Enameling Co.,
203 BROADWAY,
NEW YORK.

Office of Record, 188 Market St., Newark, N. J. S. J. MACDONALD Counsel.

PATENTS. PATENT SOLICITOR AND ELECTRICAL EXPERT.

Former Manager, now successor to the Patent Business heretofore conducted by "The Electrical World."

W. A. ROSENBAUM, 177 TIMES BLDG., N. Y.

Don't Travel-- Telephone

FOR SERVICE APPLY TO
NEW YORK TELEPHONE CO.
CONTRACT OFFICES
18 Cortlandt, 15 Dey, 952 Broadway, 115 W. 38th.

BAKER & CO.,
Newark, N. J.
New York Office: 120 Liberty St.

In Sheet or Wire, any degree of hardness.

PLATINUM
FOR ALL PURPOSES.

INDEX TO ADVERTISERS.

DYNAMO and ARMATURE
Rewinding Repairing and Reconstructing Armatures, Dynamos, Railway Motors, Transformers, Commutators.
Stucky & Heck Electric Mfg. Co., Ltd.,
85 N. J. R. R. Ave., Newark, N. J.

McIntire Patent Connector
AND TERMINALS.
Fuse Wire, Fuse Links and Strips.
C. McINTIRE CO.
15 Franklin St., Newark, N. J.

Motors Bought, Sold and Installed.
Motors Maintained at Reasonable Rates.
THE ELECTRIC MOTOR INSPECTION AND REPAIR CO. OF NEW YORK.
General Office.....34 PARK ROW, NEW YORK
H. L. SMITH, Mgr. Telephone Call, 418 Cortland.

ELECTRICAL ENGINEERS AND CONTRACTORS
RECOMMENDED BY
THE ELECTRICAL AGE.

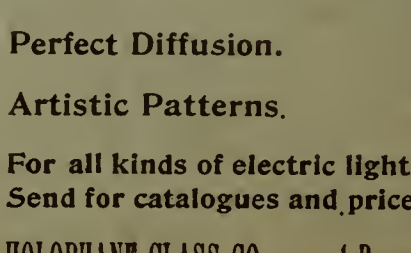
Advertisements of 4 lines or less under this head $26 per year, additional lines at proportionate rates.

ZIMDARS & HUNT.
General Electrical Contractors. Wiring complete plants, etc. 127 Fifth Ave., New York. N. Y.

HATZEL & BUEHLER
Electrical Engineers and Contractors. 114 Fifth Avenue, New York.

J. F. BIDSTRUP & CO.
35 Frankfort Street, New York. Electrical Work of all kinds. Wiring, etc. Dynamo and Motor Repairing, Electrical Supplies.

X-RAY COILS A Specialty



Telephone and Spark Coils.

C. F. SPLITDORF, 17-27 Vandewater St., N. Y.

GORDON BATTERY COMPANY.
THE BEST PRIMARY BATTERY FOR CLOSED OR OPEN CIRCUIT WORK.
594 Broadway, . . . New York.

TYPEWRITER BARGAINS.
Practically new Remingtons, Caligraphs, Smith-Premiers, Hammonds, Yosts, Densmores, fully guaranteed, only $20 to $50—Cost $100. Good machines rented $4 monthly. *Free Handsome Colored Price List.* Also, list of Revised American Standard Pitman Shorthand Books, arranged for self-instruction. Consolidated Typewriter Exchange, 245 B'way, N. Y.

HOLOPHANE GLOBES.

More Light.

No Glare.

Perfect Diffusion.

Artistic Patterns.

For all kinds of electric lighting, Send for catalogues and price lists.

HOLOPHANE GLASS CO., 1 Broadway, N. Y.

The Electrical Age

Established 1883. An Illustrated Weekly Electrical Journal. 10 cents per copy

VOL. XXV.—No. 678. NEW YORK, MAY 12, 1900. Subscription, $2.50 per year. Foreign Countries, $3.50 per year.

1889.
PARIS EXPOSITION MEDAL
— FOR —
RUBBER INSULATION.

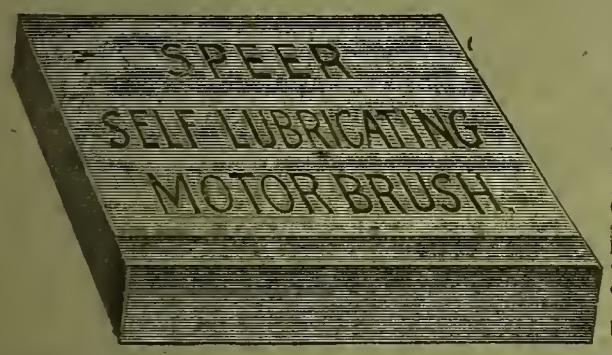
OKONITE
TRADE MARK.

1893.
WORLD'S FAIR MEDAL
— FOR —
RUBBER INSULATION.

THE STANDARD FOR RUBBER INSULATION.

OKONITE WIRES, OKONITE TAPE, MANSON TAPE, CANDEE WEATHERPROOF WIRES.

WILLARD L. CANDEE, H. DURANT CHEEVER } MANAGERS.
THE OKONITE CO., Ltd., Sole Manufacturers,
253 BROADWAY, NEW YORK.
GEO. T. MANSON, GENERAL SUPT. W. H. HODGINS, SECRETARY.



SPEER
Carbon Brushes

Are made under the direct supervision of Mr. J. S. SPEER (formerly of the Partridge Carbon Co.). This guarantees the excellency of the brushes, which are made in every type required.

NOT IN THE TRUST.

The Speer Carbon Co., ST. MARYS, Pa., U. S. A.

BUY OF THE MAKERS

BEST PURE OAK SHORT LAP LEATHER BELTING

JOSEPH MEIER'S SONS,
295 Market Street, NEWARK, N. J.

PATENTS!

FREE! Valuable Book on Patents. Tells how to secure them at low cost. Gives Mechanical Movements---invaluable to Inventors and Mechanics. Full of Money-Making Patent information.

Big Book Free!

O'MEARA & CO.
PATENT ATTORNEYS,
903 G Street,
Washington, D. C.

EXTRA SOFT SMOOTH CASTINGS
LIGHT AND HEAVY.
For Electrical and Special Purposes.
AUTOMOBILE CYLINDERS.
DROP FORGINGS TO ORDER.
DIE SINKING.
Oscar Barnett Foundry Co.
NEWARK, N. J.
L. D. 'Phone, 1045.

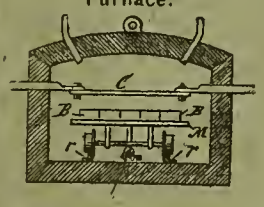
THE
PHOENIX GLASS CO.
MANUFACTURERS OF
Gas and Electric
Globes, Shades, Etc.

HAVE YOU A COPY OF OUR No. 8 CATALOGUE?
IF NOT, SEND FOR IT.

Pittsburgh. New York. Chicago.

AARON CARTER, President. C. H. WATERMAN, Treas. & M'g'r.
MAJ. W. M. COMBS, Vice-Pres. A. E. BOSSE, Secretary.
LEMUEL RUSSELL, Consulting Engineer.

Electric Enameling Furnace.



The Electric Enameling Co.,
203 BROADWAY,
NEW YORK.
Office of Record, 188 Market St., Newark, N. J. S. J. MACDONALD Counsel.

PATENTS. PATENT SOLICITOR AND ELECTRICAL EXPERT.
Former Manager, now successor to the Patent Business heretofore conducted by "The Electrical World."
W. A. ROSENBAUM, 177 TIMES BLDG., N. Y.

Don't Travel--
Telephone
FOR SERVICE APPLY TO
NEW YORK TELEPHONE CO.
CONTRACT OFFICES
18 Cortlandt, 15 Dey, 952 Broadway, 115 W. 38th.

BAKER & CO.,
Newark, N. J.
NEW YORK OFFICE: 120 LIBERTY ST.

In Sheet or Wire, any degree of hardness.

PLATINUM
FOR ALL PURPOSES.

INDEX TO ADVERTISERS.

DYNAMO and ARMATURE
Rewinding Repairing and Reconstructing Armatures, Dynamos, Railway Motors, Transformers, Commutators.
Stucky & Heck Electric Mfg. Co., Ltd.,
85 N. J. R. R. Ave., Newark, N. J.

McIntire Patent Connector
AND TERMINALS.
Fuse Wire, Fuse Links and Strips.
C. McINTIRE CO.
15 Franklin St., Newark, N. J.

Motors Bought, Sold and Installed.
Motors Maintained at Reasonable Rates.
THE ELECTRIC MOTOR INSPECTION AND REPAIR CO. OF NEW YORK.
General Office ..... 34 PARK ROW, NEW YORK
H. L. SMITH, Mgr. Telephone Call, 418 Cortland.

ELECTRICAL ENGINEERS AND CONTRACTORS
RECOMMENDED BY
THE ELECTRICAL AGE.

Advertisements of 4 lines or less under this head $26 per year, additional lines at proportionate rates.

ZIMDARS & HUNT.
General Electrical Contractors. Wiring complete plants, etc. 127 Fifth Ave., New York. N. Y.

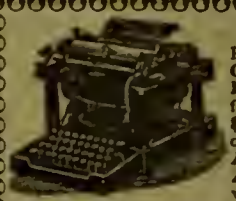
HATZEL & BUEHLER
Electrical Engineers and Contractors. 11 & Fifth Avenue, New York.

J. F. BIDSTRUP & CO.
35 Frankfort Street, New York. Electrical Work of all kinds. Wiring, etc. Dynamo and Motor Repairing, Electrical Supplies.

C. F. SPLITDORF,
MANUFACTURER OF

ELECTRO-MAGNETS and TELEPHONE BOBBINS
17-27 Vandewater St., New York.

GORDON BATTERY COMPANY.
THE BEST PRIMARY BATTERY FOR CLOSED OR OPEN CIRCUIT WORK.
594 Broadway, . . . New York.



TYPEWRITER BARGAINS.
Practically new Remingtons, Caligraphs, Smith-Premiers, Hammonds, Yosts, Densmores, fully guaranteed, only $20 to $50—Cost $100. Good machines rented $4 monthly. *Free Handsome Colored Price List.* Also, list of Revised American Standard Pitman Shorthand Books, arranged for self-instruction. Consolidated Typewriter Exchange, 245 B'way, N. Y.

ENGRAVERS & DESIGNERS.
MANHATTAN PHOTO ENGRAVING CO.
TELEPHONE 1657 FRANKLIN.
7, 9 & 11 NEW CHAMBERS ST
COR. WILLIAM ST.
NEW YORK
HALF-TONE AND LINE WORK FOR ALL ILLUSTRATIVE PURPOSES
HIGH CLASS WORK. PROMPT DELIVERY. PRICES REASONABLE.

HOLOPHANE GLOBES.

More Light.

No Glare.

Perfect Diffusion.

Artistic Patterns.

For all kinds of electric lighting, Send for catalogues and price lists.

HOLOPHANE GLASS CO., 1 Broadway, N. Y.

NATIONAL ELECTRIC LIGHT ASSOCIATION MEETING,
CHICAGO, MAY 22, 23, 24.

The Electrical Age

Established 1883. An Illustrated Weekly Electrical Journal. 10 cents per copy

VOL. XXV.—No. 679. NEW YORK, MAY 20, 1900. Subscription, $2.50 per year. Foreign Countries, $3.50 per year.

1889.
PARIS EXPOSITION MEDAL
— FOR —
RUBBER INSULATION.

OKONITE
TRADE MARK.

1893.
WORLD'S FAIR MEDAL
— FOR —
RUBBER INSULATION.

THE STANDARD FOR RUBBER INSULATION.
OKONITE WIRES, OKONITE TAPE, MANSON TAPE, CANDEE WEATHERPROOF WIRES
WILLARD L. CANDEE, M. DURANT CHEEVER } MANAGERS.
THE OKONITE CO., Ltd., Sole Manufacturers,
253 BROADWAY, NEW YORK.
GEO. T. MANSON, General Supt.
W. H. HODGINS, Secretary.

LAVA—LAVA—LAVA
Washers Bushings Threaded Pieces
Combine high heat resistance
With best insulating quality.
SEND MODEL OR DRAWING FOR ESTIMATE.
D. M. STEWARD M'F'G. CO.
NEW YORK OFFICE 107 CHAMBERS ST.
CHATT NOOCA, TENN.

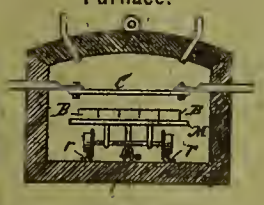
BUY OF THE MAKERS
BEST PURE OAK SHORT LAP LEATHER BELTING
JOSEPH MEIER'S SONS,
295 Market Street, NEWARK, N. J.

PATENTS!
FREE! Valuable Book on Patents. Tells how to secure them at low cost. Gives Mechanical Movements---invaluable to Inventors and Mechanics. Full of Money-Making Patent information.
Big Book Free!
O'MEARA & CO.
PATENT ATTORNEYS,
903 C Street,
Washington, D. C.

EXTRA SOFT SMOOTH CASTINGS
LIGHT AND HEAVY.
For Electrical and Special Purposes.
AUTOMOBILE CYLINDERS.
DROP FORGINGS TO ORDER.
DIE SINKING.
Oscar Barnett Foundry Co.
NEWARK, N. J.
L. D. 'Phone, 1045.

THE
PHOENIX GLASS CO.
MANUFACTURERS OF
Gas and Electric Globes, Shades, Etc.
HAVE YOU A COPY OF OUR LATEST CATALOGUE?
IF NOT, SEND FOR IT.
Pittsburgh. New York. Chicago.

AARON CARTER, President. C. H. WATERMAN, Treas. & M'g'r.
MAJ. W. M. COMBS, Vice-Pres. A. E. BOSSE, Secretary.
LEMUEL RUSSELL, Consulting Engineer.
Electric Enameling Furnace.



The Electric Enameling Co.,
203 BROADWAY, NEW YORK.
Office of Record, 188 Market St., Newark, N. J. S. J. MACDONALD Counsel.

PATENTS. PATENT SOLICITOR AND ELECTRICAL EXPERT.
Former Manager, now successor to the Patent Business heretofore conducted by "The Electrical World."
W. A. ROSENBAUM, 177 TIMES BLDG., N. Y.

Don't Travel-- Telephone
FOR SERVICE APPLY TO
NEW YORK TELEPHONE CO.
CONTRACT OFFICES
18 Cortlandt, 15 Dey, 952 Broadway, 115 W. 38th.

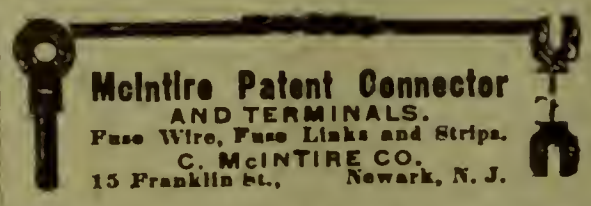
BAKER & CO.,
Newark, N. J.
New York Office: 120 Liberty St.

PLATINUM
FOR ALL PURPOSES.

In Sheet or Wire, any degree of hardness.

INDEX TO ADVERTISERS.

DYNAMO and ARMATURE
Rewinding, Repairing and Reconstructing Armatures, Dynamos, Railway Motors, Transformers, Commutators.
Stucky & Heck Electric Mfg. Co., Ltd.,
35 N. J. R. R. Ave., Newark, N. J.



McIntire Patent Connector
AND TERMINALS.
Fuse Wire, Fuse Links and Strips.
C. McINTIRE CO.
15 Franklin St., Newark, N. J.

Motors Bought, Sold and Installed.
Motors Maintained at Reasonable Rates.
THE ELECTRIC MOTOR INSPECTION AND REPAIR CO. OF NEW YORK.
General Office.....34 PARK ROW, NEW YORK
H. L. SMITH, Mgr. Telephone Call, 418 Cortland.

ELECTRICAL ENGINEERS AND CONTRACTORS
RECOMMENDED BY
THE ELECTRICAL AGE.

Advertisements of 4 lines or less under this head $26 per year, additional lines at proportionate rates.

ZIMDARS & HUNT.
General Electrical Contractors. Wiring complete plants, etc. 127 Fifth Ave., New York. N. Y.

HATZEL & BUEHLER
Electrical Engineers and Contractors. 114 Fifth Avenue, New York.

J. F. BIDSTRUP & CO.
35 Frankfort Street, New York. Electrical Work of all kinds. Wiring, etc. Dynamo and Motor Repairing, Electrical Supplies.

X-RAY COILS A Specialty

Telephone and Spark Coils.

C. F. SPLITDORF, 17-27 Vandewater St., N. Y.

GORDON BATTERY COMPANY.
THE BEST PRIMARY BATTERY FOR CLOSED OR OPEN CIRCUIT WORK.
594 Broadway, . . . New York.

TYPEWRITER BARGAINS.
Practically new Remingtons, Caligraphs, Smith-Premiers, Hammonds, Yosts, Densmores, fully guaranteed, only $20 to $50—Cost $100. Good machines rented $4 monthly. *Free Handsome Colored Price List.* Also, list of Revised American Standard Pitman Shorthand Books, arranged for self-instruction. Consolidated Typewriter Exchange, 245 B'way, N. Y.

HOLOPHANE GLOBES.

More Light.

No Glare.

Perfect Diffusion.

Artistic Patterns.

For all kinds of electric lighting,
Send for catalogues and price lists.

HOLOPHANE GLASS CO., 1 Broadway, N. Y.

The Electrical Age

Established 1883. An Illustrated Weekly Electrical Journal. 10 cents per copy

VOL. XXV.—No. 680. NEW YORK, MAY 26, 1900. Subscription, $2.50 per year. Foreign Countries, $3.50 per year.

1889.
PARIS EXPOSITION MEDAL
— FOR —
RUBBER INSULATION.

OKONITE
TRADE MARK.

1893.
WORLD'S FAIR MEDAL
— FOR —
RUBBER INSULATION.

THE STANDARD FOR RUBBER INSULATION.

OKONITE WIRES, OKONITE TAPE, MANSON TAPE, CANDEE WEATHERPROOF WIRES.

WILLARD L. CANDEE, H. DURANT CHEEVER } MANAGERS.

THE OKONITE CO., Ltd., Sole Manufacturers,
253 BROADWAY, NEW YORK.

GEO. T. MANSON, General Supt.
W. H. HODGINS, Secretary.

SPEER
Carbon Brushes

Are made under the direct supervision of Mr. J. S. SPEER (formerly of the Partridge Carbon Co.). This guarantees the excellency of the brushes, which are made in every type required.

NOT IN THE TRUST

The Speer Carbon Co., ST. MARYS, Pa., U. S. A.

BUY OF THE MAKERS

BEST PURE OAK SHORT LAP LEATHER BELTING

JOSEPH MEIER'S SONS,

295 Market Street, NEWARK, N. J.

PATENTS!

FREE! Valuable Book on Patents. Tells how to secure them at low cost. Gives Mechanical Movements---invaluable to Inventors and Mechanics. Full of Money-Making Patent information.

Big Book Free!

O'MEARA & CO.
PATENT ATTORNEYS,
903 G Street,
Washington, D. C.

EXTRA SOFT SMOOTH CASTINGS
LIGHT AND HEAVY.
For Electrical and Special Purposes.
AUTOMOBILE CYLINDERS.
DROP FORGINGS TO ORDER.
DIE SINKING.
Oscar Barnett Foundry Co.
NEWARK, N. J.

L. D. 'Phone, 1045.

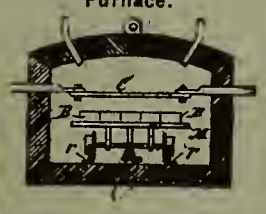
THE
PHOENIX GLASS CO.
MANUFACTURERS OF
Gas and Electric Globes, Shades, Etc.

HAVE YOU A COPY OF OUR LATEST CATALOGUE?
IF NOT, SEND FOR IT.

Pittsburgh. New York. Chicago.

AARON CARTER, President. C. H. WATERMAN, Treas. & M'g'r.
MAJ. W. M. COMBS, Vice-Pres. A. E. BOSSE, Secretary.
LEMUEL RUSSELL, Consulting Engineer.

Electric Enameling Furnace.



The Electric Enameling Co.,
203 BROADWAY,
NEW YORK.

Office of Record, 188 Market St., Newark, N J. S. J. MACDONALD Counsel.

PATENTS. PATENT SOLICITOR AND ELECTRICAL EXPERT.

Former Manager, now successor to the Patent Business heretofore conducted by "The Electrical World."

W. A. ROSENBAUM, 177 TIMES BLDG., N. Y.

Don't Travel-- Telephone

FOR SERVICE APPLY TO
NEW YORK TELEPHONE CO.
CONTRACT OFFICES
18 Cortlandt, 15 Dey, 952 Broadway, 115 W. 38th.

BAKER & CO.,
Newark, N. J.
New York Office: 120 Liberty St.

In Sheet or Wire, any degree of hardness.

PLATINUM
FOR ALL PURPOSES.

INDEX TO ADVERTISERS.

DYNAMO and ARMATURE

Rewinding, Repairing and Reconstructing Armatures, Dynamos, Railway Motors, Transformers Commutors.

LOUIS HECK, Successor to
Stucky & Heck Electric Mfg. Co., Ltd.,
35 N. J. R. R. Ave., Newark, N. J.

McIntire Patent Connector
AND TERMINALS.
Fuse Wire, Fuse Links and Strips.
C. McINTIRE CO.
15 Franklin St., Newark, N. J.

Motors Bought, Sold and Installed.
Motors Maintained at Reasonable Rates.

THE ELECTRIC MOTOR INSPECTION AND REPAIR CO. OF NEW YORK.
General Office.....34 PARK ROW, NEW YORK
H. L. SMITH, Mgr. Telephone Call, 418 Cortland.

ELECTRICAL ENGINEERS AND CONTRACTORS
RECOMMENDED BY
THE ELECTRICAL AGE.

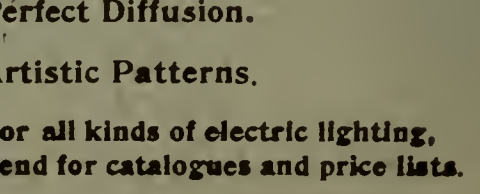
Advertisements of 4 lines or less under this head $26 per year, additional lines at proportionate rates.

ZIMDARS & HUNT.
General Electrical Contractors. Wiring complete plants, etc. 127 Fifth Ave., New York. N. Y.

HATZEL & BUEHLER
Electrical Engineers and Contractors. 114 Fifth Avenue, New York.

J. F. BIDSTRUP & CO.
35 Frankfort Street, New York. Electrical Work of all kinds. Wiring, etc. Dynamo and Motor Repairing, Electrical Supplies.

C. F. SPLITDORF,
MANUFACTURER OF



ELECTRO-MAGNETS and TELEPHONE BOBBINS
17-27 Vandewater St., New York.

GORDON BATTERY COMPANY.
THE BEST PRIMARY BATTERY FOR CLOSED OR OPEN CIRCUIT WORK.
594 Broadway, . . . New York.

TYPEWRITER BARGAINS.
Practically new Remingtons, Caligraphs, Smith-Premiers, Hammonds, Yosts, Densmores, fully guaranteed, only $20 to $60—Cost $100. Good machines rented $4 monthly. *Free Handsome Colored Price List.* Also, list of Revised American Standard Pitman Shorthand Books, arranged for self-instruction. Consolidated Typewriter Exchange, 245 B'way, N. Y.

ENGRAVERS & DESIGNERS.
TELEPHONE 1657 FRANKLIN.
MANHATTAN PHOTO ENGRAVING CO
7, 9 & 11 CHAMBERS ST
COR. WILLIAM
NEW YORK
HALF-TONE AND LINE WORK FOR ALL ILLUSTRATIVE PURPOSES
HIGH CLASS WORK. PROMPT DELIVERY. PRICES REASONABLE.

HOLOPHANE GLOBES.

More Light.

No Glare.

Perfect Diffusion.

Artistic Patterns.

For all kinds of electric lighting.
Send for catalogues and price lists.

HOLOPHANE GLASS CO., 1 Broadway, N. Y.

NATIONAL ELECTRIC LIGHT ASSOCIATION CONVENTION REPORT NUMBER.

The Electrical Age

Established 1883. An Illustrated Weekly Electrical Journal. 10 cents per copy

VOL. XXV.—No. 681. NEW YORK, JUNE 2, 1900. Subscription, $2.50 per year. Foreign Countries, $3.50 per year.

1889.
PARIS EXPOSITION MEDAL
— FOR —
RUBBER INSULATION.

OKONITE
TRADE MARK.

1893.
WORLD'S FAIR MEDAL
— FOR —
RUBBER INSULATION.

THE STANDARD FOR RUBBER INSULATION.

OKONITE WIRES, OKONITE TAPE, MANSON TAPE, CANDEE WEATHERPROOF WIRES.

WILLARD L. CANDEE, M. DURANT CHEEVER } MANAGERS.
THE OKONITE CO., Ltd., Sole Manufacturers,
253 BROADWAY, NEW YORK.
GEO. T. MANSON, GENERAL SUPT. W. H. HODGINS, SECRETARY.

SPEER
Carbon Brushes

Are made under the direct supervision of Mr. J. S. SPEER (formerly of the Partridge Carbon Co.). This guarantees the excellency of the brushes, which are made in every type required.

NOT IN THE TRUST

The Speer Carbon Co., ST. MARYS, Pa., U. S. A.

THE
PHOENIX GLASS CO.
MANUFACTURERS OF
Gas and Electric
Globes, Shades, Etc.

HAVE YOU A COPY OF OUR LATEST CATALOGUE?
IF NOT, SEND FOR IT.

Pittsburgh. New York. Chicago.

BUY OF THE MAKERS
BEST PURE OAK SHORT LAP LEATHER BELTING
JOSEPH MEIER'S SONS,
295 Market Street, NEWARK, N. J.

AARON CARTER, President. C. H. WATERMAN, Treas. & M'g'r.
MAJ. W. M. COMBS, Vice-Pres. A. E. BOSSE, Secretary.
LEMUEL RUSSELL, Consulting Engineer.

Electric Enameling Furnace.

The Electric Enameling Co.,
203 BROADWAY,
NEW YORK.
Office of Record, 188 Market St., Newark, N J. S. J. MACDONALD Counsel.

PATENTS! FREE! Valuable Book on Patents. Tells how to secure them at low cost. Gives Mechanical Movements---invaluable to Inventors and Mechanics. Full of Money-Making Patent information.

Big Book Free! O'MEARA & CO. PATENT ATTORNEYS, 903 G Street, Washington, D. C.

PATENTS. PATENT SOLICITOR AND ELECTRICAL EXPERT.
Former Manager, now successor to the Patent Business heretofore conducted by "The Electrical World."
W. A. ROSENBAUM, 177 TIMES BLDG., N. Y.

EXTRA SOFT SMOOTH CASTINGS
LIGHT AND HEAVY.
For Electrical and Special Purposes.
AUTOMOBILE CYLINDERS.
DROP FORGINGS TO ORDER.
DIE SINKING.
Oscar Barnett Foundry Co.
NEWARK, N. J.
L. D. 'Phone, 1045.

Don't Travel--Telephone
FOR SERVICE APPLY TO
NEW YORK TELEPHONE CO.
CONTRACT OFFICES
18 Cortlandt, 15 Dey, 952 Broadway, 115 W. 38th.

BAKER & CO.,
Newark, N. J.
New York Office: 120 Liberty St.

PLATINUM
FOR ALL PURPOSES.

In Sheet or Wire, any degree of hardness.

INDEX TO ADVERTISERS.

DYNAMO and ARMATURE
Rewinding, Repairing and Reconstructing Armatures, Dynamos, Railway Motors, Transformers Commutors.
LOUIS HECK, Successor to
Stucky & Heck Electric Mfg. Co., Ltd.,
35 N. J. R. R. Ave., Newark, N. J.

McIntire Patent Connector
AND TERMINALS.
Fuse Wire, Fuse Links and Strips.
C. McINTIRE CO.
15 Franklin St., Newark, N. J.

Meters Bought, Sold and Installed.
Motors Maintained at Reasonable Rates.
THE ELECTRIC MOTOR INSPECTION AND REPAIR CO. OF NEW YORK.
General Office.....34 PARK ROW, NEW YORK
H. L. SMITH, Mgr. Telephone Call. 413 Cortland.

ELECTRICAL ENGINEERS AND CONTRACTORS
RECOMMENDED BY
THE ELECTRICAL AGE.

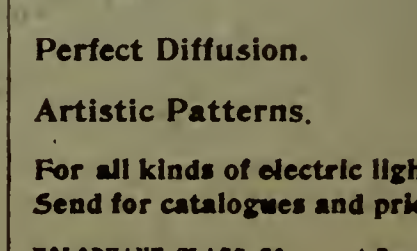
Advertisements of 4 lines or less under this head $26 per year, additional lines at proportionate rates.

ZIMDARS & HUNT.
General Electrical Contractors. Wiring complete plants, etc. 127 Fifth Ave., New York. N. Y.

HATZEL & BUEHLER
Electrical Engineers and Contractors. 114 Fifth Avenue, New York.

J. F. BIDSTRUP & CO.
35 Frankfort Street, New York. Electrical Work of all kinds. Wiring, etc. Dynamo and Motor Repairing, Electrical Supplies.

X-RAY COILS A Specialty



Telephone and Spark Coils.

C. F. SPLITDORF, 17-27 Vandewater St., N. Y.

GORDON BATTERY COMPANY.
THE BEST PRIMARY BATTERY FOR CLOSED OR OPEN CIRCUIT WORK.
594 Broadway, . . . New York.

TYPEWRITER BARGAINS.
Practically new Remingtons, Caligraphs, Smith-Premiers, Hammonds, Yosts, Densmores, fully guaranteed, only $20 to $50—Cost $100. Good machines rented $4 monthly. *Free Handsome Colored Price List.* Also, list of Revised American Standard Pitman Shorthand Books, arranged for self-instruction. Consolidated Typewriter Exchange, 245 B'way, N. Y.

ENGRAVERS & DESIGNERS.
MANHATTAN PHOTO ENGRAVING CO
TELEPHONE 1657 FRANKLIN.
7, 9 & 11 NEW CHAMBERS ST.
COR. WILLIAM ST.
NEW YORK
HALF-TONE AND LINE WORK FOR ALL ILLUSTRATIVE PURPOSES
HIGH CLASS WORK. PROMPT DELIVERY. PRICES REASONABLE.

HOLOPHANE GLOBES.
More Light.
No Glare.
Perfect Diffusion.
Artistic Patterns.
For all kinds of electric lighting, Send for catalogues and price lists.
HOLOPHANE GLASS CO., 1 Broadway, N. Y.

The Electrical Age

Established 1883. An Illustrated Weekly Electrical Journal. 10 cents per copy

VOL. XXV.—No. 683. NEW YORK, JUNE 16, 1900. Subscription, $2.50 per year. Foreign Countries, $3.50 per year.

1889.
PARIS EXPOSITION MEDAL
— FOR —
RUBBER INSULATION.

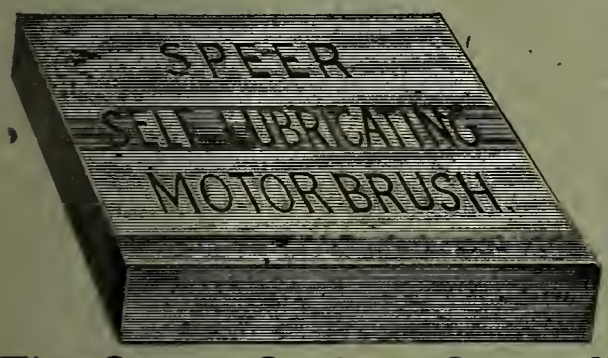
OKONITE
TRADE MARK.

1893.
WORLD'S FAIR MEDAL
— FOR —
RUBBER INSULATION.

THE STANDARD FOR RUBBER INSULATION.

OKONITE WIRES, OKONITE TAPE, MANSON TAPE, CANDEE WEATHERPROOF WIRES

WILLARD L. CANDEE, M. DURANT CHEEVER } MANAGERS.
THE OKONITE CO., Ltd., Sole Manufacturers,
253 BROADWAY, NEW YORK.
GEO. T. MANSON, GENERAL SUPT.
W. H. HODGINS, SECRETARY.



SPEER
Carbon Brushes

Are made under the direct supervision of Mr. J. S. SPEER (formerly of the Partridge Carbon Co.). This guarantees the excellency of the brushes, which are made in every type required.

NOT IN THE TRUST

The Speer Carbon Co., ST. MARYS, Pa., U. S. A.

BUY OF THE MAKERS

BEST PURE OAK SHORT LAP LEATHER BELTING

JOSEPH MEIER'S SONS,
295 Market Street, NEWARK, N. J.

PATENTS!

FREE! Valuable Book on Patents. Tells how to secure them at low cost. Gives Mechanical Movements---invaluable to Inventors and Mechanics. Full of Money-Making Patent information.

Big Book Free!

O'MEARA & CO.
PATENT ATTORNEYS,
903 G Street,
Washington, D. C.

EXTRA SOFT SMOOTH CASTINGS
LIGHT AND HEAVY.
For Electrical and Special Purposes.
AUTOMOBILE CYLINDERS.
DROP FORGINGS TO ORDER.
DIE SINKING.
Oscar Barnett Foundry Co.
NEWARK, N. J.
L. D. 'Phone, 1645.

THE
PHOENIX GLASS CO.
MANUFACTURERS OF
Gas and Electric
Globes, Shades, Etc.
HAVE YOU A COPY OF OUR LATEST CATALOGUE?
IF NOT, SEND FOR IT.
Pittsburgh. New York. Chicago.

AARON CARTER, President. C. H. WATERMAN, Treas. & M'g'r.
MAJ. W. M. COMBS, Vice-Pres. A. E. BOSSE, Secretary.
LEMUEL RUSSELL, Consulting Engineer.

Electric Enameling Furnace.

The Electric Enameling Co.,
203 BROADWAY,
NEW YORK.
Office of Record, 188 Market St., Newark, N J. S. J. MACDONALD Counsel.

PATENTS. PATENT SOLICITOR AND ELECTRICAL EXPERT.
Former Manager, now successor to the Patent Business heretofore conducted by "The Electrical World."
W. A. ROSENBAUM, 177 TIMES BLDG., N. Y.

Don't Travel--
Telephone
FOR SERVICE APPLY TO
NEW YORK TELEPHONE CO.
CONTRACT OFFICES
18 Cortlandt, 15 Dey, 952 Broadway, 115 W. 38th.

BAKER & CO.,
Newark, N. J.
New York Office: 120 Liberty St.

PLATINUM
FOR ALL PURPOSES.

In Sheet or Wire, any degree of hardness.

INDEX TO ADVERTISERS.

DYNAMO and A MATURE
Rewinding, Repairing and Reconstructing Armatures, Dynamos, Railway Motors, Transformers Commutors.
LOUIS HECK, Successor to
Stucky & Heck Electric Mfg. Co., Ltd.,
35 N J. R. R. Ave., Newark, N. J.

McIntire Patent Connector
AND TERMINALS.
Fuse Wire, Fuse Links and Strips.
C. McINTIRE CO.
15 Franklin St., Newark, N. J.

Motors Bought, Sold and Installed.
Motors Maintained at Reasonable Rates.
THE ELECTRIC MOTOR INSPECTION AND REPAIR CO. OF NEW YORK.
General Office.....34 PARK ROW, NEW YORK
H. L. SMITH, Mgr. Telephone Call, 413 Cortland.

ELECTRICAL ENGINEERS AND CONTRACTORS
RECOMMENDED BY
THE ELECTRICAL AGE.

Advertisements of 4 lines or less under this head $26 per year, additional lines at proportionate rates.

ZIMDARS & HUNT.
General Electrical Contractors. Wiring complete plants, etc. 127 Fifth Ave., New York. N. Y.

HATZEL & BUEHLER
Electrical Engineers and Contractors. 114 Fifth Avenue, New York.

J. F. BIDSTRUP & CO.
35 Frankfort Street, New York. Electrical Work of all kinds. Wiring, etc. Dynamo and Motor Repairing, Electrical Supplies.

X-RAY COILS A Specialty

Telephone and Spark Coils.

C. F. SPLITDORF, 17-27 Vandewater St., N. Y.

GORDON BATTERY COMPANY.
THE BEST PRIMARY BATTERY FOR CLOSED OR OPEN CIRCUIT WORK.
594 Broadway, . . . New York.

TYPEWRITER BARGAINS.
Practically new Remingtons, Caligraphs, Smith-Premiers, Hammonds, Yosts, Densmores, fully guaranteed, only $20 to $50—Cost $100. Good machines rented $4 monthly. *Free Handsome Colored Price List.* Also, list of Revised American Standard Pitman Shorthand Books, arranged for self-instruction. Consolidated Typewriter Exchange, 245 B'way, N. Y.

ENGRAVERS & DESIGNERS.
TELEPHONE 1657 FRANKLIN.
MANHATTAN PHOTO ENGRAVING CO.
7, 9 & 11 NEW CHAMBERS ST.
COR. WILLIAM ST.
NEW YORK
HALF-TONE AND LINE WORK FOR ALL ILLUSTRATIVE PURPOSES
HIGH CLASS WORK. PROMPT DELIVERY. PRICES REASONABLE.

HOLOPHANE GLOBES.
More Light.
No Glare.
Perfect Diffusion.
Artistic Patterns.
For all kinds of electric lighting, Send for catalogues and price lists.
HOLOPHANE GLASS CO., 1 Broadway, N. Y.

The Electrical Age

Established 1883. An Illustrated Weekly Electrical Journal. 10 cents per copy

VOL. XXV.—No. 684. NEW YORK, JUNE 23, 1900. Subscription, $2.50 per year Foreign Countries, $3.50 per year.

1889.
PARIS EXPOSITION MEDAL
— FOR —
RUBBER INSULATION.

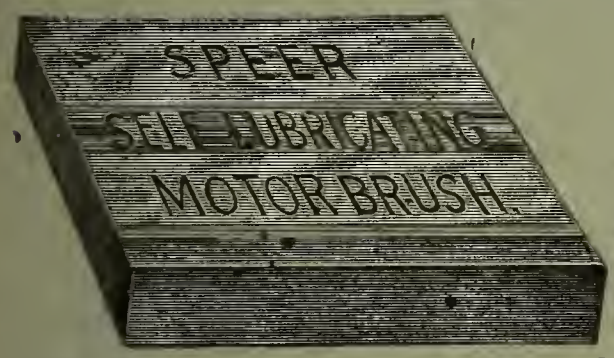
OKONITE
TRADE MARK.

1893.
WORLD'S FAIR MEDAL
— FOR —
RUBBER INSULATION.

THE STANDARD FOR RUBBER INSULATION.

OKONITE WIRES, OKONITE TAPE, MANSON TAPE, CANDEE WEATHERPROOF WIRES

WILLARD L. CANDEE, H. DURANT CHEEVER } MANAGERS.
THE OKONITE CO., Ltd., Sole Manufacturers,
253 BROADWAY, NEW YORK.
GEO. T. MANSON, General Supt
W. H. HODGINS, Secretary.



SPEER
Carbon Brushes

Are made under the direct supervision of Mr. J. S. SPEER (formerly of the Partridge Carbon Co.). This guarantees the excellency of the brushes, which are made in every type required.

NOT IN THE TRUST

The Speer Carbon Co., ST. MARYS, Pa., U. S. A.

THE
PHOENIX GLASS CO.
MANUFACTURERS OF
Gas and Electric
Globes, Shades, Etc.

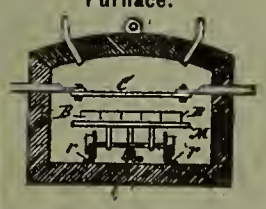
HAVE YOU A COPY OF OUR LATEST CATALOGUE?
IF NOT, SEND FOR IT.

Pittsburgh. New York. Chicago.

BUY OF THE MAKERS
BEST PURE OAK SHORT LAP LEATHER BELTING
JOSEPH MEIER'S SONS,
295 Market Street, NEWARK, N. J.

AARON CARTER, President. C. H. WATERMAN, Treas. & M'g'r.
MAJ. W. M. COMBS, Vice-Pres. A. E. BOSSE, Secretary.
LEMUEL RUSSELL, Consulting Engineer.

Electric Enameling Furnace.



The Electric Enameling Co.,
203 BROADWAY,
NEW YORK.
Office of Record, 188 Market St., Newark, N. J. S. J. MACDONALD Counsel.

PATENTS!
FREE! Valuable Book on Patents. Tells how to secure them at low cost. Gives Mechanical Movements---invaluable to Inventors and Mechanics. Full of Money-Making Patent information.
Big Book Free!
O'MEARA & CO.
PATENT ATTORNEYS,
903 G Street,
Washington, D. C.

PATENTS. PATENT SOLICITOR AND ELECTRICAL EXPERT.
Former Manager, now successor to the Patent Business heretofore conducted by "The Electrical World."
W. A. ROSENBAUM, 177 TIMES BLDG., N. Y.

EXTRA SOFT SMOOTH CASTINGS
LIGHT AND HEAVY.
For Electrical and Special Purposes.
AUTOMOBILE CYLINDERS.
DROP FORGINGS TO ORDER.
DIE SINKING.
Oscar Barnett Foundry Co.
NEWARK, N. J.
L. D. 'Phone, 1045.

Don't
Travel--
Telephone
FOR SERVICE APPLY TO
NEW YORK TELEPHONE CO.
CONTRACT OFFICES
18 Cortlandt, 15 Dey, 952 Broadway, 115 W. 38th.

BAKER & CO.,
Newark, N. J.
New York Office: 120 Liberty St.

PLATINUM
FOR ALL PURPOSES.

In Sheet or Wire, any degree of hardness.

INDEX TO ADVERTISERS.

DYNAMO and ARMATURE
Rewinding, Repairing and Reconstructing Armatures, Dynamos, Railway Motors, Transformers Commutors.
LOUIS HECK, Successor to
Stucky & Heck Electric Mfg. Co., Ltd.,
35 N J. R. R. Ave., Newark, N. J.

McIntire Patent Connector
AND TERMINALS.
Fuse Wire, Fuse Links and Strips.
C. McINTIRE CO.
15 Franklin St., Newark, N. J.

Motors Bought, Sold and Installed.
Motors Maintained at Reasonable Rates.
THE ELECTRIC MOTOR INSPECTION AND REPAIR CO. OF NEW YORK.
General Office.....34 PARK ROW, NEW YORK
H. L. SMITH, Mgr. Telephone Call, 418 Cortland.

ELECTRICAL ENGINEERS AND CONTRACTORS
RECOMMENDED BY
THE ELECTRICAL AGE.

Advertisements of 4 lines or less under this head $26 per year, additional lines at proportionate rates.

ZIMDARS & HUNT.
General Electrical Contractors. Wiring complete plants, etc. 127 Fifth Ave., New York. N. Y.

HATZEL & BUEHLER
Electrical Engineers and Contractors. 114 Fifth Avenue, New York.

J. F. BIDSTRUP & CO.
35 Frankfort Street, New York. Electrical Work of all kinds. Wiring, etc. Dynamo and Motor Repairing, Electrical Supplies.

C. F. SPLITDORF,
MANUFACTURER OF

ELECTRO-MAGNETS and TELEPHONE BOBBINS
17-27 Vandewater St., New York.

GORDON BATTERY COMPANY.
THE BEST PRIMARY BATTERY FOR CLOSED OR OPEN CIRCUIT WORK.
594 Broadway, . . . New York.

TYPEWRITER BARGAINS.
Practically new Remingtons, Caligraphs, Smith-Premiers, Hammonds, Yosts, Densmores, fully guaranteed, only $20 to $50—Cost $100. Good machines rented $4 monthly. *Free Handsome Colored Price List.* Also, list of Revised American Standard Pitman Shorthand Books, arranged for self-instruction. Consolidated Typewriter Exchange, 245 B'way, N. Y.

ENGRAVERS & DESIGNERS.
TELEPHONE 1657 FRANKLIN.
MANHATTAN PHOTO ENGRAVING CO
7, 9 & 11 NEW CHAMBERS ST.
COR. WILLIAM ST.
NEW YORK
HALF-TONE AND LINE WORK FOR ALL ILLUSTRATIVE PURPOSES
HIGH CLASS WORK. PROMPT DELIVERY. PRICES REASONABLE.

HOLOPHANE GLOBES.
More Light.
No Glare.
Perfect Diffusion.
Artistic Patterns.
For all kinds of electric lighting,
Send for catalogues and price lists.
HOLOPHANE GLASS CO., 1 Broadway, N. Y.

The Electrical Age

Established 1883. An Illustrated Weekly Electrical Journal. 10 cents per copy

VOL. XXV.—No. 685. NEW YORK, JUNE 30, 1900. Subscription, $2.50 per year. Foreign Countries, $3.50 per year.

1889.
PARIS EXPOSITION MEDAL
— FOR —
RUBBER INSULATION.

OKONITE
TRADE MARK.

1893.
WORLD'S FAIR MEDAL
— FOR —
RUBBER INSULATION.

THE STANDARD FOR RUBBER INSULATION.

OKONITE WIRES, OKONITE TAPE, MANSON TAPE, CANDEE WEATHERPROOF WIRES

WILLARD L. CANDEE, H. DURANT CHEEVER } MANAGERS.
THE OKONITE CO., Ltd., Sole Manufacturers,
253 BROADWAY, NEW YORK.
GEO. T. MANSON, General Sup't
W. H. HODGINS, Secretary.

SPEER
Carbon Brushes

Are made under the direct supervision of Mr. J. S. SPEER (formerly of the Partridge Carbon Co.). This guarantees the excellency of the brushes, which are made in every type required.

NOT IN THE TRUST

The Speer Carbon Co., ST. MARYS, Pa., U. S. A.

BUY OF THE MAKERS

BEST PURE OAK SHORT LAP LEATHER **BELTING**

JOSEPH MEIER'S SONS,
295 Market Street, NEWARK, N. J.

PATENTS!

FREE! Valuable Book on Patents. Tells how to secure them at low cost. Gives Mechanical Movements---invaluable to Inventors and Mechanics. Full of Money-Making Patent information.

Big Book Free! O'MEARA & CO.
PATENT ATTORNEYS,
903 G Street,
Washington, D. C.

EXTRA SOFT SMOOTH CASTINGS
LIGHT AND HEAVY.
For Electrical and Special Purposes.
AUTOMOBILE CYLINDERS.
DROP FORGINGS TO ORDER.
DIE SINKING.
Oscar Barnett Foundry Co.
NEWARK, N. J.
L. D. 'Phone, 1045.

THE
PHOENIX GLASS CO.
MANUFACTURERS OF
Gas and Electric
Globes, Shades, Etc.
HAVE YOU A COPY OF OUR LATEST CATALOGUE?
IF NOT, SEND FOR IT.
Pittsburgh. New York. Chicago.

AARON CARTER, President. C. H. WATERMAN, Treas. & M'g'r.
MAJ. W. M. COMBS, Vice-Pres. A. E. BOSSE, Secretary.
LEMUEL RUSSELL, Consulting Engineer.

Electric Enameling Furnace.

The Electric Enameling Co.,
203 BROADWAY,
NEW YORK.
Office of Record, 188 Market St., Newark, N. J. S. J. MACDONALD Counsel.

PATENTS. PATENT SOLICITOR AND ELECTRICAL EXPERT.
Former Manager, now successor to the Patent Business heretofore conducted by "The Electrical World."
W. A. ROSENBAUM, 177 TIMES BLDG., N. Y.

Don't
Travel--
Telephone
FOR SERVICE APPLY TO
NEW YORK TELEPHONE CO.
CONTRACT OFFICES
18 Cortlandt, 15 Dey, 952 Broadway, 115 W. 38th.

BAKER & CO.,
Newark, N. J.
New York Office: 120 Liberty St.

PLATINUM
FOR ALL PURPOSES.

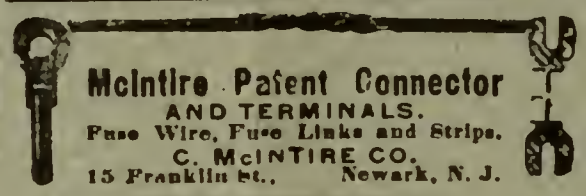
In Sheet or Wire, any degree of hardness.

INDEX TO ADVERTISERS.

DYNAMO and ARMATURE

Rewinding, Repairing and Reconstructing Armatures, Dynamos, Railway Motors, Transformers Commutors.

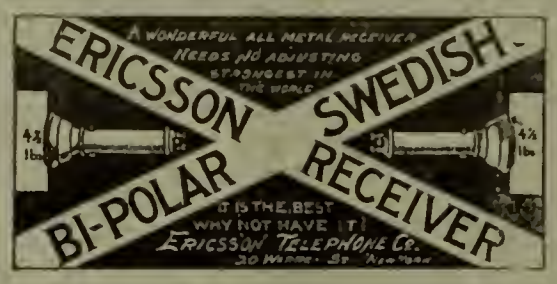
LOUIS HECK, Successor to
Stucky & Heck Electric Mfg. Co., Ltd.,
35 N. J. R. R. Ave., Newark, N. J.



McIntire Patent Connector
AND TERMINALS.
Fuse Wire, Fuse Links and Strips.
C. McINTIRE CO.
15 Franklin St., Newark, N. J.

Motors Bought, Sold and Installed.
Motors Maintained at Reasonable Rates.

THE ELECTRIC MOTOR INSPECTION AND REPAIR CO. OF NEW YORK.
General Office.....34 PARK ROW, NEW YORK
H. L. SMITH, Mgr. Telephone Call, 418 Cortland



ELECTRICAL ENGINEERS AND CONTRACTORS
RECOMMENDED BY
THE ELECTRICAL AGE.

Advertisements of 4 lines or less under this head $26 per year, additional lines at proportionate rates.

ZIMDARS & HUNT.
General Electrical Contractors. Wiring complete plants, etc. 127 Fifth Ave., New York. N. Y.

HATZEL & BUEHLER
Electrical Engineers and Contractors. 114 Fifth Avenue, New York.

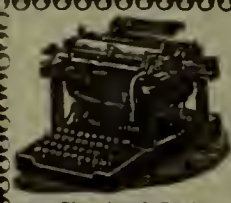
J. F. BIDSTRUP & CO.
35 Frankfort Street, New York. Electrical Work of all kinds. Wiring, etc. Dynamo and Motor Repairing, Electrical Supplies.

X-RAY COILS A Specialty

Telephone and Spark Coils

C. F. SPLITDORF, 17-27 Vandewater St., N. Y.

GORDON BATTERY COMPANY.
THE BEST PRIMARY BATTERY FOR CLOSED OR OPEN CIRCUIT WORK.
594 Broadway, . . . New York.



TYPEWRITER BARGAINS.
Practically new Remingtons, Caligraphs, Smith-Premiers, Hammonds, Yosts, Densmores, fully guaranteed, only $20 to $50—Cost $100. Good machines rented $4 monthly. *Free Handsome Colored Price List.* Also, list of Revised American Standard Pitman Shorthand Books, arranged for self-instruction. Consolidated Typewriter Exchange, 245 B'way, N. Y.

ENGRAVERS & DESIGNERS.
TELEPHONE 1657 FRANKLIN.
MANHATTAN PHOTO ENGRAVING CO
7, 9 & 11 NEW CHAMBERS ST. COR. WILLIAM ST.
NEW YORK
HALF-TONE AND LINE WORK FOR ALL ILLUSTRATIVE PURPOSES
HIGH CLASS WORK. PROMPT DELIVERY. PRICES REASONABLE.

HOLOPHANE GLOBES.

More Light.

No Glare.

Perfect Diffusion.

Artistic Patterns.

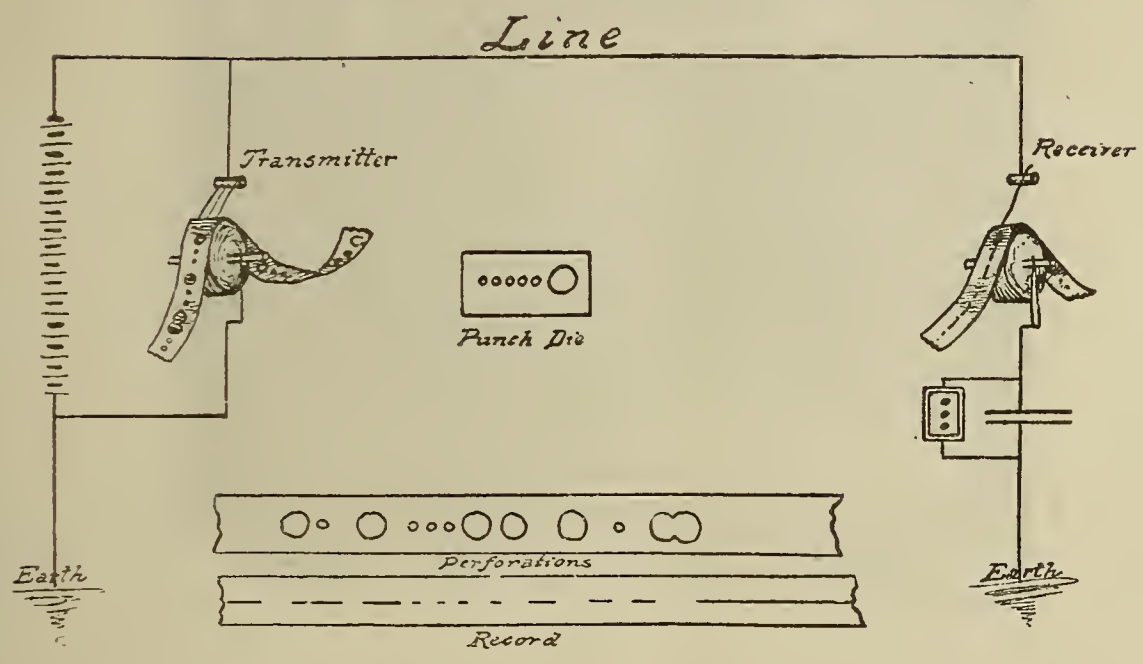
For all kinds of electric lighting,
Send for catalogues and price lists.

HOLOPHANE GLASS CO., 1 Broadway, N. Y.

The Electrical Age.

VOL. XXV—No. 1. NEW YORK, JANUARY 6, 1900 WHOLE No. 660.

Telegraphy.



MACHINE TELEGRAPHY OF TO-DAY.

COPYRIGHTED BY W. L. CRAIG.

(Continued from Page 314.)

PERSISTENT EFFORT FOR A MACHINE SYSTEM.

Twenty-five years ago, Mr. D. H. Craig, who had under his management the collection and distribution of all the news reports of the Associated Press, saw, even at that time, that telegraphic communication was greatly hampered by hand methods of operation and high rates. He turned his attention to the financial encouragement of inventions and improvements in methods of telegraphy, but more especially to the development of a machine system of transmission, which would utilize the full capacity of a wire, and electro-chemical recording of Morse characters at the receiving end, which involved no movement of any mechanical parts whatever.

The invention of the duplex and quadruplex systems, a few years later, greatly relieved the embargo on general communication by increasing the facilities and lowering the rates; but the business soon grew to the full measure of these improvements, and the necessity for a machine system was as pressing as ever, and has gained in imperativeness to the present day.

Large expenditure of money in experimentation by numerous inventors, and unflagging personal attention to the object in view, resulted in two attempts, at different times within the past twenty years, to esablish machine telegraphy; but these enterprises met with only partial success, mainly owing to immature and imperfect development of the most important parts of the systems —notably the perforating machines, by which Morse characters are punched into a strip of paper—and in the system of transmission which at high rates of speed, must overcome what is known as the "static capacity" of the wire.

The outcome of all this expense and labor is now a perfect system of machine telegraphy, with which 3,000 words per minute have already been transmitted and recorded, in characters as legible as print, between New York and Washington, over a single wire.

The credit for the scientific part of this wonderful achievement belongs to the late Mr. Frank Anderson, of Peekskill, New York, whose entire time for the past twenty years has been given to the perfection of this system, even to the smallest detail.

PREPARATION OF MESSAGES.

The perforating machine is operated by a keyboard, each key representing a complete letter. No more finger pressure is required of the operator than for operating an ordinary typewriter, and the speed at which messages may be transferred to the strip is limited only by the expertness of the manipulator. An average speed of 30 to 50 words per minute may be reached by no more skill than is required for the operation of a similiar speed on a typewriter.

THE BUSINESS MAN'S PERFORATOR OR COMPOSER.

A perforating machine of very simple construction for the use of business men or their clerks is also perfected. It will enable parties doing any considerable amount of telegraphing to prepare their own messages or letters, and send the strip to the telegraph office ready for transmission, thus diminishing the cost to themselves about 25 per cent. This machine also prints a copy of the message in roman letters, simultaneously with the perforation, so that a copy of everything punched for transmission may be retained for filing.

TRANSMISSION.

Transmission of messages is in no wise dependent upon the skill or experience of the operator. The perforated strip is wound on a reel which is placed in the transmitting machine. The strip is drawn over a metallic drum. A scraping wire brush rests on top of the strip. Contacts between the wire brush and the metallic drum, through the perforations, send the Morse characters upon the line. The strip is run through the machine at a rate of speed limited by the carrying capacity of the wire only. A No. 4 copper wire will carry 3,000 words per minute between New York and Washington, or 1,000 words per minute between New York and Chicago.

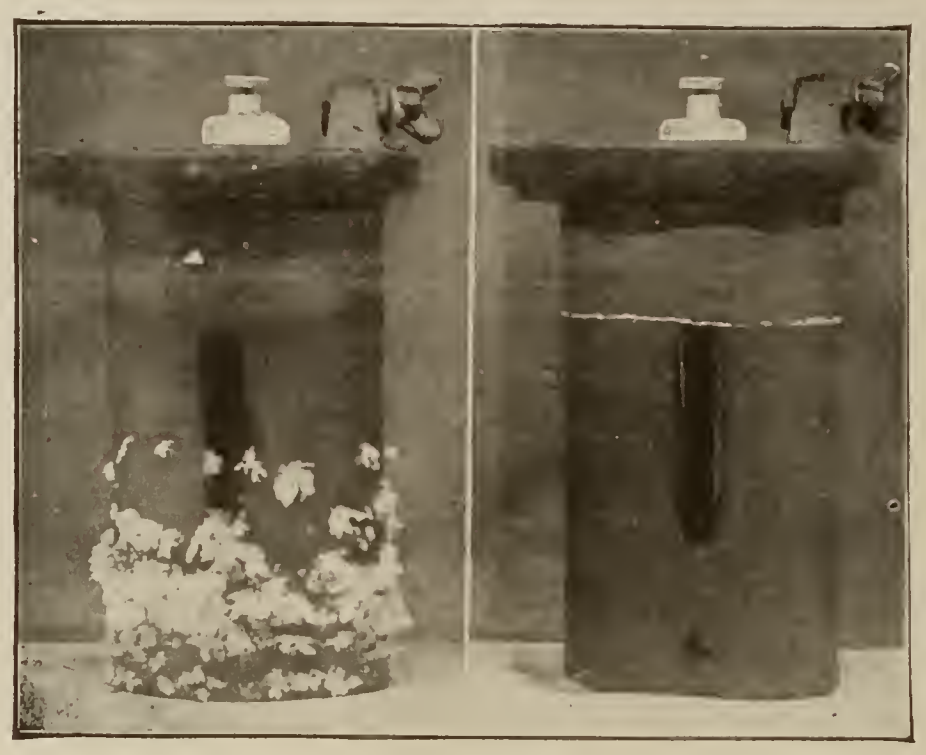
This system has already transmitted and recorded, in perfect Morse characters, 3,000 words per minute between New York and Washington and 800 words per minute between New York and Chicago, over a compound copper and steel wire of much smaller carrying capacity than a No. 4 copper wire.

(To be Continued.)

Primary Batteries.

FEDERAL SALTS IN OPEN CIRCUIT BATTERIES COMPARED WITH SAL AMMONIAC.

The action which takes place in a carbon battery using sal ammoniac as an excitant, differs entirely from that of

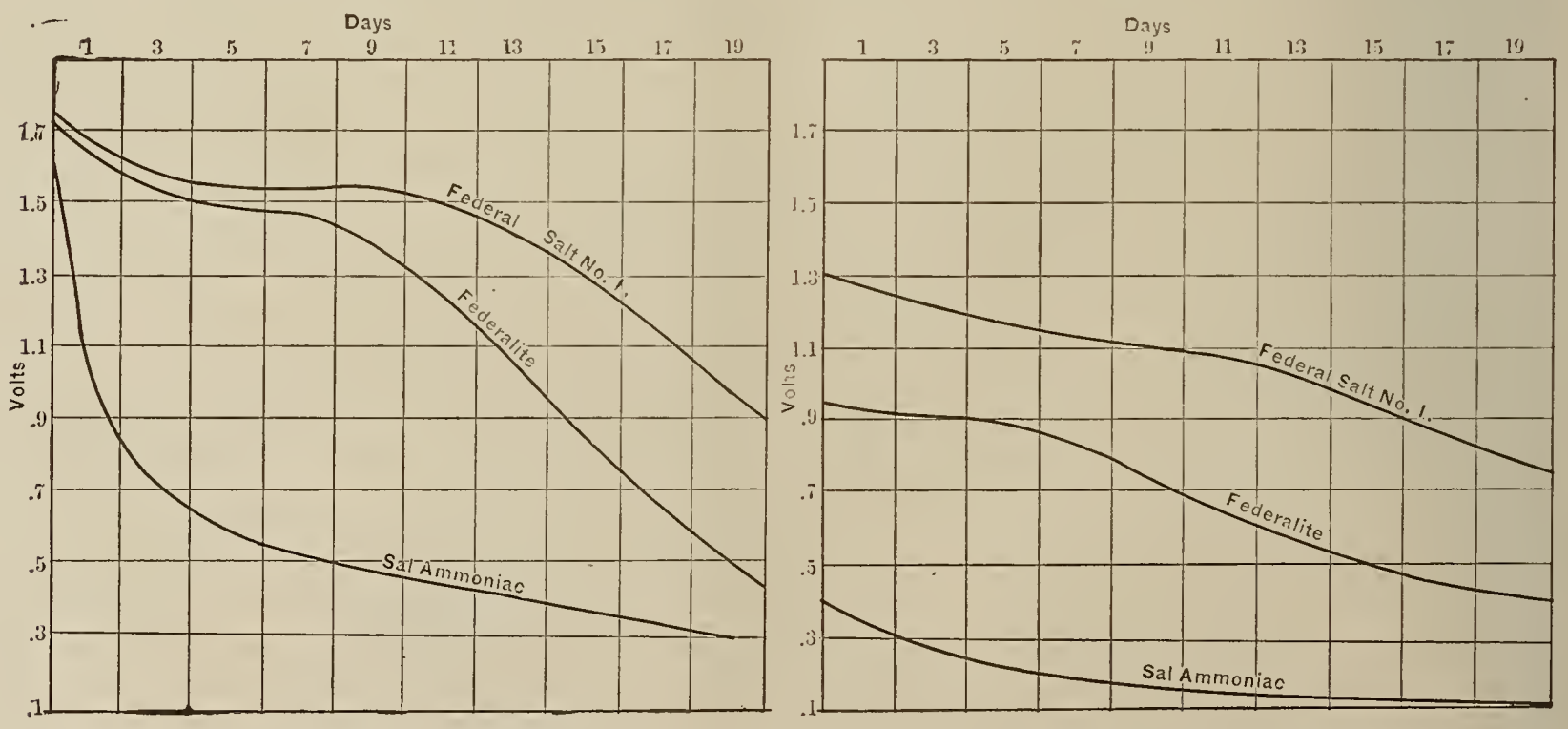


Figs 1 and 2.—Carbon Cylinders Taken From Sal Ammoniac and Federal Salt Solutions.

"Federal Salt" or "Federalite" under the same conditions.

When the circuit is closed in a cell containing sal ammoniac, the ammonium is released and an insoluble oxychloride of zinc is formed. As a result of this the internal resistance of the electrolyte increases rapidly, and as the hard oxychloride crystals form on the carbon and zinc, the active surface is gradually lessened and the efficiency of the cell is impaired.

With the above-mentioned compounds used as the electrolyte the action on closed circuit is to form a soluble sulphate of zinc which is a better conductor than the original electrolyte. As there is no insoluble matter



Figs. 1 and 2.—Open Circuit Voltmeter Readings Taken Each Morning and Each Night.

formed, the pores of the carbon are always open, and the entire active surface is presented to the zinc. The closing of the circuit releases enough acid to act on the depolarizer present in the compound, thus preventing polarization and aiding the battery to recuperate quicly.

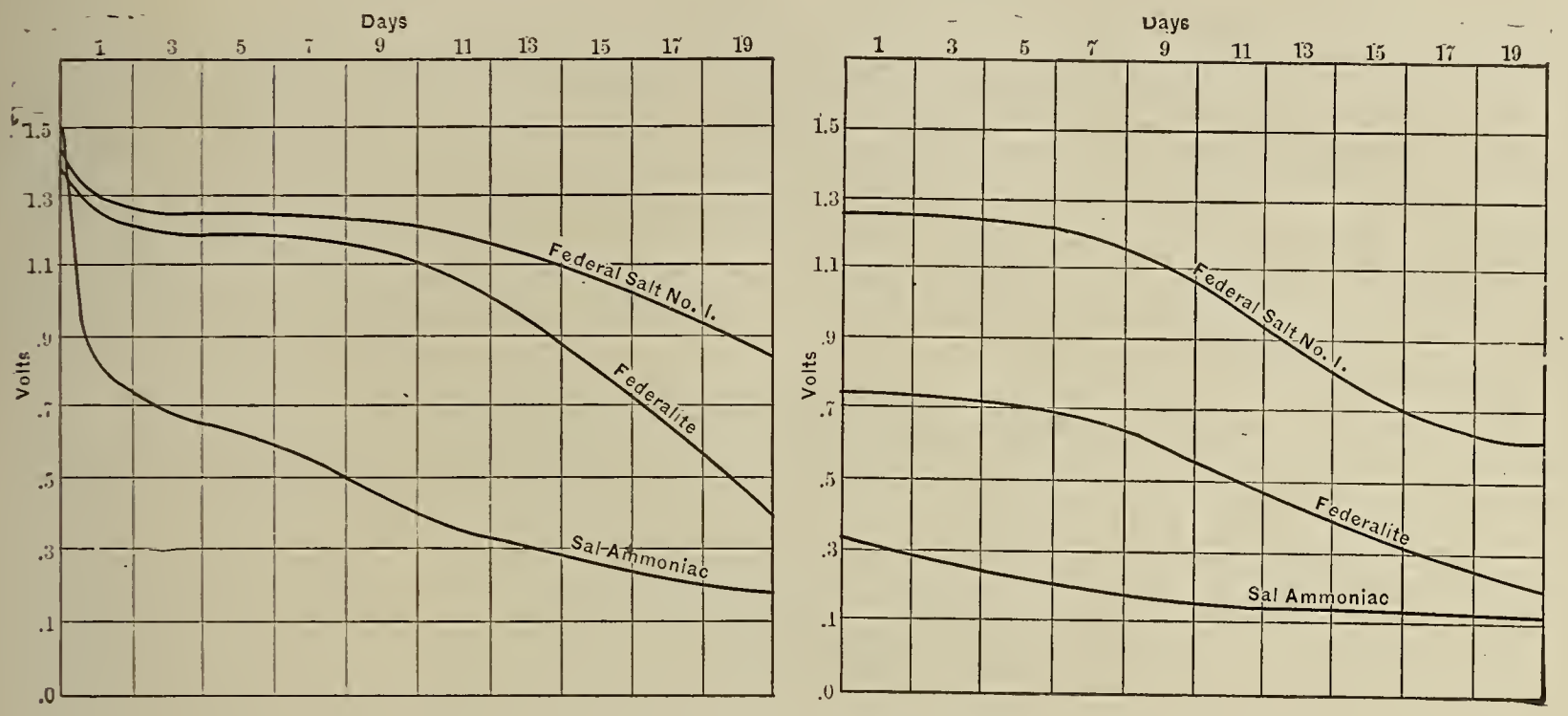
Figs. 1 and 2 show the carbons used in a recent test, one from a sal ammoniac solution all covered with crystals, and another from a "Federal salt" solution, showing the carbon perfectly clean. Both were used in tests exactly alike and under similar conditions. For purposes of comparison, curves are given of these tests.

Three batteries, one containing "Federal salts," one "Federalite" and one sal ammoniac, were connected in series on a 20-ohm telegraph instrument, and kept on closed circuit for seven hours each day for nineteen consecutive days.

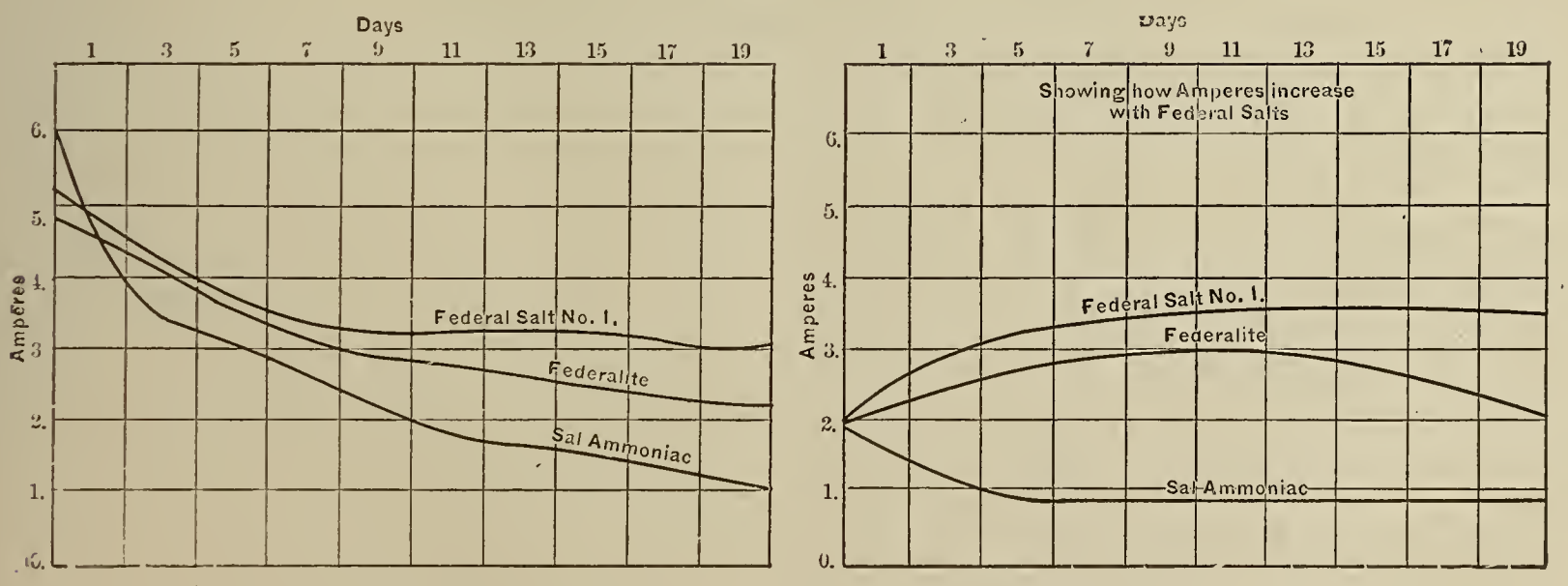
The voltmeter readings are plotted in Figs. 3 to 6. Those of Fig. 3 show open circuit voltmeter readings taken every morning for nineteen days; Fig. 4 are curves of open circuit readings each night after seven hours' work. The curves of Fig. 5 are from closed circuit readings each morning, and those of Fig. 6 closed circuit readings each hour after seven hours' work. The ampere readings of Fig. 7 were taken each morning for the nineteen days, and those of Fig. 8 are from ampere reading each night.

It can be readily seen from the above charts that the compounds give a higher e. m. f. and more constant current during the entire life of the discharge, and in addition are entirely free from crystals.

While the amperes of the sal ammoniac cell would appear to be higher at the start, it can be seen that under work both the "Federal salt" and "Federalite" are more constant, and, in fact, the amperes increase as the zinc salt is formed. For hard work, such as gas engine, gas lighting or for telephone, the compounds maintain a constant current where sal ammoniac would soon become inefficient.



Figs. 5 and 6, Closed Circuit Voltmeter Readings Taken Each Morning and Each Night.



Figs. 7 and 8, Ampere Readings Taken Each Morning and Each Night.

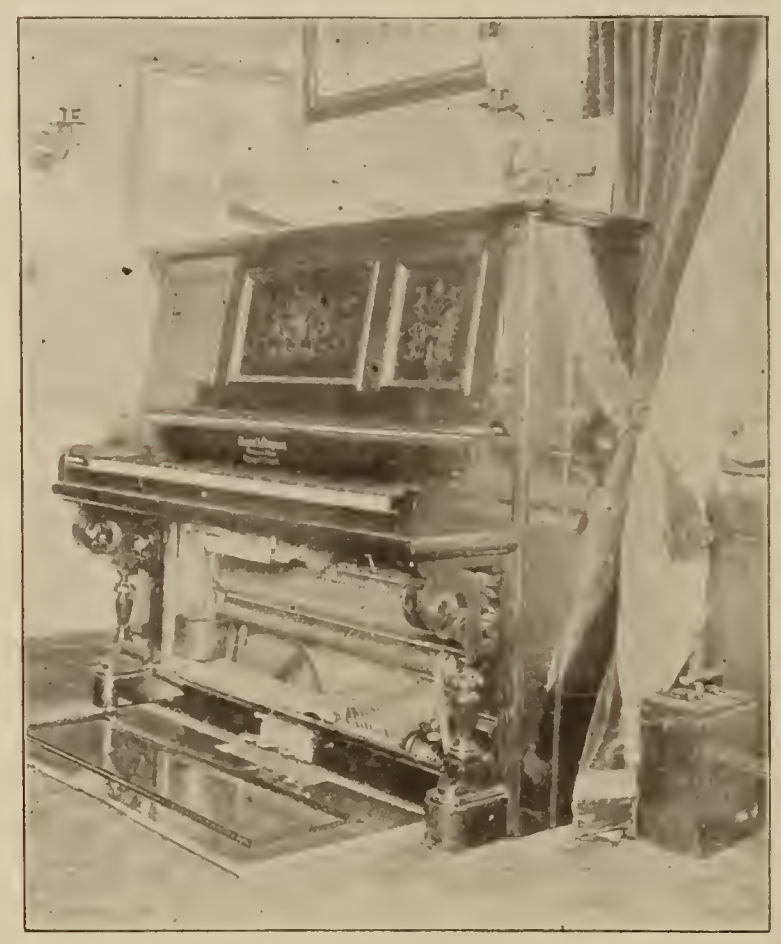
Newark, Ohio.—The Jewett Car Company, of this place, has been incorporated for the manufacturing and selling of street and other railway cars; capital, $200,000; incorporators, A. S. Sisson, W. S. Wright, H. S. Sands, P. O. Reyman, all of Newark.

Novel Applications of Electricity.

ELECTRICAL MUSICAL INSTRUMENTS.

Among recent applications of electricity in the playing of musical instruments, is the system of the Pianophone Company, 46 East Houston street, New York, which shows much ingenuity in its development and in operation gives very satisfactory results, says "The Electrical World and Engineer." The company is producing self-playing banjos and self-playing attachments for pianos, the electrical current doing all the work, no wind instruments or apparatus whatever being employed. The construction and operation of the self-playing attachment for the piano and of the "banjophone" will be understood from the following description:

A 1-50-hp electric motor is placed inside of the piano case at the base, and is belted to the mechanism which unrolls the perforated music roll and to a long steel roller.



Electrical Self-playing Attachment for the Piano.

Over this roller, which lies in a horizontal position, and which forms the common return for all the key circuits, is a row of 58 small horse shoe electromagnets set vertically in a frame, with their poles upwards. These electromagnets are about 3 inches long and less than an inch wide, and are set close together. Each magnet represents one key on the keyboard. Immediately above the roller is a frame carrying a set of small contact brushes of wire, of which there are as many as there are magnets, or keys. Each brush is the terminal of a circuit which includes one of the magnets, the roller being the other terminal.

The perforated music paper passes over the roller and under the contact fingers, and as the perforations pass under the fingers the latter come into metallic contact with the roller underneath, thus closing the circuit through the corresponding magnet. On thus closing a circuit the armature of its magnet bears down upon a short wooden rod, to the lower end of which is loosely pivoted a cam of wood with a felt bearing surface. As this cam is pressed down by the rod it bears upon the surface of the revolving roller and is carried forward and outwardly in the direction of the rotation of the roller. This tangential motion is imparted to another rod pivoted to the cam at a point on its edge about opposite the rod first referred to. This second shaft or rod lies in an upward direction, corresponding to the downward motion of the armature. At the upper end of this shaft is a hammer covered with felt, which strikes the proper string, with a quick, sharp blow, whenever the corresponding circuit is closed through the magnet. This description of the operation of one magnet, of course, applies to all 58, their operation being controlled entirely by the perforations in the music roll.

The motor used for this work is rated, as already stated, at 1-50-hp. It is the bipolar type, with one magnetizing spool. It is provided with semi-circular pole pieces which almost completely encompass the gramme ring armature. The motor is operated by one cell of storage battery, taking 4 amperes at a pressure of 2 volts. The Pianophone Company makes these motors itself.

A feature of the business is the music perforating machine, which is electric and entirely automatic in its operation of the piano and banjo mechanism, the perforations in the "original" copy of music causing circuits to close through electromagnets which set punches, these in turn perforating the paper and producing an exact copy of the original. The machine perforates 15 sheets of paper at one operation at a paper speed of 2 feet per minute or a total of 15x2=30 feet of paper per minute.

These devices are the invention of Mr. G. Howlett Davis, who is president and general manager of the Pianophone Company.

ELECTRIC RAILWAYS.

Quebec, Que.—As soon as the works of the Canadian Electric Light Co. are completed, it is the intention to operate the Clandiere Valley Railway by electricity. Other lines will be constructed in the counties of Lewis, Dorchester, Bellechasse and Lothmiere.

Port Stanley, Ont.—The Port Stanley Electric Railway Co. have applied to the Ontario government for a charter to build an electric railway from Port Stanley to St. Thomas and London. Should the charter be granted, it is proposed to commence work at once. The London and Port Stanley Gravel Road Company are the promoters.

The Electrical Age.

ESTABLISHED 1883.

Entered at New York P. O. as second-class matter, January 18, 1891.

THE ELECTRICAL AGE PUBLISHING CO., Publishers.

TERMS OF SUBSCRIPTION:

One Copy, one Year, - - - - - - - - - $2.50
One Copy, six months, - - - - - - - - - 1.25
Great Britain and other Countries, - - - - 3.50

Cable Address (all Cables), "Electage," New York.

NEWTON HARRISON, E. E., EDITOR.

ASSOCIATE EDITORS:

ALFRED E. WIENER, E. E., } ELECTRIC LIGHT AND POWER.
OSBORNE P. LOOMIS, E. E., }
JOSEPH MUIR, M. D., } ELECTRO-
FREDERICK STRANGE KOLLE, M. D., } THERAPEUTICS.

ADDRESS ALL COMMUNICATIONS TO
THE ELECTRICAL AGE PUBLISHING COMPANY,
Seventh Floor, World Building,
NEW YORK.

NEW YORK, JANUARY 6, 1900.

CONTENTS:

THE LEASING OF AUTOMOBILES.

The American public are the last to relinquish a vehicle for transportation or locomotion until it has been absolutely superseded by one of a superior type and necessarily better construction. A curious medley of vehicles may be seen in New York city at this present writing: the horse car, cable car, compressed air, underground and overhead trolley run almost side by side. While in vanrious parts of the city may be seen the gasoline, steam and electric automobile. The situation at present reminds one very strongly of the methods of illumination employed, which include the tallow candle and kerosene oil lamp, the mediaeval and the modern. Within the last few years the subject of rapid transit has become one of municipal importance. The fast speeding bicycle and the overhead steam roads have contributed in a measure to produce this strongly emphasized desire for a quicker means of locomotion. In many respects our English cousins residing in London refuse to believe in the efficacy of a method of transportation confined to fixed channels overhead, as, for instance, our electric roads. It is evident, however, that enough interest has been taken in the automobile to lead to the belief that it will play an important part in the near future, in the transportation from their homes to their workshops. The incorporations representing automobile companies of various characters include many millions of dollars but it is questionable whether the plan of building expensive automobiles for sale to a certain limited few will pay in the long run. It is entirely beyond the means of the average man to lay out a thousand dollars or more for a vehicle requiring to a certain extent considerable care in handling and some expense to operate. A feasible plan seems to be that of leasing the automobile.

The leasing of automobiles for a fixed sum per annum by a large manufacturing concern is not altogether a questionable proposition. In the first place among the many that hanker after automobiles but have not got sufficient to pay for one this proposition will be most interesting. In the second place the fact that such a company would take care of the automobile, keep it charged, etc., and in good running order would relieve the minds of many well able to pay but doubtful as to the wisdom of such laymen as they possessing an active and at times a cantankerous machine. Finally, the manufacture of automobiles carried out on a large scale would reduce the cost of manufacture down to a minimum and show certain manufacturers exactly where they stand. For these reasons, of which the first two are the most important, the leasing of automobiles by the quarter, six months or year to private citizens might mean a large and lucrative trade in a new and interesting business.

If automobiles are to be leased the question then arising would be one relating to the cheapest type of machine to keep in repair as well as to build. The advantages of the steam, gasolene and electric automobile, respectively, would be more carefully examined into than ever before and the method of ascertaining them would follow most closely along lines of a purely financial nature. The steam automobile has been tabooed in large cities unless operated by a licensed engineer. On the other hand, although the gasolene automobile is cheap to operate the noise and odor in connection with it might make it objectionable to a large class of prospective lessees. The inadequacy of the electric automobile for long runs would not interfere with its popularity, twenty-five miles being considered quite sufficient for a day's run within the city limits. The chances are that the electric and gasolene vehicles would divide the honors with an established preference however manifested for the former.

With an increasing population which constantly demands better facilities for transportation the trolley car, cable car and other street railways leave the inhabitants of side streets in the lurch. The people living there feel it most in wet and stormy weather when the nickle they invest protects them from wind, rain and snow to within a block or two of their homes but then through lack of complete connection they are forced to tramp the rest of the way and experience all that they had desired to protect themselves against. An automobile, or at least an automobile stage coach for such as these under such circumstances, would be indeed a boon and represents a case where even a delay in reaching home is not the worst phase of the situation.

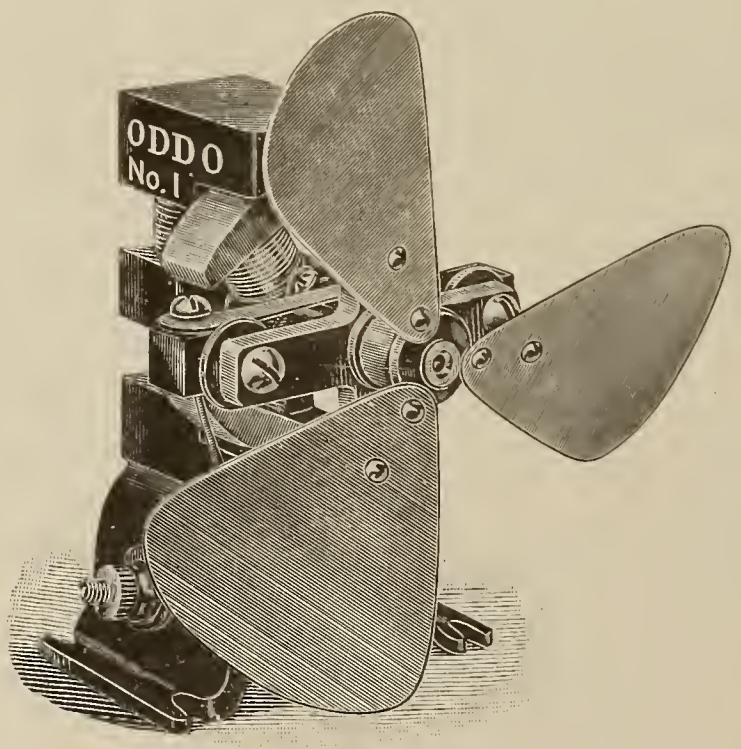
To quote from a well well known public paper: "The average trolley car is in itself a cheap, inadequate thing. Nine times out of ten it is too small and generally even in the bleakest weather it is unheated. There is no regard for the passenger's well being. And yet these same trolley cars are the largest money makers in the country." The writer seems to be well aware of the glorious future awaiting the long suffering American public for he continues, as follows: "Then as the thoroughfares are better paved and as the improvement which is one of the certainties of municipal growth goes on we can look forward to the time when the track will be removed from the street and when we shall glide along comfortably and cheaply on rubber tires."

THE ODDO FAN MOTOR.

The new Oddo double fan motor, manufactured by the American Oddity Company, 381 Pearl street, New York City, illustrated in this article, is finding a ready sale. Some fine orders have already been placed with the company for the approaching summer. This compact double fan outfit is extraordinary in that it can be run by one cell of type E or type A Oddo battery at eight hundred revolutions a minute. Two cells will run the double fan twelve hundred revolutions a minute for fifteen hours at a nominal cost. This fan motor is like all the other makes of Oddo motors, being mechanically and electrically of the highest design. Every part is made in duplicate so that it can be renewed at any time without delay. We desire also to call attention to the improved Oddo motors, Nos. 1 and 2, shown in the illustrations: No. 1 is made especially to run fans in connection with the Oddo batteries types E or A; No. 2 is shown with metal base and pulley on shaft for running small machines, toys, novelties, and everything needed for small power purposes. These motors develop a remarkable torque when in operation, far excelling the most sanguine expectations. The unusual pull is due to the unique magnetic circuit through which the lines of force pass very readily. Magnetic leakage is greatly reduced and the large diameter of the armature adds to the advantage in speed and pulling power otherwise obtained.

Oddo Double Fan Motor.

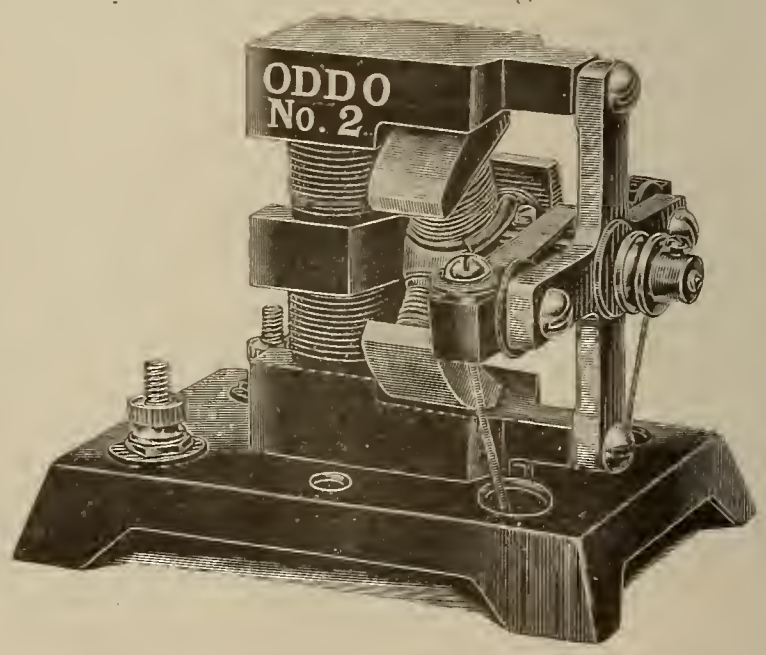
Oddo Battery Type A.



No. 1 Oddo Fan Motor.

AUTOMOBILES IN EUROPE.

There are now, according to the Annuaire Generale de l'Automobile, more than 7,000 owners of automobiles in Europe, the number of such vehicles being, perhaps, 10,000, nearly two-thirds of these being owned in France.



No. 2 Oddo Fan Motor.

Out of this number no less than 4,541 are in the departments. There are more than 600 manufacturers in France, not including the makers of parts, about 1,000 dealers in them, and 100 repair shops. The same authority gives the number of owners of automobiles in Germany as 268; 90 in Austria-Hungary, the same in Belgium, 44 in Spain, 304 in Great Britain, 111 in Italy, 68 in Holland, 114 in Switzerland.—Ex.

THE VALUE OF SMALL INVENTIONS.

The inventor of the roller skate made £200,000. The gimlet-pointed screw has been responsible for more wealth than most silver mines. One hundred thousand pounds in first-class securities, according to the Patent Record, would not represent the fortunes made by the man who first thought of copper tips to children's shoes. Even a little thing like the common needle threader is worth £2,000 a year to its owner, while the "return ball"—a wooden ball fastened on a piece of elastic—yields £10,000 per annum; this is only one of the many profitable toys. We may mention the "Dancing Jim Crow," which produces £15,000 a year; the "Wheel of Life," worth in all full £100,000; the walking figure, "John Gilpin," and the "Chameleon top." The sale of the last-named toy has been enormous, and the profits also enormous. Indeed, the "Chameleon top," as a profitable invention, has probably excelled any other discovery in modern times, however valuable and important these may have been. As far as profits are concerned, the invention of toys pays better than those of anything else. Money has been, and always can be, made more easily out of simple patented inventions than out of any investment or occupation. Great discoveries take so many years and cost so much to perfect that the fortunes made from them are small compared with those we have instanced. The man who discovered that a candle, if tapered at the end, would stick firmly into its socket patented the idea and afterward founded the largest candle factory in the world. Might not any one have thought of this simple device? Out of the millions who own umbrellas, how many realize that these unfortunately indispensable articles represent wealth untold. The frame, the cover, the materials used, all are the results of numberless experiments and patents. An umbrella years ago used to be made of whalebone and gingham. It weighed as much as a portmanteau. Alpaca was substituted for gingham, then silk for alpaca. Each change meant a fortune to the inventor who brought it about. For a long time the ribs were solid; then Samuel Fox arose, took the umbrella and cut grooves along its ribs. He designed the "Patent Paragon Frame," and lived to see his invention used universally. At the death of Samuel Fox his heir benefited to the extent of £179,000—the residue of a total profit of at least half a million.

Charles F. Brush made a million out of his arc lamp. Edison several millions from his lamp, telephone, telegraph, phonograph, kinetoscope, etc. He still enjoys enormous royalties. Nicola Tesla is paid a princely income by the Westinghouse Company and other corporations. Marconi has evidently lifted himself to wealth and fame through patient investigation and experiment, and the gates are still wide open that lead to the intricate mazes of scientific research.

Business News.

SPECIAL EXPORT COLUMN.

TOTAL AMOUNT OF ELECTRICAL EXPORTS FROM NEW YORK FOR WEEK ENDING DEC. 30, 1899, $80,994.

New York, N. Y., Dec. 30, 1899.—The following were the exports of electrical material from New York during the week just ended:

Antwerp.—41 cases electrical material, $3,949.

Argentine Republic.—36 cases electrical machinery, $1,539; 749 cases electrical material, $39,676.

British Australia.—20 cases electrical material, $1,052.

Brussels.—3 cases electrical machinery, $135.

British West Indies.—73 cases electrical material, $1,310; 73 cases electrical material, $1,210.

Brazil.—138 cases electrical material, $5,918; 18 cases electrical machinery, $1,273.

British Possessions in Africa.—3 cases electrical machinery, $52; 3 cases electrical material, $99.

Central America.—22 cases electrical material, $983.

Dutch Guiana.—1 case electrical material, $405.

Danish West Indies.—1 case electrical material, $16.

Hamburg.—61 cases electrical material, $6,001; 54 cases electrical machinery, $1,450.

Havre.—53 cases electrical material, $3,985; 100 cases electrical machinery, $2,000.

Liverpool.—5 cases electrical material, $200.

Mexico.—63 cases electrical material, $2,365; 8 cases electrical machinery, $43.

Newfoundland.—27 cases electrical material, $179.

Nova Scotia.—1 case electrical material, $15.

Odessa.—11 cases electromotors, $1,150.

St. Petersburg.—79 cases electrical material, $6,989.

NEW INCORPORATIONS.

Pleasantville, N. J.—The Pleasantville Electric Light and Power Company has filed articles of incorporation; to operate and maintain an electric light plant at Pleasantville; capital stock is $10,000.

Norfolk, Va.—The Norfolk Electric Company, maximum capital, $300,000, was chartered to erect an electric light and power plant. A. P. Warrington is president of the company.

New York City.—The Kean Power Company, of New York city, has been chartered to manufacture and supply steam and electric power; capital, $1,000; directors, Frederick W. Hunter, Crawford, N. J.; Augustus Newman, Garrisons, N. Y.; William V. Newman, New York city.

Lancaster, Pa.—The Conestoga Traction Company, of Lancaster, has been chartered to supply electricity; capital, $10,000; incorporators, J. D. Skiles, J. W. B. Bausman, E. G. Smith, all of Lancaster; S. R. Shipley, W. B. Kurtz, of Philadelphia.

Reading, Pa.—The Berks Electric Light, Heat and Power Company, of Reading, has been incorporated to supply light, heat and power; capital, $5,000; incorporators, J. H. Printz, H. Godfrey, H. M. Albright, H. L. Greenawalt, H. Hahn, all of Reading.

Buffalo, N. Y.—The Cling Surface Manufacturing Company, of Buffalo, has been incorporated to manufacture mechanical and electrical supplies; capital, $25,000; directors, Albert B. Young, Elizabeth J. Young and William D. Young, of Buffalo.

Mallison Falls, Me.—The Mallison Falls Power Company has been organized in Portland to purchase power privileges at Mallison Falls. The officers are: President, Woodbury K. Dana; treasurer, Lemuel Lane; clerk, Hanno W. Gage; directors, W. K. Dana, Lemuel Lane, E. J. Haskell, W. W. Poole, J. C. Scates and Russell D. Woodman.

Montclair, N. J.—The Electric Regulator Company, principal office No. 294 Bloomfield avenue, Montclair, N. J., has been incorporated to manufacture electric regulators; capital, $125,000; incorporators, Eri F. Wilson, Charles H. Shelton, Roger Williams, Walter Kidde, Warren D. Batting, all of Montclair, N. J.

Rochester, N. Y.—There have been filed in the office of the Secretary of State at Albany articles incorporating the Merchant Switch Company, of Rochester, with the following directors: George E. Merchant, Gerald E. Merchant, John McGarvel, N. F. Foote, of Rochester; Edward B. Talcott and James B. Brady, New York, and Augustine Voght, Troy. The company will manufacture the automatic street railway switch invented by Gerald E. Merchant.

Raleigh, N. C.—The Raleigh Ice and Electric Company was recently incorporated. The capital stock is $75,000, and the business will be for the manufacture, sale and distribution of ice, the establishment of a system of cold storage and the establishment of works for the gen-

erating and sale and distribution of electricity in Raleigh and elsewhere. The president of the company is Mr. E. C. Hillyer, of Newport News, Va.; the general manager, L. B. Eberhardt, of Raleigh, and treasurer, B. S. Jerman, of Raleigh. The water-power at Millburne, on the Neuse, six miles from here, will furnish the power for the plant.

Reading, Pa.—The Reading Electric Light and Power Company has been chartered. The new plant will be located on the Schaaber property, on Eighth street near Chestnut.

TELEPHONE CALLS.

Marietta, Ohio.—The Marietta Telephone Company, of Marietta, was chartered to construct and operate telephone lines and exchanges; capital, $50,000; incorporators, P. H. Bruck, J. S. H. Tower, A. L. Gracy, H. Strieker, J. W. Dusenbury.

Charleston, W. Va.—The Globe Telephone and Telegraph Company, of Charleston, was recently incorporated for building and operating telephone and telegraph lines; capital, $1,000,000; incorporators, T. J. Carmack, of Covington; C. M. Meadows, of Racine; P. Silman, E. M. Keatley, L. Schwartz, all of Charleston.

STREET RAILWAY NEWS.

Pueblo, Col.—The Gutheil Park Railroad Company, of Denver, was recently chartered; capital, $10,000; incorporators, F. J. Chamberlin, F. A. Joslin, A. H. Gutheil, G. R. Baker, C. E. Stratton, all of Denver.

Lincoln, Neb.—The New System Traction Company, of Omaha, has been incorporated to build street railways; capital, $300,000; incorporators, J. M. Taylor, T. W. Hazen L. H. Kent, all of Omaha.

Norwalk, Ohio.—The City Council, at a special session, has granted a twenty-five-year franchise to the Sandusky, Bellevue & Norwalk Electric Railway Company to construct a railway through certain streets of this city.

Butte, Mont.—The Butte Electric Railway Company, of New York city, was recently incorporated in West Virginia for building and operating street railways; capital, $1,000,000; incorporators, W. A. Clark, of Butte, Mont.; J. A. McDonald, W. L. Hoge, J. C. Kennedy, all of New York city.

Philadelphia, Pa.—The Frankford & Fairmount Passenger Railroad Company will make extensions to the power plant if the proposition to extend its lines to Germantown and Falls of Schuylkill is passed.

Franklin, Ind.—The City Council has granted a franchise, running thirty years, to the Indianapolis, Greenwood & Franklin Railroad Company. The line is already finished to Greenwood.

Waltham, Mass.—At a meeting of the Aldermen the Waltham, Wayland & Weston Street Railway was granted a franchise in Weston street to the Weston line. The road must be completed and in running order November 1, 1900.

Chicago, Ill.—A permit has been issued to the Northwestern Elevated Company to commence work on the connection between the line and the Union Loop.

Lancaster, Pa.—The Conestoga Traction Company, of Lancaster County, with a capital of $10,000, has been incorporated. The incorporators are William B. Given, Columbia; Samuel R. Shipley, William B. Kurz and J. Roberts Faulk, of Philadelphia; John D. Skiles, J. W. B. Bausman and Eugene G. Smith, Lancaster, Pa.

Indianapolis, Ind.—Charles L. Henry, of Anderson, secretary and general manager of the Union Traction Company, has filed an application for the right-of-way to enter Indianapolis with the interurban cars. In the application the privilege of carrying freight, express and United States mail is asked.

Killingly, Ct.—The New York, New Haven & Hartford Railroad Company has purchased the People's Tramway Company, of Killingly. A bond issue of $200,000 has already been made to cover the expenses of building the part of the road already constructed, and when the plans of the New Haven road have been further developed a bond issue of $100,000 more will be made to meet the obligations. The stock of the company will be increased to that amount.

Kansas City, Kas.—the Board of County Commissioners in Kansas City, Kan., granted W. E. Winner a franchise to construct and operate a single or double-track electric railroad from the western terminus of the Grandview line, at Eighteenth street and Grand avenue, to the western line of the county.

POSSIBLE INSTALLATIONS.

Mexico, Mo.—A committe has been appointed to investigate the cost of an electric light plant.

Brillion, Wis.—Brillion has granted a fifteen-year franchise to C. W. Behnke & Son, for the erection and maintenance of an electric light plant; the firm will furnish commercial light only.

Milwaukee, Wis.—Sealed proposals will be received January 15, 1900, for furnishing and maintaining lights by electricity or other illuminant in such streets and places in the city of Milwaukee as are now lighted by the Milwaukee Electric Railway and Light Company, and such further number of lights as from time to time may be ordered by the Common Council, for a period of either one, two, three or five years, commencing December 15, 1900, according to general specifications on file in this office. John R. Wolf, comptroller.

Thompsonville, Ct.—The stockholders of the Enfield Electric Light and Power Company, at Thompsonville, have ratified the action of the board of directors, offering their plant for sale to Apollos Fuller, of Suffield. Mr. Fuller will accept the proposition of the directors and the plant will be in his possession January 1.

NEW YORK NOTES.

THE TUCKER ELECTRICAL CONSTRUCTION COMPANY have removed their offices from 14-20 Whitehall street to the Curtis Building, 35 South William street. The Tucker Company is the oldest electrical engineering and construction company in the city, having begun business in the spring of 1887. They are also the sole licensees of the interior auto-telephone system. The officers of the company are James R. Strong, president; W. E. Gavit, treasurer and manager, and H. A. Sinclair, secretary. The latter named gentleman is the well known treasurer of the New York Electrical Society.

WESTON STANDARD

PORTALE DIRECT READING

VOLTMETERS AND WATTMETERS

For Alternating and Direct Current Circuits.

The only standard portable instrument of the type deserving this name.

Write for Circulars and Price Lists 8 and 9.

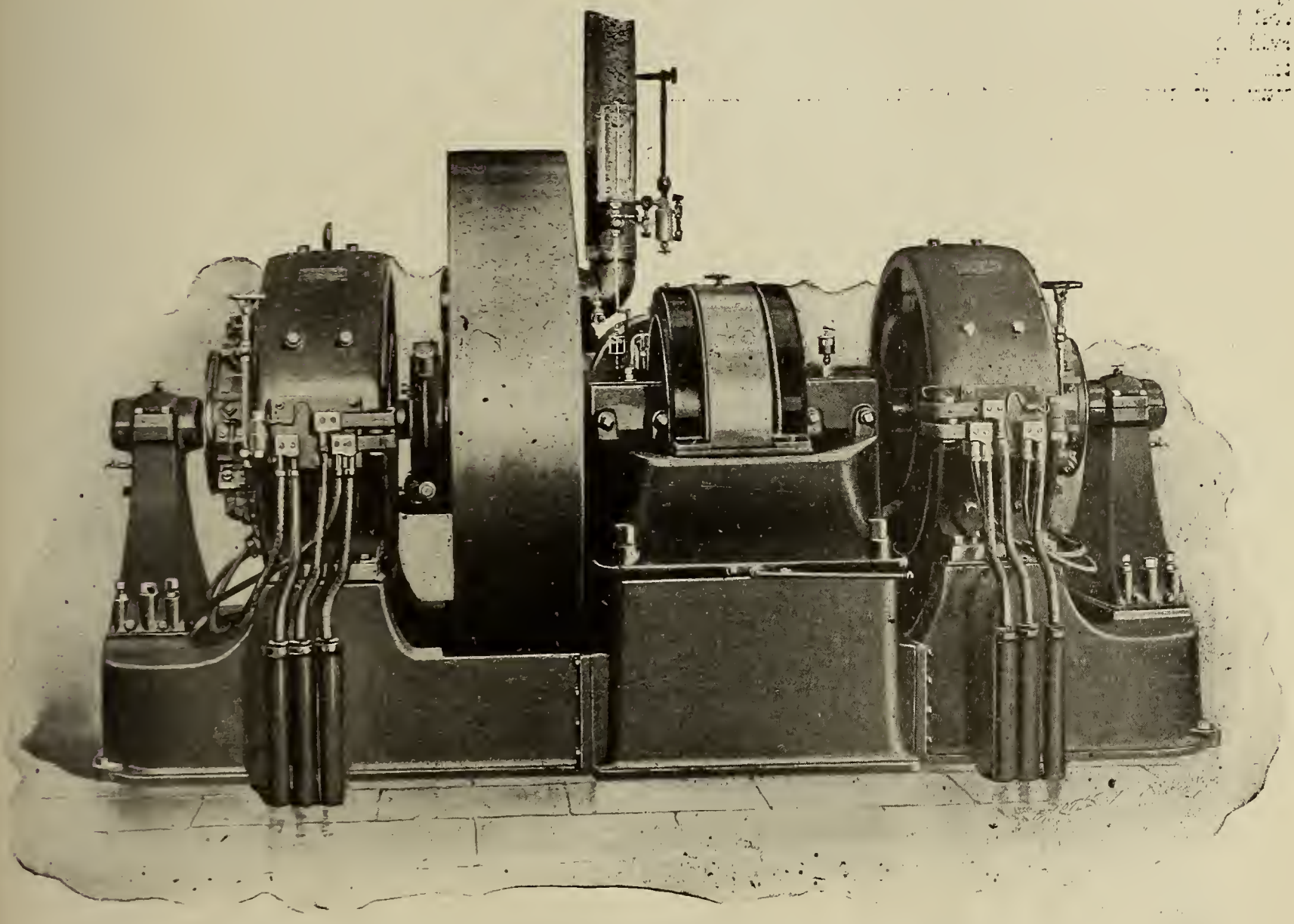
WESTON ELECTRICAL INSTRUMENT CO.,

114-120 William Street, Newark, N. J.

The Electrical Age.

Vol. XXV—No. 2 NEW YORK, JANUARY 13, 1900. Whole No. 661.

The Generation of Electric Power.



Direct-connected Unit of Two 62½-K-W. Lundell Generators, 125 Volts, 280 R. P. M.

DIRECT CONNECTED AND BELTED GENERATORS.

On the first of January, 1900, the Sprague Electric Company moved from 20-22 Broad St., New York City, to more commodious offices in their New York factory, 527 W. 34th St. The president of the corporation is John Markel; first vice-president, E. C. Platt; second vice-president and general manager, Allan C. Bakewell; secretary and treasurer, C. P. Geddes. Mr. D. C. Durland is the assistant to the general manager. Frank J. Sprague, E. E., and Robert Lundell, E. E., are the supervising engineers of the company. At the present address in West 34th St. elegant offices have been fitted up for the officers and representatives of the company, which includes the engineers and experts now employed. The various departments are in hands thoroughly skilled and accustomed to their work, thereby avoiding complications in the transaction of business. The desire of the new management of this company is for the very highest class of trade, as they manufacture the very best machinery. The management have reorganized the various selling and engineering departments and put each under the direct charge of a competent engineer.

Of all advantages that the present state of the art of designing and building of dynamo electric machinery implies the most important is the concordance of opinion among builders regarding fixed laws of design and the establishment of standards. The various elements that enter into the construction of a well operating generator are such that unless experience is largely relied upon the co-ordination of these elements will lead in the completed machine to many serious deficiencies. The experience of Mr. Lundell has been such that his labors in the production of an approximately perfect generator have been crowned with success. Armature reaction, a great fault in old machines, has been reduced to the lowest possible terms, and sparkless commutation absolutely secured for all changes of loads. The loss of energy due to heating has been reduced to a minimum, and in various other respects of a purely mechanical nature Mr. Lundell has improved the generator to an extent that has lifted the efficiency from ten to twenty per cent.

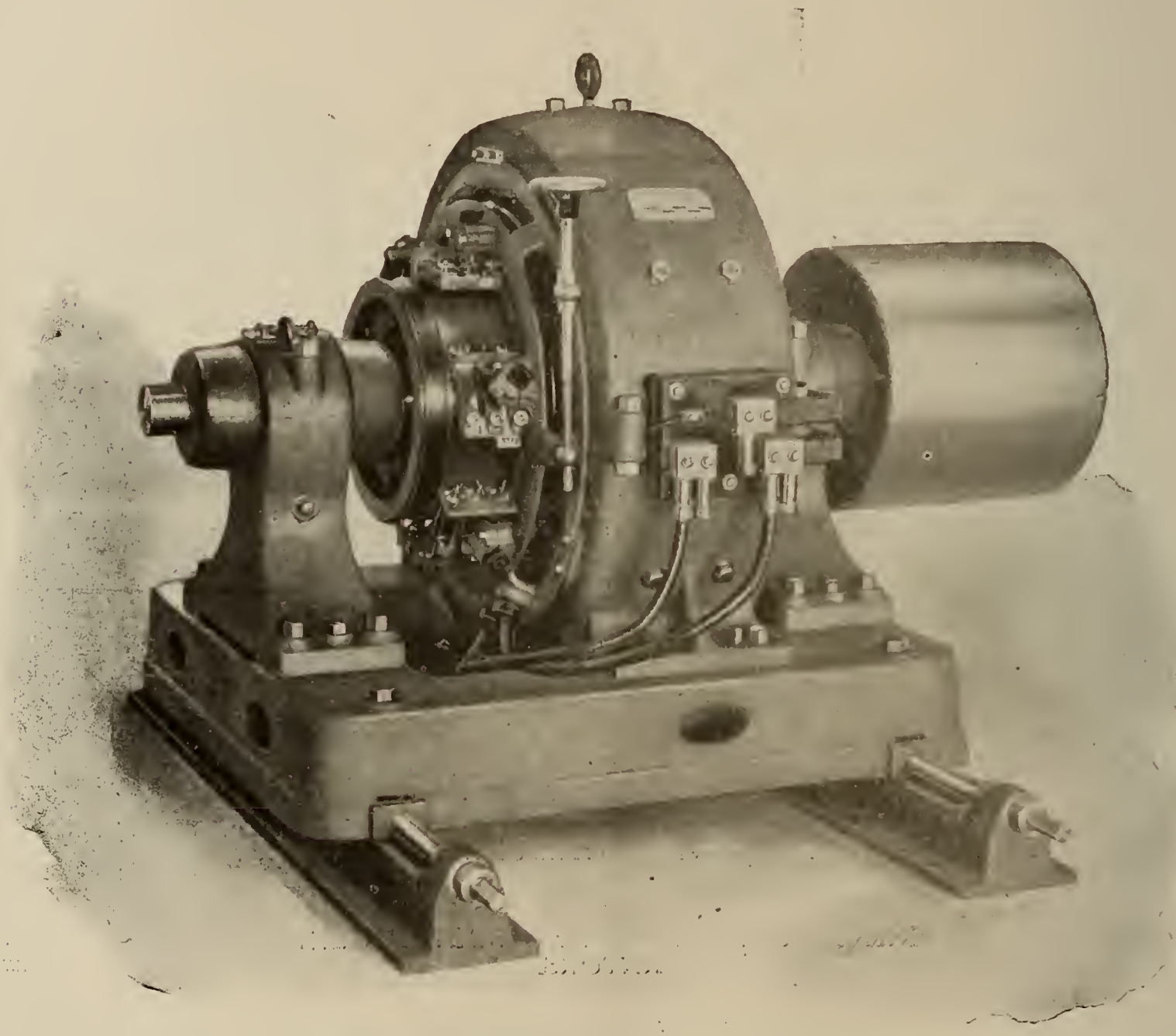
The conditions governing direct connected and belt driven generators call for a limited temperature in the

windings of not more than seventy-five per cent. above the surrounding air. The absence of sparking from no load to fifty per cent. overload is also a severe test of good design; the potential must continue uniform with all changes of load, or one of the prime requisites of a well designed generator has been neglected.

In the various illustrations introduced in this article may be seen features of design in harmony with the above specifications. The remarkable effectiveness of a single coil for supplying magneto-motive force to the fields is evident in many types of the Lundell motor and generator. This circular field coil is introduced within the frame of the machine and operates directly upon the pole pieces without involving the enormous magnetic leakage otherwise present. In this respect the machines designed by Lundell require a minimum of ampere turns; they have more than sufficient ventilation and in consequence run with all variations in load at a normal temperature. The armature conductors are of the purest copper, and for the purpose of securing an absolute system and symmetry, as well as mechanical equipoise in winding, the armature conductors are formed beforehand, the armature winding having one turn per coil. This ideal method of construction is a means of obtaining many of the advantages otherwise absent in hand wound generators of unsystematic construction.

The commutator construction is the result of careful study. It is composed of many bars of hard drawn copper, so designed as regards carrying capacity as to have ample cross section and thoroughly insulated from each other, by mica. The spider carrying the armature is employed for the support of the commutator, from which it can be readily removed. The armature core itself is driven by a cast-iron spider which represents a conjunction of solidity and strength. While the armature is operating the air circulates very freely through the windings, and, in fact, is radiated rapidly from the inside as well as the outside surface of the armature core.

The brush holder mechanism is of the same design for the single field coil type and the split pole generator. Carbon brushes are used exclusively for reasons that will stand the test of any criticism. The brush holders may be set in any direction with equal facility; they do not produce vibration or noise and are designed with sufficient cross section to allow several times the normal current to pass. An ingenious feature of construction is visible in the manner of causing contact between carbons, which prevents one from carrying more current than the other and calls for an approximately even wear over the surface of the commutator.

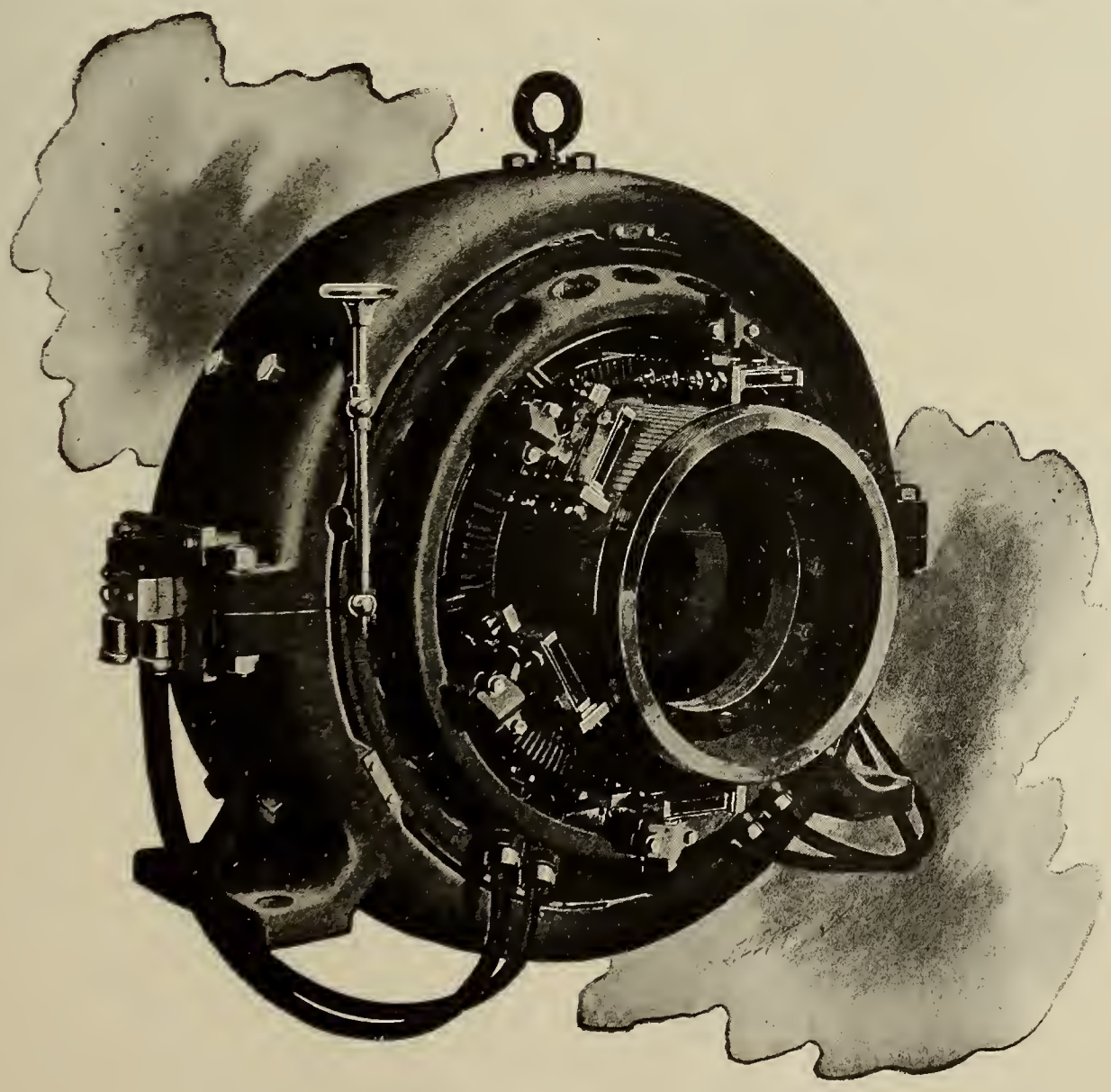


Belted-type Generator. 125 K. W., 250 Volts, 585 R. P. M.

These various details of construction collectively represent a careful study of each particular part; not alone as regards its design, but the scientific value of certain constituents when their employment is based upon sound theoretical reasoning. The Lundell generators are admirably fitted for direct connection, due to their slow speed, compact shape, large areas for ventilation, self-oiling bearings and sparkless commutation. The effi-

ciencies of the engine type and belted generators are phenomenally high: a seventy-five kilo watt belted generator has an efficiency at full load of ninety-two and one-half per cent., at twenty-five per cent. overload ninety-two and a quarter per cent.., and at from fifty to seventy-five per cent. of the full load from ninety to ninety-two per cent. The efficiency increases in belted generators from the seventy-five kilo watt through the one hundred, one hundred and twenty-five and one hundred and fifty kilo watt, to the two hundred kilo watt, which at full load has a total efficiency of ninety-three and three-quarters per cent. In the engine type of generators of the larger sizes and split pole type the efficiency is ninety and a half per cent. at full load for the thirty-seven and one-half kilo watt machine, and rises through various sizes to the one hundred kilo watt, whose efficiency at full load is ninety-three and three-quarter per cent., or ninety-one and three-quarter per cent. at twenty-five per cent. overload and nearly ninety-two per cent. on the average when operating at from fifty to seventy-five per cent. of the total load. In both the belted and engine type generators the split pole has added largely to effective regulation. The application of this idea in practice has been eminently successful and its value as a means of preventing distor-

View of Factory of Sprague Electric Company at Watsessing N. J.



Engine-type Generator, 100 K.-W., 125 Volts, 260 R. P. M.

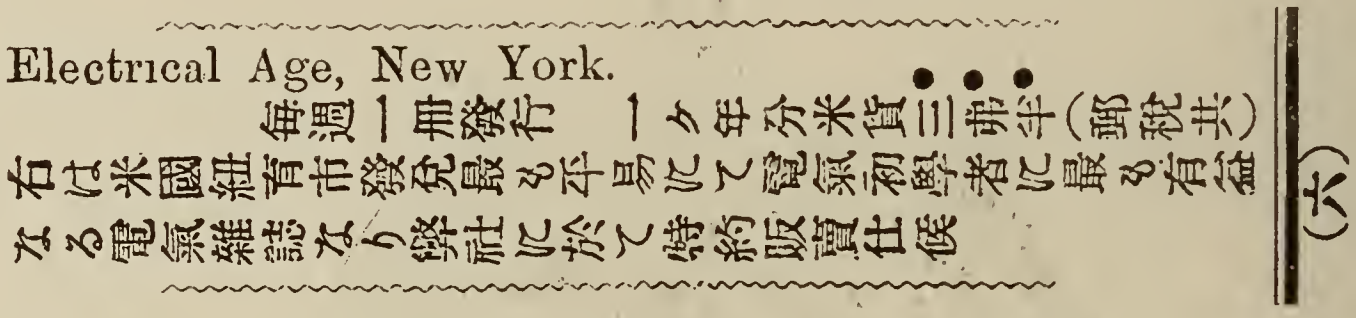
(Split-pole)

tion of the field to an unusual extent is admittedly the most practical yet devised. According to the late Dr. John Hopkinson, Lundell's idea is a most valuable one. He says: "I am satisfied that this device will be practically successful in avoiding the necessity of shifting the brushes, and in my judgment it is by far the simplest expedient which has yet been proposed to attain this desirable end." Catalogues will be sent on application, fully descriptive of the Lundell generators, both belted and directed connected, by writing to the main office.

The Sprague Electric Company, in addition, are manufacturing the Sprague multiple unit system of control for elevated railway service, Lundell fan motors of all types and all styles of exhaust and ventilating apparatus. At their large works at Bloomfield, N. J., the Sprague electric elevators keep the greater part of the hands busy. At these works also are made all their generators and motors, the Sprague railway and elevator apparatus, as well as their belted and engine type of split pole generators. They have large contracts for fitting out the elevated railways of Brooklyn with the Sprague multiple unit system of control. They have several months' work on hand in filling orders for Lundell power motors and generators. Special attention is called to the Greenfield flexible metallic conduit, which has become most popular among the up-to-date architects and contractors.

THE ELECTRICAL AGE READ IN JAPAN.

We have been recently honored by receiving a marked copy of the famous Japanese electrical paper, "The Electrical Friend," published in Tokyo, by S. N. Katogi, president and editor. The marked copy contained a reference to The Electrical Age in Japanese which we thought we would photograph bodily and reproduce for the benefit of our readers. An extract from these cabalistic signs reads: "The student of electricity will find exceptional benefit in this magazine."



Obituary.

S. DANA GREENE.

S. Dana Greene, general manager and one of the vice-presidents of the General Electric Company, and his wife, were drowned on the afternoon of January 8th while skating on the Mohawk river, at Schenectady, N. Y. Mrs. Greene was still alive when taken from the water, but died a few minutes later in spite of the efforts made to resuscitate her. Mr. Greene's body was not picked up until three hours later, the body being picked up a short distance from where Mrs. Greene's was picked up.

Mr. Greene's career had been an eventful one. He was thirty-five years old and was a son of Samuel Dana Greene, who was first lieutenant and executive officer of the Monitor in its fight with the Merrimac. He was a graduate of the Naval Academy and stood at the head of his class. About eight years ago he left the Navy and entered the employ of the General Electric Company, at Schenectady, and had soon worked his way up to a position of responsibility and emolument. Four years ago he married Mrs. Cornelia Chandler, daughter of Rear Admiral Chandler. During the late war with Spain he served as lieutenant on board the auxiliary cruiser Yankee and was appointed naval aid on Governor Roosevelt's staff in recognition of his distinguished services.

Mr. Greene was a member of the American Institute of Electrical Engineers, National Electric Light Association and a number of social organizations in New York city. He was one of the most popular figures in electrical circles and leaves a host of friends who mourn his untimely death.

RECORD-BREAKING POWER TRANSMISSION.

The starting of the large turbines and the ponderous fly-wheels and electrical machinery of the Kalamazoo valley electric company's new power plant near Allegan, marked the partial completion of a gigantic electrical enterprise, which, when the plans of its promoters have been fully carried out, will be the most interesting long-distance transmission plant in the world, and from the standpoint of the electrical engineer, the most important. So far as these plans have materialized, the enterprise has proved a success beyond the most sanguine hopes of its enthusiastic backers; and when the final tests were made, the machinery started and the main switches thrown so that the street railway system of the City of Kalamazoo was in the circuit, there was not the faintest suspicion of a hitch and the trolley cars of the hustling little city miles away were operated by power from the way, telephone and telegraph lines and bridges.

ELECTROLYSIS OF GOLD AND COPPER SOLUTIONS.

We take from Carl Hering's digest the following abstract of an article by Mr. Rovello on the "Electrolytic Treatment of Solutions of Copper and Gold." The article first appeared in the Rassegna Mineraria. The author has devised an electrolytic method, using a cell, the anode of which is made of the precipitating metal, and is in an acid solution, and the cathode is any metal that is not attacked chemically by the solution to be treated, in which it is suspended. The anode and cathode are connected by an external wire, and no external course of current is used—that is, the cell is a short-circuited battery. The form of the apparatus is described as follows: In a large trough there are suspended the vertical cathode plates, and above them upon wooden bars there are placed horizontal ingots of the anode metal precipitant. The solution to be treated is supplied through a hole in the bottom into the trough, while the treated solution can flow off at the top. The operation is begun by filling about half the trough with dilute acid and then adding slowly, through the hole in the bottom, the solution to be treated. This solution is heavier than the dilute acid, and therefore rests at the bottom. As soon as it reaches the horizontal ingots, a current goes through the solution from these ingots as anode to the cathode plates below; the solution is decomposed, the metal deposited on the cathode while the acid goes to the anode and forms a salt solution, which flows off. For the treatment of copper solutions, copper is used for the cathodes, iron ingots for the anode; 15 grm. of copper can be deposited per square metre of cathode per hour. For the treatment of auriferous solutions the cathodes are of lead and anodes of zinc.

The Electrical Age.

ESTABLISHED 1883.

Entered at New York P. O. as second-class matter, January 13, 1891.

THE ELECTRICAL AGE PUBLISHING CO., Publishers.

TERMS OF SUBSCRIPTION:

One Copy, one Year, - - - - - - - - - $3.50
One Copy, six months, - - - - - - - - 1.25
Great Britain and other Countries, - - - - 3.50

Cable Address (all Cables), "Electage," New York.

NEWTON HARRISON, E. E., EDITOR.

ASSOCIATE EDITORS:

ALFRED E. WIENER, E. E., OSBORNE P. LOOMIS, E. E., } ELECTRIC LIGHT AND POWER.
JOSEPH MUIR, M. D., FREDERICK STRANGE KOLLE, M. D., } ELECTRO-THERAPEUTICS.

ADDRESS ALL COMMUNICATIONS TO
THE ELECTRICAL AGE PUBLISHING COMPANY,
Seventh Floor, World Building,
NEW YORK.

NEW YORK, JANUARY 13, 1900.

CONTENTS:

DEPENDENCE OF LARGE CITIES ON ELECTRIC LIGHT.

Occasions will arise when the citizens of New York realize how much dependent they are upon electricity for light. Accidents to the mains or in the station will sometimes cut out a circuit and leave a neighborhood in absolute darkness. A neighborhood of this description may be found in the theatre district of New York. Here the majority of cafes, restaurants and theatres, as well as various places of amusement, are lighted by electricity and the power is supplied from one or two electric light stations in the near neighborhood.

This last week, being an unfortunate one in the stations, led to the lights being shut off, thereby plunging all the Broadway theatres and hotels in darkness. The main machine switchboard of the United Electric Light & Power Company's plant burned out and it was a curious experience to walk through Broadway in comparative darkness. The great electrical advertising signs were nearly all out and the theatres were lit by gas, with the exception of one, in which no provision had been made for anything but electric lighting. The last accident of this kind but one took place in the Twenty-sixth street station of the Edison Electric Illuminating Company. The station burned down but in spite of this accident no lights in the neighborhood were affected for a long enough period to cause any comment. The Edison network is sufficient for all emergencies of this kind and it was simply necessary for the other stations to divide up the load between them the moment the inoperativeness of the above station was made known.

The hygienic conditions now prevailing in theatres in winter and spring can be largely attributed to the use of electricity. The lamps consume no oxygen from the air, consequently the atmosphere is not vitiated; they add less than one-quarter of the heat which would otherwise emanate from gas jets and the risks from fire are considerably reduced. In addition, it has become the practice to install noiseless electric fans or erect large exhausts, which abstract the air from the theatre between the acts and thereby add greatly to the comfort of the audience.

People in New York only realize how dependent they are on electricity for the many of the comforts above enumerated when the current is suddenly cut off. In cases where this has occurred for a period of ten or fifteen minutes and gas substituted the switching on again of the current is hailed with a perceptible sigh of relief throughout the audience. It is advisable, of course, for hotels and theatres to have electroliers, so that in case of accident gas light will always be at their command.

THE FAILURE OF WIRELESS TELEGRAPHY.

The limitations of wireless telegraphy seem to be more firmly established as time speeds on. Many circumstances arise which interfere with the operation of the apparatus and the reception of signals. A case of this kind occurred in South Africa at the seat of the Boer war. According to the London "Daily Mail" the Marconi system was tried between the Modder and DeAar rivers. It seems that in this section of the country, which is inclined to be mountainous, there are hills in the neighborhood, full of iron which seriously affects the working of the apparatus. It is rather unfortunate that, in such a critical case as this, where an attempt to establish communication between distant points would make the system a matter of the deepest interest to all the military powers of the world, it should fail. At present, as is well known from daily newspaper reports, the heliograph system has been adopted by the British army to the exclusion of all other methods of communication, except by courier. Let Marconi penetrate to the seat of the war with a wireless telegraph outfit which will operate and his name will become identified with this bloody struggle as long as English history exists.

$36,000,000 LIGHT, HEAT AND POWER COMPANY.

It seems that our friend Rockefeller is not content with owning the Standard Oil Company whose stock is above four hundred but desires to become more intimately acquainted with the profits of the electric light, heat and power industry. At present the Edison Electric Illuminating Company and various other electric light interests in New York City are controlled by Whitney, Widener and Elkins. It is rumored that Rockefeller has formed a combination with the above named, either buying them out or possessing a large interest in their holdings. He is interested in the Consolidated Gas Company, which on January 3d became connected with the New York Gas, Electric Light, Heat and Power Company, which was capitalized in November, 1898, for $36,000,000. The companies held by this corporation, in addition to the Edison Electric Illuminating Co. and the United Electric Light and Power Co., include the Mount Morris Electric Light Co., New York Light, Heat and Power Co., the North River Electric Light and Power Co., the Borough of Manhattan Electric Co., Block Lighting and Power Co., Manhattan Electric Light Co., and control of the subways of the Empire City and Consolidated Telegraph and Electrical Subway companies.

CONGRATULATIONS TO "THE ELECTRICAL REVIEW."

We congratulate our contemporary, "The Electrical Review," on the excellent progress they have made within the last year. We think the success they have met with is only their due and represents the result of persistent effort and a thorough appreciation of what the electrical trade requires. Their New Year's Double Number seems to us to be second to none that has so far appeared, and we again congratulate the management on their progress and wish them continued success.

Telegraphy.

MACHINE TELEGRAPHY OF TO-DAY.

Copyrighted by W. L. Craig.

(Continued from page 2.)

RECEIVING.

Messages are received in plain Morse characters, which, after a few days' practice, may be read almost as rapidly as print. The receiving is on a chemically prepared paper ribbon, or on sheets if preferred. The ribbon is drawn over a metallic drum. A piece of steel wire is connected to the line and rests on top of the paper. The metallic drum is connected to the earth. The chemically prepared paper forms a part of the circuit, and, consequently, a path for the circuit. When a signal or impulse is sent from the transmitting station, the current unites with the chemical in the paper at the receiving station, leaving a mark of prussian blue as plain as ink. There are no moving electro-mechanical parts, no adjustmens of magnets or springs, and the speed at which the char-

of fresh reels to the transmitting machine. Each reel will hold 1,000 words. To change reels and to receive acknowledgment of the receipt of the preceding batch of messages takes about five seconds. Thus, over 50,000 words per hour may be sent from New York to Chicago on a single wire the entire twenty-four hours of the day. A second wire would deliver the same number of words from Chicago to New York.

This amount of matter would cover all telegrams exchanged between New York and Chicago by both the Western Union and the Postal Telegraph Companies, about 8,000 daily, over 30 circuits, and all the letters exchanged between the New York and Chicago post-offices, over 30,000 daily, allowing 50 words for each letter.

THE MACHINE SYSTEM COMPARED WITH THE MORSE.

A perforator will prepare messages on the ribbon faster than the Morse operator can transmit by key. A translator will print the received message on a blank, by typewriter, faster than the Morse operator can receive by sound. But, for simple comparison, if the perforator and translator are credited with the same amount of work as two first-class Morse operators, it will be ovious that the machine system in effect will keep employed over a single wire forty to fifty perforators at the transmitting station.

It is hardly a debatable question whether it is more profitable to construct and maintain a first-class line of two wires between New York and Chicago, with a carrying capacity of 2,000 or more words per minute, or to maintain several lines of poles carrying forty or fifty wires capable, by the hand system, of the same amount of work. The capital account for the original plant would be enormously in favor of the machine system. The average cost of repairs to the ordinary telegraph line is upwards of $5 per mile per annum in the open country, and five times that amount in cities. Between New York and Chicago forty wires would, at that rate, cost over $200,000 per annum to keep in repair. The greater the number of wires on poles, the greater the percentage of interruptions by crossing, breaking down of poles, fixtures, etc.

Salaries of first-class Morse operators are much higher than would be necessary for perforators and typewriters.

POSTAL TELEGRAPHY.

If this country is ever to have postal telegraphy, it must come through the machine system. It cannot possibly be put in practice without it at any less rates for telegraphing than are now charged by existing companies, unless carried on at a great loss to the Government.

Postal telegraphy at anything like existing rates would be of no advantage to the people.

The United States is the only Government that persists in carrying the mails by a slow conveyance in preference to a fast one. No valid reason can be advanced why a letter should be delayed thirty hours between New York and Chicago, when it can be telegraphed and delivered by a postman within an hour, at a cost of 25 cents for one hundred words by day or two hundred words by night. Business houses doing their own perforating and translating may reduce this expense about 50 per cent.

The change from the train to the telegraph as a means of carrying letters is quite as imperative and fully as warrantable as was the substitution of the train for the stage-coach many years ago. It would appear strange indeed if the Government should require that all mails between Buffalo and New York should go by the Erie Canal instead of by train, and yet the discrepancy between the canal and the train in point of speed is certainly no greater than the difference between the train and the telegraph.

It may be said, however, that heretofore postal telegraphy was impracticable on account of the slow hand system of operating. Private enterprise will shortly prove that there is no longer any legitimate obstacle in the way of telegraphing the mails, and that with a machine system capable of from 1,000 to 3,000 words per minute over a single wire, all correspondence of any importance or urgency will be carried on by telegraph.

(To be continued.)

Among the Societies.

NOTES ON THE ADDRESS BY J. W. LIEB, JR., BEFORE THE NEW YORK ELECTRICAL SOCIETY, DECEMBER 21, 1899. SUBJECT: "ELECTRICITY SUPPLY FROM CENTRAL STATIONS COVERING RECENT DEVELOPMENTS IN THE CONSTRUCTION AND OPERATION OF CENTRAL STATIONS IN OUR GREAT CITIES."

The speaker opened his remarks by a reference to the extent and character of the territory included within the limits of Manhattan Island, pointing out that this field presents nearly all of the varying conditions of electricity supply covering many of the problems connected with the generation and distribution of electricity for lighting and power purposes.

After a brief review of the history of the electric lighting industry previous to the starting of the old Pearl street station of the Edison Company, an interesting picture was presented of that pioneer lighting station, including reminiscences of the early difficulties encountered in the construction and operation of the station machinery and how they were successfully overcome. Some interesting maps were shown, including maps of the original underground system, diagrams illustrating a house-to-house canvass made by Mr. Edison, showing all the gas light and power users in the district, and a map on which future distributing stations are laid out, covering all the territory up to Central Park, within which thirty-eight distributing centres were located.

Series of curves were presented, showing the development of the business of the New York Edison Company from '83 to date, including curves of income, load, connected installations, etc., etc.

The loads carried by the several stations connected to the system were shown by vari-colored curves and explanations were given of the character of the business in each district as reflected in the peculiarities in the forms of the curves. Parallel curves, exhibiting the variations from month to month and from year to year, formed a graphic indication of the effect of the season and the variations in the hours of the rising and setting of the sun.

A sectional plan was shown of the water-side station now being constructed between 38th and 39th streets and the East River, by the New York Gas and Electric Light, Heat & Power Company.

The equipment of this station, covering a plot 190x273, was described in detail and data was given of the efficiency which it is expected to obtain from the engines, generators, etc. The complete plant will consist of sixteen three-crank compound condensing engines, 75 revolutions per minute, and developing each 5,200 indicated horse-power at most economical cut-off, and nearly 10,000 hp at maximum power. Each engine will be direct connected to a three-phase generator operating at 6,600 volts and rated at 3,500 kilowatts, but capable of operating with a load of 4,500 kilowatts for three hours.

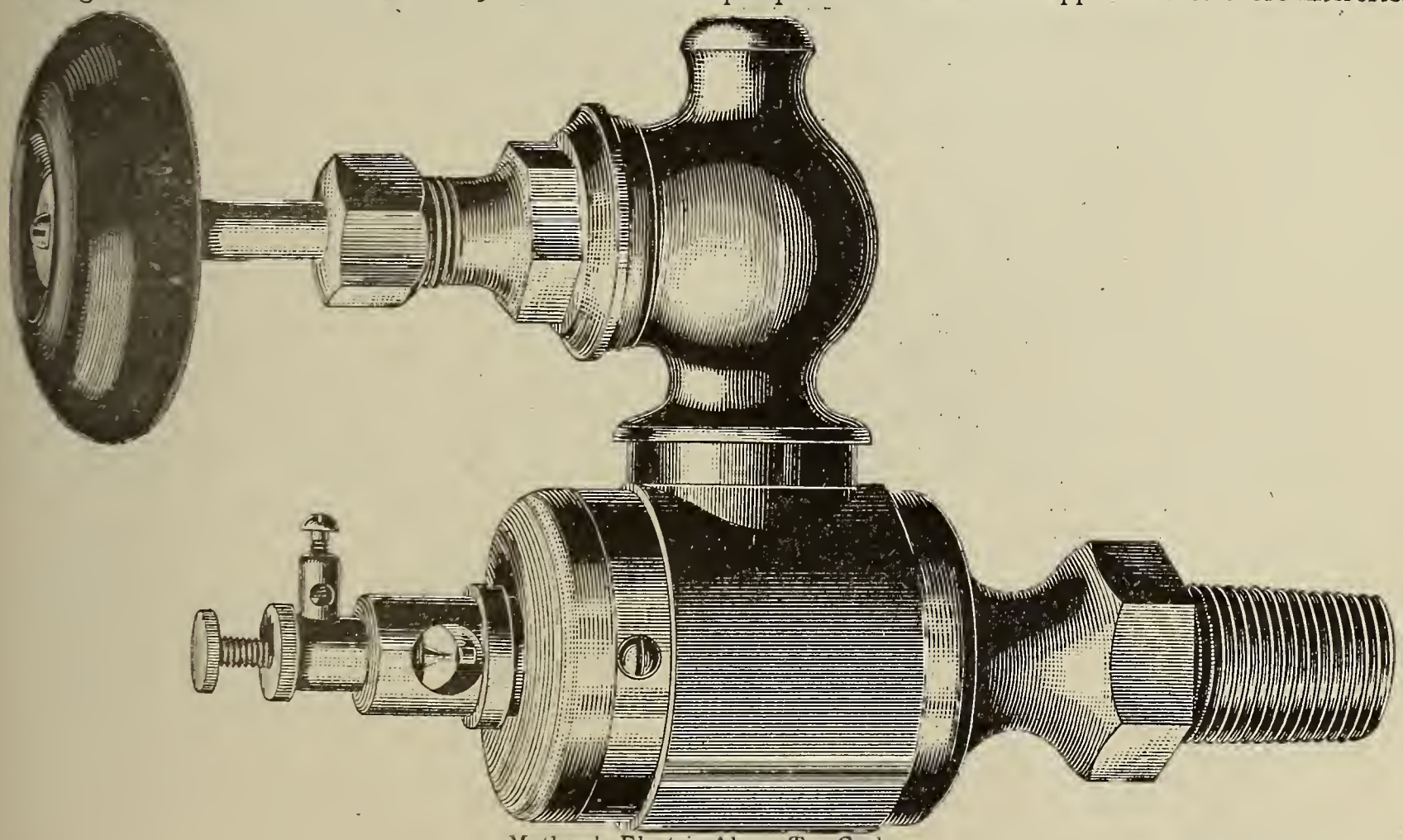
Fifty-six boilers, each of 6,400 square feet of heating surface, will furnish the steam supply, and it is proposed to equip the boilers with super heaters in addition to the usual complement of automatic stokers, feed water heaters, feed pumps, etc. The products of combustion will be discharged into four steel stacks, each 19 feet in diameter and 196 feet high above the grates, supplemented, when necessary, by forced draught from fan blowers.

A map of the extensive underground system supplied with currents from the Edison Company and by the companies associated with it, under the administration of The New York Gas, Electric Light, Heat & Power Company, was shown, for which the water-side station is to furnish the main current supply.

A number of rotary converters stations now in course of construction at Horatio street, West 84th street, East 121st street and West 124th street, will be equipped with rotary converters and storage batteries, permitting of an extension of the direct-current underground system into new and hitherto unoccupied territory, and, together with rotary converter equipments at several of the present generating stations, will afford at once a considerable outlet for the high-tension three-phase current generated at the water-side station, enabling also some of the less economical generating apparatus to be put out of commission and to be used during only a few months of the year on the peak of the lead. The speaker then briefly touched on some details in the method of distribution in future of series arc lighting, rectifiers, etc., etc., which the lateness of the hour made it impossible to consider at

MATHEWS ELECTRICAL ALARM TRY COCK.

An exceedingly ingenious device has been placed upon the market by the Electric Boiler Protection Company, 9-11-13 Maiden Lane, New York. This try cock is attached to the boiler free of charge in Greater New York, for the purpose of demonstrating its efficacy. In the illustration the device is shown full size. When the water falls below the level of the electrical alarm try cock a bell rings immediately and announces the reduced level of the water. The entrance of steam into the upper part of the main body of the device forces two contacts together by playing upon a flexible disk. The contacts are platinum and therefore do not oxydize or in any way deteriorate through exposure to the air. The try cock is supplied with bell and batteries complete for a nominal sum. This device is undoubtedly extremely valuable in private plants and electric light and power stations. Descriptive pamphlets will be sent on application to those interested.



Mathew's Electric Alarm Try Cock.

Business News.

SPECIAL EXPORT COLUMN.

TOTAL AMOUNT OF ELECTRICAL EXPORTS FROM NEW YORK CITY FOR WEEK ENDING JAN. 5, 1900, $16,501.00.

New York, N. Y., Jan. 6, 1900.—The following were the exports of electrical material from the Port of New York for the week just ended:

Athens.—3 cases electrical material, $26.

Amsterdam.—3 cases electrical material, $85.

British Australia.—5 packages electrical machinery, $648.

Canada.—8 cases electrical material, $56.

Florence.—24 packages electrical material, $613.

Havre.—104 packages electrical material, $2,072.

Hayti.—10 packages electrical material, $60.

Hamburg.—95 packages electrical machinery, $1,675.

Liverpool.—3 packages electrical cranes, $1,200.

London.—102 packages electrical material, $4,449; 11 electrical machines, $1,242.

Rotterdam.—7 cases electrical material, $75.

Stettin.—1 case electrical machinery, $151.
Southampton.—4 cases electrical machinery, $160.
St. Petersburg.—1 case electrical material, $154.
Santo Domingo.—35 cases electrical material, $3,544.
Uruguay.—13 cases electrical material, $150.
U. S. Colombia.—16 cases electrical material, $141.

NEW INCORPORATIONS.

Cripple Creek, Col.—The People's Electric Company has been formed at Cripple Creek to deal in electrical supplies; capital, $50,000; incorporators, M. S. Boal, H. L. Shepherd, E. Bell, all of Cripple Creek.

Downers Grove, Ill.—The Downers Grove Electric Light Company, of Downers Grove, has been chartered for operating electric light plants. Capital, $2,500. Incorporators, W. A. Tape, J. Klein, W. H. Edwards, all of Downers Grove.

San Francisco, Cal.—The California Gold Mining and Electric Power Company, of San Francisco, has been incorporated, with a capital of $200,000; incorporators, J. C. Jens, A. H. Rich, J. R. Turner, all of Belmont; G. Gall, N. Hanson, both of San Francisco.

Portland, Me.—The Marshall-Sanders Company has been organized at Portland for the purpose of manufacturing electrical apparatus, with $50,000 capital stock, of which nothing is paid in. The officers are, president, C. M. Drummond, of Portland, Me.; treasurer, J. M. Drummond, Jr., of Portland, Me.

El Paso, Col.—The Golden Crescent Water and Light Company has filed articles of incorporation, the capital stock being $50,000. The company will operate in El Paso, Teller and Fremont Counties, and the principal office will be at Victor. The incorporators and directors for the first year are Warren Woods, H. E. Woods and F. M. Woods.

Newport News, Va.—The Newport News Conduit Company has been chartered with a capital of $100,000 and the following officers: City Treasurer J. M. Curtis, president; O. B. Batchelor, vice-president; B. J. Pressey, treasurer; W. Lee Powell, secretary. The company has made application to the Council for a franchise to operate in the principal streets, guaranteeing to complete its conduits on the streets where paving is to be done before this improvement is made. The company is authorized, after first obtaining permission of the proper municipal authorities, to construct an underground system of conduits for conveying electricity in Newport News, Hampton and suburbs.

TELEPHONE CALLS.

Darrtown, Ohio.—The Darrtown Telephone Company has been incorporated to construct and operate telephone lines; capital, $3,000; incorporators, L. A. Miller, F. S. Butler, J. Bufleson, G. Wagenfield, J. F. Mee.

Wilmington, Del.—The American Independent Telephone Company, of Wilmington, has been chartered to construct and operate telephone and telegraph lines; capital, $1,000; incorporators, E. T. Canby, C. W. Smith, J. L. O'Neill, all of Wilmington.

Reading, Pa.—The Berks County Telephone Company has been chartered at Dover, Del., with a capital stock of $300,000. It is said that if Reading's Councils grant the new company a franchise, operations will be begun at once and the new company will extend its lines to Wilmington, to connect with the Delmarvia company there, from where connection will be made with Baltimore, the central station for the eastern and western lines of a proposed big company.

STREET RAILWAY NEWS.

Springfield, Ill.—The Los Angeles Traction Company, of Jacksonville, Ill., has increased its capital from $250,000 to $500,000.

Lima, Ohio.—The Bellefontaine, Kenton & Lima Railroad Company, of Lima, has been incorporated; capital, $100,000; incorporators, W. H. Miller, F. B. Williams, R. G. Furguson, R. Dunlap, J. K. Pierson, O. W. Williams.

Trenton, N. J.—The Township Committee of Hamilton Township has granted a franchise to the Trenton Street Railway Company to extend its line from Yardville to Allentown, N. J. The line from Trenton to Yardville is already in operation.

Camden, N. J.—The Camden & Suburban Railway Company is making extensive improvements to its power house and machinery on Cooper's Creek, on the south side of Federal street bridge, which, when completed, will make it the best equipped power house in South Jersey.

Glasgow, Ky.—Articles of incorporation are asked for the Glasgow Railway Company, with a capital stock of $100,000. H. C. Trigg, W. L. Porter, and T. P. Dickinson are the principal incorporators, and set forth that the purpose is to make a connecting road from Glasgow Junction to Glasgow.

Middleboro, Mass.—The selectmen of Middleboro have granted the petition of the Middleboro, Wareham & Buzzard's Bay Street Railway for a franchise in this town. It is anticipated that this will quickly bring the contest among this company, the Onset Bay & New Bedford line and the Freetown line to a definite solution. All three companies are fighting for a right into Onset Bay.

Brattleboro, N. H.—A new trolley project is now under consideration. It is to run an electric line from Brattleboro to Keene, N. H., a distance of 26 miles, passing through the villages of Hinsdale, Ashuelot, Winchester, Westport and West Swazey. Boston electric railroad men are interested in the matter. Should this scheme be carried out, it is not improbable that the line may finally be extended from Keene down to Winchendon, and thence it will be but a short step to connect with the road at Templeton.

POSSIBLE INSTALLATIONS.

Racine, Wis.—An ordinance has been introduced in the City Council in favor of granting to ex-Mayor M. M. Secor the right to build, maintain and operate an electric lighting plant in the city of Racine. The plant will be operated in opposition to the Milwaukee company.

Collinwood, Ohio.—The village of Collinwood is making plans for extensive improvements. A complete electric light plant, to be owned and operated by the village, is to be put in, ready for operation in June, this year. There are to be sixty-three arc lights in the village. For these improvements $18,000 worth of four per cent. bonds have been issued.

WESTON STANDARD ILLUMINATED DIAL

STATION INSTRUMENTS.

THESE INSTRUMENTS are based upon the same general principle and are just as accurate as our regular Standard Portable Direct Current Voltmeters and Ammeters, but are much larger, and the working parts are inclosed in a neatly designed dust-proof cast-iron case, which effectively shields the instruments from disturbing influences of external magnetic fields.

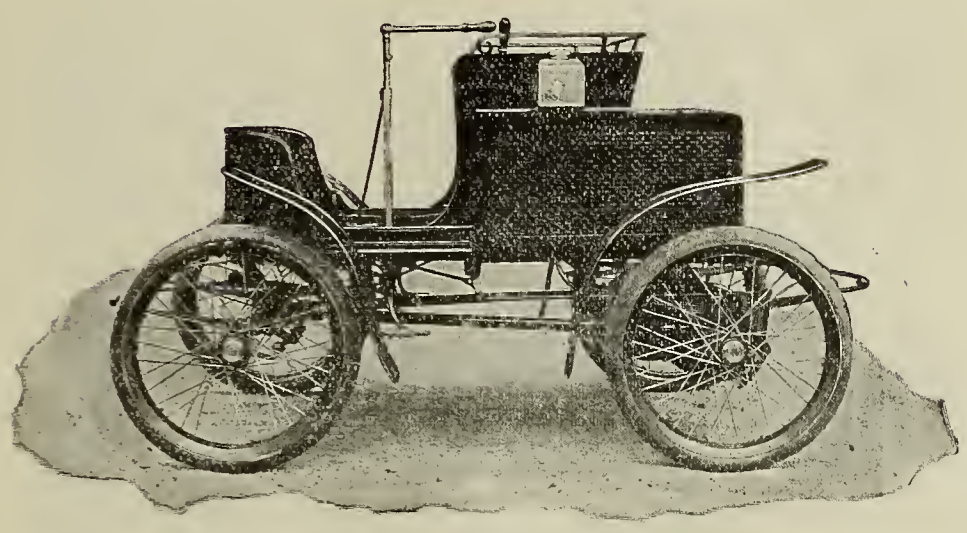
WESTON ELECTRICAL INSTRUMENT CO.

114-120 William St., Newark, N. J., U. S. A.

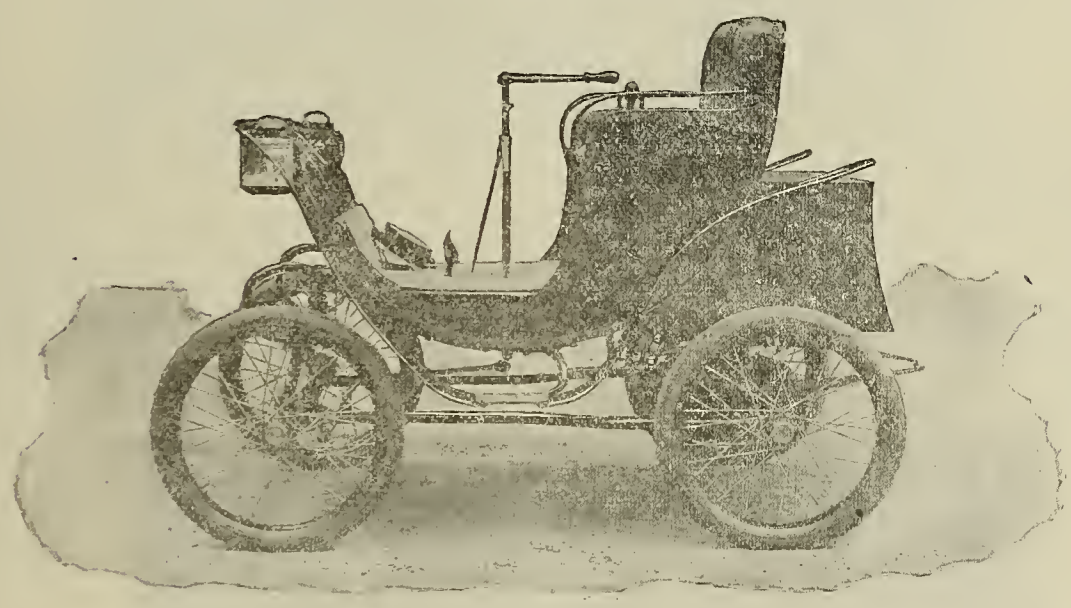
The Electrical Age.

Vol. XXV—No. 3. NEW YORK, JANUARY 20, 1900. Whole No. 662.

Automobiles.



Mark XII Runabout.



Mark XII Victoria.

COLUMBIA ELECTRIC AUTOMOBILES FOR PLEASURE RIDING.

Last summer marked the beginning of a real interest in automobile vehicles for pleasure riding at prominent summer resorts. Newport started off early in June with someten vehicles, and before the end of the season there were over forty in the hands of prominent cottage people and society leaders. "Motoring" was the reigning amusement of the summer, and the automobile flower parade which took place towards the end of the season was voted by all who saw it to be one of the most attractive and interesting of the various outdoor functions which take place in Newport from year to year.

Other seaside and inland resorts had their automobiles also, but in lesser numbers,—Long Branch, Seabright and Saratoga Springs had each a few. Almost all these vehicles were of the electric variety and made for the Electric Vehicle Company of New York city by the Columbia and Electric Vehicle Company of Hartford. The Newport automobile "stable" was behind the site of the old Ocean House and conducted by the New England Electric Vehicle Transportation Company of Boston, one of the sub-organizations of the Electric Vehicle Company.

There were a half dozen varieties of these electric automobiles in constant use, and, with one or two exceptions, a considerable number of each variety The styles included Stanhope phaetons, Dos-a-dos traps, runabouts, and victorias, both large and small.

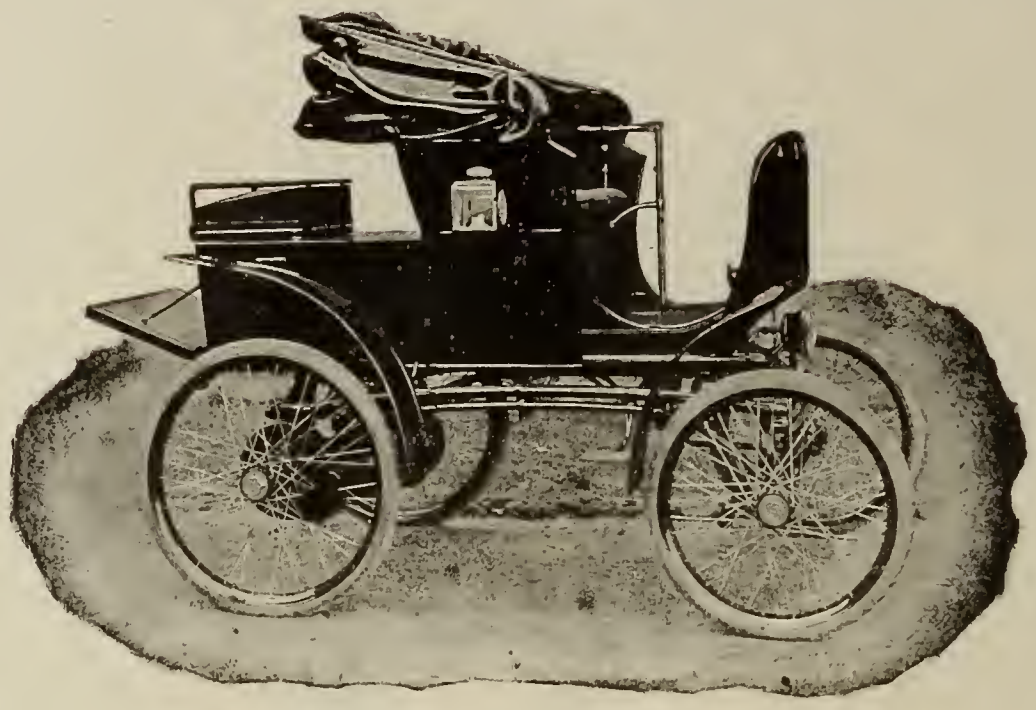
The phaeton seems to be the most popular style of electric automobile built to date, to judge at least from the fact that practically all manufacturers of electric vehicles have included at least one phaeton in their list of models. The Columbia phaeton has a large victoria hood and is provided with a removable rumble at the rear, making it possible to carry as a third occupant either a groom or other person. It is finished in black with panels of dark green, and is upholstered in dark green cloth. The body is supported by means of three transverse springs above a running frame of steel tubing, curved to harmonize with its lines and brazed into steel froged frame joints, forming a rectangular frame of great rigidity. This frame is supported by two corner hangers from the solid rear axle, and in front is centrally pivoted to arched transverse tubes which terminate in axle brackets carrying the individually pivoted front wheels. By means of this hori-

zontal frame pivot, the front wheels are allowed an oscillatory motion, thus permitting them to adapt themselves to the inequalities of the road.

Steering is effected by means of a short horizontal lever. The steering post passes down through the floor and is joined to the steering head by means of ball and socket joints.

battery deliver 75 ampere hours, giving a mileage of from 30 to 35 miles at a speed of about 12 miles per hour.

For smaller and lighter vehicles carrying each two occupants, the Columbia Mark XII. runabout and the Columbia Mark XII. victoria were very much in demand. These vehicles are similar, in respect to running gear. The body is mounted at the rear upon fore-and-aft full



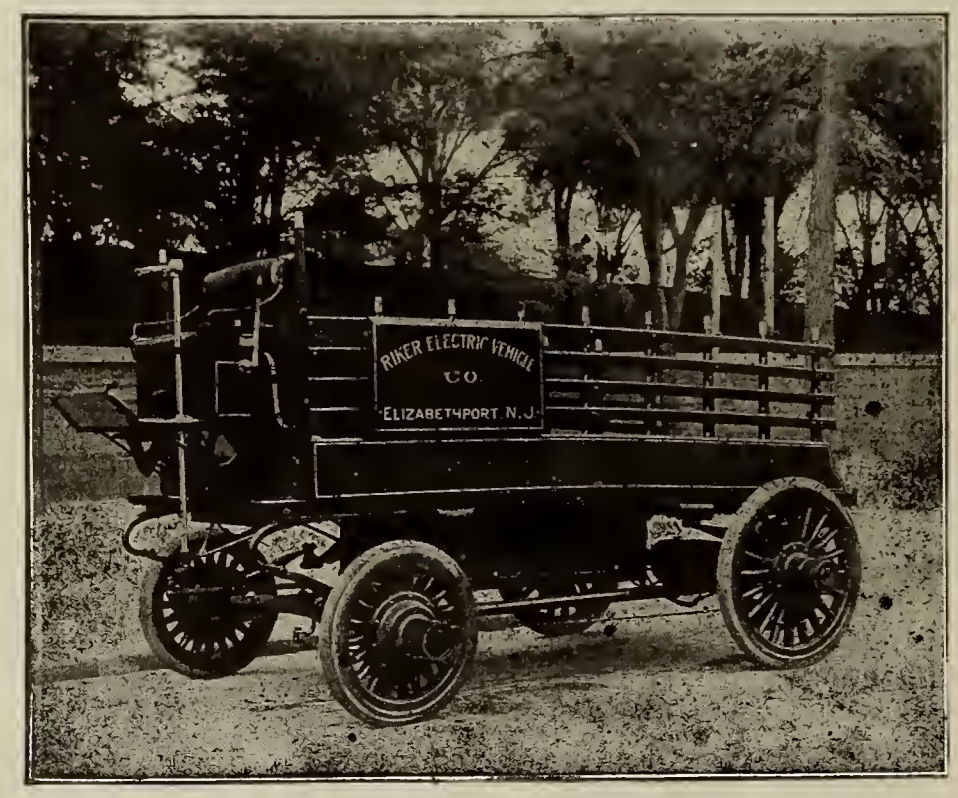
Mark III Phaeton.

The braking apparatus consists of two expanding metal bands forced into contact with the inside periphery of the driving gears by means of a foot pedal under the control of the driver

The single 25 ampere motor of cylindrical form placed centrally just ahead of the rear axle has bolted to it at each end and forming a continuation thereof, a metal housing having means of support from a cross tube, containing and concealing the transmission parts. The hallow armature shaft is placed concentric with one of the driving shafts, and keyed to the balance gear casing. From here motion is transmitted through the customary balance gears or driving shafts, terminating in steel pinions which mesh with external driving gears.

The wheel base is 65½ inches; wheel gauge 54 inches. Wheels are wire 32 inches and 36 inches in diameter, and furnished with 3 inch pneumatic tires. The 44 cells of

elliptic springs, and at the front on inverted elliptic transverse springs. The wheels are of wire 28 inches in diameter, and furnished with 3 inch pneumatic tires. The motor is of 20 amperes normal rating, and the battery of 44 cells gives 45 amperes at a 3-hour rate, thus furnishing a mileage of about 30 miles at a speed of approximately 13½ miles per hour. These vehicles weigh complete about 1,950 pounds each.



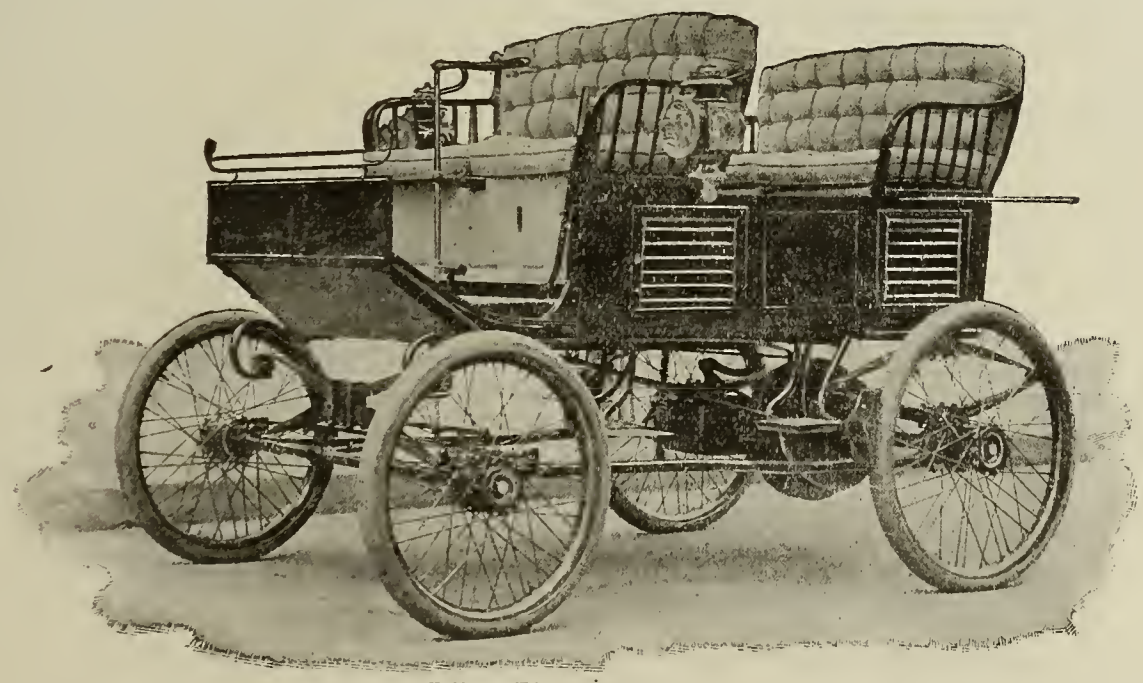
Riker Electric Truck.

THE RIKER ELECTRIC VEHICLE COMPANY.

The development of the automoble business has placed upon the market a variety of horseless carriages and autovehicles that represent all styles of design and invention. The Riker Electric Vehicle Company, of Elizabethport, N. J., are the manufacturers of a line of electric and mechanical vehicles second to none in the world. Their elegance of construction, high efficiency, smoothness of operation and general reliability has secured a reputation

for the builders which has created an enormous demand for them all over the world. The plant, which is situated at Third and Pine streets, Elizabethport, N. J., occupies a surface area of 200x600 feet a square block and includes the various departments of a thoroughly equipped and up-to-date automobile works. There is a designing department, wood working department and machine shop supplied with all the pharaphernalia and machinery for designing and constructing every detail of a vehicle. In the dynamo room a number of generators are used for charging batteries of every description, furnishing current for driving power motors in different departments of the works and for general testing. In the assembling department and paint shops a large force of men are kept busy finishing the vehicles, after which they pass a rigid inspection before being delivered ready for service. In the illustration a bird's-eye view is given of the works with their surroundings with tracks running in from the Central Railway Company's main line which are kept busy bringing in raw material and removal of the finished product. Other illustrations show the Riker electric truck, designed for the purpose of carrying heavy loads of merchandise, with tires adapted to city roads, and with controlling mechanism which places the vehicle in the hands of the operator and enables him to govern every movement. The electric surrey, brougham, dos-a-dos and demi-coach are a few of the types of vehicles turned out by this company. The Riker electric surrey has a tread of 56 inches, a weight of 2,700 pounds and a carrying capacity of from four to five persons, is driven by a two K. W. motor at a maximum speed of sixteen miles an hour. The total mileage on level asphalt is about 25 miles. The controller gives four speeds forward and two speeds to the rear. The electric brougham has a weight of 4,000 pounds and a carrying capacity of two people in adition to the operator and attendant. It is driven by two motors of two K. W. capacity each and attains a maximum speed of 10 miles an hour but can cover twenty-five miles as above described, the controller giving two seeds ahead and two in the rear. Dos-a-dos has a total weight of 2,500 younds and can carry four people.. It is driven by a two K. W. motor and attains a speed of twelve miles an hour. With a charge of the battery it will run twenty-five miles on a smoth, level road. The controller in this case gives three speeds forward and two backward All of these vehicles are supplied with a combination volt and ammeter. The driving is from the rear wheels and the steering from the front wheels. In adition each is equipped with electric side lights.

Riker Elect ic Brougham.



Riker Electric Surrey.

The careful testing through which each vehicle is put

before being considered ready for shipment has been the means of making each vehicle operate from the very start with the greatest satisfaction to purchasers. The future history of an automobile, as far as durability is concerned, depends largely upon the care with which the machine is assembled and for this reason the most skilled mechanics are employed in fitting together the various parts of the vehicle which lead to easy running and efficient operation.

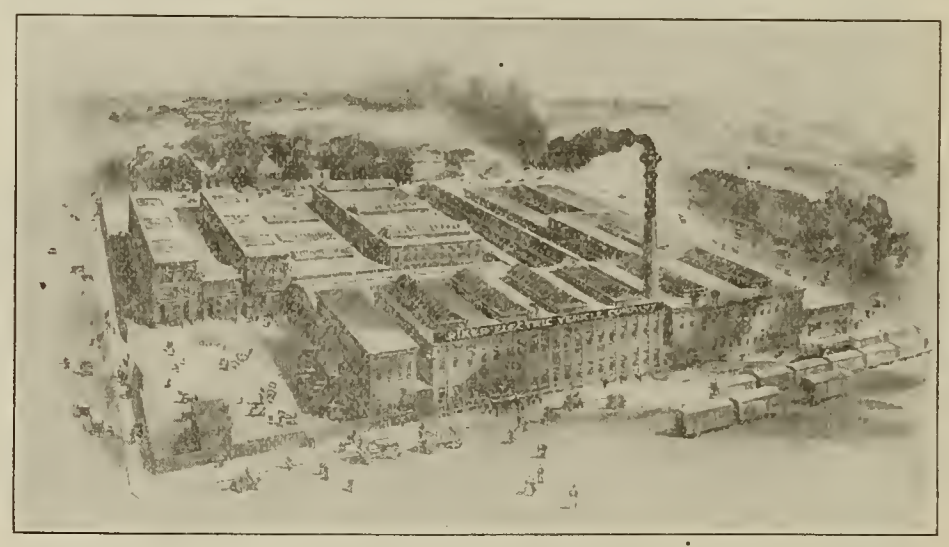
Riker Electric Dos A-Dos.

Their very extensive plant is fitted with all the modern machinery for making all their own bodies for every line of vehicles including delivery wagons like those furnished to the Gorham Mfg. Co., Altman & Co., Hearn & Son, L. S. Plaut & Co. (of Newark, N. J. also mineral water wagons such as furnished to C. H. Schultz, of N. Y.

The Riker Electric Motor Company was originally organized in New York in 1888. The plant was ultimately moved to Brooklyn and business so improved that in 1899 the present plant in Elizabethport, N. J., was purchased. In May, 1899, the Riker Electric Vehicle Company was organized and purchased the works which they now occupy, and has become one of the greatest establishments of its kind in the United States. The officers of the company are F. C. Stevens, president: who is also president of the West End National Bank, of Washington, D. C.; A. L. Riker, chief engineer, and E. Lavens, general superintendent.

THE AUTOMOBILE SHOW.

What promises to be the event of the year for the automobile will be the coming cycle and automobile show, which opens at Madison Square Garden, N. Y. City, on January 20th. The display of automobiles will be the largest of the kind ever given in this country. It will be demonstrated that the automobiles for pleasure, as well as business, have come to stay. Members of the Automobile Club of America, which includes many of the wealthiest and most prominent men in N. Y. city, have promised to attend the show during the week. Of the two and forty-two spaces at the disposal of the management all will be sold out before Saturday. The large ampitheatre will be divided into 143 spaces on the main floor, devoted exclusively to bicycles and automobiles, with 81 additional spaces on the first balcony. Space will be allotted according to the order of application, and will be limited to those products that will be of interest to the vehicle trade. Makers of parts which are used in the construction of horseless carriages will be largely represented. The show is to be under the management of Frank S. Sanger. It is acknowledged that the exhibition will be the largest of its kind ever held. All the motor vehicle and parts makers have been waiting for such an opportunity, and are not likely to neglect it.



Factory of the Riker Electric Vehicle Company.

Kansas City, Mo.—Arrangements of a preliminary character have been completed for the formation of a company to build and operate an electric railway system in the southeastern and southwestern parts of the city. E. F. Swinney, Richard Gentry, W. D. McLeod, A. A. Tomlinson, Bernard Corrigan, William Huttig, Chas. L. Robon and Joseph J. Helm are interested in the project.

The Electrical Age.

ESTABLISHED 1883.

Entered at New York P. O. as second-class matter, January 18, 1891.

THE ELECTRICAL AGE PUBLISHING CO., Publishers.

TERMS OF SUBSCRIPTION:

One Copy, one Year, - - - - - - - - - $2.50
One Copy, six months, - - - - - - - - - 1.25
Great Britain and other Countries, - - - - 3.50

Cable Address (all Cables), "Electage," New York.

NEWTON HARRISON, E. E., EDITOR.

ASSOCIATE EDITORS:

ALFRED E. WIENER, E. E., } ELECTRIC LIGHT AND POWER.
OSBORNE P. LOOMIS, E. E., }
JOSEPH MUIR, M. D., } ELECTRO-
FREDERICK STRANGE KOLLE, M. D., } THERAPEUTICS.

ADDRESS ALL COMMUNICATIONS TO
THE ELECTRICAL AGE PUBLISHING COMPANY,
Seventh Floor, World Building,
NEW YORK.

NEW YORK, JANUARY 20, 1900.

CONTENTS:

HEAT FROM ELECTRIC FURNACES.

Neither absolute heat nor absolute cold have so far been attainable. The nearest approach to absolute zero has been reached by Prof. Dewar, of England. Intense heat, on the other hand, has been developed by the electric furnace. It is impossible to form an adequate idea of the fiery nature of this furnace, as a mere expression of it in figures does not convey to the mind an idea of the enormous heat developed there. The great savant Moissan, in his illustrated lecture showing the manufacture of diamonds, gave the public an opportunity of witnessing experiments of exceedingly high temperatures. He fused a mass of iron and carbon in an electric furnace and then immersed the molten costituents in water. The heat developed on this occasion was not as great as that found in the furnaces at Niagara Falls. The temperatures there are more than 7,000 degrees Farenheit, the heat being put to the use of reducing aluminum and manufacturing calcium carbide.

Mr. E. G. Atcheson is the American authority on electric furnaces. It was entirey through his experiments and investigations that carborundum first made its appearance and became a product of such importance that the present demand for it reaches thousand of tons per annum. The original intention of Mr. Atcheson was to make use of the enormously high temperature of the electric furnace for the purpose of obtaining diamonds from a mixture of carbon and clay. His efforts were not as successful as he anticipated but the results were in many respects as satisfactory. Carborundum has many of the properties of diamonds, as far as hardness and gemlike appearance is concerned. It is now used as a substitute for emery and cannot be excelled in its properties as a means of producing a wonderfully fine polish on other gems.

The high temperature produced in an electric furnace is governed entirely by the volume of current sent through it. As the temperature rises the resistance of the furnace increases and it becomes necessary to employ a very high pressure in order to deliver energy sufficient for the purpose in view. At Niagara Falls from two thousand to twenty-five hundred volts are employed and a current of several thousands of amperes. The average power applied to a given furnace exceeds a thousand horse power and in the case of the furnaces used for the manufacture of carborundum this energy is applied for a day and a half without intermission. The temperature of a furnace of this description is so high that the intense heat will melt the most refractory metals like wax. A fire brick will dissolve before the eyes like butter on a hot stove. All the metals are immediately volatized and only a few materials resist the heat long enough to indicate the method of their disappearance.

The heat of an electric furnace is, according to calculation, from one-sixth to one-half as hot as the sun. It is probable that under the influence of such terrific heat the physical and molecular condition of bodies is sufficiently altered to bring into existence new forms of matter. For this reason the discoveries made in connection with the electric furnace have certainly not come to an end and we may expect in the near future new products in addition to aluminum, calcium carbide and carborundum.

HOW A BODY CONDUCTS.

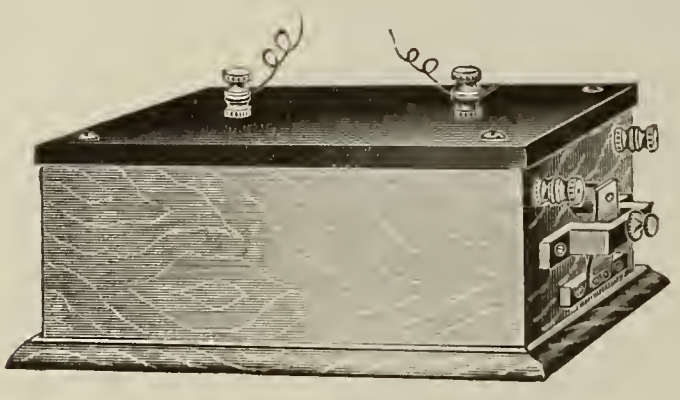
The nature of conduction and the mechanism by means of which this phenomenon occurs has had some light shed upon it by the investigations of Kohlrausch, Arrenhius, Nernst, Oswald and others. Conduction, or its converse, insulation, is dependent upon the physical and chemical properties of a body. These relations may be expressed in a mathematical form, conclusions being based upon the correspondence obtained between calculated and observed results. Conduction in solids presents a case, according to Prof. Fessenden, in which conviction plays an important part. Not that the exact means by which this phenomenon takes place have been observed but theoretical reasoning leads to that conclusion. As far as metals are concerned their conductivities depend upon their elasticity, density and valency, a fact discovered by Prof. Fessenden in 1892.

In a series of tabulated results, calculated and observed, the discrepancies were not great enough to indicate the application of an empirical rule. In fact, the calculated and observed resistances for silver were identical and for copper, gold, aluminum and cadmium the differences were not of sufficient consequence to indicate an error. The formula employed is similar to that used for calculating the velocity of sound in a body. In other words, there is a certain similarity between the two operations which indicates the presence of a decided clue, which is, that the electricity "is handed on with the same velocity as that with which the particles move." The formula employed is that the conductivities of metals are proportioned to the square root of the elasticity of the density, the whole divided by the valency. According to Prof. Lodge, the phenomenon of conduction is simply the transferance of the charge of electricity from one atom to the other, which conclusion has been borne out by many references since and in all probability will be finally adopted by the scientific world.

Automobile Specialties.

IDEAL GAS ENGINE IGNITER.

Coils of special construction used for igniting the charge in the combustion of gas, gasolene and oil engines by the use of fixed electrodes have been placed upon the market by C. F. Splitdorf, 17-27 Vandewater St., N. Y. These coils are of simple construction and are built moisture proof and are as far as all tests are concerned an ideal gas engine igniter. A condenser is used in connection with the coil which makes its action certain and gives a high potential spark of sufficient current to make ignition in very case a certainty. Other types of apparatus for igniting the mixture of gas and air have failed or will fail

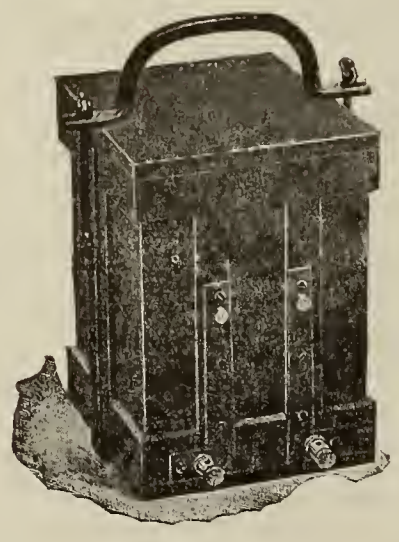


Splitdorf Jump Spark Coil.

after the short period of a few weeks but this new coil is positive in its action and produces an intense hot flame of such volume that a positive explosion is the result of each jump of the spark. Fixed electrodes in the combustion chamber facilitate the manufacture of gas engines and the best authorities recommend their use in connection with the Splitdorf jump spark coil. With a battery of from four to six volts a discharge an inch long takes place. The simple construction of the vibrator which is reinforced by a double German silver spring and the use of platinum points with regulating screw for controlling the vibrations makes this device the superior of any in use.

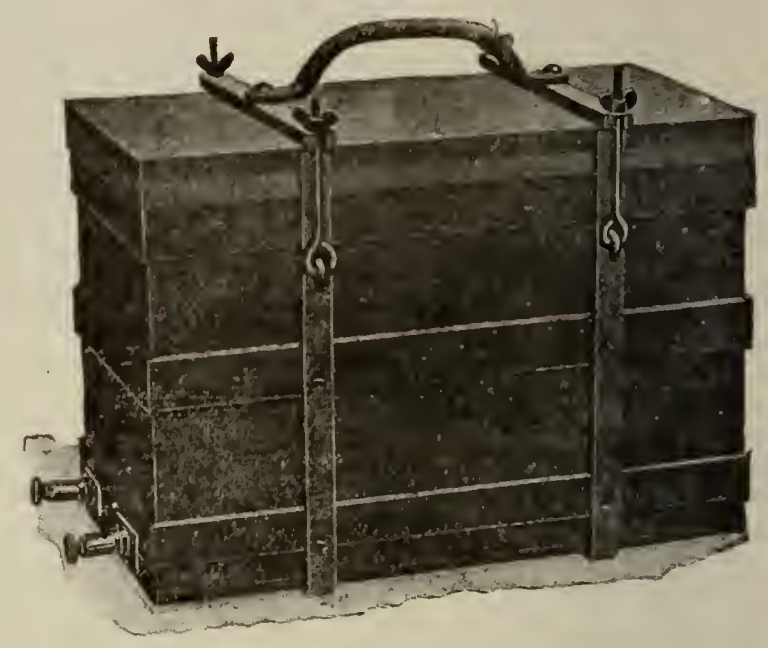
THE MOST MODERN TYPE OF PRIMARY BATTERY.

Primary batteries have been in use for many years for various purposes and it has taken considerable time and money to bring them to a state of comparative perfec-



Battery A.

tion. In spite of all efforts, however, the primary battery has been looked upon with disapproval by many users of electricity and did not assume a practical form until the Edison, Jr., Electric Light and Power Company, with offices at 27 William St., N. Y., and factory at 54 Maiden Lane, N. Y., placed before the public a battery that has been examined and approved by the most eminent electrical authorities of the United States and Europe, copies of whose testimonials may be had on application. These batteries are made in various sizes as shown in illustration, the smallest stock size of battery being a four cell outfit, about six by four and a quarter by four and a quarter inches, weighing between four and five pounds. This cell was originally intended for miners' uses as it will keep a three candle power lamp burning for ten hours at a cost of about two cents. Many other places in which this lamp is used, such as flour mills, establishments in which explosives are made, paint and varnish factories, cotton gins, etc., find it an indispensable article of use. The lamp is applied directly to the front of the battery where it is hung on connections, the light being sent forward from a parabolic reflector. The lamp is detachable and can be connected by a flexible wire to the battery and used in places where both battery and lamp could not find room. For running surgical lamps for stomach and throat examinations and various other



Batteries D and E.

physiological purposes, including dental use, this battery has found a permanent place and is in great demand by physicians and dentists all over the United States. Its output is about 7.5 volts and 5 amperes. Many other cells of larger size are manufactured by this company. By sending for catalogue a description will be found therein of battery B* which is made especially for automobile service in connection with the operation of spark coils. It is a four cell battery giving 7.5 volts and on short circuit a current of 35 amperes. Its outside dimensions are $8\frac{1}{2}$x$8\frac{1}{2}$x$7\frac{1}{2}$ and it weighs about 20 pounds charged. In addition it may be used for lighting carriages, and operating three three candle power lamps for a period of eight hours. It will also run a student's lamp, drive small motors or, if about six batteries are in use, run a small launch. Another outfit represented in the illustration, called batteries D and E, contains eight cells, having an E.M.F. of 15 volts and a current on short circuit of about ten amperes. For household purposes these cells find many applications such as driving fans, running lights in convenient places where gas cannot be secured, operating light machinery for churns, sewing machines, etc. The construction of these cells is such that no local action takes place when not in use for a reasonable time, the current is always on tap at full force and there is no risk from noxious fumes or spilling of the liquid. It is in many respects an ideal battery for various purposes which would fill a long list when enumerated.

Electri c Novelties.

PORTABLE ELECTRIC HOUSE LAMP COMPANY.

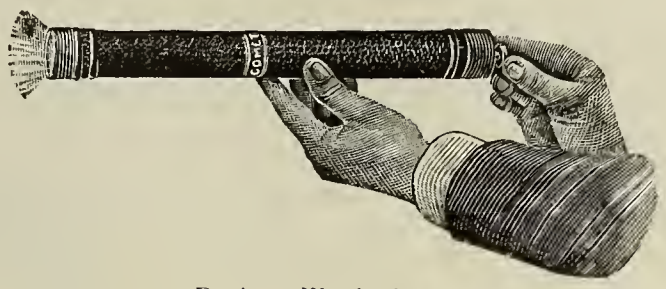
The enormous strides made in the various applications of electricity has been taken advantage of by many ingenious inventors. Various articles of use which will soon be regarded as household necessities have appeared

Electric Lamp for Sick Room.

on the market and some of them serve purposes altogether unexpected, but which illustrate the old adage that whereas demand creates a supply, supply often creates a demand. In the illustrations are shown some of the novelties manufactured by the Portable Electric House Lamp Co., of 10 Cortlandt St., N. Y. These beautiful little devices are finished with ornamental metal

Portable Electric Candlestick.

work and are mounted on polished wooden bases. To turn the lamp on a switch is moved and to extinguish it opened. Eevery part of the lamp is permanent and it is only necessary when the battery has served its time to slide out the bottom of the base, remove the old one and insert a new one. For lighting parlors in their various odd dark nooks and supplying little table lamps at banquets this company put out a line of novelties of this description of the most interesting design. In addition they handle the electric flash light with which dark corners are made light. It is in the form of a tube with the lamp at one end supplied with a parabolic reflector and several coils of dry battery enclosed. It gives from ten to fifteen thousand lights. It is made in various sizes



Pocket Flash Light.

and of various degrees of candle power. It may be regarded as an actual household necessity, and when once familiar with its use in the home it is soon considered as an indispensable article. It is extremely gratifying to the Portable Electric House Lamp Co. to realize that all their customers have given every proof of satisfaction. Catalogues will be sent on application to all prospective purchasers.

SPECIAL EXPORT COLUMN.

TOTAL AMOUNT OF ELECTRICAL EXPORTS FROM NEW YORK CITY FOR WEEK ENDING JANUARY 13th, 1900, $125,012.00.

New York, Jan. 13, 1900.—The following were the exports of electrical material and kindred lines during the week just ended:

Antwerp.—76 cases electrical material, $4,882; 4 cases electrical machinery, $1,350.

British Possessions in Africa.—9 cases electrical material, $2,196; 43 cases electrical material, $1,884.

Barcelona.—65 cases electrical material, $2,797.

British West Indies.—11 cases electrical material, $269.

British East Indies.—2 cases electrical material, $118.

Bremen.—1 case electrical material, $700; 1 case of electrical machinery, $1,078; 208 cases electrical material, $1,384.

Charleroi.—1 case electrical material, $40.

Chili.—13 cases electrical material, $29.

Cuba.—226 cases electrical material, $1,007; 2 cases electrical machinery, $222.

Dutch West Indies.—1 case electrical material, $12.

Ecuador.—1 case electrical material, $17.

Glasgow.—57 cases electrical material, $3,967.

Hong Kong.—1 case electrical material, $8.

Havre.—773 cases electrical material, $76,496.

Hamburg.—109 cases electrical material, $9,410.

Japan.—44 cases electrical material, $4,209.

Mexico.—65 cases electrical material, $2,844.

Porto Rico.—7 cases electrical material, $97.

Peru.—13 cases electrical material, $340.

Philippines.—16 cases electrical machinery, $5,127.

Stockholm.—1 case electrical material, $120.

Siam.—56 cases electrical material, $893.

Southampton.—20 cases electrical material, $950.

U. S. Columbia.—90 cases electrical material, $2,566.

NEW INCORPORATIONS.

Goshen, Ind.—The Indiana Power Company, of Goshen, with a capital stock of $100,000, has been incorporated. The company proposes to erect a dam or dams across the St. Joseph; also to construct a canal for each of the dams, to extend from a point above such dam to a point below the same. Arthur Kennedy, of Pittsburg, Pa., is principal stockholder, and Charles C. Black, Wil-

ber Syonex, D. H. Hawk, C. L. Starr, George D. Lint, Wilson Roose, Wm. Markel, of Goshen, are incorporators.

TELEPHONE CALLS.

Durand, Wis.—The Pepin Telephone Company is to build a line from Pepin to Nelson, connecting Pepin county, Pierce county and Buffalo county lines with Wabasha and Winona, Minn.

Wenatchee, Wash.—Through the efforts of Arthur Gunn a telephone exchange is to be built.

Marshall, Ind.—The Citizen's Telephone Company, of Marshall, has been formed to operate telephone lines; capital, $10,000; incorporators, J. McMurty, W. W. Cumminger, S. Hadley, C. Adams, H. Myers, all of Marshall.

Cairo, Ind.—The Cairo Telephone Company has been chartered at Cairo to operate telephone lines; capital, $8,000; incorporators, J. W. Klipinger, V. C. Klipinger, J. E. Roadrock, G. Holwerda, all of Cairo.

New Haven, Ind.—The New Haven Home Telephone Company has been incorporated at New Haven to operate the telephone lines; capital, $5,000; incorporators, H. F. Berberick, G. W. Miller, both of New Haven; G. F. Trier, of Fort Wayne.

STREET RAILWAY NEWS.

Canal Fulton, Ohio.—The Canal Fulton Council has granted to the Barberton, Doyleston & Massilon Electric Railway Company a franchise to construct tracks in the village streets.

Pittsfield, Mass.—The Pittsfield Street Railway Company petitions for the right to extend its lines in to the town of Lenox.

Norristown, Pa.—A mortgage for $200,000 has been given by the Inland Traction Company.

Worcester, Mass.—An ambitious street railway project is outlined in the petition of John A. Dunn, William Tell and others for authority to construct and operate a street railway to be known as the Worcester & Gardner Street Railway, and to run between the two points named.

Martin's Ferry, Ohio.—The county commissioners have granted the franchise for an electric railroad, to connect Bridgeport, Colerain and Mount Pleasant and ultimately Cadiz, to J. A. White and William McComas.

Reading, Pa.—Judge Eudlich has granted a temporary injunction against the United Traction Company, restraining them from laying a second track in front of H. S. Ximmerlitz's residence, the plaintiff alleging that he had not received damages for the laying of the first.

Charleroi, Pa.—The Charleroi & Monessen Connecting Railroad Company, of Charleroi, has been incorporated to operate a railroad: capital, $50,000; incorporators, W. I. Berryman, C. F. Thompson, J. C. McKean, C. Potter, J. K. Johnston, all of Charleroi, and others.

Toledo, Ohio.—The Toledo, Tiffin & Sandusky Railway Company, of Port Clinton, has ben chartered for constructing a street railroad: capital, $3,000,000; incorporators, G. D. Loomis, J. M. Naylor, R. Brown, F. E. Anderson, S. P. Calep, S. B. Hoge, R. Young, W. S. Frye, J. F. Penner, J. McCauley, C. I. Yingling, B. W. Crobaugh, J. C. Roger.

Kansas City, Mo.—A new double track electric line from Rosedale to Olathe and Emporia, Kan., is contemplated. It is to be known as the McClure Line. The power house will be located either at Rosedale or at Olathe.

Dover, Del.—The Doty Third-Rail Electric Company, of New York, has been incorporated here to transact, carry out, manufacture, sell and lease electrical appliances of all kinds. The incorporators are William W. Doty and William Reinhart, of New York city; William F. Wilson and Harry C. Frank, Mount Vernon, N. Y., and James Virden, Dover; capital, $2,500,000.

Dunkirk, N. Y.—The Dunkirk & Hickoryhurst Electric Railway Company, which has offered the city $6,000 for a franchise, has reorganized and a new board of directors has been chosen. Among the Buffalonians on the board are: Mayor Conrad Diehl, Gen. James E. Curtiss, C. V. Boughton, Dr. Ernest Wende, F. S. Weber, W. A. Calhoun, Louis B. Hart, Dr. B. J. Maycock, William H. Boughton, H. D. Qeal.

Taunton, Mass.—The Bristol County Street Railway Company has been incorporated, the directors being G. H. Swazey, D. A. Brooks, E. D. Hewins (treasurer), E. A. Swazey, E. D. Guild, C. N. Brownell and E. V. Carpenter. The line is to be 12 miles long, and run through Taunton, Rehoboth, Attleboro and Seekonk to the tracks of the Interstate Consolidated Street Railway on the Attleboro road, with a line from the junction of the Oak Hill road and Locust street to the terminus of the Attleboro & Norton Street Railway. The capital is $20,000.

Fitchburg, Mass.—Carl Dickinson and others have asked for authority to construct and operate a street railway through Ayer, Groton, Townsend, Fitchburg, Lunenburg, Shirley, Harvard, Lancaster, Bolton and Hudson, under the name of the Ayer, Lancaster & Fitchburg Belt Line Street Railway Company. The same petitoner also asks for authority to construct and operate a street railway through Billercia, Carlisle, Chelmsford, Westford, Concord, Lincoln, Acton, Maynard and Hudson, to be known as the Concord & Billerica Street Railway Company.

New Rochelle, N. Y.—The Common Council of this city has granted a franchise to the Greater New York, Westchester & Connecticut Traction Company.

Telegraphy.

MACHINE TELEGRAPHY OF TO-DAY.

Editors' Note.—Through an error in the make-up the following lines were omitted from last week's instalment of "Machine Telegraphy of To-day:"

"acters may be made on paper is practically unlimited. In this way, and in this way only, can the full signalling capacity of a wire be utilized.

The only interruption to transmission is the supplying"

Through lack of space the conclusion of the above article has been postponed until the issue of Jan. 27.

WESTON STANDARD

PORTALE DIRECT READING

VOLTMETERS AND WATTMETERS

For Alternating and Direct Current Circuits.

The only standard portable instrument of the type deserving this name.

Write for Circulars and Price Lists 8 and 9.

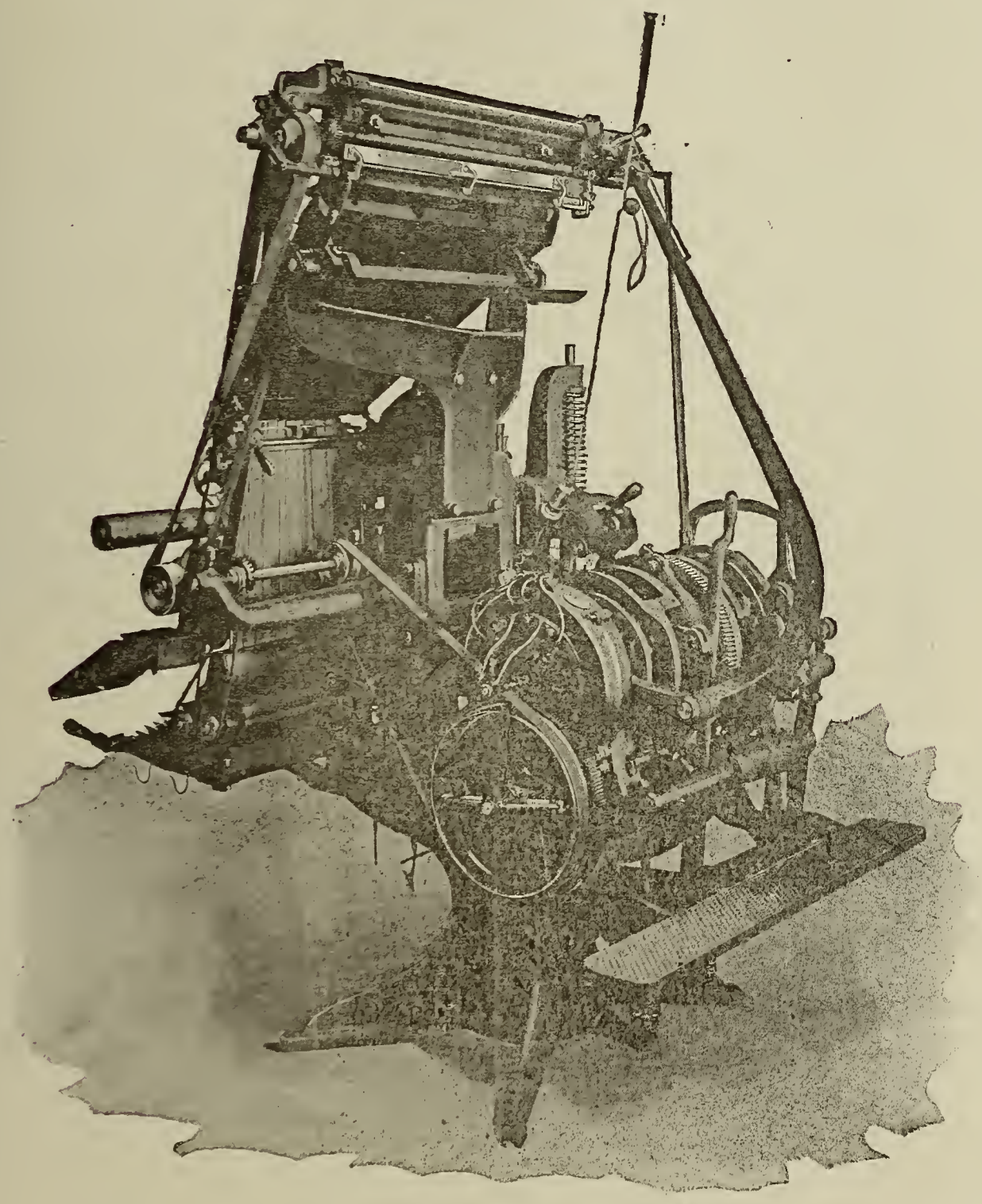
WESTON ELECTRICAL INSTRUMENT CO.,

114-120 William Street, Newark, N. J.

The Electrical Age.

Vol. XXV—No. 4. NEW YORK, JANUARY 27, 1900. Whole No. 663

Applications of Electric Power.



Lundell Motor Geared to Linotype.

MAKING BOOKS BY ELECTRICITY.

The introduction of electricity into the arts and industries has opened up new vistas to business men. Time is saved and many operations carried on much more economically. In the printing shop the use of electricity has led to many changes which have a decided effect upon the output in any specified time. The idea put into application by many firms, that power is best employed when applied directly to the machine it is intended to operate has gained considerable ground and to-day we find many of our largest printing, binding and bookmaking establishments operated entirely by electricity.

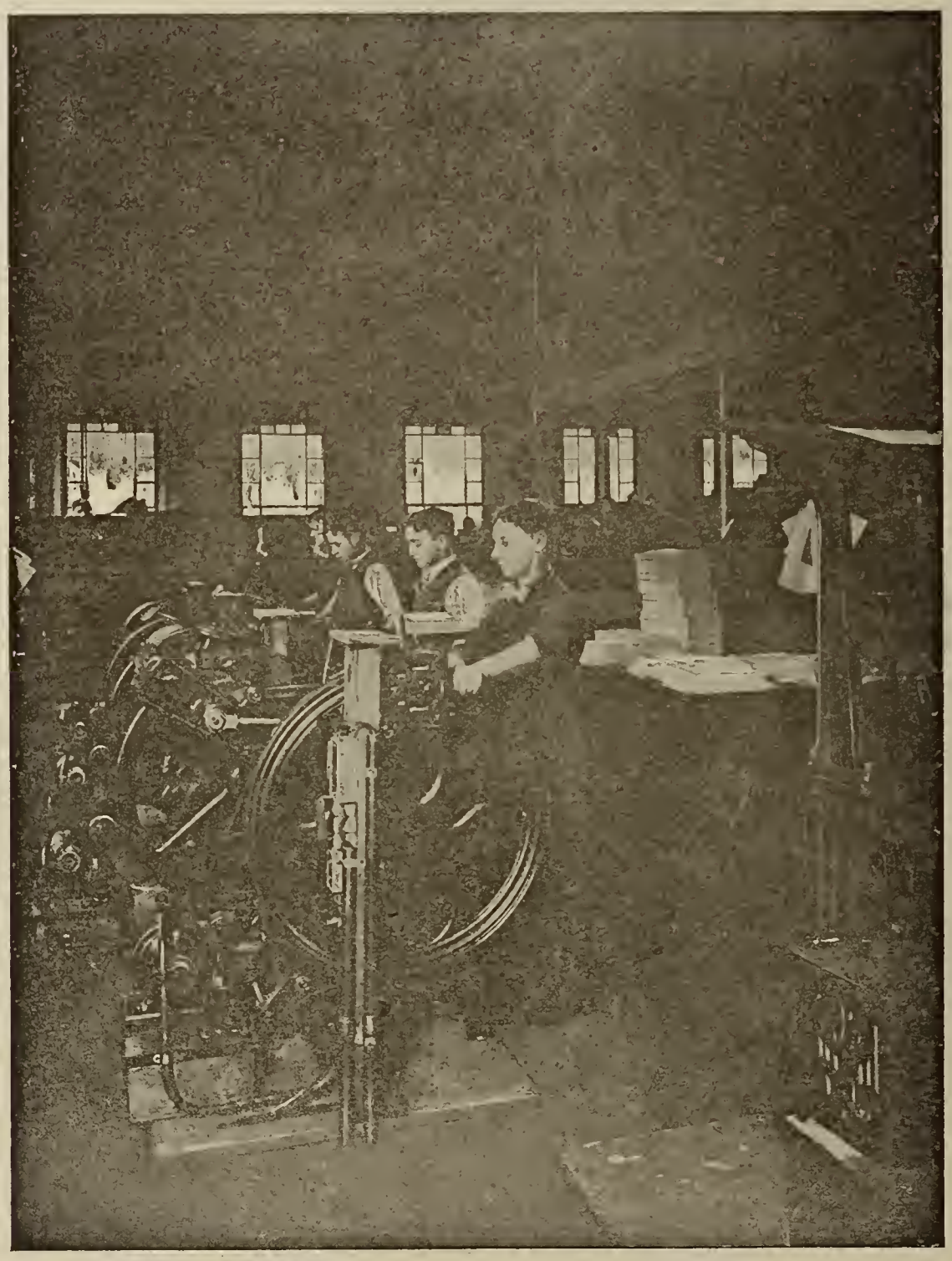
Many advantages accrue from its application in the way of motors attached directly to the various machines constituting a plant. To begin with, each machine, as the lay mind can well understand, is separately controlled. Then again, when power is not required the machine is at rest and a waste that would otherwise occur absolutely prevented; and finally, it is impossible for the entire plant to be inoperative, as might be the case were it all driven by one large motor. There are other secondary advantages, including the saving in space, and the absence of countershafting above. But it is not necessary to go into

details to realize that collectively the employment of motors directly connected to machines marks a decided advance in the running of shops.

In the illustrations connected with this article some of the machinery employed for making books by electricity is shown. The Mergenthaler linotype, driven by a Lundell motor, enables the operator to perform his functions with speed and facility, thereby increasing the output of ems per hour on straight composition to the maximum mark. The various operations performed by the machine itself are not in any way affected by the application of the motor, as shown. Nor is any danger present due to the crossing of wires or the shocking of the operator. The Lundell motor is directly geared, and, being enclosed in an iron case, is absolutely protected from injury in any shape or form. It is difficult to realize the immense change caused by the presence of overhead shafting in one case and its complete absence due to the above mentioned method of direct connection in the other.

The illustrations speak for themselves and testify to the obvious advantages of motors geared directly to presses. From an economic standpoint the saving of power in a very large shop would be considerable. In addition, the annual expense at the end of the year would be considerably reduced by the fact that time is saved in running the machine, as switches may be placed at various parts of the press, thus avoiding delay on the pressman's part in starting up.

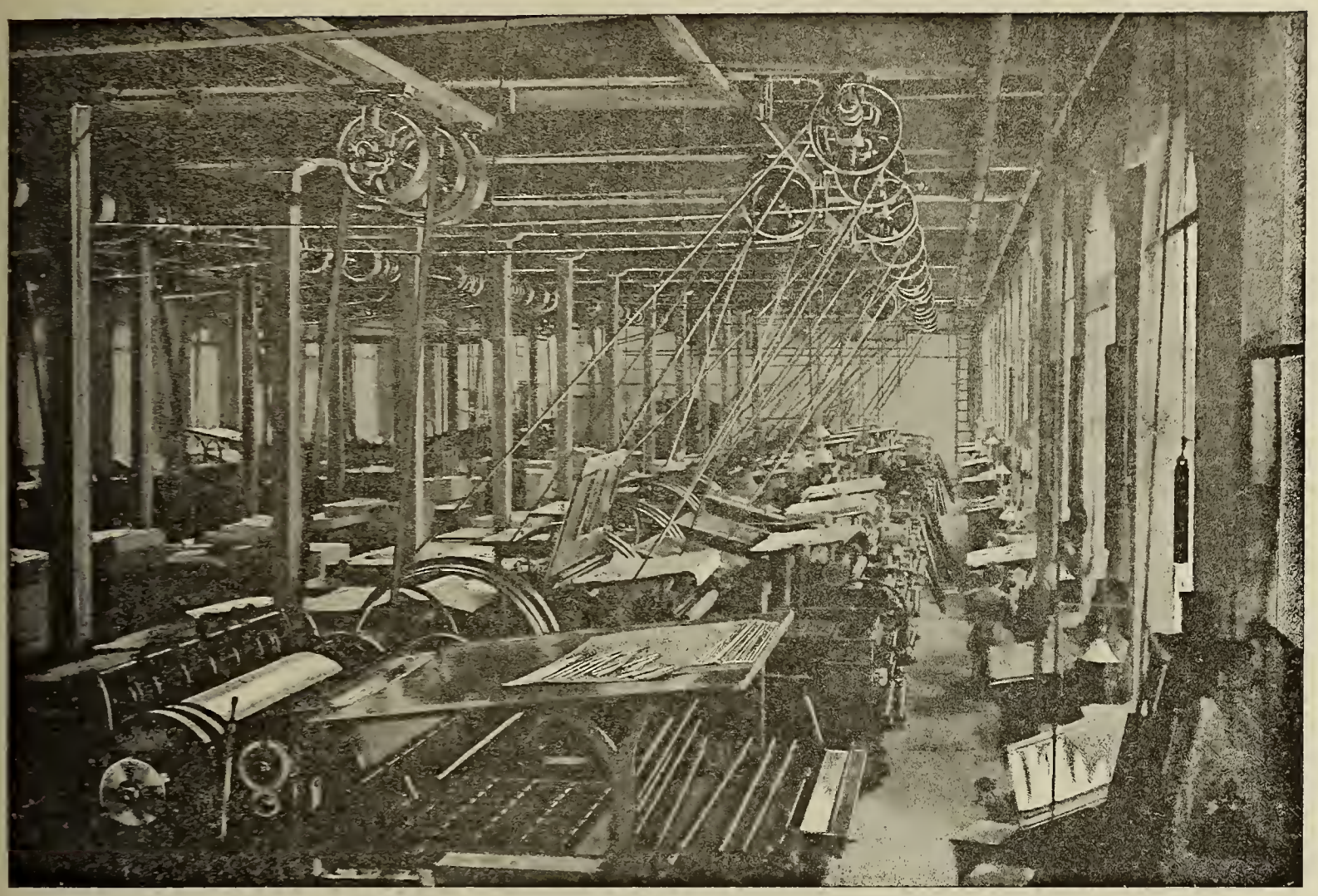
The various operations required for the making of a book are, first, the composition, which is set up from manuscript; second, the printing of the sheets; and finally, the cutting of the leaves and binding. In the illustrations



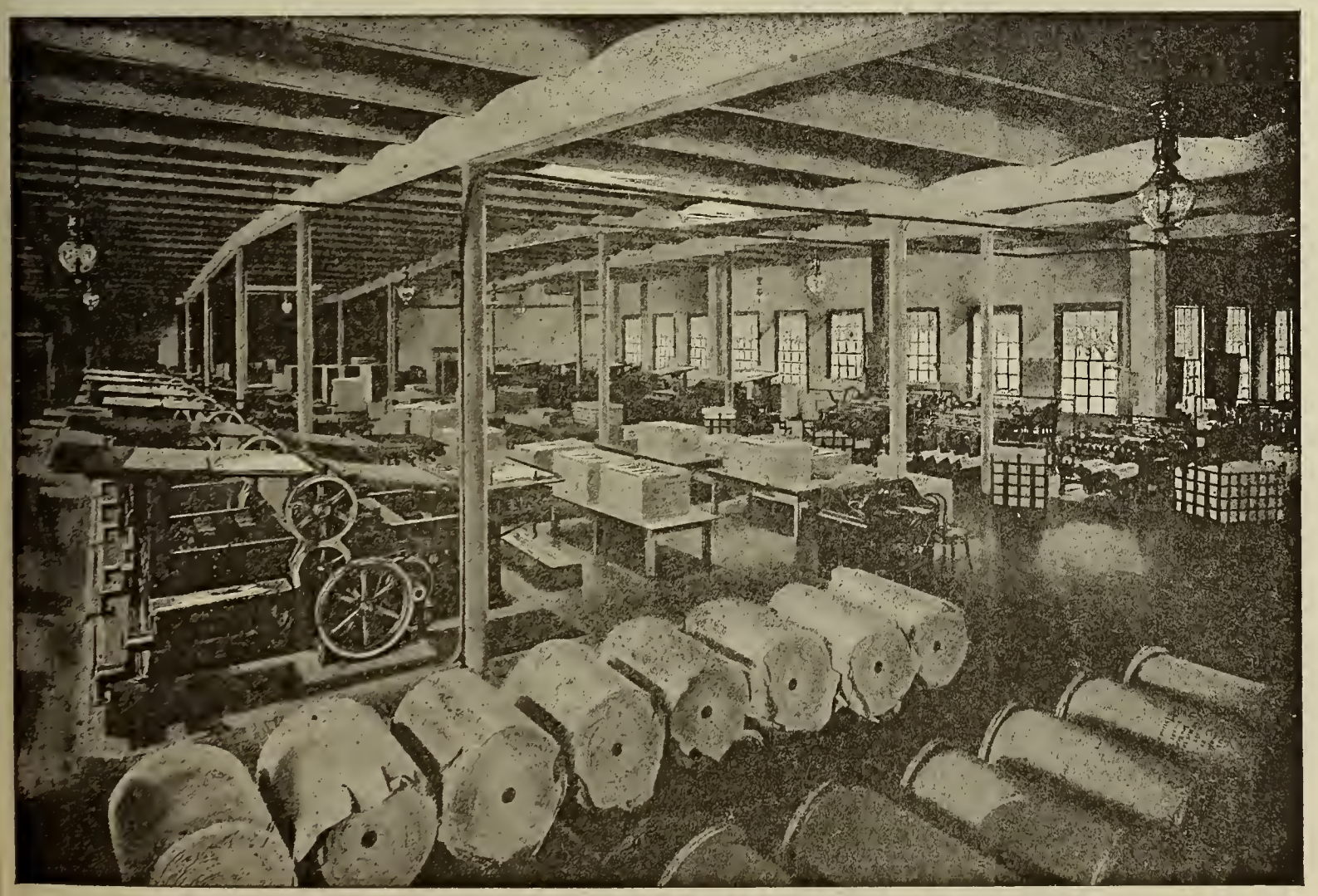
Lundell Motor Driving Job Presses.

are shown machines devoted to nearly all of these purposes, each separately controlled and driven by its individual motor. A corner of a large cylinder press, manufactured by C. P. Cottrell & Sons, with motor geared direct, illustrates the method for applying the power in the manner above described. It has become the custom, firmly established at present, through the benefits derived from it, to drive all large newspaper presses by motors, connected directly with the driving mechanism.

The presence of belting and countershafting was not only a hindrance to the pressman, but a source of danger as well. The absence of such impediments to rapid work has had its obvious advantages which, in the printing

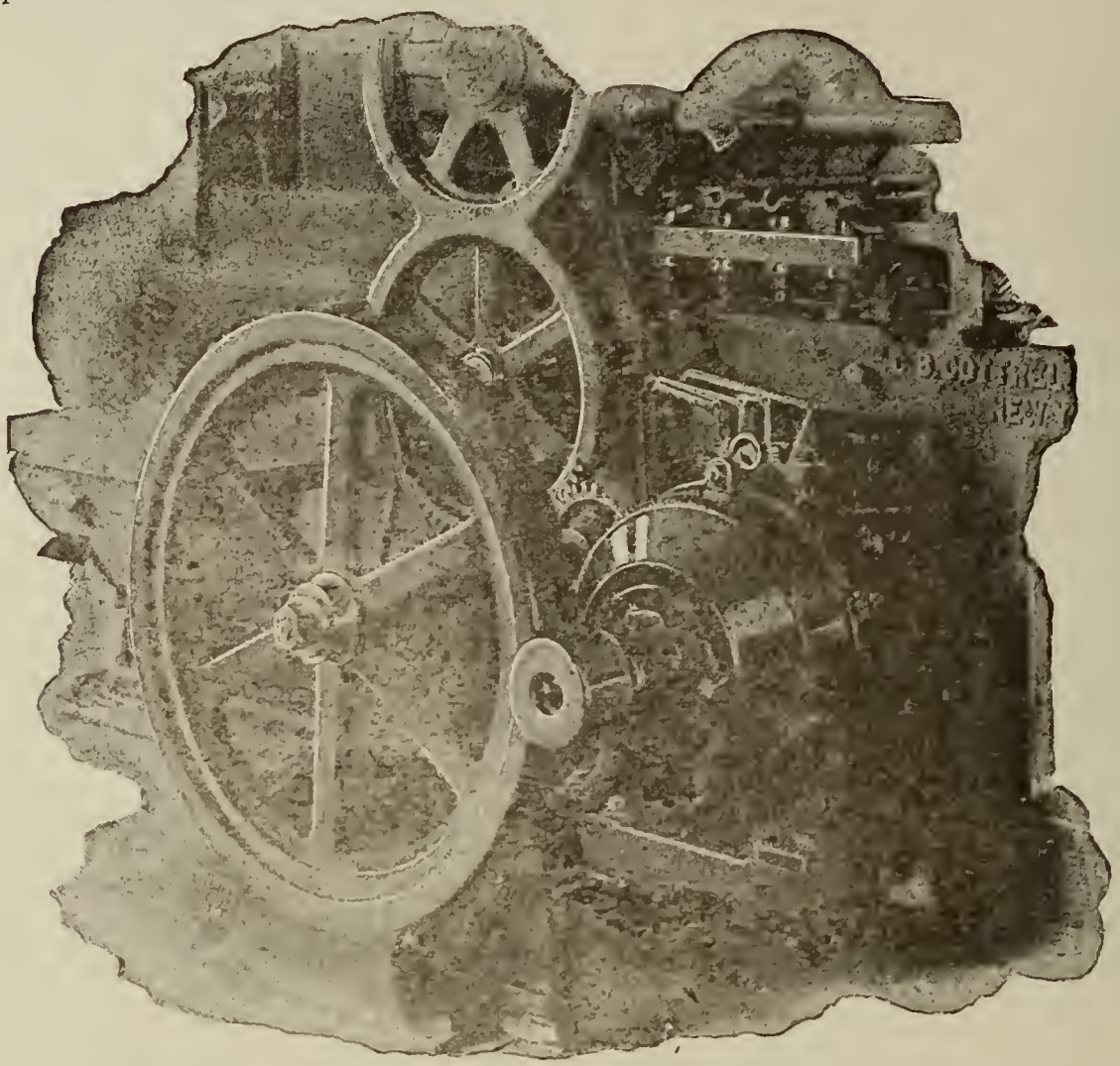


Press Room Arranged for Driving by Lundell Electric Motors.

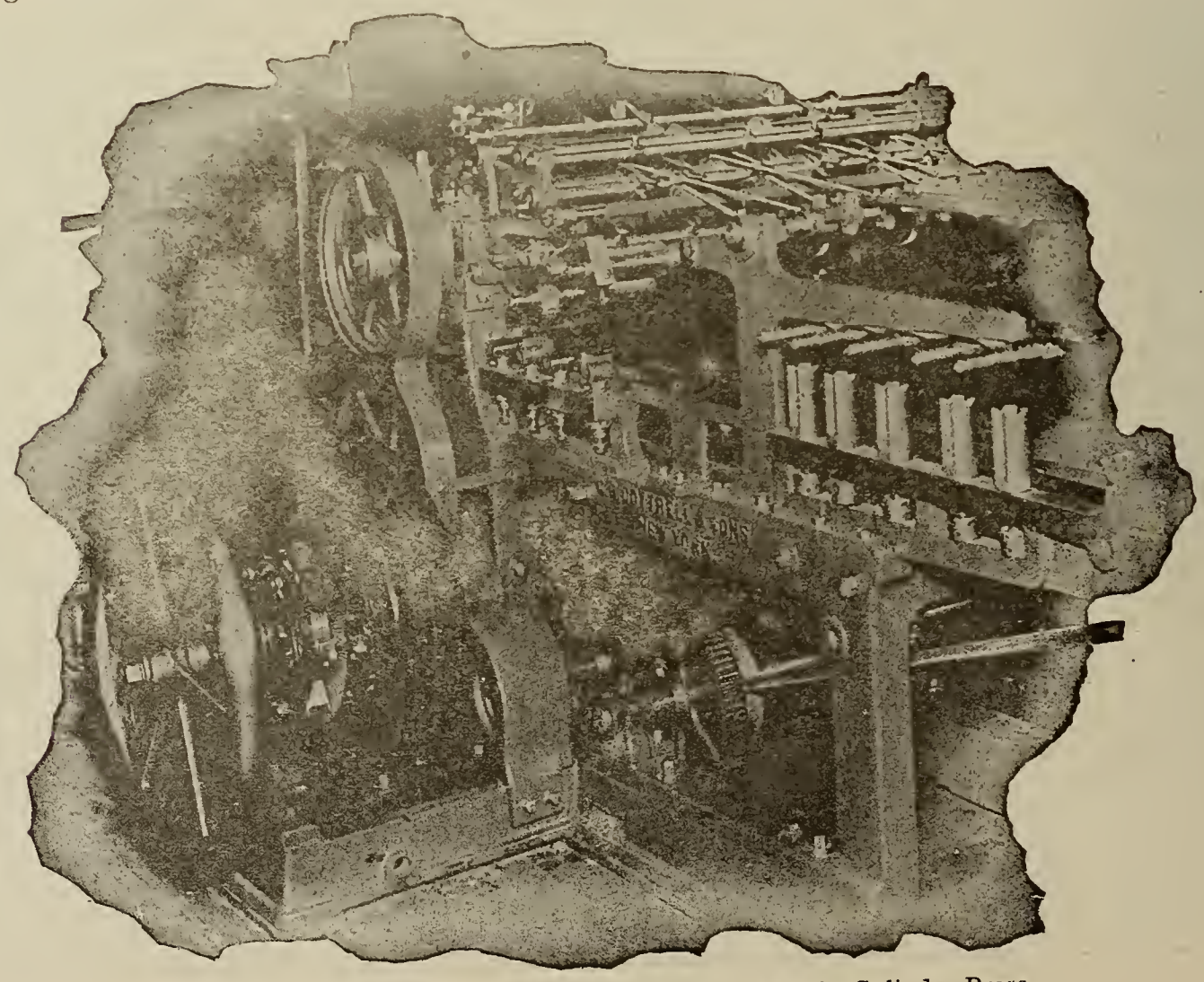


Press Room Arranged for Driving by Lundell Electric Motors.

of a daily newspaper, are fully appreciated by the business management. In job printing offices, and in that section of large printing houses devoted to job printing, motors are frequently belted from the floor, the belt passing over an idle pulley, as shown in the illustration. The motor is stopped, started and controlled from a point in near proximity to the printer's hands. The installation of such a system has in every case proven a source of great satisfaction to the workmen and a paying investment to the proprietor. In city establishments, where



Lundell Motor Geared to a Printing Press.



Lundell Motor Direct Connected to Driving Shaft of a Cylinder Press.

The Electrical Age.

ESTABLISHED 1883.

Entered at New York P. O. as second-class matter, January 18, 1891.

THE ELECTRICAL AGE PUBLISHING CO., Publishers.

TERMS OF SUBSCRIPTION:

One Copy, one Year, - - - - - - - - - - $2.50
One Copy, six months, - - - - - - - - - 1.25
Great Britain and other Countries, - - - - 3.50

Cable Address (all Cables), "Electage," New York.

NEWTON HARRISON, E. E., EDITOR.

ASSOCIATE EDITORS:

ALFRED E. WIENER, E. E., OSBORNE P. LOOMIS, E. E., } ELECTRIC LIGHT AND POWER.
JOSEPH MUIR, M. D., FREDERICK STRANGE KOLLE, M. D., } ELECTRO-THERAPEUTICS.

ADDRESS ALL COMMUNICATIONS TO
THE ELECTRICAL AGE PUBLISHING COMPANY,
Seventh Floor, World Building,
NEW YORK.

NEW YORK, JANUARY 27, 1900.

CONTENTS:

A NOVEL DEPARTURE IN VACUUM TUBE LIGHTING.

The rapid development of electric lighting has been largely due to the improvements made in the arc and incandescent lamp. The work of Edison in America and of Swan in England led to the final perfection of a filament heated to incandescence in a vacuum. From a lamp of this design light was produced with an efficiency sufficiently great to make it a business proposition to investors. On the other hand Chas. F. Brush invented and improved the arc lamp to such an extent that its automatic action could be relied upon and it became a permanent feature of industrial life. A spirit of invention seized hold of many bright American minds with the result that both arc and incandescent lamps were further improved in various details, which tended to the raising of their efficiencies, a larger period of usefulness and a much lower price. The incandescent lamp became cheaper and better, falling from seventy-five cents a piece to a little more or less than twenty cents. The arc lamp passed through a transformation, though preserving its essential features. The idea of enclosing the arc, once suggested and applied, was the means of increasing the life of a pair of carbons from eight or nine hours to one hundred and fifty. In other words, the closed globe idea prevails in both the arc and incandescent lamp of to-day and each has practically reached a state of ultimate perfection.

Various efforts have been made in the past to produce commercial light in a tube from which the air has been entirely exhausted. The names of Crookes, Geissler, Tesla, Moore and Haines are familiar to many acquainted with the history of vacuum tube lightning. Although much time has been spent in the way of earnest effort and considerable capital invested in atempts to develop a practical vacuum tube system progress to date has been very slow. There may be reasons for this which have been disregarded but they can be explicitly summed up in the following: first, inefficiency; second, limited quantity of light, and third, a diminishing vacuum. Success, in a practical sense, as far as the introduction of vacuum tubes is concerned, can only be attained by overcoming these difficulties. They are greater than might at first be imagined and in spite of careful scientific experimenting the volume of light is still imited and the efficiency questionable. A new proposition has developed, however, based upon the theory that all mediums producing light simply act as a screen upon which the energy plays to produce luminiscence. On this basis a practical demonstration of the principle above enumerated would require a tube containing within it, either in the shape of a gas or a screen, the medium brought to a state of comparative incandescence by a series of rapid etheric strains and streses. To step from the abstract into the practical world it may be stated that a lamp of this description has already been constructed and its light giving qualities far exceed anything hitherto obtained.

It cannot be said that the field of electric lighting has been limited by the introduction of Welsbach burners, although for quite an interval the public were more deeply interested in mantels than incandescent lamps, on account of their cheapness of operation and ready adjustment to the gas fixture. The efforts of various lamp manufacturers to introduce their goods has made competition very severe but has resulted in this good that more efficient and cheaper incandescent lamps are on the market than ever before and, in addition, an arc lamp, which is in minature an exact model of the closed globe type used for interior lighting on a large scale. These small arc lamps consume no more power than that required by three or four 110 volt, 16 candle power incandescent lamps. They will burn for a period of from fifty to seventy hours without renewals of carbons and are small, highly efficient and readily installed by means of a plug fitting into the socket of the fixture when hasty attachment is desired. A realization of the truth of the saying that "competition is the spirit of business" is exemplified in this last improvement. A small lamp giving 500 candle power and taking by actual measurement no more than $1\frac{3}{4}$ amperes at 110 volts is consuming about 200 watts. The watt consumption per candle power is therefore about two-fifths; in other words, one watt of electrical energy develops $2\frac{1}{2}$ candle power. The incandescent lamp is rated at between three and four watts per candle power, consequently the ratio of efficiency between the two is that of $7\frac{1}{2}$ to 1 in favor of the small arc lamp. In many of the offices of large buildings of even moderate size, where from five to ten incandescent lamps are in daily use, one or two of these miniature arc lamps will supply more than enough light on all occasions at a minimum of cost.

An incandescent lamp has been patented recently with a filament composed of rare oxids. This lamp showed by test an efficiency of one watt per candle power and seems well adapted for all kinds of station work. In a large plant like that of the Edison Electric Illuminating Company, supplying more than a hundred thousand amperes, without increasing the output of the station one per cent. a one watt lamp would enable them to triple their lighting capacity.

every square foot of space is valuable, the saving alone in this respect is to many a decided inducement. The current bills for power are on the average low and foot up at the end of the year less on the whole than the cost of operating any other type of machinery.

The Sprague Electric Company, 527 W. 34th St., New York City, have made a careful study of installations of this description and are therefore competent to advise changes in factories operating the old style that would have direct effect upon the yearly expenses. In many cases the profits of a concern are largely based upon the economic use of power. In such instances it is invariably proven that a change to electricity adds greatly to the facility with which work is done and at the same time reduces the cost of doing it. "The services and advice of the Sprague Electric Company are at command free of cost and they will be pleased to take up any form of electric power application, feeling confident that they can give entire satisfaction in every particular in every case."

In the light of the above descriptions it is quickly realized that the making of books by electricity with modern printing presses and appliances and up-to-date electrical machinery and methods has been effective in reducing the cost of literature to a minimum. There are many publishers of books who employ electricity in their printing shops and can manufacture printed volumes at so low a figure that after the first few volumes have been turned off the press the price of further publishing is merely a question depending upon the cost of paper. In printing establishments where promptness in delivery is all important and, in fact, constitutes a part of the order itself, speed is only obtained by the use of electric motors and a careful study of the latest developments in the art.

A catalogue of electric power, treating of the Lundell motor, and numbered 58, will be sent to readers on application to the above address.

Telegraphy.

Machine Telegraphy in Bad Weather.

Copyrighted by W. L. Craig.

(Concluded from page 14.)

During tests extending over thirty days, between New York and Chicago, it was demonstrated that the machine system is not unfavorably affected by bad weather, a speed of 800 words per minute being recorded perfectly over a copper wire of about 2 ohms resistance per mile during the prevalence of heavy rains throughout the distance.

It is well known that in rainy weather the operation of the Morse system is greatly impaired (including the quadruplex and the Wheatstone systems), and direct working over circuits exceeding two or three hundred miles is impracticable, owing to the depletion of the current necessary to move the mechanical parts of the apparatus by leakage at every pole to the earth. With the machine system it is entirely different. There are no mechanical parts to be moved by the power of the current. The chemical paper is a part of the circuit, and is so sensitive that a very weak current, wholly insufficient to actuate an electromagnet, will leave a perfectly plain mark on the receiving ribbon. Indeed, it has been found that the work of the machine system is just as rapid in wet weather as in dry, owing to the reduction of the static charge in the line, as is well understood by electricians.

Phantom Circuits.

According to best information the Western Union Company uses the quadruplex system on about 75,000 miles of its wires, thereby making 225,000 miles of artificial or phantom circuits, the estimated value of which is $11,000,000. Phantom circuits cost nothing to build, cost nothing for repairs or maintenance. These three artificial circuits over a single wire have made the Western Union what it is.

On February 22d, 1892, there were transmitted from Jersey City and received in Philadelphia by the machine system, in perfect Morse characters, 1,500 words per minute, over a single, small iron wire having over twenty times the resistance of a No. 3 copper wire, between New York and Chicago; 1,500 wards per minute would require at least sixty of the Western Union circuits. Here, then, with a single, small, cheap wire, we have the equivalent of sixty or seventy phantom circuits, costing, in practice, nothing for repairs or maintenance.

If three phantom circuits over the Western Union wires have a cash value of $11,000,000, the value and advantages of the machine system, affording the equivalent of from forty to one hundred phantom circuits over one wire according to the length of line, can be easily understood.

Book Reviews.

"Electric Light Home from Battery Power" is the title of an exceedingly interesting and instructive little book written by James H. Mason, the well-known electrician and designer of the Oddo motor outfits. This little book contains a full description of the most modern battery, and in addition is supplied with illustrations of the various parts of which a working cell is constructed. Connections of cells are also shown by sketch, and various practical rules, an acquaintance with which is of the utmost value to electrical students. Price with paper cover 10 cents. 121 World Building, N. Y.

Power Transmission.

THE MOST NOTABLE ELECTRIC TRANSMISSION PLANT IN EXISTENCE.

To-day the most notable transmission plant in existence is that of the Southern California Power Company, designed to carry 10,000 horse power at 33,000 volts over 83 miles of line from the power house to the town of Los Angeles. The Southern California power house is situated at the base of the San Bernardino Mountains, on the Santa Ana River, and the power water intake is at the junction of Bear Creek and the Santa Ana River, about seven miles below the famous Bear Creek dam. The water in this river, like all waters in Southern California, is owned by water companies, and as soon as it reaches the valley it is led off in irrigation ditches in different directions. Under these conditions, any power company using the water must not interrupt the flow, and the regulation of the Pelton water-wheels which are used must be by deflective nozzles. The water is carried through tunnels, and the rest of the canal is open masonry and wooden flumes. The elevation at the intake is 3,22 feet above sea level, and that of the power house, 2,670 feet. The difference, less the grade of the canal, gives a static head of 735 feet on the wheels.—Cassier's Magazine.

Sennett, N. Y.—Articles of incorporation has been filed by the Sennett Telephone Company to operate in Sennett and Weedsport, Cayuga County; Elbridge and Jordan, and other towns in Onondaga and Cayuga counties; capital, $500; directors, H. C. Crocker, S. C. Depew and Walter E. Spurr, of Sennett, Cayuga County.

Thermo Electricity.

SOME FACTS ABOUT THERMO ELECTRICITY.

Thermo electric currents are probably to be attributed to an electro-motive force produced by the contact of heterogeneous substances, a force which varies with the temperature. When two plates of the same metal, but at different temperatures, are placed in a fused salt, such as borax, which conducts electricity but exerts chemical action, a current passes from the hotter metal through the fused salt to the colder one. Nobili divides the thermopile by joining a series of couples composed of antimony and bismuth. Becquerel built a thermo electric battery of artificial sulphuret of copper, heated up to four or five hundred degrees. Clamond, in applying thermo electric currents to practical purposes, used a negative element, composed of an alloy of two parts of antimony and one of zinc, and a positive element of a thin strip of tin plate. A paste of asbestos and soluble glass was used for separating the elements. Sixty such elements give three volts with an internal resistance of one and one-half ohms. A type of thermo electric battery recently placed upon the market for the purpose of driving fans and supplying light power is shown in the illustration. The manufacturers are the Thermo Electric Company, Times Building, New York City.

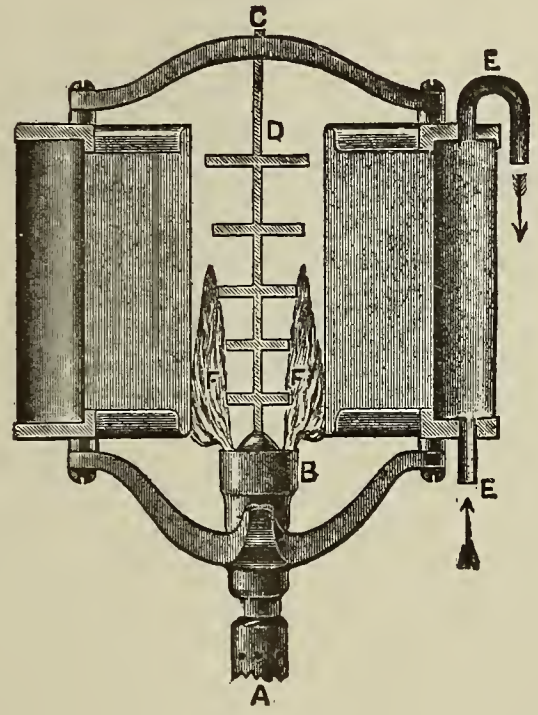
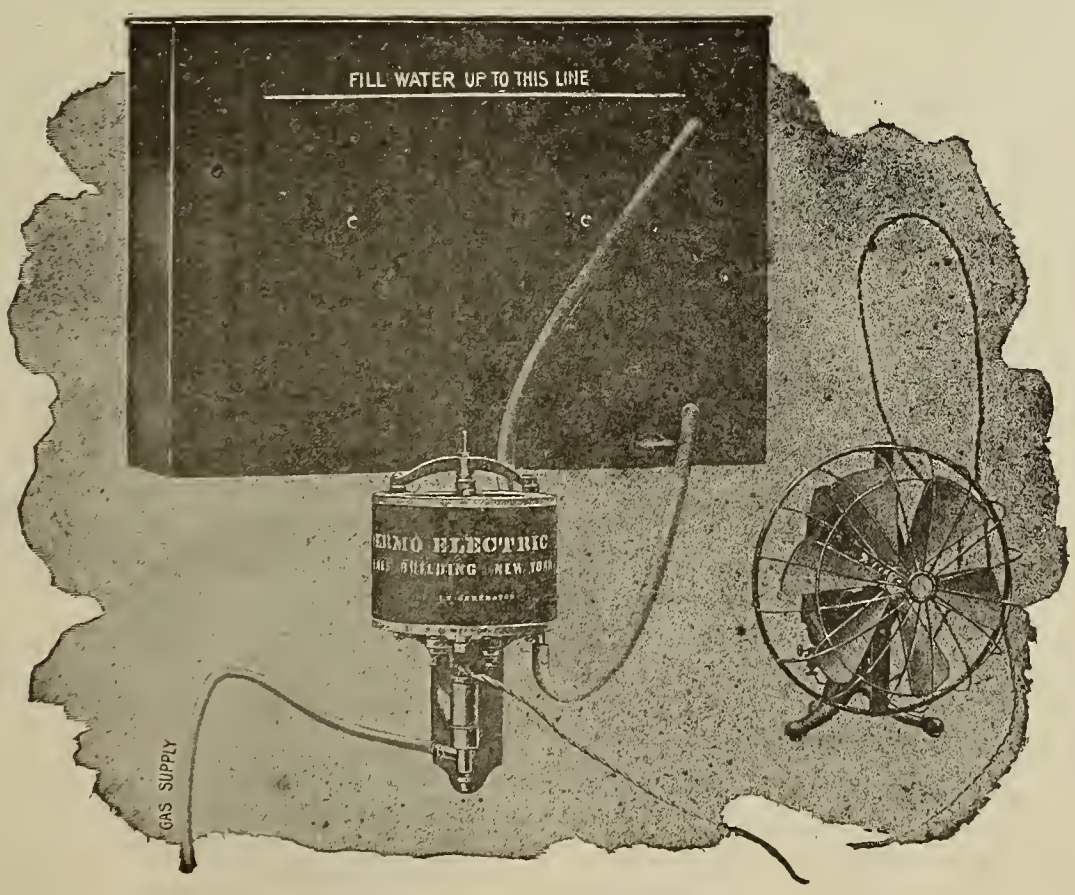


FIG. II.

Section Through Thermo Generator.



Thermo Generator in Operation.

Among the Socities.

NEW YORK ELECTRICAL SOCIETY.

The following members were elected at the 201st meeting of the New York Electrical Society held on the 17th inst: J. L. Kruger, 953 Myrtle avenue, Brooklyn, N. Y.; George H. Watson, 141 Broadway, New York City; Frank H. Roth, 165 Railroad avenue, Brooklyn, N. Y.; Joseph Hoffman, 2 West 118th street, New York City.

Business News.

SPECIAL EXPORT COLUMN.

TOTAL AMOUNT OF ELECTRICAL EXPORTS FROM NEW YORK CITY FOR WEEK ENDING JANUARY 20, 1900, $97,755.

New York, N. Y., Jan. 20, 1900.—The following were the exports of electrical material and kindred lines from the port of New York during the week just ended:

Argentine Republic.—159 cases electrical machinery, $9,317; 134 cases electrical material, $4,862; 12 cases electro-motors, $852.

British East Indies.—17 cases electrical material, $607.

British West Indies.—19 cases electrical material, $193; 3 cases electrical machinery, $35.

Brazil.—8 cases electrical material, $167; 2 cases electrical material, $60.

British Australia.—1 case electrical material, $198.

Barcelona.—46 cases electrical material, $5,155.

Berlin.—1 case electrical material, $5.

Central America.—117 cases electrical material, $840.

Genoa.—4 cases electrical material, $8,000.

Hamburg.—24 cases electrical material, $1,946; 75 cases electrical material, $776.

Havre.—241 cases electrical material, $16,051; 4 cases electrical machinery, $40; 2 cases electrical machinery, $58; 1 case electrical material, $15.

Japan.—19 cases electrical machinery, $1,370; 32 cases electrical material, $7,038.

Liverpool.—96 cases electrical material, $4,613; 43 cases electrical machinery, $954.

London.—320 cases electrical material, $13,367; 82 cases electrical machinery, $2,095; 7 electrical carriages, $823.

Nice.—66 cases electrical material, $11,283.

Peru.—21 packages electrical material, $657.

Santo Domingo.—26 cases electrical material, $993; 1 case electrical machinery, $25.

Southampton.—28 cases electrical material, $3,703; 60 cases electrical machinery, $663.

Stockholm.—1 case electros, $20.

Vienna.—5 cases electrical material, $195.

Venezuela.—21 cases electrical material, $559.

CANADIAN ELECTRICAL NEWS.

St. George, N. B.—The Pennfield and St. George Telephone Co. held their first meeting at Beaver Harbor on the 7th inst., at which it was decided to build the line to Pennfield Station this winter and the extension to Lepreaux and Bay Bay in the spring. Mr. S. L. Dakin is president of the company.

Toronto Junction, Ont.—The town council is at present considering the advisability of increasing the electric light plant for the purpose of supplying commercial lighting.

Windsor Mills, Que.—The by-law to raise $25,000 for a system of water works was carried by the ratepayers. The next step will be in the direction of securing electric lighting.

Pembroke, Ont.—The by-law to borrow $30,000 for the installation of a municipal electric light plant has been carried by the ratepayers.

Dartmouth, N. S.—The question of lighting the streets is under consideration by the council, the present contract expiring in June.

Bracebridge, Ont.—It is likely that a by-law will be submitted to the ratepayers to raise funds for an electric light plant.

Hull, Que.—Mr. Farley, city engineer, is now preparing plans for the new electric light power house to be built on Brewery Creek. It is the intention of the council to install the necessary plant at once for which tenders will be invited. There will be two 50-light dynamos, although 75 lamps will, at first, be installed. There will be about eight miles of wire.

Toronto Junction, Ont.—The mayor at his inaugural address advocates for the discontinuance of the incandescent electric lights and their replacement by arc lights.

Perth, Ont.—The need of an electric fire alarm system is being agitated.

Ottawa, Ont.—Application will be made to parliament for the incorporation of the Alaska and Northwestern Railway Company to construct a steam or electric railway from Pyramid Harbor and the Lynn Canal through Chilkat Pass and thence by way of the Dalton trail to Fort Selkirk in the Yukon district.

Weymouth Bridge, N. S.—The Sissibo Pulp Co., Limited, are now getting out timber for a dam and are arranging for survey of the proposed electric railway. It is not expected, however, that the work of the construction will be commenced before the first of March next.

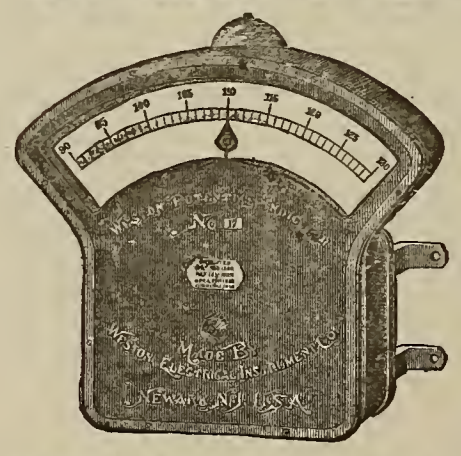
Montreal, Que.—The Mount Royal Park Incline Railway Company have appointed a committee consisting of Messrs. Mann, Valance and Turner, to confer with electrical companies as to the conversion of the power plant from steam to electricity.

St. Catherines, Ont.—At next session of legislature incorporation will be asked for the Queenstown, St. Catherines and Port Dalhousie Electric Railway Co. T. D. Cowper is solicitor for the company. The Niagara Central Railway Company has been granted permission to use the streets to extend their road through to Beamsville. J. S. Gamble, solicitor, has made application to parliament for the incorporation of the Niagara and Southwestern Railway Co. with power to construct an electric railway from Niagara-on-the-Lake through St. Catherines and Smithville to Hagersville with branches to Dunnville, Cayuga and Queenston.

Phoenix, B. C.—Duncan McIntosh has returned from Montreal, where he interviewed capitalists regarding the new tramway and electric light project here.

Newcastle, N. B.—J. C. Brown, of Richibucto, was here recently in connection with the project of building a railway from this place to the pulp mill near Catham.

WESTON STANDARD ILLUMINATED DIAL STATION INSTRUMENTS.



THESE INSTRUMENTS are based upon the same general principle and are just as accurate as our regular Standard Portable Direct Current Voltmeters and Ammeters, but are much larger, and the working parts are inclosed in a neatly designed dust-proof cast-iron case, which effectively shields the instruments from disturbing influences of external magnetic fields.

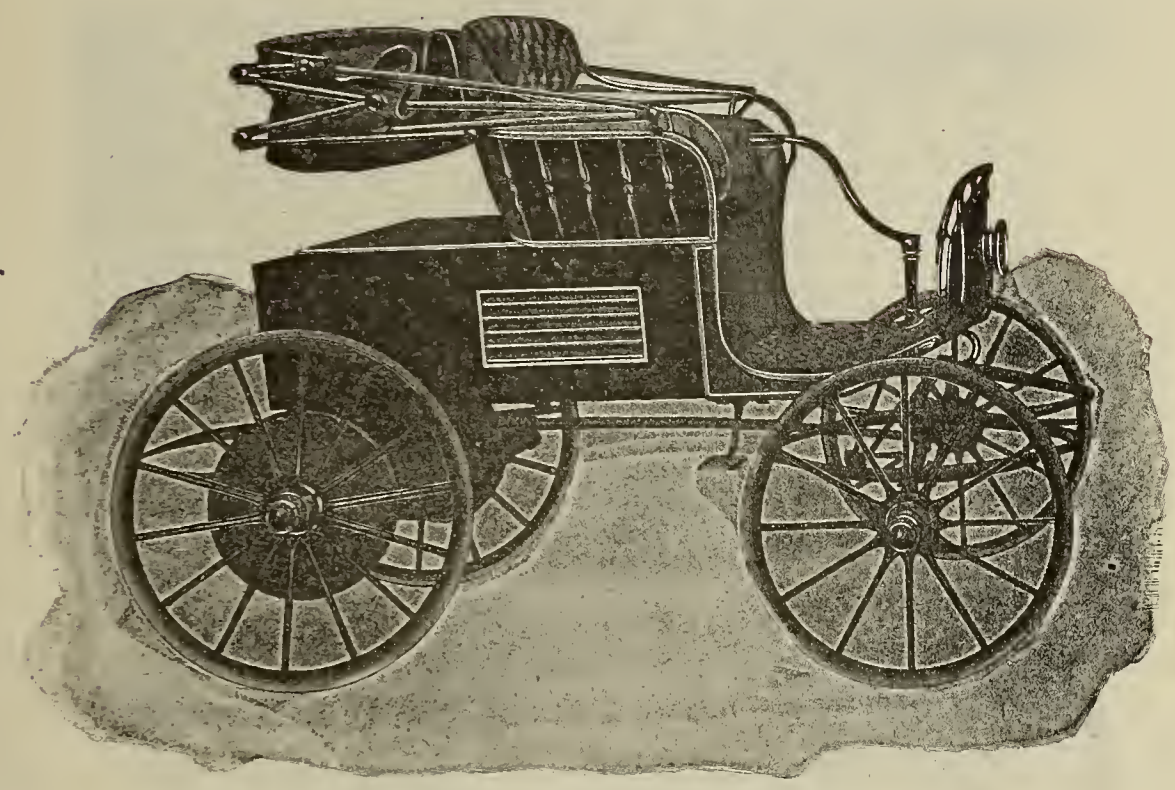
WESTON ELECTRICAL INSTRUMENT CO.

114-120 William St., Newark, N. J., U. S. A.

The Electrical Age.

Vol. XXV—No. 5. NEW YORK, FEBRUARY 3, 1900. Whole No. 664.

Automobiles.



American Runabout.

American Break.

AMERICAN ELECTRIC VEHICLE COMPANY.

At the recent Automobile Show the vehicles that excited the deepest interest and attention were those manufactured by the American Electric Vehicle Company, 134 West 34th St., New York. At their booth might have been seen the three carriages, illustrations of which grace this article. The first, an American runabout buggy, was the picture of lightness, combined with strength and speed. This buggy was tested by Mr. G. W. Knox, chief engineer of the Chicago City Railway, and he found that the maximum current used, when the wind was strongest, was only eighteen amperes, and that used under ordinary conditions about twelve. The weight of the runabout complete is between eleven and twelve hundred pounds, and at the above test grades were encountered varying from one and a half to three per cent. and various roads of the nature of asphalt, macadam,

granite and even wood. After covering a distance of sixty-one and a half miles a depreciation of speed was noticed of not more than twenty-five per cent. In many respects this carriage is the ideal of automobilists, and its lightness, beauty of finish, high attainable speed, and simple control brought it into great prominence during the show. The cost of running is about one cent a mile, and by means of a combination meter the operator can keep track of the capacity of the cells as the journey progresses. The motors used by this company are of the single reduction type, armature shaft hollow, and one motor in use for each vehicle. These motors are so constructed as to combine with their water and dust proof qualities compactness and an attractive appearance. The band brakes with which these vehicles are supplied are controlled by a foot lever which will hold the carriage in a fixed position on any grade, ascending, descending, or at any speed. The speed is under absolute control through the medium of a lever held in the operator's left hand. In addition the steering lever, held in the right hand, will, with the slightest effort applied to it, move the vehicle to any point intended. Through the aid of differential gearing the turning of corners is accomplished with ease and celerity. Reversing is a simple process likewise; a small lever at the driver's seat is given a touch and backward motion is immediately possible. In addition to these features, which add to the ease and comfort of travel, are electric lights which show the way in the darkest night, thereby supplying within a closed vehicle the equivalent of a comfortable and well lighted apartment. The cost of these vehicles is very moderate. Unusually so, in fact, when the high quality of the material and workmanship is carefully examined. In other illustrations are shown the American delivery wagon and the American brake, of the same fine finish and excellent design as the runabout. For all high-class stores, run by up-to-date, progressive business men, the electric delivery wagon is certainly an advantage whose value will become more widely understood as time rolls on. For quickness of delivery and readiness at all times these wagons are without doubt types par excellence. The weary horse is shelved and in snowy or sleety weather there is nothing to slip down and delay the delivery of packages. Finally the pleasure vehicle illustrated possesses the same general features of design as the others, but is particularly adapted for quick runs with a large party and for country roads, parks and boulevards. The government of this vehicle is as quickly learned as that of the preceding type, differing in no respect and fulfilling its functions in as admirable a manner.

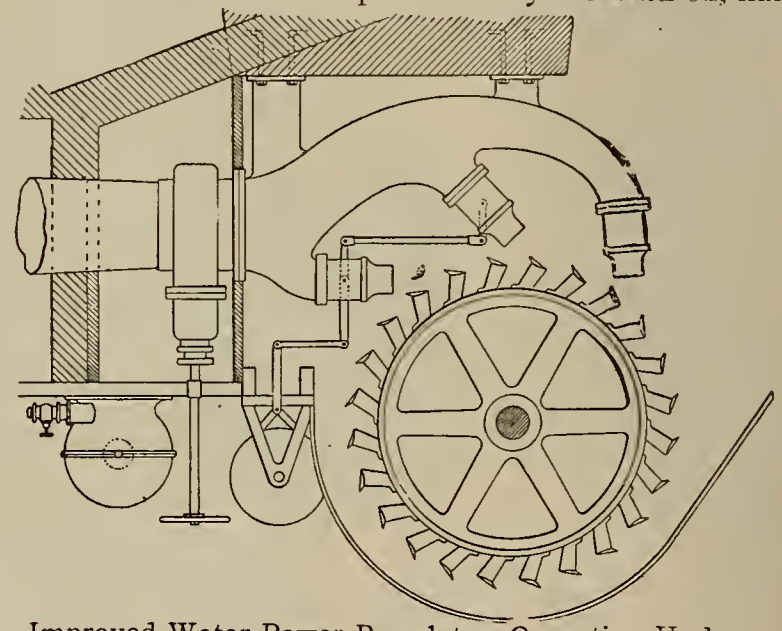
American Delivery Wagon.

Instalations for Electric Light and Power Plants

WATER POWER CALCULATIONS.

By F. M. F. Cazin. (Extract.)

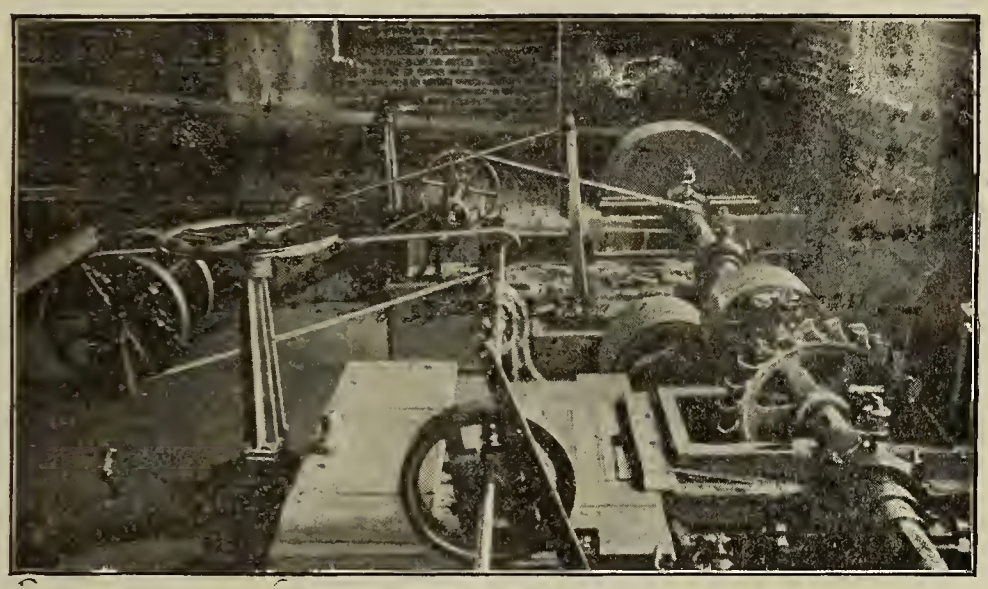
In valuating horse power by the Trautwein equation two conditions must be experimentally ascertained, name-



Improved Water Power Regulator, Operating Under Heads of From 100 to 2,000 Feet.

ly, the quantity of water ejected per second or minute and, the head, as indicated by pressure or by survey. This is the present understanding for its application but, if the equation is so used and applied then there is, in the expression for maximum labor performable in one place, a value used for velocity of jet that stands in conflict with the value for the same velocity that is used in another place. When the value for the head in the equation is ascertained by gauging pressure, or when it is established

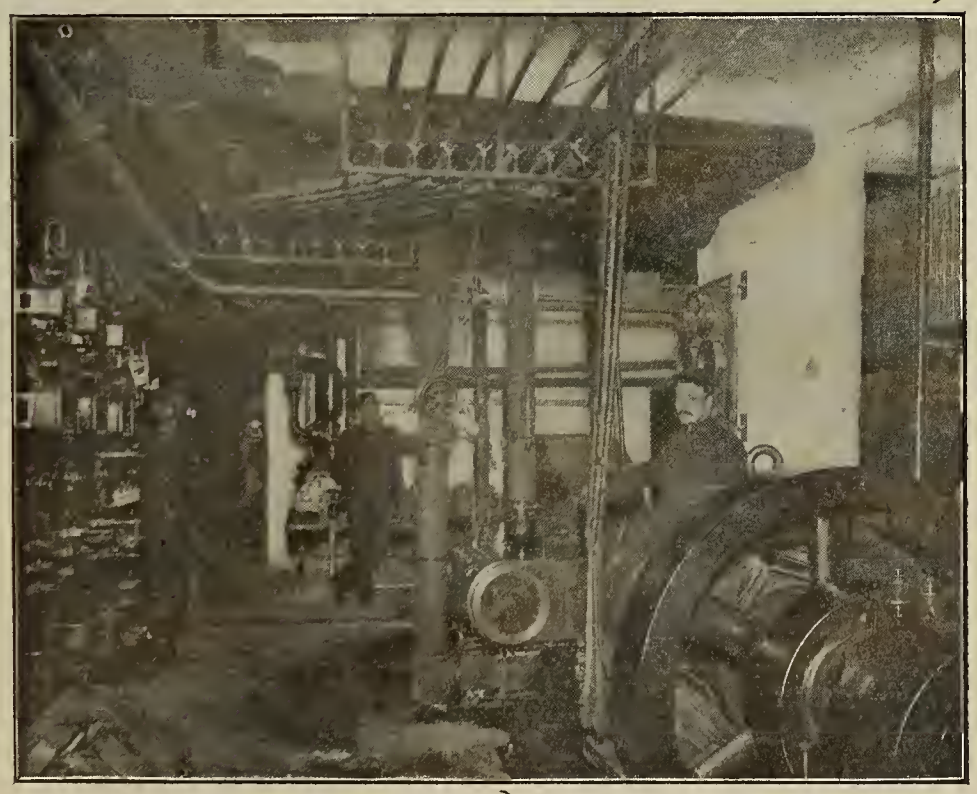
by the distance of fall surveyed then the velocity of the jet that is evolved therefrom is never the same as the actual velocity of the flow, as demonstrated by the water quantity actually ejected. In connection herewith it then should be understood that the equation expressing water power as presented by the author does not, as the Trautwein equation does, demand survey of the head or test of the pressure by instruments, but it demands, as the Trautwein equation also does, that the water quantity ejected be ascertained and, aside from this, that the section of the aperture of ejection be known. By dividing such section in the volume ejected the velocity of ejection may be ascertained and from the velocity so ascertained exclusively the correct or really effective maximum-head must be evolved; because water that has not been ejected cannot possibly have any effect and because in no known case has at any time ejection taken place with the full velocity conditioned by surved distance of the fall or by the pressure indicated by the water not in free motion.



Water Power Regulator.

ELEMENTS OF A MODEL LIGHTING PLANT.

The elements of a model lighting plant may be clearly defined in terms of its necessary constituents. The supplying of current for lights calls for a generator and possibly a small storage battery; in addition there is a switchboard with its various appurtenances, then the engine, boiler, pumps, etc., all of which collectively represent, when properly installed and related to each other, the elements of a model plant. The introduction of iron-clad generators, direct connected to a horizontal engine of the high-speed, automatic cut off type, may be regarded primarily as machinery of the first importance. The armature is drum wound and consists of a laminated core with punched slots on the periphery in which the conductors are imbedded. These conductors consist of copper bars of the highest conductivity and are separately



A Model Lighting Plant.

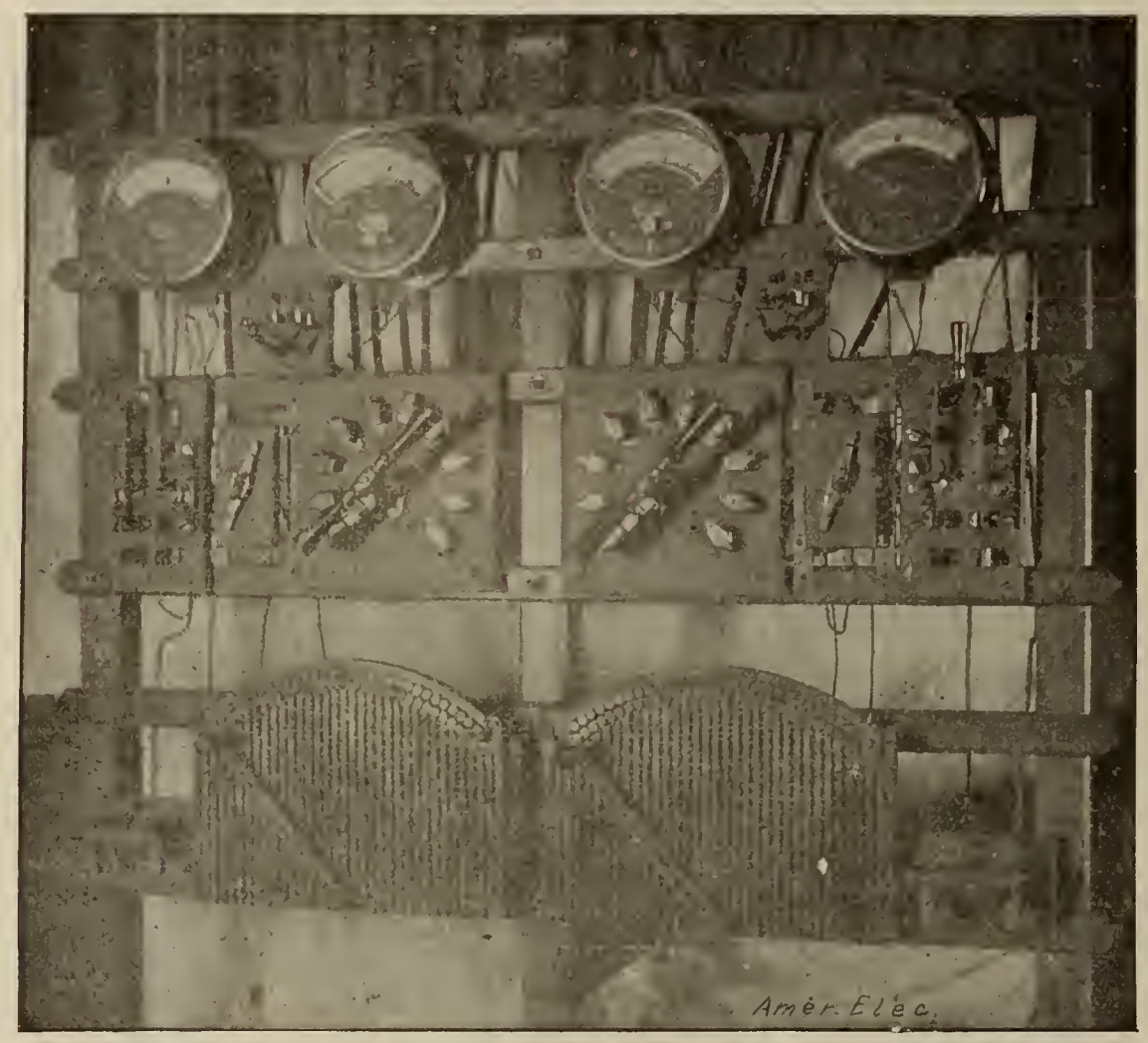
Editors' Note.—The Cazin formula referred to is that the power is equal to F x V x V squared- :-2 x g. The Trautwein formula is as follows: Power is equal to cubic feet of water active per minute times head. x lbs. x 62.39 divided by pounds x 33,000.

insulated. The core is thoroughly ventilated by openings, insuring a constant circulation of air through armature and commutator. The armature core consists of sheets of soft steel of the highest magnetic permeability and of low hysteretic qualities, thus reducing heating to a minimum and increasing the efficiency of the machine. These laminations are punched in dies and are absolutely uniform in shape. The winding is thoroughly protected by the core from mechanical injury. The commutator shell is of cast iron, bolted securely and, if necessary, independent of the shaft. The commutators are of hard drawn copper. With an additional equipment of carbon brushes, insuring freedom from sparing, the details of armature construction, each approximately perfect, will, in conjunction, give a machine of the highest efficiency.

The steam plant requires for its ultimate perfection a quick-firing boiler of large furnace area and a system of feed water heaters that will add an element of economy to the operation of the plant. With well operating boiler installed, of fair efficiency, and the elements briefly referred to above a model lighting plant not only represents a smooth running combination of complex parts, but possesses an efficiency which, in the course of time, greatly assists in the earning of a high dividend. A well installed plant should in the course of from five to six years actually pay for itself instead of consuming more than the allotment usually devoted to lighting.

STORAGE BATTERY FOR AUTOMOBILES.

Fitzgerald, a writer in one of the English electrical papers, is of the opinion that the accumulator is not



Switchboard of a Model Lighting Plant.

The switchboard in a model plant must be composed of a slate or marble, free from impurities. It must be easily drilled and inherently strong enough to resist the pressure of bolts and nuts which bind the instruments to it. The switchboard as a whole must be provided with automatic cut outs and a system of fuses which absolutely protect the main line from possible injury. A type of switchboard in a model plant of the greatest interest to the lay mind as well as expert can be found in the store of John Wanamaker, New York. In this case the measuring instruments are placed above, two systems of switches below; a system of controlling rheostats lower down; finally a line of huge switches for controlling the main circuits. A model lighting plant with a well regulated dynamo and engine of the most up-to-date construction is lacking in its most important feature if the switchboard does not possess proper measuring and controlling devices, briefly outlined above. In the largest as well as smallest of plants all practical engineers make it a point to supply on the main switchboard meters for volts and amperes, a system of fuses, a system of automatic cutouts and a system of major and minor switches.

adapted to heavy automobile service on account of the dead weight it represents. It is certain that a lighter and longer lived battery will lead to intense activity in the automobile field and open up new channels for their introduction. According to the above authority, a month's trial with a storage battery, from which the following conditions are expected, should mean its rejection unless they are successfully complied with.

1. The mean ratio of power to gross weight should attain and should not exceed 1.2 watts per pound.

2. The weight of an accumulator per ton of traction weight should not exceed 321 pounds and this should be able to supply 385 watts as an average for the whole run.

3. The mean ratio of discharge for the whole run should attain .59 amperes per pound

The above refers more to the battery for street railway purposes than electric vehicles, but the difference, if any, is in favor of the vehicle. The expressed limitations are that the battery should not exceed in weight from between twenty-five to fifty per cent. of the total outfit. According to foreign estimates the cost of a carriage pulled by horses is approximately $3 a day; the cost for elec-

The Electrical Age.

ESTABLISHED 1883.

Entered at New York P. O. as second-class matter, January 18, 1891.

THE ELECTRICAL AGE PUBLISHING CO., Publishers.

TERMS OF SUBSCRIPTION:

One Copy, one Year, - - - - - - - - $2.50
One Copy, six months, - - - - - - - - 1.25
Great Britain and other Countries, - - - - 3.50

Cable Address (all Cables), "Electage," New York.

NEWTON HARRISON, E. E., EDITOR.

ASSOCIATE EDITORS:

ALFRED E. WIENER, E. E., OSBORNE P. LOOMIS, E. E., } ELECTRIC LIGHT AND POWER.
JOSEPH MUIR, M. D., FREDERICK STRANGE KOLLE, M. D., } ELECTRO-THERAPEUTICS.

ADDRESS ALL COMMUNICATIONS TO
THE ELECTRICAL AGE PUBLISHING COMPANY,
Seventh Floor, World Building,
NEW YORK.

NEW YORK, FEBRUARY 3, 1900.

CONTENTS.

THE PRANCING AUTOMOBILE.

The daily newspapers generally devote half a column of space two or three times a week to a description of a runaway automobile. The story generally reads as follows "An automobile hansom gave Union Square considerable excitement late yesterday afternoon. It also gave to several hundred people an object lesson in the force that is represented in those ordinary looking black vehicles which they are not likely soon to forget. It came down Fourth Avenue with a man passenger, at the ordinary speed of these cabs. In an effort to get off the track the track the cab swerved sharply and the wet pavement caused it to slip so that the rear wheel struck the curb. The driver's box seat was evidently not securely fixed to the body of the hansom and when the wheel hit the curb the seat flew off the cab and the driver went with it. The driver had no chance to shut off the power from the motor, hence the manoeuvres which followed. The man in the cab escaped by opening the cab door surreptitiously. In front of the Morton House the cab rushed forward for the Washington statue, struck it, breaking off the inch and a quarter iron pickets from the horizontal railing."

Several other cases are on record of automobiles running wild, one of which was owned by the son of Thomas A. Edison. The moral of all this is that the running of an automobile requires a thorough knowledge of the machine before long trips are undertaken. Few would think of running a naptha launch until fully instructed, yet the possessors of automobiles having no technical training and but a superficial knowledge of how to operate them undertake long trips which sometimes have an unfortunate termination. With a little nerve and a little knowledge the automobile is far safer than a spirited horse yet much more dangerous if the operator loses control.

THE ELECTRICAL PROPULSION OF CANAL-BOATS.

Not long ago we prophesied that the commerce of the world would be greatly developed by electricity on the canals, the waterway having shown itself to be the means of hauling freight at one-third the cost of railroads. To prove that our prophecy was correct we now refer to the fact that the German Government, through Siemens & Halske, the great electrical engineers of Berlin, have constructed an electrical canal haulage system for the German Government on the Dortmund-Ems canal, joining the cities from which it derives its name. The government officials have reported that where there is a traffic of between three and five million tons the price by waterway is from twenty to thirty per cent. cheaper than by railroad, and where there is a ten million tonnage to be transported the cost is from forty to fifty per cent. less by canal than by railroad. There are many advantages, such as the opening up of the country through which a canal thus equipped passes. The construction of great plants along the waterway are among the future possibilities of the German canal, and now steps are being taken to erect several large plants which will create many new villages and cities along the canal waterway. Quoting from "Dampf" the following statement appears regarding the success of this enterprise "The vast importance of the cost of transportation as an element in the production of manufactured articles is now fully appreciated; the three great factors being the price of raw material, wages and the cost of freight. To reduce these to the lowest possible figure is the great problem. As an illustration of the necessity of transporting these materials cheaper it is estimated that with a tonnage of ten million to be delivered on the Mittleland Canal over a distance of four hundred kilometres, about three hundred and fifty miles, there will be a saving alone on the item of freight by canal against the railways of about twenty million marks." It is gratifying to know that Judge Adam E. Schatz is the father of electric haulage along the canals. The greatest compliment has been paid him in the adoption of his system by the German Government, and we hope that the Legislature of the State of New York will take notice of the fact that the origination of this great system is really due to the energy and time spent by Judge Schatz.

It is has been estimated by competent engineers that the Erie Canal could be equipped for one million dollars from Buffalo to New York with the Schatz system, and that the canal in its present condition would be ample and sufficient to carry all the freight that could be delivered to it for the next twenty years. Yet, notwithstaning the advantages of electric haulage on the canal, notwithstanding the fact that another government has adopted our system, Governor Roosevelt and the Legislature claim that the only salvation of the State would be the spending of sixty odd millions to make a great national waterway of the Erie Canal. Do the Governor and the Legislature forget that at the present time and under the present conditions New York is the hub of commerce? Is it possible that they forget that Chicago is to-day equipped with a ship canal which leads from the heart of Chicago to the Mississippi with an inexhaustible water supply and which in the course of time will enable a properly constructed steamer, such, for instance, as the whaleback, to carry freight from Liverpool to Chicago direct? Do the

Governor and the Legislature forget that if the Erie Canal were widened out to carry vessels such as they propose, Chicago or some other great port on the Great Lakes would be the terminus for goods to be carried direct from a German port of manufacture to an American port of consumption and that New York would simply be a midway station? These are matters which should receive immediate attention at the hands of those responsible for the future destiny of the State.

We hope and trust that wisdom will prevail and the political upas tree will not be allowed to blight the budding industries of the State of New York. One more question to the Governor and Legislature. Gentlemen: Do you for one moment believe that the people of New York will consent to approprite sixty to seventy-five millions of public money to create a waterway for Mr. Thomas Platt, Mr. Vedder and his associates, who now by reason of a contract that will run for fifty years without a dollar of revenue to the State have their hands on the throat of the future of the State of New York?

(Continued from page 36)

tricity about $1.75. Other figures of a comparative nature show that electric traction costs $95 per carriage per annum; petroleum traction $106 and animal traction from $200 to $300.

The weight of electric cabs in this city is about three thousand pounds. This is, of course, excessive, but even then considerable slip is experienced in wet weather with any other than the enormous tires they now employ. The electric tricycle is proportionately lighter and runs further, its total weight not exceeding five hundred pounds

TRANSATLANTIC NAVIGATION BY STORAGE BATTERIES.

From a commercial standpoint the manufacture of storage battery plates has become established as an industry of growing proportions. Not only have many defects been mastered and difficulties overcome in relation to the durability and capacity of a storage battery but, more important than all, the function of a storage battery is clearly defined. Neither too much nor too little is now expected from it when installed to carry the peak of the load in large central stations to operate electric launches or automobiles or to be relied on in country residences during the night when the machinery is shut down. Other questions have ben arising, however, in reference to the possible function of the storage battery for ferry-boats and even larger craft of dimensions no less than those of an Atlantic liner.

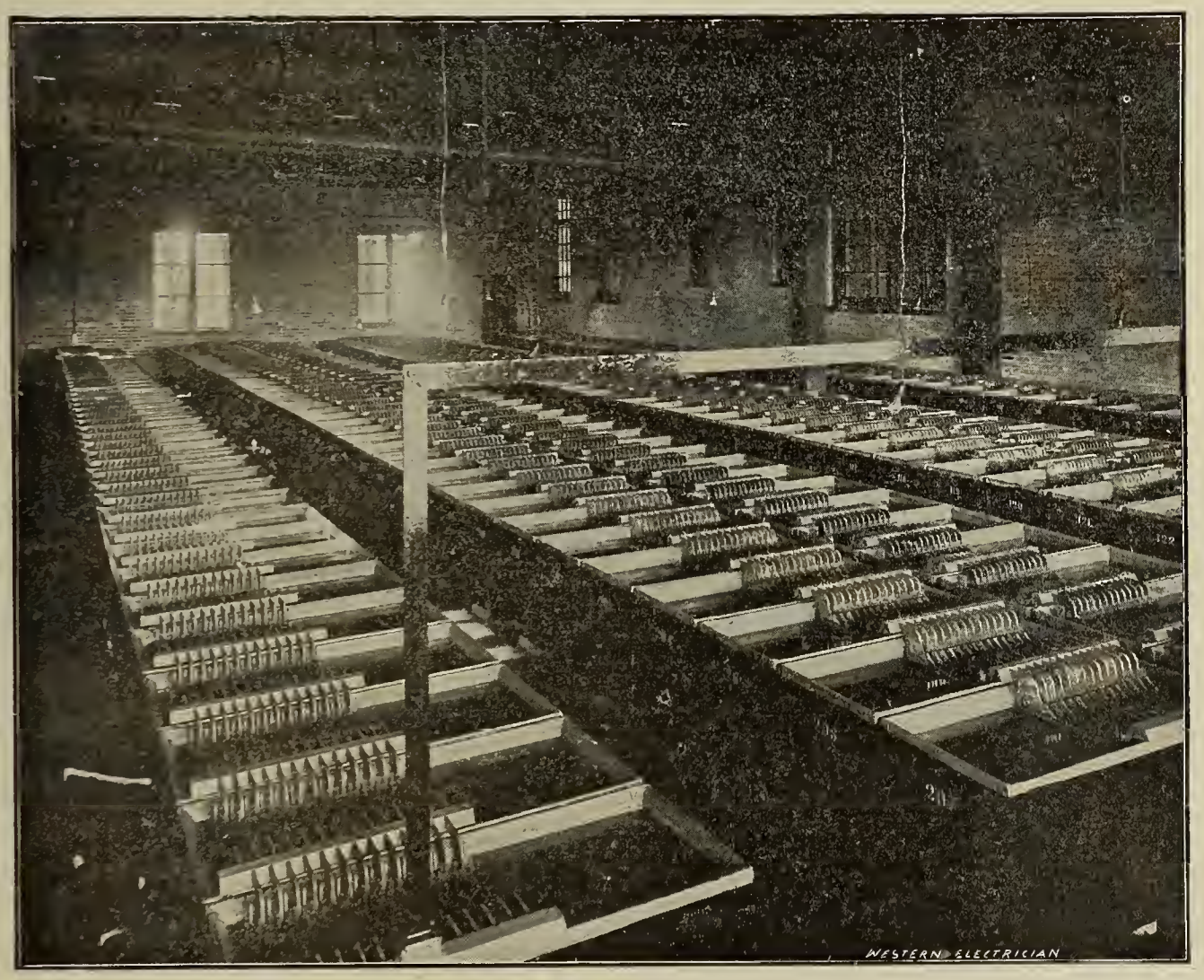
To thoroughly investigate the possibilities of this new application of the storage battery some few crude calculations have been made which, on the whole, are of a most unsatisfactory nature. The ballast required by large steamers in the nature of merchandise and coal will find a fair equivalent without question in storage batteries. From an economic standpoint there is but little doubt that the cost of construction of an ocean liner is largely dependent upon the nature of the engines on board and the modernness of the other mechanical and lighting appliances employed. In fact, the entire design of the vessel is directed along such lines that the highest possible speed is aimed for with a minimum of weight. Quadruple expansion engines and thousands of tons of coal and a net efficiency of not more than twelve per cent., with the expense inevitably associated with the care, repair and general attention a great steam plant requires, seems collectively to indicate an expense enormous in comparison with the service performed. On the other hand, with an electric equipment the deterioration of storage batteries and a possibility of defects arising in motors employed for propulsion, associated with the peculiar risks incident to this equipment, might lead to many doubts as to the feasibility of supplanting steam by electricity. As far as weight is concerned a quadruple expansion engine of ten thousand horse-power and its equivalent in motors would in many respects compare equally well, with probably a great saving in cost of construction and care in favor of the motors.

The weight of the coal and boilers and the horse-power represented by a given weight should be the next question deserving attention. A six days' trip on an ocean liner means the consumption of from three to six thousand tons of coal. Life in a stoke hole has been eloquently described by many of the daily newspapers, it being pretty well known that the heat there is unendurable for more than three or four hours at a time, thus necessitating several shifts of men. The dangerous features associated with the high speed of transatlantic travel and the vast complication in machinery upon which the vessel is wholly dependent would make a change to a simpler sys-

An Electrically Propelled Launch.
Power Delivered by Storage Batteries.

tem of propulsion highly desirable. The points to be examined are those in reference to weight per horse-power hour and cost of each horse-power hour. Summing up the weight of engine, boiler and fuel on board ship and dividing the aggregate by the horse-power of the engine will give the weight of material per horse-power for the transatlantic trip. Were this figure in any way comparable to the weight of battery and motor per horse-power the question would then resolve itself into a discussion as to whether it were better to carry power on tap ready for immediate use, at what would presumably be a higher figure, or carry coal with engines, boilers, etc., as above described. A rough estimate as to the weight of the steam plant on board ship would show that the six thousand tons of coal added to the weight of engines and boilers would give in round figures an aggregate weight of ten thousand tons. A storage battery capable of giving ten thousand horse-power for six days would weigh, on the basis of seventy-five pounds per horse-power hour, seventy-five times ten thousand times twenty-four times six, divided by two thousand, equal to nine thousand tons. Making an allowance of from two to three thousand tons for motors with their appurtenances a fair balance would be struck of twelve thousand pounds weight of electrical machinery against ten thousand pounds weight of steam appliances.

If the cost of operating this machinery is less than that of steam calculation might show no gain financially in favor of electricity but many advantages arising on board ship through increased space, available for cargo or passengers, a simpler method of operating the ship, and in all probability an ultimate gain to the owners through saving in power caused by poor stoking. Power from storage batteries may run out, also the coal supply. Motor may break down, also the engine. It is therefore evident that certain expenses incidental in one case are the means of balancing up others and lead to the belief that a thorough investigation of the possiblities of electric transatlantic transportation would be the means of bringing to light many interesting facts.



A Complete Storage Battery Installation.

Business News.

REMOVAL OF THE SAFETY COMPANY'S PLANT.

In the front ranks of the great wire manufacturers of this country are to be found the Safety Insulated Wire and Cable Company, of 225-237 West 28th St., New York City, greatly due to the untiring efforts of its treasurer and general manager, Mr. Leonard F. Requa. Having concluded some time ago that their present works were too small and that their facilities for shipment had become antiquated and too expensive, they turned their attention to securing a convenient location, having the conveniences of a seaboard site, and during the past week signed papers securing the old Carr and Hobson property, at Bayonne, N. J., containing thirteen acres of land with a large frontage on New York Bay. The depth of water at the new pier which will be erected will be about thirty-six feet, sufficient for the largest steamer afloat. This site is also on the line of the Central Railroad of New Jersey, and business and commercial men will appreciate the advantages of this location for the receiving and shipping of goods. The works will cover a large area of ground and will be mainly composed of two-story buildings for the convenient handling of the Safety Com-

pany's products. The intended extensive plant will afford all the facilities for adding other lines to the company's already large line of rubber covered wires, weatherproof, magnetic, paper and flexible wires and cables for all purposes. The present works in New York City are busy day and night filling orders for standard "Safety" seamless rubber wires and cables. The Safety Company's products are to be found on land and sea in every clime, being used for overhead and submarine telegraph and telephone lines, district, fire alarm and police telegraph, electric light, power and railway conductors.

AUTOMOBILE SHOW NOTES.

AMONG THE PROMINENT electricians at the show were Andrew L. Riker, of the Riker Electric Vehicle Company; W. D. Porter, of Porter motor fame, and Robert Shuky, E. E.

C. A. SEAMANS, of Wycoff, Seamans & Benedict, the Remington typewriter magnate, bought a four seated electric pleasure vehicle at the show, costing $1,500. He is sending it to Florida.

THE INDIANA BICYCLE COMPANY sold one of their small Waverly electric brakes at the show.

SPECIAL EXPORT COLUMN.

TOTAL AMOUNT OF ELECTRICAL EXPORTS FROM NEW YORK CITY FOR WEEK ENDING JAN. 27, 1900, $54,833.

New York, N. Y., Jan. 27, 1900.—The following were the exports of electrical material from the port of New New York during the week just ended:

Argentine Republic.—286 cases electrical material, $23,761; 2 cases electrical machinery, $603.

Amsterdam.—1 case electrical material, $125.

Alexandria, Egypt.—1 case electrical material, $20.

Bristol.—62 packages electrical machinery, $4,000.

Brussels.—1 package electrical material, $22.

Brazil.—8 cases electrical material, $460.

British Australia.—2 cases electrical machinery, $1,133.

Cuba.—140 cases electrical material, $4,449.

Central America.—3 cases electrical material, $101.

Dutch Guiana.—1 case electrical material, $50.

Frederickstad.—5 cases electrical material, $140.

Glasgow.—6 cases electrical material, $211.

Hamburg.—139 cases electrical material, $10,819.

Liverpool.—6 cases electrical machinery, $223.

Leeds.—3 cases electrical machinery, $181.

Milan.—19 cases electrical material, $1,716.

Mexico.—12 cases electrical machinery, $1,226.

Newcastle.—2 cases electrical machinery, $300; 3 cases electrical material, $370.

Rotterdam.—1 case electrical material, $15.

Riga.—5 cases electrical material, $1,558.

Southampton.—2 cases electrical material, $40.

Tasmania.—53 packages electrical material, $3,310.

NEW INCORPORATIONS.

New Brighton, N. Y.—The New Brighton Electric Light, Heat and Power Company, of Staten Island, has been incorporated. The company intends to furnish heat, light and power for public and private uses. Its capital stock is $1,000. The directors are William Irving, John Irving and George Irving, of New Brighton.

TELEPHONE CALLS.

Troy, N. Y.—The Troy Telephone Company, increase of capital stock from $10,000 to $40,000.

Albany, N. Y.—The Black River Telephone Company has been incorporated. Its general route is to be from Watertown to Utica, connecting as principal points Carthage, Lowville, Boonville and Rome, and as minor points the villages of Delta, Lee, Lee Centre, West Branch, Ava Corners, West Sydney, Mohawk Hill, Bryon's Corners, Constableville, Turin, Port Leyden, Leyden, Lyons Falls, Houseville and Martinsburg. The capital stock is $25,000. The directors of the company for the first year are John J. Domser and Philip Domser, of Lewis, Lewis County; Fred C. Myers, of Sylvester; C. Caypron and Benedict Gantner, of Leyden, Lewis County; Homer C. Markham, of Lyons Falls; David Swancott and Frank Harrington, of Lee.

STREET RAILWAY NEWS.

Brooklyn, N. Y.—South Brooklyn Railway Company. Capital, $150,000; incorporators: W. B. Cutting, J. F. Ambrose, J. A. Murray, all of New York City; D. Ward, of Irvington.

Chattanooga, Tenn.—The stockholders have authorized an issue of $100,000 additional bonds for the purpose of extending and equipping the Rapid Transit Electric Railway from Chattanooga to Chickamauga Park.

Toledo, Ohio.—The Toledo & Bay Point Electric Railway Company will build a monorail road to Bay Point, nine miles from the city, on Lake Erie. They will erect a summer hotel and theatre there at a cost of $250.000.

Hampton, Va.—A company has been organized under the title of the Hampton Roads Railway and Electric Company to build a road from Newport News to Hampton and other points. The company will also build a plant to furnish electric power and light.

Southington, Ct.—The Connecticut Lighting and Power Company has bought of the Southington & Plantsville Tramway Company all of the latter's property and assets, as a result of a special meeting of stockholders. The meeting elected J. E. Sewell, H. W. Minor and G. E. Perry, of Waterbury, and E. H. Mather, of New Britain, directors, to fill vacancies caused by the resignation of L. K. Curtis, E. G. Lewis, J. F. Pratt and Stephen Walkley, of this place.

York, Pa.—The York Traction Company has been organized by Judge W. F. Bay Stewart, Captain William H. Lanius, president of the York extension of the Western Maryland Railroad; William A. Himes, of New Oxford, Pa.; Grier Hersh, president of the York National Bank; John W. Steacy, George P. Snyser and George S. Billmeyer. The new company has purchased the York Electric Railroad and will build extensions to Dover, Weiglestown, Dallastown, Norway Park and other points in York County.

POSSIBLE INSTALLATIONS.

Alliance, Neb.—This town will soon install an electric lighting plant.

Freeport, Ill.—W. H. Wheeler, owner of the Freeport water-works, is offering to put in a great electric power plant to furnish electric power for manufacturing institutions for lighting and for other purposes.

Asbury Park, N. J.—A new electric lighting plant is contemplated at Asbury Park, N. J., by the authorities of that place. It will be equipped with three engines and three dynamos of seventy lights' capacity; one additional boiler of 200 horse power will also be required, in addition to the building, which will be brick and iron. Cost, $25,000.

WESTON STANDARD

PORTABLE DIRECT READING

VOLTMETERS AND WATTMETERS

For Alternating and Direct Current Circuits.

The only standard portable instrument of the type deserving this name.

Write for Circulars and Price Lists 8 and 9.

WESTON ELECTRICAL INSTRUMENT CO.,

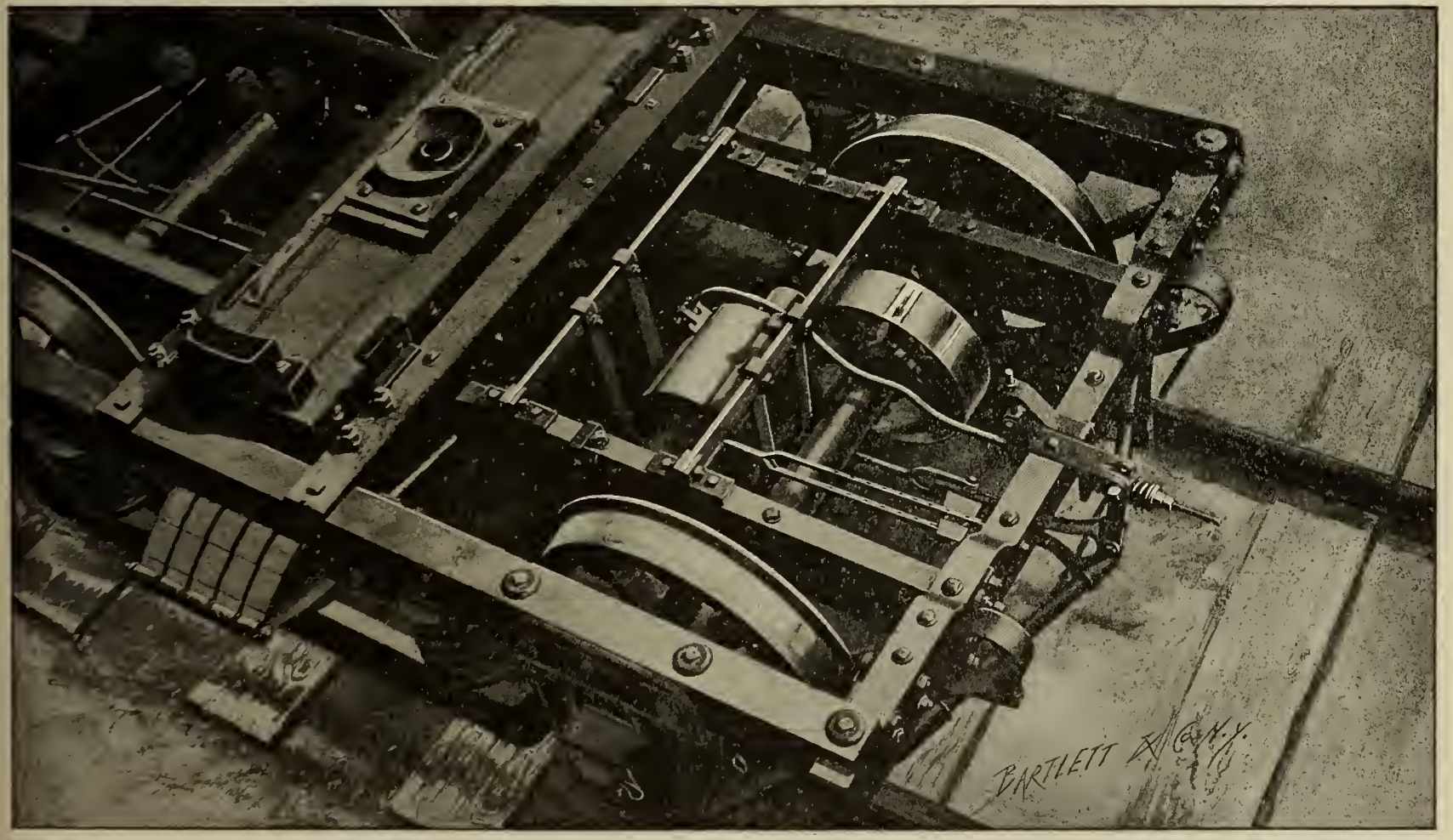
114-120 William Street, Newark, N. J.

The Electrical Age.

Vol. XXV—No. 6. NEW YORK, FEBRUARY 10, 1900. Whole No. 665.

Novel Applications of Electric Power.

Electric Lights and Fan in Buffet.

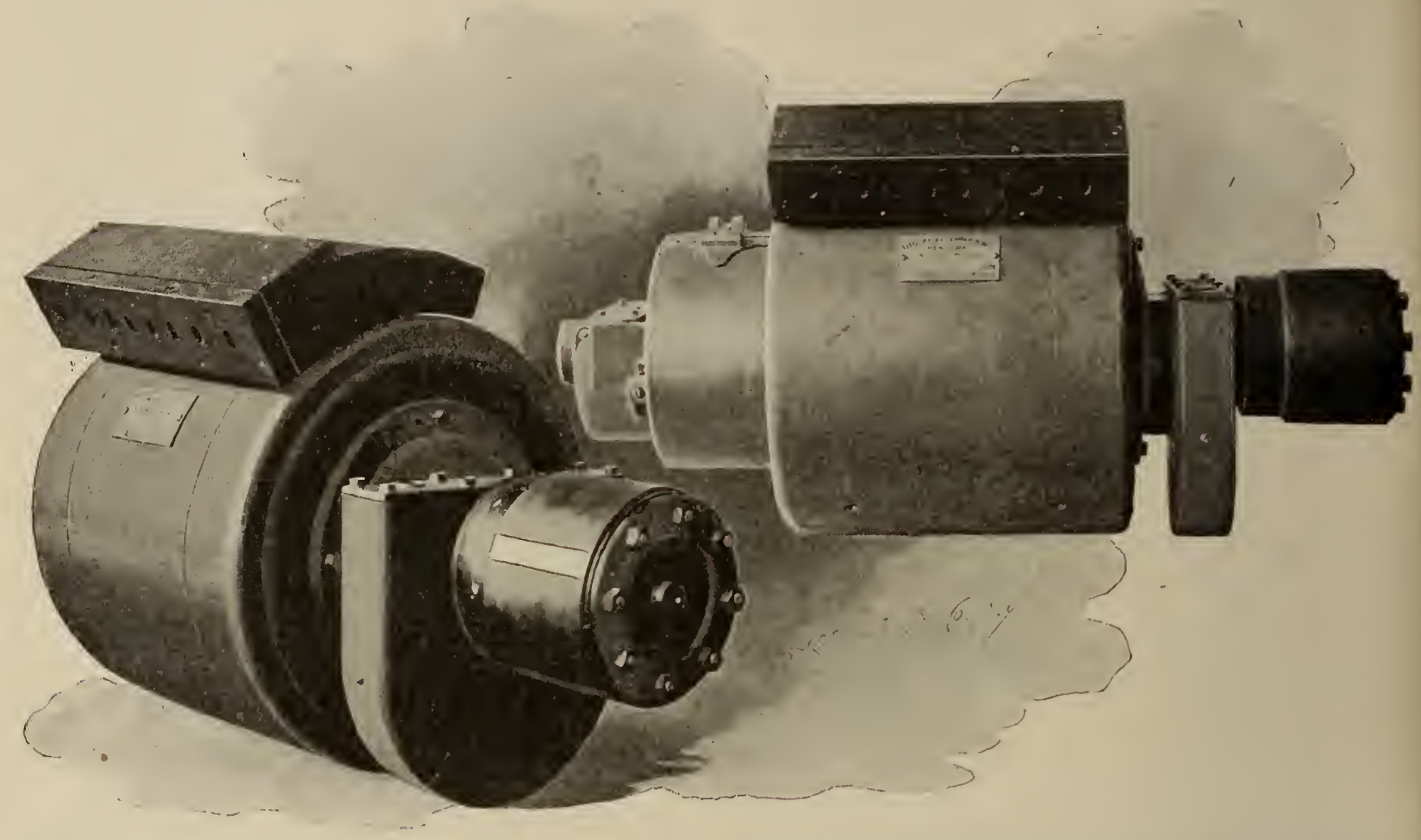


Generator Applied to a Car and Truck.

LIGHTING AND REFRIGERATING FROM THE CAR AXLE.

The method of obtaining light from the car axle has been frequently explained in technical periodicals. The desire of the public to travel comfortably, which, of course, includes plenty of light at all times, has led to the development of a system by means of which electricity is generated from a dynamo applied to the axle of the car. Some of the illustrations will give the reader an adequate idea, without unnecessary explanation, of how this is ac-

complished. By the aid of friction pulleys not only is noiselessness secured, but the rate of deterioration is reduced to a minimum and the machinery is readily accessible. The generator is protected from external conditions by its unique design. It is able to maintain a steady pressure of from 32 to 40 volts, which pressure is arrived at when the speed of the train approximates ten miles an hour. The dynamo is self-regulating and self-exciting, and after having been installed requires no more care or consideration than a pair of bearings, which, of course, must be oiled from time to time. Even in this respect the dynamo will stand a run of five hundred miles without any attention. The car switch box contains the apparatus designated as the ammeter, switch and means of automatic control employed for distributing the current to the storage batteries and lamps. It also cuts the dynamo out of circuit automatically when the velocity of the car falls below ten miles an hour. A peculiarity of



Electric Axle Light and Power Company Generator. Side and End View.

Distribution of Light in use in U. S. Postal Cars.

the automatic switches within the car switch box is the impossibility of opening them while they are carrying

Refrigerating Car Using the Ryan System.

current. In consequence of this there is no deterioration at this point due to arcing. Without reviewing either the

Distribution of Light in Passenger Coaches. Delaware, Lackawanna and Western R. R.

advantages or faults storage batteries are heir to, it may be generally stated that with an ordinary amount of care,

such as any other class of apparatus will receive, these storage batteries will perform their functions for many years.

The lamps in use on railway cars must necessarily be made to withstand vibration or mechanical wreckage will result in a very short time. A strong, short, unbreakable

filament for this purpose is secured by using a low voltage lamp. For this reason thirty volt lamps are employed of sixteen candle power, and the light obtained from them is mellow, pleasing and sufficient for all purposes. It has been generally recognized that there is as much art required in distributing light as in inventing a device for producing it. The many dark corners of a car and the merciless shadows that are cast at night are a source of great discomfort to a passenger attempting to read. A practical experience is absolutely necessary in order to arrange lamps where they will be most effective, and in this respect the Electric Axle Light & Power Company, of 100 Broadway, New York City, have fully succeeded. In addition they equip cars with electric fans, a luxury fully appreciated on a hot night when the fine coal dust sifts its way through the smallest crevice in the window. Immunity from this discomfort and the enjoyment of a luxurious breeze tends to make travel in railway cars an unalloyed pleasure.

Strange to say, the power drawn from the axle cannot be measured by ordinary means, as it forms an infinitesimal part of the vast amount of energy impelling the car along the tracks. It has been estimated to be from one to two tenths of one per cent. of the total power of the locomotive. This would mean from one to two thousandths of the total power. Certainly not enough to appreciably affect the speed of the train.

One of the greatest of modern problems is that of producing the proper refrigeration in cars carrying perishable goods. It is not necessary to dilate upon the importance of an invention which will make a refrigerating car self-contained and utterly independent of the ordinary ice supply for the preservation of its contents. The method of packing the car with ice and replenishing it when occasion requires represented at one time the highest state of the art. Now the mere fact that the car has to be opened for such a purpose renders this a questionable method. The imagination of the reader can be exercised in forming a plan to supply ice to cars running through arid wastes or hot districts like those found in the Southern States, Mexico and Central and South America. Ice cannot even be supplied along the route, and not enough can be carried in the car to tide over a

Car Switch-Box.

lengthy run. The system employed by the above company, called the Ryan system, meets all these difficulties. Cold, dry, desiccated air is employed, the properties of which for the preservation of perishable articles are generally recognized by the highest authorities in the science of refrigeration. Dynamos are attached to the axles and the current utilized for supplying the motive power consumed in operating the mechanism producing the cold air. In addition, storage batteries are installed in each

Distribution of Light in Drawing Room of Private Car.

The Electrical Age.

ESTABLISHED 1883.

Entered at New York P. O. as second-class matter, January 18, 1891.

THE ELECTRICAL AGE PUBLISHING CO., Publishers.

TERMS OF SUBSCRIPTION:

One Copy, one Year,	$2.50
One Copy, six months,	1.25
Great Britain and other Countries,	3.50

Cable Address (all Cables), "Electage," New York.

NEWTON HARRISON, E. E., EDITOR.

ASSOCIATE EDITORS:

ALFRED E. WIENER, E. E., OSBORNE P. LOOMIS, E. E., } ELECTRIC LIGHT AND POWER.

JOSEPH MUIR, M. D., FREDERICK STRANGE KOLLE, M. D., } ELECTRO-THERAPEUTICS.

ADDRESS ALL COMMUNICATIONS TO

THE ELECTRICAL AGE PUBLISHING COMPANY,

Seventh Floor, World Building,

NEW YORK.

NEW YORK, FEBRUARY 10, 1900.

CONTENTS:

UTILIZING WASTE PRODUCTS.

The comments of students of municipal economics have been directed along such lines of late that public attention has been called to some of the theories advanced by them. The demand for the municipal ownership of electric light plants, of gas retorts, and of some few other departments forming necessary adjuncts to the city's comfort, has been voiced by many of the leading dailies. Strange to say, the furore created in England over the utilization of waste products, particularly garbage, for electric lighting, has not reached these shores. The vast resources of the United States, its enormous coal mines of seemingly inexhaustible supply, and its great forests, certainly affect the population at large in allowing much that might be saved to go to waste. In Paris, in fact, in France, nothing is wasted, and to a large extent this idea is faithfully followed out in the majority of European provinces. In America alone, however, things are considered useless when they have passed that stage of usefulness for which they were originally intended, and, in consequence of this, much of the waste above referred to takes place.

Dr. William Calver, of Washington, D. C., has been deeply interested in the waste of power daily occurring through lack of a device to utilize the radiant heat of the sun. He built a machine, consisting partly of mirrors, by means of which he has been able, on the coldest days of winter, to weld metals together. He says: "I have burned a brick half way through in less than an hour. I have concentrated the combined heat of the mirrors on an unburned brick and burned it so hard that it scratched steel." It might be well to mention, in connection with the above, that the vast amount of power thrown out by the sun is so great that no adequate idea can be formed of its vastness. It has been estimated that each square yard of the earth's surface heated by the sun's rays absorbs on the average the equivalent of one horse power per hour. In the United States alone, during a summer day, or even one hour of an August morning, the energy rained down will exceed 27,000 billion horse power hours, a force of almost infinite dimensions, at least to our comprehension. Prof. Alexander Melville Bell is said to have expressed himself in the following emphatic manner, during a colloquy with Dr. Calver: "Why, by an application of this principle you can collect acres and acres of sunlight in a single spot." This statement is not far-fetched, as he has been able to concentrate at a given point the heat collected by sixteen hundred mirrors, thereby obtaining a temperature exceeding ten thousand degrees Fahrenheit. Were these mirrors merely able to concentrate the rays of heat shed down upon an acre the horse power thereby concentrated would represent approximately five thousand. In ordinary welding processes the horse power employed does not nearly approach this unless a bar of a very large diameter is to be welded. It seems as though the waste of this enormous amount of energy will not go on for many more years. The utilization of a tenth of one per cent. would be more than sufficient to keep all our factories going, rolling mills in operation, and supply power to drive all the moving mechanical and electrical devices on the face of the globe. Niagara Falls is a mere drop in the bucket compared to the infinite ocean of energy bathing us daily in its light and heat.

AUTOMOBILES FOR POSTAL SERVICE.

It is interesting to observe the various comments made upon the future of the automobile by the daily and secular press. It is destined to occupy a place in the minds of the public that will cause it to be regarded in the same light as any of the necessary inventions in use to-day of modern or ancient origin. The demand so far has proceeded from those engaged in mercantile pursuits; the dry goods store and various other large retail establishments find it advantageous in many respects. For cab work it is already a success, and a large percentage of orders have come in from private individuals with time enough on their hands to think of engaging in this new form of amusement, namely, automobile driving. The great multitude, however, are not in a position to entertain these ideas, although fully alive to the obvious advantages of the automobile. In France the Government uses the automobile for transporting mail, and, according to a contemporary, has recently ordered fifty heavy wagons, each equipped with nine horse power gasolene engines, for the purpose of carrying mail in the Soudan. First Assistant Postmaster Heath seems to think that the automobile mail wagon for the purpose of collecting mail from the street corners in bulk, as well as adding to the frequency of the collections, will greatly facilitate business transactions and probably add to the amount of correspondence. He estimates that at present the government is paying more than $400,000 to letter carriers and to sub-contractors allowing the government to use their horses and wagons. It looks as though twice this sum would be more than sufficient to equip a plant for this very purpose with automobiles.

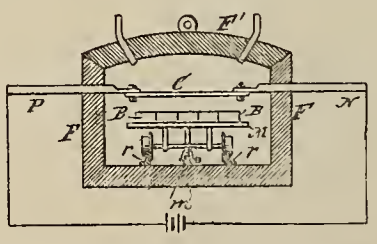
car which will keep the refrigerating apparatus in operation independently for at least three days. The temperature is maintained at about forty degrees Fahrenheit, though as great a cold as twenty degrees above zero can, if necessary, be produced and maintained. These cars are without hatches in the roof. There are no ice boxes and no drip of salt brine. The weight of the entire plant does not exceed three thousand pounds, whereas the old system means from eight to twelve thousand pounds total dead weight. The old system of supplying ice cost from fifteen to twenty dollars per car per thousand miles. The Ryan system, with little or no cost for maintenance, does not average over twenty-five cents per thousand miles per car.

Recently a party of electrical experts and representatives of the press took a lengthy trip in the special Pullman car "Olivette," equipped by the above company. This car travelled from New York to New Orleans and return and passed through some of the most important cities in the Union, including Philadelphia, Baltimore, Washington, Cincinnati, Louisville, New Orleans, Atlanta, etc. In this car light and refrigeration were obtained solely from the car axle. The test of the refrigeration car extended from Montgomery, Ala., to New Orleans. It is hardly necessary to state that the trip was in every way successful and represented a thorough test of the system. The gentlemen enjoying this unique experience were the following: T. E. Niles, managing editor, the Mail and Express; D. A. Kimbark, chief electrician the Pullman Company; Joseph R. Ellicott, general manager the Standard Brake Company; H. M. Littell, consulting engineer; David Ferguson, New York World; Maurice Barnett, electrical engineer; Robert N. Burnett, New York Commercial; Eads E. Schmidt, secretary, Electric Axle Light and Power Co.; John T. Dickinson, general agent, Electric Axle Light and Power Co.; J. F. Kelly, private secretary.

The Consolidated Railway Electric Lighting & Equipment Co. has made the following proposition to holders of Electric Axle stock: The holder of each share of Electric Axle Light & Power stock, all assessments paid, will receive sixty-seven per cent. of the par value of his holdings in full-paid, non-assessable shares of the Consolidated Railway Electric Lighting & Equipment Company. The majority of holders of Electric Axle stock have tendered their shares for the new stock at the above terms, the limitation of time expressed being Feb. 3, 1900, 3 P. M.

A NEW APPLICATION OF ELECTRICITY.

We are pleased to note that our old friend, C. H. Waterman, after many years of patient labor, has succeeded in enameling bricks, tiles, etc., by the use of electricty. He has obtained patents for this process in this country and also in foreign countries and organized the Electric Enameling Company, of 203 Broadway, New York City,



Electric Enameling Furnace.

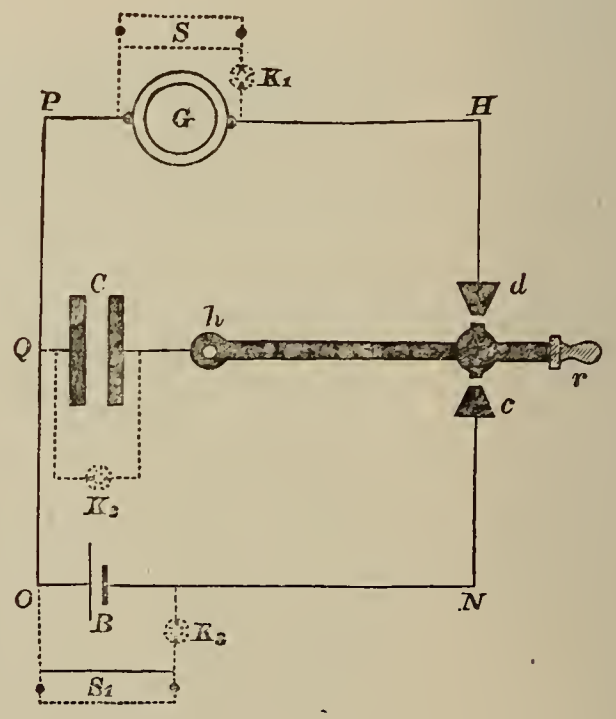
to work the patents here. The rapidity of this process and the improvement which bricks, tiles, etc., undergo will considerably cheapen the price of enameled bricks, for which there is an ever-increasing demand, and we feel assured that Mr. Waterman and his associates will meet with deserved success. The hitherto unsurmountable obstacles encountered in attempts to successfully enamel blue clay or mud bricks have been entirely overcome by this novel process. Builders will appreciate the immense practical advantages possessed by the above method over the ones hitherto in vogue.

The operation of the enameling process is as follows: The bricks are carried beneath a carbon plate heated to incandescence, on a small electrically propelled car, as shown in the patent sketch accompanying this article. The vivid incandescence of the carbon immediately causes the enamel to flow evenly and in a uniform layer over the surface of the brick or tile, though without in the least affecting the physical condition of the brick. In consequence of this improvement bricks need not be placed in a kiln or oven to be enameled, nor is there any time consumed in waiting for the brick to heat before the enamel flows. The direct application of heat, as it were, to the enamel upon the surface by this new electrical method wonderfully increases the speed with which this operation is performed.

Technical Notes.

THE PRACTISE OF MEASURING THE CAPACITY OF A CONDENSER.

The illustrations show the connections required for measuring the capacity of a condenser. The condenser C, which is represented by two thick strokes, will become charged when the lever of the discharge key is depressed against the lower stop C, for now the left hand of the condenser will receive a positive charge from the battery by the combination QOB, and the right hand pole will receive a negative charge by the connection hcNB. The key being at this charge position, the galvanometer is set to O, and when the observer is ready to take the reading,

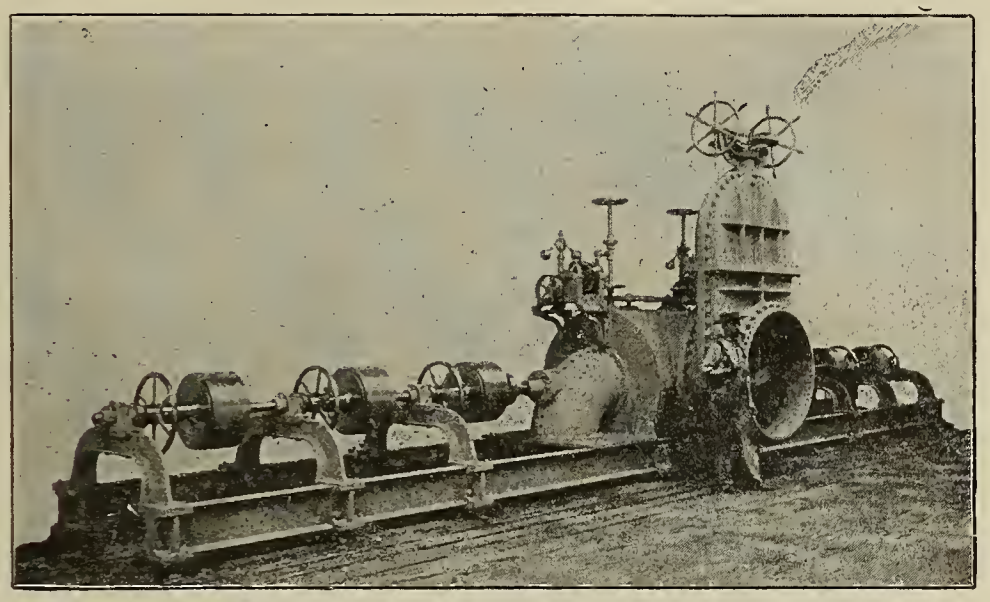


Connections of a Condenser Test.

the discharge should be caused by depressing the key at once. When this is done the poles of the condenser are placed in metallic communication by the circuit QPGHdh, and the sudden rush of electricity through the galvanometer causes the kick which has to be noted. Whilst the galvanometer is returning to rest the condenser should be short circuited by the key K second in order to get rid of any residual charge that may remain. Before again depressing the lever the short circuit key above noted should be opened. After the observation of the discharge has been repeated several times the condenser C is replaced by the second one and the processes are repeated.

TURBINES FOR ELECTRIC LIGHTING.

It is surprising to realize the immense progress made among manufacturers of turbines since the recent development of the electric light and power industry in the United States. The water turbine and electric generator are eminently adapted to each other, due to the fact that each possesses a high natural efficiency. The efficiency of a water turbine, according to the average obtained from a series of exhaustive tests, obtains a maximum of



Turbine Ready for Belt Driving.

over eighty per cent. On the other hand, the generator exceeds ninety per cent. in efficiency. The utilization of water power which would otherwise go to waste therefore places in the hands of the enterprising promoter a net quantity of energy equal to seventy-five per cent. of the actual horse-power of the stream. The construction of large turbines for driving several large generators is shown in the illustration. Six dynamos can be driven separately by an outfit of this description.

Business News.

SPECIAL EXPORT COLUMN.

TOTAL AMOUNT OF ELECTRICAL EXPORTS FROM NEW YORK CITY FOR WEEK ENDING FEB. 3, 1900, $95,649.

New York, N. Y., Feb. 3, 1900.—The following were the exports of electrical material from the port of New York during the week just ended:

Antwerp.—14 cases electrical material, $1,561.
Argentine Republic.—179 cases electrical machinery, $13,441; 59 cases electrical material, $2,924.
Amsterdam.—7 cases electrical machinery, $1,200.
British West Indies.—197 cases electrical machinery, $11,245; 21 cases electrical material, $606.
British East Indies.—3 cases electrical machinery, $605.
Brazil.—250 cases electrical material, $9,143.
Bremen.—1 case electrical material, $50.
British Guiana.—12 cases electrical material, $200.
China.—25 cases electrical material $523.
Central America.—40 cases electrical material, $1,319.
Chile.—22 cases electrical material, $1,082.
Ecuador.—5 cases electrical material, $34.
French West Indies.—2 cases electrical material, $42.
Frankfort.—1 case electrical material, $25.
Glasgow.—27 cases electrical material, $708; 12 cases electros, $265.
Glasgow.—4 cases electrical material, $495.
Havre.—75 cases electrical machinery, $3,717; 205 cases electrical material, $30,986.
Japan.—10 cases electrical material, $1,799.
London.—26 cases electrical material, $2,022.
Liege.—2 cases electrical material, $200.
Mexico.—158 cases electrical material, $6,944.
Marseilles.—35 cases electrical material, $1,353.
Nova Scotia.—2 cases electrical machinery, $188.
Newfoundland.—6 cases electrical material, $123.
Puerto Rico.—13 cases electrical material, $449.
Peru.—20 cases electrical material, $323.
Southampton.—52 cases electrical machinery, $1,101.
Siam.—44 cases electrical material, $240.
Trieste.—14 cases electrical material, $356.
U. S. Colombia.—13 cases electrical material, $103.
Venezuela.—29 cases electrical material, $277.

NEW INCORPORATIONS.

Boerne, Mo.—Boerne Electric Light and Power Company; capital stock, $4,000; incorporated by A. H. Davidson, F. W. Wassenich and C. C. McFarland.

New York City.—The Acme Electric Company, of New York City. To manufacture electrical apparatus. Capital, $25,000; directors: George H. Crosman and Louis A. Jackson, of New York City.

Kankakee, Ill.—Kankakee Heating, Lighting and Power Company, Kankakee; capital, $5,000; furnishing light, heat and power; incorporators: H. A. Magruder, R. G. Risser, W. Frith, Jr.

Newton, N. J.—Sussex County Gas Company; gas and electricity; capital, $75,000; incorporators: J. H. Avery, O. Congleton, both of New York; H. G. C. Thompson, of Cranford.

Portland, Me.—Algonquin Electric Brake Company has been organized at Portland for the purpose of dealing in electrical brakes, with $100,000 capital stock, of which nothing is paid in.

Kansas City, Mo.—Kansas City Electrical Wire Subway Company. Telegraph and telephone business. Capital, $20,000; incorporators: J. Moore, F. Hagerman, A. R. Dillon, E. A. Lawler, O. Hochland, all of Kansas City.

Trenton, N. J.—The Consolidated Railway, Electric Lighting and Equipment Company, with a capital of $16,000,000, has been incorporated. The company is empowered to make use of electric light and power, and also to manufacture gas.

Greenfield, Mass.—The Greenfield Electric Light and Power Company has organized by the choice of these directors: Joseph W. Stevens, J. H. Sanderson, N. S. Cutler, F. O. Wells, F. E. Wells. F. E. Wells was elected president, Captain Fred E. Pierce auditor, C. H. Kieth clerk, and Andrew J. Doolittle treasurer.

Dover, Del.—The Secretary of State has granted a

charter to the People's Light, Heat and Power Company, with an authorized capital of $2,000,000. The incorporators are Jay Cooke, Silas Petit, Victor Conkelin and Thos. Deegan, ofPhiladelphia, and James Megary and Peter J. Ford, of Wilmington, and that city will probably be the first in which the company will operate.

Nashua, N. H.—The Blodgett Estate Heat, Light and Power Company, with a capital of $30,000, has filed articles of incorporation. The home office of the company is in Nashua, but it will carry on business in Boston. The incorporators are Warren K. Blodgett, of Cambridge, Mass.; Edward E. and William A. Blodgett, of Brookline; Stephen H. Blodgett, of Lawrence, and Charles J. Hamblett, of Nashua.

TELEPHONE CALLS.

Farmington, Mo.—Farmington Telephone Company. Operate telephone line. Capital, $5,000; incorporators: Mrs. Anna C. Weber, T. P. Rigg, Edna Rigg, W. M. Harlan, M. P. Cavce, all of Farmington.

Highland Mills, N. Y.—The Highland Telephone Company, of Highland Mills, Orange County, to conduct a telephone system in Orange, Delaware, Ulster and other counties; capital, $2,000; directors: J. W. Cummin, of Cornwall, and W. S. Russell and Henry M. Fitch.

Albany, N. Y.—The Emergency Telephone Call Company of America has been incorporated, with a capital stock of $50,000, to operate a system of telephone and messenger calls, to publish a directory of subscribers and establish necessary agencies. The company will begin operations in New York City, but will hereafter extend its business to other cities throughout the United States. The directors are Albert Randolph, William A. Butler and Frank A. Peteler, of New York City.

STREET RAILWAY NEWS.

Pittsburgh, Pa.—Pittsburgh Southern Street Railway Company; capital, $25,000.

Millville, N. J.—The Millville Traction Company has made application to the Millville City Council for permission to extend its line to Vineland.

Allentown, Pa.—A movement is on foot looking to the consolidation of the interests of the Allentown & Kutztown, Kutztown & Fleetwood and Kutztown & Reading electric railway companies.

Columbus, Ohio.—Lancaster & Newark Traction Company. Operate a street railway. Capital, $25,000; incorporators: E. Rowles, F. S. Monnette, E. Kibler, W. D. Guilbert, S. B. Campbell.

Massena, N. Y.—The Massena Electric Street Railway Company has called a meeting of the stockholders for the purpose of increasing the capital stock from $100,000 to $125,000.

POSSIBLE INSTALLATIONS.

La Crosse, Wis.—The proposition to construct a municipal electric light plant was carried almost unanimously at the recent election. The work will be begun at once.

Indianapolis, Ind.—A project for a gigantic power plant that will furnish power to a large number of industries under one roof is being pushed by a sub-committee of the Manufacturers' Club, of which H. E. Kinney is chairman. A company is being formed to be known as the Power Building Company, with a capital stock of $300,000, divided into shares of $50 each. The board of directors comprises local capitalists. Articles of incorporation have been prepared.

PERSONALS.

Prof. Reginald A. Fessenden has resigned his chair in the electrical engineering department of the Western University of Pensylvania to accept a position in the Signal Department of the U. S. Weather Bureau, at Washington, D. C. Prof. Fessenden is the well known insulation expert and has lately attracted widespread attention through his experiments in wireless telegraphy, rivalling the fame of Signor Marconi.

NEW YORK NOTES.

THE SPRAGUE ELECTRIC COMPANY has contracted to furnish and install complete, for the Plymouth Cordage Company, two 75 Kw. direct connected generating sets, each consisting of a 14x14 Ames engine and a 75 K. W. split pole generator. The comany has also received an order for two K.W. generators to be used in the works of the Whitehall Portland Cement Company, at Cementon, Pa. One of the Sound steamboat companies ordered a Lundell generator to furnish 250 lights for one of its steamers.

THE EMPLOYEES of the New York Electric Equipment Company will give their initial reception at the Murray Hill Lyceum, 34th St. and 3d Ave., on Friday evening, Feb. 16th.

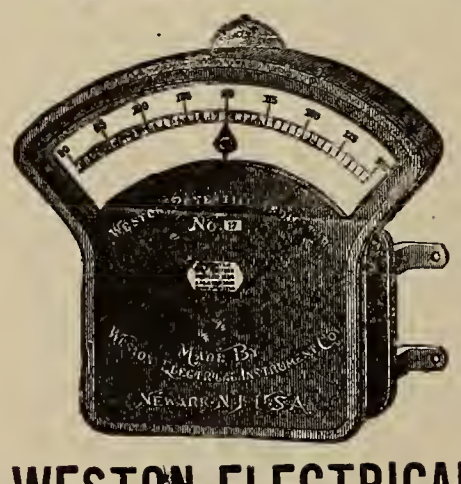
REMOVAL NOTICE OF J. H. BUNNELL & CO.

The entire building at No. 20 Park Place, New York City, has been leased by J. H. Bunnell & Company, who desire larger quarters and better facilities for transacting their business. This building is supplied with all modern improvements, including freight and passenger elevators. It is commodious and well-lighted and is situated between Broadway and Church Street. In addition to the sub-basement and basement there are five floors which are being thoroughly equipped with the necessary fittings for the transaction of their constantly growing business. J. H Bunnell & Compsny are one of the oldest and largest electrical supply houses in the United States. Of the old firm Mr. Chas. McLaughlin is the only surviving member and is now the executive of the present new concern. Through the untiring effort of Mr. McLaughlin the original firm was founded and sustained; the business policy he defined being the course pursued up to the present time. Each added year has meant additional success and the prospects of this firm's future, through the guidance of Mr. McLaughlin are brighter than ever before. The new concern is provided with efficient help, thus insuring speed and accuracy in filling orders. All the friends of J. H. Buunell & Company are requested to call and see them at their new estabiishment which, they feel sure, will be able to supply sufficient accommodation for their present needs.

MR. J. S SPEER, general manager of the Speer Carbon Company, of St. Marys, Pa., is in town this week and reports an exceedingly strong business. During the four months following the organization of the Company their business has increased beyond their most sanguine expectations. They manufacture everything in carbons for electrical purposes. Mr. Speer has closed a number of fine orders in the East.

WESTON STANDARD ILLUMINATED DIAL

STATION INSTRUMENTS.



THESE INSTRUMENTS are based upon the same general principle and are just as accurate as our regular Standard Portable Direct Current Voltmeters and Ammeters, but are much larger, and the working parts are inclosed in a neatly designed dust-proof cast-iron case, which effectively shields the instruments from disturbing influences of external magnetic fields.

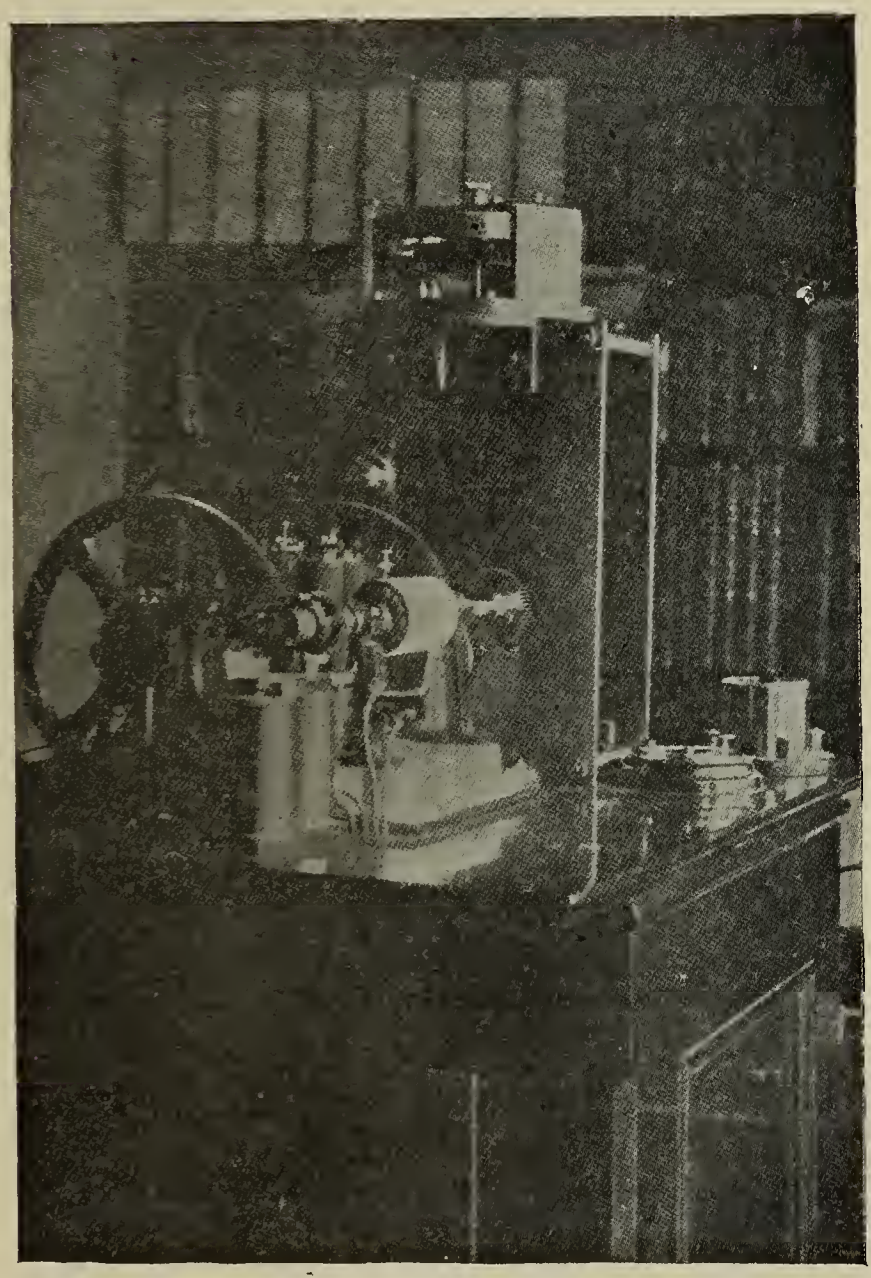
WESTON ELECTRICAL INSTRUMENT CO.

114-120 William St., Newark, N. J., U. S. A.

The Electrical Age.

Vol. XXV—No. 7. NEW YORK, FEBRUARY 17, 1900 Whole No. 666.

The Telegraph.



Telepantograph Transmitter.

THE TELEPANTOGRAPH.

The "telepantograph," the invention of R. Greville-Williams, may be described as an electrical instrument by means of which a drawing letter, photograph, shorthand, diagram or other graphic matter can be automaticlly telegraphed to an distance to which an ordinary telegram can be sent through the medium of one wire.

When you desire to send a message all you have to do is to write it, draw it, or have it photographed on to a thin metal sheet, and place this in the transmitter. You then simply turn a switch, and the inscription, whatever it may be—drawing, photograph or letter—is automatically recorded by the receiver at its destination on paper, wood, metal, etc., as desired.

If the message is to be received on paper, the receiving instrument will print two copies or more at the same time; and thus undisputed records of all messages are obtained and can be used for future reference. Should a large number of copies of the reproduction be required, the receiver will engrave it directly on copper, zinc, etc., instead of writing it on paper, and in this way thousands of copies can be printed from the plate. In this case the marker or receiver is replaced by a graving tool and the paper by a sheet of metal.

The letter or drawing to be transmitted is written or drawn on a sheet with a specially prepared ink and as soon as this ink is dry the instrument may be started. When

the message arrives at the receiving station it is complete. The ink made use of is a compound of gelatine and a bichromate and is covered by patents taken out several years ago in Great Britin, Germany, France, Russia, Austria and the United States.

A decided advantage of the telepantograph over some of the other systems of transmitting pictures, recently brought out, is that the process invented by R. Greville-Williams is a mechanical one, requiring no chemical manipulations and consequently no loss of time.

The West-End, a London publication, refers to the telepantograph as follows:

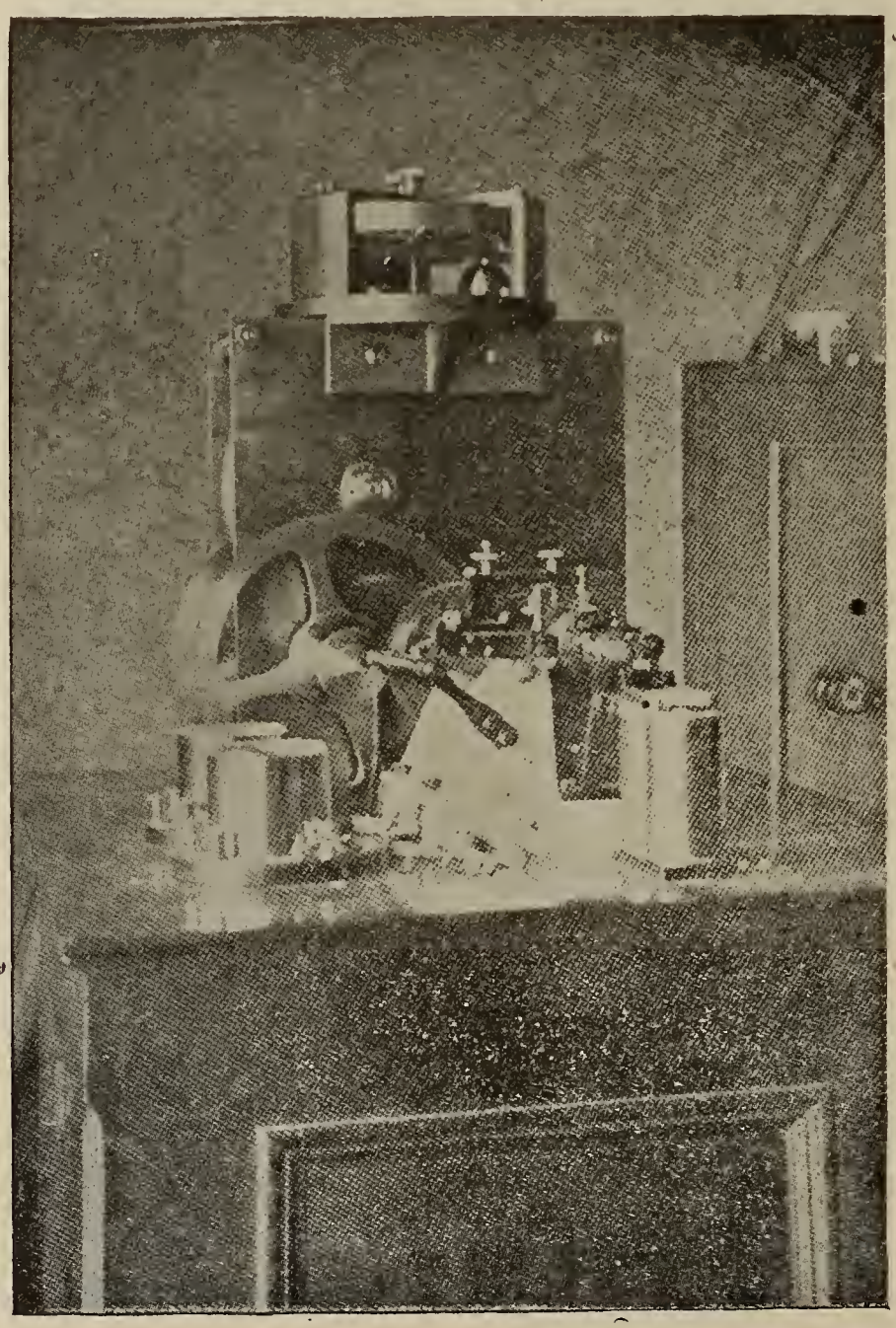
"We may imagine in the future each post office will contain a telepantograph, which would be placed beside the ordinary telegraph instrument and switched on to the same wire used for ordinary telegraphing. On the duplex system now in use, the two machines could be worked on the one wire at the same time without in any way affecting their respective messages. The cost of news can be greatly reduced if telegraphing in shorthand be resorted to, for a message written on the metal sheet in shorthand is as easily transmitted as one in which words are used."

Commenting on the field of usefulness of Mr. Greville-Williams' invention ,the paper quoted above says:

"That the telepantograph will prove of great value in many different ways cannot be doubted. We have space to hint at only a few of them. The special correspondent of a newspaper will be able by its aid to send to the printing office, sketches, diagrams, photographs, etc., of events happening in all parts of the world, for wherever the telegraph wire goes, there the telepantograph will find a sphere of action.

Picture Received on the Telepantograph.

"Pictures of some great battle in Egypt, China, or any part of America could then be sent by war artists, and the reader would find in his evening paper sketches of a battle fought but a few hours before. All this seems to point



Telepantograph Receiver.

to the fact that the newspaper of the future will be much more profusely illustrated than is the journal of to-day; in our daily paper we shall then find photographs, sketches and pictures illustrating events that took place in all the four qurters of the globe but the day before.

"To the detective and police force the telepantograph will prove a serviceable ally, for in the event of a convict being 'required,' his counterfeit presentment could be telegraphed all over the country so that however quickly he might arrive at a port with the intention of taking ship to some foreign part, his picture would be there before him and he would be at once recognized and captured."

As regards the practicability of this method of transmitting pictures and messages it is stated that many telegraphic experts in England are of the opinion that with the telepantograph practical results have been produced never before obtained.

Ancient and Modern Methods in Organ Blowing,—From the Boy to the Electric Motor.

Novel Applications of Electric Power.

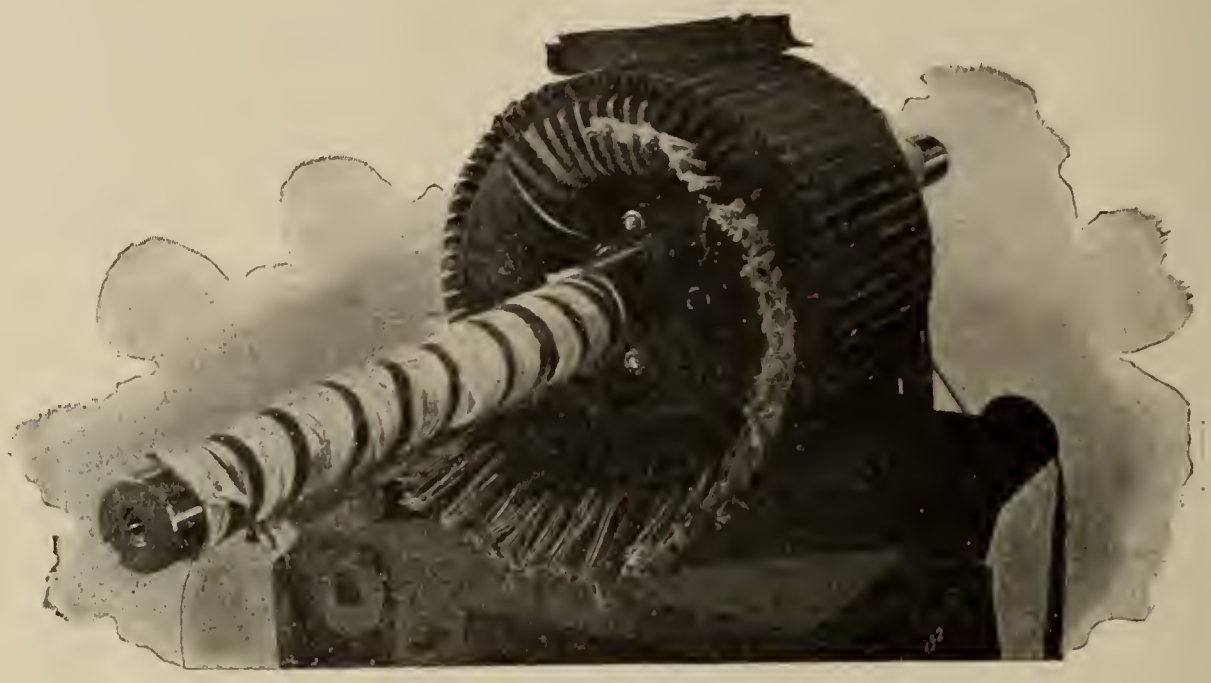
ELECTRICITY IN THE CHURCH.

Wherever personal comfort is considered, or, as the text implies in the illustration, "the old order changeth, giving place to new," electricity is employed. One of its most interesting and novel applications is its use for organ blowing. The Sprague Electric Company, of 527 W. 34th St., New York City, have installed many of their organ-blowing outfits in churches with great success. The motor is always ready for the current, and a turn of the switch sends the current through it. This can be controlled by the organist, who thereby dispenses with the organ boy, whose laborious and sometimes painful duties were not in harmony with the place of worship on the Sabbath day. The organ blower is supplied with an automatic device which governs the speed in such a manner that only the amount of wind required at any given moment is stored up. If through any sudden call upon the keys, such as might occur in playing heavy cadences, the air is apt to be suddenly utilized in full, the motor will quickly speed up and supply the wind required. Under ordinary conditions the speed of the motor is constant and the amount of wind stored pretty nearly uniform, but should the organist cease playing or descend to the pianissimo the motor responds to his efforts and the supply of wind is reduced. This device is connected to the part of a bellows most accessible, shaft, handle or wheel, thus dispensing with unnecessary connecting devices. The outfits are manufactured in sizes ranging from one-quarter to five horse power, and after being installed cause little or no trouble. They are superior to gas engine outfits, as no water or gas is used, and the chance of accident is therefore reduced to a minimum. A list of the prominent churches using these outfits will be given to those interested and writing for further information.

Technical Notes.

IN THE REPAIR SHOP.

A varieety of difficulties present themselves to the technical student in the way of faults in completed machines or defects that eventually develop and necessitate repair.



Armature During the Process of Rewinding.

In various classes of machinery, such as car motors, street railway generators, direct current generators in private plants and power stations, these faults appear under different guises and are due to varying causes. In some cases, for instance, where the magnet rests upon the base plate oil collecting there will work its way up into the windings, ultimately carbonize and cause a burn-out or severe ground in that limb of the magnetic circuit.

Making Commutators.—Scene in an Electrical Repair Shop.

This is a failing apt to occur in the inverted horse show type unless the flange is elevated above the base plate from a quarter to one-half an inch. In the armature difficulties arise due to a lack of balance in the winding. Not only must the same weight of wire be placed in the same slot of a toothed armature but the total length of wire in any given section should be situated the same as that of any other section and be of exactly the same length. Otherwise sections would develop voltages a little higher in one case than in the other. In multi-polar generators faults often arise due to either the field being unbalanced one pole piece possssing more magneto-motive force than another or having a lower permeability, etc., without preparation having been made in the winding of the armature to obviate the inevitable consequences issuing therefrom. In cases where the field is unbalanced a series or wave winding should be used on the armature.

A fault which frequently develops in machines having toothed armatures is heat at the pole piece and in the armature piece. It is due to a lack of proportion between the air gap and the width of the slot. The only remedy, if the heat is excessive, is to bore out the field to a larger diameter. The proportions best to observe are one to three or one to four, comparing length of air gap with width of slot in armature core. Sparking at full load frequently develops in machines possessing excellent mechanical design but deficient in an important detail. Sparkless commutation in dynamos largely depends upon the relations existing between the pole tip and the length of the air gap. Unless the air gap is long enough sparkless commutation is impossible at full load. The ampere stream in armatures or the full current flux and the length

The Electrical Age.

ESTABLISHED 1883.

Entered at New York P. O. as second-class matter, January 18, 1891.

THE ELECTRICAL AGE PUBLISHING CO., Publishers.

TERMS OF SUBSCRIPTION:

One Copy, one Year, - - - - - - - - - $2.50
One Copy, six months, - - - - - - - - 1.25
Great Britain and other Countries, - - - - 3.50

Cable Address (all Cables), "Electage," New York.

NEWTON HARRISON, E. E., EDITOR.

ASSOCIATE EDITORS:

ALFRED E. WIENER, E. E., } ELECTRIC LIGHT AND POWER.
OSBORNE P. LOOMIS, E. E., }
JOSEPH MUIR, M. D., } ELECTRO-
FREDERICK STRANGE KOLLE, M. D., } THERAPEUTICS.

ADDRESS ALL COMMUNICATIONS TO
THE ELECTRICAL AGE PUBLISHING COMPANY,
Seventh Floor, World Building,
NEW YORK.

NEW YORK, FEBRUARY 17, 1900.

CONTENTS:

WIRELESS TELEGRAPHY ACROSS THE ATLANTIC.

The latest news from the West is that Nikola Tesla proposes to telegraph without wires from New York to Paris. In other words, it seems as though the present Marconi system will be outdistanced by the future Tesla system of wireless telegraphy. It might be interesting, aside from speculation, to consider the conditions under which wireless telegraphy over great distances becomes a possibility.

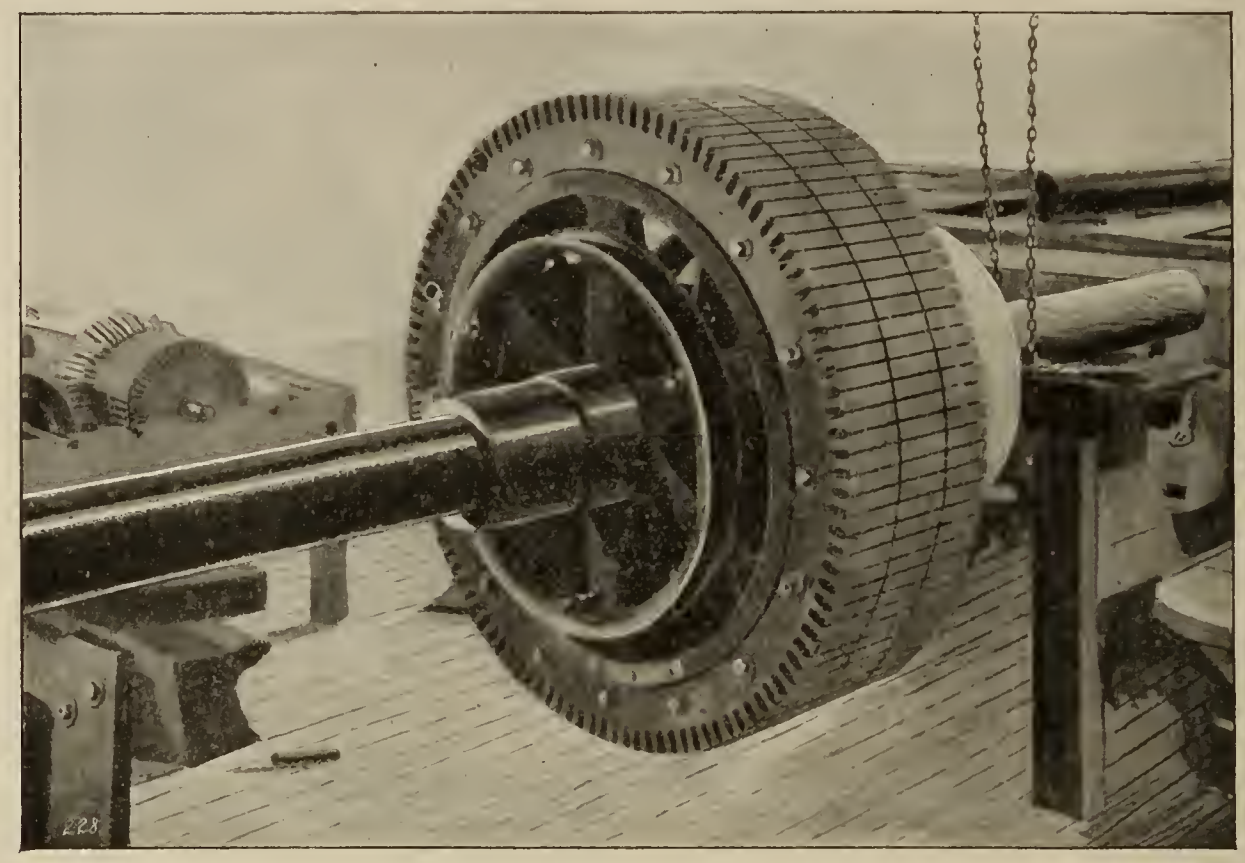
Prof. Oliver Lodge delivered a lecture on this subject in Glasgow, before the Glasgow Association. He stated that there was a wonderful similarity between signalling by flashlight and wireless telegraphy. He likened the electrical discharge from the vertical wire to an impulse along the thong of a whip, whereby a great disturbance or whip-crack is communicated to the air in the one, to the ether in the other. Little or no reference was made to other facts of more vital importance, namely, the actual limitations of wireless telegraph apparatus from a practical standpoint. If a discharge between the knobs of a coil may be likened to the appearance and disappearance of a shaft of luminous energy sent out by a search light, then it would seem that the larger the coil and the heavier the discharge between the terminals of the coil the greater the reach of the instrument. Some of the largest coils in existence have been used of late for wireless telegraphing, and it has not been noticed in any case of scientific consequence that the distance over which intelligent transmission was possible exceeded one hundred miles. This in itself is an enormous distance when we consider the means employed; merely a ripple in the ether, and a delicate electric nerve miles away waiting to respond to it. Attention must therefore be drawn to the coherer, which seems to lack the requisite delicacy necessary for a greater range of communication.

Tesla took out a patent some years ago for the electric transmission of energy without wires. It was a broad patent and required considerable courage on his part to apply for it, mainly on account of the criticism which was sure to follow from those ill acquainted with the natural conditions leading him to believe in the practical possibilities of his ideas. It is well known to those familiar with vacuum tubes through which heavy potentials operate that they are accessible to a current to a degree, depending upon the exhaustion and the pressure applied at the terminals. It is not within the realm of pure speculation to fancy a gigantic tube, exhausted of air, carrying a large percentage of the energy of a great generator. Continuing this idea, an increase in the longitudinal dimensions of the tube does not in an way vitiate the experiment, either as regards the amount of power to be transmitted or the phenomena attendant upon that particular application of the current. Carrying out this idea along other lines, it is, in the opinion of Tesla, possible to transmit large quantities of power through the upper media; in other words, through the rarer portions of the atmosphere, the power supplied proceeding from a high frequency generator connected to a transformer, one pole of which is grounded and the other supported high in the air by an aerostat with a duplicate apparatus situated miles away, the generator, of course, being unnecessary at this position. By this means currents of extraordinarily high frequency and potential, generated in the dynamo, pass through the earth and through the rarer portions of the atmosphere and complete a circuit through the transformer at the distant point. The secondary of such a device would, of course, convert the original pressure by a natural process of transformation to a lower and more useful one, which would serve any commercial purpose to which it is generally applied. On the basis of this idea, which is not founded upon purely theoretical consideration, wireless telegraphy over enormous distances, such as two or three thousand miles, is not as formidable a proposition as at first appeared.

According to Mr. Tesla, or at least, a Denver newspaper, which quotes him: "I didn't come to Colorado for my health but to learn the effect of dry air and high altitudes upon a machine I have perfected. The beauty of my machine is that it can transmit power over several thousands of miles without wires. Now the Marconi system is useless at distances of more than one hundred miles. Any operator can read the message in transit by the Marconi system. It is impossible to do this with my machine. I expect to send messages to Paris during the Fair." It seems as though the idea of Tesla is based upon the apparatus described above, which, installed at New York, with a receiving device at Paris, amounts to no more and no less than a long distance power transmission plant, the two conducting wires being the rarer limits of the atmosphere and the earth itself. It is well understood that the practical accomplishment of this would immediately sweep away all doubts in the minds of the more conservative engineers, but we may add that progress has been making startling leaps in the last quarter of a century and a revolution in telegraphic, telephonic and power transmission methods may be but one phase of this great change.

of the air gap bear a relation such that provision is made at the outset for sparkless commutation. These relations are well expressed in "Dynamo Calculations," by Alfred E. Wiener. Proprietors of repair shops have experienced considerable difficulty in trying to remedy this fault, believing it due to a ground located in the armature. If, after testing out, the sparking of the commutator at full load is still in evidence the details of construction must be carefully reviewed and a preliminary calculation gone through for the purpose of locating the seat of the trouble.

In repair shop practice in which the stripping of armatures for the remedy of grounds and short circuits and the repair of commutators occupies the majority of the time it will be noted that in nine cases out of ten failures in dynamoes are due to a series of ordinary troubles. In a small volume entitled "Diseases of Dynamos," by Crocker andWheeler, many of these failings are specified and made clear to the reader. In the illustrations are shown armatures in the process of rewinding, the manufacture of commutators and toothed armature preparatory to winding.



Toothed Armature About to be Wound.

A METHOD FOR DETERMINING THE RESISTANCE OF ELECTROLYTES.

This new method has recently been worked out by Parker C. McIlhiny (vide Journal of the American Chemical Society, Vol. 20, pages 206-209), and whilst not so accurate as that of Kohlrausch, is of advantage for making many readings in a short space of time. It consists in determining by galvanometer, preferably a D'Arsoval, the potential difference between the ends of a known resistance placed in series with the resistance to be determined. The current is suplied by a gravity batttery, and before passing through the electrolyte, it is transformed into an alternating current by means of a rotary pole changer, but the current passing through the known resistance is direct. When a current passes two resistances in series, the fall of potential in each of them is proportional to its resistance.—Ex.

Among the Societies.

NEW YORK ELECTRICAL SOCIETY.

The two hundred and third meeting of the New York Electrical Society will be held at the College of the City of New York, Twenty-third Street and Lexington Avenue, on March 2 at 8 P. M. A. R. Ledoux, M. S., Ph. D., will lecture on "Copper from the Ore to the Wire Bar."

Patents.

WEEKLY ELECTRICAL PATENT RECORD.

PATENTS ISSUED FEB. 6, 1900.

Complete descriptions and drawings of any patent mentioned below will be sent on receipt of ten cents.

642,570. Underground electric railway; W. J. Banner and H. Emmel, Johnstown, Pa.

642,589. Dynamo-driving mechanism; Robert M. Dixon, East Orange, N. J.

642,599. Dynamo-electric machine; Henry Geisenhoener, Schenectady, N. Y.—A laminated core for electric machines in which the end laminae are provided with strengthening ribs.

642,615. Dynamo-electric machine; C. W. Kragh, Madison, Wis.

642,263. Hanger for electric lamps; William F. Murphy, Iowa City, Iowa.

642,627. Electric-lighting system; Armand C. Prucker, Hanover, Germany—The inventor claims, in a system of electrical distribution, the combination with a source of current connected with main and compensating conductors, the compensating conductor being grounded, of an incandescent electric lamp having one terminal connected, or adapted for connection, with a main conductor, a switch included between the said main conductor and the said terminal, the other terminal being grounded.

642,648. Portable electric lamp; George W. Van Duzer, Hackettstown, N. J.

642,663. Means for generating ozone electrically. Charles G. Armstrong and William D. Neel, Chicago.

642,674. Electrical recording apparatus; Hugh L. Callendar, Montreal, Canada.

642,697. Electric track for receptacles; Charles Hutchinson, Arlington, N. J.

642,737. Electric railway; Bonnet, Paufique & Liniere, France—In a closed conduit system for electric railways a car having a magnetized bar and an energizing coil for imparting additional magnetism to said bar, the coil being in series with the motor and receiving the full current passing to the motor.

642,738. Electric cable for high-tension currents; Chas. Borel, France.

642,804. Electrically igniting lamps; Robert Scheiber, Germany—The wick of the lamp is ignited by lowering an igniting spiral upon the wick and then raising it back to its normal position.

642,809. Telephone switchboard; Ernest E. Yaxley, Chicago.

642,825. Socket for incandescent lamps; William Oetting, Pittsburg, Pa.

642,826. Carbon for electric arc lights; John T. Robinson, New York—The process of treating carbon electrodes for improving their quality, which consists in soak them bodily in a compound solution obtained by subjecting talcous asbestos to the dissolving action of a solution of caustic alkali.

642,844. Push-button for battery-indicators; Gustavus Heidel, St. Louis, Mo.

642,848. Railway signal mechanism; Samuel S. Neely, Pierron, Ill.

642,849. Electrical massage instrument; Edmund T. Otto, Jersey City—The invention consists of an electrical massage instrument having a pair of current-applying rollers, mounted on the same axle, but electrically insulated, the rollers being electrically connectetd to the winding of an induction coil carried in the instrument.

642,859. System of electrical distribution; Henry P. White, Kalamazoo, Mich.—A phase-displacer for use in an alternating-current circuit, consisting of a plurality of parallel coils corresponding to the number of circuits to be acted upon so that the amount of resistance and induction shall be equal.

642,869. Controlling means for spark-generators; Homer N. Notsinger, Pendleton, Ind.—A spark-generartor consisting of a generator, a speed-controlled governor operated by the generator-shaft, and means operated by the governor for intermittently moving said shaft out of and into connection with a driving means.

642,880. Connection-register for telephone lines; Chas. E. Scribner, Chicago.

642,881. Toll-collecting apparatus for telephone pay-stations; Chas. E. Scribner, Chicago.

642,911. Electric lamp support; Harry Long, Greentown, Ind.

642,913. Electric alarm try-cock; Stephen M. Mathews, Toronto, Canada.

642,933. Electrolytic separation of zinc from zinc oxid; Steinhart, Vogel and Fry, London, Eng.

642,934. Telephone instrument; Frederick A. Swan, Boston.

642,953. Electric battery; Blumenberg & Overburg, New York.

642,982. Mouthpiece for telephone transmitters; Geo. B. Hart and Francis W. Milligan, Rochester, N. Y.—A mouthpiece provided with a removable frame supporting a disinfectant.

642,995. Electric connecting device for lamp-holders, wall-plugs, etc.; Chas. Menges, Netherlands.

643,000. Brush holder; Patrick O'Shaughnessy, New York—A bracket having one or more brush-clamps mounted thereon, there being a sliding contact between the clamp and the bracket, and a lock-nut for graduated adjustment of the contact between the bracket and the clamp.

643,012. Process of producing material suitable for electric insulation or other purposes; Arthur Smith, Eng.—The process consisting in mixing acetic paraldehyde with methylated spirit, carbolic acid and methylated spirit which has been saturated with hydrochloric-acid-gas, and molding.

643,018. Utilization of Hertzian or similar radiations and apparatus therefor; Louis H. Walter, Eng.—The inventor claims in apparatus for the utilization of Hertzian or similar radiations in the form of a codal signal, of a safety device comprising a movable member, a fixed member, a local circuit between such members, means actuated by the receiving apparatus for bringing the movable member into contact with the fixed member when a codal signal is received and for releasing it when a false signal is given, and means for returning the movable member to its original position when released.

643,066. Alternating-current motor; Walter Langdon-Davies, Eng.

643,087. Electric generator for sparking apparatus of gas-engines; Daniel Drawbaugh, Eberly's Mills, Pa.—An armature for magneto-electric machines formed of separate magnetic cores open at the ends for the reception of the coil-wire, and a non-magnetic connecting-piece uniting said cores end to end and with the poles in different angular positions.

643,093. Electric motor; John C. Henry, Westfield, N. J.—Two electric motors each having pairs of pole-pieces and a switch arranged to connect the motors in series or in parallel and to alter them from bipolar to four-poled, or vice versa.

643,095. Magneto-electric lighting apparatus for bicycles; Sidney L: Holdredge, Boston.

643,096. Process of recovering gold and silver from cyanid solutions by electrolysis; Samuel B. Christy, Berkeley, Cal.

Business News.

SPECIAL EXPORT COLUMN.

TOTAL AMOUNT OF ELECTRICAL EXPORTS FROM NEW YORK CITY FOR WEEK ENDING FEBRUARY 10, 1900, $73,223.00

New York, N. Y.—The following were the exports of electrical material from the port of New York, during the week just ended:

Argentine Republic:—141 cases electrical machinery, $15,221.

Antwerp:—4 cases of electrical material, $973.

British Possessions in Africa:—1 case electrical material, $81; 9 cases electrical material, $175.

British West Indies:—16 cases electrical machinery, $5,750.

Bristol:—8 cases electrical machinery, $2,500.

Brazil:—74 cases electrical material, $3,666.

British Australia:—15 cases electrical material, $420.

Central America:—2 cases electrical material, $30.

Ecuador:—93 cases electrical material, $5,000.

French West Indies:—19 cases electrical machinery, $1,694.

Glasgow:—24 cases electrical material, $1,640.

Hamburg:—198 cases electrical material, $23,900; 109 cases electrical machinery, $2,000.

Havre:—140 cases electrical material, $10,125.

Naples:—1 case electrical material, $48.

NEW INCORPORATIONS.

Denver, Colo.—Longs Peak Power Company; furnish electric power; capital, $50,000; incorporators—S. Eastwood, W. H. Davis, W. T. Boyd, all of Denver.

San Francisco, Cal.—The Electro-Therapeutic Company, with a capital of $75,000, has been incorporated to manufacture and sell electrical apparatus.

Boston, Mass.—The Oxygen Explosive Company has been incorporated in Delaware to manufacture all kinds

of wares and to construct telegraph and telephone lines. The capital stock is $500,000.

New York City.—The River District Light, Heat and Power Company, of New York city to manufacture gas and electricity for sale in New York city; capital, $50,000. Directors—James Douglass, Cleveland; H. Dodge, E. M. Johnson, William H. Yale, and John Jay McKilvey, of New York City.

New York City.—The Bunnell Telegraphic and Electrical Company, of New York city, with a capital of $200,000, has been incorporated to manufacture telegraphic supplies. The directors are Mary T. Bunnell and Dewitt C. Bunnell, of Brooklyn, N. Y.; F. R. Green, Fredonia; Charles E. Merritt and Albert J. Wise, of New York City.

Raleigh, N. C.—The Kingston Electric Company has been incorporated with a capital stock of $10,000. The company proposes to operate an electric light plant in Kingston. The incorporators are B. W. Canady, S. H. Abbott, J. W. Grainger, L. Harvey, A. Mitchell, H. O. Hyatt, F. A. Whitaker, W. C. Fields, J. B. Temple, E. M. Hodges, Louis Einstein, D. Oettinger, T. W. Mewborne, J. E. Hood, L. Hines, E. F. Cox, J. A. McDaniel, H. C. Harmon, G. E. Kornegay, Junius Stevenson.

Tarboro, N. C.—The Carolina Telephone and Telegraph Company has been organized under the laws of North Carolina with a paid-up capital of $50,000 and an authorized capital of $150,000. W. H. Powell, Jr., Tarboro, N. C., president; A. McDowell, Scotland Neck, N. C., vice-president; Geo. A. Holderness, Tarboro, N. C., secretary, treasurer and general banager; executive offices at Tarbo, N. C. The company has purchased the entire exchanges, toll-lines, etc., heretofore belonging to the Tarboro Telephone and Telegraph Company, Fayetteville Telephone and Telegraph Company, Carolina Telephone Company and Scotland Neck Telephone Company. It is the purpose of the above company to build extensive toll-lines.

STREET RAILWAY NEWS.

Battle Creek, Mich.—An electric railroad may be built from Battle Creek to Hastings.

Atlantic City, N. J.—Philadelphia capitalists are considering the building and operating of a trolley line along the beach.

Lakewood, N. J.—It is proposed to build a trolley line from Freehold to Shrewsbury to connect with the Redbank & Long Branch Road.

Boston, Mass.—Application has been made for the incorporation of the Boston & Brockton Electric Freight Company, with a capital stock not to exceed $150,000.

Jeffersonville, Ind.—The Jeffersonville City & Suburban Railroad Company has been incorporated with a capital stock of $25,000, by T. W. Scott, C. N. McGuire, O. C. Barth, R. W. Morris, E. S. Gwinn and H. W. Heath, all of Jefferson.

Traverse City, Mich.—The Traverse City & Leelenau Railroad Company, with a capital stock of $300,000, has been organized.

Honeoye Falls, N. Y.—The property of the Lima and Honoeye Falls Electric Railroad and Light Company plant has been sold at receiver's sale. The property was bid in for $35,000 by Frank Williams, of Buffalo, representing capitalists of that city.

Rye, N. H.—Contracts have been let for the construction of a large power house for the Portsmouth, Rye & Hampton Electric Railway. The building will be located at Rye Centre. A large storage battery will form a part of the equipment.

Columbus, Ohio—It is reported that the entire capital stock of the Columbus, London & Springfield Electric Railway Company, amounting to $1,000,000, has been subscribed, largely by Boston men. Work will begin at once and it is expected that the road will be completed within a year.

Trenton, N. J.—The Puerto Principe Electric Company and the Puerto Principe Tramway Company have been incorporated, each with a capital stock of $400,000, fully paid. The companies are controlled by the same interests and will build a trolley road in Puerto Principe.

Concord, Mass.—The Selectmen have granted a franchise to the Lexington & Boston Railway Company for a road to start atthe Concord-Bedford line an dcontinue over the Bedford road and Bedford street to Monument square to the center of the town.

Atlanta, Ga.—The Atlanta & Roswell Electric Railway and Power Company, capital $500,000, has been incorporated. The incorporators are H. L. McKee, W. W. Draper, W. H. Harrison, S. Y. Stribling, Charles A. Geiger, S. Crowley, George W. Wing, William S. Ansley, J. Y. Sage and C. W. Ansley.

New Bedford, Mass.—The Taunton, Myricks & New Bedford Air Line Street Railway Company, capital $200,000, has been formed. The directors are B. G. Grinnell, Frank A. Rouse, Albert M. Field, Henry G. Crapo, William M. Dean, L. P. Churchill and James P. Pierce.

NEW YORK NOTES.

MR. F. B. SHARP, of the Electric Equipment Company, of Liberty, N. Y., was in town during the past week and reports a growing business. The section around Liberty is particularly adapted for the location of sanitariums, on account of its high altitude and pure air. Mr. Sharp was in town looking up the trade, and also to see what there was new and of interest to his customers.

THE BUNNELL TELEGRAPHIC AND ELECTRICAL COMPANY, whose incorporation is noted in another column, are occupying the building at 110 Beekman st., where they are manufacturing electrical instruments, telegraph instruments and supplies, making a specialty of the latter named. Mr. De Witt C. Bunnell the head of the company, is a son of the late Jesse H. Bunnell, the founder of the famous electrical supply house of J. H. Bunnell & Company, of 76 Cortlandt st.

THE CLING-SURFACE MFG. CO., of Buffalo, N. Y., has just been incorporated under the laws of the State of New York, retaining the same name as heretofore, with Albert B. Young as President and General Manager and William D. Young Vice-President and Secretary. The past year has been the most prosperous in the history of the company, and the demand for Cling-Surface they report to be increasing steadily. They have now three branches, one each in Boston, New York and Chicago, with others just opening in St. Louis and New Orleans, while the well-known importing house of W. J. Moxham & Co., of Sydney, Australia, has ordered a large shipment of Cling-Surface with the exclusive right to handle it in Australia.

WESTON STANDARD

PORTALE DIRECT READING

VOLTMETERS AND WATTMETERS

For Alternating and Direct Current Circuits.

The only standard portable instrument of the type deserving this name.

Write for Circulars and Price Lists 8 and 9.

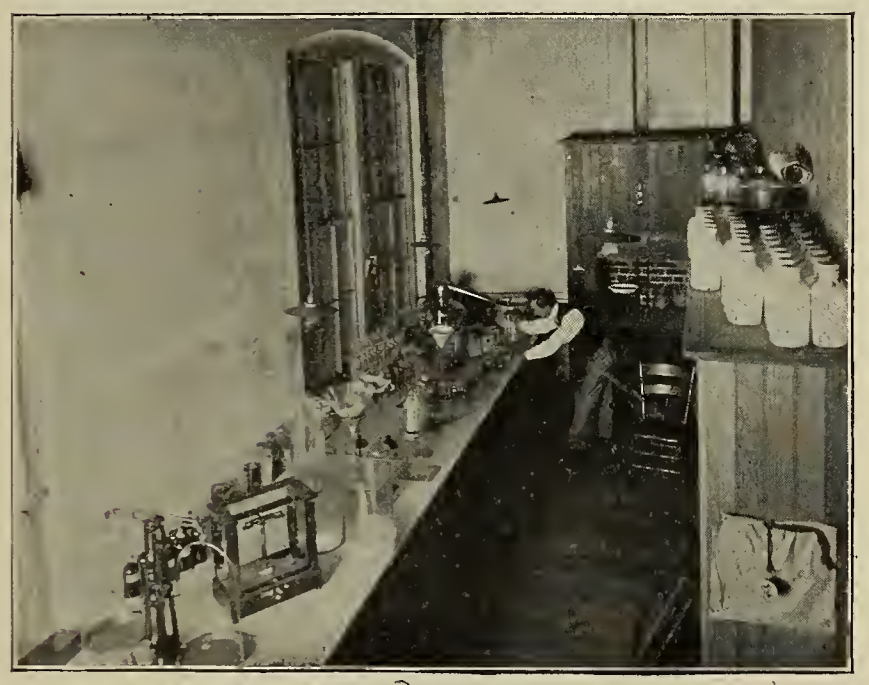
WESTON ELECTRICAL INSTRUMENT CO.,

114-120 William Street, Newark, N. J.

The Electrical Age.

Vol. XXV—No. 8. NEW YORK, FEBRUARY 24, 1900. Whole No. 667.

Novel Applications of Electricity.



Laboratory of an Incandescent Lamp Works.

Electric Fountain; Pumping Done by Electricity.

SOME FEATURES OF MODERN ELECTRICAL ENGINEERING.

Improvements in the dynamo and incandescent lamp were made almost simultaneously. As a result enough confidence was established in both generator and lamp to lead to their systematic adoption by various business houses in the United States. Problems regarding street railway work arose at the same time that were not finally solved until a decade at least had passed. The electric motor incidentally received considerable attention although its applications were limited to special cases, but with the growing use of electricity these applications widened and the motor, the generator, the incandescent lamp and all machinery derived from them developed with equal rapidity. The means employed for testing in-

candescent lamps, manufacturing the filaments and arriving at a high efficiency are no longer secrets. Neither is the application of the lamp limited to the illumination of the room. Deep down in the recesses of mines they find their use, performing a function that leaves room for no criticism.

As regards the motor its development led to its utilization for many purposes, the most modern of which is the automobile. Its service is aesthetic as well as industrious and many of our beautiful electric fountains are produced by the operation of powerful force pumps driven by electric motors. A view is given of a triplex pump in operation, the function it performs differing but little from that required of it for ejecting water for spectacular purposes.

Incandescent Lamp in Mining Operations.

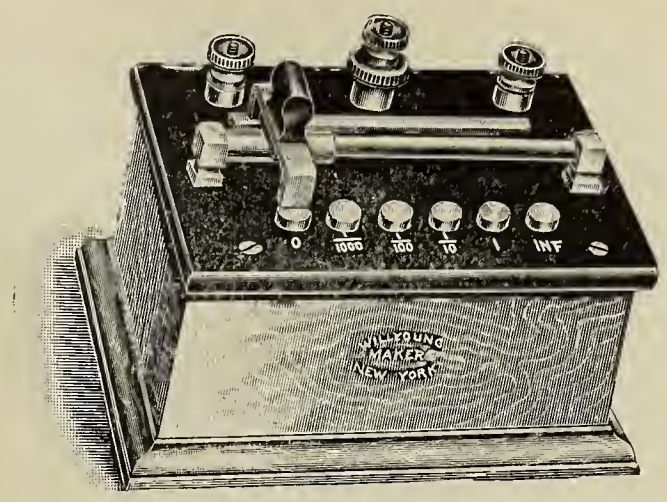
Its familiar application for automobiles requires but few words, but it may be noted that the demand existing today will fade into insignificance in comparison with the requirements of the coming century. The motor is capable of infinite application in the household as well as the factory. Much that is now considered household drudgery will disappear, and on many sides we see advantages already being taken of this device in electric shoe-shining machines, electric brooms, electric sweeping machines, electric mangles, electric cooking utensils and heaters. As soon as it is universally recognized that electricity is cheap enough to allow the motor to come into use millions of families will employ it as a means of adding comfort to the home.

The Modern Race Horse.

Electrical Measurements

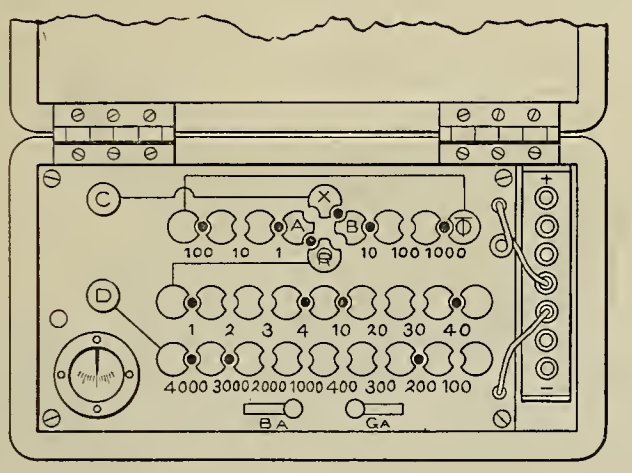
MEASURING AND TESTING INSTRUMENTS.

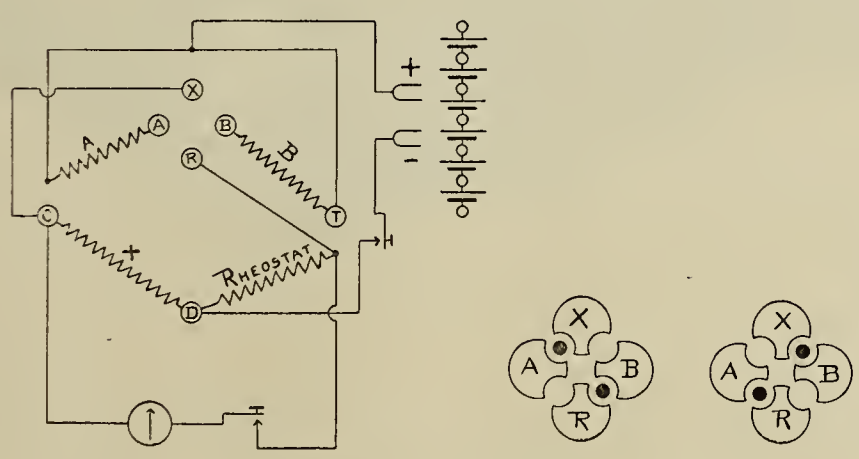
The measuring and testing instruments manufactured by Elmer G. Willyoung, 82-84 Fulton street, New York city, have earned a world-wide reputation. Some of them are illustrated in this article as being examples of the state of perfection reached by Willyoung in designing and constructing his apparatus. The Willyoung high sensibility D'Arsonval galvanometer is constructed in a modern scientific manner, the magnets are hardened and made permanent by an improved process, preserving a constant uniformity in magnetic strength. Both dead beat and ballistic systems may be used with this instrument. The systems are mounted in tubes which may be removed very quickly to make room for others. In making this change the connections are automatically made and broken. In this instrument, owing to the shape of the pole pieces, deflections are proportional to the deflecting current. They are undisturbed by magnetic changes and for cable and insulation resistance testing this galvanometer stands unequaled. The Universal shunt, often called the Ayrton shunt, is also illustrated. With this shunt the galvanometer is always short circuited by the total of the shunt. There are three ranges given with this shunt of one-tenth, one one hundredth and one one thousandth, although there is a one to one and infinity shunt in addition.



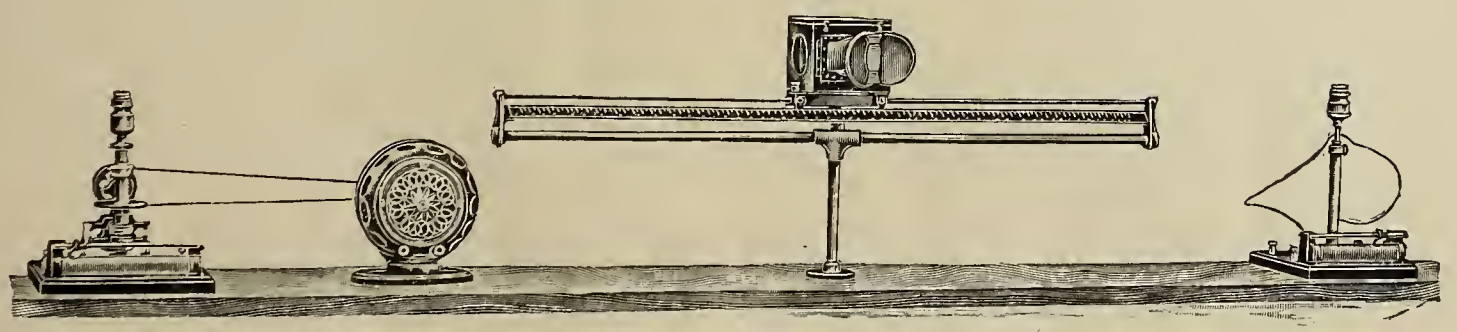
Willyoung Universal Shunt.

The Aone portable testing set is capable of infinite applications. Without the Wheatstone bridge the electrical engineer is worse off than the surgeon without his scalpel. The Willyoung portable testing set, which contains everything required for a complete and accurate test, is of most recent design. It is light in weight, small in size and has a range of measurement extending from





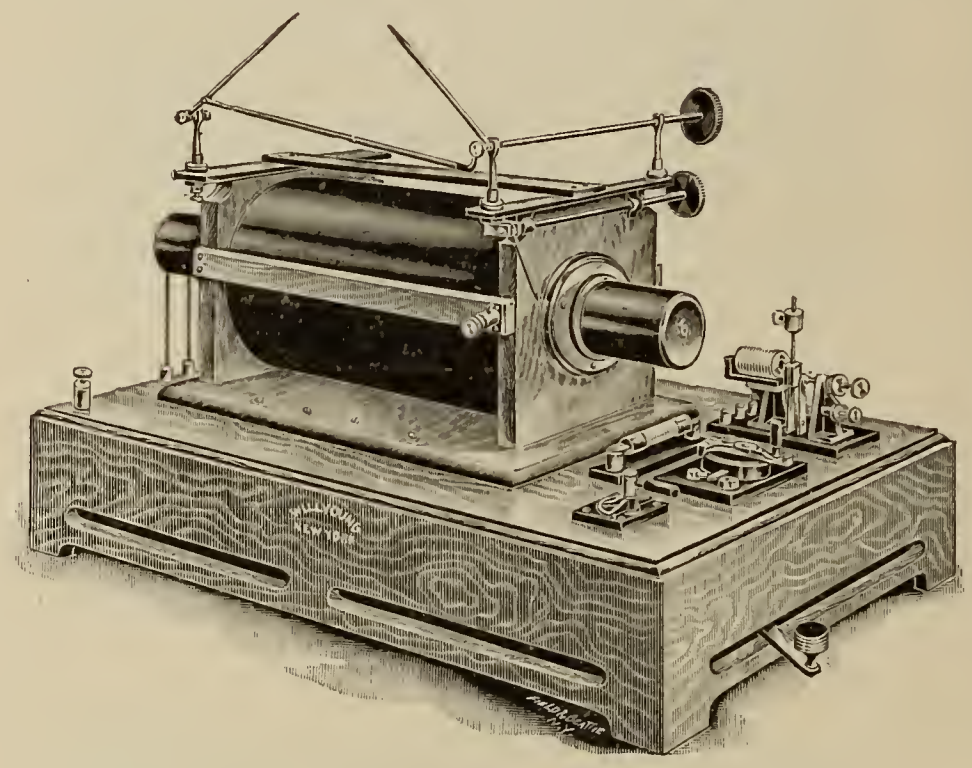
Plan of "Aone" Test Set.



Station Photometer.

one one thousandth of an ohm to eleven megohms; carrying both battery and galvanometer, and not requiring leveling it meets with all conditions of service, enabling the operator to test with dispatch and accuracy. It can be, in addition, used as a resistance box and the galvanometer, being unusually sensitive, may be used in circuit with another outfit where a test of a different character is to be made. The coil of the galvanometer is pivoted in sapphire jewels, is of the D'Arsonval type and therefore dead beat. It possesses the remarkable feature of being unaffected by disturbing external magnetic influences. The battery consists of six chloride of silver cells, mounted in a separately detachable box. In the sketches are shown diagram of connections and plan of the Aone test set. The United States Navy, the United States War Department and the Japanese Navy, Cramp's Sons & Company and others use this set exclusively.

The Willyoung X-ray machines are remarkable for the large size of spark produced from a small coil. They are built in all sizes and for any pressure required within reasonable limits, that is, for attaching to commerical circuits. These machines cannot be surpassed in reliability, compactness and perfect design. The 110 volt X-ray machine will produce a fifteen-inch spark. They will be supplied with Wehnelt or Caldwell interrupters on demand or rotary breaks or multiple vibrators. Adjustable condensers are also supplied if required. The Willyoung X-ray machines and induction coils are to be found in use at the Polyclinic Hospital in Philadelphia, the Johns Hopkins Hospital in Baltimore, the Magill University in Montreal, the Michigan University, St. Luke's Hospital, Chicago, and a long list of similar institutions all over the United States. Mr. Willyoung is a trained expert and employs only the most accurate and best informed scientists and artisans in the construction of his apparatus. A complete catalogue of electrical and scientific instruments and apparatus will be sent to those requiring information on receipt of twenty-five cents.



110-Volt X-Ray Machine.

NOVEL APPLICATIONS OF ELECTRIC POWER.

Last spring the electrical journals enthused over the fact that the greatest plant in the world for the long-distance transmission of electrical power had been completed; the Southern California Power Company, which had been built to furnish electricity to the city of Los Angeles from a dam in the Santa Ana river above Redlands. Power was to be carried eighty-one miles and a current of 33,000 volts was to be employed. The Michigan company now proposes to carry a current of 40,000 volts ninety miles. The idea is to furnish power from the dam to Allegan, Kalamazoo, Battle Creek and Jackson, the last-named of which is ninety miles from the dam. The lines to Kalamazoo, over twenty miles away, and to this town, nearly five miles from the dam, are completed and in operation. The other lines are being pushed forward. The voltage at present employed is 25,300, and it will only be increased to 40,000 when the Jackson line is completed.

The plans provide that the dam shall give a head of twenty-three feet of water, and it will when the level has been sufficiently raised and the water power developed. It is being operated now at a nineteen-foot head. It is built after the latest methods and is provided with all modern improvements, including a powerful steel "crab" on a heavy railing over the turbines for operating the overflow gates. There are eight turbines of the Leffel horizontal pattern, forty-five inch, and they aggregate 3,000 horse-power. They are arranged in two sets of four each on the same shafting.

The big generator, which is connected direct to the turbine shafting, is a three-phase alternating current dynamo of an improved type, built by the General Electric Company at the Schenectady works. Its voltage on full load is 2,300, and its rated capacity in amperes on each phase is three hundred and seventy-seven. Its rated horse-power is 2,500, but the electrical ratings would indicate more power than that, and in the tests the machine showed up well under a load of 2,700 horse-power. The engineers in charge are proud of the monster machine and claim that it could be loaded sufficiently to stop the 3,000 horse-power turbines without injury. The generator occupies a floor space of sixteen by ten feet and towers to a height of fourteen feet. Its fifty tons rest upon a heavy foundation of Portland cement and stone.

Deckertown, N. J.—The Sussex Telephone Company has commenced the extension of its lines from Lafayette to Franklin, and thence to Deckertown via Hamburg.

The Electrical Age.

ESTABLISHED 1883.

Entered at New York P. O. as second-class matter, January 18, 1891.

THE ELECTRICAL AGE PUBLISHING CO., Publishers.

TERMS OF SUBSCRIPTION:

One Copy, one Year,	$2.50
One Copy, six months,	1.25
Great Britain and other Countries,	3.50

Cable Address (all Cables), "Electage," New York.

NEWTON HARRISON, E. E., EDITOR.

ASSOCIATE EDITORS:

ALFRED E. WIENER, E. E., } ELECTRIC LIGHT AND POWER.
OSBORNE P. LOOMIS, E. E., }
JOSEPH MUIR, M. D., } ELECTRO-
FREDERICK STRANGE KOLLE, M. D., } THERAPEUTICS.

ADDRESS ALL COMMUNICATIONS TO
THE ELECTRICAL AGE PUBLISHING COMPANY,
Seventh Floor, World Building,
NEW YORK.

NEW YORK, FEBRUARY 24, 1900.

CONTENTS:

THE UNDERGROUND TROLLEY.

The objections to the underground trolley gather force with every heavy snowfall. At Buda-Pesth a system of this kind has been in use for many years and through the success it gained it was deemed feasible to install a road of approximately the same nature in New York. The critics of recent date objected to the underground trolley on the ground that it would become submerged at times, fill up with water and cease to operate. These objections were overcome by establishing the proper connections between the subway and sewer. Yet no remarks were made in relation to the effect of a snow storm. Last winter the electric road remained in statu quo for several days and there is every probability that this condition will prevail whenever an unusually heavy fall of snow occurs. It is therefore evident that snow not only chokes up the slot, packing sufficiently hard to tear all conducting apparatus from the bottom of the car, but accumulates in sufficient quantity in the conduit itself to interfere with the progress of the car. During the recent storm the electric cars were frequently superseded by trucks, dragged by horses, to the lower part of which was attached a device for clearing the slot and sweeping the conduit. It seems as though the open conduit system without constant sweeping of the track and various other attentions could not become a success in Northern latitudes. The reduction of cost per car mile while operating is too well appreciated by the directors of the road through the use of electricity to allow them to discuss further improvements. Yet if car lines are to be stalled whenever a severe storm sweeps over the city the public are no better off to-day than they were when stage coaches were in vogue.

THE ERA OF AUTOMATIC DEVICES.

Fiction at all times has taken its cue from science. At an earlier age such science as was known hardly deserved the name, yet the fables of the Arabian nights and the fairy tales that followed in a less remote period are stories of magic; of means of communication without visible means of transmitting it; of the transposition of bodies from place to place and of marvels that touched upon the philosopher's stone, the elixir of life and the fountain of perpetual youth. As the world moves on times change, in fact, the surroundings and methods of thought until in the closing year of the nineteenth century we find ourselves face to face with devices, whose name is legion, that add in various ways to the comforts of this modern civilization. We now live in an era of automatic machinery. Engines, dynamos, gas and water controlling devices, machinery for performing a variety of functions, all governed by a force proceeding from itself and belonging entirely to the class of new appurtenances included under the name "automatic." The fiction of Bulwer-Lytton, in his story of "The Coming Race," and of Edward Bellamy, in "Looking Backward," are merely modern instances of the trend of human thought, proofs in themselves of the strong appreciation of the progress made by science but, in addition, pointing an index finger in the direction in which perfection may be most rapidly attained. The automatic telephone switchboard is a crystallized example of an attempt to automatically perform certain duties which now rest upon the shoulders of thousands of employees. The automatic elevator system for office buildings, requiring no elevator boy, recently exhibited at the Electrical Exposition at Madison Square Garden is another specific case, and finally, the wave of automobilism spreading over the country is clinching evidence of the desire of many large business houses to dispense as much as possible with the use of flesh and blood. These transformations and their influences can be considered along sociological, metaphysical, philosophical and industrial lines until the mind is lost in the vast web of complexities that are bound to arise therefrom. Each need is the mother to a new need until there is little doubt that the future phases of civilized life will be entirely encompassed by a variety of means of seeing, hearing, speaking, traveling, similar in principle to those in use or proposed to-day, but differing largely in their ramifications. The era of automatic devices will have a mature beginning at the opening of the twentieth century. As they have added to the comfort of man in the near past so are they certain to bring more happiness in the future.

The Boer war is a good example of the rate at which extermination will proceed within the next decade, when armies are equipped with repeating rifles and automatic guns for playing a garden hose of death upon invading forces. Wireless telegraphy was employed for communicating between outposts within the last month and a traveling telephone equipment as well as the constant use of the searchlight added a touch of modernness to the scene. The logical conclusion arrived at by authorities on the subject of war is that further invention in weapons of death, as well as means of protection from it, will lead to such awful destruction that by general agreement it will be discontinued The function of Maxim, Nordenfeldt and Gatling are therefore more obvious to the philosophic mind than they themselves have realized. They are the real peace makers, although at present the price it demands is blood and millions.

Installation Accessories.

UNIVERSAL JUNCTION BOXES.

In the wiring of buildings for electrical illumination, transmission of power, etc., there are many conditions that necessitate the use of individual junction boxes constructed especially for such emergencies. The latest invention, and one best adapted to all purposes, is the universal junction box, just brought out by the Sprague Electric Company, and shown in Fig. 1 and 2. This box is so constructed that one, two or more inleading conduits may be put in place by knocking out one or more tongues, making the requisite openings in the box. The bottom of the box has perforations permitting a wire to be inserted to tie the conduit in place while the work is in progress. This is a very important feature, and saves much time and expense. These boxes may be applied either to ceiling or wall wherever a gaspipe passes through without the use of ceiling or wall blocks, or other means of attachment now ordinarily used.

The ceiling box shown in Fig. 2 can be secured to the gaspipe by a set-screw. Fig. 3 illustrates a new type of pipe hook made by the same company, and has the advantage of being secured to the wall or ceiling by a screw or nail, without the danger of being broken by a false blow. In fact, it would be impossible to break it in such a manner. Fig. 4. shows the new lead bushing and expanding tool which the Sprague Electric Company is now making. The bushing has a thread cast on the outside and can be screwed into the end of the pipe and then expanded by inserting the expanding tool and giving it a few short twists to the right and left, but never turning it completely around.

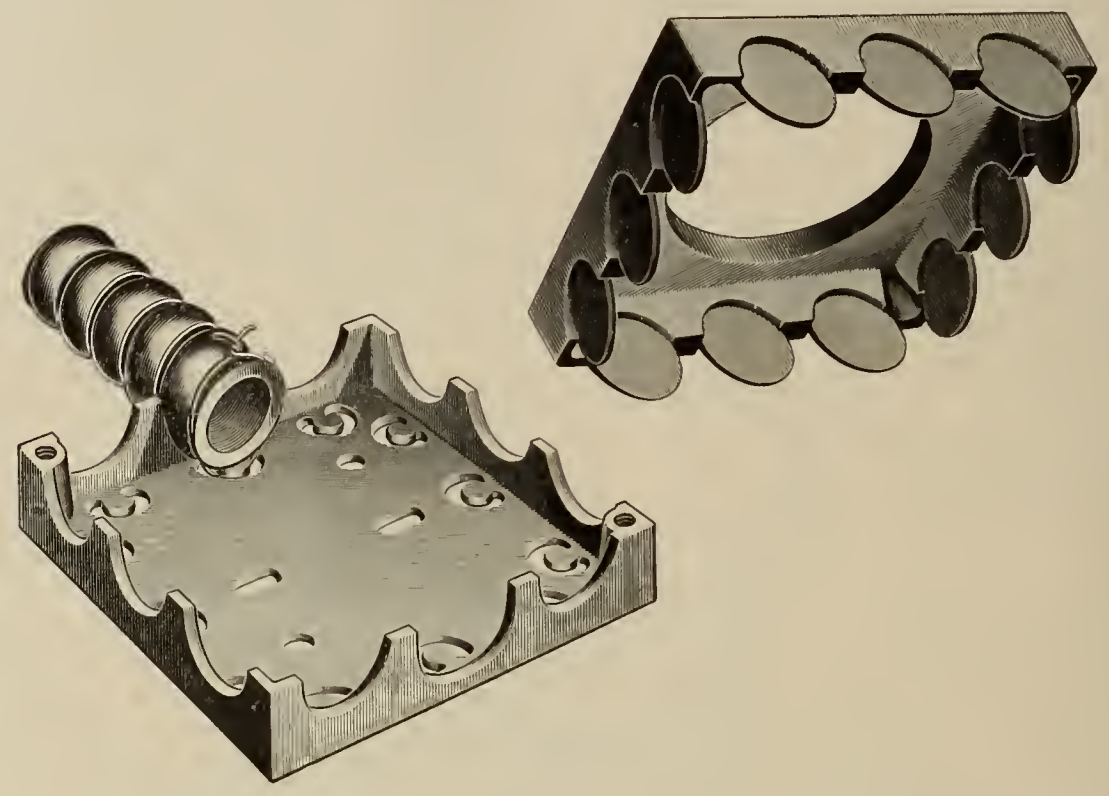


Fig. 1

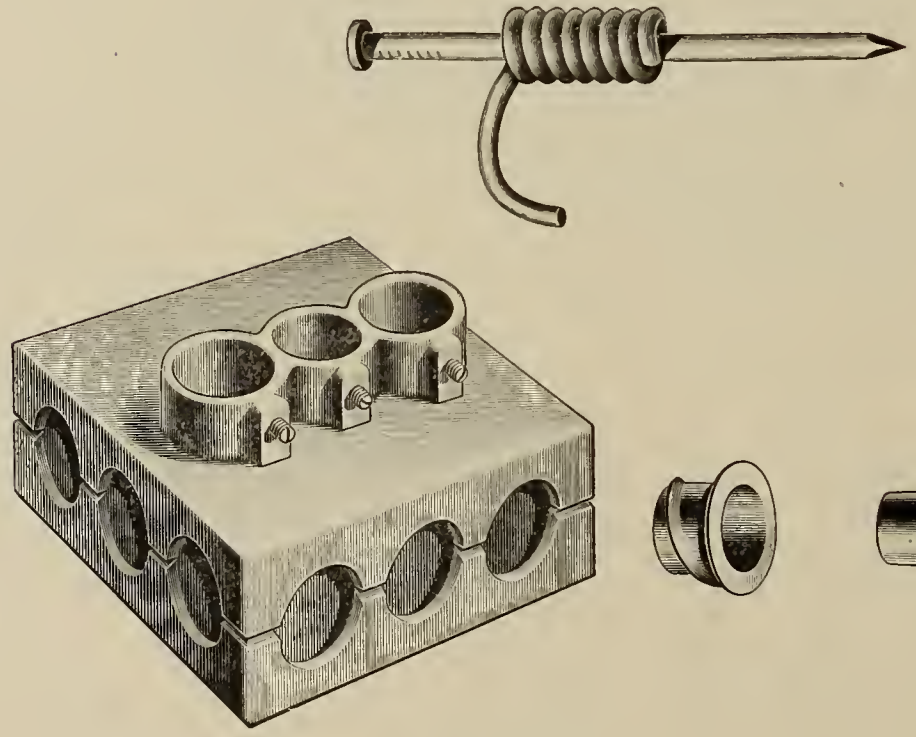


Fig. 2

Fig. 3

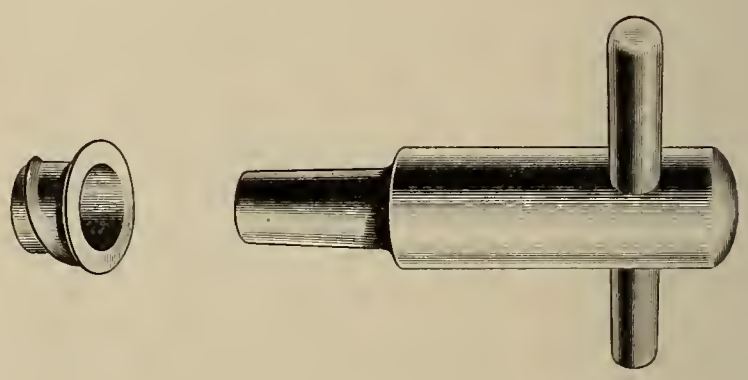


Fig. 4

Business News.

SPECIAL EXPORT COLUMN.

TOTAL AMOUNT OF ELECTRICAL EXPORTS FROM NEW YORK CITY FOR WEEK ENDING FEB. 17, 1900, $75,145.

New York, N. Y., Feb. 17, 1900.—The following were the exports of electrical materials from New York during the week just ended:

Argentine Republic.—163 cases electrical material, $5,235; 12 cases electrical machinery, $7,807.

Antwerp.—20 cases electrical material, $2,732; 4 cases electrical machinery, $60.

Brazil.—2 cases electrical material, $19.

British Possessions in Africa.—18 cases electrical material, $2,057.

British Guiana.—7 cases electrical material, $68.

Bristol.—20 cases electrical machinery, $15,000.

Bremen.—1 case electrical material, $15.

Berlin.—57 cases electrical material, $425.

Central America.—8 cases electrical material, $164.

Chile.—27 cases electrical material, $518.

Florence.—21 cases electrical material, $2,452.

Glasgow.—10 cases electrical material, $1,000.

London.—14 cases electrical carriages, $4,080; 89 cases electrical material, $5,204.

Leith.—13 cases electrical machinery, $982.

Marseilles.—269 cases electrical material, $24,292.

Manchester.—4 cases electrical machinery, $1,037.

Naples.—1 case electrical material, $66.

Peru.—13 cases electrical material, $507.

Southampton.—7 cases electrical material, $663.

St. Petersburg.—2 cases electrical material, $95.

U. S. Colombia.—9 cases electrical material, $217.

CANADIAN ELECTRICAL NEWS.

(Special Correspondence to The Electrical Age.)

Edmonton, N. W. T.—The machinery of the Electric Light Co. has been damaged recently by a flood to the extent of several thousand dollars.

Manitowaning, Ont.—B. H. Turner is preparing to introduce a local telephone system.

Revelstoke, B. C.—The council will establish an electric fire alarm service.

Ottawa, Ont.—The Ottawa Power Co. has been formed with a capital of $250,000. A. W. Fraser and M. E. Eddy are interested.

Shelbourne, Ont.—Tenders for lighting the streets for a term of ten years are invited by H. C. Dunbar, clerk.

Victoria, B. C.—Tenders will be invited at once for enlarging the civic electric light station.

Sturgeon Falls, Ont.—The Sturgeon Falls Pulp Co. have asked for a further loan of $12,000, in return for which it is agreed to renew the electric light contract, to put in a telephone service and to construct a waterworks

Thorold, Ont.—The Electric Light Committee have been empowered to purchase a new transformer.

Sussex, N. B.—The Sussex & Hammond Telephone Co. is seeking incorporation to build a telephone line to Jeffrey's Corner and other places. O. P. King and R. B. Harmer are interested.

Arnprior, Ont.—At last meeting of council a proposal was submitted by J. E. Askwith and other Ottawa gentlemen to construct waterworks and sewerage systems and

Coaticook, Ont.—The Coaticook Electric Light Co. are putting down the foundation for their power house.
system.
to supply electric lighting.
newal will be taken up at an early meeting of council.

St. Mary's, Ont.—Dr. McDorman asks tenders for interfering boxes at approximate cost of $7,000. A special meeting of the council will consider the matter.

Midland, Ont.—The present contract for electric lighting expires at the end of the year, and the question of re-

St. John, N. B.—J. F. Wilson, city electrician, has recommended improvements to the fire alarm service, consisting of putting the wire in seven circuits, with nonwiring and fixtures for electric lighting of a church 60x80 feet with basement.

Weston, Ont.—In connection with the proposed electric light plant, it is intended to buy the old mill site and deepen 600 feet of the tail race.

Erin, Ont.—The question of installing an electric light plant is being considered by the citizens.

Chatham, Ont.—Mayor Smith is negotiating with eastern capitalists for the construction of an electric railway in this city.

St. Catherines, Ont.—The Niagara Central Railway is about to be extended to Port Dalhousie, the company having decided to begin the work at once. The existing line will be converted into an electric road.

New Incorporations.

Heat and Power Company, with a capital stock of $12,000,has been incorporated.

Harrisburg, Pa.—The Bridgeport Electric Light, Heat and Power Company, of Fayette County, with a capital of $12,500, has been incorporated.

Trenton, N. J.—The Electro-Chemical Light and Heat Company, Capital $1,000,000, has been incorporated by Fred C. Dowd, James L. Gethins and P. A. Dowd.

Los Angeles, Cal.—Boyle Heights Electric Company. Electrical Business. Capital, $100,000; incorporaters: W. B. Palmer, W. C. Pelchner, D. E. Skaggs, J. Adams, C. M. Buck, all of Los Angeles.

Harrisburg, Pa.—The West Brownsville Electric Light, Heat and Power Company, of West Brownsville, Washington County, has been incorporated with a capital of $5,000.

Camden, N. J.—The Consolidated Electric Company has been incorporated with a capital of $100,000, by S. R. Ketcham, Charles F. Lumb and G. H. B. Martin, to carry on an electric light business.

St. Louis, Mo.—The Guernsey Incandescent Light Company filed articles of incorporation Monday with a capital stock of $100,000. The incorporators are: David W. Guernsey, S. T. Price, Joseph G. Branch, Charles W. Barstow, Jr.

Milwaukee, Wis.—The American Wireless Telegraph Company has been incorporated; capital, $1,000,000; by Warren S. Johnson, C. L. Fourtier and Henry Herman.

North Hempstead, N. Y.—Roslyn Light and Power Company, to manufacture electricity for light, heat and power purposes in the town of North Hempstead, Nassau County. The capital is $50,000 and the directors are: R. D. Winthrop ,of Westbury; C. H. Mackay, of Roslyn, and E. D. Morgan, of Newport, R. I.

Charlotte, N. C.—The S. B. Alexander, Jr., Electrical Supply Company has been incorporated with a capital of $25,000, all of which is paid in. The incorporators are J. F. Robertson, S. B. Alexander, Jr., and M. E. Robertson.

Baltimore, Md.—The Chesapeake Electric Company has been incorporated for the purpose of doing a general electrical business in contract work, the manufacture of electricity and supplies. The capital stock is $20,000. The incorporators are: Benjamin C. Howard, Allan M. Cohen, Eugene Greenway, Jacob I. Cohen and Francis T. Horner.

Albany, N. Y.—Certificates merging six concerns into the New York Gas and Electric Light, Heat and Power Company, of New York City, have been filed with the

Secretary of State. The concerns were the Block Lighting and Power Company No. 1, the Borough of Manhattan Electric Company, the Manhattan Lighting Company, the Mount Morris Electric Light Company, the New York Heat, Light and Power Company and the North River Electric Light and Power Company. The New York Gas and Electric Light, Heat and Power Company was recently absorbed by the Consolidated Gas Company, of New York City. The capital stock of the several companies absorbed was: North River Electric Light and Power Company, $400,000; New York Light, Heat & Power Company, $375,000; Manhattan Lighting Company, $250,000; Mount Morris Electric Light Company, $1,500,000; Block Lighting & Power Company No. 1, $98,000; Borough of Manhattan Electric Company, $1,00,000. Total, $3,623,000.

TELEPHONE CALLS.

Smith Centre, Kan.—The Exchange Telephone Company. The capital is $5,000; directors are: J. R. Burrow, W. H. Nelson, F. W. Mahire, W. B. Slagle, Henry Williams.

Harrisburg, Pa.—A charter has been issued by the State Department to the Telephone, Telegraph and Cable Company, of Pennsylvania, to operate in all the counties of the commonwealth; capital, $25,000.

Belle Plain, N. J.—Enterprise Telegraph and Telephone Company. Operate telephone line. Capital, $20,000; incorporators: E. B. Goodwin, W. Goodwin, C. M. Goodwin, all of Millville; L. M. Hess, R. B. Hess, both of Belle Plain.

Topeka, Kan.—The St. John Telephone Company; capital stock, $2,000; directors: John Thompson Gray, P. W. Thompson, O. B. Shepard, A. Aitken, Paul R. Nagle, G. W. Grandy and F. B. Gilmore, all of St. John.

STREET RAILWAY NEWS.

Toronto, Ont.—The Niagara, St. Catherines & Toronto Railway Company will build an electric line to Hamilton.

Woodstock, Ont.—The Woodstock Council has refused a fifty-year franchise to an electric railway between this town and Ingersoll.

Newark, Ohio.—A franchise has been granted to the Columbus, Buckeye Lake & Newark Traction Company by county commissioners.

Eaton, Ohio.—Richmond & Eaton Traction Company. Build and operate street railroads. Capital, $12,000; incorporators: A. Emanuel, S. A. Price, H. O. Cox, J. Weil, H. B. Pruden.

York, Pa.—York Traction Company. Traction company and furnishing electricity. Capital, $100,000; incorporators: W. H. Lanius, G. Hersh, W. F. B. Stewart, G. S. Millmeyer, J. W. Steacey, all of York.

POSSIBLE INSTALLATIONS.

Vancouver, B. C.—The Canadian Government has granted the application of a company of New Yorkers who have a plan to utilize the tide power in the narrow entrance to Vancouver harbor The water flowing in from the Pacific Ocean through this narrow pass reaches a high velocity at a certain stage of the tide. With this power a big electric plant is to be operated to supply electricity to the city a mile away.

NEW YORK NOTES.

H. O. SWOBODA, vice-president and general manager of the Falcon Electric Manufacturing Company, 432-434 East 71st St., is the inventor and designer of all the apparatus lately brought out by this company. The Falcon Company manufacture power motors of from 1-12 to 1-8 horse power, fan motors, switches, switchboards, panel boards and all the necessary accessories. Also arc lamps, attachment plugs and flush receptacles. Mr. Swoboda was formerly the designer of all apparatus manufactured by the well-known General Incandescent Arc Lamp Company, of this city.

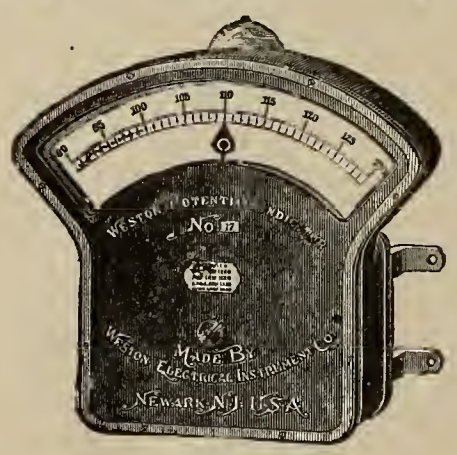
FRANK E. KINSMAN, of 26 Cortlandt St., the well-known consulting electrical and mechanical engineer and inventor, has just returned from a month's tour of the Southern States. He lost his wife last January, and this affliction told upon Mr. Kinsman's unusually strong constitution, necessitating a change of scene to recuperate. We condole and sympathize with Mr. Kinsman in his bereavement and wish him speedy return to health. Mr. Kinsman, it will be remembered, was one of the earliest telephone engineers, being associated with President Hubbard and Inventor Bell in the early seventies, during the struggle to introduce the telephone. He was the pioneer in the invention and introduction of the arc lamp on low tension circuits, and is also the inventor of the Improved "Daylight" Desk Lamp, thousands of which are in use throughout the United States and Europe. His long years of practical experience and knowledge of manufacturing and general electrical construction work cause a constant demand for his services among the electrical industry, architects and others. Mr. Kinsman makes investigations for purchasers of electrical plants, franchises, etc., and plans and specifications of electric light and power plants for the economical running of the same.

THE NATIONAL CONDUIT & CABLE COMPANY have enlarged their offices and salesrooms in the Times Building by occupying the entire second floor of the building, overlooking Newspaper Row and City Hall Park. They are having this floor entirely refitted in the most modern style, the whole effect being one of complete harmony, simple but substantial. It is only a few years ago since this company bought out the old works and all the patent rights of the Norwich Insulated Wire Company, who were the original makers of paper insulated wires and cables. All of the machinery of this company was moved to the works of the, at that time, National Conduit Company, at Hastings-on-the-Hudson. The fame of the National Conduit & Cable Company's products has grown and spread so that they have been unable to keep up with the demand, enlargement of the works and running the same day and night being necessary in order to catch up as much as possible.

THE HAZELTON BOILER COMPANY announce the removal to their new offices at 120-122 Liberty St. Also, in order to meet the requirements of their largely increased business, they have just built and equipped new works at Rutherford, N. J., on the main line of the Erie R. R.

WESTON STANDARD ILLUMINATED DIAL

STATION INSTRUMENTS.



THESE INSTRUMENTS are based upon the same general principle and are just as accurate as our regular Standard Portable Direct Current Voltmeters and Ammeters, but are much larger, and the working parts are inclosed in a neatly designed dust-proof cast-iron case, which effectively shields the instruments from disturbing influences of external magnetic fields.

WESTON ELECTRICAL INSTRUMENT CO.

114-120 William St., Newark, N. J., U. S. A.

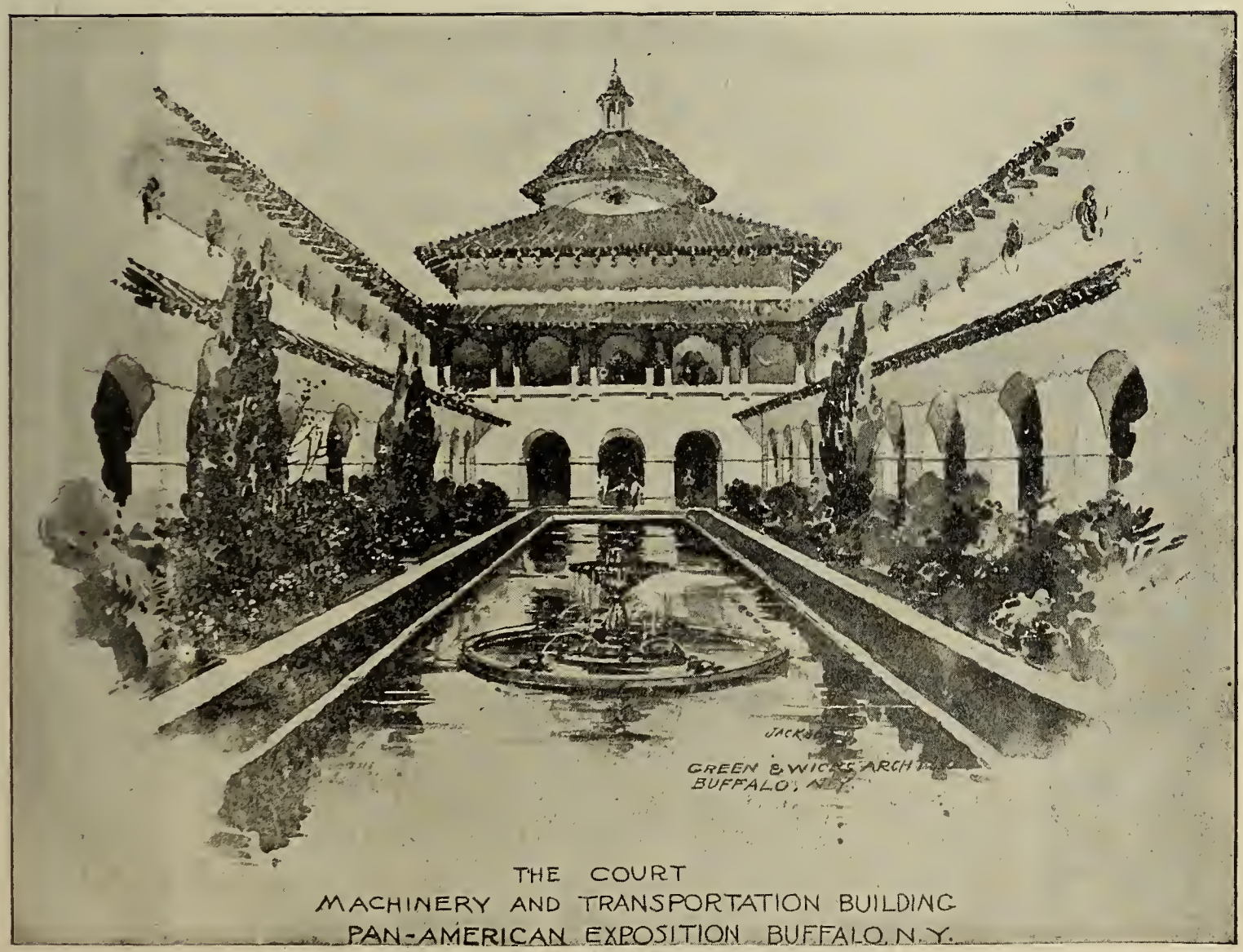
The Electrical Age.

Vol. XXV—No. 9. NEW YORK, MARCH 3, 1900. Whole No. 668.

Expositions.

Copyright, 1899, by Pan-American Exposition Co.

Machinery and Transportation.



THE COURT
MACHINERY AND TRANSPORTATION BUILDING
PAN-AMERICAN EXPOSITION BUFFALO N.Y.

Copyright, 1899, by Pan-American Exposition Co.

VIEWS AT THE PAN AMERICAN EXPOSITION.

The court of the Machinery and Transportation Building of the Pan American Exposition, which will be held at Buffalo, N. Y., on the Niagara frontier during the summer months of the year 1901, presents an interesting treatment of cloister work. The Machinery and Transportation Building itself forms a hollow square, with this court in its center. It is 200 feet long and 100 feet wide, the east and west ends opening respectively to the great entrances from the Grand Canal and the Court of the Fountains, while the great exhibiting rooms of the mall side of the building, and the two exhibition rooms and great entrance court from the Court of the Fountains side of the building, lie on either side. Along each side of this court, and extending the entire length, are roof-covered arcades under which the visitor may find rest on the comfortable benches.

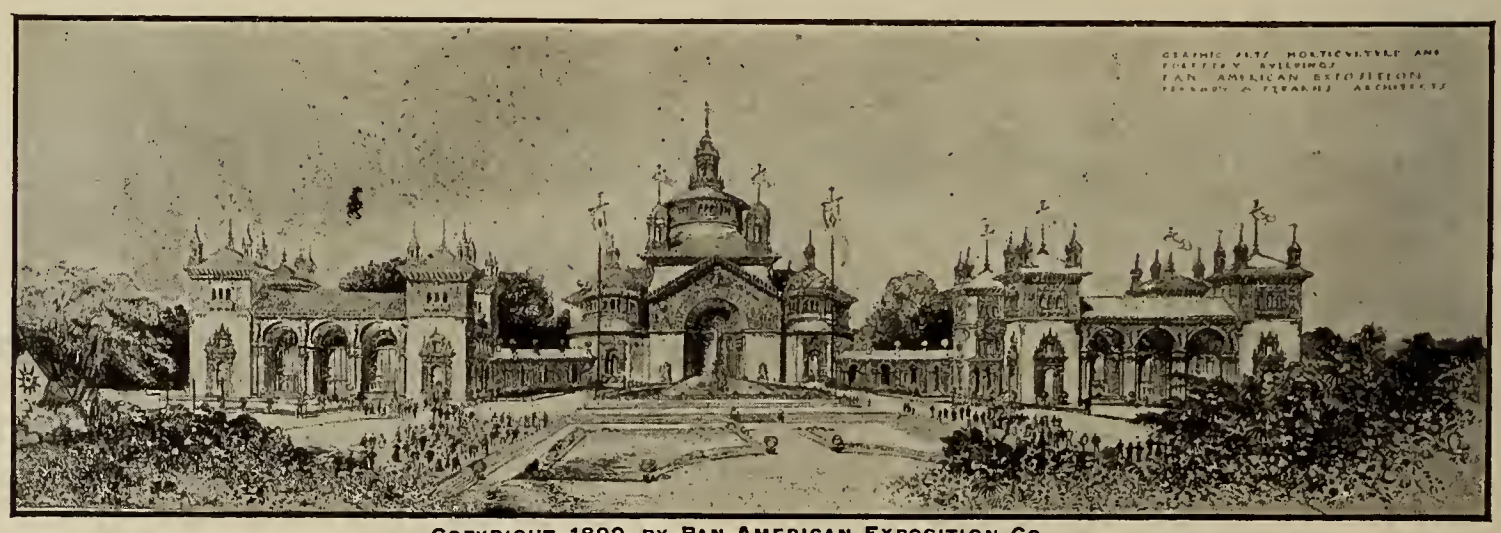
The pool itself is 175 feet long and 27 feet wide. It is placed in the center of the court. The bank is sodded and planted on all sides, forming a pleasing frame or border effect; the water is low so as to receive the reflection of the growth around the pool.

The fountain is an important feature, placed in the center of the pool and giving life to the scene and freshness to the atmosphere. Throughout the court are pleasant walks and paths, bordered with low-growing shrubbery

COPYRIGHT, 1899, BY PAN-AMERICAN EXPOSITION CO.

and plants, and at intervals at axis-points with the arcades rare plants are placed in great vases, making a truly architectural landscape effect. The entire scheme gives the effect of an admirable enclosure of a mission cloister, and is planned as one of the many little oases for the refreshment of the weary sightseer. This building and court have been designed by Green & Wicks, of Buffalo.

The electrical exhibits at the Pan American Exposition give promise of being the finest ever given. They will be unique in their way, due to the vast improvement in the various departments of electrical engineering. The recent improvements in wireless telegraphy, the advances in methods of rapid telegraphy, the development of telephony, electric lighting and transmission of power, all these will call for exhibits of great magnitude and interest. It is curious to realize that within less than decade electrical engineering exhibits have been considered an indispensable department of expositions. At the Chicago World's Fair, the Cotton States and International Exposition, the Omaha Exposition and finally at Buffalo, where the Pan American Exposition will be opened in 1901, the electrical people supply most of the mystery and novelty generally attached to public displays of this kind. The magnificent lighting effects and many of the most recent inventions in applied science of an absolutely new character will in this exposition, as in those preceding it, form an important feature of the spectacle. All of our well known manufacturers will be on hand when the time arrives to display their goods and illustrate American progress.



COPYRIGHT, 1899, BY PAN-AMERICAN EXPOSITION CO.

Horticulture. Graphic Arts and Forestry.

THE FIRST AUTOMOBILE SHOW.

The plans for the first Automobile Show have now taken definite shape. To letters sent out to a number of manufacturers making inquiry as to the most desirable time to hold such a show responses were received, all expressing a preference for the fall season, and offering their heartiest co-operation toward making it a complete and representative exposition.

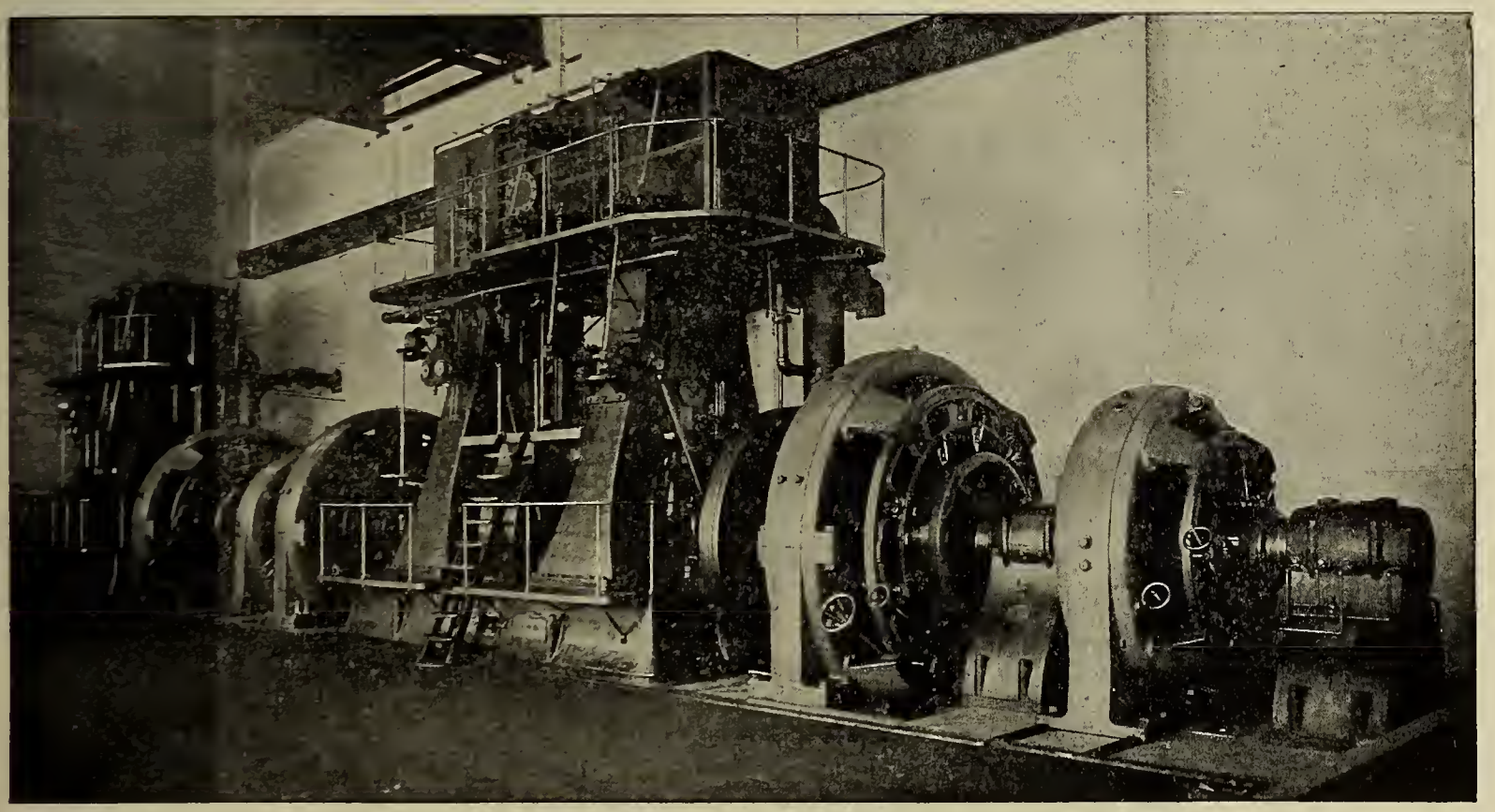
The dates selected are from Saturday, Nov. 10th, to Saturday, Nov. 24th, inclusive, and of course ample time will be allowed for installing and removing exhibits. It is considered an advantage that the Horse Show will be held during one of these weeks—from Nov. 19th to 24th. There are each year something more than 50,000 out-of-town visitors to the Horse Show, and practically the same people will be interested in automobiles. The dates chosen for the Automobile Show will therefore make it practically certain that the attendance and visitors to the Horse Show will also be secured for the Automobile Show.

Grand Central Palace, covering a city block from 43d to 44th Street and Lexington Avenue to Depew Place, has been chosen for the exposition, because it has the largest exposition space and will permit of a more comprehensive show. One hundred thousand square feet of floor space are available for automobile exhibits, and the only other exposition building in New York offers a total floor space of 34,000 square feet, which space, for a number of reasons—as several manufacturers of automobiles know from experience—is not desirable for exhibiting heavy vehicles.

The center space of this exposition hall is an amphitheatre, with glass roof 65 feet high, containing more than 10,000 square feet of floor space. This will be for the free use of exhibitors who may wish to show their automobiles in motion. Besides the wide aisles surrounding this amphitheatre and leading to it, there are two large balconies from which these demonstrations will be clearly visible—accommodating three thousand spectators—and the floors are strong enough in every part to support the weight, no matter how distributed, so that platforms in the various exhibits will be unnecessary—a saving and a convenience.

The location of Grand Central Palace is also an advantage. It is in the center of the city's street car transfer system and in the heart of the residential, and therefore the automobile district. Something of the capacity of the building for an automobile show may be gathered from the recent carriage and wagon exhibition, where more than 1,100 finished vehicles were shown and more than 20,000 square feet of floor space occupied by exhibitors of accessories.

The exposition will be under the management of Marcus Nathan, who managed the three electrical shows held in this city and is now arranging a mammoth printing and allied trades exposition for the month of May. Over three hundred prominent manufacturers in the electrical field will gladly testify to the good business results secured through his methods of correspondence, circularizing, etc. In a little folder Mr. Nathan has outlined "What We Shall Do to Make It Pay Exhibitors," some extracts from which we are glad to reproduce here. "The cost of floor space will be fixed at a much lower price than usual —so low that no exhibitor need feel compelled to crowd his samples." "Many of the 'extras,' which usually add so much to the cost of an exhibit, will be abolished." "Charging stations will be installed at convenient locations, and electric current supplied for charging vehicles free of cost (both for use in the exhibition hall and on the streets during the hours when the exposition is not open)." "Platforms, another 'extra' usually required to distribute the weight of exhibits, will not be necessary, as the floors of the exposition hall are strong enough in every part to support automobiles of every description." "While the cost to exhibitors will be reduced in every way possible, the management will, at its own expense, make special efforts to bring precisely the right people to the exposition. In addition to trade paper and newspaper advertising and press notices, which will be liberally planned, we shall have a system of correspondence and circularizing direct to users and possible users of vehicles within one hundred miles, and will appreciate the aid of exhibitors in compiling lists."



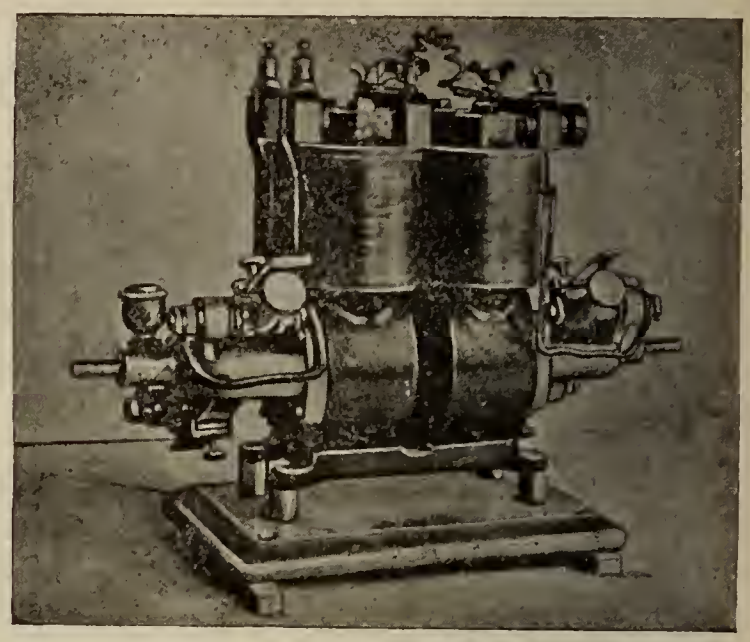
Magnetic Clutch Connecting Engines and Generators.

Electro Magnetism.

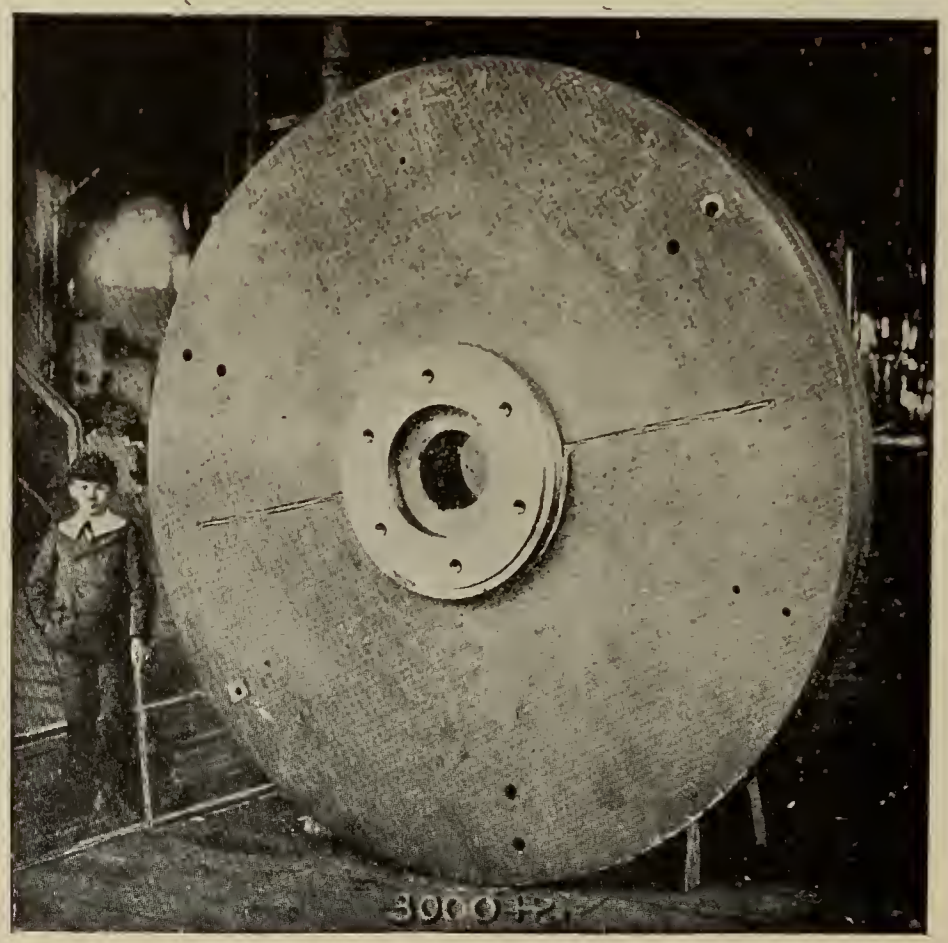
THE ARNOLD MAGNETIC CLUTCH.

The Arnold magnetic clutch is a term used to express an invention of Mr. Bion J. Arnold, the practical advantages of which on trial have been made evident to many skilled engineers. The advantages of this clutch are found in the readiness with which it can be thrown in and out of operation, thereby enabling immediate and thorough control to be exercised in throwing on or off power generators from the main source of mechanical energy. The clutch itself is shown in the illustration. This one requires no more than two amperes at 110 volts, and it is estimated that the power it requires in relation to the power it transmits is one one-hundredth of one per cent. In a ten thousand horse power plant a clutch of Arnold's design, transmitting ten thousand horse power, would only consume about one horse power. These clutches are practically friction clutches, yet the friction is super-

induced by an overwhelming magnetic attraction. The clutch consists of two parts attracted toward each other by a coil and adhering so tightly that in the various tests to which these clutches have been put no slippage has been perceived. It is calculated that an atraction of four hundred pounds to the square inch is obtained with a saturation of one hundred thousand lines of force per square inch. On this basis it is evident that one thousand square inches of contact surface at saturation would mean an adhesive pressure of four hundred thousand pounds. With smaller clutches and a lesser saturation the grip between the two halves of the clutch would be reduced, but it is evident that on the basis of this estimate the magnetic cluch can be appplied wherever a mechanical connection is required between the motive power and the generator. The clutch illustrated is one hundred inches in diameter and can transmit three thousand horse power at one hundred and fifty revolutions a minute. It is used by the Imperial Electric Light, Heat and Power Company, of St. Louis, Mo., and possesses advantages which make it an essential adjunct of station practice. The connections of the clutch are in plain view, and its construction is simple and every part readily accessible. Where smaller sizes of clutches are desired the Arnold clutch shows its superiority by a reduction in size and weight far beyond that of the ordinary friction clutch. For gas engines, lathes and wherever light powers are to be connected and disconnected rapidly, as well as in the above cases, this clutch performs its function with celerity and efficiency and may in the course of time displace other more cumbersome forms included under the head of friction clutches. For further particulars address the Arnold Electric Power Station Company, Marquette Building, Chicago, Ill.



Rotary Transformer for Light Power.



Largest Magnetic Clutch in the World.

ROTARY TRANSFORMERS FOR PLATING AND CHARGING.

The old Smee battery has been displaced this many years by platers of various grades and quality. It is not always convenient to obtain electricity at a low enough pressure to do for plating, particularly where electric lights are used and the use of batteries for plating is not practical. To obviate this difficulty and provide a means whereby low voltage can be readily and economically secured, small rotary transformers of about the construction of the machine illustrated are in the market. Many X ray cabinets are provided with them, the storage batteries beneath being charged by a low pressure generator driven either by a direct connected motor of higher E. M. F. or its equivalent, a double wound armature operating in the capacity of a motor and generator within the same field. The higher pressure produces motive power which is transformed into a low pressure current.

The Electrical Age.

ESTABLISHED 1883.

Entered at New York P. O. as second-class matter, January 18, 1891.

THE ELECTRICAL AGE PUBLISHING CO., Publishers.

TERMS OF SUBSCRIPTION:

One Copy, one Year, - - - - - - - - - $2.50
One Copy, six months, - - - - - - - - 1.25
Great Britain and other Countries, - - - - 3.50

Cable Address (all Cables), "Electage," New York.

NEWTON HARRISON, E. E., EDITOR.

ASSOCIATE EDITORS:

ALFRED E. WIENER, E. E., } ELECTRIC LIGHT AND POWER.
OSBORNE P. LOOMIS, E. E., }
JOSEPH MUIR, M. D., } ELECTRO-
FREDERICK STRANGE KOLLE, M. D., } THERAPEUTICS.

ADDRESS ALL COMMUNICATIONS TO
THE ELECTRICAL AGE PUBLISHING COMPANY,
Seventh Floor, World Building,
NEW YORK.

NEW YORK, MARCH 3, 1900.

CONTENTS:

COAL AND THE COST OF ELECTRICITY.

Electric light plants operated in the most economical manner are not always equipments composed of the most modern machinery. The cost of electricity is dependent in nearly every case upon the price of fuel, except in such cases as street railway plants, where other running expenses are so heavy that the price of fuel is comparatively unimportant. Cheap fuel, such as culm, is used wherever circumstances are propitious, that is, when it can be readily and cheaply conveyed to a given spot. An electric light plant on the borders of Lake Champlain, along the D. & H. canal, can supply electricity at a much cheaper rate than in the City of Pittsburgh; not because the site of the plant is less expensive but due to the small expense accompanying the delivery of cheap grades of coal. If freight charges vary the expenses of electric lighting change likewise, because it can be clearly demonstrated that fuel cuts a more important figure in certain phases of electric lighting than has been heretofore imagined. In a great plant like the Edison Electric Illuminating Company's very few men are employed in comparison with the large output of power. All operations are performed automatically and the main expense in addition to the depreciation of the machinery and wires is that of fuel. The price of electric lighting is, therefore, regulated by the freight charges per ton of coal and it is therefore evident that variations in this respect may so affect the price of lighting as to convey the idea that the operation of a plant in one part of the United States is more economical than in another. This is a fallacy, however, and explains why electricity may be cheaper in a small country town than in a large city where machinery is installed of the most modern type. Distance from the coal fields is in many respects the governing factor.

MISTAKES OF EARLY SCIENTISTS.

We are fast reaching a point in electrical literature where it has become necessary to decide upon the names and values of units to remain unchanged. It is probably well known to electrical experts and students of electrotechnics that the ampere differs in a ratio of one to ten to the early unit of current arrived at scientifically. In other words, the scientific unit is ten times as large as the practical unit of current. In addition, we find that the unit of capacity, the farad, is a million times too great for practical purposes. The unit now in use is the microfarad, the one millionth part of a farad. Again we find that the adoption of the ohm as a unit of resistance leaves us equally at fault when we measure very small resistances, such as one ten thousandth of an ohm, or very large resistances, to be measured in millions of ohms. It has been necessary to arbitrate on this ground as well and adopt the megohm as a unit in making insulation tests and the M. H. O. in measuring very low resistances of one thousandth of an ohm. The volt is defined in so scientific a manner that the lay mind cannot grasp its full meaning, either as a difference of potential or as an electro-magnetic phenomenon. It is therefore evident that certain practical electrical units, through the use of which thousands of people daily earn their bread and butter, should be so expressed or, at least, interpreted, that it would not be necessary to delve into mysteries in order to fully comprehend their meaning. It is quite evident that the early investigators, Ampere, Ohm, Volta, Joule, Faraday, Watt, etc., have had disciples in fields of science who did not see the tremendous commercial development electrical engineering was capable of and therefore missed opportunities of reducing scientific units down to the lowest possible terms. The mathematical complexities presented by our present system prevent practical men from understanding, or caring to understand, what units mean from a scientific standpoint. They are content to wallow in ignorance on this score although severely criticised by many who have made merely the theoretical side of the science a life study. The time is fast approaching when a reform will be absolutely necessary or some of our present units will be relegated to the scrap heap of defunct and obsolete terms.

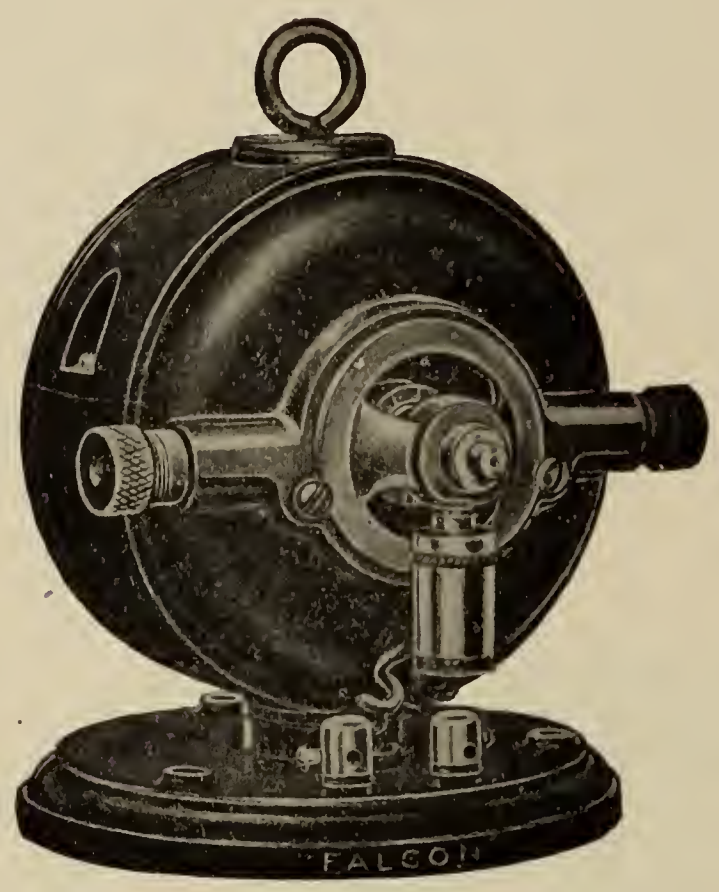
There will be an opportunity of instituting a reform, as suggested above, at the Electrical Congress, to be held at Paris in the near future. Like various other congresses that have been held in the past this congress will, metaphorically speaking, join hands in supporting a large sifter through which only eligible units will be permitted to pass. It is the intention of this congress to attempt to modify the C. G. S. system to such an extent that units may be given a practical definition, apart from the various Greek characters associated with them. The mistakes that have been made in the past may receive some attention at this coming congress and it is to be sincerely hoped that the units which then emerge will be as clearly defined to the lay mind as the pound, foot or pint. There is no necessity for dealing in abstractions in the face of the immense volume of business annually carried on in machinery and devices, such machinery and appliances being constructed in accordance with these units. Too much remodeling would be worse than too little. Whatever changes are made should be along practical as well as scientific lines.

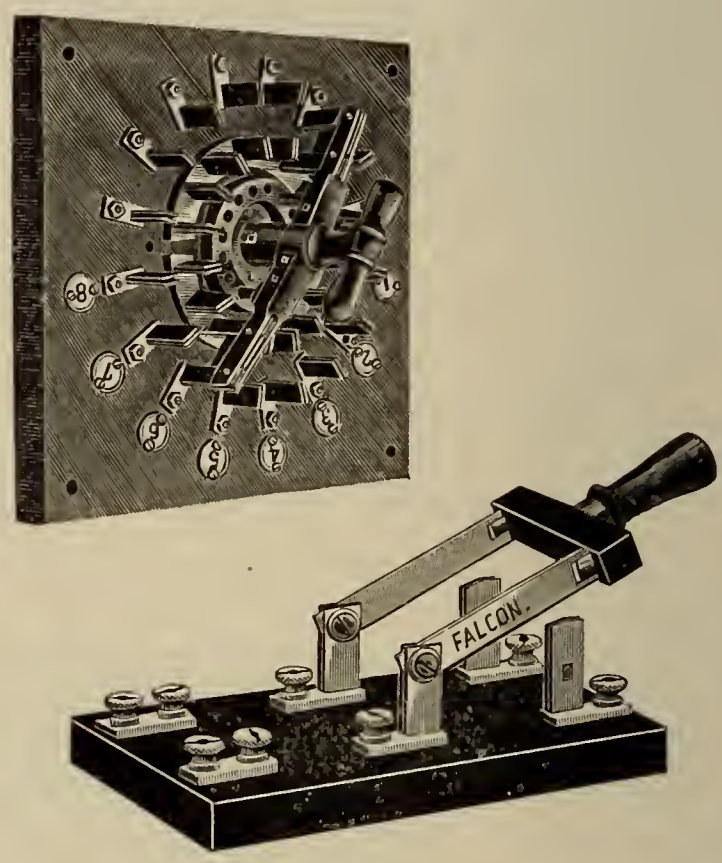
Installation Accessories.

"FALCON" DIRECT CURRENT POWER MOTORS.

The Falcon Electric Manufacturing Co., of 432-436 East 71st street, New York city, manufactures a line of direct current power motors in two sizes, a one-twelfth and one-eighth horse power. They are specially wound for 115 and 230 volts or for battery circuits. The machines are designed for either series or shunt winding, according to the nature of the work required of them. Machines are furnished with 1 1-4-inch grooved V shaped pulleys and self-oiling bearings. The motors are substantially mounted upon solid bases and all parts carrying current are carefully protected. The price of these machines is very moderate; the amperage of the twelfth horse-power, 115 volt, is .45, and of the twelfth horse-power, 220 volt, .25 of an ampere. Of the eighth horse-power, 115 volt, .6 of an ampere, and for the same horse-power at 220 volts, .33. Outfits particularly designed for dentists, light power purposes, sewing machines, etc., may be had by writing to the above address.

The "Falcon" all drawn, pure copper, knife switches, made by this company, are mounted on black enameled slate bases for single or double throw, single break. They conform in every respect to the requirements of the National Board of Underwriters. Both the single pole, double pole and triple pole, single throw or double throw switches are built with or without fuse connections as required. The "Falcon" radial amperemeter switch supplies a long-felt want in the trade. By its use the expense of equipping a large number of circuits is dispensed with. With a switch, as illustrated, one ammeter may be used for taking the readings of as many circuits as called for. In the case at hand eight circuits. The New York Electric Vehicle Transportation Company have many of these switches in use at their Fifty-third street station. These switches are originally mounted on wooden bases from which they are transferred to the switchboard, the thickness of which must be given when ordering switches. The "Falcon" radial amperemeter switch is built for three, four, five, six, seven and eight circuits, double pole. The officers of the above company are E. Leissner, president; H. O. Swoboda, vice-president and general manager and L. E. Frorup, secretary and treasurer.





Some of the Falcon Electrical Manufacturing Co's. Products.

Small Power Motor. Amperemeter Switch. Knife Switch.

AN ELECTRIC CANCELLING MACHINE.

An electric cancelling machine is being made use of quite extensively in the post offices of Greater New York. The apparatus consists of an iron table probably two and a half feet square. Across one end is an iron plate, four inches wide, placed on edge. There are openings in this plate where the printing is done. The printing wheel is back of this plate and the inking wheel back of the printing wheel. Another iron plate runs at right angles to the first one. There is still another plate which moves back and forth so that the space in front of the printing wheel can be widened according to the length of the longest envelope in the pile to be cancelled. The three plates form three sides of a square. The letters are all arranged with the stamp corners down. They are pressed against the plate holding the printing wheel and when the current is turned on by pressing a lever with the foot, the letters are caught one by one and pushed forward in front of the printing arrangement. When cancelled the letters are automatically thrown forward and out of the way.—Ex. length.

Telegraphy.

NEW SYSTEM OF TELEGRAPHY.

An inspector of the French telegraph service was recently sent by his Government to Budapest, to witness the experiments being made with the Pollak and Virag system.

It seems that exceptional rapidity is obtained by this system, which transmits from forty to ninety thousand words in one hour.

The inventors conceived the idea of using a telephone as a receiver. The transmitter sends forth positive and negative currents in succession, which act upon a telephonic plate. The vibrations of the plate are intensified in a manner described below, and are registered before the eyes on a paper. The rapid use of the positive and negative currents economizes so much time that the words are telegraphed almost as rapidly as they are spoken.

All dispatches must first be written out in telegraphic characters, as in the Morse system. Instead of the dots and dashes of the Morse system, however, the V sign is used upright, or inverted, as follows: Λ. These characters are as easily read after a little practice as the dots and dashes. Another point of resemblance to other telegraphic machines is that the machine perforates the strip on which the characters are placed, so that the paper directly over the characters is removed. The strip, or tape, is carried over a revolving cylinder, on which press two metal brushes, one bearing on the upright V, the other on the inverted Λ, so that the brushes and the metallic roller are brought into contact each time that the characters are perforated. The positive current acts on one brush and the negative on the other, and the two currents go forth in the wire of the line.

The following is the mode of telegraphing:

The telegram is placed in the machine, the cylinder turns, and the dispatch runs unaided on the line. Upon arrival, the current enters the receiving telephone, the positive attracting the telephone plate on one side and the negative on the other. Under this double influence, the plate oscillates and vibrates, but so slightly that the oscillation can not be utilized directly, so a small metal stem or wire is attached to the centre of the plate and to this little stem is attached a diminutive mirror lighted by a lamp. This idea is borrowed from submarine telegraphy. The luminous ray is reflected by the mirror, and the smallest deviation of this mirror brings about a great disturbance at the extremity of the ray. It can thus be imagined how the oscillation of the telephonic plate acts upon the mirror, which in its turn determines an appreciable movement at the extremity of the ray of light. This ray is projected on a rolling cylinder carrying sensitive paper, and at each oscillation of the plate the luminous pencil marks on the turning cylinder an upright V or inverted Λ corresponding to the positive or negative sign transmitted. It remains only to develop the sensitive paper and to read the signs and words.

The idea consists of reception by telephone and inscription by mirror as in the Thomson system of submarine telegraphy.

The results obtained by the system, therefore, have been the transmission at a distance of 1,000 kilometers (621 miles) of eighty thousand words in one hour over two bronze wires of great conducting power. Forty thousand words, or sixteen pages of journalistic matter, have been transmitted in twenty-five minutes. This represents more than thirty hours' work of an experienced telegrapher with the Hughes machine now in use, and more than five days and five nights of consecutive labor with the Morse system.

The speed of the Pollak and Virag machine is unprecedented, but it has its disadvantages, in the opinion of the writer on the subject. He enumerates the following points: The telegram must first be changed into characters, after the manner of the Morse system; then the strips must be perforated, as in the Wheatstone system; after reception, the photographed strips must be developed and then translated into ordinary language. It is thought that this complicated manipulation may lead to many errors in transmission, and for present use in France he concludes that the Baudot machine actually employed answers all requirements.

W. P. ATWELL, Consul.

Roubaix.

Patents.

WEEKLY ELECTRICAL PATENT RECORD. PATENTS ISSUED FEB. 20, 1900.

Conducted by Otto Greenberg. Complete descriptions and drawings of any patents mentioned below will be sent on receipt of ten cents.

643,649. Electric R. R. Jean J. Heilmann, France.—This invention consists in arranging four motors in series diagonally two by two, so that one of the motors on one side of the carriage is in series with one of the motors on the other side, and adapted to equalize the strains and pressure of the current in the two series of motors when the car is turning a curve.

643,706. Telegraphic Safety Device. Selden R. Wright, Morton, N. Y.

643,709. Electric Suburban Car. Michael Brillinger, Toronto, Canada.

643,722. Thermostat. Chas. E. May, New Zealand.

643,730. Electric Switch. William T. Pringle, Rimos, Pa.

643,744. Electric Heater. Gardner C. Hawkins, Boston.—In this invention an electric fan is used to create a blast of air across the coils of the heater.

643,758. Starting Box and Controller for Electric Motors. Frank R. Blake, Boston.

643,814. Electric Lighting Apparatus. Robert M. Dixon, East Orange, N. J.

643,830. Telephone Transmitter. Alfred Stromberg, Chicago, Ill.

643,834. Electric Arc Lamp. Christian J. Toerring, Philadelphia.—A part of the invention consists of a constant-potential arc lamp having its regulating coil in series and wound with resistance wire, constituting a portion of the resistance of the lamp and a supplementary resistance to adjust for the voltage of the circuit.

643,854. Electric Motor Wheel. James F. Whittlesey, Elizabeth, N. J.

643,865. Controller for Electric Automobiles. Charles G. Burrows, Windsor, Conn.

643,898. Electric Dental Oven. Harry M. Hill, St. Louis, Mo.

643,993. Telephone Transmiter. Chas. Tucker and Louis Jenkins, York, Pa.

644,029. Process of Electrodeposition of Metals. Sherard O. Cowper-Coles, London, Eng.

Business News.

TOTAL AMOUNT OF ELECTRICAL EXPORTS FROM NEW YORK CITY FOR WEEK ENDING FEB. 24, 1900, $124,685.

New York, N. Y., Feb. 24, 1900.—The following were the exports of electrical material from the port of New York during the week just ended:

Antwerp.—27 cases electrical machinery, $15,845.

Argentine Republic.—111 cases electrical machinery, $7,864.

Amsterdam.—224 cases electrical material, $11,675; 1 case elec., $150.

Berlin.—1 case electrical material, $10.

Brazil.—63 cases electrical material, $2,628; 17 cases electrical machinery, $191; 3 cases electrical material, $209.

British West Indies.—20 cases electrical material, $607.

British East Indies.—4 cases electrical material, $192.

Bremen.—2 cases electros, $20.

Belfast.—2 cases electrical material, $384.
British Possessions in Africa.—12 cases electrical material, $649.
Chile.—9 cases electrical material, $76.
Central America.—30 cases electrical material, $1,284.
Dutch East Indies.—1 case electrical material, $70.
Havre.—350 cases electrical material, $47,539; 1 case electrical machinery, $77.
Japan.—15 cases electrical material, $639.
Liverpool.—170 cases electrical material, $10,017.
London.—338 cases electrical material, $14,167.
Marseilles.—65 cases electrical machinery, $4,794; 20 cases electrical material, $2,331.
New Zealand.—12 cases electrical material, $302.
Porto Rico.—25 cases electrical material, $547.
Peru.—135 cases electrical material, $638.
Riga.—3 cases electrical material, $567.
Southampton.—62 cases electrical material, $1,024.
Uruguay.—1 case electrical material, $5.
Colombia.—8 cases electrical material, $244.

NEW INCORPORATIONS.

St. Paul, Minn.—Manhattan Light, Heat and Power Company. Manufacture and sale of electricity and steam. Capital, $1,000,000; incorporators: L. L. C. Brooks, A. W. Zahn, F. C. Nelson, all of St. Paul.

Camden, N. J.—Consolidated Electric Company. Deal in gas and electricity. Capital, $100,000; incorporators: S. R. Ketcham, C. H. Lamb, G. H. B. Martin, all of Camden.

Clinton, Ill.—Clinton Gas Company. Operating gas and electric plants. Capital, $50,000; incorporators: H. L. Olds, E. F. Irwin, both of Clinton; W. H. Odiorne, of Springfield.

Mt. Pleasant, Tenn.—A charter has been granted to the Mt. Pleasant Electric Company, with $15,000 capital stock. The incorporators are: E. L. Gregory, C. H. Ingram, H. D. Ruhm and John Ruhm, Jr.

Trenton, N. J.—The South Jersey Water and Electric Power Company, of Vineland, has been incorporated to construct dams. Capital, $250,000; incorporators: C. K. Landis, Matilda T. Landis, M. Fry, all of Vineland.

Evanston, Ill.—The Evanston Yaryan Company, of Evanston, has been chartered to furnish electricity. Capital, $2,500; incorporaters: W. O. Merrick, C. Woodward, N. J. Kasper, all of Evanston.

Dayton, Ohio—The Citizens' Electric Light, Power and Heating Company, of Dayton, has been incorporated. Capital, $200,000; incorporaters: W. T. Block, G. G. Luthy, W. Craighead, J. W. Kreitzer, S. D. Bear.

Bridgeport, Pa.—Bridgeport Electric Light, Heat and Power Company. Supply light, heat and power. Capital, $12,500; incorporators: J. S. Elliott, of Jefferson Township; W. H. Fisher, E. T. Bradshaer, both of Brownsville; G. D. Howell, W. J. Sturgis both of Union-

Youngstown, Ohio.—The Merchants' Light, Heat and Power Company, of Youngstown, Ohio, has been formed for furnishing arc and incandescent lights, etc. Capital, $50,000; incorporators: H. F. Kaercher, D. F. Anderson, G. E. McNab, W. R. Beard, P. C. Kaercher.

Newport News, Va.—The Consumers' Light, Heat and Ice Company has been chartered, the capital stock being $100,000. This organization will run in opposition to the Peninsular Electric Light and Power Company, the principal stockholders in which are Alexander Brown & Sons, of Baltimore.

Los Angeles, Cal.—San Pedro Terminal Gas, Electric and Power Company. Deal in electricity, gas, etc. Capital, $100,000; incorporators: F. H. Rindge, of Santa Monica; H. V. Carter, G. I. Cochran, W. Gilleden, L. A. Phillips, all of Los Angeles; W. J. Williams, W. W. Beckett, J. R. Haynes, all of Pasadena.

Camden, N. J.—The Sun Electric Manufacturing Company, of Camden, has been incorporated to do general telephone and telegraph business. Capital, $2,000; incorporators: E. Williamson, of Media; E. Hall, G. A. Dougherty, J. R. Cantlin, all of Philadelphia, Pa.; S. Dole, of Camden.

Columbus, Ohio.—The Morgan Engineering Company has filed articles of incorporation with the Secretary of State. The capital stock is $3,000,000, half of which is to be preferred. The company is to manufacture and deal in hydraulic, electric, pneumatic, gas and fire machinery, including guns and ordnance.

Hempstead, N. Y.—The Roslyn Light and Power Company has been incorporated to manufacture electricity for light, heat and power purposes in the towns of North Hempstead, Oyster Bay and Hempstead, Nassau County. Capital, $50,000; directors: R. D. Winthrop, of Westbury; C. H. Mackay, of Roslyn, and E. D. Morgan, of Newport, R. I.

Albany, N. Y.—Senator Ellsworth has introduced a bill incorporating the Lockport & Newfane Power and Water Supply Company, with a capital of $500,000. The business of the company shall be the development and employment of hydraulic and electrical power, and supplying it to the citizens of Niagara County. Willard T. Ransom, Henry I. Pierce, John A. Merritt and Harry L. Ransom are named as incorporators.

STREET RAILWAY NEWS.

Fort Wayne, Ind.—The commissioners of Huntington County, Ohio, have granted a franchise through that county to the Ohio & Indiana Traction Company, organized to build an electric road from Hicksville, Ohio, to Marion, via Fort Wayne and Huntington. The line runs west through Huntington County to Huntington, and then extends southwest through Mt. Etna to Marion.

Belvidere, Pa.—The Warren County Traction Company has filed papers of incorporation. The company is formed to construct and operate a trolley line from Phillipsburg to Washington, and from thence to Belvidere. The capital is $250,000, and the incorporators are: Howard Mutchler, Easton; Morris M. Reading, Phillipsburg; Robert A. Montgomery, Lambertville; Charles L. Hemingway, Easton; Richard B. Reading, Lambertville; William S. Pursell, Phillipsburg, and Frederick Frelinghuysen Kennedy, Bloomsbury.

NEW YORK NOTES.

AMERICAN ODDITY COMPANY have moved into the large new building at Nos. 170-172 West Broadway, corner of Worth Street, and are now prepared to supply "Oddo" motors and batteries promptly upon receipt of orders. Notwithstanding the fact that they have twice doubled their manufacturing facilities within the last three months they found that their factory was still insufficient to meet the rapidly increasing demand for their batteries and motors, and were therefore obliged to seek larger quarters.

WESTON STANDARD

PORTALE DIRECT READING

VOLTMETERS AND WATTMETERS

For Alternating and Direct Current Circuits.

The only standard portable instrument of the type deserving this name.

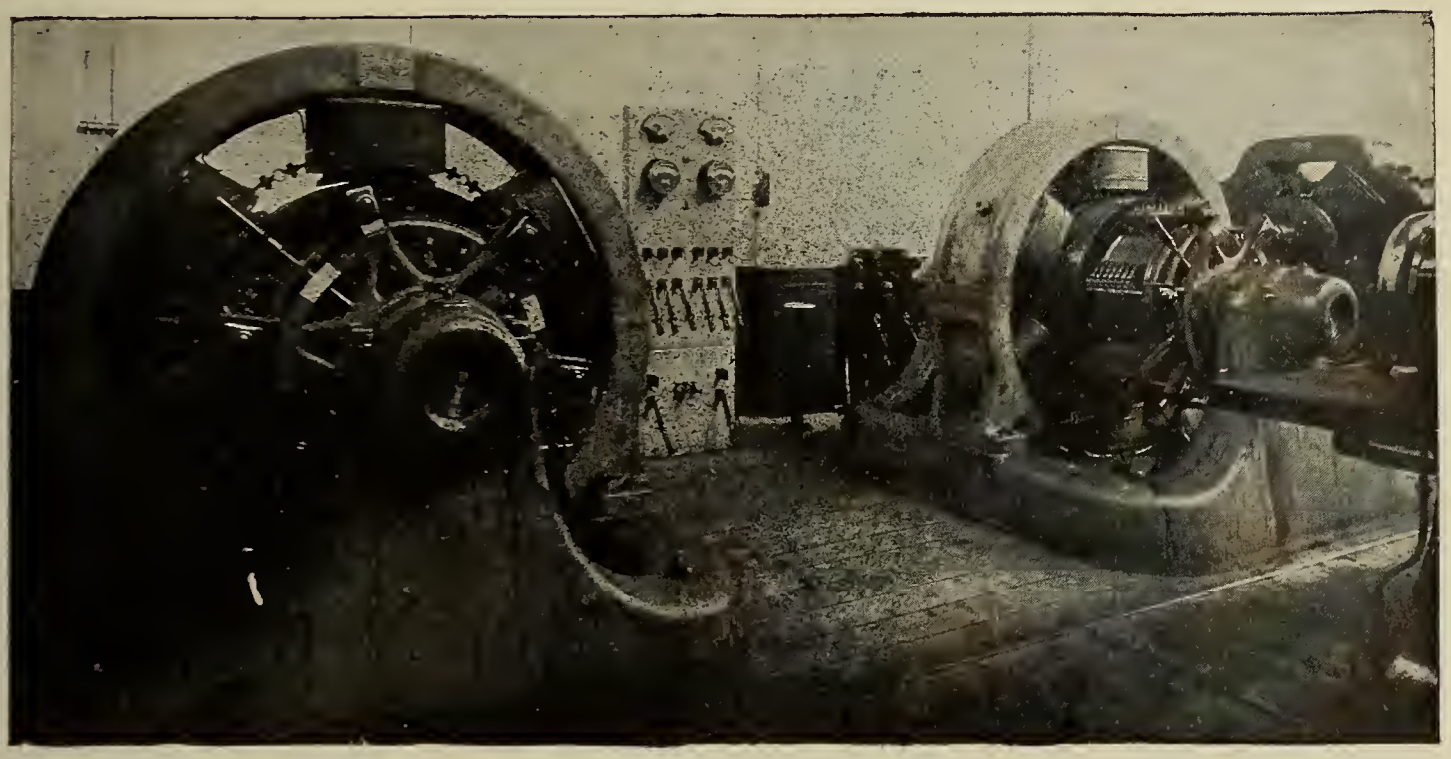
Write for Circulars and Price Lists 8 and 9.

WESTON ELECTRICAL INSTRUMENT CO.,

114-120 William Street, Newark, N. J.

The Electrical Age.

Vol. XXV—No. 10. NEW YORK, MARCH 10, 1900. Whole No. 669.



Distributing Station. Rotary Converter in Operation.

THE FUNCTION OF THE ROTARY CONVERTER.

The prejudice against the extended use of alternating currents has disappeared, largely due to the fact that a more thorough comprehension of the possibilities of alternating current machinery seems to prevail, and, in addition, due to improvements in methods of insulation and construction. The rotary converter, through the medium of which power transmission may be carried on on a large scale without any greatly magnified risks of either a commercial, mechanical or electrical nature, has been universally adopted in power transmission plants in a manner that agrees with theory and is adapted to practice. The alternator operated by distant water power generates a moderate pressure. This voltage is led into transformers which raise the pressure until it reaches the proper point for transmission over the line. At the distributing centre it is received in a similar manner by transformers and the step down process takes place. Hence it is seen that generating the power, feeding it into transformers which raise the pressure, receiving it again in transformers which lower the pressure, constitute the main outlines of a power transmission scheme. The second set of transformers feeds into rotary converters, generally of a two or three phase character. In these devices the motive power is supplied by the entering current and from the rotation which ensues the second winding on the armature, like the winding of any other continuous current generator, feeds a D. C. current at 500, 220 or 110 volts into various circuits for street railway use, operating motors or feeding incandescent light systems. From a standpoint of efficiency the following result is attainable: Allowing an efficiency of 10 per cent. in the generating station, including generators and transformers, allowing an efficiency of 90 per cent. in the line, allowing an efficiency of 90 per cent. at the distributing end, the net efficiency reduces down to figures approximating 70 per cent.

Electrical Measurements.

A FARADMETER.*

BY M. I. PUPIN.

The art of measuring the capacity of a condenser has not yet reached that stage of perfection which can be justly claimed for the resistance measurement. The prevailing method is the ballistic galvanometer method. Leakage and absorption can and often do introduce serious errors into this method. These errors can be reduced to any desirable limit by employing alternating currents of appropriate frequency.

This was the principal consideration which led to the construction of the faradmeter which forms the subject of this note. In addition to this consideration, which concerns the accuracy, there is another very important consideration which must be taken into account and that is the convenience of the method and the cheapness and durability of the apparatus to be employed. Much of the capacity measurement work, especially in connection with telegraphy, telephony, and the construction of alternating current machinery, has to be done under conditions under which it is quite inconvenient to employ the ballistic galvanometer. I believe that the faradmeter described here will be found to answer satisfactorily all reasonable requirements as regards convenience.

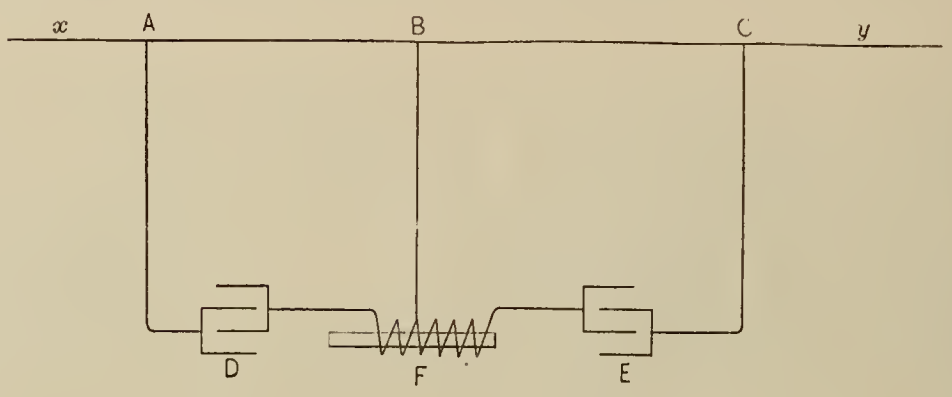


Fig 1.

The theory on which the construction of this meter is based is very simple, as follows: Let x y (Fig. 1) be a conductor through which an alternating current flows. D is a condenser of known capacity and E is a condenser of unknown capacity; F is a differentially wound telephone. Connect as indicated and adjust the resistances A B and B C until silence is obtained in the telephone. Then capacity of D : capacity of E :: resistance of B C : resistance of A B. It is understood, of course, that the resistances A B and B C are non-self-inductive and that the capacity reactance of each condenser is its own circuit by far the greatest element of the impedance. It will be seen presently that these conditions are fulfilled in the apparatus shown in Fig. 2 which our fellow member, the well known mechanician, Mr. Baillard, constructed for me and employed in some work which he has been doing for me during the last two months.

In Fig. 2, A is a cell which feeds into the primary B of a small induction coil provided with an interrupter such as is used in electrotherapy. The secondary C is connected to a row of resistance coils E and L. These resistance coils L have in addition several equal lengths of manganin wire F stretched over a graduated scale The resistance of the coil as well as of the manganin wire is carefully calibrated once for all. The condenser H is a carefully constructed mica condenser of known capacity. G is the condenser the capacity of which is to be determined. I is the differentially wound telephone. The approximate adjustment is accomplished by the plugs which control the resistance E and L, and the final adjustment is made by the manganin wire by a sliding contact F which varies the length of the manganin wire to be introduced, and therefore varies the drop which acts on one of the condensers. With ordinary frequencies capacities up to several microfarads can be determined with an accuracy of a small fraction of one per cent. easily and rapidly.

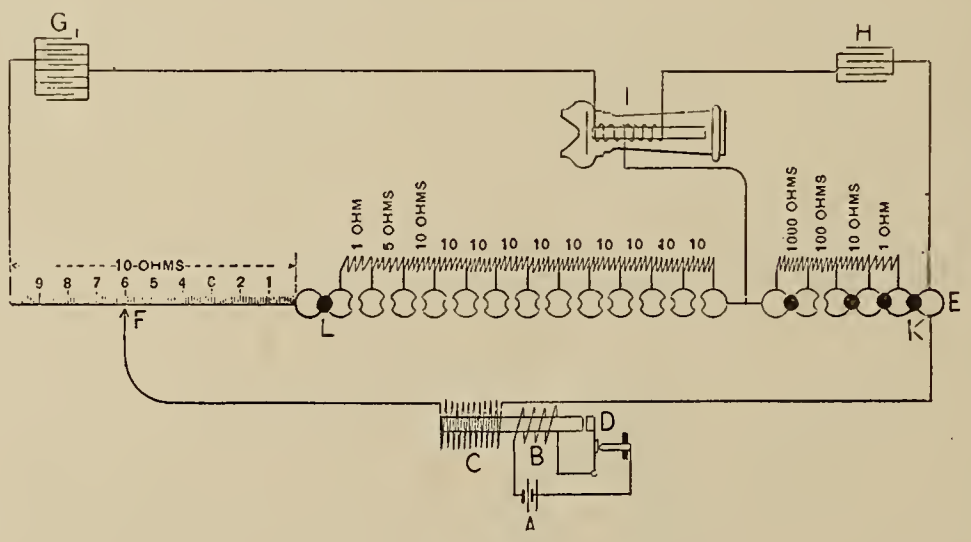


Fig 2.

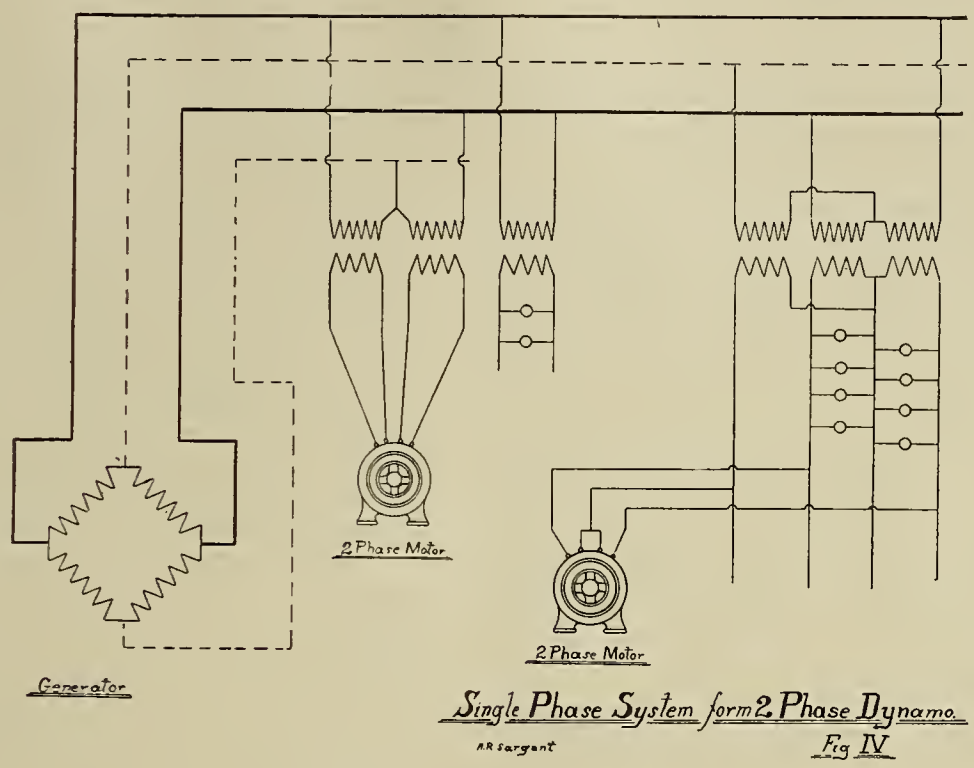
It is self-evident, of course, that in place of the differentially wound telephone I, we can use an ordinary telephone and place it in the bridge which connects a point betwen G and H to a point between the resistance coils E and L. The conditions of balance are the same as in the method employing the differentially wound telephone. In many practical cases this second method is preferable.

Our fellow member, Mr. Baillard, has experimented quite a great deal with a faradmeter of this kind and is better prepared to go into details of the apparatus and the method than I am.

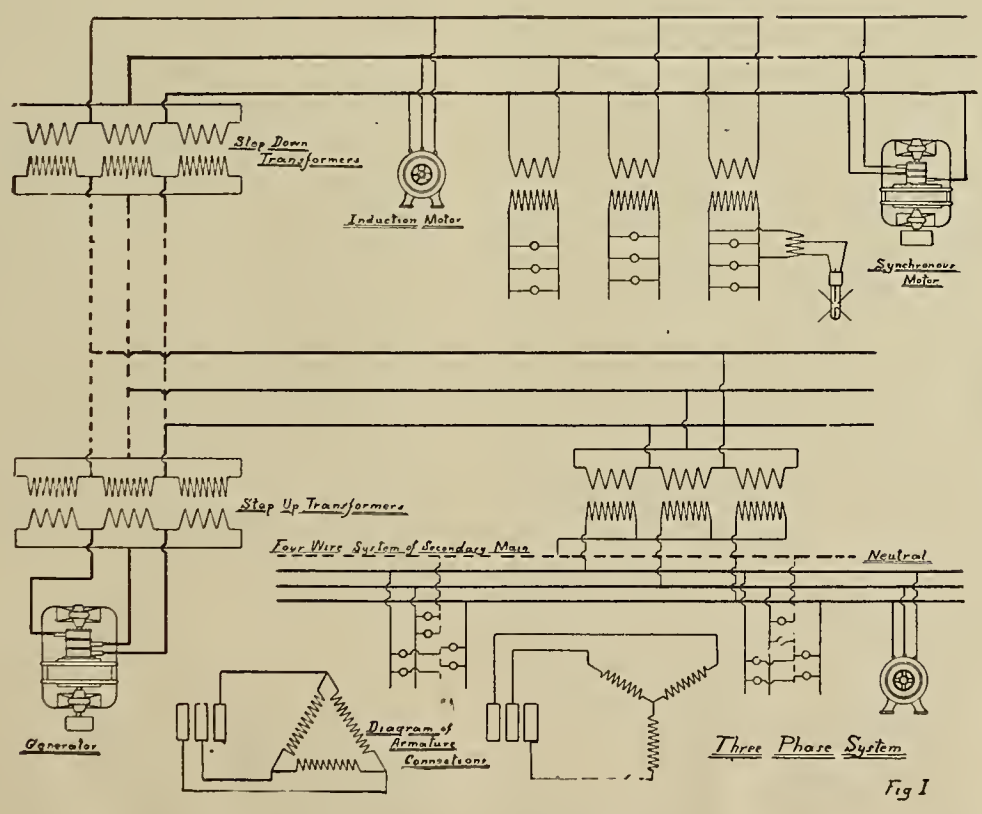
*Presented at the 140th Meeting of the American Institute of Electrical Engineers, New York, February 28th, 1900.

WIRING FOR POLYPHASE CIRCUITS.

The following diagrams are examples of the systems employed in the distribution of polyphase currents. In the particular cases presented a complete three phase system of distribution is shown and a unique case of a two phase current feeding a single phase system. As diagramatically represented the original objects are attained, but aside from the mere design of the circuit the limitations regarding size of wire, induction, length of circuit, etc., must be known. When alternating current wires are run in a single conduit, the distance between the wires being less than an inch, the conditions for continuous current wiring hold true. Where the distance is greater self-induction produces an effect, tending to increase the apparent resistance of the wire. There is no waste of energy, but a condition equivalent to drop of potential is experienced. The resistance and reactance of copper wires running parallel to each other, each a thousand feet long, at a normal temperature, are given, as stated in "Electric Wiring." The reactance at 60 cycles, when three inches apart, is .1296; at 133 cycles it is .2879. At 60 cycles, nine inches apart, the reactance is .18; at 133 cycles it is .4. When eighteen inches apart, at 60 cycles, the reactance is .2120; at 133 cycles it is .4710. The ratio between the useful E. M. F. and the impressed E. M. F. of the line is called the power factor. When the power factor of the load is known the drop in line can be calculated for one, two or three phases by a formula found in



Connections of a Single Phase System.



Connections of a Three Phase System.

many standard text books. The inductance factor and the power factor for each angle of lag are given and simplify all computations. We refer our readers to look up the volume mentioned, "Electric Wiring," page 58.

Electric Railways.

NOTES ON ELECTRIC TRACTION UNDER STEAM RAILWAY CONDITIONS.*

BY EDWARD C. BOYNTON.

On many of the large steam railroad systems in the United States, there are certain sections which present the most favorable conditions for the substitution of electricity for steam as a motive power. These conditions are the result of increasing density of population, and mean that better and cheaper transportation facilities are needed by the public than are provided by the steam road.

The electric street railroads quickly took advantage of these conditions, and by building lines more or less parallel to the steam roads, soon acquired a large share of the local passenger traffic. The fault with the steam road was not that the motive power was steam, but the fare was too high and the train service too infrequent. The whole question of the substitution of electricity for steam hinges upon that one point.

In order to provide satisfactory transportation facilities, the steam road must double or quadruple the number of its trains, and reduce the fare to at most one cent per mile. When there is sufficient density of population, this will surely cause a large increase in the number of passengers carried. This increase is due principally to the fact that many people who could seldom afford the expense of traveling would then make frequent trips. It is very doubtful whether the great number of steam trains can be operated at a sufficient profit with the low fare. Here, then, comes in the change in motive power, with the sole purpose of decreasing the operating expense.

I wish to call attention to two classes of local passenger traffic which could be considered as distinct from each other. The suburban traffic of a large city is well understood, and its characteristics are usually such as would make the change from steam to electricity profitable. The low fare will induce a part of the population to make their homes in the suburbs, and thus increase the travel. But where there are competing trolley lines, the steam road, which we will suppose has electric motive power, needs one more facility than those mentioned, and that is, high speed. Without that, there would be little advantage over the competing lines.

It has been proved by experience that the speed must be at least as great as an average steam train, and there is no doubt that if the speed be made as high as the fastest steam express train, the popularity of the line would increase. It is well-known that the business man who desires to travel from one city to another, or to and from his residence and his place of business, cannot be carried there too rapidly. It would probably surprise the average passenger on one of the fast steam express trains to be told at a certain time that he was traveling 70 miles per hour, and yet such speeds are reached every day, for short distances, over a straight, level track.

The other class of traffic referred to is that existing between cities and towns in close proximity. Let us assume a case as an example.

In a certain densely populated manufacturing state, there is a city larger than any other within fifty miles radius. Within that radius are several towns and small cities not over twenty to thirty miles from the larger city. These are connected by the steam road, which maintains what is considered a reasonable train service, and one that is as frequent as the traffic seems to demand, at the rate of fare charged, which is from two to two and one-half cents per mile. The trains are quite heavy, nearly always fully loaded, and are run from two to three hours apart. Together with its freight traffic, such a road pays well, judged from the steam road's standpoint. Suppose that electricity be substituted for steam in that section, and a train service consisting of two, or three cars running every half hour from each end, with a maximum speed of fifty to sixty miles per hour, and the fare reduced to one cent per mile. There is no doubt in the minds of those who have watched the development of such cases, that the increase of traffic and low operating expenses would result in a far greater profit than was ever earned by that section of the road. It is well-known that such conditions exist on our steam railroads in many localities.

It has been said that the steam roads will begin by equipping their branch lines with electric motive power, and little or nothing is heard of the equipment of the main trunk line. It is necessary to define what is meant by a branch. In a large system some brances are 100 miles long and may be double tracked; others are from six to forty miles in length. In the assumed case described above, the conditions may exist on one of the large branches or even on the main trunk line, which may have four tracks. It should make no difference in deciding the question of equipping the part of the system which possesses the desired conditions, whether it is on a branch or a part of the main line. It should be fully understood that no steam railroad will equip any portion of its lines, except with the provision that nothing shall be done which will prevent the running of steam and electric trains over the same track.

A well known authority, nearly five years ago, mentioned the possibility of the equipment of one or two of the tracks of a four-track trunk line by electricity, to carry the local traffic, and stated that the two tracks equipped should be those used by the freight trains. At the present day that does not seem advisable, for the reason that the speed of the electric trains must be equal to that of the steam express trains, and the slow moving freight trains would seriously interfere with the electric schedule. But it is unlikely that any steam road will equip a part of its main trunk line until it has satisfied itself, as to financial results, by giving it a thorough trial elsewhere.

The reduction of fares combined with the use of open cars during the hot summer months ,produce a class of passengers which formerly used the electric cars. These have been called the pleasure riders, and they furnish a considerable proportion of the recipts. Experience with open cars trains has shown that speeds of 30 to 35 miles per hour are the maximum which should be used, on account of the discomfort caused by the wind pressure created by the train.

(To be continued.)

*A paper presented at the 140th Meeting of the American Institute of Electrical Engineers, New York and Chicago, February 28th, 1900.

Zanesville, Ohio.—Zanesville, Adamsville & Coshocton Electrical Railway Company. Constructing and maintaining an electric railway. Capital, $10,000; incorporators: J. B. Wilson, W. O. Littick, E. C. Gordon, H. E. Baker, T. H. Southard.

Easton, Pa.—The Easton & Nazareth Street Railway Company has been given right of way through Easton.

Grand Rapids, Mich.—Secretary Benjamin S. Hanchett, of the Consolidated Street Railroad Company, heads a company which will build an electric road from Grand Rapids to Holland. The necessary capital has been secured. The road will be operated for freight or passengers.

The Electrical Age.

ESTABLISHED 1883.

Entered at New York P. O. as second-class matter, January 18, 1891.

THE ELECTRICAL AGE PUBLISHING CO., Publishers.

TERMS OF SUBSCRIPTION:

One Copy, one Year,	$2.50
One Copy, six months,	1.25
Great Britain and other Countries,	3.50

Cable Address (all Cables), "Electage," New York.

NEWTON HARRISON, E. E., EDITOR.

ASSOCIATE EDITORS:

ALFRED E. WIENER, E. E., } ELECTRIC LIGHT AND POWER.
OSBORNE P. LOOMIS, E. E., }
JOSEPH MUIR, M. D., } ELECTRO-
FREDERICK STRANGE KOLLE, M. D., } THERAPEUTICS.

ADDRESS ALL COMMUNICATIONS TO

THE ELECTRICAL AGE PUBLISHING COMPANY,

Seventh Floor, World Building,

NEW YORK.

NEW YORK, MARCH 10, 1900.

CONTENTS:

THE INCREASING USE OF ALUMINUM FOR CONDUCTORS.

Nearly every week the technical papers contain reports of transmission plants whose lines are made of aluminum. In many cases these installations represent the most modern development in electrical engineering. The most recent form of insulation is employed and generators possessing every improvement in addition to transformers of the latest design. But the various essential elements of a transmission plant are now rendered more complete by the erection of a line composed of aluminum. The properties of this strange metal as well as its unusual softness make it seem surprising that a line composed of pure aluminum performs its functions so satisfactorily. It is therefore interesting to remark the physical durability of aluminum lines which through their tensile strength lead to the conclusion that they contain a considerable percentage of copper. From the standpoint of conductivity aluminum wire has sixty per cent. of that of copper. The great advantage of aluminum is in its lightness. The specific gravity of copper and aluminum bear such a relation to each other that, bulk for bulk, one pound of aluminum contains three times as much metal as a pound of copper. From this it is seen that if aluminum possesses sixty per cent. of the conductivity of copper one pound of aluminum made into a wire of twice the cross section of a wire made from a pound of copper would be nearly a third longer. The prices of aluminum and copper in bulk are approximately the same with a trifle in favor of the copper. Were the demand for aluminum wire sufficiently great the price could be reduced to meet existing commercial conditions so that copper as a conductor for power transmission lines would be left in the background.

Changing a circuit from copper to aluminum for alternating current service possesses certain advantages with a low frequency. It has a lower inductance and less resistance. According to a writer on the subject "if computation for copper indicates the use of No. 4 wire, with a conductor six inches apart, aluminum wire may be substituted by using No. 2 wire, with the conductors eight inches apart, with approximately equivalent results. In other words, aluminum wire must be two sizes larger than copper." We are indebted to Cecil P. Poole for the above figures, which indicate that the future use of aluminum wire will be much greater than that anticipated at present. The Copper Trust has certainly been influential in bringing about the use of aluminum for conducting purposes. If aluminum were a little stronger the advantages due to its use would be more obvious and copper, even when quoted very low, would not be as desirable a conductor.

KIMBERLEY AND THE SEARCHLIGHT.

One of the means of communication employed by the military at Kimberley was the searchlight taken from H.M.S. "Terrible." During the siege the searchlight was in almost constant use, a dot and dash code being employed, the secret military code of the army supplying the alphabet. Every day the besieged employed this light for conveying information to those advancing to their assistance. When the British military were approaching Kimberley and were some twenty or thirty odd miles away the signals of this searchlight were noticed and the condition of the beleaguered garrison tersely stated. The searchlight is operated by switching the current on and off, a short flash constituting a dot and a prolonged flash of light a dash.

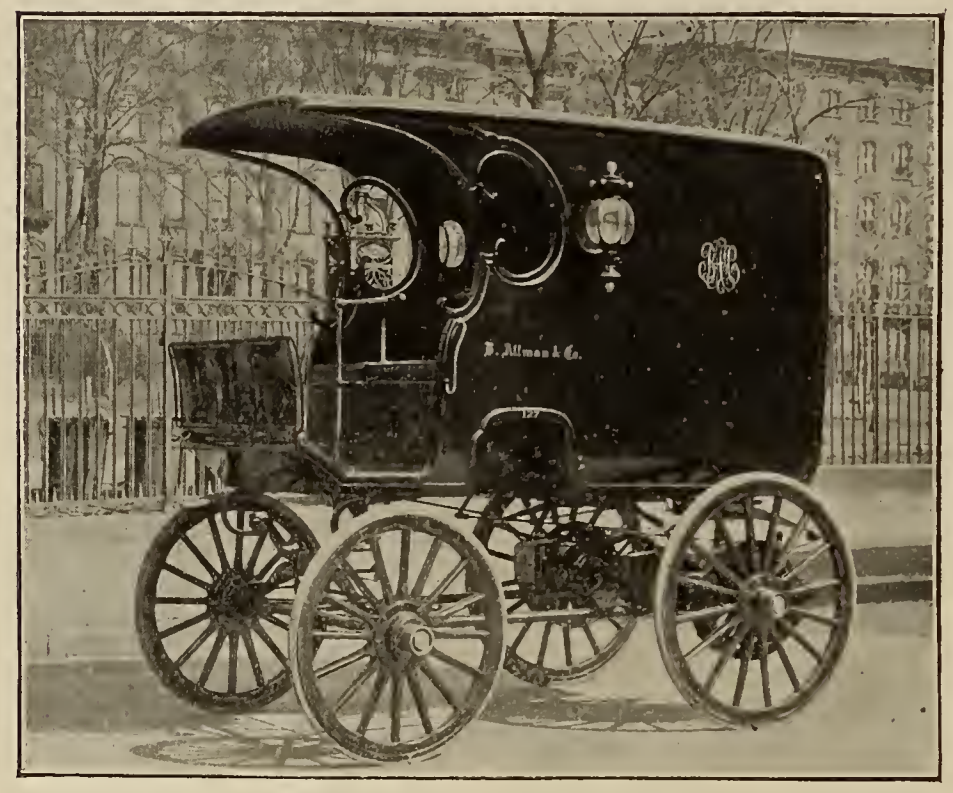
The Marconi wireless telegraph system is employed by the British in South Africa to a very limited extent. At the opening of the war the British War Office arranged with the Marconi Company for the delivery of a dozen sets. They arrived in good time, but when set up for operation were found to lack in positiveness and to get out of adjustment very rapidly. It must be considered that a Marconi system of wireless telegraphy involves the use of relay and coherer, both of which are very sensitive to outside disturbances, the coherer particularly. It has not been decided as yet whether the apparatus was not properly operated or put in charge of skilled telegraphers. If the fault lay with the instruments they will require considerable redesigning before being allowed to become an essential part of an army equipment. From the experiments performed and tests made there is every likelihood that the apparatus did not reach the hands of skilled operators and in consequence failed to perform the functions expected of them.

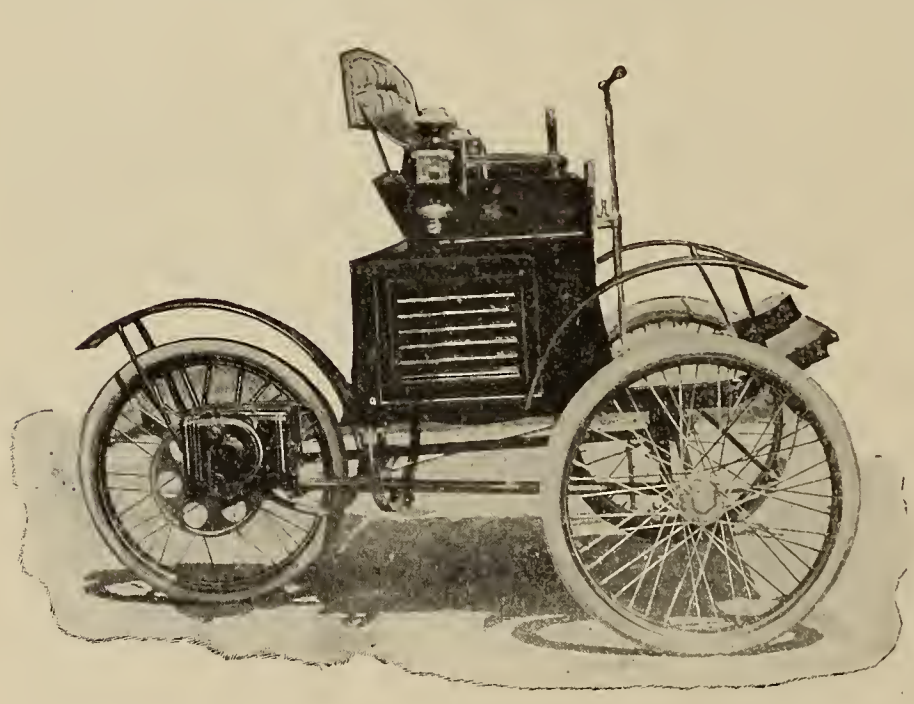
The automobile has been employed to some extent for scouting and messenger service in the Transvaal, those in use being operated by gasolene and being merely tricycles of French construction. The surface of the veldt is most irregular and at places covered with small boulders and rocks and broken up by kopjes which make traveling very, very rough. The British make use of light Maxims mounted on tricycles by the aid of which the artillery of an advancing force cannot only obtain quick range, fire and retreat, if necessary, but be used in case of necessity for transporting the wounded or carrying supplies. In connection with these modern additions to the army service signalling from a balloon containing a searchlight was carried on extensively at Ladysmith, the signals veing visible over a radius of a hundred miles.

Automobiles.

SOME DATA ON AUTOMOBILES.

A few facts regarding the automobiles of the various types shown may be of interest to technical readers. The width of the tread or diameter of the tire largely influences the rate of progress in damp weather and in the illustrations where the street hansom, delivery wagon and tricycle are shown the size of tires is determined by the weight of the machine and power applied. The horse power required to propel a vehicle is equal to the total rolling load in tons multiplied by the resistance to motion expressed in pounds per ton multiplied by the speed required in feet per minute the whole divided by 33,000 To this value we add or subtract a quantity dependent upon the inclination of the grade in ascending or descending. This added value to be treated according to the grade is equal to the rolling load in tons times 2,240 times the speed required in feet per minute divided by 33,000 and multiplied by the sin of the inclination of the grade. The resistance to motion expressed in pounds per ton would vary from ten to thirty pounds, depending upon the friction. In ordinary automobiles twenty-five would be a fair figure. One ton weight moving ten miles an hour over a grade of two degrees would call for approximately three horse power.





Various Types of Automobiles.

Patents.

WEEKLY ELECTRICAL PATENT RECORD.
PATENTS ISSUED FEB. 27, 1900.

Conducted by Otto Greenberg Complete descriptions and drawings of any patent mentioned below will be sent on receipt of ten cents.

644,051. Controller for Alternating Current Circuits. Ernest J. Berg, Schenectady, N. Y.

644,072. Automatic Gravity Cut-out for Electrical Circuits. Wm. Hanlon, Poughkeepsie, N. Y.

644,094. Electrical Bond for Railroad Rails. James M. Price, Philadelphia.

644,108. Contact Service for Conduit Electric Railroad. Carl T. Stendebach, Leipsic, Germany.

644,128. Automatic Controller for Electric Compressors. N. A. Christensen, Milwaukee, Wis.

644,143. Electric Gas-Lighting Candle-Burner. Ray N. Noyes, Haverhill, Mass.

644,144. Connecting-Plate for Storage Batteries. Harry G. Osburn, Chicago.

644,160. Electric Glow-Lamp. William Bochen, Berlin, Germany. The inventor heats the glower, which is a non-conductor at ordinary temperatures, with a gas burner placed beneath it; and then passes a current through this glower.

644,196 and 644,197. Motor Suspension for Railroad. Samuel E. Clarkson, Johnstown, Pa.

644,198. Motor Suspension for Railroad. Antoine B. DuPont, Detroit, Mich.

644,199. Motor Suspension for Railroad. Richard D. Eyre, Philadelphia, Pa.

644,200. Motor Suspension for Railroad. Alfred J. Gairing, Johnstown, Pa.

644,204. Switch Box for Intercommunicating Telephone Systems. Albert Keller, Philadelphia.

644,205. Telephone Transmitter. Albert Keller, Philadelphia.

644,206. Telephone Receiver. Albert Keller, Philadelphia.

644,212. Motor Suspension for Railroad. Edwin G. Nicewauer, Johnstown, Pa.

644,213. Motor Suspension for Railroad. Edwin G. Nicewauer, Johnstown, Pa.

644,251. Electric-Contact Apparatus. Carl G. von Kohler, Stockholm, Sweden.

644,278. Means for Regulating Electric Machines. Wm. H. Cooley, Brockport, N. Y.

644,547. Telephone-Transmitter. Ernest B. Fahnestock, Washington, D. C.

644,551. Microphone. Ernest B. Fahnestock, Washington, D. C.

644,561. Electric Signalling Apparatus. Geo. Harris, Detroit, Mich.

644,552. Electric Meter. Geo. Hookham, Birmingham, England.

644,553. Alternating Current Converter. Hutin & Seblanc, Paris, France.

644,554. Electric Recuperator. Hutin & Seblanc, Paris, France.

644,555. Process of Reducing Apparent Inductance of Electrical Circuits. Hutin & Seblanc, Paris, France.

644,311 and 644,312. Method of Winding Helices for Electrical Purposes. James C. Anderson, Jersey City, N. J.

644,315. Telephonic Relay. Fred H. Brown, Oak Park, Ill.

644,330. Electrical Measuring Instruments. James W. Packard, Warren, Ohio.

644,357. Multiple-Fuse Cut-out. James B. Hubbard and Chas. Dorsey, Baltimore.

644,407. Automatic Regulation of Systems of Electrical Distribution. John S. Creveling, New York City.

644,408. Car-Lighting System. John S. Creveling, New York City.

644,409. Electric Distribution. John S. Creveling, New York City.

644,433. Signal Apparatus for Boilers. Wm. B. Lowe, Jr., Atlanta, Ga.

644,448. Circuit-Closer for Telegraph Keys. Elmer E. Nye and Louis C. McIntosh, Los Angeles, Cal.

644,497. Wireless Telegraphy. Archie F. Collins, Saratoga, N. Y. This invention consists of a receiving apparatus for wireless telegraphy, comprising a non-conductor tube, having oppositely-disposed conductor-plugs arranged within it, the plugs having their inner ends beveled to form a tapering or V-shaped pocket for the reception of loose magnetic particles; and a magnet, in circuit with the plugs and magnetic particles, arranged to act on the particles.

644,510. Process of Electrical Reduction for chemicals or non-conducting ores which consists in forming an electric arc between an electrode and an aqueous electrolyte, and mechanically passing the ores into the arc. Ellis F. Frost, Washington, D. C.

644,517. Resistance-Switch for Electric Circuits. John H. Holmes and Frank Broadbent, Newcastle-upon-Tyne, England.

644,538. Voltaic Cell. Albert Pfannenberg, Berlin, Germany. This invention consists in the particular shapes of the electrodes.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

The 140th meeting of the Institute was held at 12 West 31st street, New York, on Wednesday, Feb. 28th. A note on "A Faradmeter" was presented by Dr. M. I. Pupin and the instrument described and explained by the author was exhibited by him. Messrs. Hering, Wolcott, Bradley and Reed took part in the discussion. A paper was presented by Edward C. Boynton, of New Haven, entitled "Notes on Electric Traction Under Steam Railway Conditions." The discussion was opened by Mr. F. J. Sprague and continued by Messrs. Hutchinson, Hanchett, Lamb, Ries, Pope, Holbrow, Mailloux, Atwood and Emerson. At the meeting of the executive committee in the afternoon the following associate members were elected: Howell Henry Barnes, John Duncan Boyd, Clement W. Evans, Lewis Warner Henry, A. M. Hunt, Wm. G. Lawrence, J. L. McCreary, H. D. McVay, Morris M. Neurath, Frans Oscar Renstrom, Mariano L. Schiaffino, Walter Eugene Smith, Geo. Lourie Wiley, J. M. Zapata.

Mr. Edward J. Willis, of Richmond, was transferred to membership.

It was voted by the executive committee that the annual business meeting should be held in New York City on May 15th, the date fixed by the constitution, at which the ballots for new officers will be canvassed. On the afternoon of the following day, May 16th, the general meeting for the reading and discussion of professional papers will open at Philadelphia, continuing possibly for three days.

Business News.

SPECIAL EXPORT COLUMN.
TOTAL AMOUNT OF ELECTRICAL EXPORTS FROM NEW YORK CITY FOR WEEK ENDING MARCH 3, 1900, $92,002.

New York, N. Y., March 3, 1900.—The following were the exports of electrical material from the port of New York during the week just ended:

Argentine Republic.—100 packages electrical material, $16,668; 290 packages electrical machinery, $11,657.

Alexandria.—1 case of electrical material, $48.

Brussels.—1 case electrical material, $71.

British East Indies.—83 cases electrical material, $11,-

384.

Bremen.—1 case electrical material, $42.

Brazil.—43 cases electrical material, $1,743.

British Possessions in Africa.—5 cases electrical material, $313.

Chili.—2 cases electrical machinery, $56; 3 cases electrical material, $183.

Cuba.—29 cases electrical material, $859.

Ecuador.—3 cases electrical material, $14.

Hamburg.—92 cases electrical material, $2,253.

Hull.—42 cases electrical material, $160.

Havre.—339 cases electrical material, $11,582.

Liverpool.—224 cases electrical material, $10,157.

London.—58 cases electrical material, $2,099.

Manchester.—13 cases electrical machinery, $3,900.

Nova Scotia.—2 cases electrical material, $48.

Odessa.—5 cases electrical material, $525.

Peru.—104 cases electrical material, $1,849.

Stettin.—64 cases electrical machinery, $13,241.

St. Helen's.—191 cases electrical material, $2,500.

U. S. Colombia.—35 cases electrical material, $541.

Venezuela.—52 cases electrical material, $109.

NEW INCORPORATIONS.

Willimantic, Ct.—The Willimantic Gas and Electric Light Company filed a certificate of organization.

Wilmington, Del.—The Electrical Development Company, of Wilmington, to deal in electrical and other vehicles, has been incorporated at Dover. Capital, $200,000

Camden, N. J.—The Electro Chemical and Heat Company, of Camden, has been incorporated to deal in electrical and chemical apparatus. Capital, $1,000,000; incorporators: F. C. Dowd, J. L. Gethins, P. A. Dowd.

Washington, Ind.—The Washington Light and Water Company, of Washington, has been chartered to construct and operate water-works and electric-light plant. Capital, $21,000; incorporators: R. A. Brown, A. J. Padgett, H. M. Geiger, W. F. Burke, all of Washington.

Wilkesbarre, Pa.—Liddon Flick and several Scranton capitalists have organized the Northampton County Electric Company and Consumers' Gas Company, of Northampton County, at Easton, and will apply for a charter.

Niagara Falls, N. Y.—The Electric Power Land Company, of Niagara Falls, has been chartered with a capital of $1,000. Directors: Frank H. Manney, of Niagara Falls, and Irwin N. Gray and William H. Ashcroft, of Binghamton.

New York City.—The Royal Furnace Improvement Company, of New York City, with a capital of $50,000, has been incorporated. Directors: Alexander Bernheimer, Benjamin Gomprecht, Joseph Oppenheimer, Jacob Samack and Walter Wolf, of New York city.

Puerto Principe, Cuba.—The Puerto Principe Electric Company has been chartered in New Jersey to furnish electric lights in Puerto Principe. Capital, $200,000; the incorporators are Israel L. Kelsey, Robert A. Belancourt, Winthrop C. Bushnell, Samuel Moorehouse, all of Jersey City.

Tom's River, N. J.—The Tom's River & Island Heights Electric Light and Power Company, of Tom's River, has been incorporated for electric lighting. Capital, $20,000; incorporators: S. R. Applegate, C. A. Holmes, M. Buley, E. E. E. Snider, A. Brant, C. Folkinburgh, C. H. Holman, J. Imlay, A. Ernst, A. Birdsall.

Trenton, N. J.—The Woven Steel Hose and Cable Company was incorporated recently in Trenton. The capital stock of the company is $100,000, of which $1,000 is paid in. It will manufacture sheathing for wire, cables and electrical conductors.

New York City.—The River District Light, Heat and Power Company, of New York city, has been organized. Capital, $50,000. Incorporators: J. Douglass, of Hudson Park; C. H. Dodge, of Riverdale; E. M. Johnson, W. H. Yale, J. J. McKelvey, all of Spuyten Duyvil.

Los Angeles, Cal.—The United Electric, Gas and Power Company has been incorporated with a capital stock of $650,000. The directors are H. V. Carter, Frederick H. Rindge, Alfred Stedman, George I. Cochran, and J. J. Davis.

Denver, Col.—The Electrical Supply and Construction Company, of Denver, with a capital of $10,000, has been incorporated with William Sayre, J. Fisher, C. W. Armstrong and D. Vance Sickman, incorporators, to engage in the manufacture, construction, buying and selling of electrical apparatus and fixtures.

Wildwood, Pa.—The Borough Council of Wildwood has granted the franchise for a new electric light plant, The incorporators of the new company are Henry H. Ottens, George Moffett and Dr. E. W. Fleming, of Philadelphia. The capital stock of the new company is $50,000, with a paid-up capital of $25,000.

TELEPHONE CALLS.

Dover, Del.—The Delaware Valley & Lake Huntington Telephone Company has been chartered to operate between various villages in Sullivan County. Capital, $2,000. Directors: James Cornwall, Cochocton; John Bennedum, Jr., and William F. Henry, Lake Huntington.

STREET RAILWAY NEWS.

Moorestown, Pa.—The Moorestown Traction Company has been organized with $100,000 capital to build a trolley line from Merchantville to Mt. Holly via Moorestown.

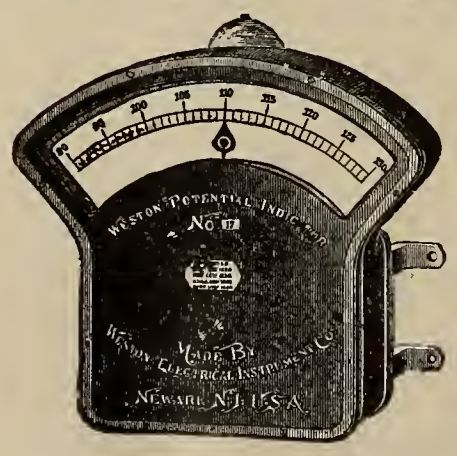
Columbus, Ohio.—The Columbus, London & Springfield Railway has been incorporated by John G. Webb, John M. Good, Hart F. Fisher, Emmet Tompkins and Fletcher S. Penfield, with a capital stock of $1,000,000. The company, besides operating a passenger and freight electric road, will have its own telegraph service, and will furnish electricity for power, light and heating to the towns along the route. It is intended to make the service equal to that of steam roads.

Lenox, Mass.—The articles of association of the Lenox Street Railway Company have been filed. The capital stock will be $11,250. The following are to act as a board of directors until others are chosen by the corporation: Charles Lanier and F. Augustus Schermerhorn, of New York city; William D. Curtis, Edward McDonald, William Mahanna, Isaac J. Newton and Murray A Brown, of Lenox.

Washington, D. C.—A bill to incorporate the Wesley Heights Railway Company of the District of Columbia was introduced in the Senate by Mr. Hansbrough and referred to the Committee on the District of Columbia. M. C. Butler, John T. Arms, Thomas E. Wagaman, Dr. Henry D. Fry and John F. Waggaman and their associates are named as incorporators of the railroad company.

WESTON STANDARD ILLUMINATED DIAL

STATION INSTRUMENTS.



THESE INSTRUMENTS are based upon the same general principle and are just as accurate as our regular Standard Portable Direct Current Voltmeters and Ammeters, but are much larger, and the working parts are inclosed in a neatly designed dust-proof cast-iron case, which effectively shields the instruments from disturbing influences of external magnetic fields.

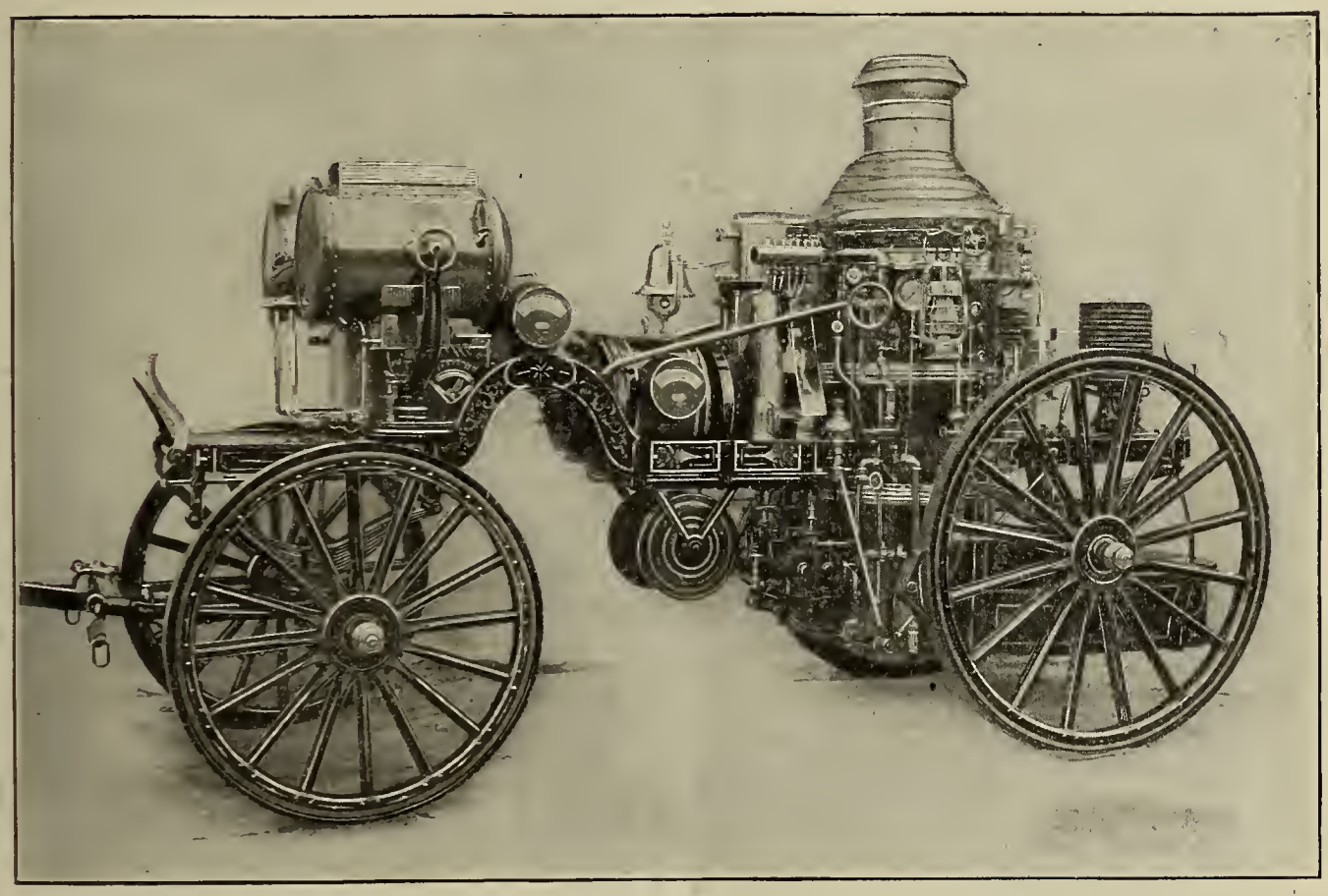
WESTON ELECTRICAL INSTRUMENT CO.

114-120 William St., Newark, N. J., U. S. A.

The Electrical Age.

Vol. XXV—No 11. NEW YORK, MARCH 17, 1900. Whole No. 670.

Novel Applications of Electric Lighting.

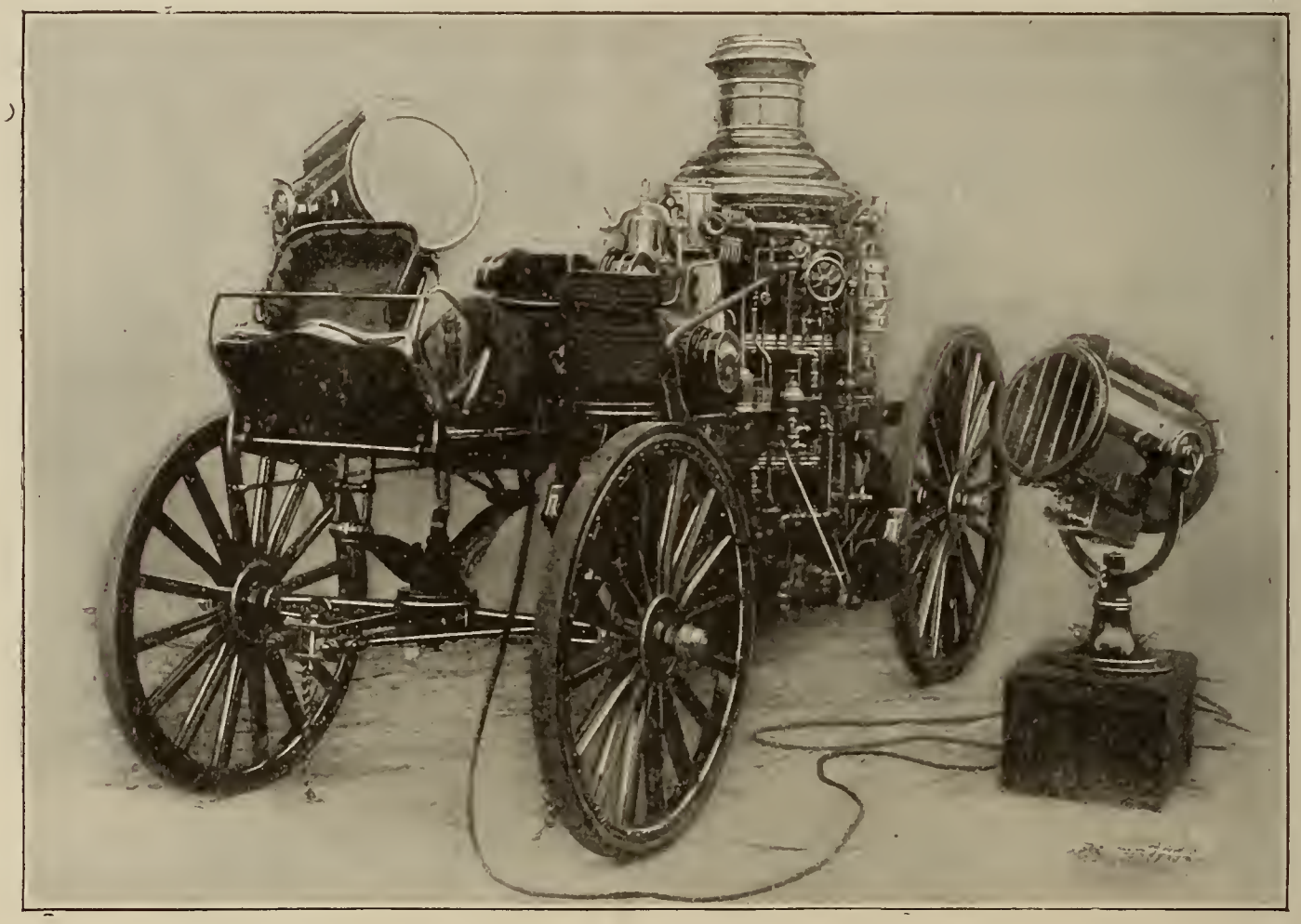


Searchlight Fire Engine.

THE FIRE DEPARTMENT SEARCHLIGHT AT WORK.

Illustrations are shown herewith of the portable searchlight used by the Fire Department of this city. It is equally serviceable when the smoke is very dense, as it penetrates the smoke very easily and is of much greater help to the firemen than even acetylene lanterns or those in which stored electricity is employed. At present only one of these searchlights is in use in this city's Fire Department, and forms part of the equipment of engine company No. 20, whose quarters are in Marion street, Manhattan, in the very heart of the dry goods district. The apparatus, which was built by the La France Fire Engine company, of Elmira, N. Y., has an upright, tubular boiler, which drives a Forbes upright engine with five by five cylinders, capable of making 600 revolutions a minute, with a pressure of 100 pounds. It has besides an independent Blake duplex feed-pump and a ten-gallon feed-tank. In direct connection with the engine is a Bullock ironclad multipolar, marine type generator, furnishing a current at a pressure of eighty volts. Thirty-five amperes of current are required for each light. The motion is rendered regular by a flywheel fixed between the engine and the generator. The two searchlights ,which are carried on the sides of the driver's seat, are of the Rushmore marine pattern, and are of 6,000 candle power each—the diameter of the barrels being eighteen inches. They can be turned to any angle, and the proper means have been provided for taking up the vibration. Each light, or both, if necessary, can be taken off the pins by which they are made fast at the front of the apparatus, and fixed on portable standards carried, along with the cables, at the rear of the boilers, where is also carried an extra projector-base, and on the spindle of each base a reel, on which is wound 200 feet of twin conducting mining machine cable—the connections being so arranged that there can be no confusion as to positive and negative. For one searchlight are provided lenses throwing a square

beam of light on the face of the building, while the other is an ordinary perfecting searchlight, whose rays may be rendered convergent or divergent at will—the light being controlled by block switches and rheostat placed behind the driver's seat. To render the apparatus complete in every way, Weston ammeters and voltmeters are provided, by means of which the electrician can obtain readings at any moment when the current is being generated. For use in fires on shipboard, these lights will be found most serviceable, as the apparatus may be run out on a pier, whence the light may be projected into the hold while the firemen are operating therein. In cellars, dark airshafts and halls also they will be of great assistance to the firemen when looking for bodies, though for the latter purpose smaller incandescent lights will probably be provided in course of time.



Searchlight Fire Engine With Several Lights Ready for Action.

Meanwhile the searchlight has again proved its efficiency—this time at a fire which broke out recently in the Hamberger building, 94-98 Mott street, Manhattan. When the special engine and searchlight arrived, the entire six-story brick building was enveloped in a dense smoke arising from excelsior and upholstery materials in process of combustion; but, as soon as the powerful lights were turned upon it, the firemen had all the illumination they needed. The light penetrated the smoke, and the men on the upper floors moved about as safely as in the daylight.

G .Stowe, the American Consul-General at Capetown, Cape Colony, states that tenders for bridge work, electrical and railway material and machinery are now open for bids. According to advices received from South Africa the close of the war will mean the inauguration of a very heavy demand for all kinds of electrical apparatus, mining machinery, etc.

Miscellaneous.

COPPER RESOURCES OF THE UNITED STATES.*

HENDERSON GILBERT.

The production of copper in the United States has grown to such proportions that we now turn out 65 per cent. of the world's copper instead of the 10 per cent .of fifty years ago.

Geographically speaking, the copper mines of this country in general may be divided into four sections. First ,those along the Appalachian chain of mountains, extending from above Maine to the Gulf of Mexico and embracing numerous branches from the East and West. Second, the Lake Region, principally on the shores of Lake Michigan. Third, the Rocky Mountain mines, which are subdivided into the Southern Arizona, Northern Montana, Colorado and Utah mines. Fourth, the California mines. Besides this, of course, there are other copper fields deposited in different parts of the country outside of the immediate sections mentioned above.

We first hear of mining operations in this country in the Appalachian section, in Connecticut, New Jersey and Pennsylvania, where small quantities of ore were mined and shipped in the crude state to England for refining in accordance with the trade laws in use before the Revolution. The first steam pumping equipment was erected at the Belleville copper mines in New Jersey in 1753. This is probably the first mention we have of

---

*From the "Yale Scientific Monthly."

working copper in any considerable quantity, but that copper existed in great bulk, which could be easily worked, was told us in the "Relations des Jesuites," as early as 1660.

Following the Revolution, mines were operated in nearly all the eastern, middle and southern states with varying success, the principal ones being in Vermont and Tennessee. The Ely mine in Vermont alone produced 3,000,000 lbs. in 1880, but since then has been closed up, although there are prospects of its being reopened in the near future. From 1846 until the breaking out of the Rebellion, the Ducktown Mines, Tennessee, were the largest producers on the continent, but these went under during the war and have never since been worked, From this it would seem to appear that copper interests in the eastern states had had their day, especially when we compare them with the enormous producers of the west, but experts say that in a short time these eastern mines will be reoperated on a very large scale and that much is expected from them.

The Southeastern copper mines contain large deposits of iron pyrites which hinder the reduction considerably, besides the ore is not of a high grade.

The Lake region was the next to receive the attention of the copper world. When this region was turned over to Great Britain by France, a company was organized in England to mine copper on the Ontonagon River under the supervision of Charles Townshend. Failing to find this copper, operations were begun in 1771 on Michipicoten Island, near the north shore, but these were a failure and work was stopped. A period of inactivity covering three-quarters of a century followed these early speculations, due, in some measure, to the unsettled ownership of Michigan, for it was not until 1796 that Great Britain ceded this territory to us, and it was not admitted as a State until 1837. In the meantime Dr. Houghton had prepared a scientific account of the famous Keweenaw series of copper bearing rocks, and in 1844 the first successful and extensive mines, the Cliff and Minnesota, were opened.

The Keweenaw series consist of beds of trap sandstone and conglomerate which rise at an angle of 45 degrees from a horizontal bed of sandstone. This series extends through Michigan into Wisconsin and Minnesota and across Lake Superior, but has been profitably worked only in Michigan. The copper occurs chiefly in the metallic state, although sulphurets are sometimes found in Minnesota. There are three classes of deposits which have been worked in the Keweenaw series. First—Mass copper, where the metal occurs in bulk. The only successful mass mine which has been worked in recent years is the Central, although most of the pioneer mines were of this type—such as the Cliff, Minnesota, Copper Falls, etc. One of the largest masses taken from the Central was one of 600 tons, to which was attached by metallic feeders 600 tons more, making 1,200 tons in one mass. This, of course, is most unusual ,and occurs only near the top, the masses growing smaller and fewer the deeper a mine is driven; consequently mass mines have never been large producers. Second—The beds of amygdaloibal diabese or ash beds appear in richer quantities around Portage Lake where there are many extensive mines. The ore found in these beds consists of small masses of copper mixed in with the sandstone trap and contains anywhere from 2 per cent. to 75 per cent. metallic copper.

When the Copper Falls Co. failed to meet with success in mass mining it turned its attention to the amygdaloidal trap and was so successful that a large number of companies followed its example and many new ones were formed, some of which are very large producers to-day. For instance, the Quincy, incorporated in 1865, has a yearly output of about 12,000,000 pounds, and the Atlantic of the same date is also a large producer.

Third—The beds of conglomerate of which the cementing material consists partly of copper. The mines in these beds are the heavy producers. As in the case of the Copper Falls Co. and the amygdaloidal trap, these conglomerate fields were opened first by a company (The Boston & Albany), which had been disappointed by its former yields and has turned its attention to the new beds. Immediately other companies were attracted, foremost among which are the Calumet and Hecla, the Tamarack and the Osceola. The first two of these have yields of only about 3 1-4 per cent. and 2 1-2 per cent. metallic copper respectively which is probably due to the great quantity of unselected rock turned into the stamping mills. The Calumet and Hecla has the finest plant of any metalliferous mine in the world, and as its supply of copper will last thirty years at twice the present rate of production, it will be readily seen that this plant alone will keep up the high average yield of the Lake regions in spite of the growth of the western producers.

(To be concluded.)

Electric Railways.

NOTES ON ELECTRIC TRACTION UNDER STEAM RAILWAY CONDITIONS.

By Edward C. Boynton.

(Continued from page 76.)

The Question of Equipment.

The questions, how much will it cost to equip a given service to be operated by electricity?—and how much will it cost to operate it? are frequently asked. The electrical engineer is now in a position to answer both these questions with great accuracy. The experimental stage has passed, and sufficient data is at hand to give all the information needed. It must be realized that the operation of a steam railway by electric power introduces many conditions which do not exist in the transportation problem within a great city, such as are operated by the elevated or surface street railroads. There are no restrictions on speed or weight of trains. Rapid acceleration is not of so much importance, for the stops are much farther apart. The trains must be operated under steam rules absolutely, and the whole equipment must comply with the laws relating to steam railway trains. The railway company contemplating the equipment of a part of its system with electric power has the choice of several methods which should be closely studied to determine which is best suited for the service it is proposed to operate.

These methods are:

First: The purchase of electric locomotives of sufficient power and weight to haul its standard passenger coaches.

Second: The equipment of a number of its standard coaches as motor cars.

Third: The purchase or building of a sufficient number of special light passenger coaches, some of which are equipped as motor cars, and the withdrawal of its standard coaches entirely from this service.

Fourth: Shall freight be hauled by electricity or steam?

The use of electric locomotives for the purpose under consideration depends upon several conditions. If the travel is heavy, that is 2,000,000 passengers per year and upward, the service frequent, the speed high, requiring an average train of four cars, and, as may be the case, the same coaches must go much farther than the electric service extends, hauled by steam, it is advisable to use

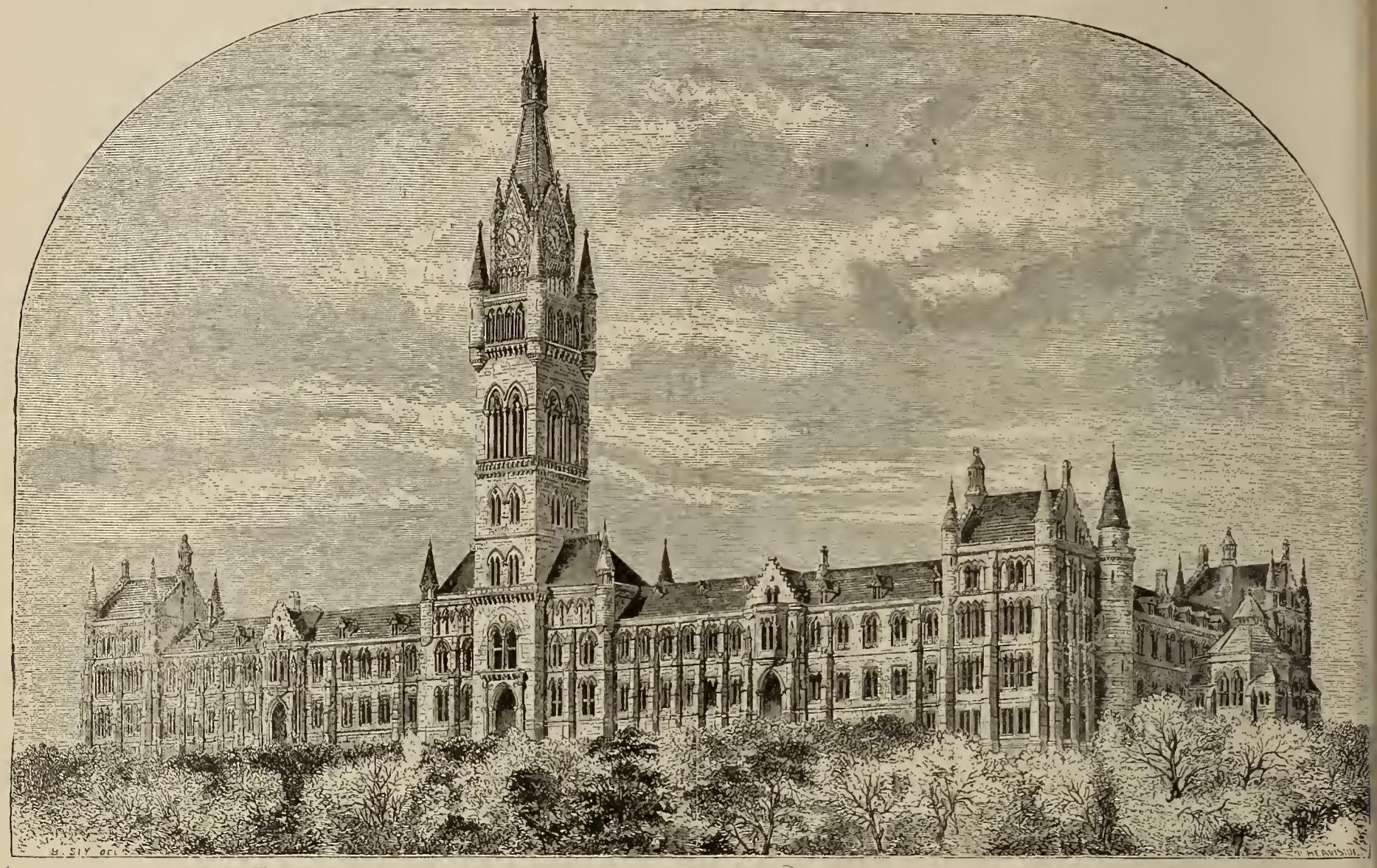
the electric locomotives hauling standard coaches. Their principal advantages lies in their ability to perform the work of a steam locomotive in every respect, and this is frequently a strong point in their favor with the railway managers. They are thus able to accommodate themselves to congested traffic which usually occurs on holidays and possibly at certain times every day, by simply increasing the number of coaches hauled as is the practice with steam locomotives. Such locomotives should weigh from 100,000 to 150,000 pounds, should have eight wheels and four motors, so that the total weight is available for traction. They must be provided with sufficient power to haul at least double the average train without over-heating. They must not only be able to perform the work of a steam locomotive in the same service, but should do it at a faster schedule speed. The rapid acceleration of a train hauled by such a locomotive enables it to perform the above duty without any increase in the maximum speed. In switching cars, the ease and rapidity with which the electric motor can be handled is a great advantage.

It is necessary to equip these electric locomotives with the best automatic brake system that can be obtained, for several reasons. They must operate the existing brake system on the coaches as well as the steam locomotive does. The law requires automatic brakes and a whistle. An independent motor compressor with a large main reservoir is therefore almost imperative.

The cost of repairs on an electric locomotive should be exceedingly low, possibly 10 per cent. of that required by a steam locomotive on account of the fewer moving parts and the entire absence of the boiler and its necessary equipment.

The fact that an electric locomotive requires but one set of controlling and air braking apparatus is a distinct advantage over other methods of employing electric motive power. This is evident, not only in the first cost but in the fewer parts to be cared for.

(To be concluded.)



University of Glasgow.

Educational.

GLASGOW UNIVERSITY.

The scene of the labors of Lord Kelvin, familiar to all interested travelers, is Glasgow University. As a man of genius little doubt will ever be entertained regarding him. Within the institution represented on these pages many of the greatest efforts of Kelvin's life were made. The boy, William Thomson, entered Glasgow University when eleven years old, and thirty-nine years later the following paragraph appeared in a well known electrical journal: "William Thomson, LL.D., D.C.L., F.R.S., the most distinguished of English electricians, about to complete his fiftieth year as professor of Natural Philosophy in the University of Glasgow, Scotland. One who helped to lay the first Atlantic cable and through whose efforts it proved to be a success. A man unequealed for the extent of his theoretical knowledge and whose practical inventions have made him unique as a genius of unlimited and even-handed power. Made Baronet and Lord for his great services to England."

Glasgow University is a famous institution, known to all the civilized world to-day through its connection with the illustrious scientist, Kelvin. A brief review of the work of Kelvin done within the university walls may pos-

The Electrical Age.

ESTABLISHED 1883.

Entered at New York P. O. as second-class matter, January 18, 1891.

THE ELECTRICAL AGE PUBLISHING CO., Publishers.

TERMS OF SUBSCRIPTION:

One Copy, one Year, - - - - - - - - - $2.50
One Copy, six months, - - - - - - - - 1.25
Great Britain and other Countries, - - - - 3.50

Cable Address (all Cables), "Electage," New York.

NEWTON HARRISON, E. E., EDITOR.

ASSOCIATE EDITORS:

ALFRED E. WIENER, E. E., OSBORNE P. LOOMIS, E. E., } ELECTRIC LIGHT AND POWER.
JOSEPH MUIR, M. D., FREDERICK STRANGE KOLLE, M. D., } ELECTRO-THERAPEUTICS.

ADDRESS ALL COMMUNICATIONS TO
THE ELECTRICAL AGE PUBLISHING COMPANY,
Seventh Floor, World Building,
NEW YORK.

NEW YORK, MARCH 17, 1900.

CONTENTS:

THEORY OF ELECTROLYSIS.

The labors of Van t'Hoff and the investigations of Clausius and Grotthues in electrolysis have led to the conclusion that this phenomenon is merely an exhibition of infinitesimal bodies, individually charged, reacting upon each other in obeyance to laws. According to this theory the transportation of electricity is accompanied by a transposition of matter, as electrolytic conduction of electricity is similar to the convection of heat in liquids. A brief resume of the situation is given below. The molecules of an ordinary solution are supposed to be in constant vibration in all possible directions. Owing to collisions between the molecules, or other causes, the constituent atoms are constantly leaving their partners and combining with others to form new molecules. Every molecule, whatever be its nature, is charged with the same quantity of electricity, half positive and half negative. The positive resides on one ion of the molecule and the negative on the other. Now upon subjecting the solution to a difference of potential between the electrodes the direction of the molecular motion is controlled and ions which by chance are isolated will tend to move towards one or the other electrode, according to their charge. If the electro-motive force is large enough to prevent recombination of these ions they will continue their movement towards the electrode and will accumulate around them. Upon touching the electrode they impart to them their minute charges, and the continuous accumulation of these maintains a current in the circuit. The remarkable connection between the results of the quantitative work of Faraday and the chemical equivalents of the elements points to electrolysis as a fertile field for the investigation of the yet unknown nature of chemical affinity.

THE BACK ELECTRO-MOTIVE FORCE OF AN ARC.

Since the first experiments of Sir Humphrey Davy the electric arc has been the cause of many discussions relating to the existence of its back electro-motive force. It has been compared by some investigators to an electrolytic process in which the electrodes are the two carbons and the electrolyte the incandescent vapor passing between them. On the other hand, it has been regarded as merely a phenomenon distinct from others of an electrical character and therefore sufficiently isolated from them to demand original investigation. The existence of a back electro-motive force in the electric arc has been proven, but the cause of its existence still remains in part undiscoverable. Does the heat cause so great a difference of potential between the electrodes or is a difference of potential the inevitable accompaniment of all similar phenomena? When matter rises to a state of high incandescence and its particles are affected by a form of energy differing from all others it can only be expected that these new conditions will produce a unique, if not a totally unaccountable, result. The electric arc has been the seat of many strange phenomena. It represents at present the basis and means by which several large and prospering industries have reached a state of commercial efficiency. It has produced metals whose form, appearance and qualities were hidden in a mixture of foreign constituents; carbide of calcium, carborundum and aluminum, for instance. It is therefore a measure which commercial conditions demand to examine into reasons for some of the effects the arc has brought into existence.

The lighting industry is passing through a transformation which speaks well for those who look forward to the universal employment of electricity as an illuminating agent. The arc light, whatever may be its form or type of mechanism actuating it, is a cheap source of illumination. It has been rendered particularly so in the last few years by the introduction of the closed globe arc lamp. In this lamp an increase in the life of the carbons has added a feature which created a stronger demand than ever for this type of light. In addition, it interested manufacturers and inventors sufficiently to lead to the redesign of the larger and heavier street lamp so as to suit it for indoor illumination. The original arc lamp, weighing from forty to sixty pounds, has passed through stages of evolution in the near past which reduced its weight and increased its light-giving capacity. The present lamp weighs less than fifteen pounds and is adapted in every way to the purposes of indoor lighting. In addition it needs little of that care and attention at one time indispensable, and the carbon renewals occur but once or twice a month. The art has gone still further, developing along unexpected lines. Smaller types of the arch light have been built of less candle power, fined mechanism, smaller carbons and less power consumption. Arc lamps may now be procured that are attached as readily to a fixture or socket as a fan motor and take but little more current. Miniature arc lamps ,adapted to practical purposes, are in use to-day, consuming the current of less than half a dozen incandecscent lamps and giving from three to five hundred candle power. Such lamps are adapted to the lighting of homes, and their extraordinary brilliancy and cheapness as a source of illumination remove forever all doubts regarding the systematic and proper development of the arc lamp within as well as without.

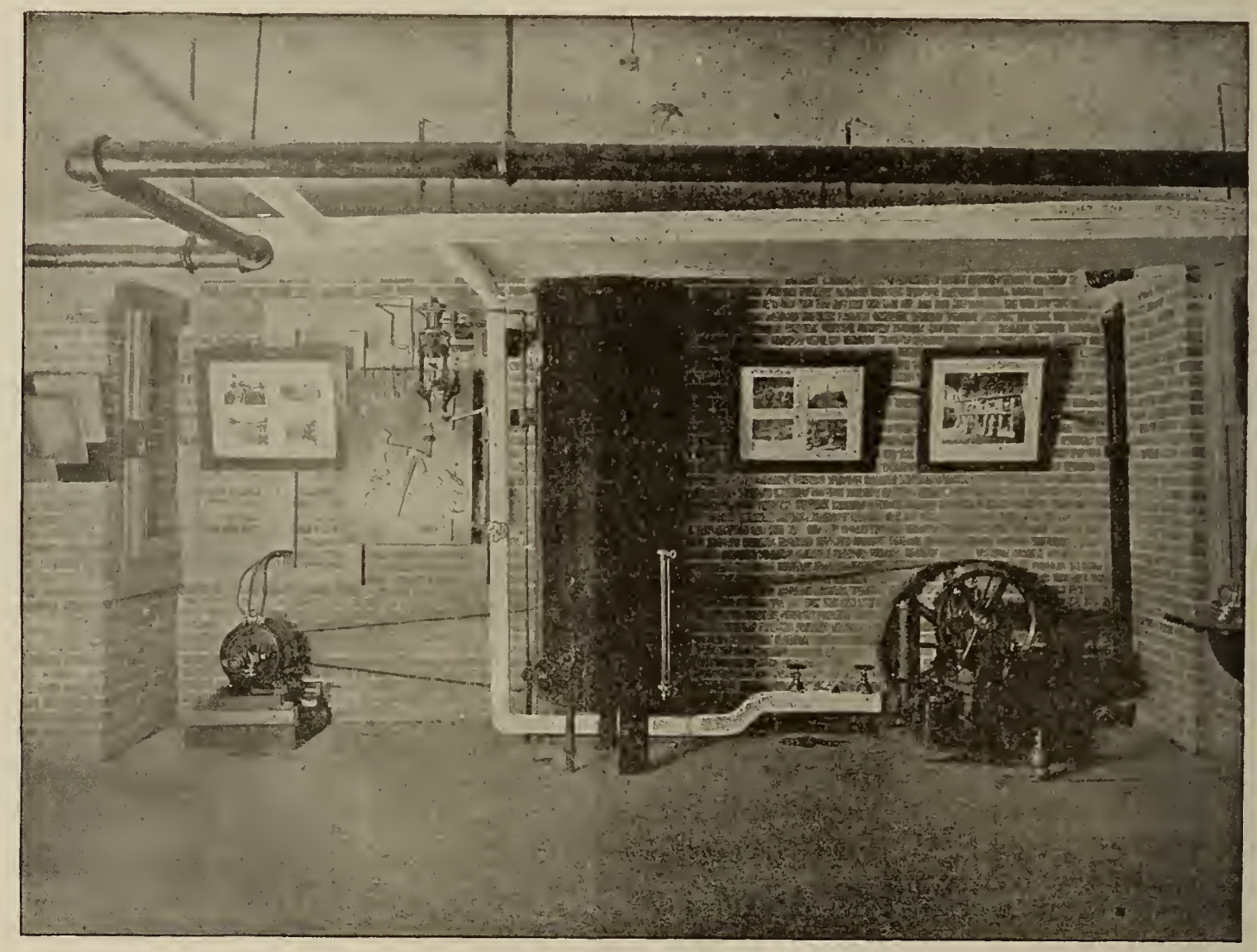
sess deep interest for many. In 1845 elected second wrangler to Cambridge; made a fellow of St. Peter's College. When eighteen years of age preparing an article on the "Uniform Motion of Heat in Homogeneous Solid Bodies and its Connection with the Mathematical Theory of Electricity." At twenty-two professor of natural philosophy in Glasgow University. Author of the article on the "Mathematical Theory of Electricity in Equilibrium," also the "Elementary Laws of Static Electricity." Editor of the Cambridge and Dublin "Mathematical Journal." In 1848 writer of a paper on the "Distribution of Electricity on Spherical Conductors," at that period inventing the electrometer. In 1858 laying the first trans-atlantic cable. In 1862 winning the chief prize given by the Royal Society of Edinborough. Author of the paper on the "Mechanical Energy of the Solar System." Also an article entitled, "On a Universal Tendency to the Dissipation of Mechanical Energy.' Sir David Brewster, speaking of the then Sir William Thomson's work, states: "These papers evince a genius which has not been surpassed, if equaled, by that of any living philosopher." Inventor of the mirror galvanometer prior to 1863. Inventor of the siphon recorder in 1866, receiving the title of D.C.L. and LL.D. from Cambride. These various intellectual medallions could not add lustre to the man's name but by making him greater brought into more immediate prominence the university at which he lectured, attendance in wihch hall was considered as great an honor as England could offer. Glasgow University will forever remain an institution associated with the work of Lord Kelvin and the successor to this great genius is a man of acknowledged capability.

SOME DATA ON ELECTRIC PUMPS.

Electric pumps meet with general application in many mining propositions as well as in those cases where their installation is desirable for purposes almost domestic in character, as in our large cities. Difficulties in mining particularly are increased by the presence of water. Some very valuable mining properties are useless at present through the drainage that occurs into them from the surrounding district. As a general rule, particularly in the West, fuel is not abundant in the neighborhood of mines, and it is therefore evident that water power must be utilized even though it be miles away. It can only be transmitted conveniently and cheaply in the shape of electricity, and as far as pumping is concerned motors will be required to drive all apparatus performing that function.

One cubic foot of fresh water weighs 1,000 ounces, or 62 1-2 pounds. One cubic foot contains 7 1-2 gallons; each gallon weighs 8.33 pounds. A column of water one foot high and one square inch in cross section weighs .434 pounds. Calling the height to which water is to be lifted H and the pressure in pounds per square inch P we have the formula P equals .434 times H, or H equals 2.3 times P. If the number of gallons per minute to be pumped is called G we have the following formula for horse power: HP equals G times H times 8.33 divided by 33,000. Allowing for water friction, loss in gearing, etc., 34 per cent., giving an efficiency of 66 per cent., we have the following for the horse power of the motor required: Horse power of motor is equal to G times H divided by 2,600.

To illustrate the application of this formula let us propose to lift 24,000 gallons of water per hour a distance of



Electric Pump for Domestic Purposes.

650 feet. Applying the formula 24,000 gallons per hour is 24,000 divided by 60, equals 400 gallons per minute. The horse power of motor required equals 400 times 650 divided by 2,600, equal to 100 horse power. Other cases may arise wherein the pumping is done against a pressure in tanks, as, for instance, in elevator work, in which case we substitute P for H in our formula, giving us horse power equal to G times 8.33 times 2.3 times P divided by 33,000 or horse power equals G times P divided by 1722. Making allowance for losses due to friction, etc., in connection with the formula G times H divided by 2,600, and substituting 2.3 times P for H, we get horse power of motor equal to G times P divided by 2,600 or horse power of motor equals G times P divided by 1130. Applying this formula to a specific case we obtain the following: Horse power of motor required to deliver 300 gallons of water per minute into a closed tank against 100 pounds pressure; horse power of motor equals 300 times 100 divided by 1130, equals 26.5 horse power. Where a hydraulic elevator is installed a motor supplied

James H. Mason.

with current from the street service will be quite sufficient to perform the work required. In this case neither motor nor pump will need attention, nor does the same risk exist of water pressure diminishing, due to low boiler pressure. Accidents from this cause have been more common than those due to the careless handling of the elevator itself.

Biographical.

JAMES H. MASON.

James H. Mason, the author of "Electric Light Home From Battery Power," and founder of the American Oddity Company, has been known to members of the electrical profession for the last fifteen years. Much of the enterprise and development of the present trade in small motors, dry batteries and acid batteries is due to his efforts. He is probably one of the best known experts on the primary battery in the United States. We are pleased to reintroduce him to our readers, many of whom are well informed regarding his interesting work in the past and present. The American Oddity Company, of which he is manager and founder, has grown to very large proportions and the motors and battery outfits manufactured by them have been received by the trade with undiminished satisfaction. Mr. Mason is a comparatively young man but characteristically energetic and in every way adapted to the commercial and scientific pursuits he has succeeded in so well. The American Oddity Company has recently moved to 170-172 West Broadway, New York City, owing to the rapid increase of business and the installation of new machinery.

Patents.

WEEKLY ELECTRICAL PATENT RECORD.

PATENTS ISSUED MARCH 6, 1900.

Conducted by Otto Greenberg. Complete descriptions and drawings of any patent mentioned below will be sent on receipt of ten cents.

644,562 and 644,563. Electric Arc Lamp. Thos. E. Adams, Cleveland, Ohio.

644,565. Transformer. Engelbert Arnold, Carlsruhe, Germany.—A transformer of rotating currents having three iron cores connected by a yoke in three sections, the ends of two sections of the yoke being magnetically connected to each core, and two cores being connected by each section.

644,594. Telephone System. Joshua Gore, Chapel Hill, N. C.

644,639. Electric Railway-Signal. Judson Shoecraft, Topeka, Kan.

644,646. Insulator for Electric R. R. James and William Thomas, Catasauqua, Pa.

644,647. Selective Signal for Telephone-Circuits. George K. Thompson and Ernest Robes, Mass.

644,652. Telephone-Transmitter. Joseph M. Wilderman and Enoch A. Nelson, St. Charles, Mo.

644,653. Coin-actuated Telephones. Arthur Wines, Chicago .

644,658. Electric Cigar-lighter. Chas. B. Abbott, Cleveland.

644,666. Controller for Electric Motors. Maxwell W. Say, Schenectady, N. Y.

644,671. Electric Motor-car. Chas . M. Johnson, New York.

644,680. Guard for Telephone Mouthpieces. Lillian B .Ordway, San Francisco, Cal.

644,684. Dynamo Electric Machine. Henry G. Reist, Schenectady, N. Y.

644,714. Telegraph-sounder. Samuel Lively, Alderson, W. Va.

644,745. Electric Switch. Norman Marshall, Newton, Mass.

644,783, 644,784 and 644,785. Electric Glow-lamp. John Van Vleck, New York.

644,790. R. R. Signaling System. Henry Bezer, New Rochelle, N. Y .

644,816. Electric Arc Lamp. Wm. Davy, London, England.

644,823. Electric Lamp for Bicycles. Gustavos Heidel, St. Louis, Mo.

644,844. Electric Switchboard. M. T. Bunnel, N. Y.

644,852. Electric Pump. Carl Eickemeyer, Yonkers, N .Y.

644,859. Electric Measuring Instrument. Adrian H. Hoyt, Penacook, N. H.

644,860. Electric Gas-lighter. Conrad Hubert, N. Y. This is a portable device consisting of a battery, an electric lamp, electric igniter and a cock-turner.

644,864. Electromotive Force Regulation. Benjamin G. Samme, Pittsburg, Pa.

644,865. System of Electric Distribution. Same inventor.

644,868. Telephone Signal-circuit. Dana McNeil, Chadron, Nebr.

644,878. Automatic Circuit-breaker. David W. Stinson, St. Louis, Mo.

644,917. Electrical Measuring Instrument. Adrian H. Hoyt, Penacook, N. H.

644,962. Electric Arc Lamp. Edward M. Barnes, Cleveland, Ohio.

644,972. Induction-coil for X-ray Apparatus. Reginald A. Fessenden, Allegheny, Pa.

644,995. Vacuum-tube Lighting. Daniel M. Moore, Newark, N .J.—An alternating-circuit generator in direct conductive or inductive connection with the tubes to be excited, is organized to produce an alternating impressed electromotive force of abruptly-changing value.

645,008, 645,009, 645,011, 645,012, 645,013 and 645,014. System of Electrical Distribution. Warren B. Reed and Lyman C .Reed, New Orleans, La.

645,010. Electrical Circuit Breaker. Same inventors.

645,015. Electric R. R. Same inventors.

645,021. Underground Electric R .R. George W. Smith, Dallas, Tex.

645,041. Vacuum-tube Lighting. Daniel M. Moore, Newark, N. J.

Business News.

SPECIAL EXPORT COLUMN.

TOTAL AMOUNT OF ELECTRICAL EXPORTS FROM NEW YORK CITY FOR WEEK ENDING MARCH 10, 1900, $63,016.

New York, Mar. 10, 1900:—The following were the exports of electrical material, from the port of New York, for the week just ended:

Havre:—328 cases electrical material, $9,229; 4 cases electros, $50.

Hamburg:—49 cases electrical material, $7,521 .

Genoa:—23 cases electrical material, $1,432; 10 cases electrical machinery, $665.

Glasgow:—4 cases electrical machinery, $190 .

Hull:—6 cases electrical material, $417.

Japan:—8 cases electrical material, $45; 4 cases electrical machinery, $135.

London:—126 cases electrical material, $4,748; 44 cases electrical machinery, $2,553; 12 cases electromotors, $1,046.

Liverpool:—23 cases electrical material, $902.

Marseilles:—34 cases electrical material, $2,755.

Antwerp:—2 cases electros, $30; 131 cases electrical material, 3,885; 17 cases electrical machinery. $1,960.

Barcelona:—4 cases electrical machinery, $22.

Aberdeen:—204 cases electrical material, $2,573.

British Possessions in Africa:—12 cases electrical material, $1,317.

Brazil:—22 cases electrical machinery, $2,937; 115 cases electrical goods, $5,508.

Bristol:—93 cases electrical material, $8,000.

British West Indies:—9 cases electrical material, $289.

Bremerhaven:—1 case electros, $30.

Central America:—47 cases electrical material, $1,820.

Chili:—222 cases electrical material, $2,401.

China:—34 cases electrical material, $556.

NEW INCORPORATIONS.

Cherawa, S .C.—The Ashworth Electrical Company, of Cherawa, capital, $100,000, has been chartered. Rhode Island capitalists are back of it.

New York.—Newton Electric Company, of New York city, capital, $1,000; directors: Dudley C. Newton, William J. Newton and Bernard J. Isicke, New York city.

New York City.—The Magnet Wire Company, of New York city, has been incorporated. Capital, $25,000; directors: R. F. Manning and J. De S. McGuire, New York city; Richard Varley, Jr., Jersey City.

Monticello, N .Y.—The Murray Electric Light and Power Company, of Monticello, has been chartered with a capital of $20,000; directors: Peter C. Murray, Delia Murray and Elmer S. Rockafeller, Monticello.

Syracuse, N. Y.—The United Gas and Electric Company, of Syracuse, has been incorporated with a capital of $4,000,000 to manufacture gas and electricity. The capital stock is divided into $1,000,000, preferred, and $3,000,000, common stock. The directors are L. Bedell Grant and John T. Kirk, of Brooklyn, and Ashley T. Cole, of New York city. The company takes over the business of the present Syracuse Electric Light and Syracuse Gas companies, and its operations will extend throughout Onondaga County.

STREET RAILWAY NEWS.

Dover, Del.—The Ohio River Electric Railway and Power Company, whose capital stock is estimated at $300,000, has filed articles of incorporation.

Mentor, Ohio.—The Cowle Transit Company, of Mentor, has been incorporated with a capital stock of $85,000. The incorporators are W .S. Manuel, N. B. Snavely, S. H. Holding, Frank S. Masten and B. Arp.

Huntington, Ind.—Promoters and capitalists interested in a new electric railway to be built between this city and Portland, Ind., have held a meeting and organized the Oil Belt Traction Company of Indiana. It will be incorporated with a capital of $10,000. The president is Z. T. Dungan.

Columbus, Ohio.—The Columbus Freight and Traction Company has been incorporated by W. D. Brickell, William D. Park, William D. Hamilton, Charles E. Morris and John W .Mooney. The capital stock is fixed at $25,000. The articles state that the purpose is to construct railway track in the city of Columbus to be operated by electricity or other power, to own real estate and erect buildings, to develop electricity for their own use and to sell to others.

TELEPHONE CALLS.

Wilmington, Del.—Gould Telephone Company, of Philadelphia, to manufacture and use telegraph, telephones and electric light products.

WESTON STANDARD

PORTALE DIRECT READING

VOLTMETERS AND WATTMETERS

For Alternating and Direct Current Circuits.

The only standard portable instrument of the type deserving this name.

Write for Circulars and Price Lists 8 and 9.

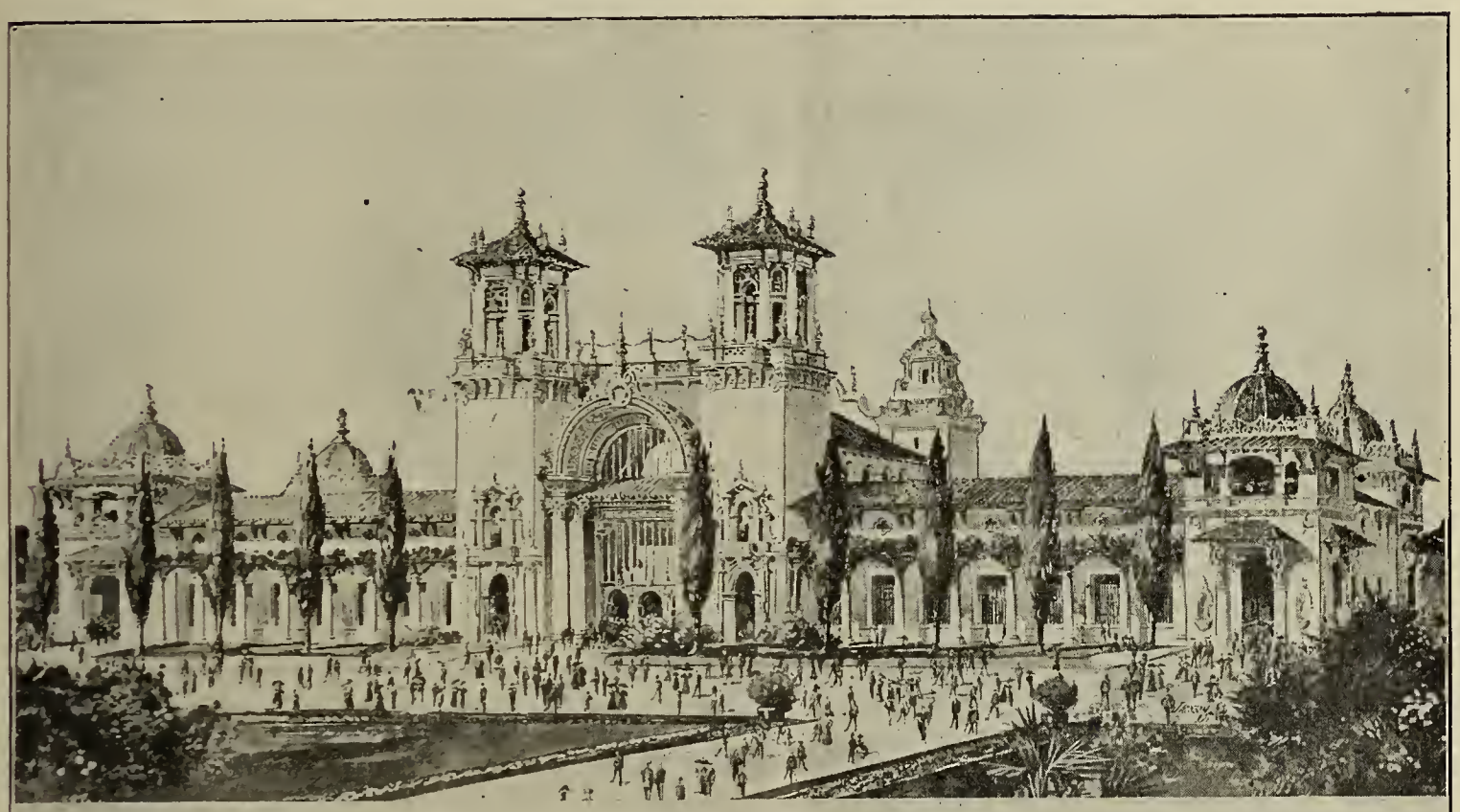
WESTON ELECTRICAL INSTRUMENT CO.,

114-120 William Street, Newark, N. J.

The Electrical Age.

Vol. XXV—No. 12. NEW YORK, MARCH 24, 1900. Whole No. 671.

Expositions.



ELECTRICAL EFFECTS AT THE PAN-AMERICAN EXPOSITION.

Elaborate designs have recently been completed for the Electricity Building for the Pan-American Exposition, to be held at Buffalo, N. Y., May 1st to October 31st, 1901. Displays of all kinds in the practical and artistic uses of electricity, together with complete exhibits of electrical machinery and appliances are to be conspicuous features of the great exposition.

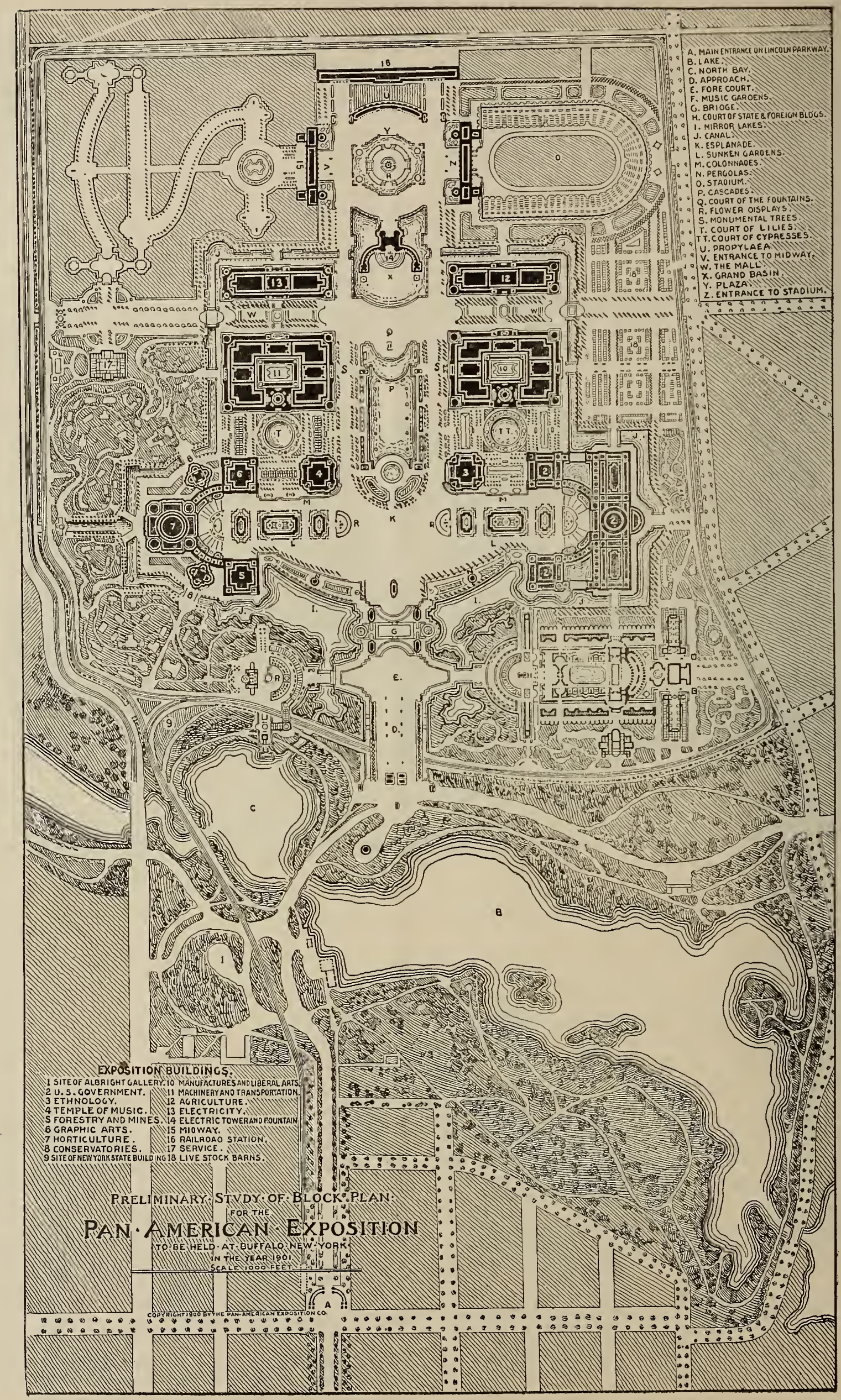
The designs contemplate a very handsome and commodious building. The structure is to be 500 feet from east to west and 150 feet wide, giving an exhibition space of 75,000 square feet.

The south facade fronts the Mall and the north fronts the Midway. The east end is toward the massive Electric Tower, while the west end faces the Grand Canal. The building is long, low and inviting. The design of the facades shows artistic grouping. The openings of the pergola-like loggias, placed at frequent intervals, present a delightful effect, showing more and more of the reveals of the pilasters and openings as the eye travels to the end of the building farthest away from the observer.

There is a pleasing ending at each corner of the building ,with a low-domed pavilion tower, and the building is interrupted at the center by the double-towered entrance. This entrance, wide and high, is spanned by an ornamental arch and supported each side by columns. The towers also have minor entrances through them.

The connecting work between the towers, the towers themselves, the pavilions at the corners of the buildings. and similar places, are to be brilliantly illuminated and made gay with banners and flags.

The modeled relief work of the building is of choicest design. The general ornamentation of the building is to be frescoes in an interesting mixture of reds, greens and yellows. The general color scheme follows that of the


A. MAIN ENTRANCE ON LINCOLN PARKWAY.
B. LAKE.
C. NORTH BAY.
D. APPROACH.
E. FORE COURT.
F. MUSIC GARDENS.
G. BRIDGE.
H. COURT OF STATE & FOREIGN BLDGS.
I. MIRROR LAKES.
J. CANAL.
K. ESPLANADE.
L. SUNKEN GARDENS.
M. COLONNADES.
N. PERGOLAS.
O. STADIUM.
P. CASCADES.
Q. COURT OF THE FOUNTAINS.
R. FLOWER DISPLAYS.
S. MONUMENTAL TREES.
T. COURT OF LILIES.
TT. COURT OF CYPRESSES.
U. PROPYLAEA.
V. ENTRANCE TO MIDWAY.
W. THE MALL.
X. GRAND BASIN.
Y. PLAZA.
Z. ENTRANCE TO STADIUM.
EXPOSITION BUILDINGS.
1 SITE OF ALBRIGHT GALLERY.
2 U. S. GOVERNMENT.
3 ETHNOLOGY.
4 TEMPLE OF MUSIC.
5 FORESTRY AND MINES.
6 GRAPHIC ARTS.
7 HORTICULTURE.
8 CONSERVATORIES.
9 SITE OF NEW YORK STATE BUILDING
10 MANUFACTURES AND LIBERAL ARTS.
11 MACHINERY AND TRANSPORTATION.
12 AGRICULTURE.
13 ELECTRICITY.
14 ELECTRIC TOWER AND FOUNTAIN
15 MIDWAY.
16 RAILROAD STATION.
17 SERVICE.
18 LIVE STOCK BARNS.
PRELIMINARY STUDY OF BLOCK PLAN
FOR THE
PAN-AMERICAN EXPOSITION
TO BE HELD AT BUFFALO NEW YORK
IN THE YEAR 1901
SCALE 1000 FEET
COPYRIGHT 1900 BY THE PAN-AMERICAN EXPOSITION CO.

Machinery and Transportation Building and other groups of buildings of the Exposition. The building was designed by Green & Wicks, of Buffalo.

The Court of the Fountains is to be the great centre-piece of the Exposition. Here the principal electrical displays are to take place. The Court is to be illuminated at night with the diffused light of more than 100,000 incandescent electric lamps, the distribution being so perfect that there will be no shadows. Colors will be extensively employed to produce fantastic effects. The huge steel tower, 350 feet high, which stands at the north end of the Court of the Fountains will be used in the production of extraordinary electric features. One of these will be an electric water-fall 30 feet wide and of 70 feet descent; from a niche in the tower. The tower itself is of imposing design and intricate workmanship. The many fountains in the great basin of the court will be made beautiful at night by means of electric lights of all colors.

The very extraordinary electrical features of the Exposition are made possible by the fact that electric power from the largest power plant in the world, at Niagara Falls, is to be provided in unlimited quantities. This power plant is only half an hour's ride from Buffalo, and is one of the great sights for visitors to the Exposition to include in their itinery.

Electric Railways.

NOTES ON ELECTRIC TRACTION UNDER STEAM RAILWAY CONDITIONS.

BY EDWARD C. BOYNTON.

(Continued from Page 84.)

The second method of applying electric motive power to an existing steam railway; the equipment of standard coaches as motor cars, will appeal to all steam railway managers as the cheapest and most convenient way to make the change. This method has strong arguments in its favor.

The motor car carries its own paying load and during the hours of light travel can be run light, without hauling other coaches. A standard coach equipped with two motor trucks and four motors will haul nearly as many coaches as the electric locomotive above mentioned and will weigh 100,000 lbs. It will easily handle five coaches, making a six car train weighing loaded 450,000 lbs. I believe that the power consumed per passenger carried in a train hauled by an electric locomotive will be less than if all the cars were motor cars, whether run singly or in one train.

Let us see exactly what must be done to a standard coach to equip it as a motor.

In most cases the conditions will be found to be such that three or four car trains with a proper schedule will be sufficient to take care of the maximum traffic. This necessitates only two motors for the coach. These should both be mounted on one truck, and this truck complete with motors will have to be purchased and used to replace one of the standard trucks. The motor truck should be built especially for the purpose, a heavy steel truck, 36 to 40-inch, steel tired wheels, brakes of the type that do not require brake beams, springs both elliptic, and equalizer of sufficient strength to support the weight of half the car body with maximum load, and this means all standing room occupied. The size and general design of the axle in the motor truck must be carefully considered. The author does not believe that steel axles 5 inches minimum diameter between wheels, are safe. It may be that in calculating their strength and considering the enormous strains which they must withstand, the result appears satisfactory, but experience shows that the excessive vibration at high speeds will cause crystallization of the steel and a high factor of safety must be employed.

The wheel journals should be at least 5 1-2 inches by 9 inches, and the diameter of axle between wheels 6 1-2 inches, with a larger diameter through the axle gear.

The wheel base cannot well be more than seven feet, on account of the curves, but it is nearly all needed in order to obtain room for motors of sufficient size. The motor should not be supported by the truck frame in any way.

Steel bars should be placed at each side of the motors extending from one axle to the other, and beneath them, just inside the wheels. These should be suspended from lugs on the motor frame by suitable links as near the center line of each axle as possible. The backs of the motors can then be carried on these bars by means of other lugs on the motor frame and springs above and below the lugs. This method of motor suspension is rapidly coming into general use, and it has many advantages. If motors should be damaged it is simply necessary to place another pair of wheels and axles with other motors in the same truck frame. The motor cars ride much easier, or practically the same as before they were equipped with motors, due to the fact that the jarring of the motors is not transmitted to the car body.

The motor car must be wired for, and furnished with a suitable number of electric lights and heaters, which is a simple matter. The same thing must be done for the coaches it is proposed to haul. The latter should also be equipped with collecting shoes connected by a wire which terminates at each end in an electric coupler of sufficient capacity to supply the motor on the motor car if necessary. The motor car is supplied with the regular air brake apparatus used by the road and piped as a steam locomotive, except that the car is double ended and requires an engineer's valve, gauge and other necessary parts at each end.

The independent motor air compressor, main auxiliary reservoirs, car wiring cables, main wires for collecting shoes, rheostats and electric couplers, all go under the car in addition to the standard equipment of a passenger coach.

A small cab should be provided at each end for the motorman, preferably inside the car, fitted with a front and side window which can be opened to their full extent. Here are located the air brake valves, the automatic governor and switch for the compressor, the motor controller, main switch, circuit breaker, electric light and heater switches. The bells or gongs, pilots and whistles at each end complete the list.

A few words about car wiring may be of interest here. The most careful work in wiring cars is very essential. The author believes that the causes of nearly all the fires occurring in motor cars can be traced to defective wiring. There is no reason why such wiring can not be made safe. Even if the insulation of wires and cables is of the best, they should be treated as bare wires, as the insurance underwriters say, and unskilled labor does not pay in this part of the work. The maze of iron pipes, rods and braces, under such cars, render it necessary to protect the wires from rubbing or chafing with the utmost care. It must not be taken for granted that the pipes, etc., remain in one position when the car is under headway. The working and straining of the car body, the swing of the trucks and brake rods and compression of springs must be carefully considered, and no care in protecting the wires however great can make them too safe. In trolley cars the removal of the pole from the wire will put out, or render a fire easy to control, but in such cars as are under discussion, I have not yet seen or heard of a method of cutting off the current at or near the contact shoes, though there may be such. It is evident therefore how helpless a train crew is when called upon to put

out a fire caused by a terrific arc under the car. It has been proved in practice that good car wiring practically prevents such accidents. Before leaving the equipment question, I will give some opinions on the performance of the motors.

(To be continued.)

Miscellaneous.

COPPER RESOURCES OF THE UNITED STATES.

BY HENDERSON GILBERT.

(Concluded from Page 83.)

Our largest amount of copper comes from the immense mines of Butte, Montana; from the Anaconda, Boston and Montana mines. The vein here consists of a granitic filling containing large masses of mineral and being thoroughly impregnated with dissembled particles. The bed is three miles in length, the whole of which distance is known to be productive and to contain masses from 50 to 60 feet in width. The ore in this State, as well as in Colorado, is rich in silver, varying from 2 ounces to 1-2 ounce per unite of copper, which can be procured as a by-product in refining, and which is almost clear profit.

Montana's rapid rise in production in her early days was remarkable. Mining in this State was begun simultaneously with the mining in Arizona, and in 1882 the latter produced 18,000,000 lbs. against 9,000,000 lbs. of the former. But in ten years these figures were considerably changed, Montana producing 114,000,000 lbs. to about 36,000,000 lbs. from Arizona. Most of this came from the Anaconda, Boston and Montana mines, which are run on a much grander scale than any of the other mines in the Sate.

Arizona is looked upon as the coming large producer especially from the Detroit, United Globe, Copper Queen and United Verde mines. The yields are rich but uncertain, and the ore of good quality for refining easily. The ores have been naturally oxidized, which has compensated for their great distance from fuel.

A table comparing the relative productions of these three States is given below:—

	1889.	1898-9.
Montana	43 per cent.	40 per cent.
Lake Region	35 per cent.	30 per cent.
Arizona	13 per cent.	20 per cent.

We notice that Arizona has risen 7 per cent., and that both Montana and the Lake Region have decreased. The falling off in Montana is due probably to the depression of Anaconda property; the grade of ore is lower at depths now reached. Also there is considerable waste in the somewhat imperfect methods of treatment used by this company. Michigan's decrease is owing to the failure of many of the smaller mining companies.

About 1864 California shipped large quantities of ore from Calaveras County, where mines were opened on lenticular masses of sulphureted ore embedded in slate, but in 1866 these mines were closed and remained so until recently. Last year most of California's copper came from the Montain Copper Company at Keswick. Utah' output amounted to 9,000,000 lbs. last year, most of which came from the Highland Boy mine. Colorado shows a gain in production, especially from the Routt and Montrose Company's mines. An unusual amount of gold and silver was found in the ores this year, making correspondingly large profits.

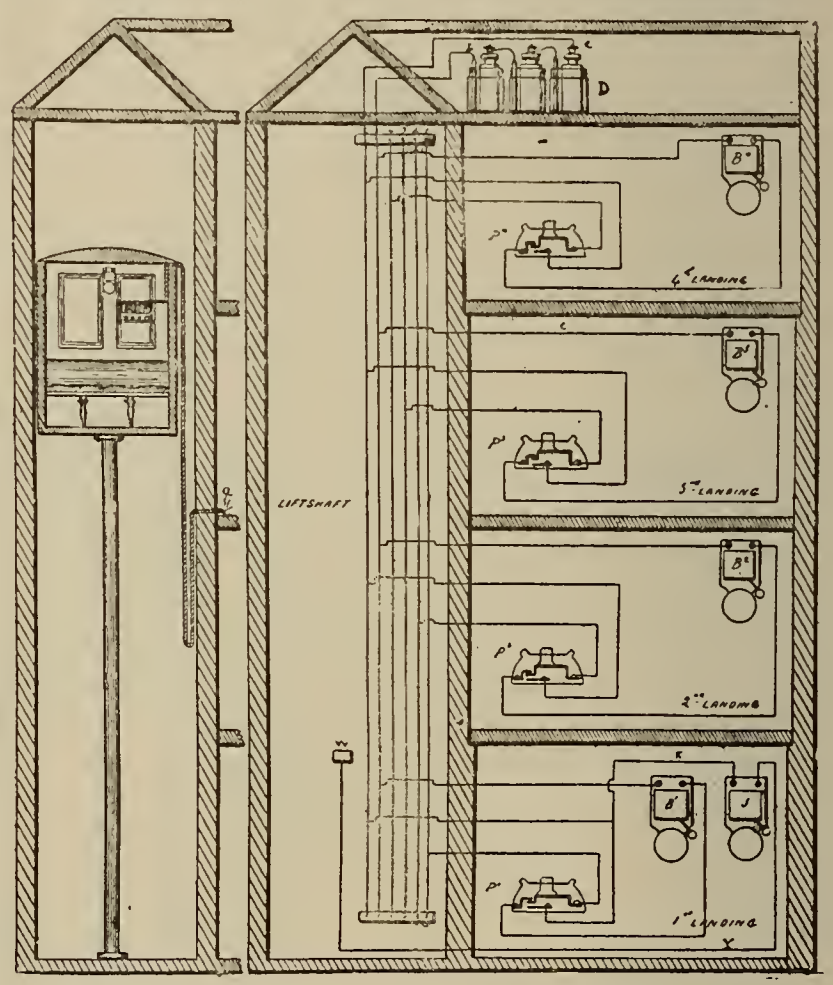
As to the general output of the United States for 1899 it may be said that in comparison to the high prices (about 17.5 cents per lb. in New York) the production was not as large as expected. There was but 10.6 per cent. increase over the year before. The exports last year were 20,000 tons less than in 1898, but this amounts to the same thing as saying that 35,000 tons were added to our domestic use, and although the production did not show such a large increase, the consumption was immense. This unusual consumption was caused by the great quantity of copper used for railroad, power-transsion, lighting, and electrolytic work. Ship builders also consume much more than in other years, as copper is being used to a larger extent for sheathing vessels.

There is no doubt that if more copper had been required for the world's use the United States could have furnished it, for its large mines were not worked to their greatest capacity.

Technical Notes.

BELL WORK ON ELEVATORS.

Aside from the fact that the cable must be installed as shown, the wiring of an elevator for bells is performed as shown in the conventional diagram where the wiring for four floors is displayed. The buttons P and bells B operate independently. Four bells are shown connected up with six wires, two of them battery wires, the other



Annunciator and Bell Diagram for Elevator.

four controlling legs of the circuit. Each push button, as shown, is tapped on the battery circuit, thereby completing the same for each floor. Many contractors prefer to run a single cable from one end of the building to the other with each of the wires composing it tagged so that connections made from different bells do not lead to confusion.

Marquette, Mich.—At a recent meeting of the City Council the ordinance extending the life of the street car company's franchise nine years was amended by adding a paragraph which makes the extension void if the company fails to spend $20,000 out of the new $70,000 bond issue it is going to float, in extending its lines and making improvements before January 1, 1901. The ordinance has to pass the Council twice in final form before it is operative.

The Electrical Age.

ESTABLISHED 1883.

Entered at New York P. O. as second-class matter, January 13, 1891.

THE ELECTRICAL AGE PUBLISHING CO., Publishers.

TERMS OF SUBSCRIPTION:

One Copy, one Year,	$2.50
One Copy, six months,	1.25
Great Britain and other Countries,	3.50

Cable Address (all Cables), "Electage," New York.

NEWTON HARRISON, E. E., EDITOR.

ASSOCIATE EDITORS:

ALFRED E. WIENER, E. E., OSBORNE P. LOOMIS, E. E., } ELECTRIC LIGHT AND POWER.

JOSEPH MUIR, M. D., FREDERICK STRANGE KOLLE, M. D., } ELECTRO-THERAPEUTICS.

ADDRESS ALL COMMUNICATIONS TO

THE ELECTRICAL AGE PUBLISHING COMPANY,

Seventh Floor, World Building,

NEW YORK.

NEW YORK, MARCH 24, 1900.

CONTENTS:

DEATH CAUSED BY LOW VOLTAGE.

One of the German technical papers relates the death of a workman, engaged in a chemical works, with very curious circumstances attending his decease. An examination of the man's body showed death to be due to an electric current, but as the only pressure employed in the building was less than a hundred volts alternating, a pressure hitherto considered harmless in this particular physiological respect, the workman's sudden death has excited considerable discussion and interest. The position of the man at the time of death was such that his body acted in the capacity of an excellent conductor. Around his feet rags were wrapped to a considerable thickness, the same being probably saturated with enough soda to make excellent conductors. He was standing on the top of an iron tank, and while in this position closed the circuit through his body by touching the alternating current circuit of the above mentioned low pressure. While the man was in a certain sense physically incapacitated through excesses from resisting a severe shock the conditions leading to his death indicate that in spite of the pressure the equivalent of a severe shock was received by him. It must be clearly understood that voltage does not kill. There are many men walking around in perfect health whose bodies have received static discharges of thousands of volts. The discharge of a pint Leyden jar may exceed ten thousand volts, and that of a moderate size Holtz machine reach above fifty thousand volts. As far as the body is concerned it has been conceded by medical authorities that a certain strength of current passed through it is required to cause death. This current varies from one to two amperes, and its passage through the body for a limited space of time is fatal. It is probable, therefore, that the limited pressure of approximately one hundred volts, which is reported to have caused the man's death, was only capable of causing a fatal termination due to the exceedingly low resistance of his body. Tests have shown that the human frame under favorable conditions varies in resistance from a thousand to two thousand ohms. In the case at hand the resistance must have been reduced to at least one hundred ohms. This is within range of probability; in fact, must have been the case, otherwise death was impossible. The metal tank on which the man stood, the increased surface of contact caused by the rags bound around his shoes, the impregnation of the flesh of his hand by the soda and the debilitated condition of the unfortunate victim all testify in favor of a fatal shock of electricity. Cases of this kind are very rare, but they show more than ever the necessity of taking every precaution to avoid risk to life or limb or the structure containing the electrical machinery.

THE UNDERGROUND TROLLEY IN NEW YORK.

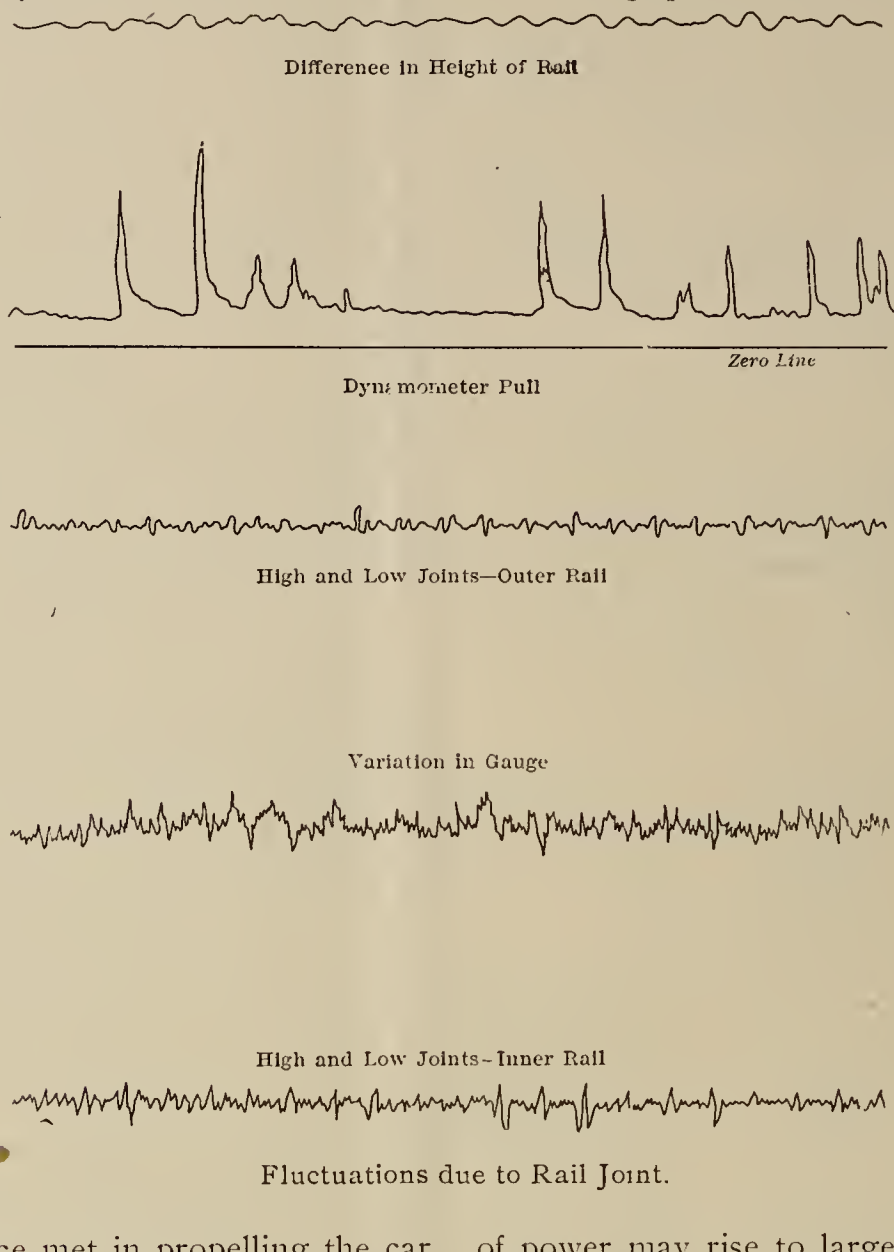
The absorption of the Third Avenue Road by the Metropolitan Traction Company was inevitable in spite of the opinion of President Vreeland that that road was not necessary to the success of the corporation of which he is the chief representative. The Whitney-Elkins-Widener syndicate now have in their possession one of the most perfect and, at the same time, the most elaborate system of street railway service in the world. It is impossible to estimate the value of this gigantic property occupying the main lines of traffic, north, south, east and west. The development of the underground trolley system has been more rapid in New York city than had ever been anticipated, and in all probability the main cross-town lines will be equipped i na similar manner. At present the owners of the Metropolitan Traction Company, whose property is represented by many miles of underground trolley and one of the finest power plants in America, are William C. Whitney and Thomas F. Ryan, of New York city; William L. Elkins, Peter A. B. Widener and Thomas Dolan, of Philadelphia. It is estimated that about eleven millions of dollars will be saved by the supply of power for the operation of the Third Avenue road coming from the present power house of the Metropolitan Traction Company. Herbert Spencer says that there is some good in things that are evil, and the unfortunate condition into which the Third Avenue road was plunged will turn out eminently satisfactory in the end to the public as far as their personal comfort is concerned. All the street railways of New York are now in the hands of one corporation; the same state of affairs exists in Brooklyn, Jersey City, and all the towns of Northern New Jersey. The benefits derived from such consolidation are best appreciated on a rainy day or by that fortunately limited class of individuals who claim that they have traveled for a whole month back and forth on one transfer.

THE PAN-AMERICAN EXPOSITION.

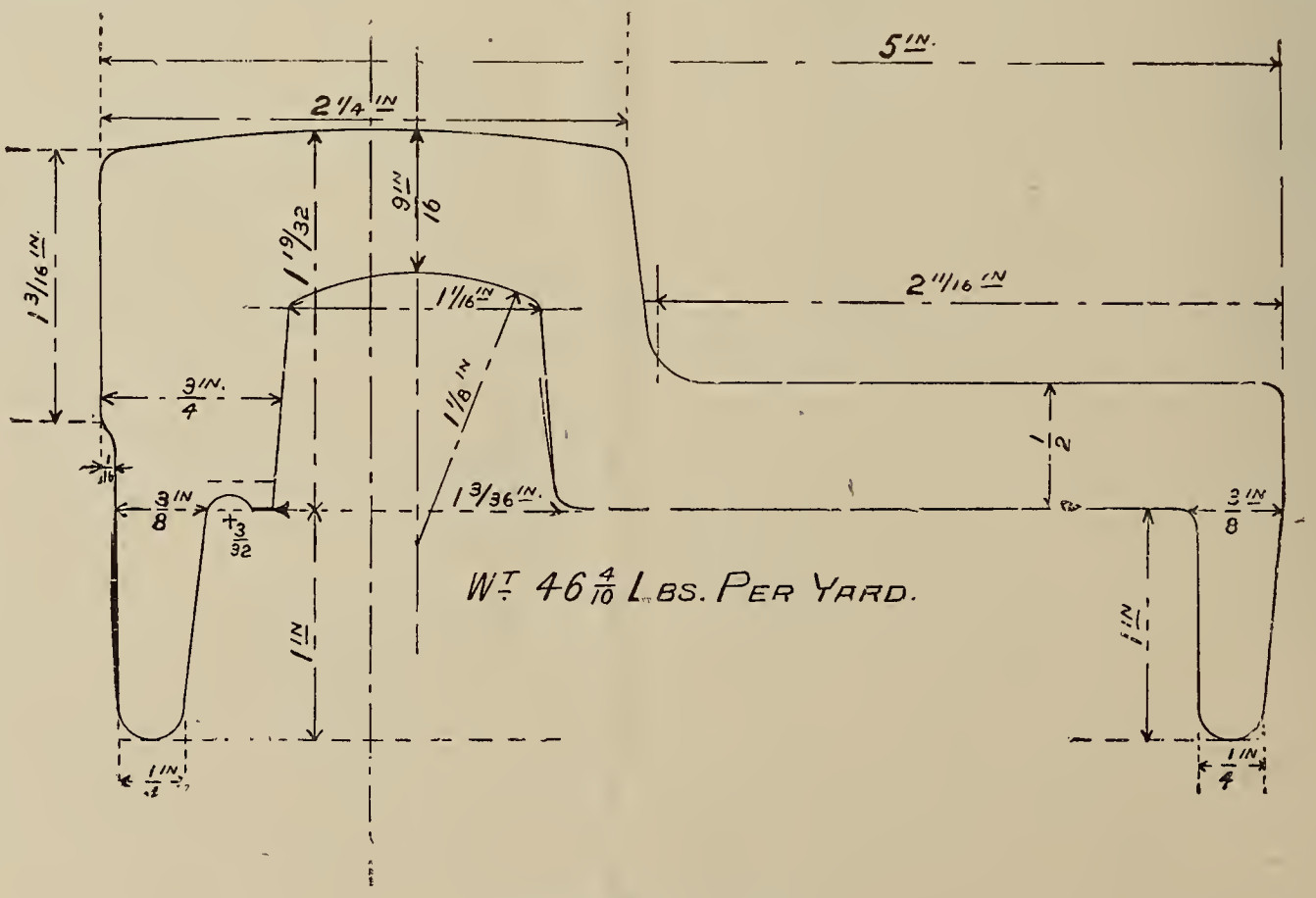
The original capitalization of the Pan-American Exposition Company was $2,500,000. In order to develop along the lines originally decided upon money is required, and the Ways and Means Committee who have attended to the financial end are in a position to sell $1,300,000 of the stock. The city of Buffalo is deeply interested in the exposition, and it will certainly prove a boon to various companies, including the railroad, to whom it will bring a heavy volume of additional business. It is very likely therefore that the various railroads, express companies, etc., will be requested to interest themselves financially in the sale of the stock, thereby securing a profit for themselves derived directly from the exposition and certainly another increase in assets through the visitors transported there.

TESTS OF RAILS FOR STREET RAILWAYS.

A series of dynamometer tests of rails for street railways have shown that the joint of the rail contributes very largely to the resistance met in propelling the car. A record of the tests made recently is shown in diagram, as well as the rail involved in the said test. The variations in gauge, the change of power due to high and low joints, changes due to the height of rail, etc., express very clearly certain conditions of railway practise only to be learned by practical experience. In poor joints a loss of from twenty to thirty per cent. is made manifest, and when the grip of the wheel on rail is insufficient the waste of power may rise to large figures. The present Third Avenue road has taken advantage of these facts in the reconstruction of its roadbed and the relaying of its rails, it probably offers the best example extant of the application of scientific principles to practical questions concerning the operation of a street railway.



Fluctuations due to Rail Joint.

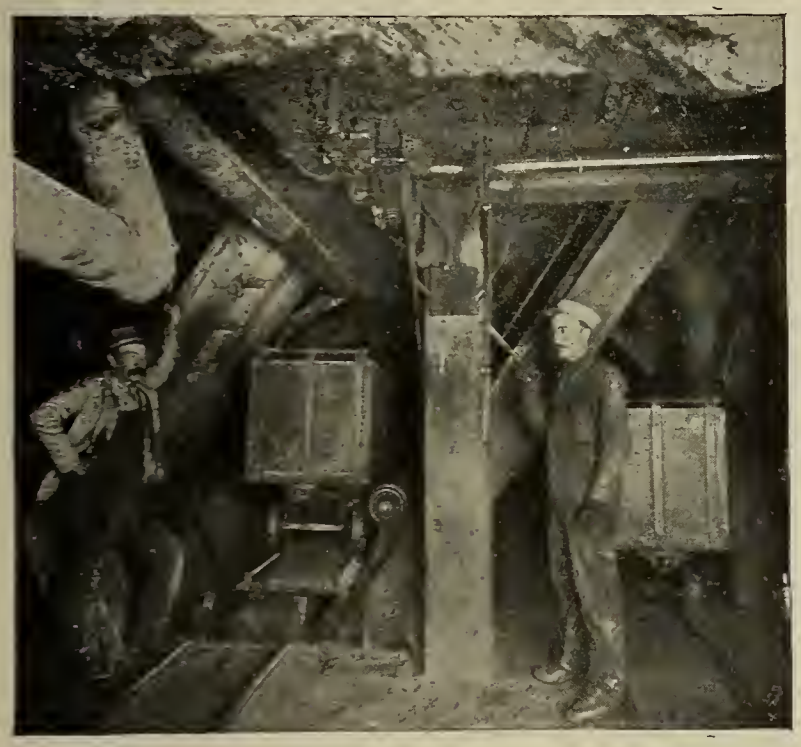


Dimensions of 46 lb. Rail.

Electricity in the Mine.

THE ALTA ARGENT MINE.

A view is shown of the Alta Argent mine, of Aspen, Colo., with motor installed in room above. The apparatus in this mine was sold by the General Electric Company whose equipment of the mine has added largely to the annual returns. The introduction of electrical machinery in mining operations has been on the rapid increase and promises well for the electrical manufacturers. Large power plants, long distance transmission lines, ventilating apparatus and hoisting and drilling machinery are common things in connection with mining operations at present. The Anaconda mine owes much of its present wealth to the successful electrical methods employed by its engineers.



Alta Argent Mine, Aspen Colo.

Patents.

WEEKLY ELECTRICAL PATENT RECORD.
PATENTS ISSUED MARCH 13, 1900.

Conducted by Otto Greenberg. Complete descriptions and drawing of any patent mentioned below will be sent on receipt of ten cents.

645,066. Electric Welding. R. Brown and F. Morse, N. Y.

645,103. Electric-Circuit Control B. N. Jones, Orange, Hamlen, Johnstown, Pa.

645,103. Electric-Circuit Control. B. N. Jones, Orange, N. J.

645,116 and 645,117. Electric-Motor Control. F. A. Merrick, Johnstown, Pa.

645,125. Alternating-Current Meter. Wm. H. Pratt, Lynn, Mass. This invention consists of a registering device operated by an induction-motor, and an auxiliary torque-producing device for overcoming the friction of the parts inductively independent of the primary motor-circuit.

645,126, 645,127, 645,128 and 645,129. Electric Meters. Lyman C. Reed, New Orleans, La.

645,130. Alternating-Current Motor. W. S. Rhodes, Salford, Eng.

645,212. Electric Lighting for R. R.. E. J. Preston and A. B. Gill, London, Eng.

645,216. Electric Lighting for R. R. W. F. Richards, Buffalo, N. Y .

645,247. Method of Starting Asynchronous and Synchronous Monophasic Electric Motors. Eugenio Cantono, Rome, Italy.

645,284. Method of Electrically Treating Materials. E. S. Acheson, Buffalo, N. Y.

645,377. Electrical Street Indicator. G. W. Stevenson, Cramer's Hill, N. J.

645,402. Telephone Exchange. J. Z. Miller, Erie, Pa.

645,478. Accumulator. Henry Leitner, London, Eng.

645,499. Electric Arc Lamp. Wm. Vogel, N. Y. In this lamp carbon disks are used instead of rods.

Business News.

NEW INCORPORATIONS.

Colorado Springs, Colo.—The Colorado Springs Power Company has been incorporated with a capital stock of $500,000, and will do a general electrical business. Directors: W. P. Bonbright, William A. Otis and L. E. Curtis.

Chicago, Ill.—The Eagle Wire Manufacturing Company has been incorporated to manufacture electrical appliances and supplies. Capital, $2,500; incorporators: F. G. Jones, Emma I. Ilg, J. W. Dunson.

Jersey City, N. J.—The National Power and Manufacturing Company has been organized with a capital of $2,000,000, and its purpose is to furnish light, heat and power. The organizers are: Armitage Mathews and Henry M. Haviland, of New York, and James C. Young, of Jersey City.

TELEPHONE CALLS.

Lansing, Mich.—The Michigan Telephone Company has increased its captial stock from $2,500,000 to $10,000,000.

Cheyenne, Wyo.—Papers have been filed in the office of the Secretary of State increasing the capital stock of the Rocky Mountain Bell Telephone Company, from $1,000,000 to $2,500,000.

Dover, Del.—A charter has been granted to The Gould Telephone Company, with a capital stock of $100,000, to make and use telephone, telegraph and electric light products.

Albany, N. Y.—A certificate of increase of the capital stock of the Hudson River Telephone Company from $2,000,000 to $3,000,000 has been filed with the Secretary of State.

Newark, N. J.—Articles of incorporation have been recorded by the North Jersey Telephone and Telegraph Company. The capital stock is fixed at $15,000, of which $5,000 has been paid in. The concern proposes to construct telegraph and telephone lines across the State of New Jersey, from the Hudson River at Jersey City to the Delaware River at Camden. It is proposed to traverse the counties of Hudson, Essex, Union, Middlesex, Monmouth, Mercer, Ocean, Burlington and Camden. The incorporators are: Union N. Bethell, Walter Brown, John H. Cahill, Joseph Kavanagh and Howard W. Thurber.

STREET RAILWAY NEWS.

Cleveland, Ohio.—The Cleveland Electric Railway Company will build an addition to its Cedar avenue power house.

New York City.—The West Tenth Street Connecting Railway Company, capitalized at $10,000, has been incorporated by the Metropolitan Street Railway Company and will operate on West Tenth street, with termini at Sixth avenue and at Greenwich avenue.

Versailles, Ind.—The Versailles & Osgood Railway Company has filed articles of incorporation. The line will be operated from the public square in Versailles to the depot in Osgood. It will also furnish power for electric lights in the two cities. The capital stock is $70,000.

New Castle, Del.—The Wilmington & New Castle Railway Company, of New Castle, Del., has had plans completed for an extension to their road of nine miles, to run from New Castle to Delaware City and to cost $135,000. Estimates for construction materials, car barns, power house, electrical equipment, etc., will be taken by the company at once.

Dover, Del.—Two electric railways are being built by the companies fighting for the lower Delaware franchises. The Hawkins Company is laying its track from the northern outskirts of Dover toward Woodland Beach, under the old Dover and Bay Shore charter. The General Electric Company is placing its cross-ties along the southern outskirts and towards Camden.

POSSIBLE INSTALLATIONS.

Kansas City, Mo.—The Holton Electric Company is making extensive improvements which will cost no less than $25,000. An entire new power plant has been built, consisting of two new Westinghouse dynamos of 1,200 lights capacity each; two engines of 125 horse power each; two new 80-horse-power boilers, together with four 200-light Westinghouse transformers and 75 Westinghouse meters. These extensions are not yet completed and there is yet considerable material to buy. Any additional information can be had by addressing Mr. W. E. Gant, manager, at Holton, Kas. Mr. C. A. Ross is president and treasurer of the company, and Mr. B. E. Ninde, Oskaloosa, Iowa, secretary.

NEW YORK NOTES.

MR. H. DURANT CHEEVER, one of the manager of the Okonite Company, Limited, was recently married Miss Zora Harlacker.

MR T. COMMERFORD MARTIN, editor of the Electrical World and Engineer, left for Europe on the 14th inst. for an extended tour. He will also visit the Paris exposition on his trip.

AMERICAN ELECTRIC NOVELTY & MANUFACTURING COMPANY, of Broome and Centre streets, will shortly issue a beautifully ornamented catalogue of their electrical specialties. A copy will be sent to all interested sending their business cards.

MR. JOHN B. TALTAVALL, editor and publisher of the Telegraph Age, who was threatened with permanent loss of sight only a short time ago, has once more returned to his duties after an extended rest, feeling greatly improved in health.

BALL ELECTRIC COMPANY, of 404 West 27th street, makers of the famous arc dynamos and series enclosed arc lamps, are meeting with a heavy demand for their improved dynamos. They have eleven of their large 180 arc dynamos in use in the Jamaica (N. Y.) Electric Light Company. They claim that their 180 arc lamp dynamo weighs only 9,000 pounds against a standard machine of the same capacity weighing 15,000 pounds.

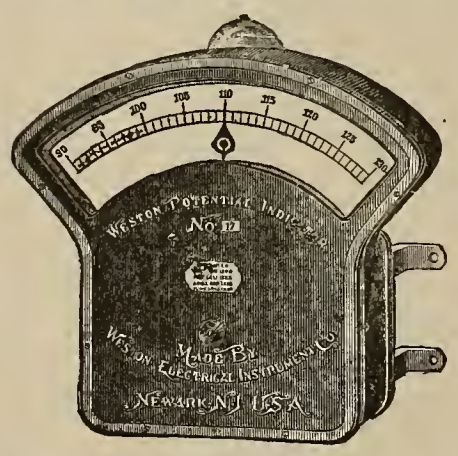
W. B. VAN DE WATER, formerly assistant general manager of the Sprague Electric Company, is about town and will shortly open up offices in this city as manager of sales, eastern department, of the Robbins & Meyers Company, of Springfield, Ohio, manufacturers of a complete line of desk and ceiling fans, power motors and dynamos. Mr. Van De Water will cover New York and the New England Sates. The trade will be pleased to know that he is well and among them again, representing an excellent line of electrical productions.

THE METROPOLITAN STREET RAILWAY COMPANY has obtained control of the wrecked Third Avenue road by purchase of stock in open market. The Metropolitan road will furnish power to the Third Avenue, thus saving the latter road an expense of about eleven million dollars, at which figure Receiver Grant, of the Third Avenue line, had placed the cost of the proposed new power house. The Whitney, Elkins and Widener syndicate is said to have engineered this deal, which is said to be the largest street railway deal ever consummated in New York.

ROBERT STEWART, E. E., of 32 York street, Westminster, S. W., London, has returned home. He was here in the interest of his company, the Perfect Arc Lamp and Accessories Company, of London, and spent two weeks with the Perfect Arc Lamp and Mfg. Co., of 239 Willoughby street, Brooklyn, looking into the improvements of the perfect arc lamp. Mr. Stewart is a well known American electrician, whose contribution to American technical journals have been read with great interest. He was one of the pioneers of the Siemens & Halske Electric Company, and can tell some interesting stories about the sale of that company's underground trolley system to the General Electric Company.

THE FIRST AND SECOND SIGNAL CORPS, N. G. S. N. Y., will participate in the Military Tournament, to be held at Madison Square Garden during the last week in March. These corps have been organized for some time, their services being severely tried during the late war. During the tournament these corps will show the advantages of the signal service in the regular army, and will try to emphasize the necessity of the members of the corps being capable electricians, thoroughly conversant with the telegraph as well. The regular army, as well as the National Guards of the various States, are gradually awakening to the fact that the signal corps should have the proper recognition. During the civil war the telegrapher or electrician in the signal service did not receive as much recognition as the private. As the whole success of a campaign practically depends upon a capable signal corps, some steps ought to be taken to give the service the standing it is entitled to.

WESTON STANDARD ILLUMINATED DIAL



STATION INSTRUMENTS.

THESE INSTRUMENTS are based upon the same general principle and are just as accurate as our regular Standard Portable Direct Current Voltmeters and Ammeters, but are much larger, and the working parts are inclosed in a neatly designed dust-proof cast-iron case, which effectively shields the instruments from disturbing influences of external magnetic fields.

WESTON ELECTRICAL INSTRUMENT CO.

114-120 William St., Newark, N. J., U. S. A.

BERLIN. European Weston Electrical Instrument Co. Ritter Strasse No. 88.

LONDON. Elliott Brothers, No. 101 St. Martins Lane.

The Electrical Age.

Vol. XXV—No. 13. NEW YORK, MARCH 31, 1900. Whole No. 672

Electric Lighting.

The Yale Sub-marine Arc Lamp.

THE YALE SUB-MARINE ARC LAMP.

SOUTHARD HAY.

When announced last year that I. E. Burdick, 1900 S, and F. G. Hall, ex-'99 S, had invented a new electric submarine lamp it was naturally a matter of some conjecture as to whether it would prove practicable and marketable. Since that time a number of improvements have been made which have added greatly to the value of the instrument and caused the future of the lamp to be sure of success. In a short time a company will be formed for its manufacture. Several tests have been held; the last one was given at New London, Connecticut, on January 11, 1900, before Captain Fersen, naval attache, of the Imperial Russian Government at Washington, who was greatly pleased with the invention. Sometime this month, a test will be given before Representatives of the United States Navy; it will take place at the Brooklyn Navy Yard.

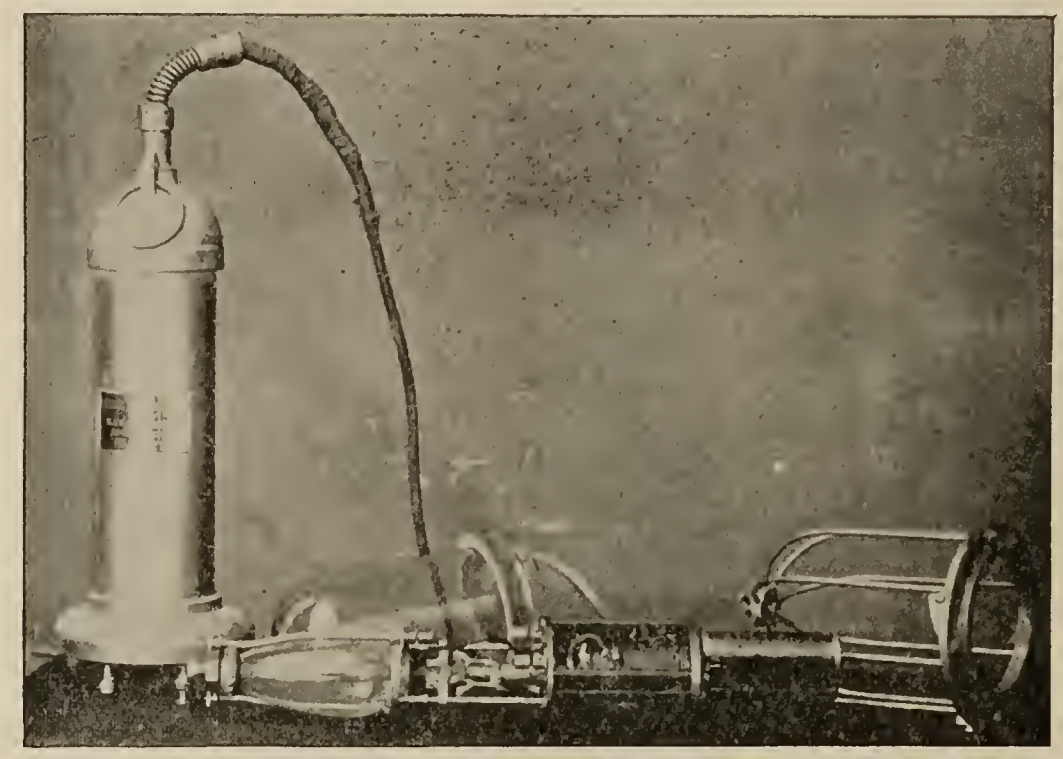
In March, 1898, experiments were begun leading to the invention of an arc lamp to be used in examining sunken vessels, ships' bottoms, and other submerged objects, and, it is also expected now that it can be used for submarine photography. At that time, though several others had experimented with the same object in view, the arc lamp had never been submerged in a manner to make its use practicable.

There are two types of arc lamps in extended use at present; the open arc where the two carbons forming the arc come together in the open air; and the enclosed arc, where a cylindrical glass chamber is provided encircling the arc and having tight ends fiting closely to the carbons. In the latter type, the lower or negative carbon is fastened rigidly inside the bottom end of the enclosing cylinder, the upper carbon feeding through the snug-fitting aper-

ture in the upper end. By means of the enclosed arc it is possible, with a good quality of carbons to obtain a light of greater steadiness and purity than from the open arc and for a period of 100 to 150 hours duration, upon one set of carbons. With the idea that air is essential to the operation of the light, former inventors have equipped their apparatus with tubes to convey air down, and to allow the gases of combustion to escape. In view of the acknowleged success and superiority of this new lamp this feature is found to be unnecessary, and in this the inventors claim originality. Although it had been previously demonstrated that arc light combustion in a vacuum is possible, the practical demonstration of the burning of arc lights without air, is of considerable interest to scientists as well as business men.

The enclosed type of arc lamp seemed, therefore, eminently acceptable for use in a sub-marine lamp. Many difficulties arose, both as to mechanical details and questions of theory, but a working model was finally ready and tested in the muddy waters of Mill River, near New Haven harbor. The first experiments were not successful, certain faults in the mechanical construction and in ism to work when the lamp is in any position, even inverted—if these difficulties could be overcome it would put the new lamp far ahead of its predecessor. The gas pressure is equal to several atmospheres, and in the first experiments the gas forced itself through the packing. This difficulty was met by a specially designed check valve. The heat of the arc is of couse intense, and, being enclosed in so small a space with only a few inches of metallic surface exposed to the cooling effect of the water surrounding the lamp, the gas soon reached a temperature sufficient to destroy the solenoid, feeding mechanism, rubber gaskets and the packing. This trouble was met by a special device in which originality is claimed.

When the lamp is burned in air the excess of heated gases of combustion and the internal pressure attendant thereon are relieved through the check valve, and also, when the lamp is burned in shallow depths. When the lamp is lowered to greater depths, the pressure within is equalized by the external pressure of the water, and the lamp is in equilibrium inside and out. A lamp thus constructed will burn for any desired length of time, provided the carbons will hold out. The lamp may be ad-



The Lamp with the Parts Disassociated

insulation being made clear. These defects were soon remedied and the practicability of the lamp established beyond all doubt.

This sub-marine arc lamp is an enclosed arc lamp absolutely water tight, with both an inner and outer globe, the upper part of the outer globe being hermetically sealed to the metal cylinder containing the feeding mechanism, by means of rubber gaskets and rings. The feeding mechanism in this lamp differs from that of the ordinary arc lamp in this respect among many others, namely: that it is enclosed in a water and air tight cylinder. From the top of the cylinder through a carefully packed aperture issue the two insulated wires, contained in a cable. The lower portion of the lamp is protected by an eight wire guard. By a special device the heat and gases of combustion are kept from entering the mechanism chamber and destroying the solenoid and other apparatus for regulating the feed of the carbons. The body of the lamp is made of gun metal which will not corrode. The lamp is 24 inches long and the greatest diameter is 6 inches. Its weight is 30 pounds. Submerged it weighs about 12 pounds.

The chief difficulties encountered were in making the lamp waterproof, cooling the heated gas, relieving the high internal gas pressure, and causing the feed mechanjusted for any voltage, and it is customary to burn it at 80 volts, at which it consumes from 5.25 to 6 amperes. An arc of very high candle power may be used to light up a large area and to enable divers and other marine investigators to carry on their work with far greater facility than heretofore. Although especially designed and adopted for sub-marine lighting this lamp may be used in the atmosphere with equally good results.

In operation the current is turned on and the light is lowered into the water. The water proof cable supplies current to the lamp and is attached to a special watertight plug and fixture on the deck of the vessel, or wherever it is desired to have the terminals of the lighting circuit. The whole lamp weighs, when submerged, but a few pounds and may remain suspended or may be carried about at will by the diver. The value of a concentrated beam of light is evident when it is desired to examine minutely an injury to a ship's hull.

For the uses to which this lamp is primarily adopted a depth of sixty feet would rarely be exceeded. The difficulties to be overcome in making the lamp available for any depth—it is not as yet possible for divers to work more than 200 feet below the sea's surface—are purely mechanical ,hence it may not be unreasonable to expect to see it used in deep sea investigations, with an electri-

..lly controlled photographic camera. The possibility of increasing the power of the arc to equal that of the most powerful search light pens a new and important field in connection with photography. Professor Louis Boutan, professor of Zoology at the University of Paris, has made some interesting photographs of subaqueous scenery by the aid of a properly constructed camera, operated by him in person, in a diving suit. Professor Bristol, of Columbia University, who experimented in Bermuda last summer, proved that submarine photography was practicable and opened and extended a most interesting field provided that proper lighting could be obtained below the surface.

The several tests this lamp has had, go to establish the fact that it will in all probability revolutionize submarine work and, as mentioned above, open up the way for submarine photography. By the use of this light wrecks can be lighted at a depth of 200 feet below the surface of the sea, so that a photograph can be made of a sunken ship at such depth. The light has at a depth of forty feet a spherical lighting radius of about fifty feet. For twenty feet of this radius the light is strong enough for use in making a photograph. The lamp will be very useful to supplement the work of a diver going overboard from a damaged or leaking ship, as he could take a photograph of the injured part and bring the picture on deck for examination. The uses to which a lamp of this design may be put are many and varied and will occur to those interested in marine and naval matters. Among the possibilities mentioned are, examining and cleaning the bottoms of merchant and battle ships, attaching hoisting chains to guns and other movable parts on sunken vessels; placing and removing submarine mines, constructing bridge piers and coffer dams, for all kinds of pearl, coral and sponge fishing, and for all uses of submarine photography.

The United States patent for the lamp was obtained under date of July 18, 1899. It has also been patented in England, Germany, Russia and France, and patents are pending in several other countries.

Editor's Note.—The above article and illustrations are used through the courtesy of the "Yale Scientific Monthly."

Electric Railways.

NOTES ON ELECTRIC TRACTION UNDER STEAM RAILWAY CONDITIONS.

BY EDWARD C. BOYNTON.

(Continued from Page 92.)

For such short distances, and the intermittent work required, the modern railway motor seems well adapted. It can be overloaded, 100 per cent. frequently, without injury, for a short time. Most types of these motors have but one or two serious faults. One is lack of sufficient ventilation. During hot weather this becomes a serious matter, and one that should be corrected by the manufacturers. The design of the axle bearing, is another. In street car work, the plan of using a gun metal lining in halves, lubricated by grease or oil is fairly satisfactory, but where these bearings become 15 inches long and 6½ inches diameter; at speeds of 40 to 60 miles per hour, the conditions are different, and while giving little trouble, the cost of repairs seems unnecessarily high. Most of the motors are similar in design to the ordinary street-railway motor, entirely enclosed by the frame, and intended to run in the mud and slush of a city street. On the other hand a steam roadbed is usually dry and clean, the motors are further above the ground, and water rarely flies above the axle. It would seem therefore that they could be more open on top. It has been found necessary to run through the hot summer months with the large covers over the commutators removed. The construction, and especially the insulation of armatures has reached such a degree of perfection, that a burn-out is seldom heard of in the larger motors.

I have had under my personal observation a considerable number of such motors, some of which have been in service over two years, making a daily mileage of over 300 miles, and have never had one armature burn out. In one case a pair of motors were in service eight months, including a winter. No repairs whatever were made during that time, beyond the ordinary daily inspection, cleaning, and renewal of carbon brushes.

In another case a pair of motors made upward of 100,000 miles after being put into service, the only repairs being renewal of armature and axle brasses, gears and pinions. As is well-known a frequent cause of burn-out in the past has been due to the wear of the armature brasses allowing the armature to strike the pole-pieces. This cause has been eliminated by making the clearance between the pole-faces and the armature slightly greater, possibly at the expense of an increase in weight of copper on the field magnets, and with no apparent loss in efficiency.

The total weight of a 60-foot standard coach equipped as a motor car with two motors will be about 80,000 pounds, without passengers, of which 55,000 pounds is on the drivers or motor truck. The speed of such a motor car running light, if geared sufficiently high, is probably only limited by its weight and the quality of its track and road bed. With a stone ballasted track, 100-pound steel rails, few curves, and those of long radius, a heavy car with the best steel tired wheels should run 100 miles per hour at full speed without difficulty.

I have mentioned a four-motor car consisting of a 60-foot car body weighing 100,000 pounds complete. This represents about 800 horse-power nominal rating of the motors at 650 volts direct current, and this is the maximum horse-power that can be placed under a standard coach, on trucks and wheels which do not necessitate any other changes in the existing standards of steam practice. The motors are capable of exerting double that power for a short time. The total cost of converting a standard coach into a motor car with two motors is about $3,800.

The third method of using electric traction in steam service, that of the use of light motor cars and trailers, built for the purpose, has some advantages. The former coaches can be used elsewhere on the system as are the locomotives. The smaller, lighter cars are cheaper to construct, the wear on the track is less, and there is considerable economy in power. It has been proposed, and no doubt will come, that such cars will run through the principal street of a city, on the existing street car track, before starting on their trip over the steam track. This would necessitate either a trolley wire over the steam track, instead of a power rail, or both collecting shoes and trolley pole on the car. There is no question but that this may prove a great advantage in time. On the other hand, the cars must be used exclusively on the line equipped with electric power. At speeds of 50 to 60 miles per hour which must be made in order to compete successfully with the existing parallel trolley lines ,the cost of maintenance and repairs due to the excessive vibration will undoubtedly be greater than that with standard coaches.

The economy in power due to the reduction in dead weight hauled is of considerable importance, not only on account of the smaller amount used, but the line conductors can be lighter, greatly reducing their cost, or the system can be extended to longer distances at no more expense for transmitting the power.

In the future there may be a decided tendency to reduce the weight of electric trains. In other words, it will be an attempt to handle a constantly increasing traffic with a lighter equipment in order to haul less dead weight per passenger. The engineer who proposes to introduce such changes must move with the greatest care in order not to save the weight at the expense of strength. It should never be forgotten that the maximum load is "no standing room," that the strains on a car and its trucks running at 60 miles per hour over a steam track which may be made of 70-pound rails with joints none too good, are not to be compared with such as are met with in a city street at low speed. An interesting problem in connection with a similar equipment has arisen within the last few years, and the time is rapidly approaching when it must be solved. It relates to the difference between the wheels of street cars and the steam railroad coaches. Though both use the standard gauge of 4 feet 8½ inches the average street car wheel has a tread 2½ inches wide and a flange ¾ inches wide and a flange 1⅛ inches deep. The problem is a serious one, for it intimately concerns the safety of the train. The steam railroad pepole after 50 years experience have settled upon the above standard, and the electrical engineer who chooses to ignore their experience in this, and in many other cases, runs a risk. There should be no doubt that it is unsafe to run the small street car wheels at high speed over steam railroad tracks, with their present form of frogs and switches; and it is, in fact, impossible to run them on steel rails weighing 90 to 100 pounds per yard on account of the wide spaces in the frogs. The question may be asked: Is it not safe to run such narrow wheels on the steam track if the latter is kept carefully to gauge, and proper frogs for these wheels are substituted for the existing ones?" If this is done steam trains can no longer run on the road, and, as it is necessary in order to round a curve at high speed with safety, to spread the guage from ¼ inch to ½ inch, the danger is greatly increased. On the other hand, the Master Car Builders' wheels cannot run on the existing street car tracks in our cities. The flange is too deep for the frogs, the size of the grooves on the inside of the straight rail is larger than the city authorities would sanction, and the outside portion of the thread would in many cases run on the pavement and crush it down to a level with the top of the rail. The only solution of the problem seems to be a compromise wheel with about 3-inch thread and 1-inch flange. Whether or not this is safe, only time can tell.

The fourth question, that of hauling freight by electric power, should, of course, be decided upon at the time of installation, as it may cause considerable difference in the plans for power stations and line transmission. As the question can only refer to local freight along the line electrically equipped, it is of doubtful importance as applied to the conditions under discussion. If the freight traffic on such lines be sufficiently heavy to necessitate the use of a locomotive for several hours daily during the hours between midnight and morning when there are few if any electric passenger trains in service, it is economy to use an electric locomotive, for it costs but little more to run the power station, if it has been shut down, and the total expense would be somewhat less than that of a steam locomotive. The whole question of transportation of freight by electric pwer is one which concerns the future more than the present.

When the time arrives that long distances are electrically equipped on our steam railways, then it becomes far more important.

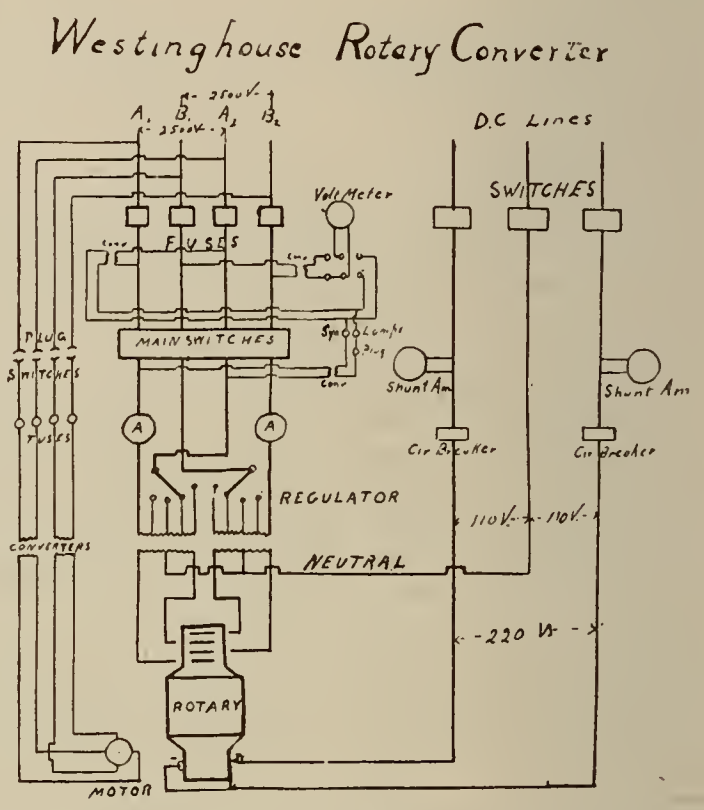
(To be continued.)

Victoria, B. C.—The construction of tramway line to the Gorge, one and a half miles from the Saanich road, will be commenced about October 1st.

Technical Notes.

TWO AND THREE PHASE SYSTEMS.

By the aid of the rotary converter a ready transformation is made from alternating to direct and from direct to alternating current. The two or three phase system is practically one fed by two or three dynamos and having two or three separate circuits. If an ordinary alternator was supplied with an additional winding so situated that each operated a separate circuit through the medium of separate collector rings the two phase system would be all but duplicated. Two distinct currents would emanate, differing from each other in phase. In one case current is circulating at its full strength while in the other it is



Connections of a Rotary Converter and Polyphase System.

just growing. When a three phase current is generated three separate armature windings are employed, the difference of phase is one-third of a cycle and the three currents pass out through collector rings. Although the armature windings are, strictly speaking, in series, no current flows when the outer circuit is disconnected. This is due to the fact that one E. M. F. in a coil is out of phase with another and the algebraic sum of their current is 0. The connections of rotary converter are shown in the diagram. A four wire circuit is employed, generating through the aid of the converter a 220 volt current for Edison three wire lighting.

Niagara Falls, Ont.—Steps have been taken to rebuild the power house of the Niagara Falls Park & River Railway. It has been found that three of the dynamos are but little damaged.

Chicago, Ill.—The Swedish-American Telephone Company has been incorporated; capital stock, $5,000; incorporators, Foree Bain, Tiodolf Lindberg and M. F. Allen.

Denver, Colo.—The Denver Independent Electric-Telephone Company has been incorporated; capital, $500,000; incorporators, Z. T. Esmond, George B. Fisher, N. C. Hughes, E. C. Miles, W. J. Smith, Douglass Washburn, George W. Wright.

Waterville, Minn.—The Canon Valley Telephone Co. has been incorporated; capital, $15,000.

The Electrical Age.

ESTABLISHED 1883.

Entered at New York P. O. as second-class matter, January 18, 1891.

THE ELECTRICAL AGE PUBLISHING CO., Publishers.

TERMS OF SUBSCRIPTION:

One Copy, one Year,	$2.50
One Copy, six months,	1.25
Great Britain and other Countries,	3.50

Cable Address (all Cables), "Electage," New York.

NEWTON HARRISON, E. E., EDITOR.

ASSOCIATE EDITORS:

ALFRED E. WIENER, E. E., OSBORNE P. LOOMIS, E. E., } ELECTRIC LIGHT AND POWER.

JOSEPH MUIR, M. D., FREDERICK STRANGE KOLLE, M. D., } ELECTRO-THERAPEUTICS.

ADDRESS ALL COMMUNICATIONS TO

THE ELECTRICAL AGE PUBLISHING COMPANY,

Seventh Floor, World Building,

NEW YORK.

NEW YORK, MARCH 31, 1900.

CONTENTS:

THE INDISPENSABLE FAN MOTOR.

Of late the fan motor has reached a point of perfection which entitles it to be regarded in many occupations as an indispensable element of convenience and comfort. Before the days in which current could be tapped at every door from the city mains many ineffectual efforts were made to introduce the fan motor in connection with batteries. Outfits could then be procured, consisting of a fan, several primary cells and a list of carefully written directions for operating the fan and taking care of the batteries. It is unnecessary to refer to the inconvenience and expense necessarily associated with this combination. One of the largest manufacturers of dynamos and motors found the task of introducing these fan motor installations an impossibility, but sufficient experience was gained in the attempt to lead to the development of other branches of the art, which, in themselves, were eminently successful. The fan motor may be regarded as the road to success as far as many of our manufacturers are concerned. At least half a dozen started out in life in a modest manner manufacturing fan motors. The art was in its infancy, and it was deemed quite an achievement to successfully build a fan motor that would stand the test of continuous running without any care. Naturally a study of the conditions governing the operations of the fan motor, which is practically a dynamo or motor in embryo, led to more ambitious desires in the field of heavier machinery so that in the course of a few years the fan motor industry was supplemented by one of greater magnitude, and which called for better engineering and a more thorough and comprehensive knowledge of electric lighting and transmission of power.

The fan motor in itself possesses peculiar advantages of such a nature that it is merely a question of time before every home in the land will regard them as an indispensable part of the household equipment. Various preparations for the summer in the majority of homes are made sometimes months in advance, and one that seems to be the most reasonable is that of selecting the proper fan motors for the cooling and ventilation of the home. In our large cities the convenience of having a breeze on tap is secured by so moderate an investment that the layman has no cause to hesitate, either through fear of shock or fire or the fact that the expense is beyond his means. Current is cheap, and fan motors are low in price, and in the light of these facts it is highly probable that the trade in electric fans will in the next few years reach figures of great magnitude. The cost of current for the operation of a twelve-inch fan is a few dollars a month. The fan itself will not cost more than fifteen dollars. On this basis a comparatively small investment will secure some slumber to those kept away from the country by the press of business, and the hot and sultry nights of midsummer will lose their horrors to those awaiting the touch of Morpheus.

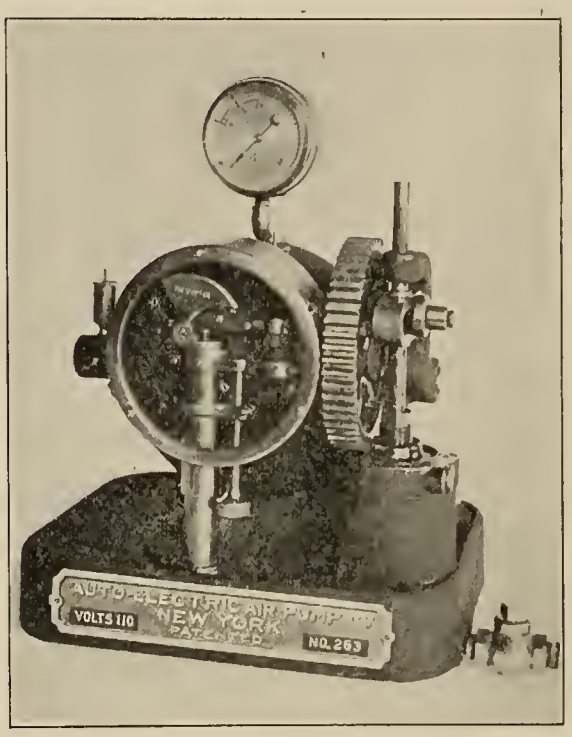
NEARLY A BILLION IN AUTOMOBILES.

There is an old saying fully appreciated by the man of horse sense that "too many cooks spoil the broth." As far as the automobile industry is concerned we find the same craze spreading over the country as took place within recent years when the bicycle became a fad. A conservative estimate of the aggregate capital representing incorporated stock companies, whose object is the design and manufacture of automobiles, approximates one billion dollars. From a purely speculative standpoint it seems evident that the automobile industry will some day attain dimensions that the demand for many many purposes will far exceed the supply. At present, however, the automobile industry is in a comparatively experimental stage, and while in this condition the horse and wagon will still have prestige. The majority of horse driven vehicles are undoubtedly in the hands of the farming element of this country. The question with them regarding innovations is largely one of price. There are many farm houses within a stone's throw of our larger cities in which the most primitive means are adopted to perform the duties of daily life. The candle is still in use; the open fire-place remains, and the well from which the water is drawn may still be found where first dug. The thrifty and saving disposition of the farmer is opposed to the so-called new-fangled notions of city folks, and they of all will be the last to respond to the influence of any great change in the means of transportation. Quoting from a contemporary we find the following facts: "The first cost of an electric hansom, such as are now in use, is eighteen hundred dollars, a difference in the first cost of six hundred dollars in favor of the horse. To keep a horse as kept in livery stables or by private owners will not exceed fifty cents a day. The leading hack stables place the cost of keeping the horse, shoeing and repairing the harness at two hundred and fifty dollars a year or about sixty-eight cents a day. A large manufacturer who keeps two teams and makes his stable account a separate item, finds the average for five years to be four hundred dollars per year for the four horses, one hundred dollars of which is for shoeing and three hundred dollars for feed, and his horses are noted for being kept in the best possible condition. In the case of the electric hansom, considering renewals, etc., makes an aggregate for the first year of twenty-four hundred as against eleven hundred and fifty for the two-wheeled hansom, a difference of thirteen hundred and fifty in favor of the horse." Repairs the second year are certainly less, but more expensive and difficult to keep in order than the horse and carriage. The automobile, however, will positively find its place a permanent one at that with the leading and useful inventions of the age.

Novel Applications of Electricity.

THE AUTO ELECTRIC AIR PUMP.

The Auto electric air pump, ilustrated in these columns, owes its name to the fact that it is operated by electricity. This pump is constructed on the simplest possible lines and is complete on one base, but two connections being necessary to set it up. All materials entering into its construction are of the best quality, and every machine is thoroughly tested sectionally and collectively before being put to practical use. The pump is peculiarly adapted for drawing ale, beer or mineral waters for the reason that it forces nothing but pure air into the pipe. The air is filtered before entering the same, and connection made with the least delay. The



Auto Electric Air Pump.

expense of running the pump is about the same as that of a sixteen candle power lamp. It is very cleanly, being run by electricity, and has none of the disagreeable features of other pumps, such as leaking pipes, slime and many minor troubles incident to the use of water. It possesses certain ornamental features, and the Auto Electric Company make a specially finished machine for those who prefer to have it on the sideboard, table or bar. This pump is adapted to the use of physicians, dentists, artists, printers, hotels, saloons, etc. Agencies have been established in all the principal cities, and the general offices of the company are at 39-41 Cortlandt street, New York City.

Conventions.

THE NINETEENTH ANNUAL CONVENTION OF THE AMERICAN STREET RAILWAY ASSOCIATION.

The nineteenth annual meeting of the American Street Railway Association will be held at "Convention Hall," Kansas City, Mo., October 16, 17, 18 and 19, 1900. Papers will be read on the following subjects: "Double Truck Cars: How to Equip Them to Obtain Maximum Efficiency Under Varying Conditions"; "Construction, Operation and Maintenance of Roads that Operate Twenty Cars or Less"; "Comparisons of the Various Systems of Electrical Distribution for Street Railways"; "Consolidation of Street Railways and Its Effects upon the Public"; "The Storeroom and Storeroom Accounting"; "Painting, Repainting and Maintenance of Car Bodies." It is expected that there will be a large exhibition of street railway supplies. The building contains 50,000 square feet of floor space, without a post or obstruction of any kind. Friday, October 19, has been set apart as a day for the examination of the exhibits. No session of the association will be held, so that all may have plenty of time to view the exhibits. The annual banquet will be held Friday evening, when the officers-elect will be installed. The headquarters of the association will be at the Midland Hotel. Hotel accommodations are ample and reasonable. Railroad rates will, in all probability, be as before—one and one-third fare for the round trip, due notice of which will be mailed in time by the secretary, Mr. T. C. Penington.

Among the Societies.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

Amelia Dickinson Pope, widow of the late Franklin Leonard Pope, died of heart failure in Amherst, Mass., on March 20th. The funeral service was held at Amherst on the 22d, and the interment was at Great Barrington, Mass., on the following day. Her only son, Leonard, is at Amherst College; the eldest daughter, Anna, at the University of Wisconsin, and the youngest daughter, Amy, at Smith College, Northampton, Mass.

LIGHTING OF INDIAN CITIES.

In reply to an inquiry from an Ohio firm, Consul Fee, of Bombay, on December 7, 1899, says: The use of electricity as power and light is yet in its earliest stages in India, Madras being the only city using it as a motive power for street cars. Bombay is poorly lighted by gas, and her tramway is run by horse-power. This company has its main office in New York City, and the stock is owned principally in the United States. It has applied to the Bombay municipality for the privilege of converting its motive power to electricity. This will undoubtedly occasion other electric improvements. Electric lights are used in a limited way in the better class of residences and bungalows. Bombay is the best place in which to locate an agency. It is not only great in population (having over 821,000). but also in wealth and trade. One-third of all the exports from the United States to India come to this port. The systems of Indian railways as well as the steamship lines center here. The bulk of electric supplies now come from Europe. The United States during the past few years has been pushing her trade in this line, and the late steamers have had noticeable shipments of these supplies from New York.

Patents.

WEEKLY ELECTRICAL PATENT RECORD.

PATENTS ISSUED MARCH 13, 1900.

Conducted by Otto Greenberg. Complete descriptions and drawings of any patent mentioned below will be sent on receipt of ten cents.

645,547. Dry Cell. W. Botz, Ludwigsshafen, Germany.—In this cell there is a liquid electrolyte, but the cell is scaled with a porous substance impregnated with oil, which, while permitting gas to escape at ordinary pressure, is closed to the passage of the electrolyte.

645,570, 645,571 and 645,572. Telephone Appliance. Chas. E. Scribner, Chicago.

645,573. Electric Mine-bell. Barry Scarle, Montrose, Pa.

645,576. System of Transmission of Electrical Energy. Nicola Tesla, N. Y.—This invention consists in producing between the earth and elevated generator-terminal, at a generating station, electrical impulses of a sufficiently high electromotive force to render the air strata at or near the elevated terminal conducting, causing thereby current impulses to pass through the air strata, and collecting or receiving at a point distant from the generating station the energy of the current impulses by means of a circuit synchronized with the impulses.

645,588. Fire-alarm Apparatus. Albert F. Doddridge, Chicago.

645,599. Fire-alarm. Chas. Low, Pittston, Pa.

645,602. Device for Locating Grounds on Electric Circuits. M. J. Myers, Syracuse, N. Y.

645,612 and 645,613. Method of Distributing Energy. Geo. Westinghouse, Pittsburg.

645,615. Electric Insulation for R. R. James E. Wright, Omaha, Neb.

645,640. Storage-Battery Cell. Rufus N. Chamberlain, Depew, N. Y.

645,646 and 645,648. Electric R. R. Edmund C. Morgan, Chicago.

645,647. Third Rail. Edmund C. Morgan, Chicago.

645,654. Third Rail. William A. P. Willard, Jr. Hull, Mass.

645,671. Electric Meter. E. W. Rice, Jr., Schenectady, N. Y.

645,674. Regulation for Dynamo-Electric Machines. Chas. P. Steinmetz, Schenectady, N. Y.

645,675. High-Potential Apparatus. Elihu Thomson, Swampscott, Mass.

645,684. Electrically-Operated Switch. Edward M. Hawlett, Schenectady, N. Y.

645,750. Storage Battery. Patrick Kennedy, N. Y.

645,764, 645,765 and 645,767. Controller for Electric R. R. Cars. A Lundell, Yonkers.

645,774. Continuous-Current Transformer. Alfred Wydts and Gustave Weissmann, Paris, France.

645,784. Electric Arc Lamp. Edward Bowen, McComb City, Miss.

645,809. Controlling Device for Electric Switches. Edward W. Hammer, Chicago.

645,902. Motor-Gearing. Elmer A. Sperry, Cleveland, Ohio.

645,903. Motor-Vehicle Brake. Elmer A. Sperry, Cleveland, Ohio.

645,907. System of Electrical Transmission. Frederick Bedell, Ithaca, N. Y.

645,917. Telephone Register. William Gray, Hartford, Conn.

Business News.

SPECIAL EXPORT COLUMN.

TOTAL AMOUNT OF ELECTRICAL EXPORTS FROM NEW YORK CITY FOR WEEK ENDING MARCH 24, 1900, $115,959.00.

New York, N. Y., March 24, 1900:—The following were the exports of electrical material and kindred lines from the port of New York for the week just ended:

Antwerp:—113 cases electrical material, $13,053.

Argentine Republic:—307 cases electrical material, $27,945.

Aberdeen:—6 cases electrical material, $2,225.

Amsterdam:—1 case electrical material, $17.

Berlin:—14 cases electrical material, $32.

Brussels:—5 cases electrical material, $86.

Bucharest:—7 cases electrical material, $75.

Brazil:—27 cases electrical material, $1,529.

British West Indies:—19 cases electrical material, $291.

British Australia:—1 case electrical material, $10; 266 cases electrical material, $13,356.

Central America:—54 cases electrical material, $939.

Cuba:—109 cases electrical material, $1,330.

Ecuador:—15 cases electrical material, $358.

Gothenburg:—8 cases electrical machinery, $1,717.

Glasgow:—15 cases electrical material, $3,825.

Hull:—4 cases electrical material, $2,000.

Hamburg:—44 cases electrical machinery, $1,525.

Havre:—330 cases electrical material, $23,646; 46 cases electrical machinery, $1,875.

Japan:—1 case electrical material, $200.

London:—73 cases electrical material, $81; 19 cases electrical machinery, $3,079; 84 cases electrical material, $5,917.

Mexico:—159 cases electrical material, $7,878.

Manchester:—7 cases electrical material, $121.

Malaga:—2 cases electrical material, $68.

Rome:—14 cases electrical material, $121.

Southampton:—10 cases electrical machinery, $1,565; 1 case electrical material, $1,055.

Vienna:—2 cases electrical material, $40.

NEW INCORPORATIONS.

Bridgeport, Pa.—A charter has been granted at Harrisburg to the Bridgeport Electric Light, Heat and Power Company, capital, $12,500.

Buffalo, N. Y.—The Buffalo Electro-Surgical Instrument Company has been incorporated with a capital of $9,000. The directors are John C. Becker, E. C. Lapham and Charles Taylor, all of Buffalo.

TELEPHONE CALLS.

Fayetteville, N. Y.—Madison and Onondaga Telephone and Telegraph Company has been incorporated to operate in the villages of Onondaga and Madison counties. Capital, $20,000; directors: Frank E. Dawley and Ellis Woodworth, Fayetteville.

Ambler, Pa.—The Ambler Telephone Company has been organized by the election of the following officers: President, John S. Buchanan; vice president, L. S. Moore; secretary, William S. Acuff; treasurer, Joseph A. Angeny; directors: John S. Buchanan, L. S. Moore, Rev. A. H. Rufe, William J. Devine, William S. Acuff, Joseph S. Angeny and Dr. D. W. Shelly. William J. Devine has been made superintendent.

Boston, Mass.—The consolidation of the American Bell Telephone Company with the American Telephone and Telegraph Company of New York is confirmed through the issuance of a call for the annual stockholders' meeting of the Bell Company. The call announces that the stockholders will be asked to authorize the conveyance of the company's entire real estate, ratifying the assignment to the American Telephone and Telegraph Company of the property of the company other than the company's Long Distance stock and distributing the shares of the Long Distance Company in exchange for the stock of the Bell Company.

Street Railway News.

Cadiz, Ohio.—Harrison County has granted to J. A. White the franchise for an electric railroad connecting Wheeling and Cadiz.

Logansport, Ind.—The Logansport, Rochester and Northern Traction Company has filed resolutions increasing the capital stock of the company from $100,000 to $1,000,000.

Pittsburg, Pa.—The contract for the branch lines of the Pittsburg and Birmingham Traction Company will be let this week. There are seven miles of new road to be built at a cost of about $300,000.

Versailles, Ind.—The Versailles and Osgood Railway Company has been incorporated with a capital stock of $70,000. The directors are Grant Johnson, Alfred H. Beer, Frank S. Jones, W. D. Wilson and Robert A. Creigmile. The company will establish an electric line from Versailles to Osgood.

Valparaiso, Ind.—The Board of County Commissioners have granted a franchise to Grant Mitchener, of this city, for an interurban railway from Valparaiso via Chesterton to Michigan City and to the West County line, where it will connect with a line to Chicago. Chicago and eastern capitalists are back of the enterprise, and work on the road will begin early in the spring. The line will connect with the Northern Indiana Railway at Michigan City.

New York City.—The New York, Brooklyn and New Jersey Rapid Transit Company, of New York City, has been incorporated. It proposes to construct and operate a compressed air or electric road six miles long from Manhattan to Brooklyn. Its capital stock is $60,000, and its directors are Geo. Wilson, Adrian H. Muller, Frank N. Glover, James M. Muller, William A. Armstrong, L. F. W. Wallace, and H. N. Glover, of New York City, and John La Bura, of Jamaica, and A. L. Falk, of Brooklyn. George Wilson subscribes for $58,600 of the company's capital stock.

Newark, N. J.—Additional articles of incorporation of the Raritan Trolley Company, which is capitalized at $1,000,000, have been filed in the Middlesex County Clerk'se office. Papers filed two weeks ago set forth that James C. McCoy was the largest stockholder. In the papers filed later the name of Adolph Lewisohn, of New York, is substituted for that of Mr. McCoy, and the latter is made agent of the company, with an office in Perth Amboy. The company intends to build a trolley line through Raritan and Woodbridge townships, connecting Perth Amboy and Metuchen.

Annapolis, Md.—A bill has been introduced to incorporate the Baltimore County and City Railway Company. The incorporators are Messrs. Richard P. Choate, John S. Waters, James S. Russell, John A. Miller, Howard M. Towles, Ambrose C. Dunn, Ferdinand Bernheimer and William C. Connors. The capital stock of the company is fixed at $50,000, with the privilege of increasing it to $300,000.

Kaukauna, Wis.—The Fox River Valley Interurban Electric Railway, which was seeking a franchise here, has been obliged to change its name to the Wisconsin Traction, Light, Heat and Power Company. The new franchise was applied for by the president of the company, John I. Beggs, of Milwaukee. The two lines will connect at Appleton and will form a link in the line from Oshkosh to Green Bay.

Pittsburg, Pa.—The Union Traction Company has been chartered with a nominal capital of $1,000. This is the new company organized to acquire control of the traction lines of Pittsburg, Allegheny City and the suburbs from Wilkinsburg to East Pittsburg. The officers of the Consolidated Traction Company have promised to issue a circular to stockholders, and a special meeting of that company will be held March 31, to vote on a proporistion to lease the property and franchises to the new company. The capital of the latter will be increased as occasion may require to a total which may reach $40,000,000. The incorporators are Arthur M. Richmond, Frank H. Clark, Arthur E. Braun, William South and Winfield B. Carson, all of Pittsburg.

POSSIBLE INSTALLATIONS.

Pittsburg, Pa.—The Southern Light, Heat and Power Company, operating electric plants at Crafton, Carnegie and McKees Rocks, has filed a mortgage for $300,000, to guarantee bonds to be issued to build proposed extensions south of the Monongahela River. The McKees Rocks plant is to be enlarged, to become the central power plant of the system.

New York Notes.

W. B. VAN DE WATER, former assistant general manager of the Interior Conduit and Insulation Company and the Sprague Electric Company, is now to be found at room 610, 136 Liberty street, where he represents the well-known Robbins &Meyers Manufacturing Company, of Springfield, Ohio.

DAVID CHALMERS, former manager for the Holtzer-Cabot Electric Company at 112 Liberty street, a familiar and well-known figure to the trade throughout North America, has opened offices 423-424, at 136 Liberty street, where he will be pleased to meet all of his old friends and the trade generally.

WESTON STANDARD

PORTALE DIRECT READING

VOLTMETERS AND

WATTMETERS

For Alternating and Direct Current Circuits.

The only standard portable instrument of the type deserving this name.

Write for Circulars and Price Lists 8 and 9.

WESTON ELECTRICAL INSTRUMENT CO.,

114-120 William Street, Newark, N. J.

BERLIN. European Weston Electrical Instrument Co. Ritter Strasse No. 88.

LONDON. Elliott Brothers, No. 101 St. Martins Lane.

The Electrical Age.

Vol. XXV—No. 14. NEW YORK, APRIL 7, 1900. Whole No. 673.

Electric Street Railways.

Re-Constructing for Underground Trolley.

FROM CABLE TO UNDERGROUND TROLLEY.

The recent transformation of New York's systems of surface roads has been an instance of expenditure, with reference to the change, unparalleled in the history of suriace roads. Possibly a little of the disaster that afiected the Third Avenue street railway system in New York was caused directly by the enormous sums of money absorbed in instituting the change from cable to system was kept in operation during the entire transelectricity. A force of men were kept constantly employed, varying in number from one thousand to two thousand, in digging up the tracks and streets, laying conduits, drilling, cementing, etc. It was necessary during the operation to be on the alert for moving cars as the formation. It was necessary for employees to hop in and out every few minutes with the result that any piece of work ordinarily requiring five or ten minutes application could not be completed before twiee that time had elapsed . In consequence of this the expenses attendant upon the change from cable to electricity cost twice as much, and in some cases more than three time the original estimate. The Broadway cable road invited an expense of $160,000 per mile. If the same system is followed the total cost will reach at least $200,000 per mile. Fortunately the conduits are in situ and it will be merely necessary to pull the cables or feeders through, attach the bond wires from the conducting rails and the system will be ready for use. The difficulties met with in the Third Avenue will be more tnan surpassed in the Broadway with the same change effected in the change of the rail. The original rails laid down on the Third Avenue road were too light for the weight of the loaded car and, in fact, insufficient for the procuring of a tight grip. The change in rails, as well as the additional electrical equipment, caused an expense a little greater than that originally anticipated. It is very likely that the cost per mile of the Third Avenue system exeeeded $200,000 per mile. In fact, the enormous debt they saddled themselves with, part of which was caused by labor bills, proves, in spite of the overcharging for general contracting, that money would have been saved if the road had ceased operating one or two days each week. It is very likely that other street railway corporations will gain through the lesson taught by the Third Avenue road and in the future transformation of the remaining cable systems from their present mode of power to electricity President Vreeland will probably be careful in selecting the time and manner of effecting the change.

NOTES ON ELECTRIC TRACTION UNDER STEAM RAILWAY CONDITIONS.

BY EDWARD C. BOYNTON.

(Continued from Page 100.)

POWER TRANSMISSION.

Feeders.—The transmission of electric power forms the most important part of the problem of the electrical equipment of a steam road. At the present day our railway motors all require the direct current, and we are therefore limited to its employment in the working conductor. By increasing its voltage from that usually employed to 700 volts, a considerable advantage is at once gained, and without additional expense in motors or generators. Experience has shown that the economical radius of operation of a power station generating such a current and delivered to the line without feeders is from 10 to 12 miles. This refers to a heavy train service with a fairly frequent schedule, and an average load of 500 amperes on each radial line of single track.

By the line or working positive conductor is here meant a steel rail of 90 to 100 pounds per yard, well bonded, and equal in conductivity to about 1,200,000 cm. of copper. The statement, "without feeders," may be wondered at, and a few words of explanation will be necessary.

It should be remembered that the conditions are very different from street or elevated road. There may be only two, or at most three trains running. The greatest fall in potential occurs when a train is leaving the further end of the line, and this may be somewhat less than 3-4 of a volt per ampere at that point, while the average efficiency of the line is over 75 per cent. Again even if the loss in the line becomes greater through an attempt to increase the number of trains, or to extend the line, the question of feeders depends almost wholly on the cost of fuel. If the interest on the cost of feeders is greater than the saving in fuel consumption effected by their use, and a satisfactory train schedule can be maintained without them, it cannot be in the interest of economical operation to provide them. It has been said that such feeders in connection with a so-called booster used to overcome the drop in the feeders, and as consequent decrease in their weight, are the most economical. Such an arrangment is undoubtedly cheaper as regards first cost, but I have seen no data showing the cost of maintenance and depreciation of these additional machines, as compared with the cost of a feeder of sufficient weight to perform the work without the booster, and on which there is practically no depreciation. Whichever method is followed, the cost of feeders for such a road will reach many thousands of dollars, and railway managers will make the most rigid investigation of traffic conditions, present and prospective, before deciding upon such an outlay.

The above statement should make intelligible the reason why 10 or 12 miles is considered the maximum radius of operation of a station delivering 700 volts direct current. It is hardly necessary to add that a larger system extending over greater distances should be supplied by multiphase generators, and a high tension transmission line combined with the usual rotary converters, located at suitable points on the system. In the absence of a practicable alternating current railway motor, the above system is the only one—there is no choice.

In regard to the most economical material to use as feeders, the extremely variable prices of both copper and steel, render it difficult at present to come to a satisfactory decision, but with both metals at what we may call their normal values, steel is cheaper and more satisfactory. The author believes a proper feeder for 700 volts direct current should be made of flat steel bars about 1 -inch by 5-inch section, two of which are placed side by side, bolted together with alternated joints and supported on at the side of the road bed, not over two feet high and edge in the slotted tops of small posts set in the ground boxed in. At grade crossings the break in these feeders must be bridged by either an underground or overhead connection. In yards and stattions where there is a multiplicity of tracks it will be frequently necessary to carry them overhead for considerable distances. Copper is of course used in such cases.

The Working Conductor.—In considering a train service consisting of heavy trains running at the speed mentioned the trolley wire as a working conductor will probably not come into general use, although it is used for such a service to-day. The cost of construction, maintenance and depreciation is greater than that of a third rail. It has few advantages, and many disadvantages for such a service. It is now generally conceded that an insulated rail placed close to the track answers all requirements, and the author's experience shows that it is satisfactory. It is difficult to understand, however, why the common form of T-rail is so generally used for this purpose unless it is due to a desire to save money by using up old rails. A more inconvenient cross-section for thorough and efficient bonding could hardly be selected. It will be admitted by all that this conductor should be so bonded that when worked at its full capacity there should be no greater loss at the joints than elsewhere. There are a number of standard commercial forms of rolled steel which are no more expensive than T-rails that are well suited for this purpose. A form that will permit the use of one or more thin copper plates of ample area of contact held at the joints between a steel splice plate and the conductor by heavy pressure obtained by the use of a sufficient number of bolts, is an inexpensive and satisfactory bond. The rule that the bond shall be equal in carrying capacity to the conductor, and the area of contact equal to or greater than the cross-section of the conductor, and the area of contact equal to or greater than the cross-section of the conductor is a safe one to follow.

One question which has been studied with care is of great importance in this latitude, and that is the effect of ice on the contact surface, and how to get rid of it. Many experiments have been tried, and few can be said to have been successful. A further possible advantage of the use of some other form of rolled steel might result in the complete elimination of this trouble. I refer to the collecting shoes having a side or under running contact. This would allow the partial roofing over the conductor by wood, which would thoroughly protect it from the weather.

Ordinary snow storms and even blizzards do not interrupt the service. I have seen a storm which tied up nearly every wheel in a nearby State, but the electric service was the last to succumb, and even then it was not on account of the conductor rail, or too much snow on the roadbed, but from a train running off an ice choked frog. It has been demonstrated that most coaches equipped with proper steel brushes for the third rail and snow plows, can go through as much snow as an ordinary passenger locomotive. Their great advantage lies in the fact that they can run through deep snow slowly, due to the enormous torque of the series motors and the absence of reciprocating parts. But when the temperature of the conductor rail is below freezing point, and it begins to rain, as is not infrequently the case, a coating of ice forms on the contact surface which closely resembles enamel. No mechanical method has been found to completely remove this.

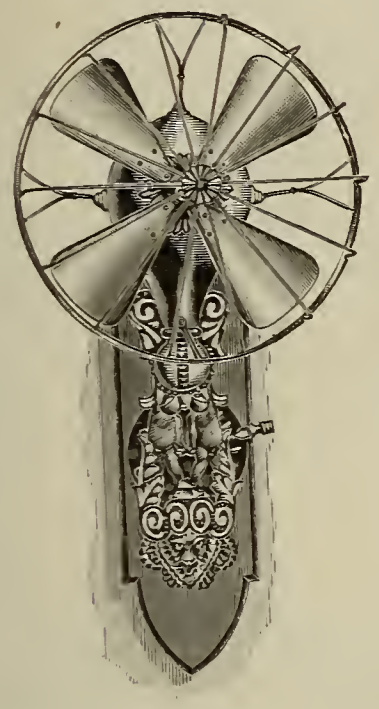
As to chemical methods, certain roads can and do use salt or brine. It is not considered advisable to salt the road bed of such a road as is under discussion owing to the danger of leakage should the track become flooded with water. When applied at the right time, an oil which does not solidify at a low temperature is sometimes successful, but the difficulty of applying it to the whole road at the proper time can be appreciated.

(To be continued.)

Fan Motors.

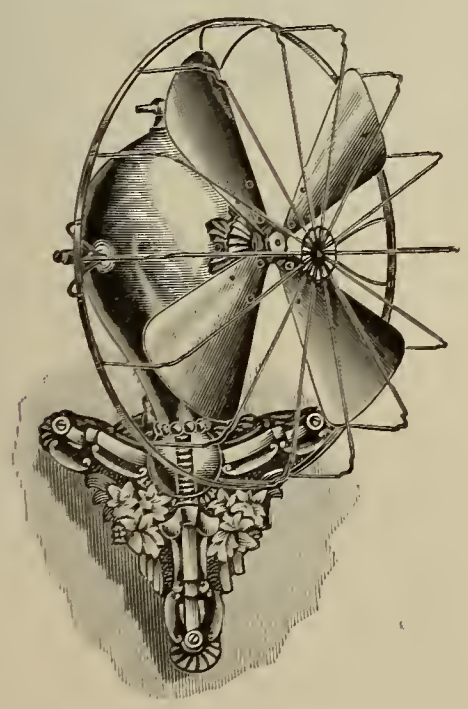
THE WING "BEAUTY" FANS.

L. J. Wing, 95 Liberty Street, New York, the well known manufacturer of Wing's disk fan, etc., has just placed upon the market his new electric portable wall and bracket fans, in twelve and sixteen inch sizes, for



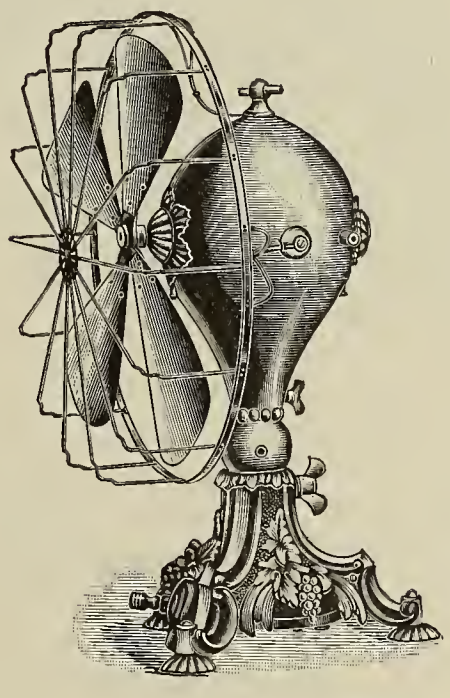
Wing's "Beauty" Bracket Fan.

incandescent circuits. Mr. Wing has been working on the design of these fans for some time and we congratulate him upon his care and judgment in presenting an article that will be appreciated by a class of consumers having a taste for the serviceable as well as



Wing's "Beauty" Wall Fan.

the beautiful. The metal case of the fans is pear shaped with the oval at the top, as shown in the illustrations, and is made of fine spun brass, at the base of which is a metal ball which rests in a socket, part of the ornamental base. This socket is part of a beautifully ornamented base; spreading out from three sides are richly carved feet with rubber cushions to secure noiselessness in the running of the fans; at the same time the rubber avoids abrasion of finely polished office furniture. Back of the ball in the upper case is a large thumb screw which allows the fan to be moved at any angle when in operation. Above this large thumb screw is a smaller one by which the fan can be moved in any horizontal plane. This is a great convenience as it avoids the necessity of lifting the fan in order to change its position. Enclosed in the upper case are the fields and armature, wound for direct current in a special manner to secure the highest efficiency, and by a new method which we are requested not to des-



Wing's "Beauty" Portable Fan.

cribe as it contains some new patented features which avoid all danger of burning out while the fan is in operation, and is automatic in connection with the three speeds. Every motor has self lubricating bearings. The fan blades are all made solid and rigid and the guard is of a very substantial pattern of solid brass. We call the reader's particular attention to the three illustrations of these beautiful designs in fans and he may see for himself after examining the details, that the fans themselves are not even given justice in the beauty of the designs as shown. They are electrically and mechanically perfect and must be seen to be fully appreciated.

Port Arthur, Ont.—The Electric Railway and Light Commissioners have recommended to the council to authorize the installation of a water power plant at Current River, the plant to be of a capacity of 300 horse power—200 horse power for electric light and 100 horse power for railway purposes—at a cost not exceeding $5,000.

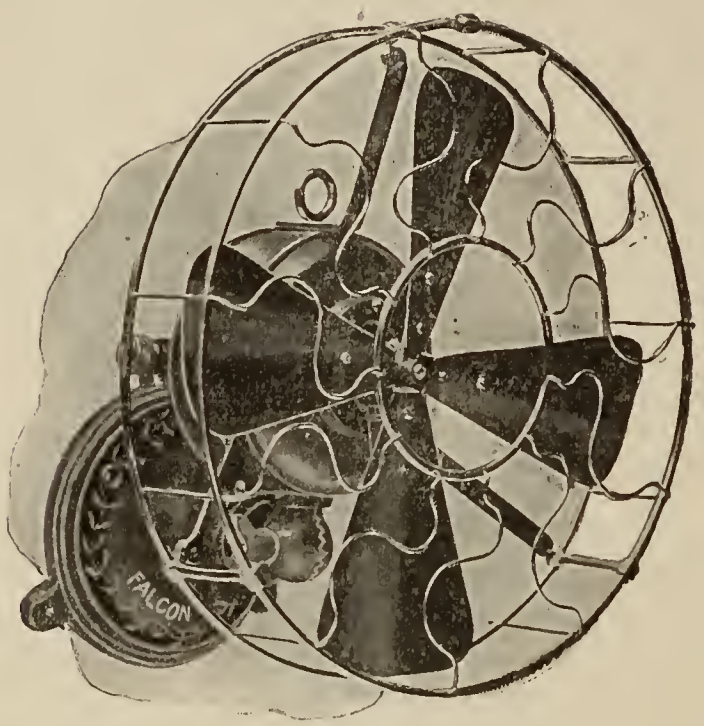
St. Catherines, Ont.—A project for an electric railway from this city to Wellandport, via Fonthill and Pelham, is under consideration. Buffalo capitalists are interested in the scheme.

Ottawa, Ont.—The contract will be let this week for the Britannia extension of the Ottawa Electric Railway.

Moncton, N. B.—It is said that negotiations are under way looking to the extension of the street railway.

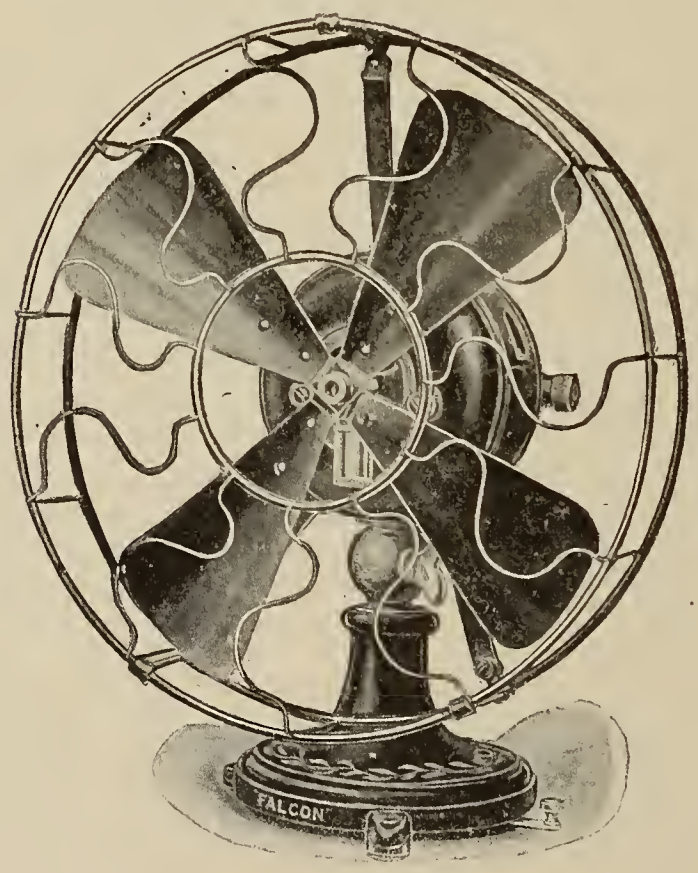
THE FALCON ELECTRIC FAN.

With the growth of the fan motor industry various improvements in fans make their appearance in connection with all new types that appear. The Falcon 1900 direct current fan motors are placed on the market with



"Falcon" Wall Fan.

the idea of giving to the public at a reasonable price a fan motor that is electrically, mechanically and in design a first class machine in every respect. These fans are guaranteed to be equal to any of the so-called superior

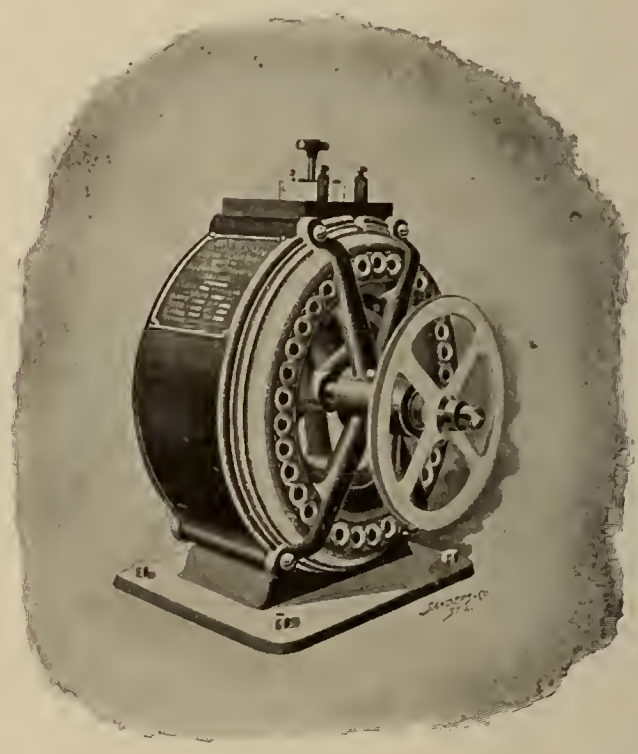


"Falcon" Desk Fan.

makes, the low price and high quality being noticeable features. Motors are manufactured for twelve and sixteen inch fans for 115 volts, 230 volts and battery circuits and are provided with a universal joint so that they can be used as desk fans or bracket fans without adding or changing parts. By means of the resistance and regulating switch in the pedestal three speeds can be obtained, the motor running noiselessly on either of the three steps. The armatures and fans are carefully balanced, thus securing a perfectly smooth running motor and, in connection with the self-oiling bearings, requiring little or no attention. These motors are finished in black japan with gold stripes and polished brass for the fan and guard. The address of the Falcon Manufacturing Company is 432-436 E. Seventy-first street, New York City.

EMERSON FAN MOTORS.

Various types of ventilating apparatus, including the newest fan motors, are presented to the public through these columns and illustrated, as shown, all representing various types manufactured by the Emerson Electric Manufacturing Company, of St. Louis. Every motor is guaranteed to be free from electrical or mechanical defects, and repairs are made free of cost for one year from date. The desk fans are strongly constructed, a shaft made of hardened steel supplied with self-oiling bearings, well ventilated and laminated so as to allow free radiation, and in various other detailed respects designed with a view to lightness and durability. The switch on the desk fan permits of operation on three speeds, and the points "Start" and "On" explain the



The Emerson Motor.

management of the same. The weight of motor complete is twenty-three pounds and it is finished in black japan and gold. It takes sixty-five watts and runs at fifteen hundred revolutions and operates noiselessly. The sixteen-inch desk fan which, as well as that above described, is operated by alternating current, possesses in detail the same high finish, design and durability. At the running it consumes one hundred watts, the speed being sixteen hundred revolutions per minute. The weight of motor complete is thirty-one pounds. It is finished in black japan and gold, with highly polished brass fan, complete with improved guard. The latest model desk fan motors are furnished in bracket fan type, as illustrated. The bracket is of handsome design and strong construction. It has a swivel base so that the direction of the breeze may easily be changed. The liability of rattling, caused by the alternating current, has been entirely avoided by this bracket, by lining the socket with felt in such a manner as to form a perfect cushion. The 16-inch size is useful for offices, restau-

The Electrical Age.

ESTABLISHED 1883.

Entered at New York P. O. as second-class matter, January 18, 1891.

THE ELECTRICAL AGE PUBLISHING CO., Publishers.

TERMS OF SUBSCRIPTION:

One Copy, one Year, - - - - - - - - - $2.50
One Copy, six months, - - - - - - - - 1.25
Great Britain and other Countries, - - - - 3.50

Cable Address (all Cables), "Electage," New York.

NEWTON HARRISON, E. E., EDITOR.

ASSOCIATE EDITORS:

ALFRED E. WIENER, E. E., } ELECTRIC LIGHT AND POWER.
OSBORNE P. LOOMIS, E. E., }
JOSEPH MUIR, M. D., } ELECTRO-
FREDERICK STRANGE KOLLE, M. D., } THERAPEUTICS.

ADDRESS ALL COMMUNICATIONS TO
THE ELECTRICAL AGE PUBLISHING COMPANY,
Seventh Floor, World Building,
NEW YORK.

NEW YORK, APRIL 7, 1900.

CONTENTS:

THE GAS ENGINE FOR ELECTRIC LIGHTING.

The enormous development of the electric light and power industry has drawn attention to the value, in a relative sense, of the various sources of power. Oil heated boilers, the use of culm and the employment of gas engines means less expense for fuel with consequently greater earning for any given corporation engaged in the sale of electricity. The use of illuminating gas in connection with gas engines for electric lighting presents a proposition which, from a purely economic standpoint, is interesting and attractive. In electric light and power stations the care of the machinery, such as deterioration of boilers, incidentally the risk of explosion, the transportation and handling of coal and the floor space occupied by the boilers, leads to the question whether it would not be cheaper, as regards the first cost of installation, and better, as regards the future operation of the plant, to install gas engines. The price of gas for power purposes could be well redueed to forty cents per thousand cubic feet and, on the basis of five cubic feet per lamp hour, two hundred sixteen candle power lamps could be operated for an hour, at a cost of forty cents plus the other incidental expenses of the station. These expenses would be certainly reduced in any plant operating under the above conditions. A smaller station could be used as the only moving machinery would be the gas engines and generators; there would be little or no heat, no coal, ashes or boilers. A thousand light plant run by gas engine would, in the end, be much cheaper if the engine is constructed on the best modern principles than possibly a plant operated by a triple expansion engine. It is not only the efficiency of the combination that must be considered, but the running expenses of the plant. Without it being necessary to actually predict the conditions under which electric lighting will be done in the future this much, at least, is certain that in many of our larger cities the employment of gas engines for the running of large generators will be a common practise. In Germany gas engines of at least five hundred horse power are in use and the conditions under which they are run indicate a great saving which, of course, finds its way into the pockets o the stockholders. But, nevertheless, it is a desirable feature in any case.

According to one of our contemporaries a gigantic gas engine electric light station is in prospectus. It is proposed to build engines, aggregating thirty thousand horse power, to drive the generators of a huge electric plant. Each of the gas engine units will be of fifteen hundred horse power, two of which are being actually constructed by the Westinghouse Machine Company's works. In the light of these facts it is certainly evident that the economic conditions in the projected scheme of using very large gas engines are much more favorable than those met with in a steam plant. Some figures given by an authority in "Cassier's Magazine" are contained in the following statement: "If therefore efficiencies in an electric station are put at eighty per cent. for boiler plant, fifteen per cent. for engines as to their delivered work, and ninety per cent. for dynamos, disregarding any battery losses, the resulting figures will be beyond actual attainment. The combined efficiencies of these several elements in electric generating plants amount to .80 x .15 x .90=10.8, that is, the energy delivered as electric current at the connections to distribution line cannot be more than 10.8 per cent. of that developed by the combustion of fuel. * * * * * * Gas engines have a low efficiency compared with electric motors and in moderate sizes their delivered power can be fairly taken to represent twenty per cent. of the heat energy in the gas consumed. Even with this low efficiency they are able to show an output equivalent to a total of fifteen per cent. of the energy in fuel consumed at gas plant." To sum up, it is necessary to take into consideration the advantages gained by the use of gas in this manner, i. e., merely as a souree of power, a gas engine far exceeding for this purpose steam engines of the highest order of construction. With gas produced at the great coal fields in Pennsylvania and transmitted from there to various large cities by means of a pipe line electric light plants in New York at least, would be driven by gas engines with a direct saving of more than two per cent. in the cost of fuel, twenty-five per cent. in the cost of installation and ten per cent. in the cost for labor.

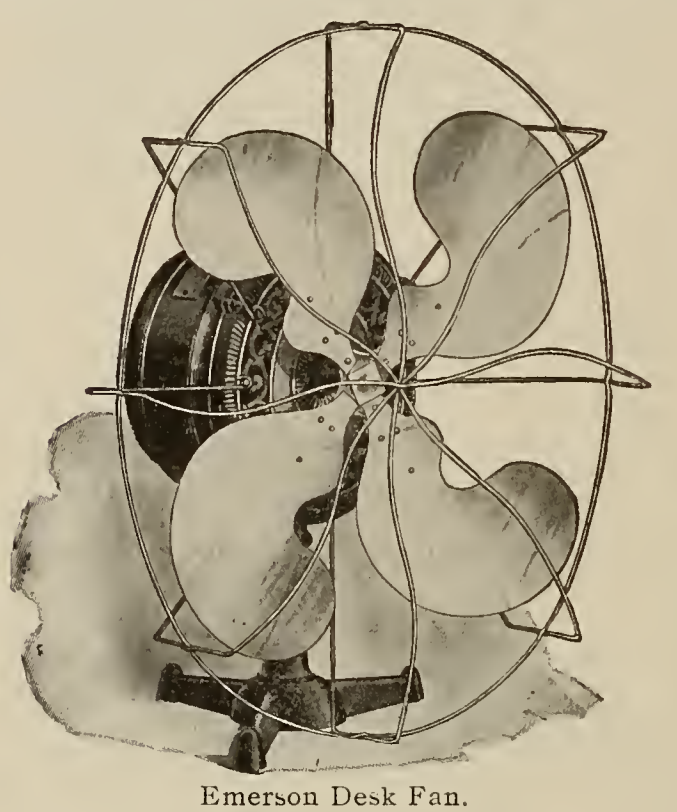
THE SOUTH MAGNETIC POLE.

It may surprise our readers to know that the earth is possessed of two south magnetic poles, one much stronger than the other, yet both are obviously in existenee. The Borchgrevink South Polar expedition recently returned from New Zeland after having discovered the exact position of the stronger south magnetic pole. It is frequently confusing to the lay mind to understand the distinction between the various poles with which our earth is blessed. There is the North pole, of Nansen fame, of a purely geographical character; then there is the north magnetic pole, situated near Hudson's Bay. Below the equator the south geographical pole exists as well as the south magnetic pole, recently located. The most remarkable feature in connection with either the north or south magnetic poles is the fact that they are constantly changing their position. A kind of terrestrial unrest affects them and the disquieting influence of the vast solar storms of a cyclonic nature, known to us as "sunspots," invites speculation of an astronomic as well as metaphysical character. The expedition of Herr Borchgrevink was organized in Norway and London through the aid of Sir George Newnes. One of the objects in view was the search for Gerlache, a Belgian explorer, the other was the discovery of the south magnetic pole, believed to be situated in latitude 75 degrees, 5 minutes south and longitude 150 degrees east.

(Continued from page 108.)

rants, saloons, theatres, lodge rooms, etc., and owing to the improved noiseless fan blade can be used in many places where the regular type of fan would cause a disagreeable buzz. The Emerson sixteen-inch residence fan operates at one-half the speed of the regular desk fan and is extremely noiseless in operation. It does not throw as strong a blast of air as the regular motor, but gives sufficient breeze for use in residences, and is the only alternating current fan motor that can be comfortably used in a sick room. At the running speed of seven hundred and fifty revolutions a minute it takes but forty watts. The weight of motor complete is twenty-one pounds.

The ceiling fan for low, alternating systems, of the Emerson Company, with or without fixtures, possesses great interest. They are made finished in brass, nickel, or oxidized copper, as ordered. All ceiling fans are completely connected when shipped, it being only necessary to bring the line wires to the binding posts on the top of the motor. In addition to the necessary wiring all ceiling fans are furnished with two wires running

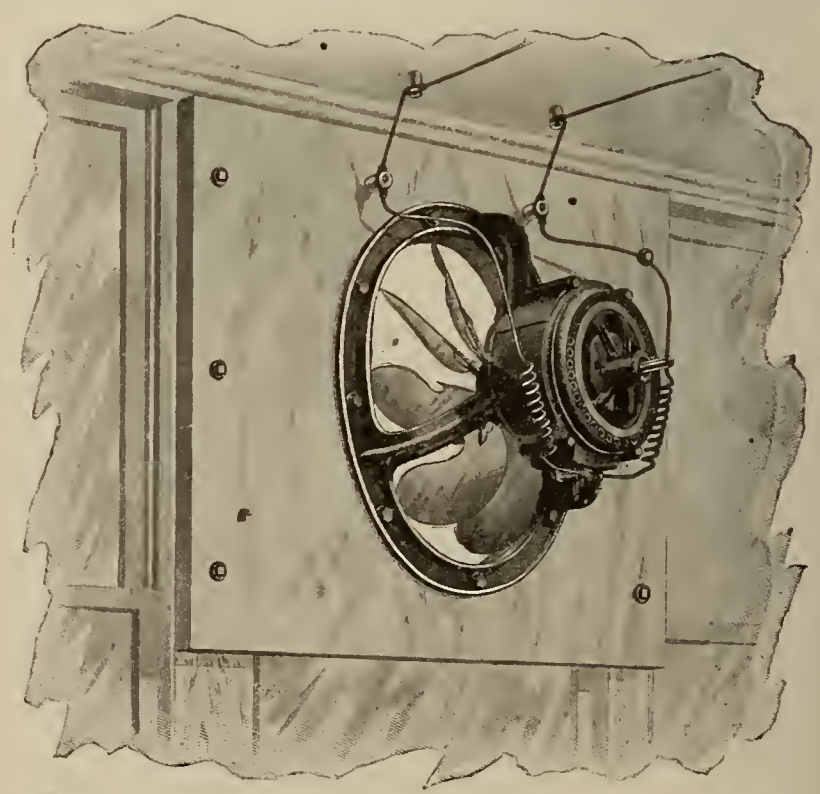


Emerson Desk Fan.

through the shaft, to which two or four incandescent lights can be added at any future time. The regular fan blades are arranged to throw the air down, but for use in offices where ventilation is desired without the annoyance of the breeze disturbing papers, left hand fans are supplied which draw the air up. The ceiling fans are all supplied with a switch, easily accessible for starting the motor and stopping it. On some two speeds can be obtained, although one is generally sufficient. The lubricating device, and the fact that the revolving armatures rest on ball bearings running in hardened steel race ways, constantly immersed in oil, are sufficient evidence of the care used in perfecting the mechanical elements. The two-bladed fan consumes about one hundred watts at 160 revolutions a minute. The ceiling fan, with four light fixtures attached, consumes the same current plus that of the lamps. The Emerson ceiling fan for high alternation systems is built with a motor the same as that on the other types, but the fan has five blades, the sweep being thirty inches. The current consumption equals one hundred watts at a speed of from five to six hundred revolutions a minute. The eighteen-inch alternating current exhaust fan direct connected with one-quarter horse-power alternating current motor attached, is the first of its kind on the market. The current consumption is about 125 watts for the twelve-inch size, 250 a much larger motor for the same size fan, as the exhaust fan must move the fan at a very much greater velocity. Occasionally the work is done against a wind pressure, therefore a sixteen-inch fan motor would be selected to drive a twelve-inch exhaust fan, etc. The above concern have also placed a line of small power alternating current induction motors for single phase currents on the market. The motors are built for medium and slow speeds. Their form and characteristics are well shown

Emerson Ceiling Fan for High Alternation Systems.

in the cut, and in all probability this type will cover satisfactorily a large part of the demand for motors having from one-quarter to one-tenth actual brake horse-power. As there is no insulated wire in the armature there is no danger of a burn-out, and the application of the induction principle as shown in these motors leaves them without brushes and commutator. As far as reliability



Emerson Direct Connected Alternating Current Exhaust Fan.

and substantial construction is concerned these motors certainly rank with the highest and find great application for driving plate glass machines, dental work, small pumps, sewing machines, telephone generators, etc. The New York office of the above company is at 136 Liberty street, in charge of Thomas T. Richards, the vice president of the Emerson Electric Manufacturing Company, who will handle the trade in the eastern market.

Book Reviews.

ELECTRIC WIRING.

By Cecil P. Poole.

If originality is any indication of high quality the little volume, modestly termed "Electric Wiring," by Cecil P. Poole, certainly belongs to that category. It is refreshing to occasionally meet with a volume whose contents not only appeal to those for whom it was intended, but to another class of readers, more or less critical, whose opinion of a book is based upon its scientific foundation as well as its contents. In the one hundred or more odd pages of "Electric Wiring," the subject of drop is discussed with reference to lamp feet and a system followed illustrating the application of this idea. The book contains sufficient diagrams to fortify the reader's mind when in doubt, and tables for two and three wire circuits, covering the ground in every detail. The most interesting part of the book, however, which many practical men have sadly needed, is that treating of alternating current wiring. The writer is thoroughly well acquainted with the subject, and shows a well organized mind by dividing this important subject up under the headings of inductive circuits, impedance, corrected drop, power factor, primary lines, etc., gradually leading into the subject of two and three phase wiring. So much rule of thumb has been in vogue regarding this peculiar class of work that, as remarked in the beginning, it is refreshing to meet with a presentation of the subject based not only upon sound, practical experience, and a full appreciation of the conditions, but upon reasoning that reaches into the very roots of the matter and, therefore, can be relied upon by the technical as well as the practical man. This excellent volume treats of aluminum wires for alternating current circuits, gives comparative tables for copper and aluminum, and a variety of diagrams illustrating transformer connections for all kinds of systems of the polyphase order. The book can be highly recommended and will prove a great source of instruction to those presuming to be fully acquainted with the details of direct and alternating current wiring. Published by the Power Publishing Company, $1.00.

CONDENSERS.

By F. R. Low.

A series of articles that have appeared in the columns of "Power" have been collected under the head of "Condensers" and published in book form by the above periodical. This volume contains an immense amount of interesting matter relating to condensers, their practical application, the advantages of various types, and many other important details relating to their use. The subject is treated in a simple, lucid, and, at the same time, scientific manner. The premises are carefully established and the conditions relating to the use of condensers brought to the reader's mind without effort. It is necessary in treating this subject to consider the various types of condenser separately, and in this respect the author has done full justice to the subject. The jet condenser, the surface condenser, the injector or siphon condenser, and the exhaust steam and induction condenser indicate a system in treating this indispensable article of steam practice approximating a classic style. Many other useful facts are discovered in the pages, and a mechanical engineer cannot do better than occasionally read through this little volume to refresh his memory and crystallize ideas that are apt to become more or less dim. This excellent volume may be obtained from the Power Publishing Company.

COMMERCIAL AND BUSINESS ASPECTS OF MUNICIPAL ELECTRICITY SUPPLY. A PRACTICAL HANDBOOK FOR THE USE OF ELECTRICAL ENGINEERS TO MUNICIPAL CORPORATIONS AND MEMBERS OF MUNICIPAL ELECTRICITY COMMITTEES. BY ALFRED H. GIBBINS.

This volume, parts of which have appeared in the columns of "The Electrician," London, is intended for the purpose of discussing the conditions governing the supply of electricity for commercial purposes. In the development of this idea the author defines the position of the electricity department in relation to other municipal departments and considers the profits made by the Bolton corporation, which does its own wiring work; the Corporation of Leicester, etc. The author then discusses the rates to charge for electrical energy and divides the expenses up under the head of "The Cost of Generation" and the "Standing Charges" which are again subdivided into their various constituents. In this manner, aided by various references, illustrations, etc., the wiring question, the charge for current, the installation of arc and incandescent lamps, the hiring out of motors and other apparatus are considered from a financial standpoint. The meter question meets with some attention, as well as the use of current for purposes which call for a yearly contract without meters. The author concludes by saying: "To sum up the whole matter, it appears that at the present time the great object for municipalities to aim at is the reduction of the price at which electricity can be supplied." The book is curious because it is an English volume of unique character and treats a subject with which the American expert is not particularly well acquainted. While possessing interest for many readers of electrical literature relating to the economics of the subject, it might fall flat with those seeking for the latest in science. The book is sold by the Macmillan Company, $4.00.

ELECTROLYTIC DISSOCIATION.

By Harry C. Jones.

The theory of electrolytic dissociation owes much of its present progress and future history to the labors of Van t'Hoff. His work was in part repeated by Svante, Arrhenius, by Oswald and other investigators in this field. In this volume, containing a review of the subject, it is possible to follow intelligently the various phases of the science to its present rather advanced stage. The work of each savant is carefully and explicitly treated and certain mathematical conclusions necessary for the proper elucidation of the text given in the simplest possible manner. In the latter part of the book, on page 276, the dissociation theory, with reference to animal physiology, is discussed and certain remarkably interesting conclusions arrived at. The author states in the last paragraph: "A careful study of the applications of the theory will bring out a fact of profound significance. The theory co-ordinates and co-relates heterogeneous masses of facts which apparently bore little or no relation to each other, and refers them to a common cause. Physical chemistry is furnishing us, largely with the aid of the theory of electrolytic dissociation, with rational explanations of chemical processes whose meaning was entirely concealed, and is rapidly placing chemistry upon that exact mathematical basis which physics has so long enjoyed." Published by the Macmillan Company, $1.60.

Business News.

SPECIAL EXPORT COLUMN.

TOTAL AMOUNT OF ELECTRICAL EXPORTS FOR WEEK ENDING MARCH 31st, 1900, $51,785.

New York, N. Y., March 31, 1900.—The following were the exports of electrical material from the port of New York for the week just ended:

Antwerp.—79 cases electrical material, $4,428.

Argentine Republic.—1 case electrical machinery, $187.

British Australia.—55 cases electrical material, $2,290; 2 cases electrical motors, $280; 39 cases electrical machinery, $3,875.

Barcelona.—2 cases electrical machinery, $34.

Bremen.—1 case electros, $20; 6 cases electrical material, $89.

British Guiana.—35 cases electrical material, $5,075.

Brazil—36 cases electrical material, $1,348; 3 cases electrical machinery, $613.

British East Indies.—34 cases electrical material, $771.

Berlin.—2 cases electrical material, $611.

Copenhagen.—3 cases electrical material, $78.

China.—1 case electrical material, $61.

Ecuador.—4 cases electrical machinery, $18; 1 case electrical material, $32.

Havre.—20 cases electrical machinery, $1,000.

Japan.—11 cases electrical material, $1,651.

Liverpool.—274 cases electrical material, $21,296; 10 cases electrical machinery, $875.

Lisbon.—81 cases electrical material, $3,042.

Mexico.—26 cases electrical material, $884.

Newfoundland.—2 cases electrical material, $89.

Peru.—26 cases electrical material, $914.

Southampton.—12 cases electrical material, $1,789.

Stockholm.—3 cases electrical material, $130.

Siam.—13 cases electrical material, $285.

Patents.

WEEKLY ELECTRICAL PATENT RECORD.

PATENTS ISSUED MARCH 27, 1900.

Conducted by Otto Greenberg. Complete descriptions and drawings of any patent mentioned below will be sent on receipt of ten cents.

645,933. Telephone. Michael Beck and Emil Ferrant, Minneapolis, Minn.

645,945. Dynamo-Electric Machine. G. Dolen and A. Hultquist, Stockholm, Sweden. This dynamo consists of two or more rotating disks in contact with each other at their peripherys; and so disposed in magnetic fields, that electromotive force is generated in the direction from the center of one disk to the center of another disk.

645,958. Telephone System. Albert K. Keller, Philadelphia.

645,959. Telephone Receiver. Albert K. Keller, Philadelphia.

645,960. Telephone Transmitter. Albert K. Keller, Philadelphia.

645,978. Secondary Battery. Wm. L. Silvey, Dayton, Ohio.

645,984. Electric Switch. J. C. Tournier, Schenectady, N. Y.

645,990. Trolley Wheel. Richard Windsor, Alexandria, Va.

645,992. Primary Battery. Francis B. Badt, Chicago.

646,068. Electric Switch. John S. Creveling, N. Y.

646,092. Dynamo-Electric Machine. Benjamin G. Lamme, Pittsburg, Pa.

646,100. Thermostat. Chas. B. Rogers, Stevenson, Md.

646,110. Ammeter. Peter H. Spies, Yonkers, N. Y.

646,114. Portable Electric Lamp. A. F. Vetter, N. Y.

646,121. Duplex Multiple Metallic Telephone System. F. C. Hughes, Detroit, Mich.

646,124. Combined Telephone and Vending-Machine. Chas. H. Kraft, Salt Lake City, Utah.

646,146. Snap-Switch. G. W. Hart, West Hartford, Conn.

646,147. Electric Motor. Henry F. Joel, London, Eng.

646,149 and 646,150. Electric Connections. John Langton, N. Y.

646,155. Electric R. R. Switch. Philip E. Perry, Boston, Mass.

646,179. Electric Coupling. Robert S. Ireland, Winthrop, Mass.

646,222. Electric Bell. Francis and Henry Keil, N. Y.

646,229. Surface-Contact System for Electric R. R. Robert Lundell, N. Y.

646,281. Electrolytic Apparatus. Louis Hazard-Flamand, Boulogne-sur-Seine, Fr.

646,308. Automatic Regulator for Alternating Dynamos. G. S. Neeley, Pacific, Mo.

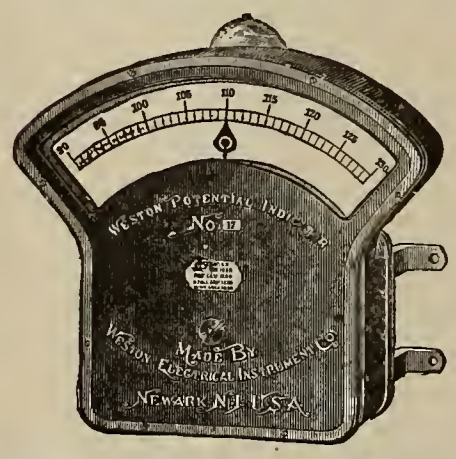
646,309. Induction Motor. G. S. Neeley, Pacific, Mo.

646,348. Secondary Battery. Henry Blumenberg, Jr., and Frederick C. Overbury, N. Y. This battery consists of a lead and zinc electrode, a porous partition between them, an electrolytic solution for the lead electrode of sulphuric acid and a sulphate of an alkali metal and a solution of the zinc electrode of bisulphate of soda.

646,362. Roentgen-Ray Apparatus. James Davidson, London, Eng.

WESTON STANDARD ILLUMINATED DIAL

STATION INSTRUMENTS.



THESE INSTRUMENTS are based upon the same general principle and are just as accurate as our regular Standard Portable Direct Current Voltmeters and Ammeters, but are much larger, and the working parts are inclosed in a neatly designed dust-proof cast-iron case, which effectively shields the instruments from disturbing influences of external magnetic fields.

WESTON ELECTRICAL INSTRUMENT CO.

114-120 William St., Newark, N. J., U. S. A.

WESTON ELECTRICAL INSTRUMENT CO.,

114-120 William Street, Newark, N. J.

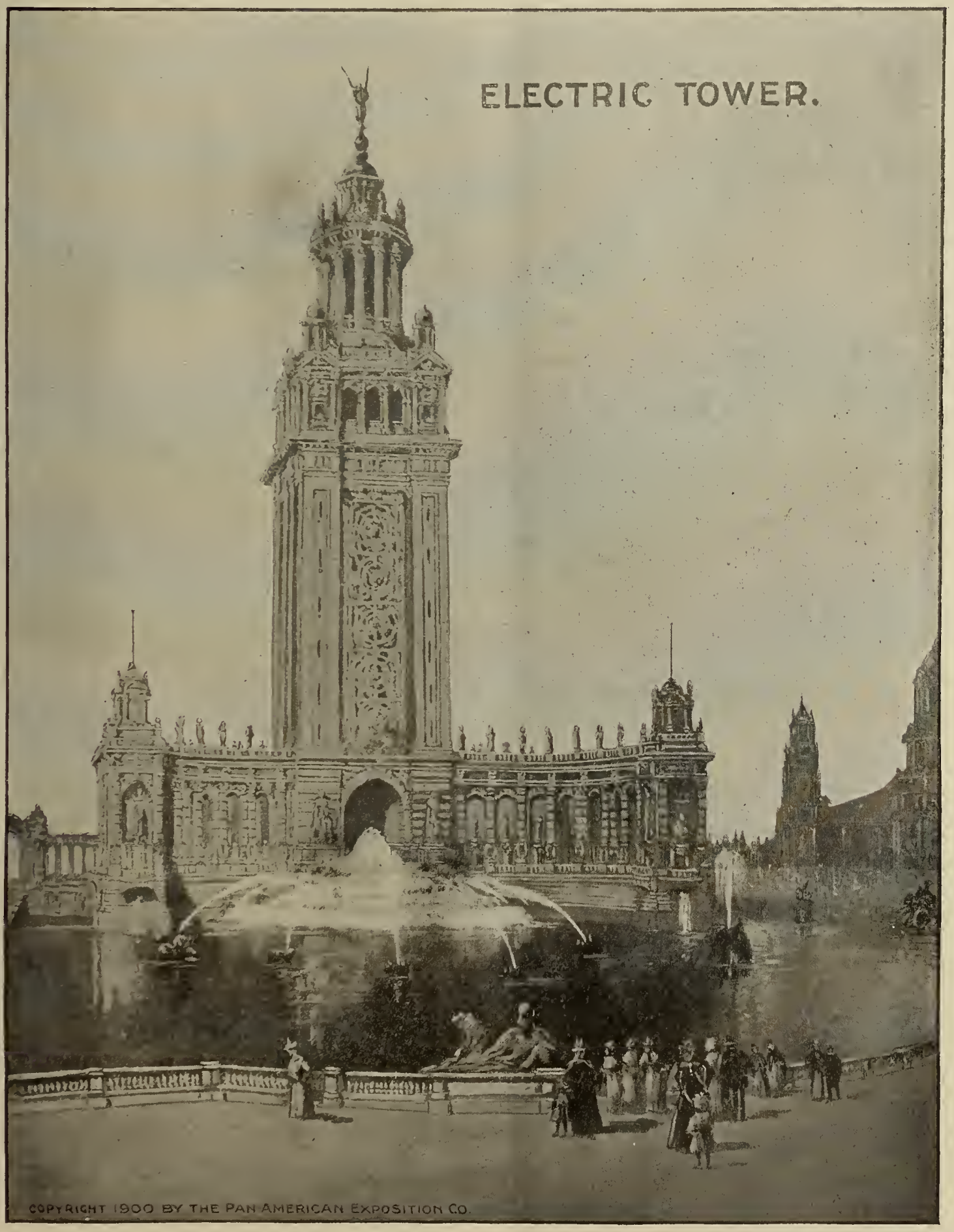
BERLIN. European Weston Electrical Instrument Co. Ritter Strasse No. 88.

LONDON. Elliott Brothers, No. 101 St. Martins Lane.

The Electrical Age.

Vol. XXV—No. 15. NEW YORK, APRIL 14, 1900. Whole No. 674.

Expositions.



THE ELECTRIC TOWER AT THE PAN-AMERICAN EXPOSITION.

The dignified and stately beauty of the great electric tower which will form the conspicuous center-piece of the Pan-American Exposition at Buffalo next year will command the rapt admiration of every visitor. The genius of the architect has been taxed to preserve lines and elements of beauty in a work of such tall proportions,

but the problem has been well mastered.

The height of the tower is 348 feet above the surface of the broad basin in which it stands. Its position is between the Court of the Fountains and the Plaza, on the north side of the Mall. It looks down upon the Agricultural Building at the east and the Electricity Building on the west. The tower proper is flanked on the east and west by long curved colonnades, which sweep to the southward and terminate in airy pavilions, forming a semi-circular space 200 feet across. Within this space and in a high niche in the main body of the tower are cascades, while all about the basin are leaping jets and countless playful figures, each with its spurt of water, combining to make a brilliant water scene. At the center of the niche is a tall geyser fountain, whose waters find their way from the high basin within the niche over successive ledges and among a multitude of vases to the level of the pool.

The main body of the tower is eighty feet square. From the surface of the water to the top of the colonnades is seventy-five feet. This portion of the structure is enriched by a system of decorative rusticated bands, which give an aspect of great solidity to the base. The shaft of the tower is treated with great simplicity. The center of each side is paneled with fantastically perforated work, through which is indistinctly revealed the massive framework of the tower. This feature is calculated to produce a remarkable effect when lighted from within, as it is the intention to do. The main shaft of the tower terminates in an elaborate entablature at the height of 200 feet. The crown of the tower rests upon this entablature and is composed of three stories of diminishing proportions and varying design. The lower of these stories is an arcaded loggia, rich in ornamentation and having the wall surfaces brilliantly colored. Pavilionettes at the corners terminate in light fantastic cupolas. The second stage, or lantern of the tower crown, is in the form of a high, circular colonnade, entirely open, so as to allow the effect of the sky to be seen between the columns. A spiral staircase within the colonnade leads to the last stage of the tower, the cupola, over whose soaring dome is poised the superb figure of Electricity herself, thus dominating the entire exposition, which owes so much to her generously exerted power.

The entrance to the tower is across an ornamented bridge from the Plaza, on the north side. Elevators will carry passengers to the various floors, which will be devoted to different purposes of the exposition, such as reception rooms, offices, restaurants, belvederes and amusement halls. A large restaurant, at a height of 200 feet, will give the diner a broad and beautiful view of the exposition and the surrounding landscape. From the cupola the eye can sweep the whole Niagara frontier and look far into Canada, beyond the majestic river that separates that country from the States.

Sculpture plays an important part in the decoration of the tower. Two magnificent monumental groups of statuary flank each of the four sides of the base. Above the water niche in the southern face of the tower is a magnificent escutcheon, representing the arms and seal of the United States. In the spandrels of the arch above the niche are sculptures in high relief. The pavilions and wings are also richly decorated with sculptures and other architectural devices. The entire exterior of the tower will be studded with myriads of electric lights, so arranged that a great variety of effects can be secured. The use of electric lights in combination with the sparkling fountains and cascades will produce scenes of fantastic beauty.

Sarnia, Ont.—David Mackenizie, representing the Sarnia Electric Railway Company, has informed the council of the willingness of the company to proceed at once with the construction of an electric railway.

Electric Railways.

NOTES ON ELECTRIC TRACTION UNDER STEAM RAILWAY CONDITIONS.

BY EDWARD C. BOYNTON.

(Continued from page 106.)

Insulation:—The question of insulating the positive rail of a 700-volt grounded circuit has in actual practice been developed to such an extent that the results obtained are remarkable, to say the least. If such methods as are now in use had been proposed ten years ago, they would have been regarded as impracticable.

For years it was the custom to consider the ground a conductor of electricity. It was of course realized that the service rails must be bonded in some way, but the ground was considered to be a great aid to the rails in returning the current. I do not propose to deny that this is true in a crowded city where there are thousands of tons of iron pipes buried but a short distance beneath the rails, but can we call this a ground return? My experience shows that the road bed of a steam road, consisting of sand, gravel or rock ballast, when dry, is a good insulator, and when wet there is but little difference. A rock-ballasted track in particular needs no insulation whatever except the wooden ties.

I am aware that such a statement may be regarded with doubt, but perhaps it can be made clearer if we take all things into consideration. The road runs through an open country, the soil is of the average composition, some of it wet, but most of it dry. If we stand on a wet spot and place our body in circuit from positive to ground we receive a shock, perhaps of maximum voltage. This would apparently show the ground to be a conductor, but a little thought will prove that it conducted a few milliamperes only. If we stand in dry earth or on a tie, we feel no shock. But the one test that proves the insulation of such a line is the leakage test. From tests made every night, for over a year, the leakage averages half an ampere per mile in dry weather to one and a quarter amperes in wet weather, and I am convinced that nearly all of this is in the underground work necessary at grade crossings and switch points. The above refers to a rail insulated upon creosoted wood blocks attached to the ties. A complete covering of snow has little or no effect on the leakage. The form of the positive rail may influence the leakage somewhat. For example, the inverted V form acts as a roof to shed water and keeps the contact surface between the block and rail dry. But there is in use several miles of ordinary T-rail as a positive conductor, laid on blocks of wood 1 1-2 inches thick attached to the ties, not creosoted, but dipped in an insulating compound. No leakage is noticeable here. We can easily understand that if any appreciable amount of the current in amperes should leak through these blocks, whether prepared or not, they would burn up. The writer, therefore, believes that such insulation of the positive rail for the current and voltage under discussion is ample, and much expense can be saved by steam roads by its use.

Track Bonding:—One of the most necessary and at the same time expensive parts of the work in changing existing steam roads into an electric line is the bonding of the service rails. The author believes he has done some of the heaviest bonding in the country, and is of the opinion that there is no satisfactory method of bonding a T-rail at present. When such bonding costs two dollars per joint it becomes a very serious matter. Bonding around the angle plate with the bonds about two feet long is out of the question, for the cost of copper would be too great and it would be exposed. Riveting the lugs on the bonds through the web of the rail is not good practice, because to secure sufficient area of contact four holes

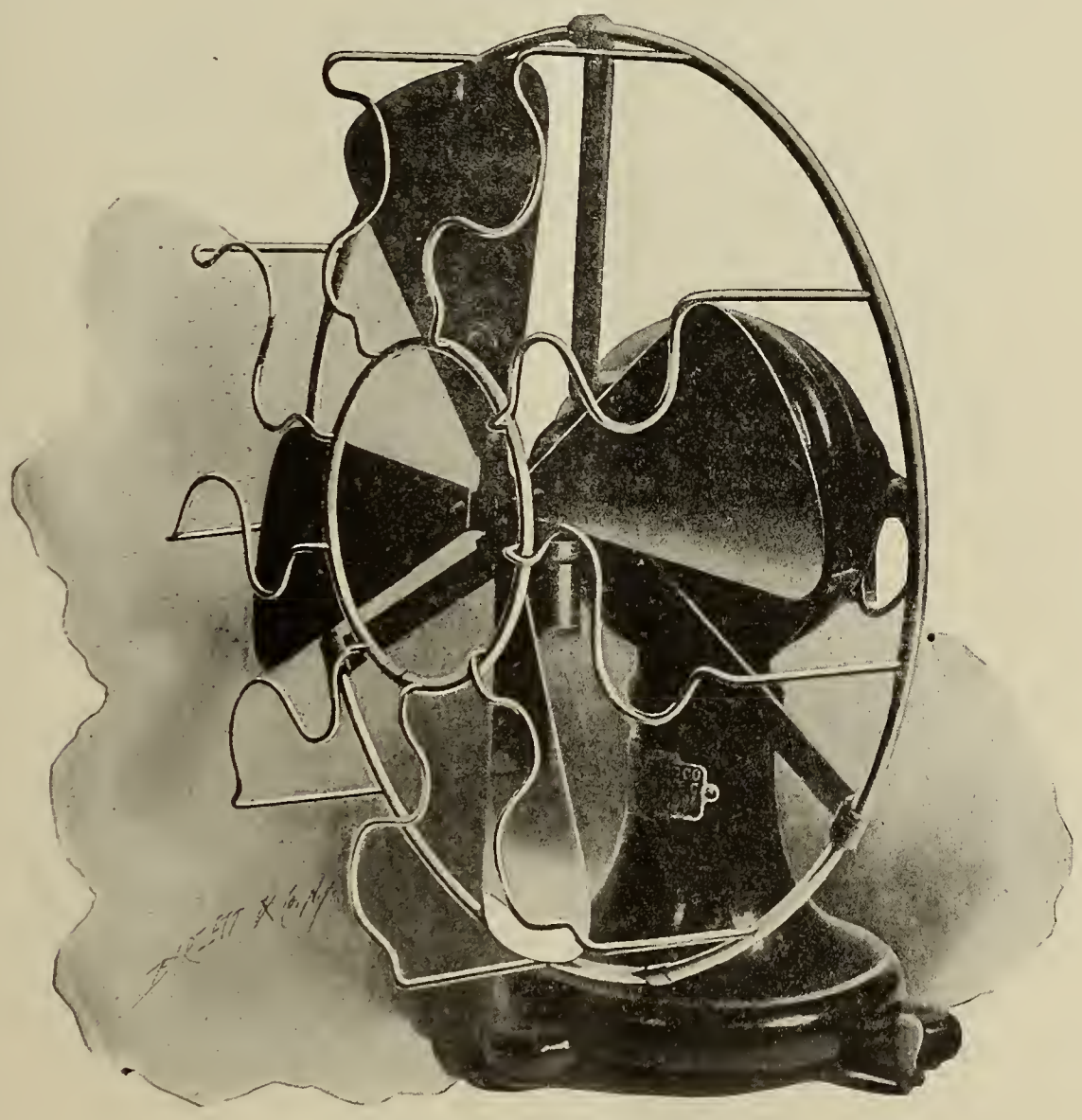
would have to be drilled in the ends of each rail, which so weakens it as to render it unsafe. The shortest possible bonds should be used under the base of the rail. It requires four one-inch holes in the base of each rail, and we can easily see how unsatisfactory and expensive this is, with four bonds of 300,000 cm. area for each joint of 100 pound steel. In nearly all rail bonds the principal resistance is in the contacts. It is a simple matter to use sufficient copper, but to secure a proper contact is a difficult problem. The bonds must have the utmost flexibility to withstand the vertical motion of the rail ends, and even then many of them will gradually break off strand by strand. What is urgently needed at the present day is a cheap and efficient bond for a T-rail. Such a bond, to be satisfactory, must show no greater fall in potential than an equal length of the rail itself, when the maximum current is flowing through the joint. On account of the fact that the ground is practically of no value in augmenting the conductivity of the return circuit, the entire circuit must be regarded as metallic, and the ground should not enter into any calculations.

Power Stations:—The writer does not propose to enter into the subject of the design and arrangement of machinery in a power station for a steam road, as there are no engineering features which differ from those encountered in such a station intended for a large street railway. An abundance of water and cheap fuel are of course important points. Such power stations can be built for from $80 to $90 per kilowatt, exclusive of the land.

A few words about the amount of power required may be of interest. An important figure is the amount of power delivered at the switchboard per train mile. It eliminates all losses due to resistance of circuit, and current used for air compressors, electric lights and heaters. This figure will vary from four to six kilowatt hours per train mile, reaching its maximum in December and January, due to the longer hours of lighting the cars, the constant use of electric heaters, and the frequent running through snow.

The question of heating a standard coach by electricity is one that should be thoroughly understood. Street car heating is totally different. The public demands the same temperature as is furnished by steam, which is 68° or 70° F. It makes but little difference what heater is used, provided there are enough of them. One may radiate its heat faster than another, and so raise the temperature of the car more rapidly, but it will require, in any case, from 12 to 15 kilowatts of energy for each coach. An ordinary train consisting of a motor car and two coaches weighing 200,000 pounds, will require at a speed of 35 to 40 miles per hour on a level track, about 125 kilowatts, or about 166 H. P., of which the car alone would consume 75 K. W., if running light. The motor will consume an average energy of four to five kilowatt-hours per train mile, or 40 to 50 watt hours per ton mile. Power can be produced with condensing engines and fuel at about $2.30 per ton, for about .008 ($^{8}/_{10}$ of a cent) per K. W. hour.

(To be concluded.)



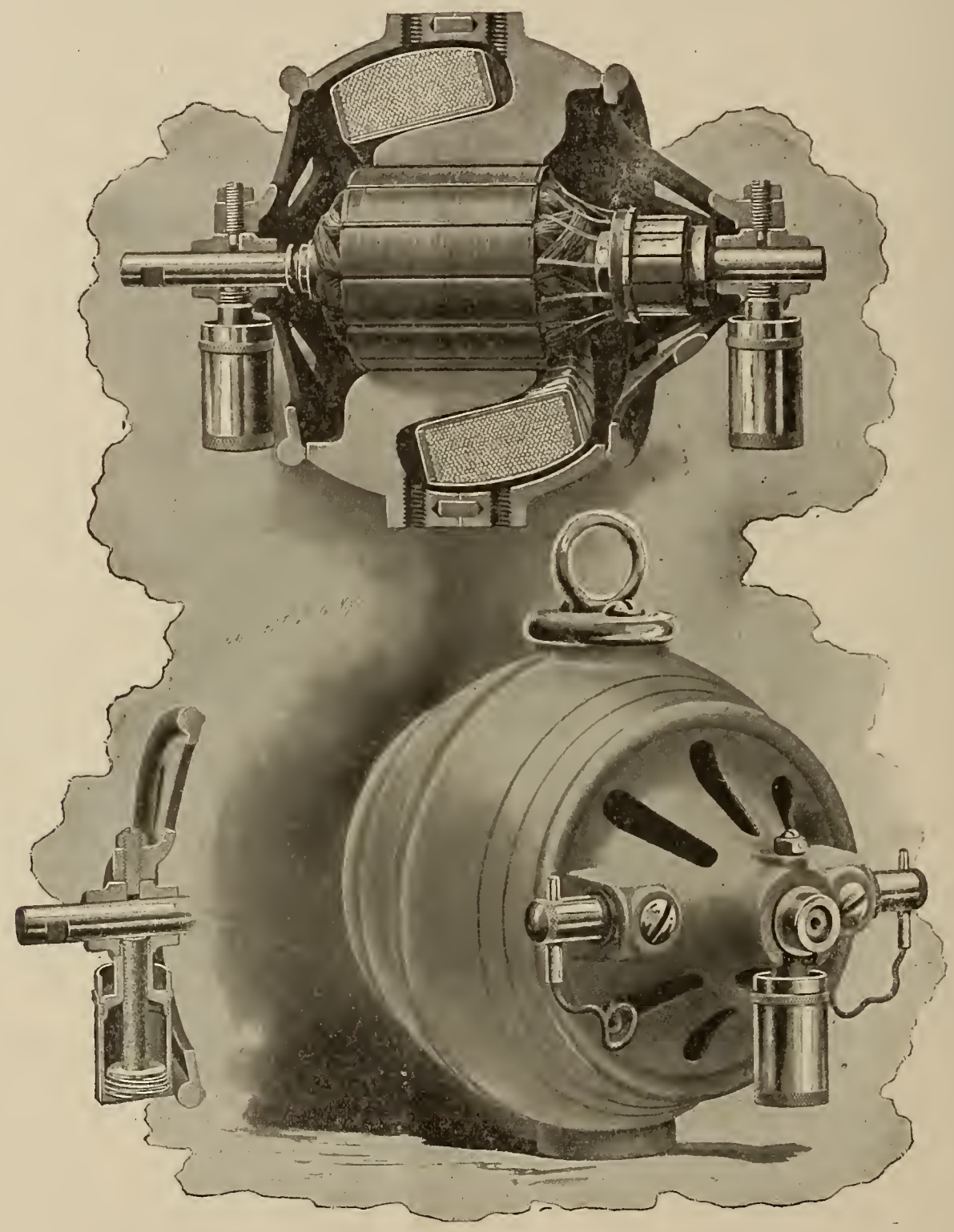
Lundell Desk Fan Motor.

Fan Motors.

LUNDELL FAN MOTORS.

The fan motor represents one of the most interesting products of the century. In convenience and ready application it cannot be excelled by any other device. Consisting essentially of the parts which compose a model motor the Lundell fans are designed with a view to compactness, strength, smoothness of operation, efficiency

and noiselessness. The ingenious idea of using a single field coil to energize the magnetic poles and, at the same time, giving a motor of iron-clad type, has been fully appreciated by all professional engineers. Simple in construction and built according to a system which makes one fan motor the absolute fac-simile of the other, these fans have won a reputation at home and abroad of the finest character. The fans, as illustrated, are made up in various designs to suit a variety of purposes. Though identical in design with others, they are made for attaching to the wall and constructed so that the breeze may be thrown forward at any angle in the horizontal or vertical plane. In the 115 and 230 volt motors of the twelve-inch size the new style of guard is supplied. The fine external finish and high polish of the exposed metal parts, together with the noiselessness of operation, make this fan highly desirable from an ornamental as well as a utilitarian standpoint.



Sectional Views of Lundell Fan Motors.

The Lundell alternating fan motors, designed by Mr. Robert Lundell, are constructed in the following manner: "The external primary is built up of laminated iron with eight internally projecting poles, each wound with a coil supplied with alternating current. No auxiliary coils or phase displacing arrangements are used whatever. The internal rotating part or armature is laminated, slotted and wound with two circuits, one of which is short circuited in a suitable way to act as a secondary to the eight primary poles. A pair of brushes bears on this commutator, connecting it in series with a field circuit. On starting the machine acts as does any series motor, both armature and field magnetization reversing simultaneously, thus giving a pulsatory torque always in the same direction. As the machine runs up in speed the short circuited secondary winding takes hold and gives a powerful torque, running the speed up almost to synchronism. At synchronism the commutator obviously acts as a rectifier, giving a pulsatory direct current to the rotor winding connected to it. This pulsatory direct current, of course, sets up direct magnetic poles in the rotor which react on the A. C. field and make of the machine a synchronous alternating motor with an internal rotating field magnet, energized by the rotary transformer action of its commutator. At synchronism the short circuited winding exerts no torque at all, but it does serve in connection with the self induction of the rotor winding to smooth out, by the currents induced in it, the pulsatory magnetization of the rotor teeth and thus renders this magnetization practically constant."

The Electrical Age.

ESTABLISHED 1883.

Entered at New York P. O. as second-class matter, January 18, 1891.

THE ELECTRICAL AGE PUBLISHING CO., Publishers.

TERMS OF SUBSCRIPTION:

One Copy, one Year,	$2.50
One Copy, six months,	1.25
Great Britain and other Countries,	3.50

Cable Address (all Cables), "Electage," New York.

NEWTON HARRISON, E. E., EDITOR.

ASSOCIATE EDITORS:

ALFRED E. WIENER, E. E., } ELECTRIC LIGHT AND POWER.
OSBORNE P. LOOMIS, E. E., }
JOSEPH MUIR, M. D., } ELECTRO-
FREDERICK STRANGE KOLLE, M. D., } THERAPEUTICS.

ADDRESS ALL COMMUNICATIONS TO
THE ELECTRICAL AGE PUBLISHING COMPANY,
Seventh Floor, World Building,
NEW YORK.

NEW YORK, APRIL 14, 1900.

CONTENTS:

THE RELATION OF MATHEMATICS TO SCIENCE.

With respect to electricity, mathematics has been applied in a broader sense and a more comprehensive manner than any other department of theoretical or applied science. Many of the conclusions arrived at, which have at present a direct bearing on the practical development of electrical engineering, were the direct results of mathematical investigation. In fact, it seems necessary to apply mathematical formulæ at the very start in order to gain an adequate idea of the operations of given laws under various circumstances. Possibly the most prominent example of the effect of mathematical investigation directed along scientific lines is the discovery of Ohm's law, the corner-stone, as it were, of all electrical science. Though this is but an isolated case and, incidentally, an important one, many others could be cited which show the necessity for analytical methods of a mathematical nature in obtaining exact results or expressing the proper relationship between various quantities. This is more exemplified in the work of Clerk Maxwell, whose mathematical investigations made him famous, than any other savant of the recent school. In the field of electro-magnetism and an examination of many of the almost metaphysical phenomena taking place the higher branches of mathematics pave the way for all of the conclusions arrived at by Maxwell, the most brilliant of which was the identification of light as an electro-magnetic phenomenon. Lord Kelvin, Helmholtz and some few American authorities, among which may be mentioned Pupin and Steinmetz, possess great analytical powers in the field of applied mathematics. The results obtained by them frequently have immediate practical value. Lord Kelvin, for instance, by applying the calculus to the transmission of power obtained a formula expressing the relationship between the cost of a line and the power wasted in it. Steinmetz discovered a law in relation to hysteresis and many of the deductions of Pupin are valuable in the newly developing science of electrical resonance. It is therefore evident that a mathematical knowledge is of the utmost value as a means of properly investigating and interpreting scientific results, and with few exceptions, such as Michael Faraday, few succeed or raise themselves to a position of prominence or fame unless equipped with a mathematical education.

ELECTROLYSIS IN THE STREETS.

It might be stated that the degree of electrolysis resulting from leaking current derived from a street railway and the damage inflicted by it is to be partly gauged by the spirit of economy prevailing among the directors of the traction company. This economy is sometimes manifested in a more distressing manner as greed. The payment of dividends on stock or the announcements of large earnings by a street railway company mean one of two things as a rule: first, that the traffic has been very great and the profits naturally large, or, second, that the earnings have not been extraordinary, but the expenses have been kept down to a minimum. One of the ways of keeping expenses down to a minimum in the case of a street railway is to pay little or no attention to sections of the track requiring immediate repair. The required repairs may not mean the renewals of rails exactly; in fact, the exact nature of the change when made may be beyond the scope of the layman's mind. It might, for instance, be the renewal of bond wires, which in themselves deteriorate but slowly. During the year, however, the gradual degeneration of these parts will have the effect of causing the return circuit to be partly composed of water pipes and gas pipes, as well as the tracks. If the corrosion of the bond wires continues to any great extent the greater part of the current will take the path offering the least resistance, namely, return through an earth circuit. It is but natural in such a case for electrolytic action to occur whenever a sufficiently great difference of potential exists between contiguous pipes. Were all the pipes connected to the rails directly, thereby forming one vast return circuit, the difference of potential between part and part would be considerably reduced; but as contact is made at infrequent intervals an injurious electrolysis results, costing in some cases many thousands of dollars to repair the loss. Pierce D. Schenck, in the "Yale Scientific Monthly," states that in one instance a pipe, which had been subjected to electrolysis for four years, was found to have lost about thirty per cent. of its transverse length and forty-five per cent. of its tensile strength. He also adds: "Reports from different parts of the country show that danger from electrolysis may be expected wherever there are single trolley electric railways. In 1891 the lead sheathing of many miles of telephone cable in Boston was found to be damaged by electrolytic action. A few years later three hundred miles of telephone cable were rendered useless in Brooklyn from the same cause, and since that time twenty or thirty cities have experienced more or less trouble from electrolysis. Many thousands of dollars have been spent by the railways in perfecting their ground return systems. Of course, the most absolute remedy would be to place the trolley wires under ground and use double metallic circuits, as has been done on the lines of the Metropolitan Railway Company in New York." The great expense of this form of construction makes this impossible for most companies, but a solution, on the other hand, is found in the use of perfect bonding and bond wires.

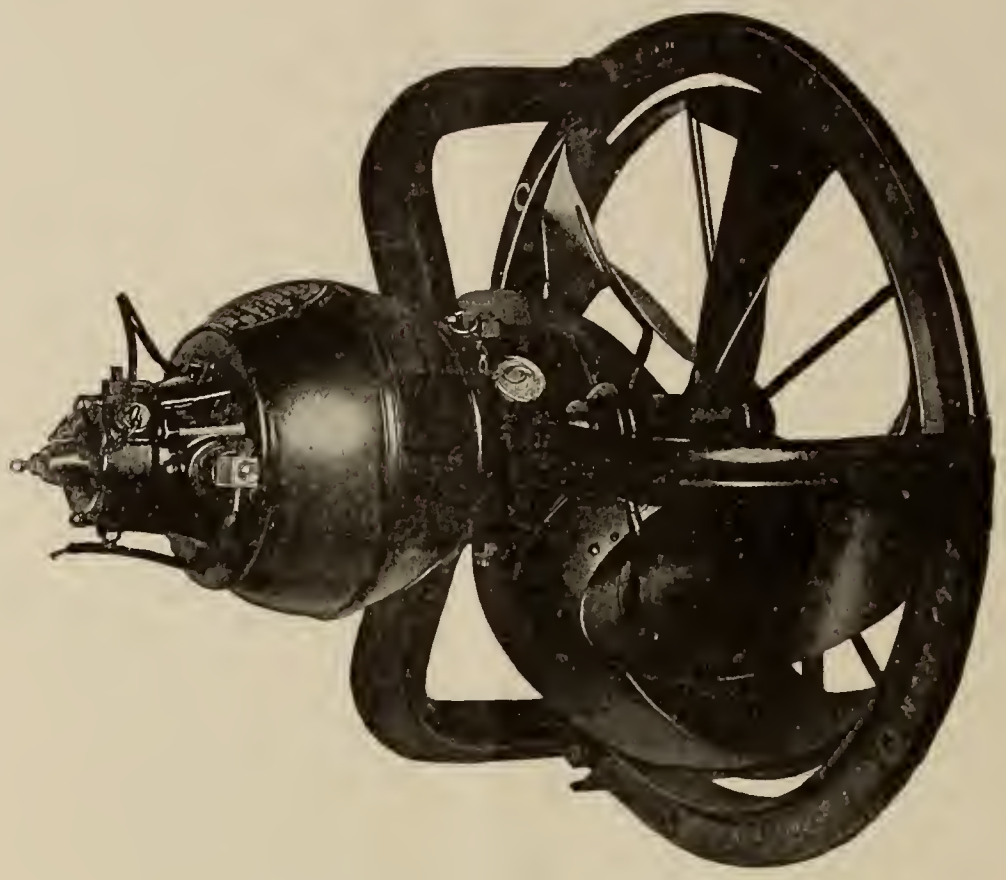
These motors are built with twelve-inch fan and guard, for 14,000 and 16,000 alternations and a voltage of from 52 to 104.

The exhaust fans are constructed so as to be readily applied in restaurants, theatres, hotels, etc., without unnecessary changes being required. The exhausts will rid the room of a given number of cubic feet of air per hour or per minute and perform this function with a minimum of vibration and noise.

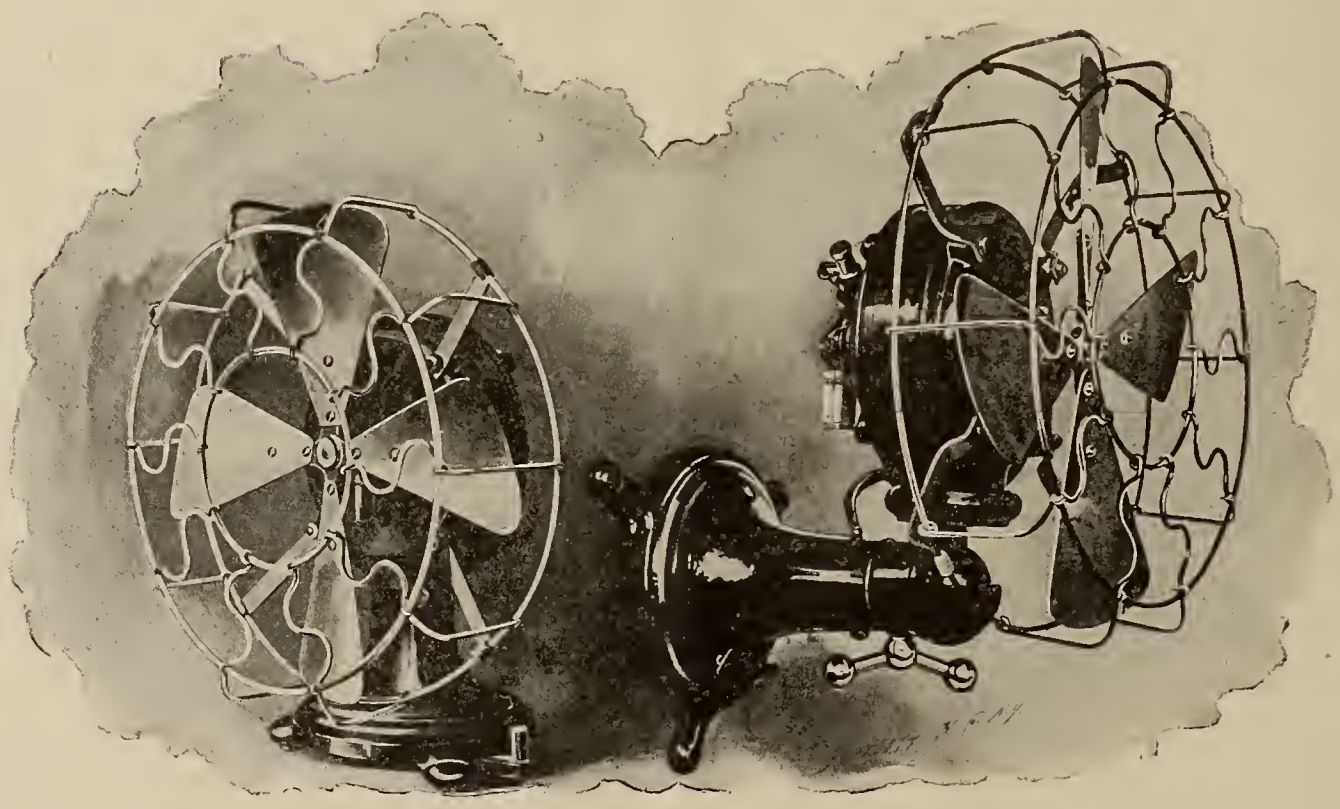
These fans are manufactured by the Sprague Electric Co., 527-531 W. 34th St., New York City, who will be pleased to send catalogue No. 88, descriptive of the Lundell fan, to all who apply for same.

TUERK'S ALTERNATING CURRENT CEfILING FANS.

Illustrations are shown herewith of Tuerk's alternating current ceiling fans, manufactured by the Hunter Fan & Motor Company, of Fulton, N. Y., E. B. Latham & Company, 136 Liberty street, New York city, general sales agents. These fans are made to run on from 52 to 220 volts, wound for from 45 to 140 cycles with a watt consumption of from 100 to 110. The Tuerk ceiling fans were about the first fans manufactured for this purpose and improvements have been made in them from



Lundell Motor Attached to Exhaust Fan.



LUNDELL ALTERNATING FAN MOTORS.

Desk Style. Bracket Style.

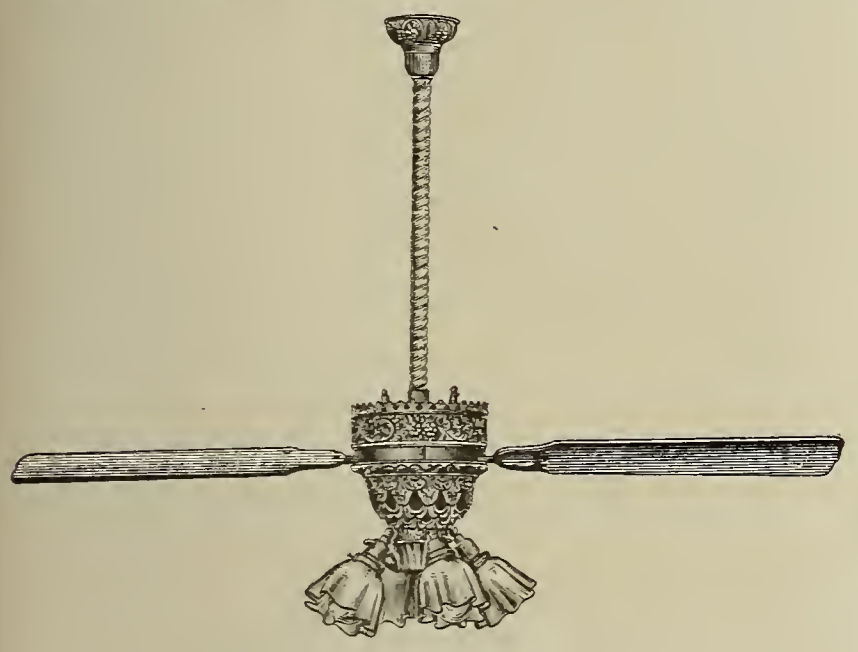
year to year, making a fan of the greatest reliability and efficiency. They are made in many styles of finish to match interior decorations and are among the handsomest fans on the market.

Patents.

WEEKLY ELECTRICAL PATENT RECORD.
PATENTS ISSUED APRIL 3, 1900.

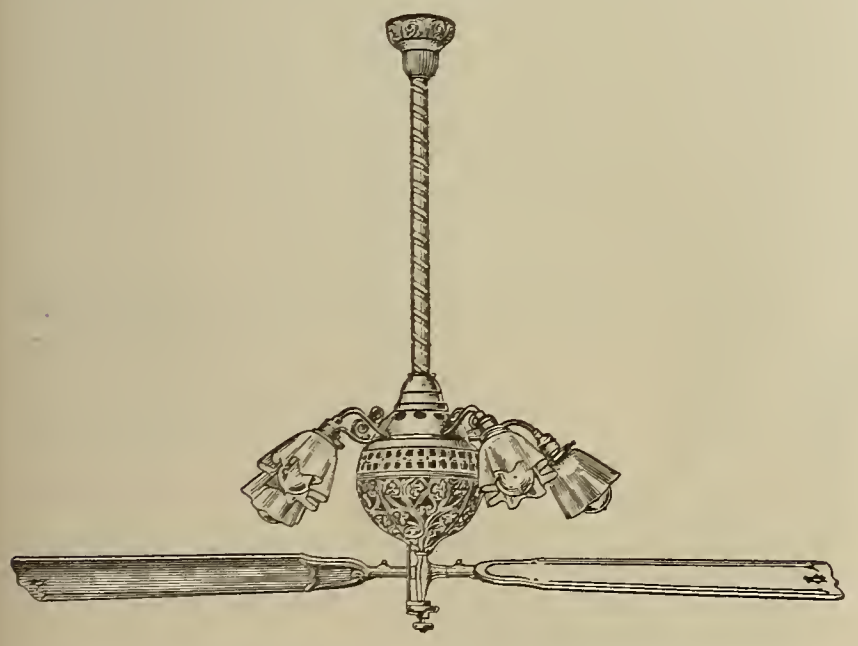
Conducted by Otto Greenberg. Complete descriptions and drawings of any patent mentioned below will be sent on receipt of ten cents.

646,418. Static Machine. Dodd & Struthers, Des Moines, Iowa.



Hunter Direct Current Ceiling Fan.

646,454. Track-Circuit Closer. Samuel Neely, Pierron, Ill.



Hunter Alternating Current Ceiling Fan.

646,460. Trolley. Wm. Potter, Schenectady, N. Y.

646,467. Motor-Frame. Sidney Short, Cleveland, Ohio.

646,476. Carbon Brush. Elihu Thomson, Swampscott, Mass. The brush is composed of superposed sheets or plates of carbon, and individually adjustable, each plate or sheet having a coating of good conducting metal.

646,485. Reversing and Cutout Switch. T. Zweigbergk, Cleveland, Ohio.

646,500. Electric Transformer. Walter Moody, Schenectady, N. Y.

646,526. Electric Controller. John Lincoln, Cleveland, O.

646,552. Storage Battery. Geo. Gesner, N. Y. In this invention a plate is made from an alloy of iron and hydrogen, the latter being present in such proportions as to prevent oxidation or corrosion of the iron in said alloy.

646,598. Relay. Luigi Cerebotani, Germany.

646,619. Electric Metal-Working Apparatus. Chas. Coffin, Detroit, Mich.

646,626. Surface Contact R. R. System. Gustave Paul, Munich, Germany.

646,643. Instrument for Measured-Service Telephone. Chas. Gierding, West Haven, Conn.

646,675, 646,677, 646,679, 646,680, 646,681, 646,682 and 646,683. Telephone Exchange System. Ed. Clement, Washington, D. C.

646,676. Annunciator and Spring-Jack. Ed. Clement, Washington, D. C.

646,689, 646,690, 646,692, 646,694, 646,695, 646,696 and 646,697. Telephone Exchange System. Wm. D. Gharky, Philadelphia.

646,688. Device for Shifting Electric Current from one Conductor to Another. Wm. D. Ghorky, Philadelphia.

646,691. Circuit-Protective Device. Wm. D. Ghorky, Philadelphia.

646,693. Annunciator and Spring-Jack. Wm. D. Ghorky, Philadelphia.

646,721. Electric Indicator for Elevators. W. Barker, Central Falls, R. I.

646,742. Electric Bond for Street Mains. Adolphus A. Kundson, Rutherford, N. J.

646,768. Controlling Apparatus for Electric R. R. Cars. August Sundh, Yonkers, N. Y.

646,793. Medical Galvanic Battery. Harry Bentz, N. Y.

646,858. Vacuum-Tube Light. Daniel M. Moore, Newark, N. J.

646,883. Electric Arc Lamp. Peter Spies, Yonkers, N. Y.

646,889. Controller for Electric R. R. Cars. August Sundh, Yonkers, N. Y.

646,894. Storage Cell. Henry J. Cogswell, Hartford, Conn.

646,911. Electric Heater. George Known, Philadelphia, Pa.

646,922. Storage Battery. Elmer Sperry, Cleveland, Ohio.

646,923. Cellulose Envelope for Storage Battery Elements. Elmer Sperry, Cleveland, Ohio.

Business News.

SPECIAL EXPORT COLUMN.
TOTAL AMOUNT OF ELECTRICAL EXPORTS FROM NEW YORK CITY FOR WEEK ENDING APRIL 7, 1900, $126,078.

New York, N. Y., April 7, 1900.—The following were the exports of electrical material from the port of New York during the week just ended:

Argentine Republic.—49 cases electrical material, $6,528.

Antwerp.—14 cases electrical machinery, $860; 5 cases electros, $501; 53 cases electrical material, $3,383.

Amsterdam.—11 cases electrical material, $1,437.

Brazil.—33 cases electrical material, $1,716.

Bristol.—109 cases electrical machinery, $50,000.

Bremen.—2 cases electrical material, $27.

British East Indies.—113 cases electrical material, $5,832.

Barcelona.—12 cases electrical material, $528.

British West Indies.—17 cases electrical material, $509.

Cuba.—876 cases electrical material, $7,722.
Chili.—38 cases electrical material, $2,546.
Central America.—14 cases electrical material, $412.
China.—31 cases electrical material, $1,127.
Dublin.—77 cases electrical material, $20,855.
Florence.—4 cases electrical material, $42.
Glasgow.—210 cases electrical material, $3,919.
Japan.—118 cases electrical material, $6,029.
Liverpool.—97 cases electrical material, $6,816.
Mexieo.—38 cases electrical material, $1,850; 11 cases electrical material, $1,891.
Puerto Rico.—33 cases electrical material, $1,070.
Southampton.—5 cases electrical material, $110.
Stockholm.—1 case electrical material, $115.
U. S. Colombia.—4 cases electrical material, $73.
Vienna.—2 cases electrieal material, $57.

NEW INCORPORATIONS.

Smith's Falls, Ont.—The Citizens' Electric Company, of Smith's Falls, has been incorporated, with a capital of $35,000.

San Francisco, Cal.—The Utica Electric Company, of San Francisco, has been incorporated. Capital, $10,000. Incorporators: J. V. Eichbaum, F. H. Eichbaum, J. W. Wright, H. Brooks, B. B. Rosekars, all of San Franciseo.

East Liverpool, Ohio.—The People's Light and Power Company, of this city, has been incorporated. Capital, $25,000. Incorporators: C. A. Smith, A. G. Mason, J. A. Flood, J. E. McDonald, W. L. Smith.

Yardley, Pa.—The Yardley Electric Light, Heat & Power Company has been incorporated. Capital, $25,000. Incorporators: E. J. Moore, S. J. Moore, Jr., T. A. Royal, Jr., J. MacFadden, R. Remont, all of Philadelphia.

San Francisco, Cal.—The Cape Nome Electric Light & Telephone Company has been incorporated, with a capital of $150,000. Incorporators: D. Rich, E. Folger, C. S. Benediet, E. Holland, all of San Francisco; C. S. Rosener, of Nome, Alaska.

Siegfried, Pa.—The Northampton County Electric Company has been incorporated. Capital, $1,000. Incorporators: L. Fiick, O. Lincoln, both of Wilkesbarre; H. T. Hyndman, W. W. Watson, W. E. Sullivan, all of Scranton; W. L. Watson, of Cementon.

Catasauqua, Pa.—The Lehigh County Electric Light Company of Catasauqua has been chartered. Capital, $1,000. Incorporators: L. Flick, O. Lincoln, both of Wilkesbarre; H. T. Hyndman, W. W. Watson, both of Scranton; W. D. Watson, of Cementon.

TELEPHONE CALLS.

Mooresville, N. C.—The Mooresville Telephone Company, with capital stock of $5,000, has been organized by S. C. Rankin and others.

Port Arthur, Texas.—The Port Arthur Telephone Company has been incorporated, with a capital of $5,000.

Phoebus, Va.—The Phoebus Telephone Co. has been incorporated. Capital, $10,000. Incorporators: A. M. Hanger, A. Heinckel, both of Phoebus; W. J. A. Cumming, J. V. Bickford, J. W. Lee, all of Hampton.

West Alexandria, Ohio.—The West Alexandria Telephone Company has been incorporated. Capital, $3,000. Incorporators: J. E. Davis, W. H. Brubakes, G. W. Ehles, O. E. Dyer, J. Winkleman.

Albany, N. Y.—The Madison & Onondaga Telephone & Telegraph Company has been incorporated. Capital, $20,000. Incorporators: F. E. Dawley, W. T. Gaynor, E. Woodworth, P. H. Smith, H. B. Clark, A. G. Carr, all of Fayetteville; D. G. Gates, of Chittenango; H. B. Clark, attorney, Syraeuse.

Burlington, Vt.—The Addison & Panton Telephone Company has been formed at Vergennes, officered as follows: F. E. Sears, president; L. C. Seegar, secretary and treasurer, and F. E. Sears, L. C. Seegar, H. W. Spooner, E. A. Field and R. H. Noonan, directors.

F. N. Grove, attorney, New York city.

STREET RAILWAY NEWS.

Parkersburg, W. Va.—The Citizens' Traction Company has been incorporated. The incorporators are J. L. Cramer, G. B. Gibbens and C. D. Forrer, of Parkersburg; A. Williams, of Salama, W. Va., and L. Cramer, of Clarington, Ohio.

New York, N. Y.—The New York, Brooklyn & Jersey City Rapid Transit Company has been incorporated. Capital, $60,000. Incorporators: G. Wilson, A. H. Mullen, F. N. Glove, J. M. Muller, all of New York city; J. La Burt, of Jamaica, L. I.; Etta L. Foulk, of Brooklyn; F. N. Grove, attorney, New York city.

Milbridge, Me.—The Milbridge & Cherryfield Electric Railway has been incorporated with a capital stock of $60,000. The directors of the road are Frederick Yates, C. E. Goodwin, J. O. Bradbury, F. K. Wilson, J. G. Gay and E. A. Hubbard.

Indianapolis, Ind.—The Central Traction Company, of Anderson, has been incorporated. Capital, $1,200,000. Incorporators: H. C. Stilwell, G. Lilly, both of Anderson; C. A. Ford, of Kokomo; W. L. Kann, of Pittsburg, Pa.; S. J. Marck, of Indianapolis.

POSSIBLE INSTALLATIONS.

Abbeville, S. C.—The Abbeville Electric Light & Power Company is on the market for 75-hp. boiler and engine, with auxiliary apparatus.

Adel, Iowa.—An electric light plant is proposed for this place.

Cooper, Texas.—An electric light plant is to be established here.

WESTON STANDARD

PORTALE DIRECT READING

VOLTMETERS AND WATTMETERS

For Alternating and Direct Current Circuits.

The only standard portable instrument of the type deserving this name.

Write for our Catalogue of Portable Instruments.

WESTON ELECTRICAL INSTRUMENT CO.,

114-120 William Street, Newark, N. J.

BERLIN. European Weston Electrical Instrument Co. Ritter Strasse No. 88.

LONDON. Elliott Brothers, No. 101 St. Martins Lane.

The Electrical Age.

Vol. XXV—No. 16. NEW YORK, APRIL 21, 1900. Whole No. 675.

The Perret Electric Vehicle.

THE PERRET AUTOMOBILE AND BATTERY.

In 1896 Mr. A. Frank Perret built an automobile to carry five persons, using as a source of motive power the electric storage battery. This vehicle was completed and was operated in a most satisfactory manner, but, in common with nearly all other automobiles of similar carrying capacity and mileage, required a great weight of battery, about 1,200 pounds. This, of course, necessitated the use of very substantial materials in the construction of the vehicle itself, making the total weight quite considerable. This disadvantage, coupled with the various troubles arising from the best batteries he could obtain and their limitations of output and current, led him to the construction of a type of storage battery which should in itself combine lightness in weight, high rate of charge and discharge, long life and freedom from buckling. Briefly, this is a lead and sulphuric acid type of cell, with Plante element, and in its manufacture nothing is used to cause chemical or electrical troubles in the course of its natural life. Its capacity is stated to be over 14 watt hours per pound of complete cell (including acid), at a discharge rate of 1 ampere per pound. This discharge rate may be greatly exceeded without in any way injuring the cell, but, as is the case with all batteries, it is not advisible to prolong high discharges. The charging may be accomplished

much more rapidly than is usually the case.

To make a practical road test of the battery in order to ascertain its real merits as a source of motive power for automobiles, the Perret Storage Battery Co., 21 State street, New York, decided to build a light vehicle in which should also be included some of Mr. Perret's inventions in these vehicles, which is shown in the accompanying illustration. The vehicle complete, with battery, weighs about 440 pounds, but this weight could be reduced in a future similar carriage. It is well and substantially built, and, while it is only a one-man vehicle, it will carry with each a person weighing 250 pounds. The truck is made of steel in the form of two triangles connected in the centre by a horizontal king-bolt, to give absolute flexibility to the truck. The reaches terminate at the hubs of the wheels, thereby transmitting all strains in proper directions and eliminating the possibility of breaking of the axles in consequence of any collision. The wheels are 28 inches in diameter and have ball bearings.

This automobile is unique in being operated by a worm gear, which renders it absolutely noiseless. This gear is of a special design, giving a high efficiency. The motor is suspended on the rear triangle of the truck and is directly coupled to the worm shaft.

Another special feature of this vehicle is the controller, which is so arranged that speed changes are effected by means of a divided motor field. Several advantages arise from this method of control, among them being the easily obtained variation of speed, the compactness and positive action of the controller itself, the ability to always discharge all of the cells of the battery in series. No multiple series grouping is necessary, and the cells can also be charged in series, without the necessity of making any complicated connections, before throwing on the charging circuit. The controller itself is very compact, being only about six inches in diameter and three inches in depth. It is operated in the usual way by a lever which is connected to the controller by a crank carrying an appliance for reversing the polarity of the current. By means of this arrangement the same set of contacts on the controller are put in use, whether the vehicle is running forward or backward, thus ensuring great simplicity of operation and a minimum of contact points. The steering is accomplished in the usual manner by pivoted hubs operated by crank levers connected to the steering handle.

One hundred and seventy-five pounds of battery is used to operate this automobile, and on one charge will run it about 40 miles over moderately good roads, at an average speed of 13 miles an hour. This little vehicle, of course, is simply intended to demonstrate Mr. Perret's inventions in the line of the storage battery and the improvements in the automobile itself. It is not expected that this vehicle will itself be a type that will come into extensive use, though there are many who will desire automobiles of this kind for special purposes. What has been demonstrated in this vehicle is the ability to build others of greater carrying capacity that will be very much less in total weight than many now on the market, and embodying strength, flexibility and simplicity of operation.

THE RIKER ELECTRIC VEHICLE WINS THE AUTOMOBILE RACE.

Over the finest stretch of turnpike in the neighborhood of the metropolis nine members of the Automobile Club of America competed for a cup on Saturday, April 14, presented by a member of the Automobile Club of France, and, appropriately enough, the winner drove a motor car built especially to compete in the international cup race in Paris early in the summer.

Fifty miles was the distance of the contest, the course being laid over the famous Merrick road, in Long Island, with start and finish at Springfield and the turn at Babylon. Mr. A. L. Riker, driving the only electric motor car in the list of fifteen entries, easily outspeeded gasolene and steam, and covered the half century in 2h. 3m. 30s., or nearly a quarter of an hour in advance of his nearest competitor. Mr. Riker carried with him Mr. A. H. Whitney.

MAGNIFICENT DISPLAY OF HORSELESS VEHICLES AT THE PAN-AMERICAN EXPOSITION.

Thomas M. Moore, recently appointed Chief of Transportation and Machinery exhibits at the Pan-American Exposition, to be held in Buffalo, May 1 to Nov. 1, 1901, who is working on preliminary arrangements for these exhibits, makes the following statement:

"The preliminary and merely mechanical work was our first care, when we issued a letter to prospective exhibitors. The letter was sent out to the automobile manufacturers, those who make the vehicles and those who own the motor systems especially designed for the propulsion of these vehicles, and to all others who have made a study of automobiles and could aid us in making the Pan-American display of such vehicles a pronounced success. Up to now, exhibitions of automobiles have been but tentative, for the art is in its formative state, and is but now reaching a point where practical results can be shown. The Pan-American will be the first exposition able to avail itself of these results to the fullest extent, and show to the world these vehicles of transportation, which are destined to effect as radical a change as was brought about by the use of the bicycle. Our success so far has been gratifying and assures us of great success in this particular unit of our exposition. Replies are reaching us from all directions; and, while we, in the letter referred to, did not solicit exhibits, but asked only for suggestions as to a plan for display by evolutions, races, etc., nearly seventy-five per cent. of the responses inform us of the desire to co-operate with us and of the determination to make the best possible exhibit. Our correspondents evince a cordial spirit, and, with hardly any exception promise to do all in their power to aid us."

Electric Railways.

NOTES ON ELECTRIC TRACTION UNDER STEAM RAILWAY CONDITIONS.

BY EDWARD C. BOYNTON.

(Concluded from page 115.)

Cost of Operation.—It is most desirable in operating a heavy electric service over a railway on which steam trains are also operated, to arrive at a satisafctory conclusion as to the comparative cost of operating each type of train per mile. If an electric service is entirely substituted for one which has been operated by steam, the railroad company is in a position to know accurately the difference in cost of the two systems. But when both are operated over the same tracks the problem becomes very complex. For example, even if we omit the maintenance of the road way, which may be a little higher in an electric service, there are many other items such as salaries of agents, ticket sellers, gatemen, etc., all of which properly belong to the operating department, which must be proportioned between the two services. It may be said that the cost of operating a steam passenger train has been estimated all the way from 30 cents to $1.00 per mile depending upon the length of the train and other conditions which are seldom alike in the different localities.

The author cannot go into this subject in detail, but will give a few points of difference between the two services upon which an approximate estimate can be based. A fair average cost of running a steam locomotive, including fuel, when coal is about $2.30 per ton; water, wages, repairs, etc., is 22 cent per mile. The average cost of repairs to coaches may be taken at one cent per mile each. The wages of train crew, consisting of a conductor, baggage master and one brakeman will average .05 per mile, making a total of 30 cents. This figure is intended to represent the lowest possible cost of operating a train of only three cars by steam with the understanding that it is kept almost constantly moving for about 9 hours, and covering from 150 to 200 miles. It is well known that a train making but a few miles per day cannot be run at a profit, either by steam or electricity, due to the fact that cost of wages per mile increases rapidly, as the crew has to be paid the same in either case. A great advantage of the electric service may be mentioned here. The above service is all that can be required of one crew and one locomotive, but the motor car can easily make 300 to 400 miles in 18 hours, and as the daily service is in operation at least that long, one motor car does the work of two locomotives. In the operation of a similar three-car train in which one car is a motor car, we will assume the same crew with the addition of a motorman and omit the locomotive. The cost per mile in wages will then become 6 1-2 cents, that of repairs to cars the same as before, 1 cent, maintenance of motors, 1-2 cent and cost of power delivered to train, 6 cents, making the total cost per train mile, 14 cents for the electric service.

ELECTRIC LIGHTING.

All steam roads, which have introduced electric motive power, will consider the question of lighting their passenger stations and freight houses along the line. It will be found that lighting in this way is very satisfactory and far cheaper than the purchase of gas or electricity from others. For lighting freight sheds, platforms and other outside lights, the simple wiring of the lights in groups of five or six in series, and connected directly between the feeder or working conductor and the service rails, has been found satisfactory. The occasional interruption of the current due to the opening of a circuit breaker will shut off these light for a few seconds, which makes them inconvenient for indoor lighting. For stations requiring not over 60, 16 C. P. lights, a small storage battery of 58 cells, together with a rheostat and switchboard with the necessary switches and instruments can be installed for about $900. By making the rheostat of about 55 ohms resistance and 35 amperes capacity and connecting it in series with the railway current, it can be used to charge the battery.

The battery and rheostat are connected in parallel with the lighting load, and the resistance so regulated that the railway current does the lighting, the battery merely acting as a regulator, charging slightly when the voltage rises and discharging into the light circuit when the pressure falls, due to the movement of the trains. This maintains a practically constant voltage of about 120 on the lighting circuit, and the battery does little or no work except when the power station is shut down. The principal advanage of this arrangement is that it is practically automatic in its action, and requires no regular attendant. The station employes can handle the switches when necessary to turn on or off the lights. An occasional inspection of the battery is all that is necessary. The cost of such lighting is much less than it can be purchased from lighting companies. In larger stations requiring several hundred lights, a motor generator can be used instead of the rheostat and connected to the battery and the load in exacly the same way. Such a plant should have an attendant.

Central Electric Light Stations.

A NEW INDUSTRIAL SITUATION.*

In the past few years there has been a remarkable development in the manufacture of gas engines. Not only has the number in use increased enormously, but the size in which the gas engine is considered practicable has gone up by bounds. Five or six years ago the one hundred horse power units used at Danbury, Conn., were exceptional for size. Now the works of the Westinghouse Electric and Manufacturing Co., at Pittsburg, are run by a 650 horse power gas engine, one thousand and fifteen hundred horse power units are being manufactured abroad, and the illustration herewith, showing 1,500 horse power units, is reproduced from a brochure entitled "A New Industrial Situation," recently issued by the Westinghouse interests, where it bears the rather ambiguous legend:

"Illustrating a 30,000 horse power gas engine electric station, two 1,500 horse power units of which are now under construction in the Westinghouse Machine Company's works."

We have been unable to determine whether such a station is actually contemplated and the engines contracted for, or whether it is a possibility in the minds of Mr. Westinghouse and his engineers, for the realization of which the engines under construction are an initial step. Mr. Westinghouse is certainly much impressed with the possibilities of the gas engine. In an introduction to the brochure above mentioned he says:

"Engineers the world over have long recognized the fact that gas if supplied at a practical cost; conveyed economically over long distances and utilized in a form of engine which should in speed regulation and smoothness of working equal the best steam engine, would be the ideal fuel."

The second of these three essential conditions was, he says, worked out first in the pipe line transportation which for a generation has been a success in the gas regions. The third essential is of more recent attainment, but gas engines are now running successfully in large sizes, and the engines mentioned as now being under way are of a capacity which would have attracted attention in a steam engine ten or fifteen years ago. The limit of capacity in a single cylinder has not been found nor is there as yet any indication of where the limit may be. It will probably be found to be much higher than at present expected.

The 650 horse power, 25 inch diameter, 30 inch stroke engine, above referred to, weighs 240,000 pounds or 369.23 pounds per rated horse power, and occupies 220 square feet of floor space and 3,520 cubic feet of room or 5.41 cubic feet per rated horse power, the outside measurements being used, which are 11 feet wide, 20 feet long and 16 feet high.

The corresponding value for the 1,500 34 inch diameter, 60 inch stroke units are:

Weight: 753,000 pounds total, or 502 pounds per horse power.

Floor space: Engine being 19 feet wide x 39 feet long x 25 feet high=741 sq. ft. or 49 sq. ft. per hp.

Cubic space: 18,525 cubic ft. or 12.35 cu. ft. per hp.

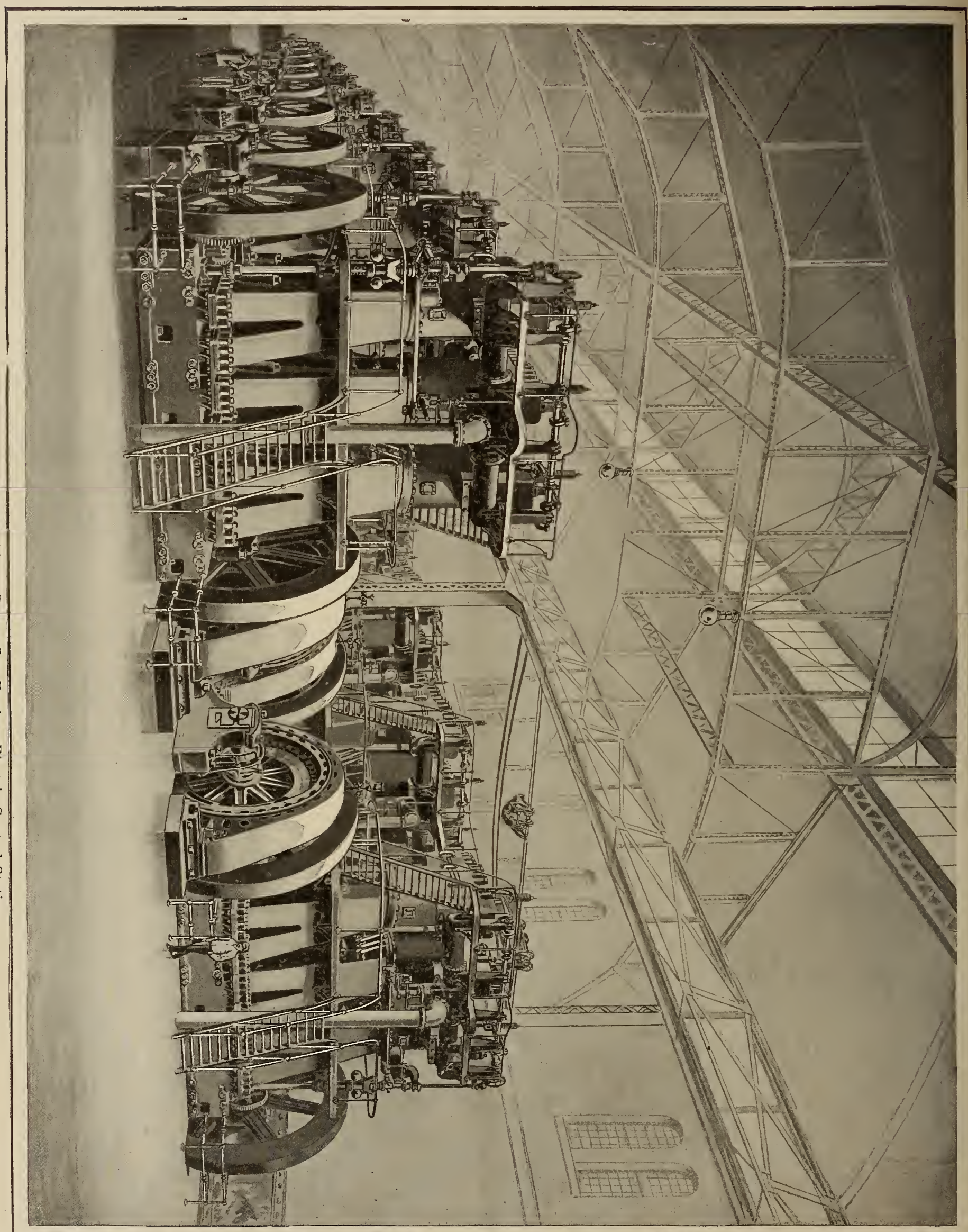
A 1,500 horse power Westinghouse compound steam engine would be as follows:

Weight: 250,000 pounds or 166.66 pounds per hp.

Floor space: Engine being 16 feet wide x 20 feet long x 24 feet high=320 sq. ft. or .21 sq. ft. per hp.

Cubic space: 7,680 cu. ft. or 5.12 eu. ft. per hp.

*By the courtesy of "Power."



Proposed Thirty Thousand Horse Power Gas Engine, Electric Central Station.

The Electrical Age.

ESTABLISHED 1883.

Entered at New York P. O. as second-class matter, January 18, 1891.

THE ELECTRICAL AGE PUBLISHING CO., Publishers.

TERMS OF SUBSCRIPTION:

One Copy, one Year, - - - - - - - - - $2.50
One Copy, six months, - - - - - - - - 1.25
Great Britain and other Countries, - - - - 3.50

Cable Address (all Cables), "Electage," New York.

NEWTON HARRISON, E. E., EDITOR.

ASSOCIATE EDITORS:

ALFRED E. WIENER, E. E., OSBORNE P. LOOMIS, E. E., } ELECTRIC LIGHT AND POWER.
JOSEPH MUIR, M. D., FREDERICK STRANGE KOLLE, M. D., } ELECTRO-THERAPEUTICS.

ADDRESS ALL COMMUNICATIONS TO
THE ELECTRICAL AGE PUBLISHING COMPANY,
Seventh Floor, World Building,
NEW YORK.

NEW YORK, APRIL 21, 1900.

CONTENTS:

LIGHT AN ELECTRICAL PHENOMENON.

If regarded from a purely scientific standpoint the phenomenon of light and all its varied manifestations might be included within the scope of such mechanico-mathematical theories as those expressed by Clerk Maxwell. Judged from a practical standpoint, however, theories accounting for the development and various manifestations of light are not capable of fully explaining all secondary effects associated with it. Perhaps a reason for this may be found in the general and prevailing ignorance regarding the exact constitution of the ether. On the other hand, the accepted conclusions regarding the apparent nature of the ether may not coincide in every respect with all observed phenomena. Light, viewed simply as a series of undulations of the ether, obeying definite laws and responding to certain influences well within the field of scientific examination, can be comprehended by even the lay thinker. When approached, however, by the theorist, the mathematician and the physicist the explanation is not sufficiently satisfacory. It is generally admitted that light is a form of energy produced, however, in such a manner that a more intimate knowledge of the nature of the medium transmitting it is absolutely required before a further analysis can be made of it. Maxwell's electro-magnetic theory of light has fortunately outlined the manner of investigation. According to his theory, based upon cast iron logic, all good conducting bodies must be opaque and high class insulators transparent. In the light of these facts, which bring to our attention many familiar references, we see that hard rubber sheets will not transmit light but gold, silver, copper and, in fact, nearly all conductors, when in finely laminated form, are more or less translucent. There is this to be said, however, in respect to the conductivity and and non-conductivity of bodies and that is that this quality is a purely relative one. In the same sense the permeability to light waves is governed slowly but entirely by the native quality of the material tested. Certain rays of invisible light might pass freely through an ebonite sheet. Others of shorter length and greater frequency meet with more difficulties in passing through until, at length, those waves of visible light, whose rate of oscillation is estimated to lie between 400 to seven hundred million million oscillations per second, meet with an insuperable obstruction in attempting to pass through. Experiments have been tried which show that hard rubber can be penetrated by heat waves, but, as above described, is absolutely opaque to those of a more rapid oscillatory character. It has been stated by a well known English writer that "ingenuity will not be wanting to complete in time all the necessary electro-magnetic analogues and to build up an impregnable body of proof that will indicate that electro-magnetic radiation and what we commonly call light are one in essential nature though differing in degree."

It is sometimes difficult for the untrained mind to grasp the situation presented by the field of optics as regards phenomena relating to different light waves. The primary supposition experimentally deduced is that all actions in the medium conveying light waves travel with the same rapidity. Light, heat, magnetism and electrostatic induction is conveyed at the rate of one hundred and eighty-six thousand miles a second. It is merely a question then of the essential difference between these manifestations in order to comprehend the meaning of magnetism, light or heat as an ether disturbance. An explicit statement might be made to the effect that whatever differences do exist are differences in the length of the ether waves. When once the conception has arisen that the result of electrical oscillation, magnetic disturbances, etc., is to propagate out into surrounding space radiations which are in all respects of the same nature as light except in that they cannot affect the eye it becomes evident that a new experimental field has been opened and one in which it would be possible to reproduce many familiar optical phenomena by means of electro-magnetism. The effects of dispersion, reflection, refraction and polarization of light have been duplicated with rays of dark heat which, of course, are not visible to the optic nerve though more or less perceptible to the sense of feeling. These waves are simply longer than the visible waves called light. When a condenser is discharged it sets up vibrations in the surrounding medium infinitely shorter than those produced by a hot stove or a heated body but still invisible to the eye though perceptible by other means. The Hertzian wave is a fair example of this. An invisible electro-magnetic radiation is set up in space; it is received by a coherer and thereby produces a telegraphic signal which appeals to other senses, that of hearing, for instance. Were it possible to build a condenser of such infinitely small dimension that the discharge would set up infinitessimal vibrations the scientific possibility exists that they would be visible and possess all the well known characteristics of light. The wave length of all these manifestations would vary in size. In visible light the wave is less than one ten thousandth of an inch in length. Heat waves may be several hundred yards in length while others of intermediate size produce all the characteristics generally associated with electro-static and electro-magnetic disturbances.

And three water tube boilers of 250 horse power each, full of water as follows:

Weight: 225,465 pounds or 300.62 pounds per hp.

Floor space: One boiler 15 feet 8 inches high, 11 feet 4 inches wide and 19 feet 9 inches long, and a battery of two boilers having the same height and length, and a total width of 21 feet 10 inches. Total floor space being 656.7 sq. ft. or .87 sq. ft. per hp.

Cubic space: 10,283.92 cu. ft. or 13.71 cu. ft. per hp. The total values for the gas and steam plants compares as follows:

	Gas engine per hp.	Steam engine and boiler per hp.
Weight	502 pounds.	467.28 pounds.
Floor space	.49 sq. ft.	1.08 sq. ft.
Cubic space	12.35 cu. ft.	18.83 cu. ft.

The mean effeetive pressure in a compound steam engine, referring to the low pressure cylinder, is about twenty-five pounds and it take two cylinders to develop it. The mean effective in a gas engine is around sixty pounds, and it would take four cylinders to produce four working strokes to a revolution. The greater mean effective of the gas engine then about offsets the fact that its workins strokes occur less frequently.

As to the efficiencies attained, Mr. C. H. Robertson, in a test of some 125 horse-power Westinghouse gas engines, reported at the last meeting of the American Society of Mechanical Engineers, got one observation showing 11.87 cubic feet per hour and per horse power of natural gas at 14.7 pounds absolute and 62 degrees. Such gas contains somewhere around one thousand heat units per cubie foot. Common coal gas contains bebetween six and seven hundred. The engines in Mr. Robertson's test were taken just as they were running in regular work and under some disadvantageous circumstances. The Westinghouse Company claims to have developed an indicated horse-power on as low as ten cubic feet per hour. The station tested by Mr. Robertson paid only seven cents per thousand cubic feet for gas, so that if it ran on 15 cubic feet per hour per horse power it would cost only about one-tenth of a cent to sustain that unit for that time. This corresponds in cost with one pound of coal per hour per horse power, with coal at two dollars per short ton.

Ventilation.

THE TRIUMPH EXHAUST FAN.

The Specialty Manufacturing Company, of Indianapolis, Ind., manufacturers of the Triumph exhaust fan for belted service, are now prepared to furnish this fan, direct connected, with detachable motor, cut of which is shown. This fan is offered in sizes of 30, 36, 42 and 48 inches, the motors being wound for all standard voltages of direct current.

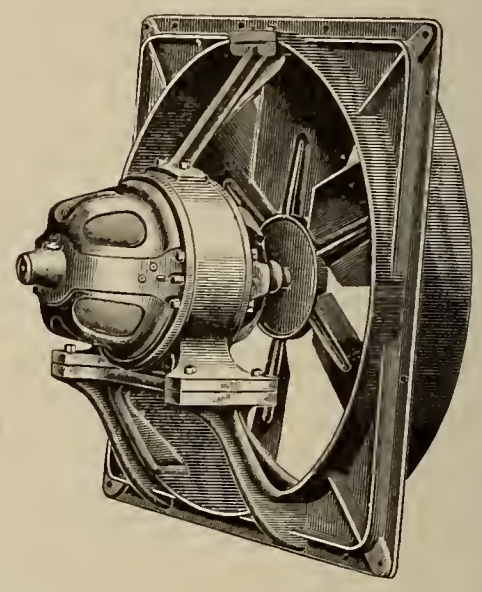
This fan presents some decidedly new features in the line of direct connected fans which will be of interest to the electrician. The Triumph exhaust fan for belt service is well known, having been on the market for a number of years, hundreds of them being in daily use, rendering satisfactory service, which is quite a sufficient guarantee as to the efficiency, durability and general merits of the fan.

The flat square back of the Triumph exhaust fan, affording such convenience in installation, is utilized in the direct connected fan, and the manufacturers have carefully borne in mind the idea of convenient installation in designing this fan. The motor, being detachable. is entirely separate and is shipped this way, the bracket or motor support being a part of the fan frame.

To install this direct connected fan the square frame is lagged or bolted with flat back to the opening, the motor is then placed on the bracket, being held securely and firmly by cap screws, the fan wing then being secured to the shaft, and when the motor is connected up the fan is ready for operation.

The detachable feature of this machine should not be overlooked, as it offers advantages well worth consideration; for instance, a temporary use of such a motor might be of great value, and this motor is easily taken from the bracket and can be set where desired, and with fan wing removed and pulley used on shaft instead we have a motor that will furnish belted service. Then again it is possible at certain seasons of the year that the service of the fan is not desirable or necessary; at such times this motor may be removed and utilized as suggested above.

The motors furnished with these fans are of the most approved modern electrical and mechanical construction, and will carry the fan at full speed without injurious heating and without sparking at the brushes.



Direct Connected "Triumph" Exhaust Fan with Detachable Motor.

As shown by the cut, the motor is of the protected type, thus affording ample protection against the accumulation of dirt and consequent damage to the machine, which has been a source of great annoyance to the operators of direct connected fans, and a forcible argument against their use.

The rheostat furnished with this motor is thoroughly fire-proof, and is provided with automatic release.

Carbon brushes with automatic feed are used on this motor. The bearings of this machine are interchangeable and self-oiling; the machines are accurately balanced, so there is practically no vibration when the fan is in operation, and all parts are made in duplicate.

The convenience for inspection of this machine merits attention. Especial attention has been given to the distance between the motor and frame, which is reduced to a minimum, and thus reducing the protrusion of the motor into the room to the least considerable distance, thereby obviating the unsightly appearance so common with others fans of this class.

The well known manufacturers of this direct connected exhaust fan claim to have run exhaustive tests, and are willing to risk their reputation on the efficiency of this machine.

Conventions.

MEETING OF THE NATIONAL ELECTRIC LIGHT ASSOCIATION.

The National Electric Light Association will hold its annual meeting at the Auditorium Hotel, Chicago, May 22, 23 and 24. No special arrangements have been made for exhibits, but it is said that the supply men will meet at the same time in Chicago. The Pennsylvania Railroad is arranging for a special train to the meetng, and it is said that Harry Kirkland, Robert Corey and others are interested in the same.

Patents.

WEEKLY ELECTRICAL PATENT RECORD. PATENTS ISSUED APRIL 14, 1900.

Conducted by Otto Greenberg. Complete descriptions and drawings of any patent mentioned below will be sent on receipt of ten cents.

647,006. Special Apparatus for Electric Baths. Antonio Maggiorani, Rome, Italy.

647,007, 647,008, 647,009. Apparatus Employed in Wireless Telegraphy. Guglielmo Marconi, London, Eng. The invention consists of a receiver for electrical oscillations composed of an imperfect electrical contact, a local circuit through it, an induction-coil, the primary of which consists of wires connected in parallel, the secondary of which is wound in sections each consisting of several layers, a capacity connected to one end of the primary, a conductor connected to the other end, and connections between the ends of the imperfect contact and the ends of the secondary.

647,071. Electric Indicator for Doors. Ralph H. Broadman, New Britain, Conn.

647,085. Secondary Battery. Harold S. Gladstone, London, Eng.

647,095. Railway-Signal. John Jorgenson, San Francisco, Cal.

647,155. Automatic Switch for Electric Car-Lighting Apparatus. Willard F. Richards, Buffalo, N. Y.

647,175. Transmission of Electrical Impulses. Frederick Bedell, Ithaca, N. Y.

647,210. Electromagnetic Engine. Peter Watson, Philadelphia, Pa.

647,219. Electric-Arc Lamp. Walter J. Cochran, Le Roy, N. Y.

647,250. Electric Metal-Working Apparatus. Chas. L. Coffin, Detroit, Mich.

647,254. Centrifugal Electric Switch. Edouard Croo, Paris, France.

647,300. Telephone Signalling System. Newman H. Holland, Brookline, Mass.

647,309. Electric Clock. Adam Lungen, N. Y.

647,364. Electrical Gas-Lighter. Harry Bennett, San Francisco, Cal.

647,414. Electric Switch. Walter F. Jones, London, Eng.

647,426. Secondary-Battery Plate and Process of Manufacturing Same. Pedro G. Salom, Philadelphia, Pa.

647,434. Electric-Arc Lamp. Royal E. Ball, N. Y.

647,436. Automatic Brake for Electric Motors. Mathias A. Beck, Milwaukee, Wis.

647,442. Secondary Battery. Clyde J. Coleman, Chicago, Ill.

647,454. Electromagnetic Traction Apparatus for Street Cars. Geo. N. Moore, N. Y. This invention consists in magnetic circuits for increasing the traction of car wheels constructed of two pairs of car wheels and axles, rails and massive iron yokes supporting the rails in combination with a coil or stationary helix about each axle, these coils being wound for producing like and therefore opposing poles in the rails between the wheels, to confine the circuits to the yokes.

Business News.

SPECIAL EXPORT COLUMN.

TOTAL AMOUNT OF ELECTRICAL EXPORTS FROM NEW YORK CITY FOR WEEK ENDING APRIL 14, 1900, $78,310.

New York, N. Y., April 14, 1900.—The following were the exports of electrical material from the port of New York for the week just ended:

Argentine Republic.—74 cases of electrical machinery, $7,513; 6 cases of electrical material, $553.

Amsterdam.—10 cases electrical material, $125.

Bristol.—27 cases electrical machinery, $2,500.

British East Indies.—4 cases electrical material, $155.

British West Indies.—28 cases electrical material, $599; 2 cases electrical machinery, $39.

British Possessions in Africa.—67 cases electrical material, $2,245.

Cuba.—24 cases electrical material, $514.

Central America.—54 cases electrical material, $847.

Christiana.—4 cases electrical material, $80.

China.—1 case electrical material, $15.

Dunkirk.—92 cases electrical material, $2,520.

Glasgow.—101 cases electrical material, $3,606.

Gothenburg.—10 cases electrical material, $4,313.

Havre.—39 cases electrical material, $2,171; 183 cases electrical material, $9,966.

Hayti.—2 cases electrical material, $24.

Hamburg.—1 case electros, $40.

London.—75 cases electrical material, $1,350; 22 cases electrical machinery, $5,750; 1,855 cases electrical material, $10,635.

Liverpool.—133 cases electrical material, $10,638.

Mexico.—86 cases electrical material, $3,047; 10 cases electrical machinery, $2,678.

Manchester.—2 cases electrical machinery, $210; 2 cases electrical material, $16; 2 cases electrical material, $480; 59 cases electrical material, $3,800.

Peru.—47 cases electrical material, $1,571.

Colombia.—21 cases electrical material, $292.

Vienna.—4 cases electrical material, $18.

NEW INCORPORATIONS.

Chicago, Ill.—The Monroe Electric Company has been incorporated. Capital stock, $5,000; incorporators: Eric Winters, A. Jackson and B. Bounds.

Pittston, Pa.—The Manufacturers' Electric Light, Heat and Power Company has been incorporated with a capital of $10,000.

New York City.—Baldwin & Rowland Switch Company has been formed to manufacture electric switches. Capital, $25,000; directors: H. Rowland and R. T. Baldwin, South Norwalk, Conn.

Chicago, Ill.—The Illinois School of Electro-Therapeutics and Pathology has been incorporated. Capital stock, $20,000; incorporators: A. B. Slater, C. E. Heckler and G. Shadbolt.

Spring Valley, N. Y.—The Spring Valley Gas and Electric Company has been incorporated. Capital, $40,-

New Albany, Ind.—The New Albany Light and Water Company, with a capital stock of $25,000, has been incorporated with the following directors: George E. Steinhauer, George Borgerding, E. M. Birod and C. O. Kelso, of New Albany, and C. D. Knight, of Fort Wayne.

Menomonee, Wis.—Senator James H. Stout, John Hopwood and John H. Knapp are the incorporators of a new company, the Submerged Electric Motor Company, of Menomonee, organized for the purpose of manufacturing electric-propelling mechanism for boats, the invention of Tracy B. Hatch and S. N. Smith. The capital stock of the company is $50,000.

Troy, N. Y.—The Electric Supply and Maintenance Company, of Troy, has been incorporated to do a general electrical business. The capital stock is $5,000, divided into shares of $10 each, and the directors are: Augusta S. Crable, Albert C. Phillips and Charles H. Smith, of Lansingburgh; Henry Schneider, of Troy, and Benjamin Vogel, of Green Island.

Trenton, N. J.—The Inter-Oceanic Canal Company, capitalized at $100,000,000, has been incorporated to build a waterway across Nicaragua connecting the Atlantic and Pacific oceans. The company's charter also grants the right to build, own and operate railways, telegraph and telephone and steamships. The incorporators are: William B. Crowell, Levi B. Gilchrist, James M. V. Rooney, James J. Traynor, George W. Bell, Charles P. Codley and Richard D. Purcell, all of Jersey City.

Colorado Springs, Colo.—The Colorado Springs Electric Company has filed incorporation papers, the incorporators being: W. P. Bonbright, W. A. Otis and L. E. Curtis. The company is capitalized at $1,000,000 — 10,000 shares having a par value of $100 each. The directors named for the first year are: W. P. Bonbright, W. A. Otis, S. Reading Bertron, Philip B. Stewart, J. A. Hayes, J. F. Burnes, R. J. Bolles, L. E. Curtis, Henry Hine, James F. Pomeroy, Spencer Penrose, F. M. Morley and C. E. Palmer. This is the corporation that assumes charge of the El Paso Electric Company.

Los Angeles, Cal.—The Mountain Power Company has been incorporated for the purpose of acquiring and selling electricity. The capital stock is $500,000, divided into 5,000 shares. Forty-five of the shares have been subscribed. The term of its existence has been placed at 50 years, and its place of business Los Angeles. The directors are: John S. Cravens, John B. Miller, William R. Staats, J. S. Torrance, J. H. Holmes and W. S. Wright, all of Pasadena, and Henry Fisher, H. H. Sinclair, of Redlands, and George H. Barker, of New York.

TELEPHONE CALLS.

Montrose, Pa.—The Montrose Telephone and Telegraph Company has been rechartered with a capital stock of $1,500.

Emlenton, Pa.—The Valley Telephone Company, Emlenton, Venango County, capital $5,000, has been incorporated.

Indianapolis, Ind.—The Jennings County Telephone Company was incorporated with a capital stock of $6,500. The directors are: Charles Wright, Samuel L. Wright and William G. Kendrick.

Wilmington, Del.—The American Multiplex Telephone, Telegraph and Cable Company of Boston, to manufacture and construct all kinds of electric appliances for the transmission of messages; capital $1,000,000.

Trenton, N. J.—The Keystone Telephone Company, capital $2,000,000, has been incorporated to operate telephone and telegraph lines. The incorporators are: Norman Gray and S. Stanger Iszard, Woodbury, and William H. Chew, Camden.

Indianapolis, Ind.—The Flat Rock Telephone Company has been incorporated with a capital stock of $3,000. The company will build a line in Bartholomew, Johnson, Shelby and Decatur counties. The directors are: Joseph Andrews, John Gant, Thomas Woolley, A. W. Sanin and C. A. Swaile.

Fayetteville, N. Y.—A certificate of incorporation of the Madison & Onondaga Telephone and Telegraph Company, capital $20,000, has been filed. The company proposes to construct and maintain telephone and telegraph lines in the counties of Madison and Onondaga, and particularly to connect the villages of Fayetteville, Manlius, Chittenango, Canastota, Cazenovia and Oneida. the directors are: Frank E. Dawley, Ellis Woodworth, William T. Gaynor, Platt H. Smith, Henry B. Clark and Albert Carr, of Fayetteville, and Daniel G. Gates, of Chittenango.

STREET RAILWAY NEWS.

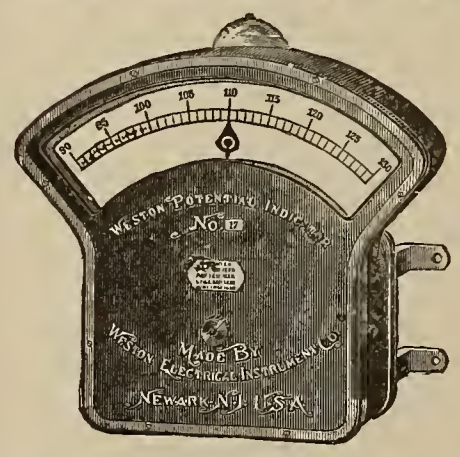
Wabash, Ind.—The Wabash River Traction Company has been incorporated to build an electric road from Wabash to Peru. Capital stock, $20,000; directors: Dennis A. Blakesbee, F. Coleman Boyd, Dewight W. Blakesbee, John S. Bradley and Nelson G. Hunter.

ELECTRICITY AT THE ELKS' CARNIVAL.

In connection with the Elks' great carnival, to be held at Brooklyn for three weeks, beginning April 16, the F. C. Bosdock Mighty Midway Carnival will hold forth at Broadway, corner of Halsey St. This will necessitate the use of buildings covering an area of three square blocks and closing one of the main streets of the city. More direct, alternating, static, voltaic and magnetic currents of electricity will be used in connection with this exhibition than have ever before been employed in the display of electrical effects at an affair of this kind. All electricians are cordially invited to attend and invitations have been sent to Edison, Tesla, Thomson and other prominent electrical experts to be present at several of the entertainments, illustrating the marvelous uses to which electricity can be put. The electrical effects, signs and exhibits have been installed by Mr. Wildman, the well-known electrical engineer of Flatbush and Seventh Aves., Brooklyn, to whom great credit is due for the originality and ingenuity which he has displayed in the installation of the same.

WESTON STANDARD ILLUMINATED DIAL

STATION INSTRUMENTS.



THESE INSTRUMENTS are based upon the same general principle and are just as accurate as our regular Standard Portable Direct Current Voltmeters and Ammeters, but are much larger, and the working parts are inclosed in a neatly designed dust-proof cast-iron case, which effectively shields the instruments from disturbing influences of external magnetic fields.

WESTON ELECTRICAL INSTRUMENT CO.

114-120 William St., Newark, N. J., U. S. A.

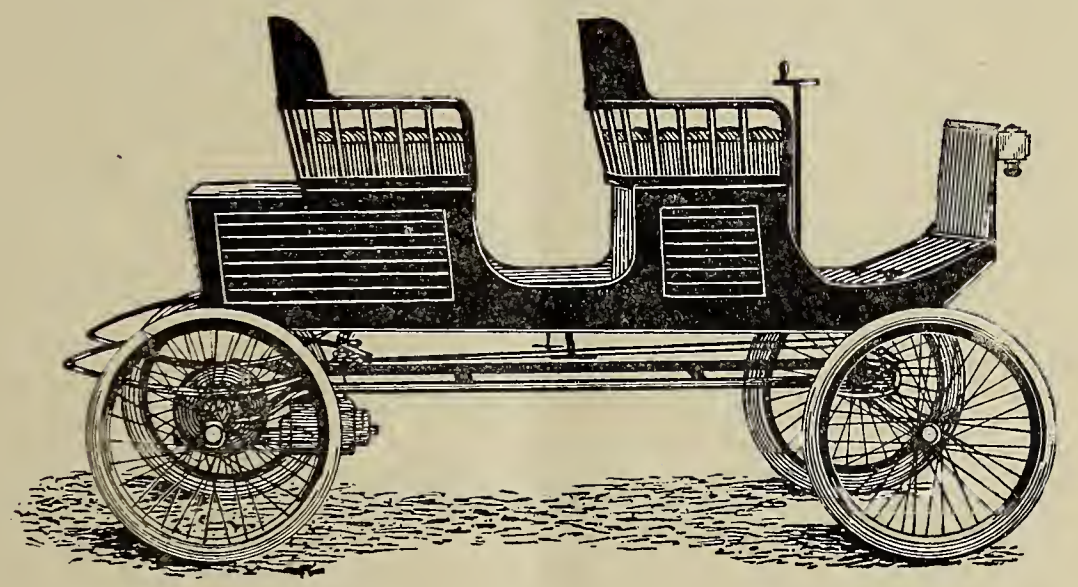
BERLIN. European Weston Electrical Instrument Co. Ritter Strasse No. 88.

LONDON. Elliott Brothers, No. 101 St. Martins Lane.

The Electrical Age.

Vol. XXV—No. 17. NEW YORK, APRIL 28, 1900 Whole No. 676

Automobiles.



The "Bradbury."

THE POMEROY ELECTRIC VEHICLE.

An entirely new type of vehicle, to be propelled by power from a new Plante type of storage battery, is in course of construction by The Pomeroy Electric Vehicle Company, of 239 Willoughby street, Brooklyn, N. Y. This new type of electric vehicle is the invention of Mr. B. H. Pomeroy, the electrical engineer, assisted by Mr. Robert W. Brodmann, electrician. The above company has been organized for the purpose of manufacturing the above vehicles and storage bateries. They will be made in every style and shape required and for all purposes. The two main features of this system are the direct action of an electric motor with a worm gear upon the rear axle of the vehicle and the perfect flexibility of the frame of the same. Mr. Pomeroy invented and designed this system several years ago. In fact, he showed the writer of this article the various applications in his system over two years ago. Among the main features of the system, which are all patented, is the application of two pedals in the front part of the vehicle, to be operated from the front seat. One pedal is used for applying the brake, the other for starting, stopping and reversing the vehicle with one or both feet. A hand wheel, shown at the front seat of the vehicle, is used for steering. The braces shown under the body of the vehicle are composed of steel tubing and connected as shown in the illustration. The front section of the tubes is fastened to a socket resting on ballbearings, making a perfect ball and socket joint, which gives great flexibility to the vehicle as well as the motor resting on the rear of this frame. The motor is of a special type, direct connected to the rear axle by a worm gear, which runs in oil, as shown in the illustration. The motor is constructed to run continuously while in action at its highest speed, thereby saving in current when starting, stopping or reversing. The motor is also out of action when going down hill. This system, as described, is the most flexible extant and will be made attachable to all present styles of vehicles with very little alterations. The Pomeroy Company's new storage battery will be compact, light and very economical, guaranteeing 50 ampere hours to every pound of composition. The vehicle illustrated with this article will be designated the "Bradbury" after Freeborn G. Smith, the great philanthropist of Brooklyn and maker of the noted "Bradbury" pianos.

Miscellaneous.

COPPER FROM THE ORE TO THE WIRE BAR.*

By Albert R. Ledoux, M. S., PH. D.

Electrical engineers are familiar with copper in its finished form, but not all of them know where it comes from nor what are the various steps through which it passes before it gets into their hands. The production of copper on a commercial scale in the United States dates from 1845, although temporary mining of ores and smelting had been tried at intervals for one hundred years previous to that date. The production of copper in America from 1845 up to 1890 amounted in round numbers to 1,000,000 tons. Prior to 1880, Lake Superior produced nearly the whole quantity, but from 1880 to 1890 Montana and Arizona began to compete with the Lake region, and the figures for that decade are:

Lake Superior .....45 per cent.
Montana .....36 per cent.
Arizona .....15 per cent.
Elsewhere ..... 4 per cent.

In 1890 Montana passed its rival, the figures for that year being:

Lake Superior .....38 per cent.
Montana .....43 per cent.

The following table shows the increase in production in the last five years. It is stated in pounds and in round numbers:

	1895.	1896.	1897.
Lake Prod	129,000,000	143,000,000	145,000,000
Montana	190,000,000	232,000,000	237,000,000
Arizona	47,000,000	72,000,000	81,000,000
		1898.	1899.
Lake Prod.		158,000,000	155,000,000
Montana		216,000,000,	239,000,000
Arizona		111,000,000	122,000,000

In 1899 the production of the world increased 50,000 tons and the consumption nearly as much.

Copper is more easily discovered than gold because its compounds are conspicuous, and its ores are blue, green or yellow, as a rule. Gold is seldom visible to the naked eye excepting in "specimen mines," which are usually not large producers.

There are three types of copper ore—metallic, sulphides and oxides. All three types are frequently found in the same mine or district, but, broadly speaking, the metallic mines are confined to Lake Superior, the sulphide ores have received their greatest development in Montana, and the oxide ores are characteristic of Arizona. There are many other districts producing copper, such as the veins and lenses which constitute beds in North Carolina, Tennessee, Vermont and elsewhere on the Atlantic Coast. In fact, the first mining on a large scale was at the Ely mine in Vermont. At the Union Copper mine in North Carolina, veins which were operated for gold in the beginning of this century are now being reopened for copper, and a very large expenditure has been made upon the surface as well as underground to make this old property a remunerative producer.

METALLIC DEPOSITS.

The Lake Superior ores carry the copper in an almost chemically pure form. The metal is disseminated through lavas, sandstones and conglomerates, sometimes in masses but usually in tiny specks—the average assay of the district being less than four per cent. of copper, but the distribution is so uniform and the average so sure that the Great Lake mines are among the most reliable from the point of view of the investor. The Calumet and Hecla has paid its shareholders over $66,000,000 since 1871, and has produced nearly 1,500,000,000 pounds of copper. The ore is raised from twelve shafts, one of them over four-fifths of a mile in vertical depth, and the life of the mine is assured for many years by the ore blocked out. From this mine 5,000 tons are hoisted daily an average distance of 3,000 feet. The cost of Calumet copper laid down in New York in the form of wire bars or ingots probably does not exceed six cents per pound. The Tamarack is another Lake mine with a history. Its deepest shaft is 4,600 feet, and will soon reach a mile in vertical distance from the surface.

The Lake Superior ore admits of simple treatment. It is pulverized in steam stamps each handling hundreds of tons in a day. When pulverized and automatically screened and separated into several grades of fineness it passes to jigs and concentrating tables or buddles. A jig is practically a sieve plunged up and down in water. The lecturer illustrated this by supposing a flour sieve to contain a mixture of white sand and shot of substantially the same size. If the sieve were forced up and down in water the ascending current would finally bring all the lighter sand to the surface leaving the heavier shot on the bottom. If the mixture flowed into the sieve continuously the light sand would overflow the side of the sieve with the water, and by and by the shot would all be collected on the bottom, whence it could be continuously or intermittently removed. The finest ore in size goes to tables over which a stream of water flows—the lighter and worthless gangue being washed away while the heavier metal remaining upon the table is caught or diverted into another direction. While the ore of the Calumet probably averages 4 per cent copper, there are other paying mines that have phenomenal records of economic working. Among these is the the Atlantic. In 1898 it produced 4,500,000 pounds of copper—yielding the company 11.83 cents per pound. The average of the ore was about 6-10 of one per cent., or a value of $1.40 per ton of ore raised; mining cost 90 cents, transportation 5 cents, and milling 24 cents; the total operating expenses, including freight and commissions, were $1,3481 per ton. The copper, therefore, cost 9 cents a pound—giving a net profit of nearly three per cent. This record is not equalled in any other copper mine.

The so-called mountain system of veins is characteristic of the Rocky Mountains and Sierra Nevadas, and, as stated, they receive their greatest development in the vicinity of Butte, Montana, as far as sulphide ores are concerned. The Butte mines are complex. There is no "bed" corresponding to the Calumet conglomerates. but sulphides are interspread in bunches or otherwise through altered granites. The Butte district is seven miles by four in extent, but the mines that have made Butte famous underlie an area of about 3,000 by 7,000 feet. The Butte mines, many of them, were started as silver proposition—the altered surface ores being rich in that metal. As depth increased rich ores grew somewhat more scarce, but at the depth of to-day, from 1,500 to 2,000 feet, the grade is quite uniform—in the neighborhood of six per cent. copper is the average of the camp. In their early days the Butte mines used to ship ore to sampling works in New York, which contained over fifty per cent. copper. All the Butte ores contain gold and silver as well as copper. The Anaconda has produced over 1,000,000,000 pounds of copper, 50,000,000 ounces silver, and 150,000 ounces of gold. This copper mine is the largest silver producer in the world. From 3,000 to 6,000 tons of ore are mined daily from the Anaconda. The caverns produced from this extraction of ore can be readily computed. A volume equal to

*Synopsis of a lecture before the New York Electrical Society, March 2, 1900.

the building space on any one of our city blocks is excavated every month under Butte. The Anaconda supports the surface by the introduction of a forest of 60,000,000 feet of lumber yearly. The ore is carried twenty-seven miles to the metallurgical works, which reduce it. The difference in the treatment as compared with Lake Superior is due to the fact that in the first case we have only metallic copper to separate, refine and remelt into wire bars or ingots, while the sulphide ores contain a larger proportion of impurities than Lake

copper—the principal impurities being sulphur and iron, although arsenic, antimony, bismuth and other undesirable substances, including tellurium, are usually present. The metallurgy of the Butte copper ore, therefore, consists of several stages: first, the concentration to separate the sulphides from the granite or other gangue; second, roasting to get rid of the greater part of the sulphur with its accompanying volatile impurities; third, the smelting of the roasted sulphides to form what is called a "matte"; fourth, the so-called "bessemerizing" of the matte to produce impure copper, and finally the refining of this impure copper. The ore arriving at the Anaconda works is discharged from the cars at the highest point, the works being situated on a side-hill; it passes through crushers which break it up small enough to go into the steam stamp mills, from which being automatically separated into various grades of fineness or size it passes to jigs similar to those employed in Lake Superior,which separate the ore from the gangue and deliver the concentrated ore at the roasting furnaces. Some of the very fine ore is treated separately on tables, the details of which is not necessary to describe. The ore is roasted in several mechanical roasting furnaces of different make and principle. In the early days of copper smelting the sulphides were usually roasted in heaps on the ground and sometimes in so-called stalls, but in the most modern plants the roasting is performed in mechanical furnaces.

Before describing the furnace it may be well to say that these and all concentrating works are as nearly automatic as possible. The ore descends by gravity from cars through the crushers and other apparatus to the lowest level of the works, and is carried from place to place by streams of water. Even the ashes from the roasting and smelting furnaces are continuously carried away by a current of water flowing through the ash bed, and they are discharged at a long distance from the works without the intervention of any hand or tool.

Expositions.

THE PAN-AMERICAN EXPOSITION.

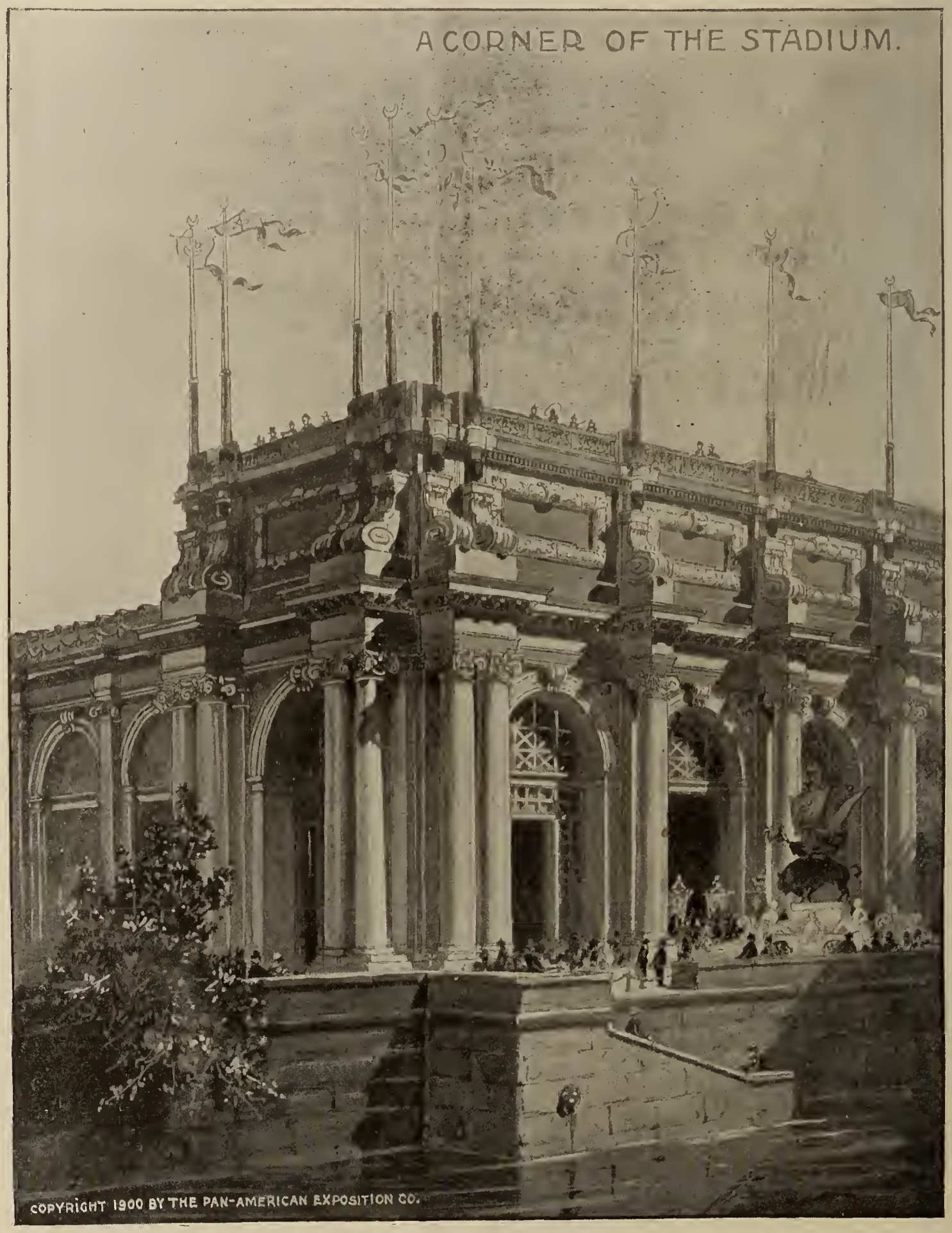
THE GOVERNMENT BUILDING AND STADIUM.

So vast is the number of valuable and interesting objects for exhibition in the possession of the United States Government that none but a building of great proportions

could possibly contain them. Instead of one building, however, at the Pan-American Exposition in Buffalo, N. Y., in 1901, the Federal group will consist of three massive structures connected by colonnades. The main building of this splendid architctual trinity will be 130 feet wide and 600 feet long. The others will each be 150 feet square.

color and gilding giving, with the intricate plastic decorations and sculpture groups, an ensemble both striking and interesting. Portions of the roofs, covered with red Spanish titles, will add much to the character of the buildings as a whole.

In plan, the buildings are shaped like a letter U, the opening being toward the west. The main building cor-



The Government work is under the directions of James Knox Taylor, Supervising Architect of the Treasury Department. Like the others, these buildings will be constructed of staff, already made familiar to the public by its use at the Chicago and more recent Omaha Exposition. The color scheme, in marked contrast to that used at Chicago, will be rich and brilliant, the lavish use of

responds to the bottom of the U, which will accommodate the greater portion of the Government exhibits, the administrative offices, guard room, etc. Connected by colonnades to the main building are the two lesser buildings or pavilions, one of which is intended to hold an exhibition typical of life and labor in the Government's new possessions; while the other will contain a branch station

The Electrical Age.

ESTABLISHED 1883.

Entered at New York P. O. as second-class matter, January 18, 1891.

THE ELECTRICAL AGE PUBLISHING CO., Publishers.

TERMS OF SUBSCRIPTION:

One Copy, one Year,	$2.50
One Copy, six months,	1.25
Great Britain and other Countries,	3.50

Cable Address (all Cables), "Electage," New York.

NEWTON HARRISON, E. E., EDITOR.

ASSOCIATE EDITORS:

ALFRED E. WIENER, E. E., OSBORNE P. LOOMIS, E. E., } ELECTRIC LIGHT AND POWER.

JOSEPH MUIR, M. D., FREDERICK STRANGE KOLLE, M. D., } ELECTRO-THERAPEUTICS.

ADDRESS ALL COMMUNICATIONS TO

THE ELECTRICAL AGE PUBLISHING COMPANY,

Seventh Floor, World Building,

NEW YORK.

NEW YORK, APRIL 28, 1900.

CONTENTS:

AN ELECTRIC EYE.

An instructor in science, bearing the euphonious title of Professor Jagadis Chunder Bose, of Calcutta, India, has advanced the opinion and backed it up by some experimental data that electromagnetic waves produce a molecular change in particles of matter exposed to them. He built what he called an electric eye, a name applied to the coherer by some few at a previous date. By means of this eye, which really consists of a series of particles of granulated metal, he made observations and noted that when the metal particles were swept by a wave of electromagnetism the stream of minute sparks, passing from particle to particle, did not account for the increased conductivity of the metal mass as a whole. It is not necessarily true that all metals are affected similarly. Experiments would prove that in one case the electromagnetic waves increase the resistance and in the other decrease it, although in each case in which a variation is observed it is due to the play of electromagnetic waves upon different substances. Arsenic, for instance, becomes more or less non-conducting when affected in this manner. On the other hand, iron filings diminish in resistance. This effect is not as strange as it may seem and has already been commented upon by physicists without an exhibition of undue enthusiasm. The resistance of selenium is affected by light to a marked degree and another metal when exposed to the magnetic field varies likewise. By directing the attention of the scientific world to this phenomenon some explanation ought to be forthcoming regarding the immediate cause.

THE CO-ORDINATION OF TRACTION SYSTEMS IN LARGE CITIES.

As an exemplification of the truth of the truism "in union there is strength" we find combination and recombination occuring between the main artery and the various ramifications of any large traction system in our great cosmopolitan cities. This has happened in Chicago, St. Louis, San Francisco, Boston, Brooklyn and finally New York. There are many other illustrations of this tendency in important centres of trade and commerce, but few approximate in figures the immensity of the last combination, through which the Metropolitan Traction Company is practically put in control of every important street railway in New York city. In this case co-ordination brings its blessings. These blessings fall upon the public who in return for getting more give more, though not always in the way that they themselves are conscious of. Few New Yorkers do any walking. They live in the cars and only occasionally on fete occasions take that form of exercise considered by Englishmen as important as sleep. The habit of riding in cars is developed through the transfer systems which now prevail. For five cents a complete circuit of the city may be made and cross roads utilized and homes reached which were previously entirely out of the way and difficult of access. In addition the suburban sections of the city have been brought into more intimate relationship with the commercial centres so that these things considered, which have been brought about by a full comprehension of the possibilities in view through the amalgamation of all the surface roads by a far sighted and able manager, collectively add to the earnings of the organization and the comfort of the public. Co-operation has met with success wherever it has been undertaken along legitimate lines, such as those referred to above; cases, of course, in which the public get the direct benefit, as it were, from their very doors. This, at least, is one phase of the consequences of combination which brings to public notice the meaning in the better sense of the word trust. There may be many other cases where the public indirectly receive benefit but with blinded eyes and closed ears they listen to tirades against them without a full consciousness of the loss they would themselves sustain were the combination dissolved.

A discussion is now in progress in the columns of the technical press regarding certain physical manifestations that bear upon the nature of matter and electricity. The proposition occasionally stated that atoms may be subdivided is fully believed in by Sir Williams Crookes, who some years ago advanced his theory of radiant matter. It has been noticed in connection with similar experiments that certain peculiar effects can so far only be attributed to ruptured atoms. In other words, atoms are broken into smaller particles which, of course, possess new properities through this extended subdivision. The intimacy of the relation existing between the forces that operate upon matter and matter itself are such that the eye of science cannot detect the dividing line. The corpuscular theory of Newton, the theory of Liebnitz regarding monads, the recent conclusions of Van t'Hoff in the field of electrolysis and the theory of vortex rings, firmly believed in by many English physicists, show a trend which will eventually lead to the open question of what is the manifestation called matter. In all probability the line of demarkation commonly accepted as distinguishing matter from force will fail in the light of future investigations. The characteristics are already in certain respects identical and the mystery enveloping many of the most commonplace phenomena will be unveiled by the discovery of a few simple facts.

of the United States Weather Bureau, and the exhibit, aquariums, etc., of the United States Fish Commission.

The completed Stadium will offer to the lovers of sports the most spacious and splendid arena ever erected in America. It is said that the great Colosseum at Rome, built in the first century of the Christian Era, could accommodate 87,000 spectators. The Pan-American Stadium will be 129 feet longer and but ten feet narrower than the historic amphitheatre of Rome. The Stadium, however, will have a larger arena, and the seating capacity is estimated for 25,000 people. The Stadium will have a quarter-mile track and a sufficiently large space inside of this for any of the athletic games. Great attention has been paid to having a large number of aisles to reach the seats, and, in addition to the principal entrances on the west, there are provided seven large exits. These exits are made of sufficient breadth and height to admit, in case of need, the largest vehicles or floats, as it is proposed to use the Stadium for certain pageants, exhibits of automobiles in operation, judging of live stock, horses, agricultural machinery, road machinery, etc. No exhibitor has ever had such a splendid arena in which such exhibits could be displayed. The space under the seats is to be used for exhibition purposes, and is in itself the equivalent of a very large building.

The Stadium will cover ten acres of ground and is situation on the east side of the Plaza, opposite the Midway. It is near the great entrances from the steam and trolley railway station, at the extreme north end of he Exposition grounds.

ELECTRIC POWER IN MACHINE SHOPS.

All experience thus far with electric power for shop service has gone towards establishing the fact that electric motor installations are money savers. The friction of long lines of main shafting and sometimes of subsidiary shafting is avoided, and this, as has become well known, represents a very substantial portion of the total power ordinarily consumed. With its elimination, the power required to operate an establishment has been known to come down to astonishingly low figures, in one recorded instance being only about 26 per cent. of the actual rated motor equipment of the shop, while in another it barely exceeded 15 per cent. of the shop capacity, even though in this the power necessary for an electric crane had been included, and that required for lighting. It is interesting to note in connection with this that in the extensive establishment of the Baldwin Locomotive Works at Philadelphia, with electric motors in service requiring collectively 3,500 horse-power, the generator capacity provided is only 1,550 horse-power, and of this, too, a 250 H. P. unit is kept in reserve, leaviing only 1,300 horse-power in service. Of the motor equipment 400 horse-power are said to be constantly idle or undergoing repairs, so that the final proportion is 1,300 H. P. in the generators to 3,100 in the motors, or about 1 : 2.4. According to one authority, one-third of the rated motor capacity will usually be ample for the generator capacity in large plants; according to another, one-sixth has been found sufficient. These proportions obviously require qualification for different conditions, but they all help to bear out the truth of the original proposition as to the economy of the new order of things.—Cassier's Magazine.

Electrical Novelties.

THE "LIGHT OF ASIA."

Sir Edwin Arnold, in his magnificent poem bearing the above title, threw light upon various phases of Japanese life that bore testimony to the exalted sentiment and poetic imagination of the Japanese. The "Light of Asia," as represented here, has a more humble origin but possesses qualities that have made it receive careful consideration from the general public. It is a portable electric light less than an inch in diameter and about eight inches long. It weighs about five ounces and, of course, can be carried in any pocket. At the end of this cylindrical device is a small electric lamp which is illuminated by a battery contained within the cylinder. The cylinder is handsomely ornamented with leather, tipped at the ends with aluminum. A cap fits over the lamp, protecting it and allowing a beam of light to issue

The "Light of Asia."

through a slot in the cap when required for sudden use. The battery is remarkable as it possesses great durability and recuperates very rapidly. The battery cartridge is readily replaced when worn out and a new one substituted by the manufacturers, who are the Electric Contract Company, of 61 Elm street, New York city. The market demand for a lamp possessing the qualities above mentioned is ever on the increase and in consequence the "Light of Asia" lamp has enjoyed remarkable prominence, as shown by the rush of orders. A particular feature to which the "Light of Asia" owes much of its success is the clover leafed dry cell which does not deteriorate until used and in consequence enables dealers, laying in a stock of goods, to place perfect reliance upon the outfits they sell. This is not true of any other device of this kind and naturally adds immeasurably to the value of the "Light of Asia" lamp.

Batteries.

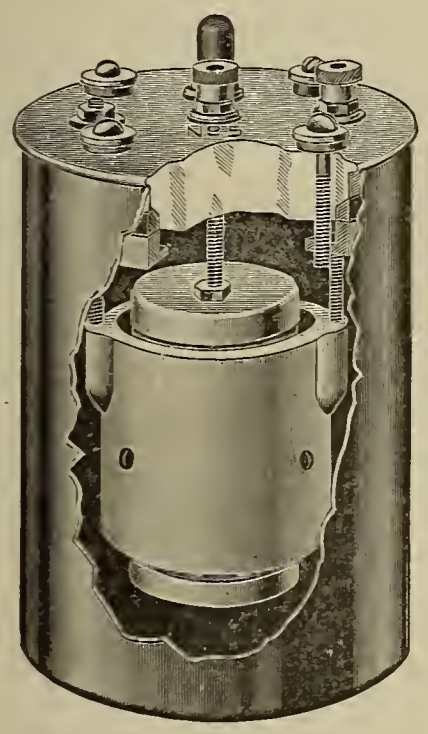
A NEW PRIMARY BATTERY.

The accompanying illustration shows the latest improved, liquid tight primary battery on which United States letters of patent have been allowed. It is designed especially for electrical ignition on gasoline propelled automobiles, pleasure yachts and launches. This battery possesses many new and strikingly valuable feautres. It is put up in heavy, seamless stamped steel glazed jars with vitrified porcelain covers from which the elements are suspended. The porcelain cover has a metallic ring on the under side. This ring is held in position by four screws which pass through the cover. Between the cover and the metallic ring a soft rubber gasket is used. When the screws are loosened, the tension or compression is taken from the soft rubber gasket, and the cover and the elements connected thereto can be removed from the jar with the greatest ease. If it is desirable to seal the cell and make it absolutely liquid tight so it can be safely handled, or used in any position, the four screws are tightened with a screw driver, thereby firmly compressing the soft rubber gasket against the steel cell. This makes the cell absolutely air tight and liquid tight.

The interior construction is unusually heavy to resist the roughest usage. The copper element is suspended inside of the heavy amalgamated cast zinc; the zinc is

suspended by two heavy copper rods. The copper rods which support the elements pass through soft rubber bushings in the porcelain cover; this gives elasticity to the copper supporting rods and prevents breakage in the heaviest service, as well as making a liquid tight joint between the rods and the cover.

In this perfectly sealed and air tight battery no oil is used on the solution. In all closed circuits batteries having an alkaline solution, it is necesary to use a heavy paraffine oil on the solution to prevent the solution from decomposing, which it will do, if allowed to remain in contact with the atmosphere.



The Nungesser Primary Battery.

Practical experience has demonstrated that the most serious results by the use of oil on the solution in portable batteries which are frequently exposed to very rough usage are caused by the oil coating the copper and zinc elements. When the elements are thus coated with the oil, the battery appears exhausted and is practically unfit for service.

This battery when used for motor carriage ignition has a milage capacity of not less than 3,500 miles. Its total weight when ready for use is about 7 lbs.

This batery is manufactured by the Nungesser Electric Battery Company, Cleveland, Ohio.

Patents.

WEEKLY ELECTRICAL PATENT RECORD. PATENTS ISSUED APRIL 17, 1900.

Conducted by Otto Greenberg. Complete descriptions and drawings of any patent mentioned below will be sent on receipt of ten cents.

647,456. Automatic Maximal Switch for Electric Power and Lighting Currents. Theodor Allemann, Olten, Switzerland.

647,492. Electromagnetic Switch Arrangement. Paul Hoffmann, Charlottenburg, Ger.

647,536. Zinc Support for Batteries. Samuel E. Smith, Beloit, Wis.

647,565. Electric Thermostat for Fire Alarms. Hammond V. Hayes, Cambridge, Mass.

647,584. Inductor-Alternator. Sidney Short, Cleveland, Ohio.

647,585. Means for Balancing Multipolar Electric Machines. Sidney Smith, Cleveland, Ohio.

647,589. Induction Coil. Richard Varley, Jersey City.

647,614. Electric Furnace. Marcus Ruthenburg, Philadelphia.

647,617. Electric Gas Lighting Device. Schunemann & Rieder, Buda-Pesth, Austria.

647,624. Trolley-Fork. Elias Eddy, N. Y.

647,666. Electric R. R. System. John Murphy, Torrington, Conn.

647,716. Method of Regulating Electric Machines. Wm. Cooley, Brockport, N. Y.

647,741. System of Electric Transmission. Frederick Bedell, Ithaca, N. Y.

647,748. Plow for Conduit Electric Cars. James B. Gottsberger, N. Y.

647,752, 647,753 and 647,754. Storage Battery Electrode. Roderick Macrae, Philadelphia, Pa.

647,797. Galvanic Battery. Henry Blumenberg, Jr., N. Y.

647,839. Trolley Wheel. Chas. Johnson, East Liverpool.

647,874. Electric Arc Lamp. Chas. Pfluger, Chicago, Ill.

Business News.

SPECIAL EXPORT COLUMN. TOTAL AMOUNT OF ELECTRICAL EXPORTS FROM NEW YORK CITY FOR WEEK ENDING APRIL 21, 1900, $141,257.

New York, N. Y., April 21, 1900.—The following were the exports of electrical material and kindred lines, from the port of New York, for the week just ending:

Argentine.—29 cases electrical material, $1,554; 36 cases electrical machinery, $3,622.

Bristol.—2 cases electrical material, $54; 5 cases electrical material, $1,078.

British Australasia.—64 cases electrical material, $5,257.

Bremen.—4 cases electrical material, $500.

Brazil.—283 cases electrical material, $16,002.

Berlin.—4 cases electrical machinery, $60.

Chili.—3 cases electrical material, $101.

Central America.—157 cases electrical material, $6,317.

Cuba.—50 cases electrical supplies, $80; 30 cases electrical material, $10,009; 226 cases electrical machinery, $36,210.

Dublin.—3 cases electrical material, $125.

Glasgow.—199 cases electrical machinery, $20,098; 19 cases electrical material, $1,554.

Genoa.—6 cases electrical matrial, $50.

Havre.—145 cases electrical material, $8,361.

Hamburg.—31 cases electrical material, $5,023.

Kiref.—2 cases electrical material, $30.

Liverpool.—94 cases electrical material, $4,601; 4 cases electrical machinery, $619.

London.—75 cases electrical material, $4,832; 75 cases electrical machinery, $6,117.

Mexico.—221 cases electrical material, $4,991.

Manchester.—1 case electrical machinery, $60.

Newfoundland.—1 case electrical machinery, $19.

Philippines.—50 cases electrical material, $525.

Peru.—20 cases electrical material, $2,532.

Santo Domingo.—6 cases electrical material, $57.

Southampton.—15 cases electrical material, $516.

U. S. Colombia.—2 cases electrical material, $248.

NEW INCORPORATIONS.

Wilmington, Del.—Crescent Automobile Manufacturing Company, of New York city, to make motor vehicles. Capital, $500,000.

Troy, N. Y.—The Electric Supply and Maintenance Company, of Troy, has been incorporated to do a general electrical business. The capital stock is $5,000, divided into shares of $10 each, and the directors are August S. Crable, Albert C. Philips and Charles H. Smith, of Lansingburgh; Henry Schneider, of Troy. and Benjamin Vogel, of Green Island.

Trenton, N. J.—The Rowland Telegraphic Company, with principal office on Washington street, Jersey City, and a capital stock of $500,000, has filed a certificate of incorporation. The company is organized to control and use the patents of Henry A. Rowland, which cover inventions and improvements in telegraphy. William H. Corbin, six shares; William D. Kellogg, two shares, and George T. Vickers, two share, are the incorporators.

Philadelphia, Pa.—A charter has been issued in Dover, Del., for the Anglo-American Rapid Vehicle Company, which, it is said, intends to secure control of various concerns manufacturing automobiles and unite them in one company. W. W. Gibbs, of this city, president of the Pennsylvania Vehicle Company, is president of the new concern. The capital stock is $75,000,000, all of which is common, and is divided into 750,000 shares at a par value of $100 each. Among the incorporators are: H. B. Twyford, Windley, England; Ernest Martin, New York city, and James Virden, Dover, Del. It is said that Richard Croker and other well known New York men are interested in the company.

TELEPHONE CALLS.

Muncie, Ind.—The Delaware County Mutual Telephone Company was organized in Muncie, Ind., recently, to operate a rural telephone system connecting all sections of the country.

Pendleton, Ind.—The Pendleton Telephone Company, of Pendleton, Madison County, has been incorporated. Capital stock, $10,000; directors: E. D. Allen, S. Morrison and S. B. Walker.

Rome, N. Y.—Rome Home Telephone Company, to operate in Rome and the towns and villages surrounding in Oneida, Lewis and Madison Counties. Capital, $150,000; directors: John S. Wardwell, F. H. Shelley and John E. Mason, Rome.

Albany, N. Y.—A certificate of increase of the capital stock of the American Telephone and Telegraph Company, of New York city, from $75,000,000 to $100,000,000 has been filed with the Secretary of State. The amount of capital of the company actually paid in is $70,975,000, and the amount of its debts and liabilities is $24,078,431. The certificate is signed for the company by Edward J. Hall and Edward P. Meany, chairman and secretary of the meeting of stockholders which authorized the company's increase of capital.

STREET RAILWAY NEWS.

Grand Rapids, Mich.—The Grand Rapids, Mich, Grand Haven & Muskegon Electric Railway Company has decided to build power houses at Spring Lake and Lamont.

Wilkes Barre, Pa.—Surveys are being made for an electric railway from Hazelton to Wilkes Barre, Pa., a distance of 27 miles. The distance by railroad is 50 miles.

NEW YORK NOTES.

THE STANDARD UNDERGROUND CABLE COMPANY announces the removal of its New York offices, April 30th, to more commodious quarters at No. 56 Liberty street (corner Nassau), and at the new location will be glad to welcome its customers and friends.

THE W. C. VOSBURGH MFG. CO. LIMITED, of Brooklyn, Nw York, recently furnished the gas and electric fixtures for the library buildings at Oshkosh and Appleton, Wis., the goods being installed by Langstadt & Croswell, of Appleton.

THE WESTERN ELECTRIC COMPANY'S construction deparment is making some radical changes in the lighting effects of the Pulitzer Building, better known as the World Building, the home of THE ELECTRICAL AGE. The edges of the ceiling in the main vestibule of the building have all been torn out and are now being wired for 16-candle power lamps, which will be set in stucco work. The iron supporting columns, running through from floor to floor, will be covered with plaster, in which are imbedded the wires supplying current to the incandescent lamps which will encircle the pillars. These columns will be finished in gold thus affording a novel background to the strings of lights. Thousands of dollars are being spent by the Press Publishing Company, the owners, in remodeling the interior of the building. The offices are being fitted up with richly finished hardwood parquet floors, improved electric light fixtures, etc., and no expense is being spared to make them the most attractive and habitable of any on Manhattan Island.

H. T. HOCHHAUSEN, 445 Atlantic avenue, Brooklyn, N. Y., is installing a special electric hoist at No. 122 Nassau street, New York. These hoists are adapted to all styles of rope sheave and drum hoists. The attachment consists of two hollow grooved wheels running in opposite directions to each other and driven either by an electric motor or extra pulleys and shaft. A rope running down the shaft from a lever arm is gripped by the two wheels, which are brought close together by pulling either rope or lever after the article to be lifted has been placed on the car, thereby raising the same to any floor or height desired. These hoists are made to run at any speed desired and can be installed with motor for from $200 to $350, and will more than save their cost in time and labor within a few months.

THE MANUFACTURERS' & INVENTORS' ELECTRIC COMPANY have taken the building at No. 84 Nassau St. The Edison, Jr., Electric Light & Power Company will exhibit a complete line of their famous batteries for automobile and other purposes.

ROBERT SHEEHY, the noted electrical engineer, care of the Garvin Machine Company, Spring and Varick Sts., N. Y., has been experimenting for some time and has lately been importing a French auto-vehicle with a carrying capacity of one person. The rated speed of this vehicle has been over sixty miles an hour.

The Electrical Age.

Vol. XXV—No. 18. NEW YORK, MAY 5, 1900. Whole No. 677.

Improvements in Electric Lighting.

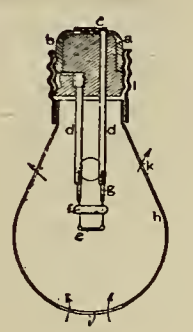


Fig. 1.

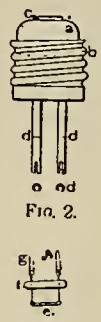


Fig. 2.

Fig. 3.

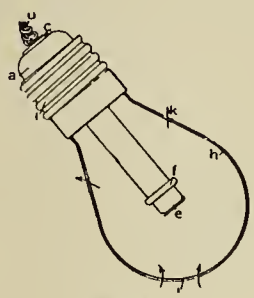


Fig. 4.

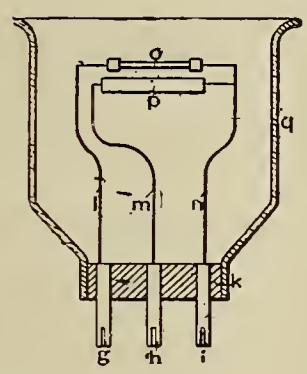


Fig. 5.

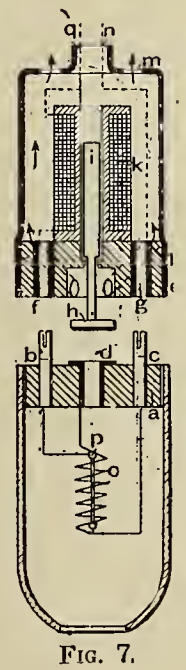


Fig. 7.

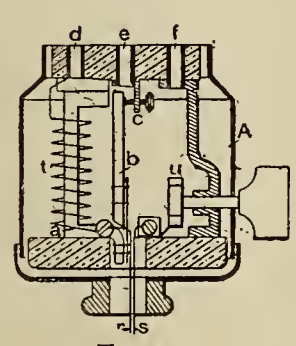


Fig. 6.

RECENT DEVELOPMENTS IN NERNST LAMPS.*

Although the fundamental mechanism of the Nernst lamp has now been patented for some years, and largely capitalized companies have been formed for the purpose of exploiting these patents both in this country and abroad, yet the only instance of its commercial employment so far has been in Göttingen, and that quite recently. Engineers, however, have not been idle, and in the meantime we gather that much time and energy, and also money, have been expended in developing and improving this lamp. Judging from the Patent Office files, these attempts have not been directed at merely evading Nernst's fundamental patent, but rather at devising improvements in the lamp itself which would render it more convenient to use.

The first patent to which we desire to draw attention (No. 6,024, 1899) was taken out on behalf of the Allgemeine Electricitaets-Gesellschaft, and describes a form of lamp which can be fitted to an ordinary Edison or Swan lamp-holder. The special features of this type of lamp are clearly indicated in Figs. 1, 2, 3. The illuminating body e (Fig. 3) is connected in a manner which will be described later on, to two metal wires fastened to the pointed metal pieces g g. These are forced into the slotted metal tubes d d (Fig. 2), and the complete holder is then screwed or otherwise fastened on to the globe, which also contains openings for the introduction of the light which heats the pencil. This lamp very readily admits of the interchanging of the pencils and cleaning the globe. Fig. 4 illustrates a similar lamp for obliquely placed lamp-holders, u being a small spring attached to the contact piece c and ensuring constant connection with the center of it. Slight modifications of the above holder are described for adaptation to a Swan lamp. The simple form of the type of lamp just described has the advantage of cheapness, but, on the other hand, the necessity for holding a light to it for some little time renders its employment somewhat inconvenient, and must react against its exclusive or even extensive use.. This difficulty has been ingeniously met and, we suppose, overcome in the lamps described in patents Nos. 6,025, 6,026 (1899), also taken out by the Allgemeine Company. The

*From the "Electrician," London.

principle made use of is in every case to pass the current simultaneously through an auxiliary heating coil in close proximity to the illuminating pencil and the parallel circuit containing the pencil itself. At first, when the pencil is cold and its existence is extremely high, nearly all the current will pass through the auxiliary coil. This becomes heated, and in turn raises the temperature of the pencil, which rapidly increases in conducting power, taking an increasing portion of the current. The auxiliary circuit is completed through a steel contact key situated near to the iron core of an electromagnet placed in series with the illuminating circuit; and when finally the current passing through this circuit is sufficiently strong, the core will attract the steel hammer of the contact key and break the auxiliary circuit.

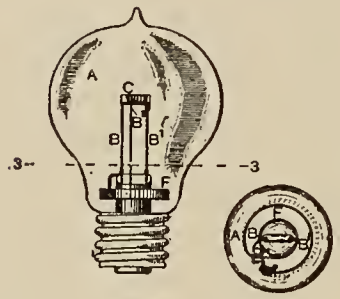


Fig. 8.

Fig. 9.

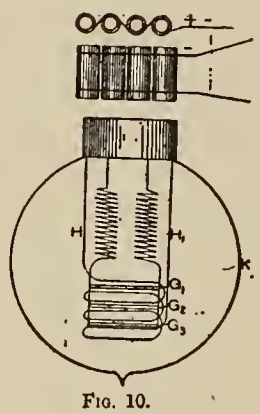


Fig. 10.

Figs. 5 and 6 illustrate the lamp and holder respectively of a lamp of this kind. The two circuits are here plainly discernible. The first passes from r through the iron piece b, making contact with the screw c, and through e and h to the auxiliary heater p, and back through the parts marked n, i, f, u to the other leading wire s. The second circuit starts also from r and passes round the coil t of the electromagnet, and thence through l to the illuminating pencil o, and back as before. When the temperature of the pencil has been raised sufficiently to make it a good conductor, the current passing through the electromagnet will cause the core to attract the iron piece b and break the auxiliary circuit. Fig. 7 illustrates another lamp of the same kind. In this case the auxiliary heating circuit may be traced from g through the metal bobbin of the electromagnet, which at its lower extremity rests on the contact tube d, and from this through the heating coil o and back along the dotted line to n. The pencil p, in this case inside the heating coil, is electrically connected to the coil of the electromagnet k, to which g is also connected. When this circuit takes a sufficient amount of current, the iron core i will be drawn up into the coil, and the auxiliary circuit will thus be broken. A slight modification of the construction of this lamp readily adapts it for the case of bayonet contacts instead of the sliding contacts illustrated in the figure.

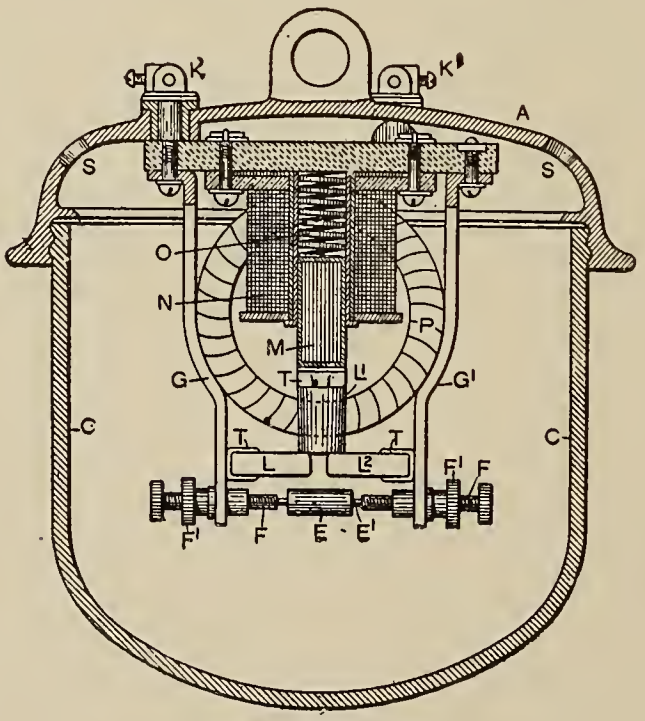


Fig. 11.

The same object is attained in a slightly different manner in the case of a lamp patented by the British Thomson-Houston Company (patent No. 5,941, 1899) and illustrated in Figs. 8 and 9. In this case the pencil is surrounded by a heating coil, c, of high resistance, and an arrangement is provided whereby the current in this circuit is automatically broken when the pencil d takes a sufficient amount of current. Porcelain, clay or magnesia are some of the substances mentioned in the specification for the illuminating pencils. It is particularly claimed for this type of lamp that it is specially suited for high-voltage circuits and also for alternating currents of low frequency. Fig. 9 is a section taken through 3, 3 (Fig. 8). An entirely different kind of lamp has been designed by Prof. Fessenden. In this the mechanism permits of coating the pencil with a thin layer of carbon or graphite sufficient to conduct the current in the first instance, and finally to be burned away when the pencil is working properly. This coating of graphite must be reapplied on every occasion on which the lamp is to be lighted.

The lamp shown in Fig. 10 is specially designed to hold a reserve of several pencils, each of which comes automatically into use when the lower one has burned out. The method of arranging these pencils is shown in the side view.

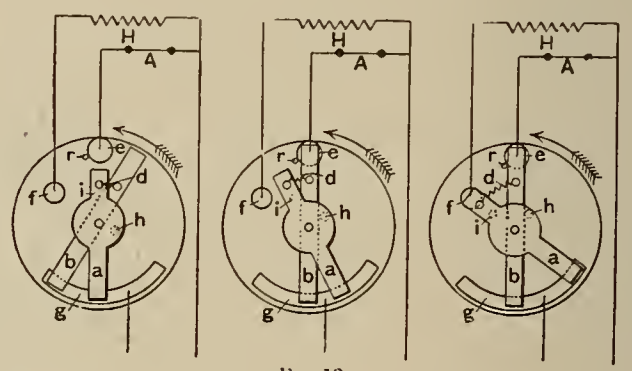


Fig. 12.

A lamp of somewhat different type was patented by the British Thomson-Houston Company (No. 13,404, 1899) and is represented in Fig. 11. Here the auxiliary heating is performed by striking an arc in close proximity to the pencil, the flame of which heats it. When this conducts sufficiently well, a solenoid in series with it draws the carbon pencil up and the auxiliary circuit is thus broken.

Mr. Hirst, of the General Electrical Company, has patented (No. 24,264, 1898) also a switching device for use with Nernst lamps of the independent heating type. This is illustrated in Fig. 12, which is self-explanatory. The first figure represents both circuits open; the second the heating circuits closed. In use the heating circuit switch is held for an instant, during which time the filament will have become sufficiently heated to conduct, and is then allowed to fly back by means of the spring arrangement shown.

The great difficulty in connection with all types of Nernst lamps, and which must in the first instance be satisfactorily overcome, is that the materials of which the pencils are made conduct like electrolytes, in so far as their resistance diminishes with increasing temperature. There exists, therefore, considerable danger that the illuminating pencil will be burned out. Much ingenuity has been expended in discovering a material which would properly compensate for this effect by a corresponding increase in its resistance under the same cir-

cumstances. In the Allgemeine patent specification (No. 6,027, 1899) no materials are specifically referred to as being employed, but it is intended to apply broadly to all materials having a high temperature coefficient. This compensating resistance is to be placed near the pencil, and to be subjected to a slight preliminary heating in order to bring it more nearly in correspondence to its resistance when the final current passes through it.

Another important difficulty lies in the method of connecting the non-conducting pencil to the metal wires connecting it to the external circuit. Patents have been taken out by the Allgemeine Company for the following soldering mixtures, which are said to be suited for this purpose:

	Thorium, P.C.	Zirconium, P.C.	Yttrium, P.C.	Cerium. P.C.
1	93.7	3	3	0.3
2	80.0	..	20	..
3	95.0	..	5	..
4	70.0	10	20	..
5	70.0	..	30	..
6	80.0	..	19.5	0.5

In addition to these, Messrs. Siemens & Halske have patented a method (18,489. 1899), in which by the repeated heating of the pencil to incandescence, and dipping into certain powders or pastes of the following metalloids—boron, silicon and their oxygen-free compounds—the end becomes soft and admits of the conducting wire being pushed into it. The metals, manganese, molybdenum, chromium, titanium, nickel, the platinum groups of metals, and the oxygen-free compounds of these metals, such as the sulphides, phosphides, nitrides and carbides, are referred to as being suited for the same purpose.

Miscellaneous.

COPPER FROM THE ORE TO THE WIRE BAR.

By Albert R. Ledoux, M. S., Ph. D.

(Concluded from page 131.)

There are two types of roasting furnaces in Anaconda. The Bruckner furnace is a cylinder some 20 feet in length by 10 feet in diameter, lined with brick, and revolving slowly. The unroasted ore goes in at one end and is discharged at the other, while the gases from the burning sulphur go up the stack. Each furnace handles about 18,000 pounds of concentrates in a day, reducing the sulphur from 40 per cent. to 10 per cent., which is a most favorable proportion for subsequent operations. It takes about one ton of coal a day to fire each furnace, the coal available in Montana being much inferior to eastern coals. It also takes the labor of two men per day of twenty-four hours to handle the material passing through one furnace. Another type employed at the Anaconda is the Wethy furnace, which consists of three or more horizontal shelves, one above the other; at the end of each shelf, but alternating in their position are holes through which the ore can drop from the upper to the lower level. An endless chain carries a rake along the upper shelf, dragging the burning ore toward the opening, through which it drops to the second shelf. The chain comes out at the end of the furnace over a sprocket wheel, re-enters the second shelf, dragging the ore in the opposite direction, whence it falls to the third, then the chain, still traveling onward over a second sprocket, drags the same ore along the bottom shelf, from which it drops into the car to receive it more or less prepared for the subsequent operations.

A third type of roasting furnace now successfully employed is the so-called Nichols furnace, the invention of Mr. Frank Herreshoff. These furnaces are circular instead of rectangular in section and have rakes revolving horizontally and not traveling from one shelf to another.

The next step is the matting of roasted ore. It is fed into an upright furnace of the so-called cupola type, which is surrounded by a water-jacket to keep it cool. Coke or limestone or other necessary fluxes are added and a blast of air introduced. Under the effect of the blast and of the heat evolved the ore melts. The impurities are largely slagged off, this slag carrying iron, silica, lime, etc., and the sulphide of copper is concentrated still further into a matte, which runs about 30 per cent. of copper, or can be brought up to 45 or 50 per cent., or even higher is advisable. At this point begins the bessemerizing of the copper which is the most important of recent discoveries in the metallurgy of this metal. The well-known Bessemer furnace, which has been used for many years in converting iron into steel, is now universally employed for taking advantage of the oxygen of the air in removing the 30 to 40 per cent. of sulphur which the matte contains. The Bessemer furnace is of various kinds, being the ordinary pear-shaped "converter" with which the steel industry has made us familiar or a simple trough. In the bottom of the converter air tubes are introduced; the molten matte is run in from the furnace and the blast turned on; the sulphur combining with the oxygen is discharged as a gas—the remainder being brought up to a purity of from 96 to over 98 per cent. of copper. Of course this copper carries with it the gold and silver which were originally present in the ore. The converter is discharged when the reaction has ceased, and the copper produced is cast into pigs or converter bars as they are called. Of course there are many details not necessary to enter into at this tmie. For instance, the converters are lined with various mixtures in order that the substance of the lining may unite with some of the impurities in the copper that are not volatile, and, forming into a slag, be easily caried off.

The next step at Anaconda and elsewhere where converter copper is produced, carrying precious mtals, is the electrolytic separation of the metals.

The ores of Arizona and of the south-west in general are of the carbonate or oxide type as far as the surface ores are concerned—remembering, of course, that only general terms are being used and that in every district, as well as in every mine, there are more or less of all types of ore. In Arizona there has never been any glacial erosion, which has removed the oxidized ores with all the decomposed rocks of the surface in our north-eastern States and in many parts of the Rocky Mountain range. These oxidized ores always overlie sulphides where they have not been artificially removed. As a type of the carbonate and oxide mines of the south-west, the "Copper Queen" is the most worthy of attention. This mine was opened in 1880 and a small furnace operated on its ores that year. To-day it has become one of the largest mines in the world, with some twenty miles of shafts, tunnels, galleries and levels, and ore in sight capable of yielding 3,000,000 pounds of copper per month for many years The occurrence of the "Copper Queen's" and similar ores is in limestone and in this rock they are deposited in eccentric and curious ways. Bodies of ores are come upon without the slightest indication or warning, and equally without warning they suddenly disappear. From barren rock showing no trace of copper a drill will sometimes enter a cave of great extent, the sides and walls being magnificent with blue, red and green copper stalacites, and underneath large bodies perhaps containing thousands of tons of rich ore. In the "Copper Queen" there are to-day cubes of ore blocked out on all sides that exceed 400 feet on the edge. Up to 1884 this mine

produced 20,000,000 pounds of copper, from a body of ore which was then exhausted. Almost by accident, after groping about in all directions for another ore body, a bonanza was discovered, from which mine is still taking out millions of pounds of copper a month and with no indication of immediate exhaustion. The surface ores of these carbonate mines could be smelted without any bessemerizing or roasting, producing in the furnace by one operation black copper equivalent to the converter bars and suitable for the electrolytic separation, but, with depth, sulphides came in, and now the "Copper Queen" also is bessemerizing mattes and producing converter bars which come east for their electrolytic refining. The metallurgical works of the "Copper Queen" are most thoroughly modern in every respect. They use the trough converters, previously mentioned, holding about 30 cwt. of matte, which assays about 33 per cent. of copper. These converters are 8 feet long by 6 feet in diameter.

As has been intimated, the final stage of copper refining is the electrolytic. The lecturer stated that it was not his purpose to go into the detail description of this process before a society of electrical engineers, many of whom had been actively engaged in the electrolytic copper refining. But, speaking in general, he stated that up to last year all the electrolytic establishments of the country could in a sense be considered experimental, but that works erected in 1899 were probably the most perfect that could be devised for some years to come. The lecturer deplored the extreme jealousy and consquent secrecy which existed in some works, preventing the men in charge exchanging with one another improvements and variations in method for the common good of all. He stated that in the application of this process, as he had observed it in visiting various works, the differences were comparatively slight. Some used wooden vats and some slate, some prefer the arrangement in series, some in multiple arc. Some companies thought best to increase capacity by enlarging the number of tanks, thus adding to their permanent investment, others increased their permanent expense by increasing the power in a fewer number of tanks. He stated that the chief difficulty was the maintenance of a constant current density, and quoted Dr. Keller's statement that he did not believe that a current density of over 18 amperes had ever ben successfully exceeded for any length of time in the United States, and that the average density did not exceed 12 to 15 amperes per square foot. He discussed briefly the relative merits of the Hayden and other systems employed at different works, stating that the chief difference was in the form of the anode. In most works operating under Hayden's patent the anodes were rolled into sheets, although in one of the works in England they had successfully cast their anodes into plates not over quarter of an inch thick. He spoke of different methods of hanging the anode which were practiced, stating that the Hayden system economized space, as the anodes could be set more closely, thus admitting of greater current density and a more rapid turning over of the copper, the result being to decrease the amount of metal tied up in the tanks.

The cost of the electrolytic operation at Anaconda has been published, and is stated to be 3-4 cent per pound of copper. In eastern refineries, however, contracts have been made by which the refiner agrees to return to the miner all the copper, gold and silver the assay certificates call for in the form of refined copper, gold and silver, and charges for their services in some cases are so much less than one cent per pound that it is evident that it does not cost the eastern refiner as much as 3-4 cent, even including interest on money tied up in the metals in the vat.

The lecture was illustrated with lantern views of western mines, both surface and underground, views of traction, timbering, etc., also views of metallurgical mills and equipments.

DRAWBACKS OF THE NERNST LAMP.

The commercial value of Prof. Nernst's famous lamp, it is thought by experts, will be seriously diminished by two drawbacks. One of these is the fact that it does not light instantaneously by simply turning on the current; the rod of refractory oxides has first to be heated, for which purpose two devices are used, namely, a small spirit lamp that requires to be lighted with a match and turned out when the electrolyte has become hot and begun to glow, and, further, a heater in the form of a coil surrounding but not touching the incandescent glower—this heater being supplied by the current from the moment when it is turned on, and so arranged that, on the rod becoming heated and beginning to glow, the heater is automatically cut out of the circuit, relapsing into disuse until needed again to light the lamp. The large expense thus involved is a serious objection. Then, too, the life of the incandescent glower, if operated at so high a temperature as to reach the best efficiency, does not exceed 300 hours, as against 600 to 1,000 hours of the carbon filament.

NIAGARA FALLS POWER DEVELOPMENT ON THE CANADIAN SIDE.

The agreement between the Ontario Power Company of Niagara Falls and the Commissioners of the Queen Victoria Niagara Falls Park was signed by the Canadian authorities Wednesday, April 11. This is the end of a long and bitter opposition by the American company to the rights asked by the Ontario company.

The charter of the Ontario company was granted by the Dominion government several years ago, and the approval of the agreement by the Ontario government completes the franchise for the develpoment of 300,000 horse power or more on the Canadian side of Niagara Falls. To the personal efforts of Banker R. Paine, of Niagara Falls, Ont., and Arthur C. Denniston, of Philadelphia, during a period of six years, is largely due the successful issue of the negotiations.

The estimated cost of the entire development of 300.-000 electrical horse power is $10,000,000. The plan is to bring water from a point where the Welland River empties into the Niagara by a canal to the bluff below the Dufferin Islands, where under a head of 45 feet the first development of 60,000 horse power will be made. Thence the water will be carried by an open canal through the park to a point just below Table Rock, where under a head of 160 feet, 240,000 horse power will be developed.

The company's plans contemplate the immediate commencement of development wark. A capacity for 60,000 horse power will be the initial development at a cost of $2,000,000. This will be increased to meet the demand up to 300,000 horse power or more. Negotiations for power are in progress with many large electrolytic industries and an immense steel plant. Locally, there is a large demand, and also a prospect of transmitting power to Toronto, Hamilton and Buffalo.

The officers of the company associated in this great enterpries are prominent citizens of Buffalo. J. J. Albright is president; Gen. Geo. S. Field is vice-president, and in charge of the active management of affairs. and Franklin D. Locke, Buffalo; Henry C. Symmes and and Farnklin D. Locke, Buffalo; Henry C. Symmes and Banker R. Paine, Niagara Falls, Ont.; W. M. German, M. P., Welland, Ont., and Arthur C. Denniston, Philadelphia.

The Electrical Age.

ESTABLISHED 1883.

Entered at New York P. O. as second-class matter, January 18, 1891.

THE ELECTRICAL AGE PUBLISHING CO., Publishers.

TERMS OF SUBSCRIPTION:

One Copy, one Year,	$2.50
One Copy, six months,	1.25
Great Britain and other Countries,	3.50

Cable Address (all Cables), "Electage," New York.

NEWTON HARRISON, E. E., EDITOR.

ASSOCIATE EDITORS:

ALFRED E. WIENER, E. E., OSBORNE P. LOOMIS, E. E., } ELECTRIC LIGHT AND POWER.

JOSEPH MUIR, M. D., FREDERICK STRANGE KOLLE, M. D., } ELECTRO-THERAPEUTICS.

ADDRESS ALL COMMUNICATIONS TO

THE ELECTRICAL AGE PUBLISHING COMPANY,

Seventh Floor, World Building,

NEW YORK.

NEW YORK, MAY 5, 1900.

CONTENTS:

IMPROVEMENT IN CENTRAL STATION METHODS.

If viewed from an historical standpoint, the electric light station has certainly graduated and necessarily developed from a most humble beginning. Not more than a decade ago the experimental features of electric lighting were more prominent than those which have since been regarded as permanent accessions. The dynamo, the wiring system, the lamps, and all that pertain to electric lighting were quite recently of a questionable character. The science itself was subject to changes caused by a fuller interpretation of known laws. Many of the appurtenances now in use were not applied in a manner indicated either by science or experience. It is therefore evident that the elctric light station of to-day is the practical outcome of a series of experiments which were fortunately so productive that this particular science, i. e., that of electric lighting, classified and subdivided in a most reasonable and scientific manner. The systems of arc lighting, of incandescent lighting, with continuous and alternating current have been resolved into such constituents that stations equipped for any of these purposes differ radically from each other. To quote from the pen of an eminent writer: "When Mr. J. E. H. Gordon wrote a practical treatise on electric lighting in 1884 he filled the rather large book with descriptions of dynamos and electric lamps made in forms which are now nearly all discarded, but at that time there was little else to write about in respect to the question of electric lighting. There were at that time no great electric lighting plants such as we have to-day. Nor were there any even to be compared with those in existence only five years later than the date of the book. With the same courage and optimism which led him to say in 1881 'the day will come when gas-light will be as obsolete as wooden torches and when in every house the incandescent lamp will have replaced the gas jet' Mr. Gordon left space in his book for a chapter called 'Central Station Lighting.'" How electric lighting has developed can be best appreciated and understood by those that labored in the midst of startling innovations, viewing change after change following each other in quick succession at the period referred to Mr. Gordon above. Great central stations feeding one or two hundred thousand amperes into underground mains are operated along such systematic lines that labor and risk and expense are reduced to the lowest possible terms. The storage battery has come into play to perform its function during periods of overload in a manner comprehensible alike to the engineer and stockholder. In fact, central stations with storage battery adjuncts represent the highest state of the art of elecric lighting. Not only is each individual element of the plant a type of mechanical perfection and the highest efficiency, but the system considered as a whole appeals to the practical mind from an economic and financial standpoint. In the great central stations of to-day the labor is reduced to that of a dozen or less men; the coal consumption is limited and every pound burned weighed beforehand and recorded and the safety devices for the protection of the power circuits leaving the building leave no room for criticism. The engineering art has certainly developed in the field of electric lighting and every improvement adds to the efficiency of large installations and the financial success with which they are managed.

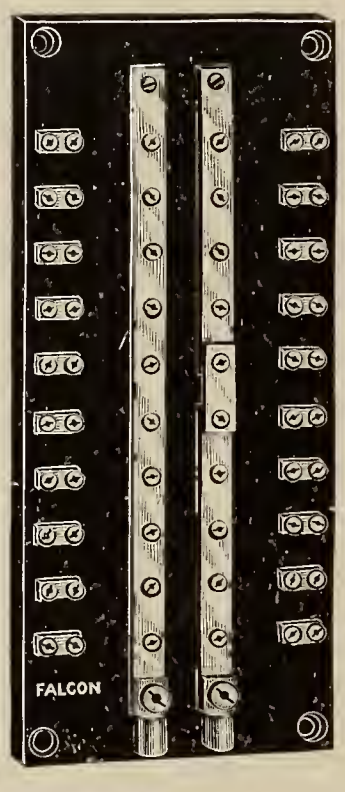
THE INTELLIGENT WIREMAN.

If wiring is an art and not an occupation it is certainly evident that at times those engaged in it should be guided by some of the fundamental rules as well as their own judgment. In equipping a building for electric lights many peculiar phases of the problem of electric wiring present themselves. They are often of such a character that not only is a scientific knowledge required for the determination of the dimensions, length and drop in wires, but a commercial experience, or rather a business experience, for the purpose of avoiding errors which will call heavily upon the pocket books of the installee. The mere knowledge of the size of wires and the calculation of drop is no more valuable than the knowledge which comes more or less from a varied experience and which relates to the situation of the wires in the walls and building. Various occasions arise where feeders and mains are more or less expensive to install, according to their situation. Other cases are frequent where an overplus of copper has been used by an over-conscientious contractor. Where time work is being done of any magnitude such incidents as these do not play an important part in the sum total, but may frequently give rise to disagreements regarding time spent which must be paid for, yet leaves no distinct proof of its consumption in the manner of the work performed. The proprietor of a large china house, whose wires were renewed so as to accord with the laws of the Board of Fire Underwriters, raised many objections to the expense subsequently involved because of his inability to see where the time was spent in merely changing the wires of a house. To keep such figures as these down to a minimum, as well as the prices of wiring material, certainly calls for a thorough knowledge of the art of wiring and the contractor is most successful who fully appreciates not only the technical requirements, but those of a business character as well.

Electric Lighting Appliances.

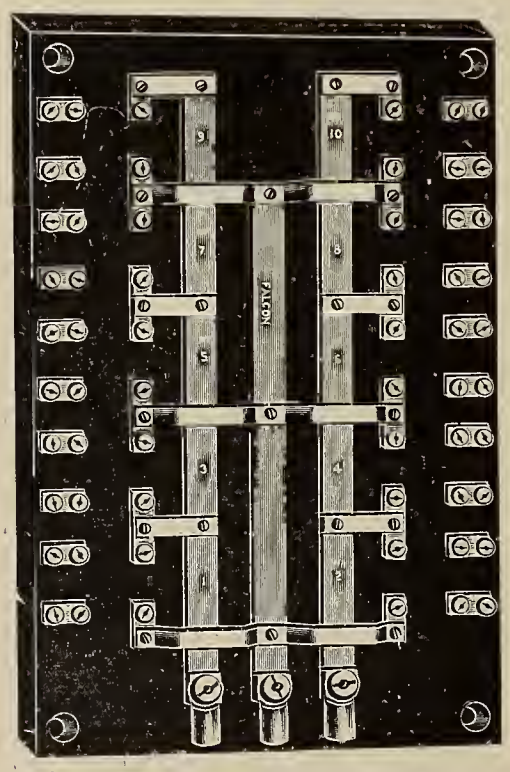
PANEL BOARDS.

The Falcon Electric Manufacturing Company, with general offices and works at 432-436 E. 71st street, New York city, have placed upon the market a line of panel boards that meet with all conditions of practice and are built in conformity with the rules of the National Board



Fuse Panel, Two Wire System.

of Underwriters. While this would be recommendation enough to any practical contractor it may be stated that these panel boards, built to suit circuits having pressures not exceeding 125 volts, possess slates, black enamelled. The metal parts are finished either plain or polished and the boards are so constructed for two and three circuits



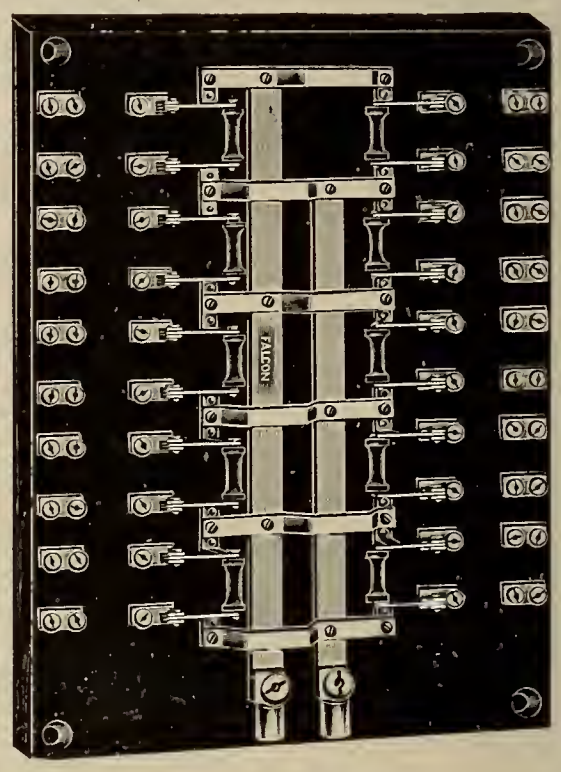
Bridged Wire Fuse Panel.

that they can be immediately utilized. The price list for standard switch panel boards, ranging from to 2 to 30 circuits, for straight fuse panel boards, ranging from 2 to 39 circuits and for bridged fused panel boards, ranging from 20 to 30 circuits, will be mailed on application by the manufacturers.

Conventions.

NATIONAL ELECTRIC LIGHT ASSOCIATION CONVENTION.

Unusual interest is being manifested by central station managers throughout the country in the meeting to be held in Chicago May 22, 23, 24. The indications are that there will be a very large attendance of electric lighting men. The program has been made up in accordance with suggestion from central station managers as to their needs, and a glance will show that the themes treated are in the hands of men that thoroughly understand their subjects. Among the papers to be read are



Standard Wire Switch Panel.

the following:

"Uniform Accounting," by Lieutenant James Blake Cahoon, Syracuse, N. Y.

"Equitable, Uniform and Competitive Rates," Henry L. Doherty, St. Paul, Minn.

"Central Station Economies," W. L. Abbott, Chicago, Ill.

"Series Inclosed Alternating Arc Lamps," William Lispenard Robb, Hartford, Conn.

Other papers, of equal interest, will be announced later. The committee reports are also of value and promise to be very complete.

Patents.

WEEKLY ELECTRICAL PATENT RECORD.

PATENTS ISSUED APRIL 24, 1900.

Conducted by Otto Greenburg. Complete descriptions and drawings of any patent mentioned below will be sent on receipt of ten cents.

847,937.—Electromagnetically Operated Railroad Switch. F. Baldwin, New York.

647,940.—Support for Electric Conductors. Thomas J. Cope, Philadelphia.

647,946.—Electric Igniter for Gas Engines. W. H. Cotton, Chicago.

647,960.—Electrolytic Cell. Geo. W. Gesner, N. Y. This cell comprises a vessel and an anode and cathode of an alloy of iron and hydrogen, the hydrogen being present in such proportion as to prevent the oxidation of the iron in the alloy.

647,970.—Apparatus for Indicating Leakage of Current from Electric Conductors. Martin Kaltmann, Berlin, Germany.

647,980.—Electric Elevator. James F. Morrison and Orlando M. Woodrow, Wellston, Ohio.

648,052.—Brush Holder. E. D. Priest, Schenectady, N. Y.

648,081, 648,082, 648,083, 648,084, 648,085 and 648,086.—Electric Rail Bond. Constant F. de Redon, N. Y.

648,092.—Electromagnetic Electric Railroad Switch. Philip B. Williams, Washington, D. C.

648,144.—Electric Lighting Apparatus. Rufus N. Chamberlain, Depew, N. Y.

648,252.—Electric Signaling System for Railroad. Manious Garl, Akron, Ill.

648,273.—Brake for Electric Motors. Chas. A. Sindstrom, Chicago.

648,295.—Electric Arc Lamp. William E. Pugsley, Lincoln, Neb.

648,296.—Electric Clock. Peter M. Ravenskilde, Cabery, Ill.

648,335.—Coin-Freed Electric Motor. Frederic J. Beaumont, London, Eng.

Business News.

SPECIAL EXPORT COLUMN.

TOTAL AMOUNT OF ELECTRICAL EXPORTS FROM NEW YORK CITY FOR WEEK ENDING APRIL 28, 1900, $116,390.

New York, N. Y., April 28, 1900.—The following were the exports of electrical material from the Port of New York for the week just ended:

Antwerp.—28 cases electrical material, $2,406.

Argentine Republic.—19 cases electrical machinery, $1,871; 53 cases electrical material, $6,175.

British Possessions in Africa.—86 cases electrical material, $6,266; 48 cases electrical machinery, $13,978.

Barcelona.—21 cases electrical material, $1,399.

Brazil.—2 cases electrical material, $175.

Berlin.—55 cases electrical machinery, $1,120.

British Guiana.—1 case electrical material, $55.

Bristol.—7 cases electrical machinery, $400.

Cuba.—11 cases electrical material, $94.

Canada.—2 cases electrical material, $110.

Central America.—38 cases electrical material, $391.

Ecuador.—206 cases electrical material, $1,953.

Genoa.—33 cases electrical material, $10,341.

Hamburg.—52 cases electrical material, $3,094.

Havre.—25 cases electrical material, $5,485.

Kieff.—1 case electrical material, $60.

London.—339 cases electrical material, $37,402; 63 cases electrical machinery, $13,522; 15 cases electros, $573.

Marseilles.—30 cases electric material, $300.

Manchester.—6 cases electrical material, $450.

Mexico.—15 cases electrical switchboards, $2,505; 71 cases electrical material, $997.

Porto Rico.—4 cases electrical material, $54.

Peru.—28 cases electrical material, $3,328.

Southampton.—11 cases electrical material, $316; 85 cases electrical machinery, $1,013.

Stockholm.—2 cases electrical material, $15.

St. Petersburg.—9 cases electrical machinery, $519.

U. S. Colombia.—10 cases electrical material, $383.

NEW INCORPORATIONS.

Leadville, Colo.—The Leadville & Red Cliff Water, Light and Power Company has been incorporated. Capital, $65,000; Chas. Boettcher, S. W. Mudd, William B. Page, John F. Campion and Charles Cavender, Leadville.

Chicago, Ill.—The J. M. Atkinson Company, Chicago; capital, $10,000; has been chartered for manufacturing electric machinery and supplies; incorporators: J. Marshall Atkinson, William E. Pimlott, James S. Cummins.

Elwood, Ind.—The Lea Electric Manufacturing Company has been incorporated here with $50,000 capital. It absorbs the Robinson Heater Company, and will manufacture electric light and heating apparatus.

Port Washington, N. Y.—The Port Washington Electric Light, Heat and Power Company. Capital, $7,500; directors: Charles F. Lewis, L. B. Smull, J. O'Brien, John J. McDermott and John H. Burtis, of Port Washington.

New York City.—The Richmond Park Water, Land, Light and Power Company, of the Borough of Richmond, has been incorporated. Capital, $10,000; directors: Frederick G. Andrews and Ezekiel Roe, of Brooklyn, and Katherine Whithead, of Richmond.

Peoria, Ill.—The Illinois Lighting Company has filed incorporation papers. The objects are to manufacture, buy and sell illuminating and lighting fixtures and to construct and maintain illuminating and lighting plants. The capital stock is $2,000, and Rudolph L. Pasquay, Ernest C. Pfeiffer and John G. Meyer have been selected directors for one year.

Peru, Ind.—The City Lighting Company, of Peru, has been incorporated. Capital stock, $25,000; directors: Samuel V. Perrott, Henry C. Ulen, Jr., and Albert G. Perrott.

St. Louis, Mo.—The City Lighting Company, of St. Louis, with a capital of $600,000, has been incorporated by B. M. Shaw, George Mayer, John H. Brown and others.

Casper, Wyo.—The Casper Electric Company, with a capital of $20,000, has filed articles of incorporation to erect a plant at Casper. The trustees are: C. H. King, Dr. F. Salathe and T. M. Becker.

Brookings, S. D.—Articles of incorporation have been filed for the Electric Loom Company, at Brookings, with a capital of $100,000; incorporators: Albert Berry, George A. Beatty, Louis N. Fuller, J. P. Cheever and Walter M. Cheever.

Lacombe, Colo.—The Lacombe Electric Company has been formed with a capital of $1,000,000. Charles F. Lacombe, William S. Bagot, Zeph. T. Hill, Frederick Dorr and Henry J. O'Bryan, directors.

Overton, Tenn.—The Overton Telegraph Company, of Overton County, has been incorporated. Capital stock, $50,000; the incorporaters are: Harris Hatcher, Moses Miller, H. K. Vaughn, R. H. Hawkins and W. H. Hawkins.

Portsmouth, Va.—A charter has been granted to the Electrical Construction Company. The capital stock is $40,000, which may be increased to $100,000. The prin-

cipal office is to be in Portsmouth. The officers, all of Philadelphia, are as follows: Powell Evans, president; Axel H. Engstrom, vice-president; Magnus Hellstrom, secretary and treasurer; A. M. Bodine, Axel H. Engstrom, Powell Evans, Magnus Hellstrom and S. Bowman Wheeler, directors.

TELEPHONE NEWS.

Childress, Tex.—The Panhandle Telephone Company, of Childress, with a capital stock of $7,500, has been incorporated by R. H. Norris, B. B. Bates, W. N. Motes and others.

Brownstown, Ind.—The Brownstown Telephone Company, of Brownstown, Jackson County, has been incorporated. Capital stock, $5,000; directors: Frank Branaman, C. F. Robertson and I. N. Persinger.

Trenton, N. J.—The Keystone Telephone Company, capital $2,000,000, has been incorporated to operate telephone and telegraph lines in South Jersey. The incorporators are: Norman Grey and S. Stanger Iszard, Woodbury; William H. Chew, Camden.

Point Pleasant, N. J.—The Seashore Telephone Company has been chartered with its principal office at Point Pleasant, N. J Objects, telephone business. Capital, $2,000; incorporators: Charles W. Dampan, Henry Johnson, Joseph W. Johnson.

Dubuque, Iowa.—Articles of incorporation have been filed of the Dubuque Telephone Company, with a capital stock of $50,000. The directors are: B. F. Blocklinger and J. M. McFaden, Dubuque; O. J. Hager and L. A. Howe, Waukon, Iowa; J. A. Ellsworth, McGregor; V. H. Stevens, Waterville, Iowa, and G. J. Cass, Caledonia, Minn.

San Jose, Cal.—The San Jose Telephone Company, which was recently organized to carry on business in opposition to the Sunset Company, has filed amended articles of incorporation. The capital stock has been increased from $100,000 to $250,000. The sum of $10,000 has already been subscribed. The directors named are: E. Knickerbocker, Frederick Brown, H. C. Doerr, F. C. Sanford, H. O. Hickox, Charles Herrmann and R. S. Ammen.

STREET RAILWAY NEWS.

Buffalo, N. Y.—The Buffalo, Niagara Falls & Rochester Railway Company has been incorporated with a capital of $1,250,000. The company is to construct a street surface road, 120 miles long, to be operated by horse, cable, electricity or compressed air power. The directors are: Allan C. Beach, of Watertown; Charles S. Baker, George L. Brown, George Moss, Milton Clark, George A. Brooks, Henry D. Quinby and William C. Grey, of Rochester, and William H. Gillette, of Charlotte.

Lockport, N. Y.—The Lockport & Olcott Railway Company has been incorporated with a capital of $200,000. It purposes building an electric line 18 miles in length between Lockport and Olcott. The directors include W. Van Horn, general manager of the Buffalo & Niagara Falls Company; David Millar, Lockport, and Henry J. Pierce, Buffalo.

AUTOMOBILE NEWS.

Rochester, N. Y.—Empire State Automobile Company, of Rochester. Capital, $20,000; directors: Martin F. Pinckney, George E. McElroy, Albert L. Cole and Herbert Clark, Rochester.

NEW YORK NOTES.

THE NEW YORK ELECTRIC VEHICLE TRANSPORTATION COMPANY has opened a salesroom at 541 Fifth Avenue, New York City, where all types of Columbia automobiles are exhibited and where information regarding prices, etc., can be obtained.

THE GARVIN MACHINE COMPANY, Spring and Varick Sts., New York, have now ready for distribution their new catalogue of machine tools, which also includes universal and plain milling machines, special labor-saving machines of all kinds, etc. This catalogue is complete in every respect and can be had upon application.

THE NATIONAL CONDUIT & CABLE COMPANY, Times Building, have issued a catalogue of their various conduits and wires and cables. This catalogue is a handsome specimen of the art preservative and contains illustrations of various installations, cables used in same, details of construction, specifications for the guidance of engineers, and is about the most perfect of its kind ever issued.

GOULD STORAGE BATTERIES were used by Mr. A. L. Riker in his electric vehicle which won the fifty-mile road race on Long Island April 14. Not only did the batteries carry the automobile over the course in 2 hours, 3 minutes and 30 seconds, but sixteen miles further after the finish, after which there was still enough current left in the batteries to run a considerable distance.

MR. D. M. STEWARD, of the D. M. Steward Manufacturing Company, Chattanooga, Tenn., manufacturers of a varied line of lava insulators, mechanical goods of all kinds, etc., has left for a tour of the Continent. While abroad he will visit the Paris Exposition and also give his attention to business connected with his concern. His son, Mr. R. B. Steward, has left the New York office at 107 Chambers St. in charge of a competent gentleman, Mr. D. C. Gray, while he takes hold of the reins at Chattanooga.

THE NEW JERSEY ELECTRIC VEHICLE TRANSPORTATION COMPANY has arranged to install automobile stations during the coming season at the following points on the Jersey coast: Seabright, West End (Long Branch), Allenhurst, Spring Lake and Atlantic City. At each of these stations Columbia vehicles, both electric and gasoline, of various designs, will be for sale, and a specialty will be made of charging and caring for Columbia automobiles owned by private parties. The location of the various stations insures proper accommodations for vehicles and offers a large field for driving. Park wagonettes and omnibuses will be available for special service and for parties wishing to make trips through the surrounding country.

WESTON STANDARD ILLUMINATED DIAL

STATION INSTRUMENTS.

THESE INSTRUMENTS are based upon the same general principle and are just as accurate as our regular Standard Portable Direct Current Voltmeters and Ammeters, but are much larger, and the working parts are inclosed in a neatly designed dust-proof cast-iron case, which effectively shields the instruments from disturbing influences of external magnetic fields.

WESTON ELECTRICAL INSTRUMENT CO.

114-120 William St., Newark, N. J., U. S. A.

BERLIN. European Weston Electrical Instrument Co. Ritter strasse No. 88.

LONDON. Elliott Brothers, No. 101 St. Martins Lane.

The Electrical Age.

VOL. XXV—NO. 19. NEW YORK, MAY 12, 1900. WHOLE NO. 678.

Water Power Installations.

Melvin D. Compton, Inventor.

THE COMPTON TIDE POWER SYSTEM.

The utilization of tides for the purpose of storing and using power has gained the interest of the scientific world in recent times through certain features in connection with it of a most practical nature. The force of water has been thoroughly appreciated since the days of primitive man and the redundant energy it contains when rising and falling is fully known to even the most primitive people. The idea of Melvin D. Compton of East Orange, N. J., inventor of the Compton tide power system, is to make use of the vast fund of energy each day created and wasted by the rise and fall of the tide. It is certainly evident to even the lay mind that the cheapness of the power thus obtained would be the means of creating vast industrial changes and adding greatly to the cheapness of manufacture of a host of articles in daily use. Light, heat and power might be made so cheap by the utilization and application of the force of the tide that the poorest as well as the richest could enjoy all the advantages procurable from it.

In the report of William M. Barr, mechanical engineer, the following statement occurs: "The problem of tidal power, as viewed by the casual observer, seems simple enough but nearly all experiments have failed mainly through the effort to utilize the power of waves as they roll inwards towards the beach, endeavoring to use the lateral force of the waves rather than the rise and fall of the tide. There are too many uncertainties connected with the lateral motion of waves to make any train of mechanism at all reliable in the generation of power for commercial purposes if wholly dependent upon such lateral wave motion."

References to the variations in the height of the tide at different points in the earth's surface are sufficient to show that the principle of utilizing the rise and fall of the sea in this manner is exceedingly practicable. At Liverpool, England, for instance, the height of the tide is practically 30 feet; at Pembroke, Wales, 22 feet; at Eastport, Me., 24 feet, and at New York City, 6 feet. Of course, it is stated that the rise of the tide at the Bay of Fundy is approximately 60 feet, yet the significance of this fact loses its importance on account of its location. If, at important commercial ports or industrial centres,

the tide rises to such an extent that use can be made, a financial and commercial proposition is at once presented of a character extremely interesting to business men. It is generally admitted that the utilization of water power is exceedingly satisfactory in all cases where its potential energy is used for the moving of electrical machinery. The great plant at Niagara is primarily a water power installation, though secondarily a large electric plant. In the same manner the engineering science may be brought into play for the purpose of making use of the millions of horse power that have been wasted since the tides first sprang into existence at our very shores, as it were.

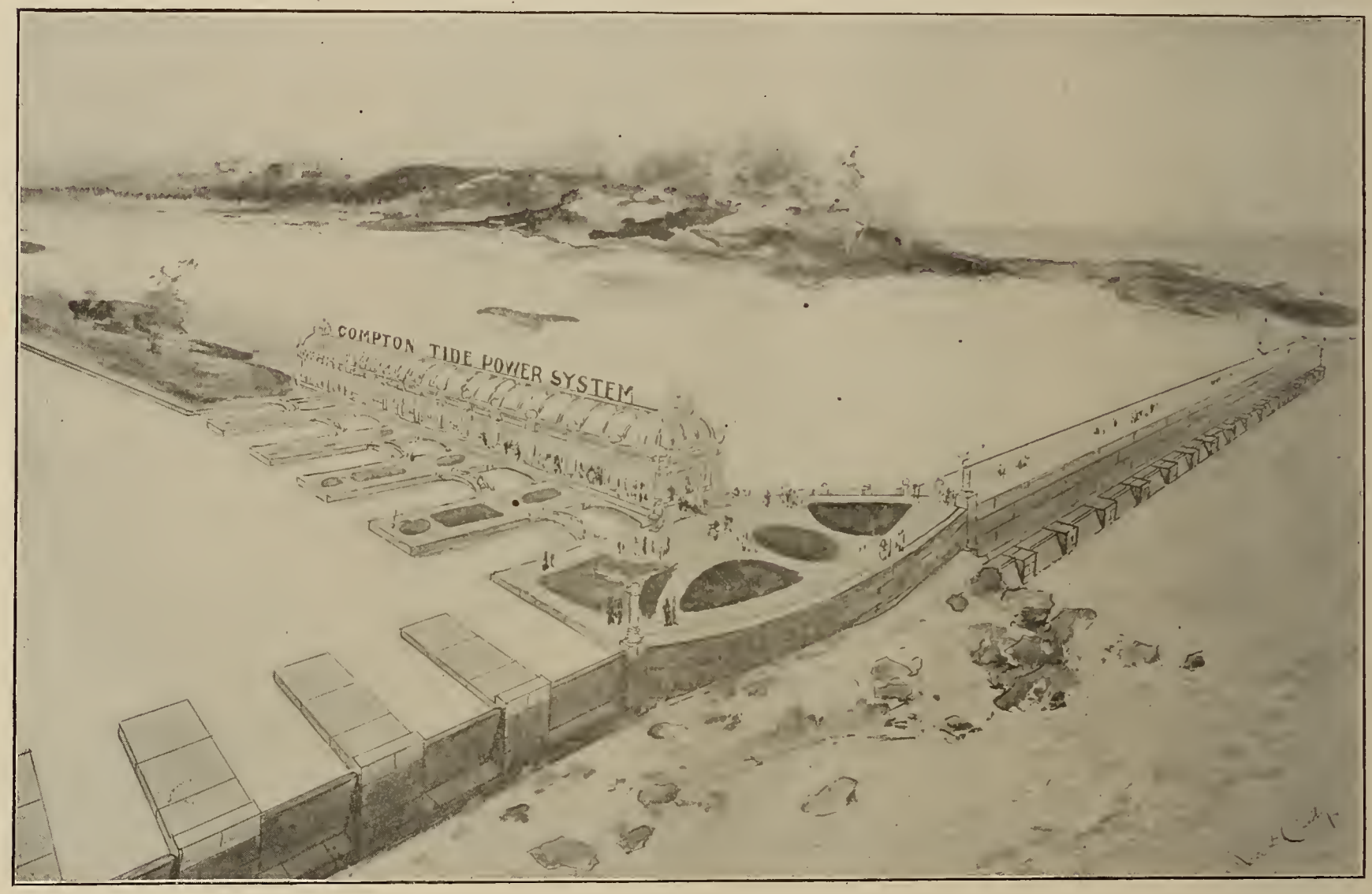
It is the idea of Mr. Compton in his system of tide power control to utilize the head of water due to the difference in level between the low or ebb and the high or flood tide. This is a most reasonable proposition because in France a head of water of a foot or less is frequently made use of for the development of power. In the case at hand the water is stored at high tide and let out at ebb in the manner described and its energy used for driving electric generators; which would light, heat and supply power in sufficient quantities to make such a centre entirely independent of coal or fuel of any description.

The Compton system of tide power makes no account whatever of wave motion; it is as wholly independent of waves as it is wholly independent of atmospheric conditions; it rests upon the most reliable of all fundamental bases—gravitation is therefore absolutely certain in its operation.

Motors operating by the Compton system can run without stoppage throughout the twenty-four hours, and, similarly, throughout the entire year, wholly regardless of atmospheric conditions, and with a certainty of performance not excelled by any other prime mover. It possesses an economical superiority over steam power whatever may be the price of coal.

The Compton system, unlike ordinary water powers, is uninfluenced by persistance in summer droughts, and is also exempted from those destructive torrents which periodically menace the permanency of water power improvements when situated in valleys along natural water courses.

The Compton tide power utilizes the head of water due to the difference of level between the low ebb and the high or flood tide. Much confusion has arisen in the popular mind in not making a clear distinction between the horizontal movement of the sea or wave motion, and the vertical rise and fall to which the word tide should only be applied. The range of a tide is the vertical distance between the low and high water levels; the length of a tide is the distance measured on the surface of the sea from one low water to the next. A short calculation will readily show the energy developed by a comparatively small area of water subjected to a tidal rise of six feet. Taking an aqueous surface 10 feet by 10 feet in area and allowing a quantity of water represented by a six foot depth to fall through the medium of turbines for the development of electrical energy, the horse power generated would be equal to 10 times 10 times 62.5, or, 6,250 pounds falling through a distance of 6 feet would give 37,500 foot pounds. If the total plant gave a resultant efficiency of 85 per cent. the net result would be the de-



Exterior of Power Plant. Compton Tide Power System.

velopment of approximately 1 horse power. On this basis it is very evident that a water front 1,000 feet long and 100 feet wide rising and falling six feet develops 1,000 horse power. In the light of these facts it is therefore only necessary to build reservoirs along the water front, in the manner indicated in the illustration, and place thorough dependence upon every hundred feet of superficial surface, representing one horse power under the conditions mentioned above. In all probability in practice more energy than this would be obtained but, on the whole, the figures show the immediate practical application of this principle for the development of electrical power.

In one of the illustrations, showing the water front built up for the purpose of storing power, the lower portion of illustration shows the ocean front at low tide.

As high tide keeps the upper reservoir full, and low tide empties the tail water from turbines out of lower reservoir, the generation of electric power is continuous, day and night, year in and year out. The volume of power obtained is only limited by the capacity of the plant. The ocean, through the agency of the tides, will supply power sufficient to light, heat and turn the wheels of industries throughout the world.

The accompanying illustration shows the interior of a power house containing dynamos driven by turbines generating 5,000 H. P. each, 50,000 H. P. being the capacity of the entire plant.

The artist has furnished a background, showing a "smoky city" in the distance, where fuel is used to create power, while at the left is another city, where the entire power, heat and light is obtained by the tide power

Interior of Power House. Compton Tide Power System.

To the left a bay or reservoir, separated from the ocean by a sea wall, having gates that swing inward, which will admit water at high tide and retain the same as tide recedes.

To the right is a similar bay or reservoir, with a sea wall, having gates that swing outward, which will discharge the water from said bay at low tide, but will not admit water as the tide rises.

Between these two bodies of water one of which is constantly maintained within a foot or two of high tide, and the other within the same variation of low tide, the power plant is located. Turbine wheels suitably located therein are operated continually under a water head equal to the height of surface of high tide reservoir, above the surface of low tide body of water. Dynamos connected to the turbines generate electric power, which may be transmitted anywhere.

system.

U. S. patents have been issued. Patents applied for, Great Britain, France, Germany, Russia, India, Japan, Spain, Portugal, Belgium, Canada, Brazil, Argentine Republic, Chili, U. S. of Colombia, Queensland, West Australia, North and South Australia.

Millions have been expended to perfect improved apparatus that would reduce the cost of power. "Economy in fuel," the one great factor necessary, has ever been the object sought.

To harness the tide and use this exhaustless element as a substitute for fuel in the development of power, heat and light, is such a startling proposition that the public will naturally stand aghast and eagerly wait for proof of the success of a system that means the saving of millions of dollars yearly in the production of the keystone to the world's commercial existence.

The practicability of this system is apparent to anyone of ordinary intelligence.

Well known methods and apparatus are simply harnessed together in a new combination that will bring tidal power into commercial use throughout the tide-bounded world.

Export Hints.

WATER ELECTRIC POWER IN MORRISBURGH, CANADA.

Consul Hamilton reports that, after many futile efforts, mayor and the town council of Morrisburg have obtained a lease from the Government for twenty-five years of 250-horse water power, to be used for the development of electric power for manufacturing industries, furnishing light for streets, houses, etc. This development will cost about $30,000, as per estimate of hydraulic engineer in charge. This power can and will be materially increased as necessities may require.

ELECTRIC RAILWAY IN NOTTINGHAM.

Following the lead of Liverpool, Sheffield, Bradford, Glasgow, Manchester, and other cities of Great Britain, it is promised that an electric street-railway service will soon supersede the present horse tramways in Nottingham. The city owns both extensive gas and electric-light works, and it is assured that no expense will eventually be spared in creating a modern street-railway system, with a central depot and adequate suburban service. Contracts for experimental motors have been placed in Sheffield. If not satisfactory upon trial, other offers will be considered. The bodies of the cars will be built in England, but a Philadelphia firm is under contract to make and deliver the wheels. The wire contracts are likely to go to New Jersey. American steel rails are also under consideration. American bids for miscellaneous material will receive attention, and inquiries should be addressed to Mr. Arthur Browne, city engineer.

Nottingham. S. C. M'FARLAND, Consul.

TRACTION RAILWAY IN NICARAGUA.

Consul Donaldson, of Managua, sends a letter from Consular Agent Manning, of Matagalpa, as follows:

A company has been organized, incorporated under a very favorable charter by the Government of Nicaragua, with the title, "Compania de Trasportes de Matagalpa, Limitado" (capital stock, $20,000), for the purpose of doing a general freight and passenger transportation business between this point and the national railway at Momotombo, or Leon. It is intended to place improved traction wagons, or "traction trains," on the road. It seems to me that this is a good field for the traction companies of the United States to look into. The export from here next year will amount to at least 18,000 to 20,000 bags of coffee, and half as much freight will be required to supply the district, which will be brought up from the railroads. The distance is nearly 110 miles, and I can see no serious obstacles to the use of these freighting machines.

AUTOMOBILES AND ELECTRIC POWER PLANTS IN SWEDEN.

Many business men here think that the import of motor carriages into Sweden, if once properly started, will be considerable, provided they can be made durable, neat in apearance, safe and easy to handle, and not too expensive. Cab owners, especially in Stockholm, are considering the advisability of purchasing motor carriages, and a short time ago they sent experts to Berlin, to study and examine motor cabs manufactured in Germany. The report they made on their return was not altogether favorable. They said that automobiles which in catalogues seemed to be ideals of perfection in reality did not come up to expectations. It was said that few of the carriages exhibited were of the type desired—that is, with room for from two to four passengers. American manufacturers ought to pay attention to the markets in the other cities of this Kingdom, especially Gothenburg and Malmo. It would be of great advantage for American firms to be represented here at once.

Another thing of importance is electrical machinery in general, which will be in great demand as soon as the people have fully learned the value of their numerous waterfalls. A large electric-power plant will soon be built at Trollhattan; electric railways and tramways are being planned for Gothenburg, Lund, Bjerrod, and Jonkoping.

Electric-motor carriages are preferred for city traffic. Those with benzine motors are said to be noisy and to emit offensive gases.

ROBERT S. S. BERGH, Consul.

Gothenburg.

PROPOSED ELECTRIC RAILWAY IN LEICESTERSHIRE.

Slowly, but none the less surely, electric traction is superseding the inadequate horse railways of England and is even being introduced where these never existed. In a recent report a summary of the situation as regards Nottingham was made. Another enterprise of similar character has practically culminated in Loughborough, Leicestershire, and a brief review of the scheme will probably be of interest to American promoters, manufacturers and contractors. The scheme is being promoted by the Loughborough and District Electric Traction Syndicate, Limited, with the support of the Brush Electrical Engineering Company, Limited, Falcon Works, Loughborough. The proposed lines are to run from Hathern through Loughborough and Quorn to Mountsorrel, with a cross line in Loughborough from the Falcon Works. In his opening statement, a solicitor said the total length of the line was 8 1-4 miles, with a gauge of 3 feet 6 inches. The motive power would be the overhead-electric system. The cost of the undertaking was £111,162 ($540,970), and the capital of the company £150,000 ($728,975). The cost of construction would include equipment. At present, there was no means of communication between Loughborough and many of the outlying villages and hamlets. The Leicestershire council, he said, was in favor of the "very antiquated" system of underground wires. Grooved girder rails would be used, with concrete, granite setts, or tar macadam. The lines would be constructed on the overhead-electric system, in the usual manner. The cost of construction would, he estimated, be £2,500 ($12,166) per mile on the side of the road; and on the road, with tramway construction, £6,000 ($29,199) for a single track.

Nottingham. S. C. M'FARLAND, Consul.

Cheyenne, Wyo.—The Osborne Elevated Railway Equipment Company, of Cheyenne, has been chartered to manufacture electrical supplies. Capital, $250,000; trustees: B. E. Osborne, J. A. McGeer, J. H. Pierson, F. E. Candy, C. F. Parcels.

The Electrical Age.

ESTABLISHED 1883.

Entered at New York P. O. as second-class matter, January 18, 1891.

THE ELECTRICAL AGE PUBLISHING CO., Publishers.

TERMS OF SUBSCRIPTION:

One Copy, one Year, - - - - - - - - - $2.50
One Copy, six months, - - - - - - - - - 1.25
Great Britain and other Countries, - - - - 3.50

Cable Address (all Cables), "Electage," New York.

NEWTON HARRISON, E. E., EDITOR.

ASSOCIATE EDITORS:

ALFRED E. WIENER, E. E., } ELECTRIC LIGHT AND POWER.
OSBORNE P. LOOMIS, E. E., }
JOSEPH MUIR, M. D., } ELECTRO-
FREDERICK STRANGE KOLLE, M. D., } THERAPEUTICS.

ADDRESS ALL COMMUNICATIONS TO
THE ELECTRICAL AGE PUBLISHING COMPANY,
Seventh Floor, World Building,
NEW YORK.

NEW YORK, MAY 12, 1900.

CONTENTS:

THE ORIGIN OF THE EARTH'S MAGNETIC POLES.

Borchgrevink's discovery of the south magnetic pole of the earth has led to a review of the causes of this peculiar and remarkable manifestation of magnetic energy at the North and South pole. If coincidences possess any value as evidence in arraigning Nature's varied phenomena before the judgment seat of scientific criticism it is certainly worth while noting the simultaneous appearance of solar disturbances, commonly called sunspots, and terrestrial changes of a broad and sweeping character taking place within the earth. The aurora borealis and australis with their magnificent corruscations, the tremendous magnetic storms and the perturbations that occur in the magnetic field of the earth, either caused by or producing a maelstrom of electrical energy in the terrestrial sphere, all these manifestations occur simultaneously with the appearance of sunspots. It has now become a matter fit for serious scientific inquiry to try to establish between these phenomena some fact of common interest, upon which a foundation can be reared of value in the explanation of these modern mysteries.

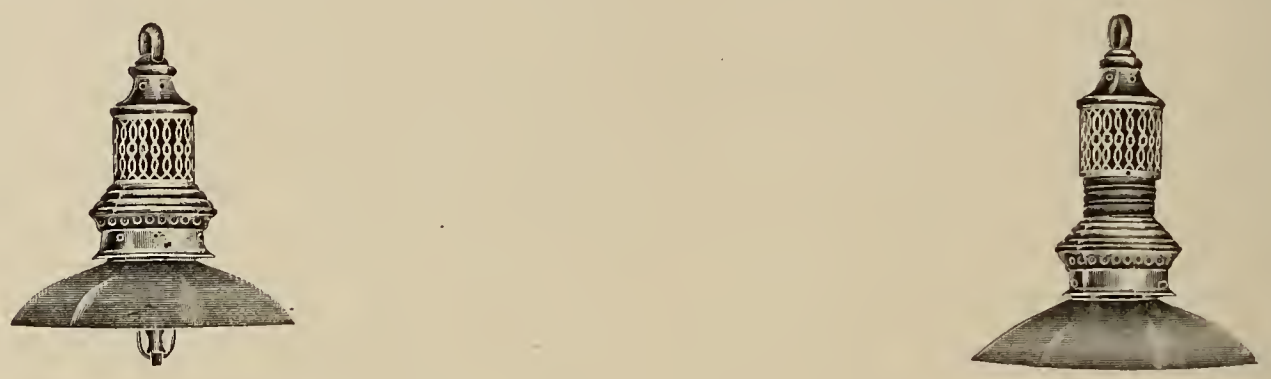
It has been recently discovered by Rowlands, of John Hopkins University, that the rapid rotation of a metallic disk in space produces magnetism. This may be the first stepping stone leading across the stream of scientific inquiry to the shore of fact. The earth, the great sphere rotating in space, may, in some manner at present unknown, create within itself, as do other planets in all probability, the electric and magnetic changes possessing so much interest for the scientific world. The north and south magnetic poles are in all probability created by electric currents circulating around the earth and varying occasionally in strength to an extent sufficient to produce changes noted in its magnetic condition. It does not subtract from the interest of the subject to inquire still further into the origin of this maelstrom of electric power. Whence comes this current and is its character such that the configuration of the earth within and without requires its flow? Or is this great stream of electrical energy due to external conditions? Is the sun responsible for the changes our sphere experiences in this respect? Does the great void stretching between ourselves and the mother planet convey impulses of which we are in ignorance and transmit forces that travel with undiminished energy over the 92,000,000 miles of emptiness? Does electro-magnetic or electro-static induction produce electrical changes on the earth? Or, has each mass of unformed world matter as it began its slow rotation in space developed within itself electrical energy, whose characteristics are those most familiar to the astronomer in the character of heat and light? With the boundless ether stretching on all sides towards infinity and within this immeasurable space great masses of formed and unformed matter rotating with system and regularity, the question to be asked is this: From whence came the power that moves these masses? From what outer or inner source sprang the forces that gave the world its motion? It is thought by many scientists that the relations existing between ether and matter may be traced with logical sequence to a cause inherently electrical. It is thought by others that the limited comprehension of man can never allow a comprehensive view to be taken of the true situation. It seems that the secret can only be wrested from Nature when more of the absolute constitution of matter is known and the manner in which force is correlated and transmitted from it to the ether and back again. Exhibitions of terrestrial magnetism are merely phases of this relationship; the final and ultimate cause will require careful analysis to trace if it is ever to be discovered. Then the bond of relationship existing between planet and planet will assume the simplicity of character apparent in every case where the operation of great laws is brought within our cognizance.

Many of Prof. Rowlands' discoveries in magnetism have been of immense value to the electrical as well as scientific world. He was one of the first to produce a formula expressing the relationship existing between magnetizing force and the lines of force, taking into due consideration the permeability and susceptibility of the iron. He identified static and dynamic electricity and proved that the difference between them is merely one of motion, change of position, as it were. He rotated at an immense speed a copper disk charged with static electricity and thereby produced enough deflection in a magnetic needle to satisfy the scientific world that the difference between static and dynamic electricity is not quantitative but qualitative. He was one of the first in this country to utilize quartz fibres for the suspension of magnetic needles in galvanometers. These are fibres spun from molten quartz, reduced to this condition by the electric arc. By their use the twisting and shifting of the needle is entirely obviated and readings can be taken of almost absolute accuracy in galvanometric work. In various other departments of scientific and technical investigation Rowlands has earned a world wide reputation. He is considered at present an authority on the subject of magnetism and his latest experiments for the purpose of proving that the rotation of the earth is productive of this phenomenon will be received with the greatest interest all over the civilized world.

Electric Lighting

THE "PERFECT" ARC LAMP.

A large number of the lamps illustrated are in operation in New York and Brooklyn. They have in every respect earned the name they own through their high mechanical and electrical design. These lamps are built to burn singly across 100 or 125 volt circuits, direct current, and consume 1 1-3 amperes at 78 volts at the arc. The lamp will last over sixty hours with one six-inch positive, a three and one-half-inch negative, five-sixteenth-inch diameter pair of solid carbons. The simple construction, absence of springs and gears and the existence of but one loose joint in the entire mechanism brings this lamp up to a high standard of excellence. The lamps are finished in polished brass, oxydized copper, silver or black, and are about 500 candle power a piece. The "Perfect Gem" arc lamps are built for attachment to wall brackets and gas chandeliers. In fact, they can be introduced wherever gas and electricity are in use and correspondence in this direction is solicited by the manufacturers. The factory of this enterprising concern is at 123-125 Raymond St., and the office at 239 Willoughby street, Brooklyn, N. Y. The manager is Chas. E. F. Lewis and the electrical engineer Bennerd H. Pomeroy.



Types of the "Perfect Gem" Enclosed Arc Lamp.

NEW MINERS' LAMP IN GERMANY.

Arthur Eitner, of Leipzig, has patented a magnetic-locking arrangement for miners' lamps. He makes use of a horseshoe magnet with one pole cranked, so that, instead of lying in the same horizontal plane as the other, it occupies a rather higher position. When the lamp ring is brought under the cranked end corresponding to one pole of the magnet, a short vertical bolt is attracted so as to be drawn upward, and this leaves the locking bolt free, which latter is then drawn out horizontally by application of the other pole of the magnet.

Conventions.

NATIONAL ELECTRIC LIGHT ASSOCIATION.

As already announced, the various passenger associations have granted a rate of a fare and one-third, on the certificate plan, for delegates and their friends attending the Chicago convention, to be held May 22, 23 and 24. Arrangements have been made to have the New York delegation leave on Sunday, May 20th, via Pennsylvania Railroad, leaving West 23d St. Ferry, 1.55 p. m.; Cortlandt and Desbrosses Sts., 2.00 p. m.; Brooklyn, 1.35 p. m.; Philadelphia, 4.30 p. m.; Harrisburg, 7.20 p. m.; Pittsburg, 1.10 a. m.; arriving in Chicago at 5 p. m. Monday. The railroad fare is $20 from New York, and the berth rate $5, making a total of $25. The train selected is first-class in all its appointments and carries a dining-car. In purchasing tickets, delegates should be particular to obtain a certificate from the ticket agent from whom the purchase is made, as in the absence of this certificate no rebate can be allowed on the return passage. In case the number of delegates attending should warrant, a special train will be run as a second section to the train named. Tickets can be procured at any ticket office of the Pennsylvania Railroad, and space reserved by applying to either the undersigned, or to Samuel Carpenter, Eastern Passenger Agent, 1196 Broadway, New York.

Trenton, N. J.—The Hanscom & Hough Storage Battery Company has been incorporated with a capital stock of $3,500,000. The amount with which the company commenced business was $1,000. The principal office in New Jersey is at 60 Grand street, Jersey City, N. J.

ELECTRIC RAILWAY AND LIGHTING IN VLADIVOSTOCK.

Commercial Agent Greener, of Vladivostock, sends copy of a letter from the municipal government, as follows:

City Hall, Vladivostock, Feb. 25, 1900.

To the American Commercial Agent at Vladivostock:

Sir—It having been proposed to grant a concession for constructing a tramway and an electric-light system in Vladivostock, I send herewith plan of the city, a profile of the Svetlanski and Aleutski streets, on which the probable course of the tramway is traced, and have the honor to request you to make this known to persons in the United States who are skilled in such work; and, also, to give notice that the question of the construction of a reservoir and waterworks for the city of Vladivostock will soon be brought forward.

NEKRASSOFF, Member of the City Council.

Mr. Greener adds: The length of the road will be about 12 miles; no favoritism on the ground of nationality will be shown. Electric power must be used. No time limit has been set for sending in proposals, nor for the completion of the work. The city will be responsible for payment. It is impossible to state the number of lights that will be needed for illuminating the city.

SUBURBAN HOMES NORTH OF THE HARLEM.

The above is the title of a splendid 48 page folder just issued by the passenger department of the New York Central, for the information and service of those seeking permanent or temporary homes in the suburbs of the Metropolis.

This folder contains a carefully prepared paragraph concerning each station in the suburban district north of the Harlem River, on the Hudson River Division, Harlem Division and Putnam Division, giving the distances, number of trains, fares and other information about the service.

The admirable map in this folder enables home seekers to utilize time and travel effectively in prospecting.

A copy of "Suburban Homes North of the Harlem" will be sent free, post-paid to any address, upon receipt of a one-cent stamp, by George H. Daniels, General Passenger Agent, New York.

Patents.

WEEKLY ELECTRICAL PATENT RECORD. PATENTS ISSUED MAY 1, 1900.

Conducted by Otto Greenberg. Complete descriptions and drawings of any patent mentioned below will be sent on receipt of ten cents.

648,378. System of Electric Distribution. Oskar Behrend, Germany.

648,388. Voltage-Regulator. William H. Chapman, Portland, Me.

648,446. Electromagnetic Coil. Richard Varley, Jersey City.

648,481. Electrical Resistance. Arthur W. Berresford, Westfield, N. J.

648,487. Electric Clock. Walter J. Dudley, Somerville, Mass.

648,489. System of Distribution. Wm. Emmet, Schenectady, N. Y.

648,492. Thermo-Electric Generator. John W. Harrison, Pueblo, Colo.

648,493 and 648,494. Regulating Dynamo-Electric Machines. Edward M. Hewlett, Schenectady, N. Y.

648,505. Electric Fishing Apparatus. Ivar W. J. Lind-Bohm, Helsingfors, Russia. This invention consists of an apparatus for facilitating the capture of fish by killing or stunning them.

648,516. Electric Lamp with a burner of second class. Karl Ochs, Berlin, Germany.

648,517. Electric Glow-Light. Karl Ochs, Berlin, Germany.

648,518. Electrical esistance. Karl Ochs, Berlin, Germany.

648,526. Emergency Circuit Closer. Arthur Purinton, Waterbury, Conn.

648,529. Dynamo-Electric Machine. Edward W. Robinson, Schenectady, N. Y.

648,533. Connection-Counter for Telephone Lines. Chas. E. Scribner, Chicago, Ill.

648,546. Electrical Measuring Instrument. Joshua F. Begole, St. Louis, Mo.

648,555. Electric Switch. Wm. Ely, Providence, R. I.

648,625. Electric-Arc Lamp. Henry James, Salford, Eng.

648,659. Phonographo-Telephonic Announcer. John E. Evard, Indianapolis, Ind.

648,660. X-Ray Apparatus. Reginald A. Fessenden, Allegheny, Pa. The invention consists in forming an anticathodic plate of osmium.

648,696. Method of Controlling Electric Motors. Martin T. A. Kubierschley, Berlin, Germany.

648,764. Apparatus for Producing Ozone by Electricity. Joshua H. Samprey, London, Eng.

648,805. Service-Meter Apparatus and Circuit for Telephone Substations. Herbert E. Shreeve, Boston,

648,834. Trolley. Christopher Bierbaum, Buffalo.

648,874. Booster Apparatus for Systems of Electrical Distribution. Lamar Lydon, N. Y.

648,895. Indicator for Telephones. Chas. F. Black, Goshen, Ind.

Business News.

SPECIAL EXPORT COLUMN.

TOTAL AMOUNT OF ELECTRICAL EXPORTS FROM NEW YORK CITY FOR WEEK ENDING MAY 5, 1900, $106,004.

New York, N. Y., May 5, 1900.—The following were the exports of electrical material, etc., from the port of New York, for the week just ended:

Antwerp—13 cases electrical material, $1,793.
Alexandria—2 cases electrical materials, $340.
Argentine—61 cases electrical motors, $3,839; 3 cases electric motors, $549.
Bremen—1 case electric motors, $18.
British Australia—13 cases electrical machinery, $1,792.
Bristol—2 cases electrical machinery, $125.
Brussels—3 cases electric motors, $62.
British West Indies—62 cases electric motors, $937.
Christiania—1 case electric machinery, $93; 1 case electric motors, $32.
Cuba—20 cases electric motors, $910.
Central America—2 cases electrical machinery, $82; 76 cases electric motors, $199.
Danish West Indies—2 cases electric motors, $26.
Glasgow—11 cases electric machinery, $1,490.
Genoa—11 cases electric motors, $6,971.
Havre—19 cases electrical machinery, $1,262; 378 cases electric motors, $10,946.

Hamburg—86 cases electric motors, $10,978.
Hayti—1 case electric motors, $20.
Japan—70 cases electric motors, $9,993.
London—158 cases electric motors, $6,103; 11 cases electric motors, $430.
Liverpool—192 cases electric motors, $20,198; 6 cases electric motors, $38.
Mexico—178 cases electric motors, $8,934.
Naples—61 cases electric motors, $4,000.
Peru—31 cases electric motors, $6,649.
Riga—3 cases electric motors, $716.
Southampton—7 cases electric motors, $2,894; 48 cases electrical machinery, $765.
St. Petersburg—1 case electric motors, $198.
Stettin—8 cases electric motors, $89; 52 cases electric motors, $1,740.
Venezuela—23 cases electric motors, $478.
Zurich—5 cases electric motors, $315.

NEW INCORPORATIONS.

Trenton, N. J.—Hub Motor Company, with a capital stock of $1,500,000. The incorporators are: L. B. Dailey, E. J. Dudley and K. K. McLaren.

Wilmington, Del.—National Electric Hose Signal Company, of Boston, to make and sell electric hose, batteries, wires and signals; capital, $150,000.

Wilmington, Del.—Keystone Electric Company, Philadelphia, to engage in manufacturing, engineering and construction; capital, $200,000.

New York City.—The B. B. Electric Company, of New York City. Capital $30,000; directors: J. T. Beswick and David Beswick, Brooklyn; E. Nicholson, New York city.

New York City.—New York District Telegraph Company, of New York city, to provide messenger service. Capital, $5,000; directors: Dennis W. O'Day, Alfred A. Kearney and Mary O'Day, New York city.

Ticonderoga, N. Y.—The Consolidated Graphite Company, of Ticonderoga, Essex County, to carry on a general mining business. Capital, $50,000; directors: F. E. Harvey, Sandy Hill; A. S. Harvey, Ticonderoga; G. W. Watkins, Moriah; W. F. Whitney, South Ashburnham, Mass.; A. H. Eggleston, G. D. Martenez and William Leavens, Boston.

Trenton, N. J.—The White Knob Copper Company, Limited, with an authorized capital of $15,000,000, today filed articles of incorporation. It is authorized to do a copper and general mining business. Edson Pearsall, R. Rennie Atterbury and William T. Pendleton are the incorporators.

Elwood, Ind.—The Lea Electric Manufacturing Company has been incorporated with a capital stock of $50,000. The headquarters will be in Elwood, and the directors are: John L. Griffiths, Mortimer Levering, Jacob Loomis, Conway Robinson, T. J. Levering, A. A. Wells and Robert Schell.

Agamenticus, Me.—The Agamenticus Light and Power Company has been organized under the Maine laws, for the purpose of operating an electric light plant in York, Wells and Kittery, with $50,000 capital stock, of which $100 is paid in. The officers are: President, Edward S. Marshall; treasurer, Joseph P. Bragdon, both of York. Certificate approved, April 3.

TELEPHONE CALLS.

Etna, Ind.—The Etna Telephone Company, of Etna, Whitney County, has been incorporated. Capital stock, $600; directors: J. W. Scott, John F. Bockman and Lawrence Gerard.

Wilmington, Del.—The Wyoming Telephone Company, to construct and operate telephone lines in Wayne, Wyoming, Lackawanna and adjoining counties of Pennsylvania; capital, $10,000.

Trenton, N. J.—Eastern Telephone and Telegraph Company, to operate lines in New Jersey. The capital stock is $250,000. The incorporators are: J. W. Morgan, John J. Burleigh and E. A. Armstrong, of Camden, each holding $27,500.

Malone, N. Y.—The Franklin County Telephone Company, to operate in Malone and the other villages of Franklin County. Capital, $8,000; directors: E. B. Ferensen, J. A. Crawford, M. S. Crawford, N. S. Ferensen, John Chambers, R. L. Crawford, of Hamden, and Frederick C. Ward, Delhi.

Plymouth, Mich.—The Plymouth Telephone Company has filed articles of incorporation. The capital stock is $2,000, with $500 paid in. L. C. Hough, E. C. Hough, J. R. Rauch, C. H. Rauch, F. M. Briggs, B. B. Bennett, A. A. Tafft, Louis Steel, H. B. Joliffe, D. Joliffe, and Charles A. Fisher are the incorporators. A. A. Tafft, C. H. Rauch, Charles A. Fisher, E. C. Hough, and H. B. Joliffe are the board of directors.

STREET RAILWAY NEWS.

El Paso, Tex.—The El Paso & Juarez Traction Company, with principal offices in El Paso, has been chartered; capital stock, $200,000. Purpose to construct, acquire, maintain and operate street railways in and near the city of El Paso, Tex., and Juarez, Mexico. Incorporated by: J. A. Terry, of New York city; Anson Mills, of Washington, D. C.; Max Weber, Joseph Magoffin and John A. Happer, of El Paso.

New York Notes.

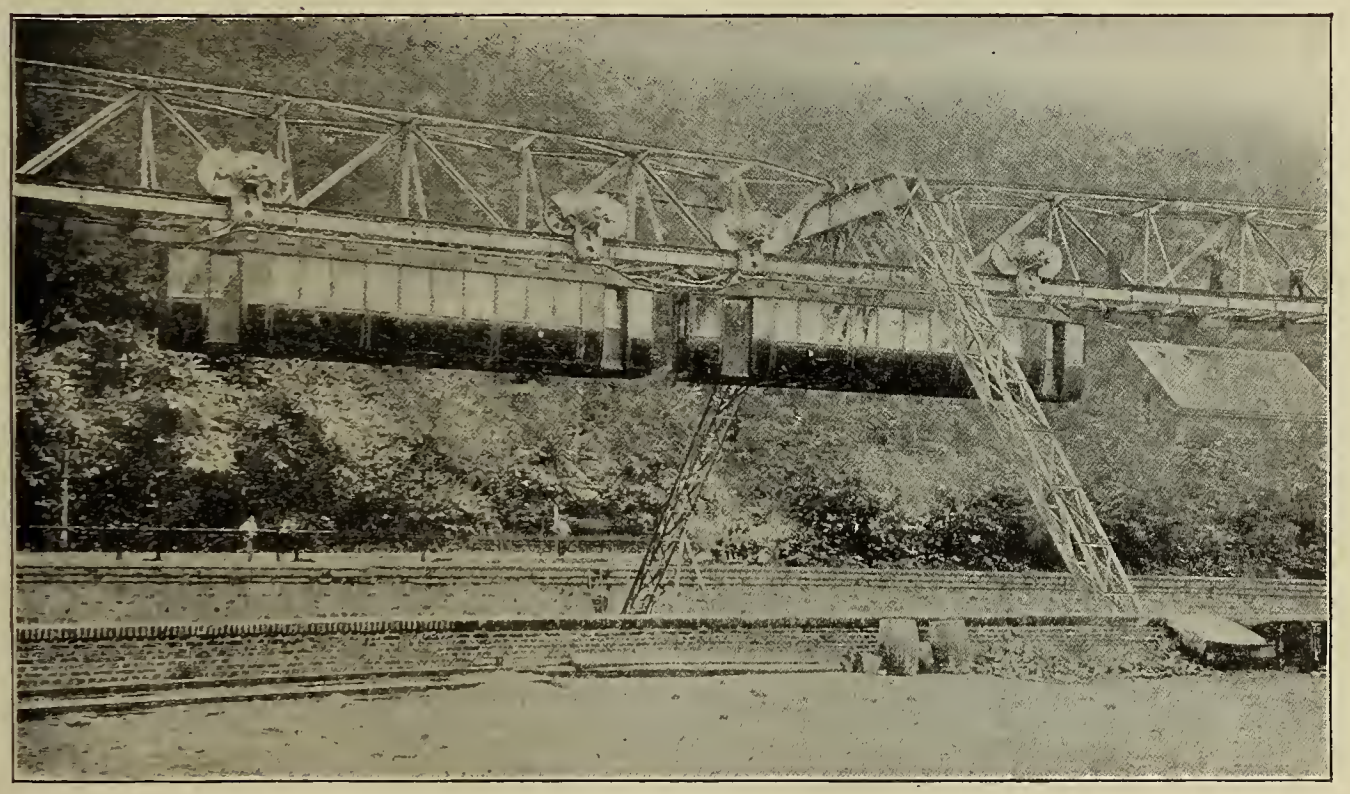
THOMAS T. RICHARDS, vice-president of the Emerson Electric Manufacturing Co., of St. Louis, Mo., and manager of their Eastern Office at 136 Liberty St., has gone to St. Louis to close a big contract for life. He is expected in New York with his bride, Mrs. Richards, about May 15.

WESTON STANDARD
PORTABLE DIRECT READING
VOLTMETERS
AND
WATTMETERS
For Alternating and Direct Current Circuits.
The only standard portable instrument of the type deserving this name.
Write for our Catalogue of Portable Instruments.
WESTON ELECTRICAL INSTRUMENT CO.,
114-120 William Street, Newark, N. J.
BERLIN. European Weston Electrical Instrument Co. Ritter strasse No. 88.
LONDON. Elliott Brothers, No. 101 St. Martins Lane.

The Electrical Age.

Vol. XXV—No. 20. NEW YORK, MAY 19, 1900. Whole No. 679.

Electric Railways.



Side View of Electric Suspension Railway, Barmen-Elberfeld.

BARMEN ELECTRIC SUSPENSION RAILWAY.

By Max Bouchsein, U. S. Consul at Barmen, Germany.

A double-railed line, 8.3 miles in length, with eighteen stations, has been partly constructed in Barmen according to the single overhead-railway system of the Langen patent. This is, I understand, the first suspension railway for the conveyance of passengers that has been built.

The road commences at Barmen-Rittershausen and follows the river Kupper through the thickly populated cities of Barmen and Elberfeld. Beyond Elberfeld the line extends toward the west as far as Vohwinkel, leaving the river at Sonnborn and running over the public highway to Vohwinkel.

The marginal gradient is 4.5 per cent All gradients and curves are so arranged as to avoid a decrease of speed in the main lines. The iron framework over the river is supported by buttress piers of ironwork inclined toward each other; but in the public highways the structure is supported by vertical iron columns, which require no more space than lantern posts.

The cars are suspended on two rotary bogies, 26.2 feet in length. Each truck, or bogie, has two axles, between which an electromotor of 36 horse power, at 500 volts, is arranged. The special construction of the trucks is shown in the figures. The frame surrounds the rail carrier in such a manner that the wheels cannot rise from the rails and the cars cannot slip off in case a fitting breaks or there is some other mishap. The current is fed by a contact shoe from a rail.

The speed will be regulated in the same manner as in electric street cars. The traveling speed is supposed to be 25 miles per hour. It takes only from 10 to 15 seconds to start; so that, in spite of the eighteen stations of the road, an average speed of 18¾ miles per hour will be maintained. Each car holds fifty passengers and is divided into first and second class and smoking compartments. The number of cars in the make-up of a train is not limited; but at first each train will consist of one or two cars only, although the station platforms are so arranged that a four-car train can receive and unload passengers. The speed of the train is not dependent on the number of cars, as each car has its own motor.

The employment of an automatic block system, by

which the car itself regulates the signals, allows the trains to start in either direction at intervals of two minutes. Braking is effected in four different ways: (1) By a Westinghouse pneumatic brake, operated by the motorman; (2) by a hand brake working on the fittings of the Westinghouse brake, operated by motorman and guard; (3) by an electrical brake; (4) by an electrical return-current brake, serving as a distress brake.

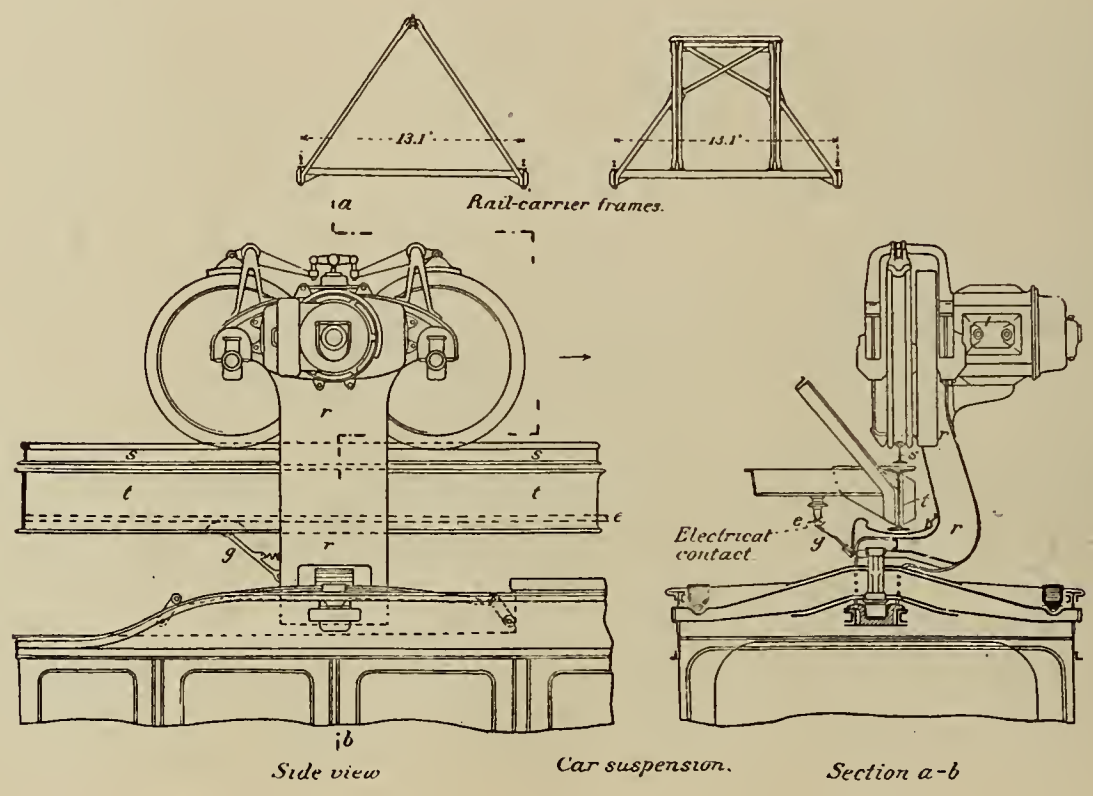
The rails are of the Haarman system, installed on iron-plate slippers with a layer of felt to the rail supporters. These are made in T sections and have a curved bottom with a slight play, which allows the cars to swing easily without running off the rails.

The stations are built on the same plan as those of the American elevated road, with separate entrances for each platform.

The spans of the piers are very wide, owing to the difficulty of finding solid foundation on the river banks and to avoid interrupting traffic on the public road. Although the span averages 98.4 feet, the total weight of the double-railed line over the river, including the piers, is only about 838 pounds to the foot; over the highway, 783 pounds. This makes the cost of construction from $200,000 to $225,000 per mile, including the foundations and stations. Counting the rolling stock (it is intended to start a train of one or two cars at intervals of three minutes), the cost would be about $265,000 per mile. The underground railways of London involved an expense of about $1,500,000 per mile.

The car station at the terminus in Vohwinkel has eight sets of tracks, which are connected by return switches in order to facilitate the arrangement of the cars.

The railway is about half finished, and part of it is expected to be in operation in a year.



Automobiles.

AUTOMOBILE EXPOSITION AT NUREMBERG.

By Gustave C. Werner, U. S. Consul at Nuremberg.

There will be held in the city of Nuremberg, from June 1 to July 1, 1900, a general automobile exposition. It will not be very large, the ground to be covered having an area of but one acre, and prizes will not be awarded; but it will nevertheless be very interesting, in showing what German automobile manufacturers have produced of late.

All kinds of automobiles will be exhibited, viz., private carriages, freight cars, vehicles for transporting prisoners, for sanitary and military purposes, fire brigade, fire engine, motor cars, etc.

The machines will not only be shown in the exposition grounds, but also in the city. Races to the neighboring cities of Wuerzburg, Kissingen, Bamberg, etc., will take place.

Austria has sent some automobiles to this exposition. France, Belgium and England, renowned for their progress in the automobile industry, could not be induced to take part in it, as they were too much engaged in the forthcoming Paris exposition.

The most important feature of this exposition will be, undoubtedly, the exhibits of the Schuckert electrical factory in Nuremberg. A large space has been reserved for this firm, where it will exhibit all its latest inventions in motors, etc., for automobiles. As Schuckert is the leading concern in Germany in this branch, I would especially call the attention of our automobile manufacturers to this exposition.

AUTOMOBILES IN GERMANY.

By Brainard H. Warner, Jr., U. S. Consul at Leipzig.

The automobile industry, though still in its infancy in Germany, is being rapidly developed and before long is destined to become an important factor in the manufacturing circles of this country. The large amount of capital and energy which are being spent upon this branch of industry indicate that German business men, the most conservative financiers in the world, have great confidence in the future of automobilism. Last year, there were about 1,000 men employed in and around Berlin in the automobile industry, and, to judge from the present outlook, this number will be more than doubled during the present year.

In France, where automobiles were first seriously taken up and pushed, the results which have been aimed at for the most part have been to obtain excellence in

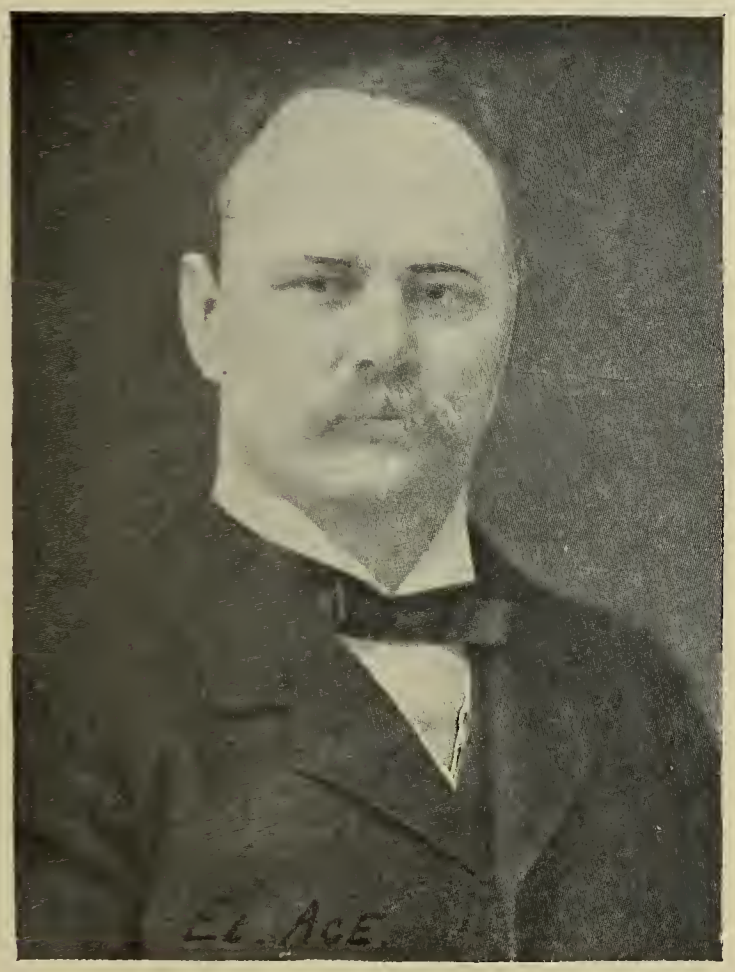
sporting and luxury automobiles, while in Germany just the opposite state of affairs has existed, the manufacturers having given more of their attention to making freight automobiles—not without success either, as was shown at the international motor-wagon exhibition which was held in Berlin last year.

For motive power, electricity and benzine are almost exclusively employed; the use of steam power is as yet hardly out of the experimental stage; the same may be said of the employment of compressed and liquefied air, and of combined systems (benzine and electricity, etc.), the advantages of which are offset by a too complicated mechanism and the great amount of attention which is necessitated thereby. Electricity as a motive power has a strong competitor in benzine. The employment of the electromobile depends upon the nature of the lead accumulator; the great weight of this apparently as yet irreplaceable metal increases the weight of the motor to such an extent that the electromobile can be used to advantage only in carrying persons and light loads on good roads with easy grades.

The electromobile necessitates the establishment of charging stations. It is well adapted for omnibuses in cities with electric-light plants and good streets, and also for delivery and luxury vehicles.

The electric automobile seems to be preferred to the benzine automobile on account of its much simpler mechanism, less noisy running and absence of the unpleasant odor of the benzine motor. Then, too, the public has a preference for all electrical contrivances, and the unfounded fear of explosion by the benzine motor works also to its prejudice. These reasons are sufficient to assure preference for the electric automobile.

The benzine automobile is used principally for transporting heavy loads, where great speed is desired, long and undetermined distances, heavy grades, and where other difficulties are likely to occur. Hence its adoption for brewery wagons, drays, omnibus lines connecting railroad stations with inland towns, and for carrying persons and loads in the country. The advantageous use of benzine motors for freight-carrying purposes is made doubtful by the present high price of benzine.



A. M. Young, Past-President National Electric Light Association.

Conventions.

TWENTY-THIRD ANNUAL CONVENTION OF THE NATIONAL ELECTRIC LIGHT ASSOCIATION.

There is every indication that the coming convention to be held at Chicago, May 22, 23 and 24, will be one noted in the annals of electric lighting as remarkable not only for the heavy attendance, but the unusual prosperity which it marks. Though of comparatively humble origin, the National Electric Light Association has developed along certain lines which brought under its in-

S M. Hamill, Brush Electric Co.

Elihu Thomson, Gen. Elec. Co.

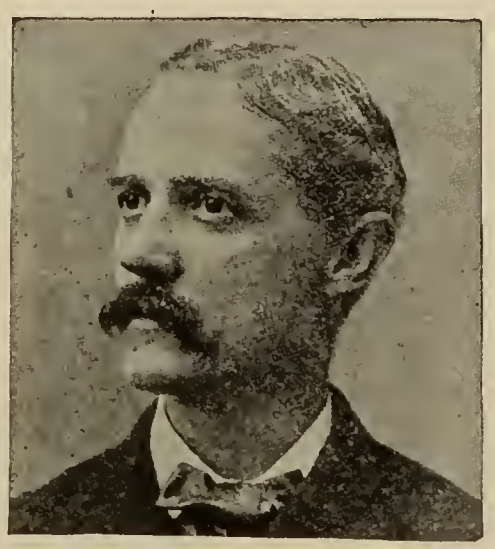
Edwin J. Houston, Author and Expert.

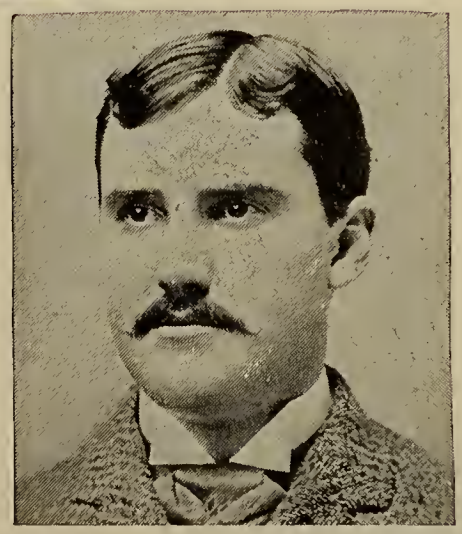
C. O. Baker, Jr. Master of Transportation.

A. Kennelly, Author and Expert.

C. R- Huntley, Ex-Pres, N. E. L. A.

F. Nicholls, Ex Pres. N. E. L. A.





W. L. Candee, Okonite Co.

C. H. Wilmerding, Ex-Pres. N .E. L. A.
J. P. McQuaide, Nat'l Conduit & Cable Co.

Samuel Insull, Past Pres. N. E. L. A.
E. F. Peck.

H.L. Shippy, Roebling Sons & Co.

Geo. F. Porter. Sec. N. E. L. A.
W. J,Godfrey, Habirshaw Wire.

J. A. Seely

Popular Faces at the N. E. L. A. Convention.

The Electrical Age.

ESTABLISHED 1883.

Entered at New York P. O. as second-class matter, January 18, 1891.

THE ELECTRICAL AGE PUBLISHING CO., Publishers.

TERMS OF SUBSCRIPTION:

One Copy, one Year, - - - - - - - - - $2.50
One Copy, six months, - - - - - - - - - 1.25
Great Britain and other Countries, - - - - 3.50

Cable Address (all Cables), "Electage," New York.

NEWTON HARRISON, E. E., EDITOR.

ASSOCIATE EDITORS:

ALFRED E. WIENER, E. E., OSBORNE P. LOOMIS, E. E., } ELECTRIC LIGHT AND POWER.
JOSEPH MUIR, M. D., FREDERICK STRANGE KOLLE, M. D., } ELECTRO-THERAPEUTICS.

ADDRESS ALL COMMUNICATIONS TO
THE ELECTRICAL AGE PUBLISHING COMPANY,
Seventh Floor, World Building,
NEW YORK.

NEW YORK, MAY 19, 1900.

CONTENTS:

CANALS EQUIPPED WITH ELECTRICITY.

Aside from the politics relating to the subject, canals in New York State and vicinity possess a great interest for the farmer and financier. They are of such a character that in the performance of those functions for which they were intended commerce can be stimulated and industries developed with a rapidity greater than could be possibly anticipated. Canals have ever been a fruitful source of wealth and convenience. These internal waterways connect distant towns, bringing from one the manufactured product and the other raw materials or food supplies. In the days of the Pharaohs great canals were built which caried water from the Nile to arid spots and gave a ready road to those merchants who preferred the planking of a boat to a camel's back for the transportation of their goods. Without discussing the advantages of canals as a means of irrigation it is but necessary to refer to them in the manner we are most familiar with, namely, a road always open for transportation. The slow going barge, however, and the mule which drags it with slow going pace are soon to be relegated to that province which is now littered with all manner of antiquities and age-hardened inventions. It is proposed to supply the canalboats with a new power and the canals with a new force, by means of which speed will be attained in the delivery of freight and all forms of merchandise. At present there is a great canal in Illinois, called the Chicago Drainage Canal, fed with water from Lake Michigan, and the ultimate intention is to make it into a ship canal to connect with the Missouri river. Canals from the Ohio river to the city of Cleveland are now under consideration, as well as from Lake Superior to Lake Michigan. The source of supply in such cases would undoubtedly be the Great Lakes, and were canals directly connected with the ocean or a body of water leading therein a perceptible difference in level would be noticed in the lakes which would certainly affect the power output at Niagara Falls and possibly blast the promise of its budding prosperity.

With the presumption, however, that the canals are built, the ready and convenient transportation of goods along the route can only be best accomplished by the employment of electric power. Various schemes have been brought forward for this purpose, among which are those of Messrs. Schatz and Hawley. In both cases the predominant idea is that of substituting for the patient mule an electric vehicle, motor or locomotive of such a character that it would drag the boat along it afterward. Other plans have been forwarded in which the boat is equipped with motors and propeller and electricity obtained from shore through the aid of an insulated conductor mounted in the same manner as the trolley. At present there are certain difficulties to be met with due to the shallowness of the canals in many parts of the State which might absolutely prevent the use of propeller wheels of any description. The most satisfactory plan is that of pulling the canal boat by means of a motor, mounted in such a manner on the rails that its grip and progressive movement is an established certainty. The cost of equipping canals with electric power would be mainly that of laying tracks and conductors, which is not an expense of too great a magnitude to prevent its practical consideration. In Holland the waterways have added so much to the prosperity of the land that it seems strange that we, who consider ourselves the most progressive of all nations, should not be engaged already in the construction of facilities which unquestionably cheapen transportation and simplify the handling of all kinds of freight. With electrically equipped canals hundreds of thousands of people would be able to buy articles of domestic use cheaper and will undoubtedly be encouraged to invest more frequently in many small articles which aggregately represent in price at present more than the pocket of some of our white slaves can afford to pay.

STEEL IN DYNAMO CONSTRUCTION.

It has been said and stated by an author conversant with the steel situation that never in the history of the nation was there such an enormous output of steel and iron products, and he notes the peculiarity associated with the consumption that the larger the supply the more rapidly the prices rise. The effect of this upon manufacturing electrical engineers was such as to raise the price of dynamos and motors. In some cases the difficulty of obtaining steel castings in time as well as the enormous increase in price for the same led to the use of cast iron in that place. A considerable percentage of the business in iron and steel is done by the electric companies whose orders for castings of all descriptions reached many millions of dollars per annum. The enormous volume of business done through the rise in the iron and steel industries can be best appreciated by referring to the largest city associated with industry, Pittsburgh. In this city the banks in 1899 cleared for $1,528,000,000. As prosperity in the field of electrical manufacturing is in harmony with the general growth of trade there is every indication that the near future has as much in store for builders of machinery as the recent past.

fluence the representatives of the greatest lighting interests in the United States. In the organization of this association certain plans were drawn up and accepted which have been faithfully adhered to in regard to conventions. It was the idea of those connected in an executive sense with the operations of this body to provide instruction and amusement to all delegates traveling from the various corners of the United States to attend the meeting. It is hardly necessary to refer to the city of Chicago on account of the prominence it received during the World's Fair. Pictures of every corner of Chicago were sent all over the world and visitors soon learn how to travel to all parts of this city without any difficulty. Chicago, with its great lake front, its unusual shipping facilities, its manufacturing plants and great commercial activity is admirably suited to become the meeting place upon this occasion. It is a great railway centre, and on account of its location can be readily reached by those in the east, west and northern part of the country. In other issues of The Electrical Age the plan of procedure in regard to the convention and the program in regard to amusements has been given in full. In order to acquaint some of our readers with those whose labors have proved fruitful in the organization and management of the National Electric Light Association, many of the ex-officios are put in print as well as those at present in office. It has been thought wise to mention again for the benefit of those not well informed that round trip tickets to Chicago can be obtained from C. O. Baker, master of transportation, at the regular convention rate of a fare and one-third.

The headquarters of the convention at Chicago will be the Auditorium Hotel. Here delegates will be received by the officers of the association and further and fuller information extended in regard to the course of future events in connection with the same.

The president of the National Electric Light Association is Capt. S. T. Carnes, of Memphis, Tenn. The past presidents of the association are given below: James F. Morrison, of Baltimore; Samuel A. Duncan, of Pittsburg; Edwin R. Weeks, of Kansas City; Marsden J. Perry, of Providence; Charles R. Huntley, of Buffa'o; James I. Ayer, of St. Louis; Edward A. Armstrong, of Camden; M. Judson Francisco, of Rutland; C. H. Wilmerding, of Chicago; Frederic Nicholls, of Toronto; Samuel Insull, of Chicago; Alden M. Young, of Waterbury.

The following are the various conventions of the association which have been held so far: First, Chicago, Feb. 25, 26, 1885; second, New York, Aug. 18, 19, 20, 1885; third, Baltimore, Feb. 10, 11, 12, 1886; fourth, Detroit, Aug. 31, Sept. 1, 2, 1886; fifth, Philadelphia, Feb. 15, 16, 17, 1887; sixth, Boston, Aug. 9, 10, 11, 1837; seventh, Pittsburg, Feb. 21, 22, 23, 1888; eighth, New York, Aug. 29, 30, 31, 1888; ninth, Chicago, Feb. 19, 20, 21, 1889; tenth, Niagara Falls, Aug. 6, 7, 8, 1889; eleventh, Kansas City, Feb. 11, 12, 13, 14, 1890; twelfth, Cape May, Aug. 19, 20, 21, 1890; thirteenth, Providence, Feb. 17, 18, 19, 1891; fourteenth, Montreal, Sept. 7, 8, 9, 10, 1891; fifteenth, Buffalo, Feb. 23, 24, 25, 1892; sixteenth, St. Louis, Feb. 28, March 1, 2, 1893; seventeenth, Washington, Feb. 27, 28, March 1, 2, 1894; eighteenth, Cleveland, Feb. 19, 20, 21, 1895; nineteenth, New York, May 5, 6, 7, 1896; twentieth, Niagara Falls, June 8, 9 10, 1897; twenty-first, Chicago, June 7, 8, 9, 1898; twenty-second, New York, May 23, 24, 25, 1899.

Cleveland, Ohio.—The American Electrical Company has been incorporated with a capital stock of $3,000; incorporators: J. R. McQuigg, John Colahan, J. E. Lloyd, G. B. Riley, L. G. Hopperk.

Electricity in the Mine.

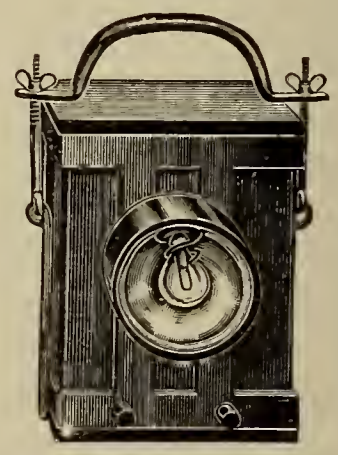
EDISON JR.'S LAMP AS A LIFE SAVER.

INTENDED TO GUARANTEE SAFETY FROM FIREDAMP.

RADICAL CHANGE IN MINING WILL FOLLOW ITS INTRODUCTION IN THE BITUMINOUS REGIONS.

If an application which has been made to James E. Roderick, chief of the Bureau of Mines of Pennsylvania, is granted there will be instituted a radical change in the method of coal mining in that State, in West Virginia and in Ohio, and which, in all probability, will be extended through all the mining regions of the United States where firedamp threatens the lives of careless or reckless miners. Thomas A. Edison, Jr., has perfected a primary battery, intended for use in coal mines, to give light without danger to the men who "dig the dusky diamonds from beneath the ground." A demonstration of the powers and utility of the battery was recently given in the Grand Hotel by Mr. Edison.

This primary battery is in contradistinction to the storage battery. It creates its own energy and gives a light of three-candle power, which will burn continuously



The "Edison Jr." Lamp for Mines.

for ten hours, at a cost of two cents. The primary battery is designed to take the place of the oil and gasoline lamps now in use in the bituminous and anthracite regions in almost all parts of the world. It consists of a small hard-rubber box containing four cells.

In the centre of each cell is a column of practically indestructible carbon. Outside, and at each of the four corners of the box, is a space into which are slipped zinc plates. To produce electrical energy the zinc nest is filled with diluted sulphuric acid and the inner space with acid of greater strength.

On one of the outer faces of the rubber box are two slots, into which is fitted an incandescent lamp protected by a bevel-glass front. Should this glass be broken by accident or design the light is extinguished immediately. No heat whatever is produced, and it is said by the inventor that the lamp could be smashed with safety in a barrel of gunpowder.

From 1887 to 1896, the number of miners who lost their lives in the United States was 8,140. Of this number, 6,433 perished in Pennsylvania alone—4,049 in the

anthracite region, and 1,384 in the bituminous. During the same period the lives lost by accident in mines in England, Scotland and Wales were 10,482. In the year 1899, 719 miners were killed in Pennsylvania. The latest disaster was in Utah, a few weeks ago, when 300 men were smothered to death by an explosion, believed to have been caused by a naked light coming in contact with a strata of explosive vapor.

Under the laws of Pennsylvania, and in almost all other States where coal is mined, the character of the light used in the work of mining—and it is as important a factor as the pick and the tram car—cannot be changed without the sanction of the body which controls mining regulations. Electricity has been used in the levels, the power being supplied from a dynamo on the surface, but this has been found to be dangerous. A miner's pick striking a wire mutilates the protective covering, and a spark is emitted, which, if fire damp is present, means an immediate explosion.

The application of a primary battery carrying its own light has not been attempted up to this time. The old Sir Humphrey Davy lamp, with its gauze covering, was abandoned years ago, although the popular belief is that it still is used. Its place was taken by a safer and more convenient light, one produced by oil and the other by gasoline. These now may give way to the new and novel method of applying electrical energy.

LITERARY NOTE.

"Acetylene" is the title and subject of a profusely illustrated work of some five hundred pages which the Macmillan Company will publish at an early date. The history of the origin, properties, and application of this gas is very fully treated, and the cuts, of which there are upwards of one hundred and fifty, add greatly to the descriptive value of the text.

Patents.

WEEKLY ELECTRICAL PATENT RECORD.

Conducted by Otto Greenberg. Complete descriptions and drawings of any patent mentioned below will be sent on receipt of ten cents.

648,919.—Electric Telegraph Apparatus for Use on Cable or Other Lines. Sidney G. Brown Bournemouth, England.

648,939.—Electric Circuit Closer. Harrison H. Fowler, Waverly, Tenn.

648,951.—Electric Switch. Augustus Hanson, Chicago, Ill.

648,977.—Signal for Selective Calling Appliances. Frank R. McBerty, Evanston, Ill.

648,995.—Electric-Train System. William Potter, Schenectady, N. Y.

649,003.—Envelope for Storage Batteries. Elmer A. Sperry, Cleveland, Ohio.

The envelope or separator consists of an agglomeration of pyroxylin fiber and cellulose fiber in sheet form.

649,006.—Alternating Current Motive Apparatus. Chas. Steinmetz, Schenectady, N. Y.

649,007 and 649,008.—Frequency Indicators. Chas. Steinmetz, Schenectady, N. Y.

649,015.—Current Interrupter. Elihu Thomson, Lynn, Mass.

649,031.—Electromagnet. Samuel M. Young, New York.

649,069.—Supervisory Signal for Telephone Lines. Frank McBerty, Evanston, Ill.

649,076, 649,077 and 649,078.—Telephone Apparatus. Chas. E. Scribner, Chicago.

649,086.—Electromagnetic Coil. Richard Varley, Jersey City.

649,102.—Telegraph Receiving Instrument. Nicolas Flechtenmacher, Bucharest, Roumania.

649,105.—Apparatus for Electric Lighting. Osborn P. Loomis, Depew, N. Y.

649,138.—Electromechanical Typewriting System of Intercommunication. Albert D. Neal, Boston.

649,179.—Transformer Secondary. Adolph Rietzel, Lynn, Mass.

649,182.—Apparatus for Producing Radiation and Light by Electricity. Chas. Stearn, London, Eng.

649,199.—Electric Switch. William Ely, Providence, R. I.

049,235.—Trolley Wheel. James A. Collins, Cincinnati.

649,250.—Marine Electric-Lighting Fixture. Geo. L. Martin, New York.

649,295.—Accumulator. Luis G. Garcia, Aspe, Spain.

649,388.—Lightning-Arrester. Alexander J. Wurts, Pittsburg, Pa.

649,398.—Primary Electric Battery. Victor J. Busson, Paris, France.

Business News.

SPECIAL EXPORT COLUMN.

TOTAL AMOUNT OF ELECTRICAL EXPORTS FROM NEW YORK CITY FOR WEEK ENDING MAY 12, 1900, $146,280.

New York, N. Y., May 12, 1900.—The following were the exports of electrical material from the port of New York for the week just past:

Brazil.—325 packages electrical material, $13,126; 7 packages electrical material, $578.

Antwerp.—37 packages electrical material, $3,688.

British East Indies.—9 cases electrical material, $460.

British West Indies.—16 packages electrical material, $1,829.

Barcelona.—2 cases electrical machinery, $96; 5 cases electrical material, $143.

British Australia.—49 cases electrical material, $2,739; 549 packages electrical machinery, $59,250.

Cuba.—11 cases electrical material, $489.

China.—12 cases electrical machinery, $875; 27 packages electrical material, $3,292.

Central America.—18 cases electrical material, $230.

Frienne.—5 cases electrical machinery, $773.

French Possessions in Africa.—6 packages electrical material, $289.

Hull.—6 packages electrical material, $450.

Hong Kong.—45 packages electrical material, $3,020.

Havre.—159 packages electrical material, $4,450; 35 packages electrical material, $5,776; 2 cases motors, $800.

Japan.—3 packages electrical material, $65.

London.—21 packages electrical material, $1,749.

Liverpool.—212 packages electrical material, $28,824.

Mexico.—83 packages electrical material, $2,221; 84 packages electrical material, $1,554.

Marseilles.—50 packages electrical material, $300.

Newfoundland.—4 cases electrical material, $33.

Nova Scotia.—3 cases electrical material, $60.

New Zealand.—3 cases electrical material, $105.

Porto Rico.—4 packages electrical material, $980.

Peru.—36 packages electrical material, $2,377.

Southampton.—8 cases electrical material, $2,619; 80 cases electrical machinery, $1,118.

St. Petersburg.—8 packages electrical material, $250.

Tasmania.—5 cases electrical material, $400.

U. S. Colombia.—3 cases electrical material, $123; 1 case electrical machinery, $250.

Venezuela.—50 packages electrical material, $918.

NEW INCORPORATIONS.

Kansas City, Mo.—The Kansas City Electric Light Company, of Kansas City, has filed a statement of an increase of its capital form $450,000 to $2,500,000.

Philadelphia, Pa.—The Consolidated Electric Company has filed papers with the secretary of state increasing its capital from $100,000 to $400,000.

New York City.—The Constant Battery Company, of New York city, has been formed. Capital, $100,000; directors: Edmund Tweedy, Bert Levyn and Mark Raffalsky, of New York city.

Hartford, Conn.—The Upson-Judson Electric Company, of Hartford, has received articles of incorporation to inspect and maintain electrical machinery, etc. Capital stock, $2,000.

Philadelphia, Pa.—The Keystone Electric Company, of Philadelphia, has been incorporated, to engage in manufacturing, engineering and construction. Capital. $200,000.

Norwalk, Ohio—The Norwalk Gas and Electric Company has been incorporated with a capital stock of $125,000. This is the new company succeeding the Northern Gas and Electric company, which now owns the Norwalk plant.

Oswego, N. Y.—The People's Gas and Electric Company, of Oswego has been formed. Capital $450,000; directors: H. P. Kernochan, Jr., and John J. Kennedy, Albany; Harold Footman, E. N. P. Dailey and Samuel Stein, Schenectady.

Alliance, Neb.—The Alliance Electric Light and Power Company has been incorporated, at Alliance, with a capital of $25,000. It is expected to have the city lighted by electricity by the middle of May.

Port Washington, N. Y.—The Port Washington Electric Light, Heat and Power Company, capital, $7,500 has been incorporated. Directors: Charles F. Lewis, L. Burdette Smull, Jeremiah O'Brien, John J. McDermott, John H. Burtis, of Port Washington.

Phillipsburg, N. J.—The Lehigh-Northampton Gas and Electric Company, principal office, Phillipsburg, N. J., has been chartered. Objects, manufacture electricity, etc. Capital, $250,000; incorporators, Liddon Flick, W. H. Walters, E. G. Holzer.

New Rochelle, N. Y.—The Huguenot Electric Light, Heat and Power Company of New Rochelle, has been formed to furnish electricity to New Rochelle, Mount Vernon and the villages and towns of Westchester county. Capital, $50,000; directors: John J. Crennan, John H. Scofield and Martin Corwin, of New Rochelle.

Havana, Cuba—The Cuba Company has been chartered to operate railroads and electric railways in Cuba. Capital stock, $8,000,000, of which $2,500,000 is already subscribed for. The stock is divided into shares of $50,000 each. Incorporators: Sir William C. Van Horne, Levi P. Morton, W. C. Whitney, Thomas Ryan, C. G. Hannen, E. A. Harriman, James J. Hill, William J. Bull and H. L. Terry.

TELEPHONE CALLS.

Sidney, Mo.—The Sidney Telephone Company, of Sidney, has been incorporated as a mutual telephone system; incorporators: John M. Love, P. H. Muran and W. P. Jones.

Camden, N. J.—The Eastern Telephone and Telegraph Company, principal office, Camden, N. J., has been chartered with a capital of $250,000; incorporators: Joseph W. Morgan, John J. Burleigh, E. A. Armstrong.

Ithaca, N. Y.—The Ithaca Telephone Company, of Ithaca, has been chartered. Capital, $10,000; directors, John P. Van Ostrand, F. S. Bronson, Lansing G. Haskins, Fred C. Bloodgood, Mark T. Atchley, William Thomas and Arthur W. Sperry, of Geneva.

Birmingham, Ala.—Articles of incorporation have been filed in the probate office by the People's Home Telephone Company. The incorporators are: S. B. Claypool, D. M. Foraker, W. H. Hassinger and J. J. Altman. The capital is $200,000. The company has recently obtained a charter from the City Council to construct and maintain a telephone system in Birmingham and it is now taking steps to that end.

STREET RAILWAY NEWS.

Elkton, Pa.—The Delaware & Susquehanna Electric Light and Railway Company, of Cecil County, has been organized in Elkton by electing Joseph T. Grove, president; Carlton Kimble, vice-president, and Alfred B. McVey, secretary and treasury. The capital stock of the company is $100,000. The incorporators went over the proposed route, which is from a point near Newark, Del., to the Susquehanna River.

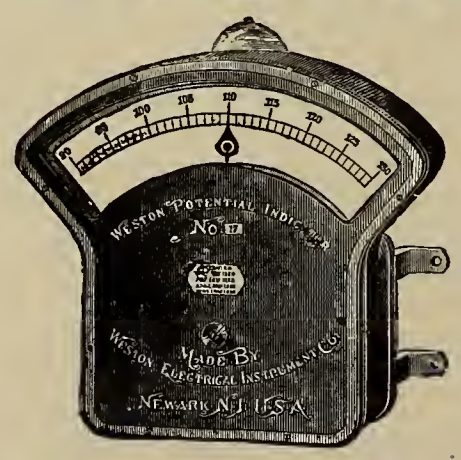
Business News.

THE HOME OF THE ELECTRICAL AGE.

Manufacturers of electrical and kindred apparatus prefer to centralize their offices and agencies not only for the convenience of buyers but for that of their representatives as well. They usually locate where they can economize in rents and at the same time secure the most eligible and homelike offices. Offices where their representatives can induce buyers to call should contain every comfort and attraction. The Pulitzer of World Building, as it is commonly called, adjacent to Brooklyn Bridge, overlooking City Hall Square and the general post office, and on the route of the principal elevated and surface roads of New York and Brooklyn, is without a doubt the most centrally located office building in Greater New York and offers every inducement for the trade to centre here. The elevators are run day and night and current for light and other purposes is furnished free of cost to tenants. This building, ever since it first opened its doors to the public, has been the home of The Electrical Age, and although every inducement has been held out to us to change our address we have decided to make this our permanent location. The writer has visited every prominent office building in the city, especially in the down-town district, but nowhere has he found the same courtesy extended to tenants as that shown by the officers and subordinates of the Press Publishing Company. When the vast improvements, such as lighting effects, decorations, parquet floors, relief ceilings, burlapped walls, etc., now in course of construction, have been completed the World Building will have no equal in this city or any other. Manufacturers locating here will be in the very heart of the electrical trade. We will be pleased to show those of our friends who call on us some of the beauties as well as advantages of our home building

WESTON STANDARD ILLUMINATED DIAL

STATION INSTRUMENTS.



THESE INSTRUMENTS are based upon the same general principle and are just as accurate as our regular Standard Portable Direct Current Voltmeters and Ammeters, but are much larger, and the working parts are inclosed in a neatly designed dust-proof cast-iron case, which effectively shields the instruments from disturbing influences of external magnetic fields.

WESTON ELECTRICAL INSTRUMENT CO.

114-120 William St., Newark, N. J., U. S. A.

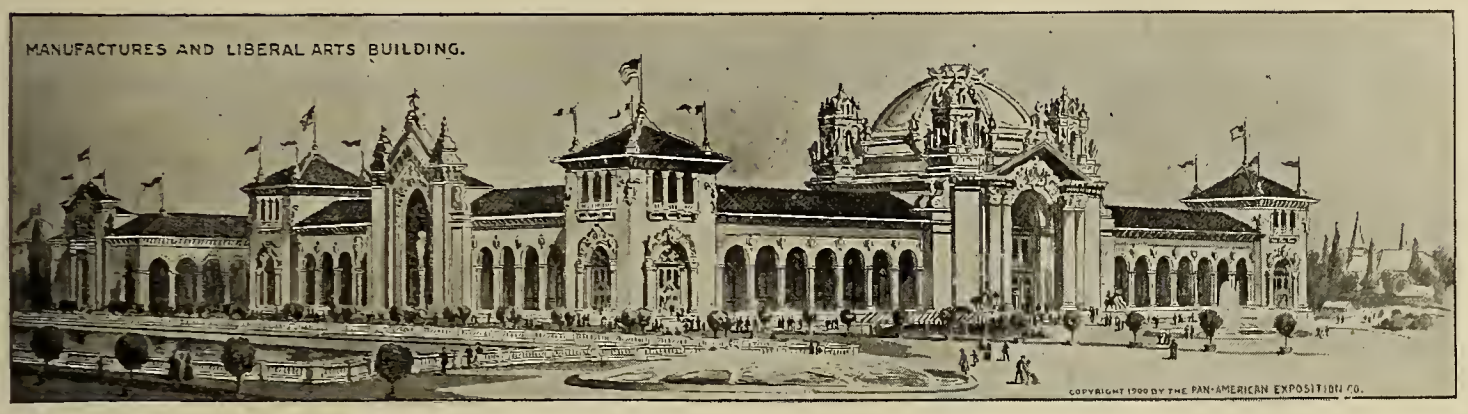
BERLIN. European Weston Electrical Instrument Co. Ritterstrasse No. 88.

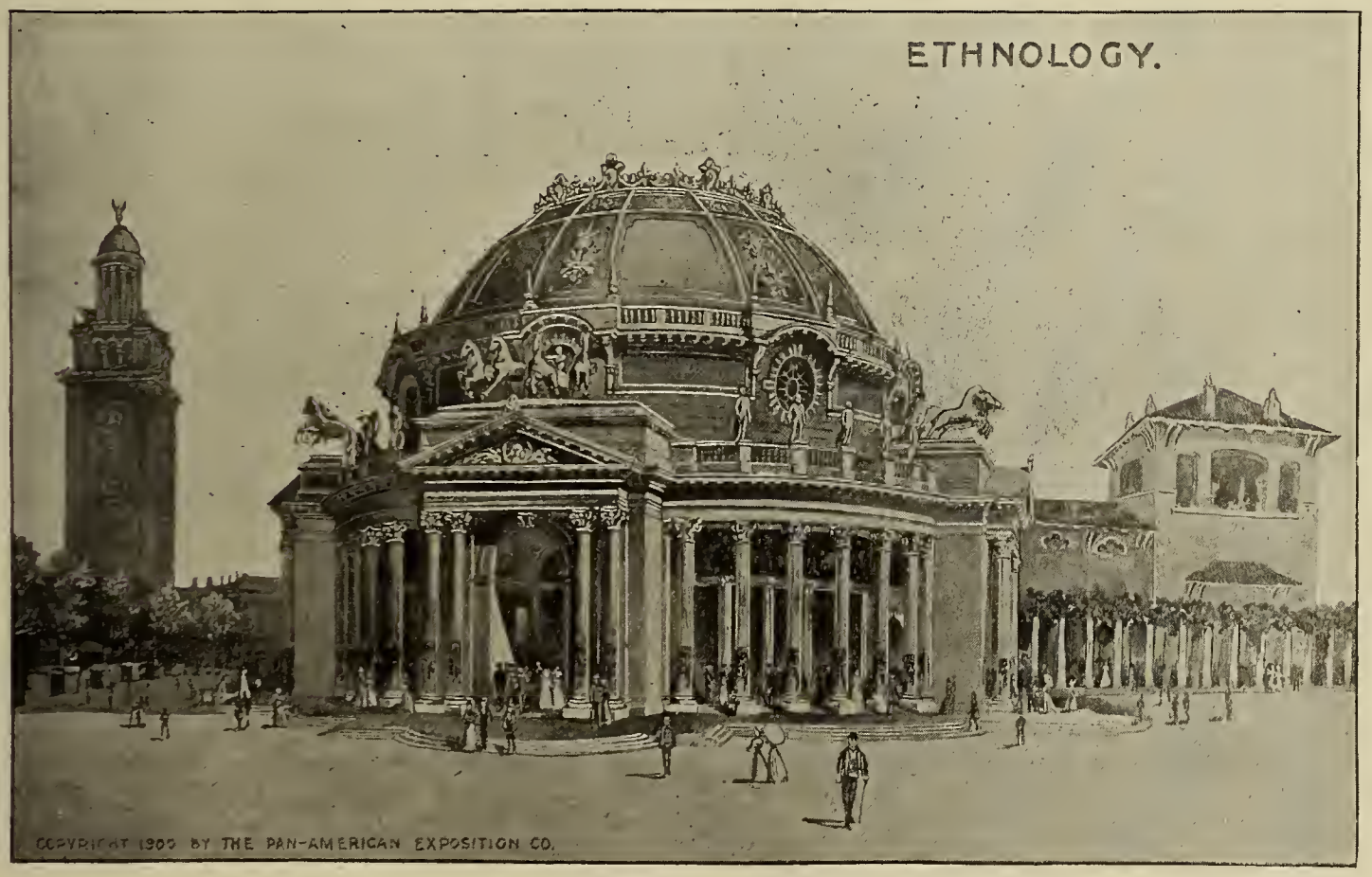
LONDON. Elliott Brothers, No. 101 St. Martins Lane.

The Electrical Age.

Vol. XXV—No. 21. NEW YORK, MAY 26, 1900. Whole No. 680.

Expositions.





MORE BUILDINGS FOR THE PAN-AMERICAN EXPOSITION.

In a recent issue we showed a view of the Electricity Building which will be erected for the Pan-American Exposition, to be held at Buffalo, N. Y., May 1 to Nov. 1, 1901. Displays of all kinds in the practical and artistic uses of electricity, together with complete exhibits of electrical machinery and appliances, are to be conspicuous features of the great exposition.

The designs contemplate a very handsome and commodious building. The structure is to be 500 feet from east to west, and 150 wide, giving an exhibition space of 75,000 square feet.

The south facade fronts the mall and the north fronts the Midway. The east end is toward the massive electric tower, while the west faces the Grand Canal. The building is long, low and inviting. The design of the facades shows artistic grouping. The openings of the pergola-like loggias, placed at frequent intervals, present a delightful effect, showing more and more of the details of the pilasters and openings as the eye travels to the end of the building farthest away from the observer.

There is a pleasing ending at each corner of the structure, with a low-domed pavilion tower, and the building is interrupted at the centre by a double-towered entrance. This entrance,wide and high, is spanned by an ornamental arch and supported on each side by columns. The towers, also, have minor entrances through them.

The connecting work between the towers, the towers themselves, the pavilions at the corners of the building, and similar places, are to be brilliantly illuminated and made gay with banners and flags.

The modelled relief work of the building is of the choicest design. The general ornametation of the structure is to be frescoes in an interesting mixture of reds, greens and yellows. The general color scheme follows that of the Machinery and Transportation Building and other groups of buildings of the exposition. The structure was designed by Green & Wicks of Buffalo.

Ilustrations of the Manufactures and Liberal Arts and Ethnology Buildings are shown above.

Telephony and Telegraphy.

TELEPHONING THROUGH THE ATLANTIC CABLE.

PROF. PUPIN'S DISCOVERY TO INCREASE THE LIMITS OF TELEPHONY AND TO ACCELERATE TELEGRAPHING.

For a number of years Prof. M. I. Pupin, of the Department of Mechanics of Columbia University, has carried on a series of experiments dealing with electrical waves of considerable length, and has ascertained from these studies that by means of cables and long-distance air-lines constructed in a peculiar manner it is possible to increase to a marked degree the limits over which telephony can be conducted, besides adding greatly to the usefulness of submarine cables by making them available for many more messages. The final results of Prof. Pupin's investigations were announced at the annual meeting of the American Institute of Electrical Engineers in Philadelphia. At a meeting last year of the same body Prof. Pupin read a paper on "The Propagation of Long Electrical Waves," and at the recent annual meeting of the American Mathematical Society he described the purely mathematical questions involved in his investigations.

Prof. Pupin became interested some years ago and first attacked the problem from a mathematical point of view, reaching a solution which he has since verified by extensive experimentation. He found that if inductance coils are introduced along the line at intervals determined by a formula the result would be to diminish the attenuation of the waves and to increase the current. Having reached this mathematical solution Dr. Pupin proceeded to perform a series of experiments which have shown a remarkable coincidence in their results with those obtained by purely theoretical considerations. For the study of these long waves he first required a conductor of great length and capacity, such as a cable. This was obtainable by the construction of a condenser of original design, where on parafined paper were placed pieces of tinfoil, arranged so as to possess the greatest possible length and thus have a certain amount of resistance. A number of these conductors could be connected in series, and an accurate imitation of a cable was achieved, the condensers being so made as to possess a resistance and capacity equivalent to that of an actual cable. The construction of these cables and other parts of the apparatus, which was done for the most part by Prof. Pupin's pupils and mechanician, was a task of no little magnitude, and during the time occupied in the research three separate cables were made. For purpose of study the cables are subdivided into lengths of one mile, and at these intervals the inductance coils can be introduced or cut out of circuit by the mere insertion of a plug. These cords are about five inches in diameter and have an inductance of .058 henry, two cords being wound on the same support.

With such a cable line as a base to work on, Prof. Pupin then began to study the conductor under varying conditions. By means of a slide contact and galvanometer he was able to ascertain the condition of the current at any point along the circuit, and was thus able to plot a curve. By short circuiting the coils he could reproduce the conditions of an ordinary cable and the curve would distinctly show the attenuation of the waves, while introducing the inductance coils at other than favorable positions the effects of reflection, which rendered valueless the earlier experiments already referred to, were plainly visible. From this series of experiments, where the wave lengths and frequencies could be altered and adjusted at the dynamo, Dr. Pupin was able to study the behavior of the waves, and his next work was to make the apparatus available for telephony, as it was in this field that the advantage of using the coils in order to improve a non-uniform conductor seemed most promising. Accordingly, at either end of the line an ordinary telephone was installed, and the apparatus adjusted for waves of the length and frequency sent out by the telephone. In these experiments it was only necessary to take into consideration waves having a frequency of about 750, as the highest pitch it is necessary ever to consider in telephone work is 1,000 a second. On the trial line in Prof. Pupin's laboratory one can hear distinctly a conversation from another part of the building which is transmitted through the 250-mile-long cable, but as soon as the coils are removed from the circuit by the insertion of the plugs the audibility rapidly increases and soon disappears.

By the use of such a conductor Prof. Pupin believes that a far higher rate of speed as well as multiplexing could be secured in an ocean cable, and it would tend greatly to increase use and cheapen the rate for messages. It seems also probable that the present limit for speaking by aerial metallic circuit wires, now at St. Louis, at 1,200 miles from New York and barely satisfactory, will be exceeded by the use of this new system and the great expense of the copper conductors will be appreciably lessened.

Just what tests in the field will be made by telephone engineers of this method it is not yet possible to say, but the paper elicited much interest when read at Philadelphia before the institute, and it is probable that trials on a large scale will shortly be undertaken.

Electric Lighting.

CHICAGO'S GREAT LIGHTING PLANT.

Chicago is remarkable in its being one of the most representative American cities and its citizens are imbued with a strong progressive spirit, leading them into enterprises of the greatest magnitude. The development of electrical enterprises in Chicago has made it noteworthy and during the World's Fair the magic influence of the architect and electrician transformed this busy and prosaic city into a glittering fairy land. Chicago is remarkable for the gigantic size of all that pertains to it. In this respect the development of electric lighting has reached dimensions and obtained a prominence which has led to its being the seat and centre of many important conventions. During this week the National Electric Light Association is holding its annual convention, and delegates from all parts will assemble to participate in a gathering composed of the best known electric light experts in the country. A series of interesting papers has been prepared in relation to this field of work, and the growing industry and its many increasing side issues will be commented on with a view to the improvement and further development of the art. Within the last decade electric lighting has changed to a marvelous extent. A complete transformation has been instituted, both in systems and the machinery employed, so to-day the problem differs in every respect presented even five years ago. The magnitude of the plants in use and the tremendous interests at stake have brought in a finer class of financiers as well as engineers and the subject is now considered from a double standpoint.

One of the great Chicago plants is that controlled by the Chicago Edison Company. On these pages we have tried to give the reader an idea, through the aid of a plan view, of the engine and boiler rooms of this immense establishment. The downtown section of Chicago is almost

The Electrical Age.

ESTABLISHED 1883.

Entered at New York P. O. as second-class matter, January 18, 1891.

THE ELECTRICAL AGE PUBLISHING CO., Publishers.

TERMS OF SUBSCRIPTION:

One Copy, one Year,	$2.50
One Copy, six months,	1.25
Great Britain and other Countries,	3.50

Cable Address (all Cables), "Electage," New York.

NEWTON HARRISON, E. E., EDITOR.

ASSOCIATE EDITORS:

ALFRED E. WIENER, E. E., } ELECTRIC LIGHT AND POWER.
OSBORNE P. LOOMIS, E. E., }

JOSEPH MUIR, M. D., } ELECTRO-
FREDERICK STRANGE KOLLE, M. D., } THERAPEUTICS.

ADDRESS ALL COMMUNICATIONS TO
THE ELECTRICAL AGE PUBLISHING COMPANY,
Seventh Floor, World Building,
NEW YORK.

NEW YORK, MAY 26, 1900.

CONTENTS:

TRANS-OCEANIC TELEPHONY.

The recent invention of Prof. M. I. Pupin, of Columbia University, of a system of telephoning through a cable possessing the general features of capacity usually experienced in Atlantic cables, has been the subject of daily newspaper comment during the past week. The problem that Prof. Pupin set himself to solve was one calling for an unusual degree of scientific knowledge and to a large extent a mathematical training of the highest order. The cable is a huge condenser, stretching along the ocean valley from New York to Waterville, Ireland, via Newfoundland. At present the difficulties due to capacity interfered with the rapid transmission of ordinary telegraphic signals. It is for this reason within the comprehension of even the lay mind to realize the skill and knowledge required to effectively transmit currents of infinitely greater delicacy and weakness, such as proceed from a telephone transmitter, through a cable of this character. At a recent meeting of the American Institute of Electrical Engineers, held a Philadelphia, Prof. Pupin exhibited his apparatus, and, to the great surprise of many of the experts present, was able to send audible speech through a section of an artificial cable approximating two hundred and fifty miles in length, with absolute clearness. Apart from other considerations, this feat may be regarded as an unparallelled exhibition on account of difficulties which have until this time been deemed insurmountable. Even Thomas A. Edison, who spent much time on this subject, believed it to be one of the most difficult propositions in the field of electrical engineering. Two hundred and fifty miles does not represent the length of the Atlantic cable; only a portion of it. But it seems that even a limited success with this length would indicate possibilities of a most interesting nature.

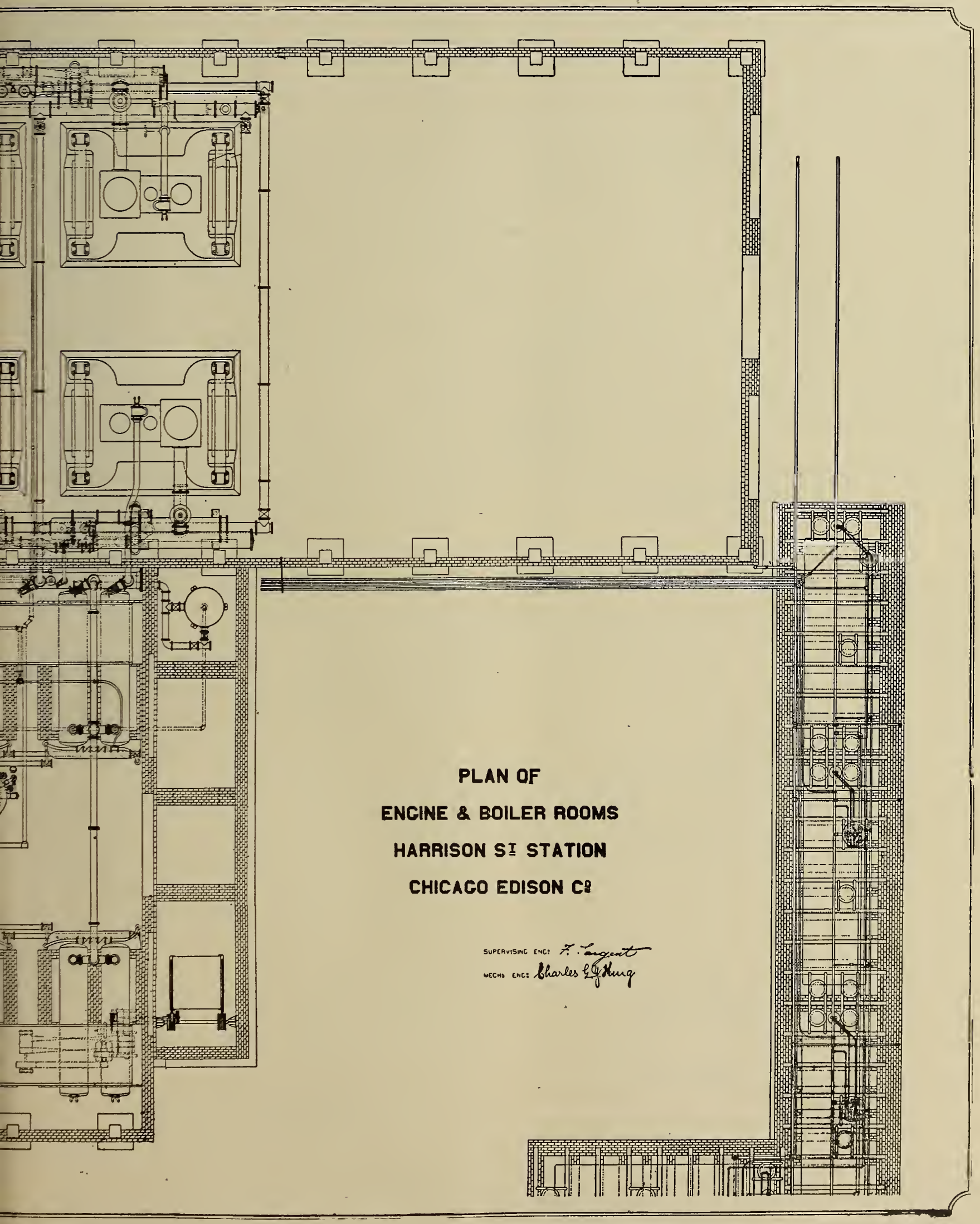
The cable, or any other condenser, possesses the property of absorbing a certain electric charge before it has properly discharged its function, that is to say, before it fills up and is ready to transmit part of what it has received, or any surplus, to the other end. On the other hand, it is necessary to sweep the cable clean for a return signal in submarine cableing. That is to say, the first charge must be neutralized and a second reverse charge sent in to enable the message to reach the other end in the manner of the first. Under these conditions the Atlantic cable might be compared to a gigantic sponge, which, as it were, must be saturated with water before enough will drip off to perform the work intended for it. Imagine a body of this character made to respond to the influence of a few drops of water. Imagine the tremendous difficulties in the way of getting a currrent through the cable so weak in strength that it requires the finest galvanometers in our possession to indicate its existence. Prof. Pupin, as we understand, will use an inductive device situated at various points of the cable so as to facilitate the proper transmission of these minute currents. It is certainly a great scientific achievement to succeed even in a small degree with conditions so unpropitious as those presented at present.

From a purely commercial standpoint it would be difficult to imagine a more fascinating situation than that presented by the practical establishment of a system by means of which speech could be conveyed across the Atlantic and Pacific with the same readiness with which it is transmitted on land. Not only would the two continents be more closely united, as far as their financial commercial and industrial interests are concerned, but the employment of trans-Atlantic 'phones would lead to a more thorough study of language and would establish between the civilized races on this globe a more intimate companionship in a social and commercial sense than has hitherto exited. The marvel of speaking across the Atlantic will be as great as the transmission of speech by telegraphic code half a century ago. It is not any more wonderful than the transmission of signals without wires or the viewing of the invisible by means of the X rays. All of Nature's phenomena are wonderful, but in the case of telephoning through the Atlantic ocean immense difficulties are met with of a technical character which will require the mind of a genius to overcome. There is every likelihood that with the establishment of a telephonic system of a trans-Atlantic nature even the smaller business houses of New York, Chicago, London and Liverpool would communicate immediately and directly with each other and this in itself would lead to importations and exportations from both countries far surpassing in volume and importance those of the present hour. Americans could well feel proud if through one of their engineers this becomes an accomplished fact. We wish Prof. Pupin every success.

entirely illuminated with power drawn from this company's plant. The lighting is largely divided up between the Commonwealth Company and the Chicago Edison Company. The stations of the Chicago Edison Company, which are more or less associated with those of the Commonwealth Company, are enumerated as follows: Edison Station No. 1, corner of Harrison and Charles streets; Edison Station No. 2, 2364 Wabash avenue; No. 3, substation and storage battery station of Edison Company, 139 Adams street; Edison Station No. 4, Newberry Library, Oak and Clark streets; Edison Station No. 5, Market and Washington streets; Station No. 6 is

the Edison rotary substation on North avenue; No. 7 is called the Commonwealth Station D of the northern district and No. 8 is the Commonwealth transformer

light interests with the Chicago Edison Company. The Commonwealth Electric Company controls the Hyde Park Thomson-Houston Co., the Englewood Electric



substation; No. 9 are the Commonwealth offices of the western distict and Nos. 10, 11 and 12 are stations belonging to the same company associated in the electric

Light Co., the Western Light & Power Co., the People's Electric Light & Motor Power Co. and the Mutual Electric Light Co. The combination of interests of these two

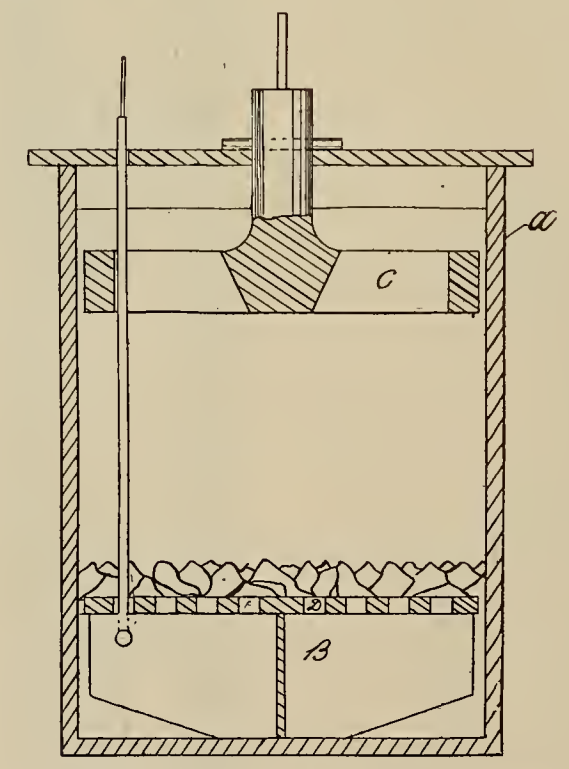
great concerns is evinced by the fact that the executive officers of both corporations are Samuel Insull, president; F. S. Gorton, secretary and treasurer; W. M. Anthony, comptroller, and L. A. Ferguson, general superintendent.

In the plan of the Harrison street station, to which additions have been made, there are now ten vertical triple expansion triple crank engines. Each engine drives two multipolar generators operating a three wire system. This, of course, means a plant of twenty generators of the following capacities: twelve of 400 K. W. a piece and eight of 200 K. W. a piece, making a tatal of 6,400 K. W. In the boiler room, represented by sketch, are 10 500 H. P. Heine boilers. A coal conveyor operates when required and can supply eighty tons per hour. The room for four extra boilers will be filled in the near future, making a total boiler battery of fourteen boilers. A main line runs from the Harrison street station to a substation at 139 Adams street, which is practically used as a centre of distribution. In this substation is a large storage battery plant with a capacity of 44,800 ampere hours. This plant, with its various substations, will be viewed with a great deal of interest by the various delegations of the convention. Being one of the most modern installations in the world, it has been the source of study to the best engineering element in the West. In conclusion it may be stated that the Chicago Edison Company was among the first to undertake the responsibility of supplying power to other stations through the aid of rotary converters and their accessories.

Primary Batteries.

THE BAINES' PRIMARY BATTERY.

In the gravity battery now in use the electro-motive force falls off as soon as the battery is set in action, and it continues to fall steadily until the battery becomes useless for the purpose of transmitting current on telegraph, firm alarm, and other high resistance systems. This loss of E. M. F. is the greatest evil existing in the fire alarm system, for, although the battery may, to all appearances, be clean, it fails to work the line just when it is required to do so. In order to guard against this danger, the present style of gravity battery has to be continually cleaned, causing great loss of the zinc electrode and copper sulphate, and the negative electrode is soon destroyed, causing the expense of a new one and often, in trying to get the electrode and refuse out of the jar, the jar is broken. All of this danger, worry, and expense is avoided by the use of the Baines battery, for with ordinary attention the E. M. F. of this battery is constant, as the negative electrode is at all times in a clean solution, and as the crystals of copper sulphate are on a grid and above the negative electrode, the current passing through the battery decomposes them and sets free its equivalent of acid.



Cross Section of Baines' Primary Battery.

Owing to the resistance of the refuse, the sulphate of zinc, etc., in contact with the negative electrode of the present type of gravity battery, it is seldom that a constant current of more than two-tenths of one ampere can be maintained for a reasonable time, while the Baines' battery will give twice this amount of current.

Another disadvantage of the present type of gravity battery is that, as the battery works, sulphate of zinc forms and coats the copper electrode with zinc, and this stops the action of the battery altogether. This cannot occur with a Baines' battery as long as there is a crystal of copper sulphate on the grid, and is another reason why this battery is the only one which can be depended upon in places where the positive action of the battery is of vital importance.

Every atom of copper sulphate used in a Baines' battery does useful work, and there is a continual process of copper refining going on, metallic copper in a pure and valuable condition remaining on the plate, and the refuse going to the bottom of the jar.

The advantages of the Baines' battery are:

First—The current given by the battery is twice that of the ordinary gravity battery.

Second—The current passing through the battery decomposes the crystals of copper sulphate and liberates acid sufficient to keep the E. M. F. of the battery constant.

Third—This battery, with ordinary attention, will not polarize, as sulphate of zinc cannot pass through the crystals of copper sulphate to the negative electrode, and the battery will not fail to act when most needed.

Fourth—The life of a negative electrode is unlimited, as no copper or refuse is at any time deposited upon it.

Fifth—Every atom of copper sulphate placed in the battery does useful work.

Sixth—The grid after use is sold for more than cost, due to the value of the pure copper deposited upon it.

Seventh—Absolute certainty of action at all times.

Eighth—No loss or waste of material.

Ninth—The battery can be taken apart in a few seconds without damage to any of the parts.

Tenth—No changes are required in the form of jars, zincs, or coppers now in use.

The Baines' battery will not only take the place of the gravity battery now in use in telegraph, fire alarm, and other high resistance circuits, but it will take the place of the expensive and troublesome battery now used in electro-plating, charging storage batteries, driving motors. etc. For further information address Baines' Improved Primary Battery Co., 594 Broadway, N. Y.

Among the Societies.

INTERNATIONAL ASSOCIATION OF MUNICIPAL ELECTRICIANS.

The executive committee of the International Association of Municipal Electricians held a meeting at the Clarendon Hotel, Brooklyn, N. Y., May 17, at 10 A. M. The meeting was presided over by Capt. Wm. Brophy, presi-

dent of the association, and the following officers and members of the executive committee were present: Wm. Brophy, G. F. MacDonald, Adam Bosch, Burt C. McAllister, Morris W. Mead, W. Y. Ellett, J. W. Aydon, F. G. Boyd and F. C. Mason. In the absence of a secretary Mr. F. G. Boyd, of Baltimore, was named as secretary pro tem. The minutes of the last meeting of the executive committee were read and approved. It was then by motion decided that four topics should be selected for discussion at the next meeting at Pittsburg, Pa., Sept. 25, 26 and 27. Accordingly the following topics were selected and assigned: No. 1, "Benefits to be Derived from Our Association," assigned to Capt. Wm. Brophy, of Boston; No. 2, "Contact Points," assigned to Frank C. Mason, Superintendent of Brooklyn police telegraph; No. 3, "Trials and Troubles of Instituting and Enforcing Municipal Inspection and Control," assigned to M. G. Canfield, of Grand Rapids, Mich.; No. 4, "Automatic Fire Alarm Systems," assigned to Chas. Burger, of Boston.

It was decided that there shall be two sessions daily, the morning session to begin at 9:30 and terminate at 1 P. M., the afternoon session from 2:30 to 5:30 o'clock. Immediately upon roll call, which shall be the first order of business upon convening, all members not answering the roll call shall be recorded as being absent, unless reasonable excuse be given by such members to the presiding officer. Upon motion it was decided that the printing and distribution of the reports of the Pittsburg convention be left in the hands of Mr. M. W. Mead. The report of ex-President J. W. Aydon, of Wilmington, Del., was received and approved.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

At the meeting of the Institute held at Philadelphia last week Prof. Carl Hering, the well-known electrical engineer, expert and author, was elected president. Mr. Hering was also recently appointed a member of the jury of awards at the Paris Exposition by the U. S. Government.

Patents.

WEEKLY ELECTRICAL PATENT RECORD. PATENTS ISSUED MAY 15, 1900.

Conducted by Otto Greenberg. Complete descriptions and drawings of any patent mentioned below will be sent on receipt of ten cents.

649,491.—Electric Storage Battery. Elmer A. Sperry, Cleveland, Ohio.

649,526.—Safety Synchronizing Device. John Pearson, Minneapolis, Minn.

649,549.—Electric Light System. Harry F. Roach, St. Louis, Mo.

649,551.—Carbon for Electric Lights. John F. Sanders, Portland, Ore. The carbon stick has a core composed of resisting material, and a body composed of a homogeneous mass of carbon material proper and oxide of magnesium and phosphate of calcium.

649,554.—Electric Switch. Ferdinand Schwedtmann, St. Louis, Mo.

649,586.—Closed Conduit Electric Railroad. Dwight G. Stoughton, Hartford, Conn.

649,587, 649,588, 649,589, 649,590 and 649,591.—Electric Clock. Samuel Thrasher, New Haven, Conn.

649,621.—Apparatus for Transmission of Electrical Energy. Nikola Tesla, New York.

649,653 and 649,654.—Battery Compound. Henry Blumenberg, Jr., New York.

649,699.—System of Motor Control. Carl W. Larson, Schenectady, N. Y.

649,707.—Electric Meter. William H. Pratt, Lynn, Mass.

649,726.—Process of Protecting Electric Heating Conductors. William S. Hadaway, Jr., New York.

649,767.—Electric Switch. Frank L. Sessions, Oak Park, Ill.

649,868.—Telephone Exchange System. William D. Sharky, Philadelphia.

649,893.—Printing-Telegraph. Joseph Stockert, Kothen, Ger.

New Books.

LITERARY NOTE.

A second edition revised and enlarged of Lummis-Paterson's work on "The Management of Dynamos" will be issued immediately by the Macmillan Company. The author has thoroughly revised and brought his work up-to-date, embodying many suggestions for improvement which have come to him from various sources. He has also added a chapter on motors, their construction and management. There are about ninety cuts illustrating the text, and the book has been made a very complete, handy book of theory and practice for the use of mechanics, engineers, students and others in charge of dynamos.

Business News.

SPECIAL EXPORT COLUMN.

TOTAL AMOUNT OF ELECTRICAL EXPORTS FROM NEW YORK CITY FOR WEEK ENDING MAY 19, 1900, $166,721.

New York, N. Y., May 19, 1900.—The following were the exports of electrical material from the port of New York for the week recently ended:

Argentine Republic.—33 cases electrical machinery, $2,216; 180 packages electrical material, $7,973; 18 cases electrical motors, $2,625.

Antwerp.—20 cases electrical material, $2,828; 11 packages electrical material, $375.

Brazil.—124 cases electrical material, $3,542; 12 packages electrical machinery, $756.

Bristol.—114 cases electrical machinery, $11,139.

British Guiana.—21 packages electrical material, $867.

British West Indies.—10 cases electrical material, $146.

Brussels.—27 packages electrical material, $689.

British Possessions in Africa.—45 packages electrical material, $2,627.

British East Indies.—23 packages electrical material, $481; 19 packages electrical machinery, $5,510.

Barcelona.—110 packages electrical material, $7,751.

Central America.—83 cases electrical material, $831.

Chile.—4 cases electrical material, $58.

Cuba.—96 packages electrical material, $4,023; 805 packages electrical machinery, $16,038.

Dunkirk.—2 packages electrical material, $375.

Genoa.—5 cases electrical material, $1,101; 4 cases electrical material, $427.

Glasgow.—23 packages electrical material, $921.

Havre.—182 packages electrical material, $19,639; 2 cases electrical machinery, $634.

Hamburg.—50 cases electrical material, $4,800; 1 case electros, $10; 6 cases electrical machinery, $1,950.

Ipswich.—121 packages electrical material, $12,502.

Liverpool.—26 packages electrical material, $1,610; 22 packages electrical material, $1,168.

London.—166 packages electrical machinery, $5,524; 61 packages electrical material, $3,517; 1 case electrical instruments, $880; 2 boxes electros, $134.

Margate.—112 packages electrical machinery, $21,127.

Mexico.—43 packages electrical material, $5,088; 9 packages electrical machinery, $1,050.

Manchester.—2 cases electrical material, $1,200.

Marseilles.—19 packages electrical material, $1,163.

Peru.—205 packages electrical material, $5,242.

Philippines.—18 cases electrical machinery, $5,780; 1 case electrical material, $10.

Rotterdam.—4 cases electrical material, $69.

Southampton.—9 cases electrical material, $233.

U. S. Colombia.—9 packages electrical material, $92.

NEW INCORPORATIONS.

Salem, Ore.—The Oregon Light & Power Company, of Baker City, has been incorporated. Capital, $50,000. Incorporators: G. Thornberg, W. J. Patterson, J. Schmitz, W. J. Moorhead.

Albany, N. Y.—The Orange County Gas & Electric Company was incorporated a few days ago, with a capital of $300,000, to furnish gas and electricity and steam in Middletown.

Warren, Mass.—The Warren & Brookfield Electric Light Company has been chartered. Capital, $55,000. Incorporators: F. Slater, G. M. Faulkner, T. C. Perkins.

Albany, N. Y.—The Huguenot Electric Light, Heat & Power Company has been incorporated, with a capital of $50,000, to operate in New Rochelle and adjoining towns.

Republic, Wash.—The Republic Water, Light & Power Company has been incorporated. Capital, $100,000. Incorporators: F. C. Whitney, W. R. Ralston, both of Republic; W. C. Morris, attorney, Republic.

Oswego, N. Y.—The People's Gas & Electric Company, of Oswego, has been incorporated. Capital, $450,000. Incorporators: H. P. Kernochan, Jr., J. J. Kennedy, both of Albany; H. Footman, E. N. P. Douley, S. Stein, all of Schenectady.

Kenosha, Wis.—It is reported that Milwaukee men, including A. E. Smith and E. J. Cowdery, of the gas company, are negotiating for the purchase of all the electric and gas lighting plants. The Milwaukee men represent Eastern capitalists.

Camden, N. J.— The West Jersey Electric Company has been chartered. Capital, $40,000. Incorporators: R. A. Anderson, of Haddonfield; D. L. Clever, W. S. Moslander, both of Camden; R. A. Sheets, of Westmont; J. F. Harned, of Camden.

Baltimore, Md.—The Delaware & Susquehanna Electric Light & Railway Company, of Cecil County, organized in Elkton by electing Joseph T. Gove, president; Carlton Kimble, vice-president, and Alfred B. McVey, secretary and trasurer. The capital stock of the company is $100,000.

TELEPHONE CALLS.

Harrisburg, Pa.—The Harrisburg Telephone & Telegraph Company has been organized.

Tippecanoe, Ohio.—The Tippecanoe Telephone Company has been incorporated. Capital, $10,000. Incorporators: J. A. Kerr, J. C. Geyer, E. J. Kerr, S. Perkins, F. E. Kerr.

Charlotte, N. C.—The Raleigh (N. C.) Telephone Company has been organized, with a capital stock of $15,000. The company expects to have an exchange of 1,000 telephones.

Norfolk, Va.—The West Norfolk Telephone Company has been incorporated. Capital, $25,000. Incorporators: G. N. Wiel, W. J. Nelms, E. M. Brakton, of Newport News; W. J. Carney, C. W. Coleman, H. Kern, Jr., R. L. Raby, of Norfolk.

Plainfield, Ind.—The Plainfield Telephone Company has been incorporated. Capital, $7,000. Incorporators: A. Curtis, W. B. Welsh, A. Ballard, all of Plainfield.

Dubuque, Iowa.—The Dubuque Telephone Company has been chartered. Capital, $100,000. Incorporators: V. H. Stevens, R. W. Stewart, J. H. Ellsworth, O. J. Hager, G. J. Cars, C. A. Beeman, all of Dubuque.

St. Paul, Minn.—The Luverne Telephone Company, of Luverne, has been incorporated. Capital, $10,000. Incorporators: E. A. Brown, J. A. Kennicott, A. D. La Due, V. C. Mead, G. W. Millhouse, all of Luverne.

Lawrenceburg, Ind.—The Lawrenceburg, Guilford & Dover Telephone Company has been chartered. Capital, $10,000. Incorporators: H. W. Nowlin, W. H. Dawson, both of Guilford; H. Fitch, of Lawrenceburg.

Willmar, Minn.—The Northern Electric Telephone Company, of Willmar, has been incorporated. Capital, $30,000. Incorporators: D. N. Tallman, J. Williams, A. Larson, all of Willmar; J. L. Schoch, C. H. Dirks, both of New Ulm.

BUSINESS CHANGE.

The Electrical Age, N. Y. City.

Gentlemen:—We beg to advise you of the recent change in the firm of the Stucky & Heck Electrical Manufacturing Company, Limited, the undersigned having bought the entire interests of the same and as their successor assumes all assets and liabilities.

There will be no change in the management, which has been in the hands of the writer since the organization of the above company and exclusively since Nov. 4, 1898.

We are in a position, as we have been for years past, to handle all branches of work in our line with facilities equal to any house in the trade.

Thanking you for past favors and trusting that we may receive the same in the future, we are,

Yours very truly,

LOUIS HECK,

Electrical Manufacturing Works.

Mr. Heck further states that they have more orders on hand than ever before and are working overtime in order to keep pace with the rush. For the last three months business has been steadily increasing.

WESTON STANDARD

PORTABLE DIRECT READING

VOLTMETERS

AND

WATTMETERS

For Alternating and Direct Current Circuits.

The only standard portable instrument of the type deserving this name.

Write for our Catalogue of Portable Instruments.

WESTON ELECTRICAL INSTRUMENT CO.,

114-120 William Street, Newark, N. J.

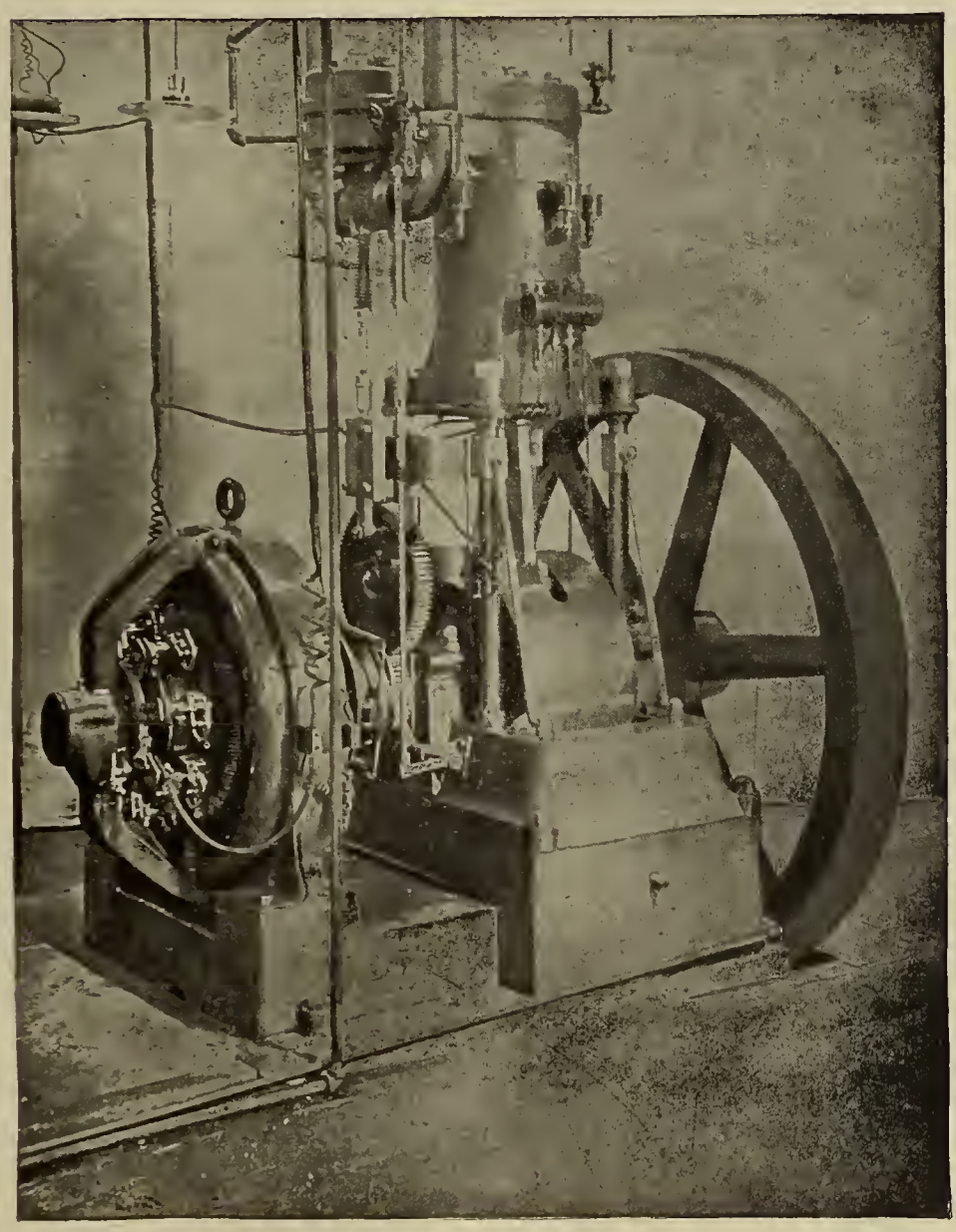
BERLIN. European Weston Electrical Instrument Co. Ritterstrasse No. 88.

LONDON. Elliott Brothers, No. 101 St. Martins Lane.

The Electrical Age.

Vol. XXV—No. 22. NEW YORK, JUNE 2, 1900. Whole No. 681.

Power For Driving Generators.



Secor Oil Motor Direct Connected to Generator.

THE SECOR OIL MOTOR.

INTRODUCTORY.

The advantages of the gas engine as a prime mover are well known, but it is equally well understood that it has limitations which materially detract from its utility. Among the advantages are fuel efficiency, from four to five times greater than steam, and a considerable saving in space, owing to the absence of boilers, as well as a saving in cost of attendance. It is the opinion of eminent experts, as for example, Mr. Dugald Clerk, that the removal of the following limitations would however be of great advantage to this type of motor: (1) The gas engine requires a special fuel which is usually costly, and frequently not obtainable. (2) It is more balky and uncertain in its performance, and requires more skill to operate, than the steam engine. (3) In regularity and smoothness of running it is inferior to the steam engine. These drawbacks have not only hindered the introduction of the gas engine, but in some notable instances have caused it to be replaced by the steam engine. The successful motor must, therefore, retain every advantage of the gas engine and must also be capable of using some low cost fuel that is everywhere obtainable. It must always be thoroughly reliable in operation. Further, its mechanism and performance must equal the best steam engine. The removal of its defects would render the internal combustion engine better fitted for universal use than any other existing motor.

THE SECOR OIL-ELECTRIC GENERATOR.

The installation of isolated electric plants of moderate size for public or private use is sometimes hindered, if not entirely prevented, by inability to determine upon a satisfactory source of power. The Secor oil-electric sysem of generating electricity for light or power was developed in response to a demand for a self-contained, reliable and economical generating system, suitable for general adoption. The Secor oil-electric generator consists of a single Secor motor directly coupled to a dynamo by a rigid coupling or a continuous shaft extending through engine and dynamo. In general appearance the motor resembles a modern high-grade steam engine. The mechanical inferiority of gas engines is nowhere shown as conclusively as when direct coupled to a

dynamo for the generation of electricity. The ordinary method is to employ two engines connected to one shaft, with spring coupling, to a dynamo. When rigid coupling is attempted, it is found necessary to use three independent engines connected to a three-throw crank.

Mr. H. E. Conklin, the electric expert, remarks: "I have never seen the performance of a single cylinder Secor motor equalled except by steam engines.

A comparison of the cost of 1600 candle power light for one hour by various methods:

Electric light company's charge,	75	cents.
Gas company's charge.....	50	"
Kerosene oil lamp.....	20	"
Secor electric system.....	10	"

The above figures are based upon a charge by the electric light company of 3-4 of a cent per hour for each 16 candle power incandescent lamp, although more than this is frequently charged. The cost for gas is based on an assumption of requiring 5 cubic feet per sixteen candle power hour at a charge of one dollar per thousand feet. The kerosene oil is charged at 10 cents per gallon.

Electric illumination has heretofore been costly and only locally available. The new system reduces its cost below that of any other known method of artificial lighting, and entirely removes the local limitation. The cost of arc lights in a Secor installation would be almost nominal, say about one-quarter the cost of incandescent lighting. No other existing method of generating electro-motive force combines as many important advantages as the Secor oil-electric system. It is therefore the ideal system for public buildings of all kinds, for churches, benevolent institutions, theatres, factories, country homes, private residences and flats in the city.

The Commercial Visible Typewriter Co. have made an examination into the merits of various forms of power, especially of internal combustion engines of different kinds, with the result indicated in the followng letter:

"THE COMMERCIAL VISIBLE TYPEWRITER."

300 Broadway, New York.
New York, April 7, 1900.

The General Power Co.,
Ft. 43d St., Brooklyn, N. Y.:
Gentlemen:

We are in the market for an engine and have examined very carefully the various makes which have been offered for sale. Our Supt., who has had this matter in charge, reports to us that your engine supplies a want which heretofore has never been met in a gas or oil engine. One great point that attracted us was that while there are about one hundred manufacturers of gas engines in the world, not one of them use their own engine as motive power, but use steam, while in contrast your factory is run by your own engine. We therefore feel that it must have some point of merit that is lacking in the other makes on the market, and after carefully examining same, we feel that we are not wrong in the conclusion we drew.

Will you please quote your lowest price on a thirty horse power engine similar to the one you are running?

Yours very truly,
Commercial Visible Typewriter Co.
Dictated to G. H. (Signed) Wm. B. Baldwin.

From Lee's "American Automobile," 1900.
(Laird & Lee, Chicago, Publishers.)

Among the American kerosene motors, the Secor may be given as an example of latest construction. It was first perfected with a view of furnishing a cheap, convenient and absolutely uniform motive power for driving dynamos in isolated electric plants, and, this being accomplished, has been adapted to automobile purposes, the requirements for carriage use consisting mainly in new means for the suppression of vibration, which presents a more difficult problem when the motor is carried on a movable support than when it is used for stationary work. The stresses to be balanced are those caused by the expansion of the gases against the cylinder walls, those due to the change from the reciprocating motion of the piston to the rotary motion of the shaft, and those due to centrifugal effect. This adaptation is said to have been successfully consummated in the latter part of 1899.

The principle of the stationary motor has been described in American Machinist, with reference to the diagram herewith produced, Fig. 35, in part as follows:

"From the fuel tank, A, having the emptying cock, U, the oil descends through a curved pipe, B, and the valve, C, which is governed by the float, B, to the constant-level tank V. The object so far is to obtain a constant gravity head for the flow of fuel, which next descends through the best pipe, E E, to the fuel admission valve, F, whence it flows downward through the brass-cased glass sight-tube, H, into the air-admission bend, I. The air admission to the cylinder is controlled first by a butterfly valve, not shown, but placed in the vertical air-admission pipe, through which air is sucked downward by the action of the engine piston.

"Next below the butterfly valve is a bored seat, in which is placed a segmental rocking valve, L, which is under control of the governor, and is the effective member of the air-admission controlling mechanism. The valve, F, is controlled by the rod, K, pivoted to a lever on the horizontal actuating arm, M, of the valve, L. The governor rod, N, is pivoted to the right-hand end of M. This makes a single governor rod control both the oil admission and the air admission. To provide an independent adjustment of the volume of either the air or fuel admitted, a micrometer adjustment is provided at G for the oil valve, F, and at M for the air valve, so that precisely such relative volumes of air and oil can be delivered together as are required to form a perfectly combustible mixture.

"The action of the governor is thus made to deliver the same proportionate combination for every charge, the regulation being effected by increasing or decreasing the volume of this mixture for a single cylinder charge. Throttling the total volume of the charge very rapidly reduces the cylinder pressure produced by the firing of the charge, although every charge, no matter what its bulk may be, is perfectly burned. Under these circumstances the governor action is very prompt. The Secor motor is believed to be the first to place both the fuel admission and the air admission under control of the governor.

"Referring again to the diagram, J is the admission valve, operated through the rod, R, from a cam of the usual type employed in explosion motors working on the Ottocycle. The rod, S, is similarly operated and drives the exhaust valve, P, which opens communication between the cylinder and the exhaust pipe,T, leading into the open air.

"The ignition is electric. The current from six cells of battery is led through a Rhumkorff coil to a jump-spark igniter, screwed into the top cover of the compression chamber.

"The Secor motor is water-jacketed, compression chamber and cylinder both, and the engine is remarkably cool when in operation."

Editor's Note.—The diagram referred to above will be reproduced in a later issue of the AGE.

Conventions.

TWENTY-THIRD ANNUAL CONVENTION OF THE NATIONAL ELECTRIC LIGHT ASSOCIATION.

The twenty-third annual convention of the National Electric Light Association was opened at 11 A. M. on Tuesday, May 22d, by President S. T. Carnes, and viewed from the standpoint of attendance, papers read and the good fellowship which prevailed throughout the entire meeting was about the most successful effort the association has ever made.

ADDRESS OF PRESIDENT CARNES.

In opening the session of the twenty-third convention, I congratulate you upon meeting again for the fourth time in the great city of Chicago, for aside from the natural advantages of these regular meetings for the discussion of the various practical questions that most deeply interest us and for the further advantage of absorbing the ideas and practices of the most advanced and scientific workers in this most wonderful branch of modern science, we have here in this great city these most advanced workings and up-to-date practices practically illustrated in a manner most satisfactory to the inquiring mind of the average central-station manager, who, in the majority of cases, perhaps, holds his positon, not for his original knowledge of the science, but for his ability to utilize this knowledge so absorbed for the benefit of his stockholders, whose investments are made solely with the view of the returns

I am sensible of the contrast between this session and your previous ones, and especially the twenty-first and twenty-second, just preceding, when we were presided over by gentlemen of marked ability and scientific attainments, and whose opinions carried all that weight and value to which their own eminent success entitled them, while your present presiding officer represents that class of smaller central-station managers, who while in some sort veterans in the business management, are yet neophytes in the science

I appreciate to the fullest the compliment of being placed at the head of this organization, notwithstanding the fact that I accepted the honor as one to my section of the country, the South, and not to myself individually, for I am fully cognizant of my inability to reflect any credit upon the organization which has already obtained such a high standard. My case is not so exaggerated, perhaps, but it reminds me of the story of the country boy whose father took him to the city for the first time. He explained to this boy that there was a great difference between the manners and customs of the people of the metropolis and those in the rural districts, and that while he must see and hear all that passed, he must refrain from talking or engaging in conversation, for fear it might be discovered that he was a green country fool. The boy, fully impressed with this advice, resolved to follow it implicitly. A good-natured city gentleman, observing the verdant hue of this somewhat remarkable looking young provincial, was curious to know something of his origin and history, and undertook to engage him in conversation. He applied a number of questions, and while the boy looked rather intelligently at him, he made no answer. Then the man asked him, "Are you deaf and dumb?" The boy shook his head, but answered not a word. "Then you must be a fool," said the man. "There, now, dad," cried the boy, "they have found me out already, and I never opened my mouth."

Your indiscreet indulgence in this compliment, at the expense of your better judgment, constrains me to confess that I became sufficiently inoculated with that same unaccountable nerve to entertain seriously the idea of making an effort to deprive you of the advantages of meeting in Chicago, by calling this session in my own city of Memphis, with naught to recommend it but its natural southern hospitality, warm as its summer sun, genuine as its native corn juice, and as refreshing as its world-renowned mint—the combination of which has the happy tendency to produce an absolutely irresistible power factor in the establishment of fraternal affection and brotherly love. A more mature reflection, however, convinced me that I would have to deprive myself of showing you the livest city in the South, by consulting your better interests and coming to Chicago, as originally intended. In this, I am sure, we have lost nothing, for I find that the wide-awake, up-to-date, progressive, whole-souled, all-around good fellows of the electrical

James Blake Cahoon, of Syracuse, N. Y., President, National Electric Light Association. (*Reproduced th ough courtesy of the "Electrical Review."*)

fraternity here have, with their usual enterprise and accustomed hospitality, made every provision for our entertainment and pleasure; and when the programme is announced I predict that the power factor of good fellowship will be so fully established with the same high efficiency which has always characterized this famous city that we wil be unanimous in offering the least possible resistance.

Believing that the papers, which have been prepared by several gentlemen in response to urgent request, will cover subjects of most interest to the greatest number present, I refrain from offering any further recommendations than a careful consideration and a free discussion of them.

I now declare this convention formally opened.

LIEUTENANT J. B. CAHOON, PRESIDENT NATIONAL ELECTRIC LIGHT ASSOCIATION.

James Blake Cahoon of Syracuse, N. Y., the new president of the National Electric Light Association graduated from the United States Naval Academy at Annapolis

in 1879. He served on the U. S. S. Vandalia on the North Atlantic station until 1881 and was afterward transferred to the U. S. S. Brooklyn, on the South Atlantic station, where he served until 1884, taking part in the Transit-of-Venus expedition in Patagonia in 1882. He received further technical training in the United States Torpedo School, from which he graduated in 1885. He was one of five selected to take a post-graduate course at that school in electricity. During this time Lieutenant Cahoon suffered such a serious injury to the sight of his right eye while conducting searchlight experiments that he was ultimately, in 1889, impelled to retire from the service.

In the latter part of the year last mentioned Lieutenant Cahoon became connected with the Thomson-Houston Electric Company as manager of the expert department. He retained this connection with the company for five years, and at the same time was also successively engineer-in-charge at the Lynn (Mass.) works and of the railway, marine and special-production departments, perfecting the reorganization of these departments and placing them on a working basis. Subsequently he became engineer for the local companies' committee, having engineering charge of the local lighting companies in which the General Electric Company (into which the Thomson-Houston Company had meantime become merged) held a controlling interest.

Lieutenant Cahoon left the General Electric Company in May, 1895, to become general manager of the electric light, gas, water and street railway companies in Elmira, N. Y. More recently Lieutenant Cahoon has taken up engineering work while still retaining an interest in central-station properties. He was selected to design and build a 4,000-horse power plant at Syracuse. However, this plan was given up upon the purchase of the existing electric light company's property by the syndicate with which the subject of this sketch was connected. Mr. Cahoon is now located in Syracuse as a consulting engineer and is also vice-president of the Oneida Light and Power Company. In addition, he is taking up the management of lighting properties. He is a veteran of the Spanish-American war and is a member of the Military Order of Foreign Wars, the American Society of Mechanical Engineers and the American Institute of Electrical Engineers.

PHOTOMETRIC VALUES OF ARC LAMPS.

ABSTRACT OF REPORT OF THE COMMITTEE TO INVESTIGATE THE PHOTOMETRIC VALUES OF ARC LAMPS.

The tests outlined by the committee are of a very extensive character, and, should they be carried to a finish, a store of useful data will be given to the electrical engineering profession. Arc lamp manufacturers and manufacturers of carbons throughout the country have come to the assistance of the committee, and the report mentions receipt of apparatus from the Adams-Bagnall Electric Company, Helois-Upton Company, Manhattan General Construction Company, General Electric Company, Jandus Electric Company, General Incandescent Arc Lamp Company, J. C. Toerring Company, Sterling Arc Lamp Company, Lea Manufacturing Company, Standard Thermometer and Electric Company, Schiff, Jordan & Co., Hugo Reisinger and the National Carbon Company.

After a report on the moneys expended in the progress of this work and an acknowledgment of the generosity of the members of the association who have contributed to the arc light fund, there follows a letter from Professor Goldsborough, in which he outlines the scope of the tests and transmits the report of Professor C. P. Matthews, photometrist for the committee.

Professor Matthews first acknowledges the valuable assistance rendered by six senior students of the School of Electrical Engineering at Purdue University, Messrs. G. H. Kelsay, A. B. Golden, L. W. Cromwell, O. F. Slimp, P. B. Sawyer and C. Branigan. He then goes into a detailed description of the methods and devices perfected by him to minimize the errors and uncertainties arising in arc light photometry. The most unique of these is the adoption of two mirrors, instead of one, to direct the light from the source of the photometer. These mirrors are placed on opposite sides of the arc, and, as a result, the illumination of the photometer disk is rendered fairly uniform. Thus the fluctuations, so troublesome when measurements are made in the usual way, with a single mirror, are greatly reduced. The color difference is also lessened by the use of a rotating

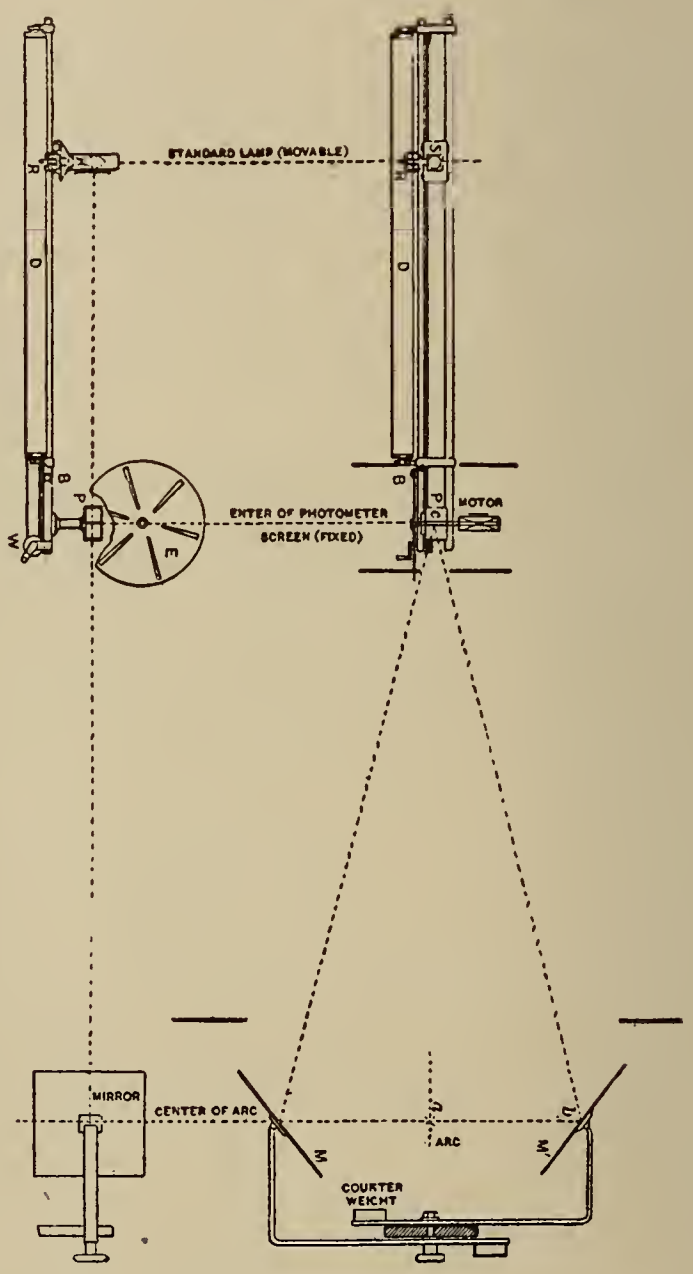


Fig. 1. Photometric Values of Arc Lamps.

sectored disk of very small aperture. This diminishes the apparent illumination of both sides of the photometric field to a point where the color difference ceases to be troublesome. Another device for lessening the labor of the proces and also the retinal fatigue is the recording drum. This has been already described, but in these tests it has been used with an electromagnetic recorder, which somewhat enhances its usefulness. To test the efficacy of this combination of devices in eliminating errors peculiar both to the source and to the method readings were made by a number of observers. These measurements, which show a very satisfactory agreement, demonstrate that the end sought has been accomplished and that personal and other errors are not greatly in excess of those met with in the photometry of steady and monochromatic sources.

The Electrical Age.

ESTABLISHED 1883.

Entered at New York P. O. as second-class matter, January 18, 1891.

THE ELECTRICAL AGE PUBLISHING CO., Publishers.

TERMS OF SUBSCRIPTION:

One Copy, one Year, - - - - - - - - - $2.50
One Copy, six months, - - - - - - - - 1.25
Great Britain and other Countries, - - - - 3.50

Cable Address (all Cables), "Electage," New York.

NEWTON HARRISON, E. E., EDITOR.

ASSOCIATE EDITORS:

ALFRED E. WIENER, E. E., OSBORNE P. LOOMIS, E. E., } ELECTRIC LIGHT AND POWER.
JOSEPH MUIR, M. D., FREDERICK STRANGE KOLLE, M. D., } ELECTRO-THERAPEUTICS.

ADDRESS ALL COMMUNICATIONS TO
THE ELECTRICAL AGE PUBLISHING COMPANY,
Seventh Floor, World Building,
NEW YORK.

NEW YORK, JUNE 2, 1900.

CONTENTS:

CONVENTION OF THE NATIONAL ELECTRIC LIGHT ASSOCIATION.

The successful ending of the convention of the National Electric Light Association, though expected, was a source of great satisfaction to the delegates. The growing interest taken in these annual meetings is shown by the increasing number of attendants and the co-operation met with from the municipal officials. The National Electric Light Association has become an organization of more than technical, scientific or industrial importance. It represents vast interests which, co-ordinated for mutual advancement, assist not only in the development of electric lighting throughout the United States, but in improving and devising new ways for the further extension of the various systems, with an eye to increasing cheapness and convenience. The papers read by the various engineers gave proof that the evolutionary process is still rapidly going on in the field of electric lighting and all that relateas to it. A closer examination has been made each year of the requirements imposed upon station managers and electric light specialists and in all respects it is now evident that special training of the highest order is required to prepare and fit a man for the responsibilities of this branch of the profession. The papers read by the various engineers were well received and covered such subjects as "Alternating Current Generators," by H. G. Reist; a paper by Prof. W. L. Robb on "Series Enclosed Alternating Arc Lighting, etc.," and others of the same high standard.

CORONOIDAL EFFECTS AT THE RECENT ECLIPSE OF THE SUN.

Prof. M. I. Pupin read a paper before the National Academy of Sciences in Washington, April 22d, 1892, entitled "Electrical Discharges Through Poor Vacua and Coronoidal Discharges." The value of this paper has shown itself by the increasing interest taken in subsequent years in its unique contents. The question frequently asked by men of scientific accomplishments and which is to-day, in view of the recent eclipse, of even deeper interest than before, that question we say, is what is the nature of the corona? Prof. Pupin, in the above mentioned article, makes the following statement: "The fact that electrical discharges in poor vacua resemble in many characteristic details the appearance and behavior of the solar corona attaches additional interest and importance to that class of experimental investigations which are pointed out only in this paper." In other words, it seems that the physical characteristcis of the corona as they appear to scientists in the various astronomical observatories have so far been beyond logical explanation. This mysterious halo of light seen around the sun during a total eclipse was first described in 1706. As years rolled by other observations were made at intervals to be noted by the dates 1715, 1724, 1778, 1806, and finally, in 1842, Arie and Arago gave it their particular attention. The radiating streaks often occupy a curious position and the length of them frequently exceeds 4,000,000 miles. Profs. Young, Langley, Abbe and Newcomb have observed the enormous scope of the solar nimbus and in 1868, 1871 and 1878 accurate sketches were made of this remarkable phenomenon.

The various experiments performed by Prof. Pupin in relation to this gigantic solar manifestation should have considerable influence in leading to a belief in its electrical nature. An artificial corona has been produced by electrical means which is, in many respects, identical in appearance with that actually observed during eclipses. The author of the paper states, in reference to one of the experiments, illustrated in past issues of The Electrical Age: "The discharge started in the form of four large streamers, together with a very large number of short luminous jets, which were more or less uniformly distributed over the sphere. In consequence of these jets the appearance of the sphere reminded one very much of the granular structure of the sun's disk as revealed by Rutherford's, Janssen's and Vogel's photographs of the sun. Very luminous spots appeared from time to time at several points of the surface, which reminded one very much of the sun's faculae." This presumption, borne out by experiment, that the corona of the sun is an electrical phenomenon seems to be much more satisfactory than any ordinary physical explanation. There are tremendous influences at work on the surface of the solar sphere and they are of such a character that the earth in some mysterious way responds to them. It is not necessary to refer to the aurora borealis and aurora australis and their unusual brilliancy at a time coincident with magnetic storms, the appearance of sunspots every eleven years and in the increasing magnitude of the corona. Coincidents are not generally admitted to possess value by scientists, but the continued repetition of them certainly calls for a further examination of this remarkable phenomenon along the lines indicated by Prof. Pupin.

Reference to Fig. 1 will show the disposition of the apparatus, as used in these tests.

The two mirrors (M) (M') are mounted at the extremities of iron arms and are suitably counterbalanced, as shown. The arc is fixed in the center of rotation at (a), and light is incident upon the photometer disk at (c), by the two paths shown in dotted lines, direct light from the arc being cut out by a screen not shown in the figure. This plan necessitates a fixed photometer (P), and, in order that the variable illumination may be produced to balance that due to the arc, a cord and windlass (W) are arranged, permitting the observer to move with facility the secondary standard (S), which is an incandescent lamp.

At (D) is shown a long wooden cylinder, upon which is wrapped the paper to receive the records of the test. These records are made by an electro-magntic device (R), which punctures the paper whenever an electric circuit is closed at the button (B).

The observer, seated before the photometer, in a closely screened enclosure, operating with one hand the windlass, and with the other the push-button, is enabled to take settings with relatively great rapidity and accuracy. At a point 200 centimeters to the right of the photometer disk, a reserve standard is mounted on an arm, which may be swung into a position in line with the bar. This reserve standard was carefully evaluated once for all in terms of the Hefner lamp. To determine the intensity of the secondary standard (S), it is only necessary to turn the reserve into position, and record a series of readings in the same way as for the arc. This operation is carried out at the end of each test, or more frequently, if any change has been made in the temporary standard. Thus, it will be seen that, should the lamp under test be found particularly weak at certain angles, the limit of the bar might be reached in the attempt to get a sitting. In such a case, it is necessary to stop down the temporary standard, and to again refer it to the reserve. It may be added that the reserve is never allowed to burn more than a few minutes, and cannot possibly deteriorate under such conditions of use.

With this disposition of the mirrors, the angle of incidence at the photometer disk is constant. In Fig. 1 this angle is shown at more than twice its actual value, in order to reduce the length of the drawing. The real value of this angle was 5 degrees, 54 minutes. To make a correction for this lack of normal incidence would mean the divison of the intersities as found by the cosine of 5 degrees 54 minutes, or 0.9947. Failure to do this introduces an error of about one-half of one per cent., which is clearly negligible in work of this character.

It is, of course, necessary in testing sources with large globes or shades to use mirrors of size such that the globe or shade may be seen in its entirety when the eye is placed at the point (c), Fig. 1; and it is further necessary that the distance (abc) should be large.

It is important to note that the double-mirror method, while enormously diminishing the fluctuaton due to wandering of the arc, can have no effect on such fluctuations as are due to variations in length of the arc, or to variations in the current.

(To be continued.)

GAS ENGINES FOR ELECTRIC CENTRAL STATIONS.

By Alton D. Adams.

The great importance to central stations of a satisfactory distribution for their large heat product, as well as for their small electric product, is now more generally felt than formerly, and on the solution of this problem must depend the ability of central stations to displace isolated plants. Unfortunately for the cause of heat distribution, if not for that of central station revenue, the present tendency is to remove electric generating stations so far from their service areas that the distribution of their heat from exhaust becomes entirely impracticable. This tendency is especially marked in large cities where the demand for heat is the greatest and large isolated plants are most numerous.

If central stations are to sell the greater portion of the heat as well as the electric energy that they derive from coal and thus reach a position where they can seriously compete with large isolated plants in the supply of light, heat and power, it seems certain that the electric generator and its driving engine must be moved back to the vicinity of the area to be served. The many objections to a number of steam plants scattered over a thickly populated territory, as to fuel and water supply, removal of ashes, value of ground area occupied, smaller economy of power production as to coal, and the increased labor attendance, all have their weight; but the isolated plant, though hampered in all of these respects, still wins in competition with central stations that distribute as electric current only 10 per cent. of the energy in coal.

Happily, however, it is not necessary to bring boilers and a complete steam equipment to the electric generating station. The steam engine must be quite close to its boiler, for economical results, but gas engines may be located some miles from plants where the gas is produced without serious effect on the economy of power production. Electric generating stations driven by gas engines are especially suited to crowded areas by reason of the relatively small amount of room that they require. The problem of transportation for coal and ashes is absent with them, and the only water required is that for cooling engine cylinders, this water being cooled and subject to loss only by evaporation.

Owing to the ease with which gas is transmitted through pipes, the plant for its production may be located where all of the possible economies as to transportation, water and the labor of operation may be practiced, and such a plant may supply electric generating stations over a very large area. The efficiency of gas engines, which ranges from 20 per cent. in small engines to 25 per cent. in large sizes, allows a delivery of from one-third to two-thirds more electric energy for the same coal consumption than does the steam engine with its efficiency of 15 per cent. Having made this positive gain of efficiency in the production of electric energy, the gas engine delivers the remaining heat from its internal combustion in a form that can be readily untilized. For gas engines of medium size the distribution of heat may be fairly taken as:—delivered work, 20 per cent.; conduction and radiation, 10 per cent.; jacket-water, 40 per cent., and exhaust-gases, 30 per cent. of the total heat produced by the gas consumed.

The temperature of the jacket-water may well be about 150 degrees Fahr., and that of the exhaust gases 700 degrees Fahr. These hot exhaust gases can readily be used to raise the temperature of the water from the cylinder jacket to 212 degrees or even a higher point, and thus fit the water for heating purposes as well as can be done with exhaust steam. This hot water may be pumped through a system of hot water mains for general heating purposes, the return flow passing again to the cylinder jackets and the coils exposed to the exhaust gases.—Cassier's Magazine.

Pomona, Cal.—The Sierra Power Company has been incorporated with a capital stock of $75,000, of which $58,500 has been subscribed. Directors: C. G. Baldwin, J. Albert Dole, B. S. Nichols, A. W. Burt and A. P. Nichols.

Patents.

WEEKLY ELECTRICAL PATENT RECORD.
PATENTS ISSUED MAY 22, 1900.

Conducted by Otto Greenberg. Complete descriptions and drawings of any patent mentioned below will be sent on receipt of ten cents.

649,917.—Electric shampoo apparatus. Henry G. Doerch and David W. Cranston, Nyack, N. Y.

649,922.—Apparatus for electrically lighting lamps; Henry C. Farquharson, New York, N. Y.

649,927.—Rheostat; Carl Flohr, Berlin, and Reinhard Dietz, Coswig, Germany.

649,933.—Electric releasing device for shutters; James Hueston, New York, N. Y.

649,942.—Synchronizer for electric machines; Carl J. A. Mishalke, Charlottenberg, Germany.

649,950.—Battery-plate; James K. Pumpelly, Chicago, Ill.

649,959.—Signal for trunk lines of telephone systems; Charles E. Scribner, Chicago, Ill.

649,972.—Electric motor controlling device; Thomas S. Watson, Milwaukee, Wis.

649,974.—Dynamo engine; Marcy L. Whitfield, Memphis, Tenn.

649,976.—Electric incandescent lamp; Jacob Atherton, London, England.

649,989.—System of electric distribution for electric railways; Fedor R. Koss, Charlottenburg, Germany.

649,990.—Underground electric railway system; John B. Larkin, Pittsburg, Pa.

649,994.—Automatic circuit closing telegraph key; Louis F. Ritchie, Elwyn, Pa.

649,998.—Element for storage batteries; Elmer A. Sperry, Cleveland, O.

650,010.—Electric switch; Jesse B. Heller, Philadelphia, Pa.

650,014.—Electric motocycle; Isidor Kitsee, Philadelphia, Pa.

650,015.—Electric welding; Eugene Lagrange and Paul Hoho, Brussels, Belgium.

650,030.—Apparatus for operating contacts for electric traction; Arthur Ballance and Samuel A. Jefferson, Hull, England.

650,051.—Electroplanting apparatus; Louis Potthof, New York, N. Y.

650,057.—Controller for electric circuits; Abraham L. Waters, San Francisco, Cal.

650,062.—Thermo-electric pile; Lucien Gottscho, Charlottenburg, Germany.

650,090.—Electric ear trumpet; Frances MacDaniel, New York, N. Y.

650,094.—Track and conduit construction for underground electric street railways, John H. Robertson, New York, N. Y.

650,096.—Recorder for rapid automatic telegraphy; Carl F. Rodde, Berlin, Germany.

650,109.—Apparatus employed in wireless telegraphy; Guglielmo, Marconi, London, England.

650,113.—Insulating coupling; Louis McCarthy, Boston, Mass.

650,115.—Insulating coupling for electric wire conduits; Gardner W. Prouty, Littleton, Mass.

650,119.—Electric switch; Edward J. Wade, London, England.

650,123.—Contact device for electric railways; William M. Brown, Johnstown, Pa.

650,124.—Electric metal working apparatus; Clyde Coleman, Chicago, Ill.

650,141.—Static induction generator; Rome, Wagner, Chicago, Ill.

650,172.—Telegraphic sounder; Allen A. Dittmar, Jersey City, N. J.

650,196.—Switch for electric motors; Gustav A. Scholler, Mulheim-on-the-Ruhr, Germany.

650,219.—Storage cell; Fred W. Barhoff, Hartford, Ct.

650,246.—Armature for dynamo electric machines; Gustavos Heidel, St. Louis, Mo.

650,247.—Electrode for secondary batteries; Franz Heimel, Vienna, Austria-Hungary.

650,255.—Space telegraphy; Isidor Kitsee, Philadelphia, Pa..

650,258.—Accumulator plate; Wilhelm Majert, Grunau, Germany.

650,274.—Voltaic battery operated with fused materials; William S. Rawson, London, England.

650,275.—Electric light dimmer; Henry A. Reeve, New York, N. Y.

650,305.—Composition for exciting fluid for electrical batteries; Frank J. Curtis, Everett, Mass.

650,358.—Fire alarm telegraph apparatus; William H. Kirnan, Bayonne, N. J.

Business News.

SPECIAL EXPORT COLUMN.
TOTAL AMOUNT OF ELECTRICAL EXPORTS FROM NEW YORK CITY FOR THE WEEK ENDING MAY 26, 1900, $168,867.

New York, N. Y., May 26, 1900.—The following were the exports of electrical material, and kindred lines, from the port of New York for the week just ended:

Antwerp.—27 cases electrical material, $4,384

Amsterdam.—1 case electros, $15.

British East Indies.—10 cases electric motors, $823.

Brussels.—59 packages electrical material, $2,647.

British West Indies.—13 packages electrical material, $504.

Bristol.—3 packages electrical material, $350.

Bologna.—5 packages electrical material, $125.

Bradford.—10 packages electrical material, $1,188.

Chili.—55 packages electrical material, $2,731.

Central America.—1 case electrical material, $10.

Cuba.—17 boxes electrical material, $630.

Darlington.—1 case electrical material, $165.

Genoa.—18 packages electrical material, $6,505.

Glasgow.—20 cases electrical material, $1,002; 1 case electros, $10.

Garran.—6 cases electrical material, $300.

Havre.—17 cases electrical machinery, $9,025; 147 packages electrical material, $26,964.

Hamburg.—80 packages electrical material, $10,184; 1 case electros, $20.

Liverpool.—14 cases electrical material, $598; 1 case electros, $40.

Lisbon.—652 packages electrical material, $8,703

London.—34 cases electrical material, $1,578; 240 packages electrical machinery, $26,622; 1 box electros, $19.

Mexico.—15 packages electrical machinery, $533; 63 packages electrical material, $2,353.

Madrid.—2 cases electros, $74.

Manchester.—6 cases electrical machinery, $3,415.

Naples.—62 packages electrical material, $17,118.

New Zealand.—10 cases electrical material, $159.

Odessa.—7 packages electrical material, $607.

Porto Rico.—36 packages electrical material, $360.

Peru.—511 packages electrical material, $32,254.

Riga.—6 cases electrical material, $1,500.

San Domingo.—399 packages electrical material, $4,187.

Stockholm.—1 case electrical material, $110.

Southampton.—19 cases electrical material, $642; 1 case electros, $15.

U. S. Colombia.—6 cases electrical material, $200.

Venezuela.—13 packages electrical material, $157.

NEW INCORPORATIONS.

Auburn, N. Y.—The Citizen's Light and Power Co., of Auburn, has been incorporated; capital $30,000. Directors: G. B. Leonard, F. T. Pierson, T. H. Mather, and C. D. Beebe ,of Syracuse.

Chicago, Ill.—The Zenith Electric Light Co. has been formed; capital $15,000; furnishing electric light and power. Incorporators: C. W. Buckley, Lewis J. Osborn, William G. Husband.

Mound City, Ill.—The Mound City Water, Light, Power, Hat and Manufacturing Company, of Mound City, has been chartered; capital stock $60,000; incorporators: A. J. Dougherty, G. J. Murphy and L. D. Stophlet.

Waterville, Me.—The Federal Wire Co. has been organized in Waterville with a capital stock of $150,000. The officers are: President, D. A. Proctor; clerk and treasurer, C. W. Davis. Wire cables and other electrical apparatus will be manufactured.

West Orange, N. J.—The Edison Manufacturing Co. has ben incorporated. Principal office, Lakeside ave., West Orange, N. J.; object, manufacture electrical apparatus; capital, $500,000. Incorporators: John E. Helm, Edward H. Duryee, Howard W. Hayes.

Trenton, N. J.—The Welsbach Company was incorporated in the office of the Secretary of State recently, with a capital stock of $3,500,000. The company is to furnish light, heat and power. The incorporators are: F. H. Morris, of Philadelphia; John W. Develin, of Gloucester City, and E. Smalling, of Philadelphia.

Los Angeles, Cal.—The Excelsior Company has been incorporated with a capital stock of $150,000, divided into 1,500,000 shares, which amount has been fully subscribed. Los Angeles will be the company's principal place of business. The directors are: C. A. Hooper, George W. Hooper, D. C. Henry, San Francisco; R. P. Winters, Riverside; F. L. Morgan, F. B. Crosier, and Sheldon Borden, Los Angeles.

Johnstown, N. Y.—The Fulton County Gas and Electric Company, with a capitalization of $1,500,000, to manufacture and supply gas and electricity for lighting the streets and public and private buildings of Gloversville and Johnstown, Fulton County, has filed articles of incorporation with the Secretary of State of New York. The directors are: George E. Spencer, of Brooklyn; John B. Summerfield, Armitage Mathews and Henry C. Everdell, of New York City; and James C. Young, of Jersey City. The company will also carry on operations in other towns of Fulton County. The capital stock is to consist of 15,000 shares at $100 each.

STREET RAILWAY NEWS.

Winnebago, Wis.—Articles of organization of the Winnebago Traction Company have been filed with the register of deeds. The capital stock is placed at $650,000, divided into 6,500 shares at $100 a share. The incorporators are: H. I. Weed, M. H. Eaton and G. W. Athearn. The Winnebago Traction Company is the same as the Citizens' Traction Company, only the name has been changed since the Emerson-McMillen Company absorbed the property some time ago.

Grand Rapids, Mich.—A new suburban company has ben formally incorporated under the name Grand Rapids, Spring Lake & Grand Haven Rapid Transit Company. The company is chartered for 30 years with a capital stock of $500,000, divided into 5,000 shares. The amount of stock paid in is $16,000, being about $500 per mile for the full length of the road. The stockholders are as follows: Justin R. Whitney, St. Clair, Mich.; George W. Carman, Marine City, Mich.; Seward L. Merriam, Detroit; Ithiel J. Cilley, Grand Rapids; Earl O. Cilley, Charles O. Smedley, Byron E. Parks.

Newark, N. Y.—The Newark-Marion Electric Railway Company has filed articles of incorporation in the office of the Secretary of State at Albany. The companay has a capital stock of $100,000. The road is to be eight miles in length, with terminals at the villages of Newark and Marion. The directors are: Ernest V. Pierson, Frank D. Burgess, William H. Nicholoy and William H. Kelly, of Newark; Caleb L. B. Tylee, William C. Snow and Clinton N. Tylee, of Penn Yan; Henry R. Sill, of Bluff Point, and C. H. Scutt, of Marion. Work on the road will be commenced at once. It will be constructed to accommodate both freight and passenger traffic.

Olympia, Wash.—Articles of incorporation of the Seattle General Railway Company have been filed in the Secretary of State's office. J. M. Frink, George F. Meacham, E. P. Tremper and W. H. White are the incorporators, and the capital stock is $250,000, divided into 2,500 shares of $100 each. The objects of the new incorporation are set forth as follows: To acquire, construct, equip, own and operate street railways within the State of Washington, with the right to operate the same by steam power, electricity or cable traction; to sell light, heat and power; to engage in the steamboat business, etc. The principal place of business is to be Seattle.

TELEPHONE CALLS.

Trenton, N. J.—The American Electric Telephone Co. has been incorporated in Trenton with an authorized capital of $3,000,000. The company is empowered to manufacture telephones and other electric appliances. Of the capital $1,000,000 is preferred with six per cent noncumulative dividends. The incorporators are Barnett R. Rugles, Henry M. Haveland, of New York, and James C. Young, Jersey City.

NEW YORK NOTES.

B. BLUM, dealer in all kinds of electrical machinery and supplies, has moved to No. 141 Liberty street.

EDWARD R. KNOWLES, C. E., E. E., has opened up offices at No. 136 Liberty street since May first. He is an expert electrical engineer and electrical power specialist, and was formerly with the Sprague Electric Company. Mr. Knowles was also with the General Electric Company, constructing and designing.

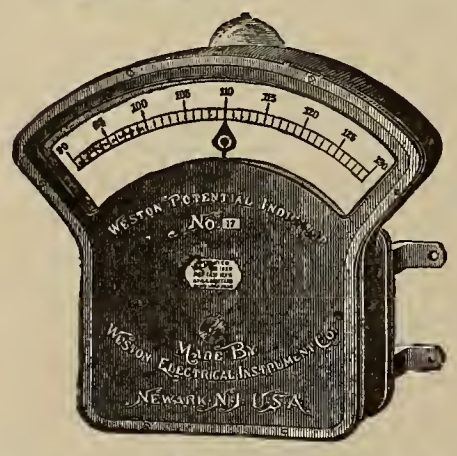
FRANK MOSSBERG, of the U. S. Automobile Company, of Attleboro, Mass., was in town last week looking over the field.

CHARLES McLAUGHLIN, president and manager of J. H. Bunnell & Co., Park Place, the noted manufacturers of telegraph and electrical supplies has returned, much invigorated after his Southern trip lasting several weeks.

SWANN MANUFACTURING are at No. 27 Thames street. They are manufacturers of "Faultless" coloring and frosting liquid for incandescent electric lamps. This coloring is scientifically made, quick drying and is also brilliant and durable.

WESTON STANDARD ILLUMINATED DIAL

STATION INSTRUMENTS.



THESE INSTRUMENTS are based upon the same general principle and are just as accurate as our regular Standard Portable Direct Current Voltmeters and Ammeters, but are much larger, and the working parts are inclosed in a neatly designed dust-proof cast-iron case, which effectively shields the instruments from disturbing influences of external magnetic fields.

WESTON ELECTRICAL INSTRUMENT CO.

114-120 William St., Newark, N. J., U. S. A.

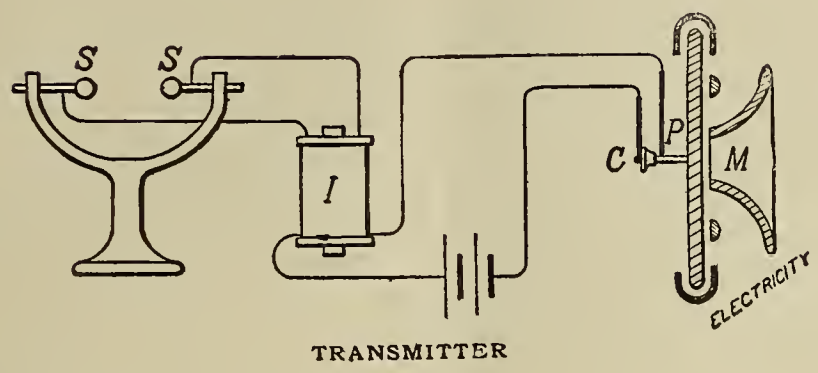
BERLIN. European Weston Electrical Instrument Co. Ritterstrasse No. 88.

LONDON. Elliott Brothers, No. 101 St. Martins Lane.

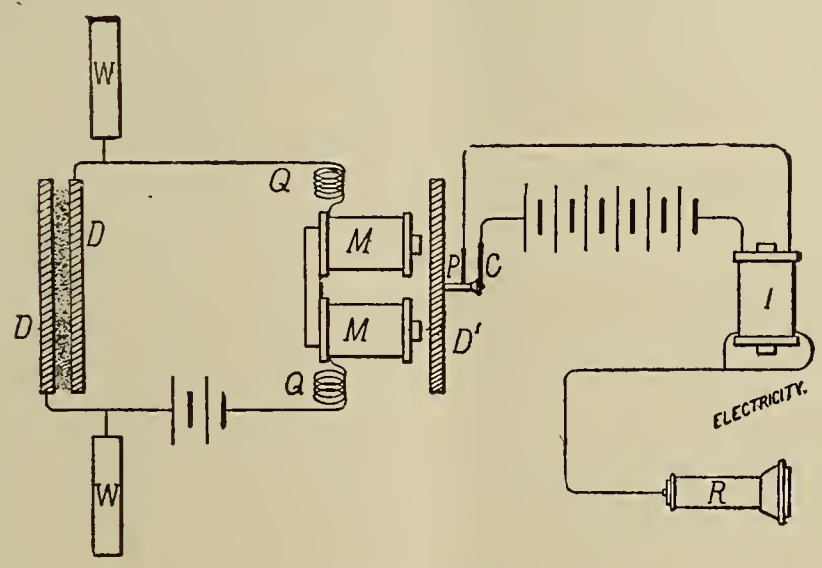
The Electrical Age.

Vol. XXV—No. 23. NEW YORK, JUNE 9 1900. Whole No. 682

Telephony.



TRANSMITTER



Receiving Apparatus.

WIRELESS TELEPHONY.*

In an endeavor to adapt—even on paper—the principle of "wireless telegraphy" to the sister service, telephony, the first essential divergence of the two systems of communication, telegraphy and telephony, presents itself at once as an obstacle for manipulation. In telephony there must be nowhere in the chain of conversions any gross mechanical agency, such as a "relay" or the "contact breaker" of a sparking coil, these and kindred devices being much too ponderous and inert to convey the rapid pulsations of a telephonic message. The nearest approach to a purely mechanical link in the system is the "carbon" transmitter in all its many modifications—"Blake," "Hunnings," etc. I have endeavored to include these two types (slightly modified) in an arrangement which, if experimented with and developed, would perhaps evolve into a workable system of wireless telephony for moderately short distances.

Briefly, the sparking coil of wireless telegraphy is replaced by an induction coil I (Fig. 1) whose primary circuit receives its pulsations from an ordinary Blake transmitter when spoken into at the mouthpiece, M. This coil, in order to produce sufficiently long sparks, would require to be much more highly wound than the little coil found in the transmitter of an ordinary telephone instrument. Its secondary circuit is open, the two ends terminating in brass spheres, S S, or, if these proved to have too great an electric capacity to admit of such rapid alternation, merely in two points. As regards the length of the spark gap, that is determined by the distance over which the message is to travel to the receiving station. That is all that is comprised in the transmitting apparatus illustrated in Fig 1.

The receiving apparatus is illustrated in Fig. 2. The two wings, W W, receive the pulsations, but instead of being connected to the "coherer" of wireless telegraphy their connecting wires are attached to the two diaphragms, D D, arranged as in the Hummings transmitter, the interspace being filled with granules of carbon or silver, etc., as experiment might direct. These diaphragms and the granules are included in circuit with a battery, and the coils, M M, which are placed on the arms of a magnet whose poles are in position behind the diaphragm, D, as in the manner of an ordinary telephone receiver. This diaphragm has, however, on the other side of it, the platinum head and carbon button of a Blake transmitter, and this arrangement serves as a "relay," so to speak, to intensify the vibration received from the wings, W W. The platinum and carbon are circuited in the ordinay way with an induction coil, I, and a battery of, say, six Leclanche cells. The secondary circuit of the coil, I, goes direct to the ordinary telephone receiver, R. A decoherer can, if necessary, be connected in the usual way, if packing should occur. Should the vibrations of the Blake transmitter be too small, an Edison electromotograph can be used, as has already been suggested by another writer when dealing with the subject of telephone relays.

The diaphragms do not, of course, represent a complete or working apparatus, but it is hoped that the arrangement may be favorable to practical development, and that, at least, it is not an unconscious plagiarism.

*From "Electricity," London.

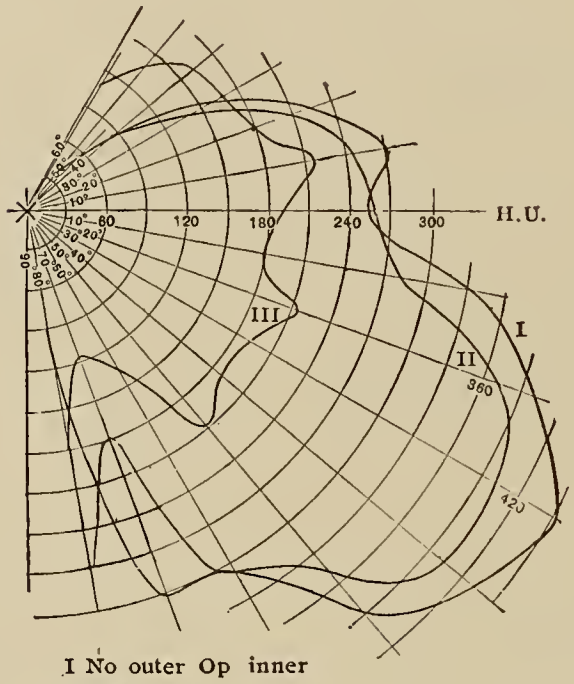
Lighting Measurements.

PHOTOMETRIC VALUES OF ARC LAMPS.*

(Continued from page 174.)

A preliminary test of much interest is described by the writer, as follows: "When an opalescent inner globe is used, the globe itself becomes more or less luminous by diffusion. The diffusion differs with the height of the arc in the globe, that is to say, with the length of the lower carbon. To ascertain the magnitude of this effect, I have carried through three tests on the same lamp and inner globe, and also the same carbons, the lower carbons being cut successively to the length of 4 3-4, 2 3-4 and 1 1-4 inches. The results appear in Fig. 2. In every case the arc was placed at the center of the mirror system.

"An inspection of these results shows that least light is obtained with the arc at the top of the globe, and most



I No outer Op inner
II Clear " " "
III Op. " " "

Fig. 3.

light when the arc is at the mid-point. This is explained in part by the fact that, with the arc at the top, a good part of the luminous flux is incident upon the non-reflecting surface of the gas cap.

"While the second and third positions yield a considerably increased flux of light with a clean globe, they must be considered as impossible conditions in practice, since, by the time the arc has descended to these points, the globe has received a coating. The result, then, as the lamp burns, is due to an increase in light flux, due to the formation of a coating. How this affects the quantity of light emitted, i. e., the product of flux and time integrated throughout the life of the carbons, is a subject for future investigations, and involves the questions of carbons, shape of globe, etc.

"In the tests which follow, I have chosen the initial condition as the simplest to obtain, even though the light emitted may be less than at some subsequent period in the life of the carbons.

*Abstract of N. E. L. A. Committee to Investigate the Photometric Values of Arc Lamps,

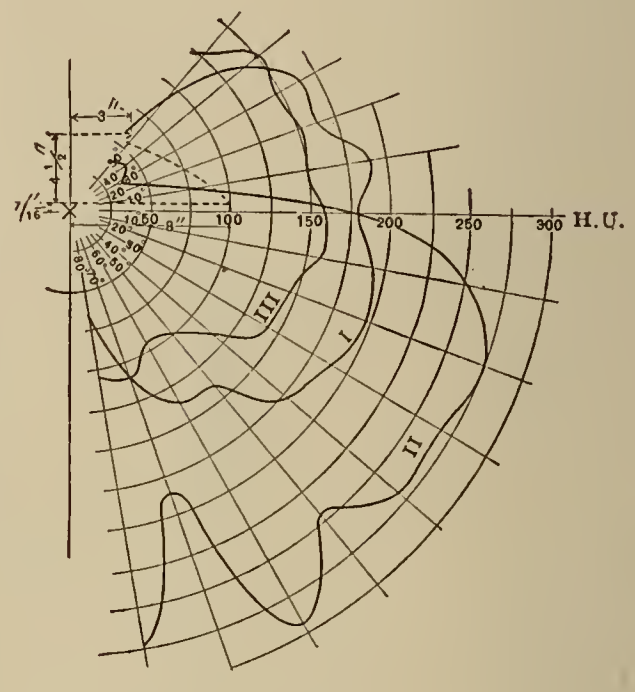
"Should anyone desire to test a lamp for the purpose of obtaining comparative results, he would not be under the necessity of burning the lamp for many hours to get the proper conditions, as he would necessarily have to do were one of the lower positions chosen in these tests."

The first investigation taken up by Professor Matthews is intended to settle the status of the 110-volt, direct-current, enclosed-arc lamp, as found in its commercial form to-day. Reports are made upon eight different lamps of this type. The tests were made upon the lamps as sent by the makers, but with a certain uniformity in conditions.

These conditions are:

1. The same brand of carbons throughout.

2. An opalescent or milky inner and a clear outer globe, as supplied.



I Op inner: Clear outer
II Op " : Shade
III Op " : Op. outer

Fig. 4.

3. An opalescent inner and an opal ground or milky outer globe, as supplied.

Fig. 3 shows the results of a representative test on one of these lamps. The regularity and relative position of these curves are indicative of the accuracy of the methods employed.

The curves show very clearly the slight absorption of the clear outer and the large absorption of the opalescent outer. The clear outer globe shows some diffusion, as it tends to round out the curve. Thus, there are two regions where curve II. extends beyond curve I. In the case of the opalescent outer globe, the diffusion is so marked that the luminous intensity is practically constant throughout a very large solid angle. In the higher angles above the horizontal, the intensity is greatly increased, producing the effect, approximately, of a luminous sphere of equal intrinsic brightness. This results in the elimination of shadows and the production of a pleasing light for interiors. The quality of light is also changed to a considerable extent, through the absorption of the excess of violet rays otherwise very marked in the light of the arc. This result is attained, however, at a diminished efficiency. In this and nearly all the curves with the opalescent outer globes, a certain wavy outline is noticed. This effect is due, in large part, to the variations in the diffusive power of the globe itself. One finds difference in thickness and translucency to a considerable extent in such globes, and as the angle of view changes, these differences would tend to distort the distribution curve.

(To be continued.)

TELEPHONY OVER CABLES AND LONG DISTANCE AIR LINES.*

BY DR. M. I. PUPIN.

This paper describes a method of constructing cables and long-distance air lines for power transmission by electrical waves, particularly for long-distance telephony and telegraphy. This method is one of the practical applications of the general mathematical theory of wave-propagation over non-uniform conductors, which is given in the second part of the paper. The first contains a physical explanation of this mathematical theory and a description of experimental researches bearing upon it. It also describes an experimental verification of long-distance cable telephony.

PHYSICAL THEORY OF ELECTRICAL WAVE-PROPAGATION OVER CABLES AND LONG-DISTANCE AIR-LINES.

A. Wave Propagation Over Uniform Conductors—Transmission of electrical energy over conducting wires is a wave transmision when the distance between the transmitting and the receiving appartus is sufficiently long to permit the development of electrical waves. Such a transmission exists in long-distance telegraphy and telephony. It does not exist to any practically appreciable extent in ordinary transmissions of electrical power by alternating-currents over distances which up to the present time have been bridged by electrical power transmission lines. In cases of wave transmission considered here the conductors will be called wave conductors. The circumstances attending wave transmission are considerably different from those attending ordinary electrical transmission and should be carefully differentiated from them. In ordinary transmission the reactions set up in the receiving apparatus are the most essential reactions which the force impressed by the transmitting generator has to overcome. The reactions set up in the transmitting line itself are small in comparison to it. The case is analogous to the transmission of power from the piston of a steam engine to a motor connected to the engine by a short, stiff, piston rod. The reactions set up in the piston rod itself are small in comparison to the reactions which the motor opposes to the driving pressure. Hence, neither the elastic nor the kinetic reactions of the piston rod, nor the reactions due to internal frictional resistances in the rod are seriously thought of when we analyze the reactions attending this case of power transmission. But consider now what will happen if we increase the distance between the piston and the receiving motor and consequently increase the length of the piston rod. We can no longer consider the rod as a perfectly rigid connection between the driving pressure of the piston rod and the reactions of the receiving motor. The rate at which the piston delivers energy at any moment is not equal to the rate at which energy is delivered at the receiving motor at that moment. There is a lag in the phase. The energy transmitted is first stored up in the piston rod and then delivered from the rod to the receiving motor. While it is stored up in the rod it exists partly as kinetic energy of the moving mass of the rod and partly as potential energy, due to the rod's elastic deformations. The process of transmission consists in successive transformations of the kinetic into the potential energy of the rod and vice versa. These transformations being progressive the energy is propagated along the rod and we say that the propagation is a wave propagation, in order to state in a single word that the progressive motion along the rod is a periodic one. Analogous conditions exist when electrical energy is transmitted by a periodically varying electromotive force on a long conductor. The transmission is not a direct one; it is stored up first in the medium surrounding the transmission line, and from there it is transferred to the receiving apparatus. While it is stored up in the medium it exists there partly as magnetic energy stored up in the field of magnetic flux and partly as electrical energy stored in the field of electrical flux. The process of propagation consists in the progressive transformation of the magnetic into the electrical energy and vice versa. When the electro-motive force impressed by the transmitting the electrocomotive force impressed by the transmitting generator is a periodic one the propagation will be in the form of electrical waves. The expression "electrical wave" is nothing more or less than a brief statement of the physical fact that in the case under consideration the energy which at any moment is stored up in the medium surrounding the transmission line is distributed periodically over this line. The current and the potential also vary periodically. At points of maximum magnetic energy the current is maximum, and at points of maximum electrical energy the potential is maximum. Roughly speaking, points of maximum current are points of minimum potential and vice versa.

(To be continued.)

* Read before the 17th general meeting of the American Institute of Electrical Engineers, Philadelphia, May 18, 1900.

THE INDEPENDENT TELEPHONE CONVENTION.

The fourth annual meeting of the Independent Telephone Association of the United States of America is to be held in the City of Cleveland, Ohio, June 12, 13 and 14.

OFFICIAL PROGRAM.

Monday, June 11.—The Ohio Telephone Association will meet at 12 o'clock M. in the Electric Building for the purpose of organization to assist in the entertainment of the delegates and visitors.

At 8 o'clock P. M. there will be a meeting of the Advisory Board and Executive Committee of the Independent Telephone Association of the United States of America at the headquarters of the association on the third floor of the Electric Building.

Tuesday, June 12.—At 8 o'clock A.M. the headquarters of the association will be opened for the purpose of registering and issuing credentials to the delegates and visitors. The headquarters will be in room 301, third floor of the Electric Building. All persons are required to register before receiving credentials and tickets to the various entertainments.

At 12 o'clock M. first session of the convention will be called to order in a room prepared especially for this occasion on the first floor of the Electric Building.

First will be an address of welcome; second, the response, which will be followed by preliminary business and general introductions. After lunch, the balance of the day will be devoted to inspection of the various exhibits of the manufacturers and material men, which will be on the first, second and third floors of the Electric Building.

Eight o'clock P. M. will be devoted to a reception given by the Cuyahoga and United States Telephone Companies, on the seventh floor of the Electric Building, at which time the offices of the different telephone interests and the switchboard of the Cuyahoga Telephone Company will be thrown open to visitors. There will also be music, flowers and light refreshments.

Wednesday, June 13.—Ten o'clock A. M.: Second session of the convention. First: Annual address of the president.

PAPERS.

Second: "Toll Line Traffic," J. B. Ware, Sec. Gen. Mgr. Citizens' Tel. Co., Grand Rapids, Mich. Third: "Telephone Development," Ed. L. Barber, Pres't N. W.

Tel. Construction Co., Wauseon, Ohio (discussion). Fourth: "Telephone Investments," Hon. Hugh Daugherty, Pres. United Tel. & Telg. Co., Bluffton, Ind. (discussion). Fifth: "Our Duty to One Another," Hon. C. W. Kline, Pres. Interstate Tel. & Tel. Co., Philadelphia (discussion). Sixth: "Telephone Construction," Jas. E. Stewart, Con. Eng. Tel., Teleg. & Cable Co. Am., New York (discussion).

At 3 o'clock P. M. ladies attending the convention will be given a tally-ho ride through the parks and boulevards, leaving the Colonial Hotel at 2:30 P. M. (compliments of Williams-Abbott El. Co.).

Wednesday evening, ladies, delegates and friends will be entertained at Haltnorth's Garden. Special car will leave Euclid avenue and Bond street at 7:15 P. M. (compliments of Cleveland Elec. Ry. Co.).

Thursday, June 14.—At 10 o'clock A. M.: Third session of the convention. First: Unfinished business. Second: Election of officers. Third: "The glad hand to new members," followed by inspection of exhibits and social sessions.

Thursday afternoon, boat ride for delegates, ladies and friends, of the convention, in the steamer "City of Erie, Cleveland & Buffalo Transit Company. Boat leaves foot of St. Clair street at 2 o'clock sharp, standard time, and returns to the same dock at 6 o'clock P. M.

Thursday evening, 8 o'clock P. M., banquet. This will be the great sical feature. The best land and sea afford to eat will be placed before the visitors. There will also be music and flowers and much eloquence.

The Passenger Associations, covering the entire territory of the United States, have granted a special rate of one and one-third fare the round trip to this convention. Tickets will be sold on the certificate plan, the purchaser paying full fare coming, and upon the presentation of the certificate, which he should procure from the railroad agent at the time he purchases his ticket, he will be granted one-third fare for his return trip. All visitors should arrange with their agent a few days before starting for this rate. Reduced hotel rates will be given in the city of Cleveland. Upon application to C. W. Wason, Electric Building, Cleveland, Ohio, rooms will be reserved at the hotels.

All persons desiring tickets to the entertainments should make application therefor to the president, James M. Thomas, Room 731 Electric Building, Cleveland, prior to June 12, as it will be necessary to know the number that will have to be entertained.

The officers of the association are as follows: James M. Thomas, president, Chillicothe, Ohio; Charles Flowers, first vice-president, Detroit, Mich.; I. A. Lumpkin, second vice-president, Mattoon, Ill.; George T. Hedges, third vice-president, Cedar Rapids, Iowa; S. P. Sheerin, secretary and treasurer, Indianapolis, Ind.; George W. Beers, first assistant secretary, New York, N. Y.; Samuel E. Wayland, second assistant secretary, Wilkesbarre, Pa. Advisory Board: James M. Thomas, Chillicothe, Ohio; S. P. Sheerin, Indianapolis, Ind.; Hugh Dougherty, Bluffton, Ind.; H. D. Critchfield, Mt. Vernon, Ohio; E. B. Fisher, Grand Rapids, Mich.; Thomas W. Sennott, Chicago, Ill.; H. C. Young, Columbia, Pa.; W. B. Seaton, Ashland, Ky.; W. H. Durin, Cedar Rapids, Ia.

The following gentlemen compose the committee of entertainment: C. W. Wason, chairman; D. J. Kurtz, Wm. Binghan Company; A. M. Barnes, Miller Chemical Engine Company; J. E. Ebersole, George Worthington Company; Wm. Smith, W. M. Pattison Supply Company; W. E. Davis, National Carbon Company; H. W. Jones, Electrical Supply and Manufacturing Company; A. B. Foster, Electric Supply and Construction Company; G. C. Steele, North Electric Company; H. W. Avery, Avery Stamping and Tool Company; L. Sands, Williams-Abbott Electric Company; W. P. Bowman, John A. Roebling's Sons Company; H. T. Pratt, American Steel and Wire Company; C. S. Powell, Westinghouse Electric and Manufacturing Company; S. R. Driffield, Consumers' Rubber Company; W. A. Foss, American Toll Telephone Company; Carl Seyler, McIntosh Huntington Company.

THE ERICSSON TELEPHONE COMPANY AT THE TELEPHONE CONVENTION.

The Ericsson Telephone Company, 296 Broadway, New York city, will have an exhibit of their telephones and sample imported switchboard, Room 215, Electric Building, Cleveland, during the coming telephone convention, where they will be pleased to see all of their friends and to explain the merits of their goods. It is expected that they will be represented by Messrs. J. H. Montague and J. F. Hemenway. They are making the exhibit in connection with that of the McIntosh-Huntington Company, their Cleveland distributing agents, who are assisting them by arranging for outside connections, which will enable their visitors to call outsiders from their telephones.

Miscellaneous Applications of Electricity.

GERMAN ELECTRO-ENGRAVING SYSTEM.

By Brainard H. Warner, Jr., U. S. Consul at Leipzig.

The elcetro-gravure is an electro-chemical etching, such as is used in making the illustrations for books, periodicals, etc., which, however, produces pictures in relief, which formerly could only be made by engraving.

In 1897, Josef Rieder, of Munich, succeeded in producing an etching on a steel plate by using a porous gypsum model dipped in a special solution capable of conducting an electric current. Two full years of hard work were necessary, however, to make the invention of practical worth, as it was found that the electric current became ineffective almost instantly (in fifteen seconds), on account of the etching ingredients, the carbon refuse from the eaten steel especially preventing the transmission of the electric current, thus necessitating the cleaning of the model. The cleaning could not be done by hand, and so a machine was invented which made it possible to remove the model from the plate and replace it in exactly the same position.

The model is brought in contact with the plate and allowed to remain there about fifteen seconds; then it is raised and carefully cleaned with a sponge brush, and again applied to the plate.

This new machine works to perfection, and is so simple that it is thought that before long it will come into general use and enable lithographic and cardboard factories, manufacturers of jewelry, stamped-leather goods, wall paper, etc., to make their own dies easily and quickly.

A company has been recently organized for constructing these machines, and before long will be able to put them on the market.

DECLINE IN RUSSIAN TRADE.

The following is a translation of an article in the Novoe Vremia of the 15th instant, showing the decline of trade in Russia, as well as the causes:

The figures published in the last edition of the financial budget (Viestnik of Finance) of our foreign trade during the first eight months of 1899 show a perceptible decrease of our trading balance. Compared with the same periods of the last two years, the export of goods diminished in 1899 in the following proportion:

	Rubles.	
In comparison with 1898.	112,700,000 equals	$58,040,500
In comparison with 1897.	54,500,000 equals	28,067,500

The Electrical Age.

ESTABLISHED 1883.

Entered at New York P. O. as second-class matter, January 18, 1891.

THE ELECTRICAL AGE PUBLISHING CO., Publishers.

TERMS OF SUBSCRIPTION:

One Copy, one Year,	$2.50
One Copy, six months,	1.25
Great Britain and other Countries,	3.50

Cable Address (all Cables), "Electage," New York.

NEWTON HARRISON, E. E., EDITOR.

ASSOCIATE EDITORS:

ALFRED E. WIENER, E. E., OSBORNE P. LOOMIS, E. E., } ELECTRIC LIGHT AND POWER.

JOSEPH MUIR, M. D., FREDERICK STRANGE KOLLE, M. D., } ELECTRO-THERAPEUTICS.

ADDRESS ALL COMMUNICATIONS TO

THE ELECTRICAL AGE PUBLISHING COMPANY,

Seventh Floor, World Building,

NEW YORK.

NEW YORK, JUNE 9, 1900.

CONTENTS:

THE FAILURE OF COMPRESSED AIR CARS IN NEW YORK CITY.

One of the most astute business men and best managers of a street railway system is President H. H. Vreeland of the Metropolitan Traction Company. His experience with the use of compressed air for surface traction has reached a point where but one conclusion can be drawn by him, which is, that the use of compressed air for street cars is a failure. It was the purpose of the Metropolitan Traction Company to absolutely transform all main and branch lines into open conduit systems run by electricity. At present two of their crosstown lines are operated respectively by compressed air at Twenty-eighth and Twenty-ninth streets and drawn by horses in Thirty-fourth street. The expense in connection with horses is so great that even on a short line it is impossible to compete with cable, compressed air or electricity. On the other hand, the imminent risk of explosion and the difficulties attendent upon the continued operation of a compressed air plant makes such an equipment unpractical.

A condition of things has presented itself through which the advisability of constructing an underground trolley system on these three crosstown lines above mentioned has been questioned. Estimates have shown that the cost of the open conduit system where it crosses the avenue is equal in each case to the expense incurred in the construction of one mile of track. Where the necessity of intersecting two underground trolley systems is imperative the expense must be assumed, particularly where traffic and business is concentrated. The necessity for many crosstown routes has been fully appreciated by the Metropolitan Company, but the immense expense has made them deem further progress in that direction, at least, worthy of some discussion.

The compressed air system at present in use is unquestionably deficient, although successful on the continent, particularly in Paris. At an outlay of such dimensions that the big air compressor alone cost $80,000 a compressed air plant was installed at the foot of West Twenty-fourth street with twenty-one cars in use. The entire installation will probably reach several hundreds of thousands of dollars. President Vreeland makes the following statement: "While the company was operating only two air cars nobody could tell how much work the cars were actually doing. What I wanted was to put them on an important line where the traffic was heavy and have them carry the whole traffic. Then if they failed in any way not only the company but the public would know it. The use of air compressed at 2,500 pounds to the square inch presented problems which were brand new. The compressor is capable of supplying air for about eighty cars but with the air half as thick as water and straining under a pressure of thousands of pounds to the square inch to get free the slightest defect in a valve would cause trouble. The cars, however, had no sooner begun under the heavy running and hard conditions of the crosstown line than they began to belie the records which had been made of their earlier performances."

It has been proposed to run the Thirty-fourth street cars by storage batteries. It has now been definitely announced that they will be put into service in a very short time but under circumstances that indicate the likelihood of success. Storage batteries have been tried on various occasions in New York city for street railway work and failures have been frequent. But with the improvement in machinery and batteries there is manifestly no reason why riper results should not be obtained than formerly.

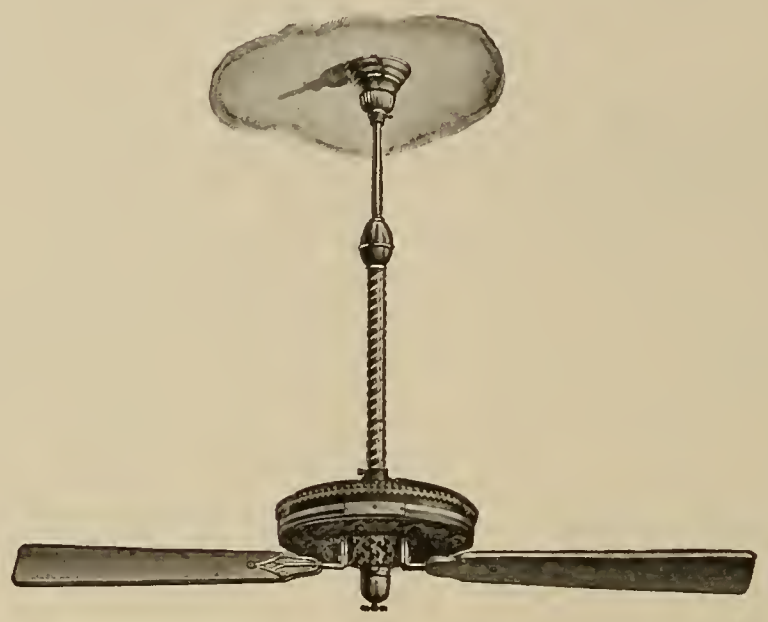
The old cars invite an expense of about sixteen cents a mile in New York city; there is a saving of about twenty-five per cent. by the employment of electricity, thus reducing the cost of this motive power to twelve cents a mile. Of this sum the absolute cost of electricity is about one cent per mile, the eleven cents representing the motormen's and conductors' wages. The belt line which embraces the city's limits can be best operated by storage battery cars on account, primarily, of the nearness of this line to the shore; then again of the great length of run and finally on account of the undulating character of the road, particularly in the northern section of the city. The rise and fall of the tide might affect a conduit system to such an extent that the conductors would be flooded at certain periods. Aside from other considerations, a storage battery system run with any degree of economy, with stations along the route to supply relays of cells, would undoubtedly remove many of the objections to the road now apparent through the slowness and discomfort of travel in these cars.

It is now evident that storage battery street railway systems will pay for short lines or long lines where physical conditions forbid the use of the under trolley. It will be exceedingly interesting to street railway men to watch the results of an experiment on a line twenty-five miles long in which storage batteries are exclusively employed for motive power. Success in this direction may lead to a second phase in the history of the storage battery, chiefly in the direction of their application to street car lines.

Ventilation.

THE EMERSON CEILING FAN.

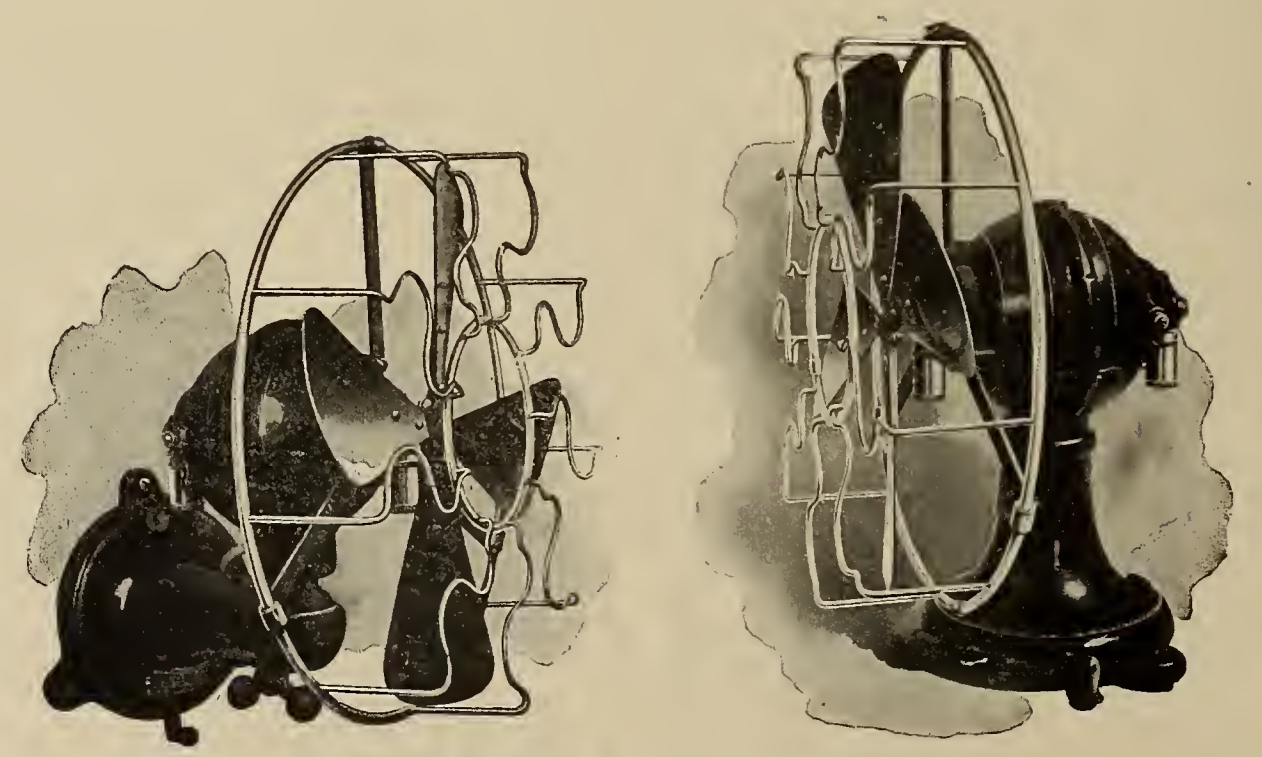
The Emerson alternating current ceiling fan has met with great popularity and success in the Eastern and Western markets. The durability of its parts and simplicity of construction have all combined to add to its ready sale. Tastefully finished and constructed with or without electrolier, as required, it occupies a permanent place in the minds of contractors, supply dealers, jobbers and consumers. The Emerson Electric Mfg. Co., of St. Louis, Mo., are the manufacturers of the above fan. Mr. T. T. Richards, the vice president of the company, is the Eastern representative, with offices at 136 Liberty street, New York city.



Emerson Ceiling Fan.

SPRAGUE DESK AND WALL FANS.

The famous Lundell fans are known all over the United States and abroad, and regarded by all dealers in the light of a standard article. They consume less current than other fans in the market and their efficiency and durability have been tested on thousands of occasions. To dealers a lines of the new Lundell fans means quick sales an dan increase in orders. The comfort and advantage obtained from a device of this kind at the low prices now prevailing leaves no excuse to those who complain of the heat in the dog days. The above desk fans and wall fans are beautifully ornamented and constructed, and are manufactured by the Sprague Electric Company, 527-531 W. 34th street, New York city.



Sprague Wall and Desk Fans.

Pomona, Cal.—The Sierra Power Company has been incorporated with a capital stock of $75,000, of which $58,500 has been subscribed. Directors: C. G. Baldwin, J. Albert Dole, B. S. Nichols, A. W. Burt and A. P. Nichols.

Miscellaneous.

DISCOVERY OF THE SOUTH MAGNETCI POLE BY BORCHGREVINK.

The Borchgrevink South Polar expedition, which returned to New Zealand from Victoria Land on Sunday, reports that it has located the position of the south magnetic pole. Several years ago Sir Joseph Hooker said that "the key to the future knowledge of terrestial magnetism lies in the determination of the exact position of the south magnetic pole; for we are not within 300 miles of a guess of its exact position." Sir Joseph had reference to the work of Capt. James Ross, who, early in 1841, sought a harbor in Victoria Land with a view to wintering there and planting his flag on the south magnetic pole in the following summer. The nearest he came to it, however, was when he was off Mount Erebus. Through calculation based on the dip and declination of the needle he concluded that the magnetic pole was 300 miles from the mountain, or, in other words, somewhere near 150 degrees east longitude and 73 degrees south latitude.

Sixty-seven years ago Sir John Ross discovered the position of the north magnetic pole, but no redetermination of its position has since been made. A knowledge of where the north and south magnetic poles are is needed to set at rest the question, still in dispute among scientific men, whether their position is fixed or variable. If these poles are not stationary a comparison of their positions at different times will show the direction and rate of their motion. When these data are obtained the specialists in this branch of physics have high hopes that they may be able to find the law that governs the constantly occrring changes in magnetic declination, inclination and intensity so that, perhaps, these variations may be calculated for future periods as eclipses are. This discovery would be not only of great scientific interest but also of practical utility to all navigators and surveyors.

It follows that if the position of the south magnetic pole has now been correctly determined another great advance has been made in our knowledge of the complex and as yet only partly understood subject of terrestrial magnetism.

His expedition left Hobart, Tasmania, December 19, 1898. During the latter part of February the members landed from the Southern Cross, near Cape Adare, Victoria Land, on the Antarctic Continent. There the party was left, and the ship was to return for them this year.

Borchgrevink's party comprised Lieutenant W. Colbeck, R. N. R., as first magnetic observer, assisted by Mr. Louis Bernacchi, Mr. N. Hansen and Mr. Hugh Evans, as zoologists; Dr. H. Kloevstad, as medical officer; Mr. Fougnat, as general utility man and cook, and two natives of Finland to look after ninety dogs.

If the Borchgrevink expedition has done nothing else than discover the southern magnetic pole it has paid for its cost. As the despatch says nothing about further explorations in Victoria Land it may be that the proposed sledge expedition toward the South Pole proved to be impracticable, though it is certain that a journey of considerable length was necessary, either by boat or sledge, in order to reach the magnetic pole.

Patents.

WEEKLY ELECTRICAL PATENT RECORD.

PATENTS ISSUED MAY 29, 1900.

Conducted by Otto Greenberg. Complete descriptions and drawing of any patent mentioned below will be sent on receipt of ten cents.

650,364. Electric R. R. System. A. H. Armstrong, Schenectady, N. Y.

650,370. Apparatus for Starting Motors. William Cooper, Cincinnati, Ohio.

650,381. Facsimile Telegraph. Wm. Dun Lang, Cleveland, Ohio.

650,384. Trolley. Chas. Feist, Sioux City, Iowa.

650,416. Knife-Switch. Chas. Perkins, Hartford, Conn.

650,425. Automatic Magnet Circuit-Breaker. W. M. Scott, Philadelphia.

650,430. Electric-Current Controller. Arthur L. Stevens, N. Y.

650,445. Insulator. Emilio Zertuche, Pueblo, Mexico.

650,452. Electric R. R.. F. E. Case, Schenectady, N. Y.

650,485, 650,486, 650,487, 650,488 and 650,489. Telephone. Chas. E. Scribner. Chicago, Ill.

650,531. Incandescent Lamp. Reginald A. Fessenden, Allegheny, Pa.

650,548. Telephone. W. Smith and J. Thompson, North Tonawanda, N. Y.

650,550. Electric Cable. Milton I. Baird, Glenfield, Pa.

650,551. Electrical Distributor. Milton I. Baird, Glenfield, Pa.

650,582. Rheostat-Switch. Rodolphus Fuller, Detroit, Mich.

650,585 and 650,586. Electric R. R. J. B. Larkin, Pittsburg, Pa.

650,602. Electric Cut-out. S. W. Downes, Providence, R. I.

650,668. Electric Lighter for Incandescent Burners. Gustave Burkhardt, Chicago, Ill.

650,704. Automatic Apparatus for Protecting Compound-Wound Dynamos. Chas. N. Block, New Haven, Conn.

650,808. Storage Battery. James P. Clarke, Quincy, Mass.

Business News.

SPECIAL EXPORT COLUMN.

TOTAL AMOUNT OF ELECTRICAL EXPORTS FROM NEW YORK CITY FOR WEEK ENDING JUNE 2, 1900, $145,547.

New York, N. Y., June 2, 1900.—The following were the exports of electrical material, and kindred lines, from the port of New York for the week just ended:

Argentine Republic.—4 cases electrical material, $354; 27 packages electrical material, $1,487.

Antwerp.— 6cases electrical material, $1,486.

Amsterdam.—2 cases electrical material, $59.

Brussels.—2 cases electrical material, $450.

Barcelona.—21 packages electrical material, $4,473.

British West Indies.—14 packages electrical material, $278.

Bristol.—124 packages electrical machinery, $5,820.

Breslau.—1 case electrical material, $16.

British Possessions in Africa.—18 cases electrical material, $1,313.

Berlin.—1 case electrical material, $5.

British Guiana.—22 packages electrical material, $1,015.

Brazil.—24 packages electrical material, $1,092; 1 case electrical machinery, $80.

Cuba.—23 boxes electrical machinery, $15,100.

Central America.—29 cases electrical material, $912.

Genoa.—5 cases electrical material, $2,119; 1 box electros $20.,

Glasgow.—29 cases electrical material, $6,025.

Gyon.—10 cases electrical material, $288.

Hamburg.—135 packages electrical material, $18,141, 22 packages electrical machinery, $3,945.

Havre.—188 packages electrical material, $10,869; 56 packages electrical machinery, $4,983.
Hayti.—2 cases electrical material, $35.
Lisbon.—2 cases electrical material, $396.
London.—151 cases electrical machinery, $37,291; 106 packages electrical material, $4,205; 6 boxes electros, $124; 48 packages electrical machinery, $3,000.
Liverpool.—29 packages electrical machinery, $5,000; 16 cases electrical material, $273.
Mexico.—47 packages electrical material, $1,349.
Margate.—3 cases electrical machinery, $5,367.
Nova Scotia.—1 package electrical material, $52.
Naples.—26 cases electrical machinery, $7,400.
New Foundland.—50 packages electrical material, $327.
Porto Rico.—2 packages electrical material, $22.
Peru.—8 packages electrical material, $284.
Southampton.—4 cases electrical machinery, $44.
Vienna.—2 cases electrical material, $21.
Zurich.—2 cases electrical material, $25.

NEW INCORPORATIONS.

New York City.—Federal Electric Company, of New York city, has been incorporated. Capital, $1,000; directors: Benjamin Blum and Nathan Blum, New York city.

Dover, Del.—Mexican Gas Construction Company has been incorporated to build and equip refrigerating plants and gas, electric light, heat and other apparatus in the Mexican States; capital, $100,000.

South Bend, Ind.—The Miller-Knoblock Electric Manufacturing Company has received a charter. It is to be located in St. Joseph County. Capital stock, $125,000; directors: John C. Knoblock, Otto M. Knoblock, William H. Miller and Horace G. Miller.

New York City.—The Carleton Electric Company has been formed to carry on the business of electricians; capital, $100,000; directors: Henry Guy Carleton, Chas. E. Phelps, New York city; Josn C. Osgood, Denver, Colo.

Toledo, Ohio.—The Valley Electric and Power Company, which is now erecting its plant in this city, has received incorporation papers. The incorporators are: W. B. Taylor, G. K. Detwiler, A. K. Detwiler, H. E. King and T. H. Tracy. The capital stock is $100,000.

Springfield, Mass.—The Springfield Electric Manufacturing Company has been organized at Saco, Me., with a capital of $10,000, of which $3,000 is paid in. The president is Herbert E. Bosworth and the treasurer Bentley C. Starr, both of Springfield, Mass.

Elmira, N. Y.—The Elmira Water-Light Company, of Elmira, has been chartered to furnish light, heat or power for Elmira and for the towns of Elmira and Horseheads, and other towns in Chemung County. Capital, $1000,000; directors: Charles F. Uebelacker, Ross M. Lovell and E. Watson Personius.

Poughkeepsie, N. Y.—The Empire Lighting Company, of Poughkeepsie, has been incorporated to manufacture gas and electricity for use in Poughkeepsie and villages and towns in Dutchess County. Capital, $100,000; directors: F. A. Stratton and Charles H. Werner, New York city, and L. B. Grant, Brooklyn.

TELEPHONE CALLS.

Canastota, N. Y.—The Farmers' Telephone Company, of Madison and Oneida Counties. Capital, $1,000; directors: Milton Jennings, of Canastota, and R. D. Buttons, of Cottons, Madison County.

Stone Bluff Ind.—The Shawnee Telephone Company, of Stone Bluff, Fountain County, capital stock $3,000, has been incorporated. The names of twenty-five people are given as the incorporators.

Maxwell, Ind.—The Citizens' Telephone Company, of Hancock County, with headquarters at Maxwell, has been incorporated. Capital stock, $10,000; directors: Vard Finnell, T. Thomas, B. Piper, Charles Kingen, Thomas Seaman and Eli Hagan.

New Prague, Minn.—The New Prague Telephone Company has filed papers of incorporation with the Secretary of State and paid the fee on a capitalization of $100,000. The new company proposes to operate a telephone system in towns of less than 20,000 through Scott, Le Seuer and Rice Counties, with headquarters at New Prague. S. A. Vopatek, J. F. Barta, M. Rybak, all of New Prague constitute the board of directors.

STREET RAILWAY NEWS.

New York City.—Articles of incorporation of the Electric Railroad Syndicate, of New York, capitalization $1,000,000, with Stephen H. Emmens and Newton W. Emmens of New York, directors, were filed recently. The business is to take and execute contracts for constructing and equipping electric lines.

New York City.—The Elm Street Connecting Railway Company, of New York, with a capital of $20,000, has been incorporated. Directors: Charles E. Warren, Sharon Graham, William A. Dibbs, Mark J. Martin, Clifford S. Beattie, Henry L. Jeffries, Andrew J. Loughlin, Lewis H. Thrall, all of New York city, and D. E. Clifford Moorhead, of Jamaica, L. I.

Amsterdam, N. Y.—The Amsterdam & Hagaman Traction Company has been incorporated with a capital of $100,000, to operate a street surface electric road five miles long, from Florida avenue and Broadway road, Amsterdam, to Paulding and William streets, in the village of Hagaman. The directors are: William K. Archbold and Robert P. Reid, of New York; Paul T. Brady, Robert E. Drake and Simon B. Storer, of Syracuse; J. George Kaelber, of Rochester; W. Barlow Dunlap and Louis E. Harrower, of Amsterdam, and William H. Cornell, of Buffalo.

POSSIBLE INSTALLATIONS.

Halifax, N. S.—The City Council is at present considering the installation of an electric light plant.

Port Maitland, Ont.—Negotiations are in progress with a view of installing an electric light plant here.

Bedford, Que.—The Council is considering the question of lighting the streets by electricity.

St. Mary's, Ont.—The by-law to take over the electric light plant will be voted on by the ratepayers on July 21.

Woodstock, Ont.—The gas, electric light and waterworks plants will be united and a large power plant will be established.

St. John, N. B.—The City Council has decided to invite tenders up to June 30 for lighting the city for a term of five years. A committee will also report on the advisability of installing an electric light plant (municipal).

WESTON STANDARD

PORTABLE DIRECT READING

VOLTMETERS

AND

WATTMETERS

For Alternating and Direct Current Circuits.

The only standard portable instrument of the type deserving this name.

Write for our Catalogue of Portable Instruments.

WESTON ELECTRICAL INSTRUMENT CO.,

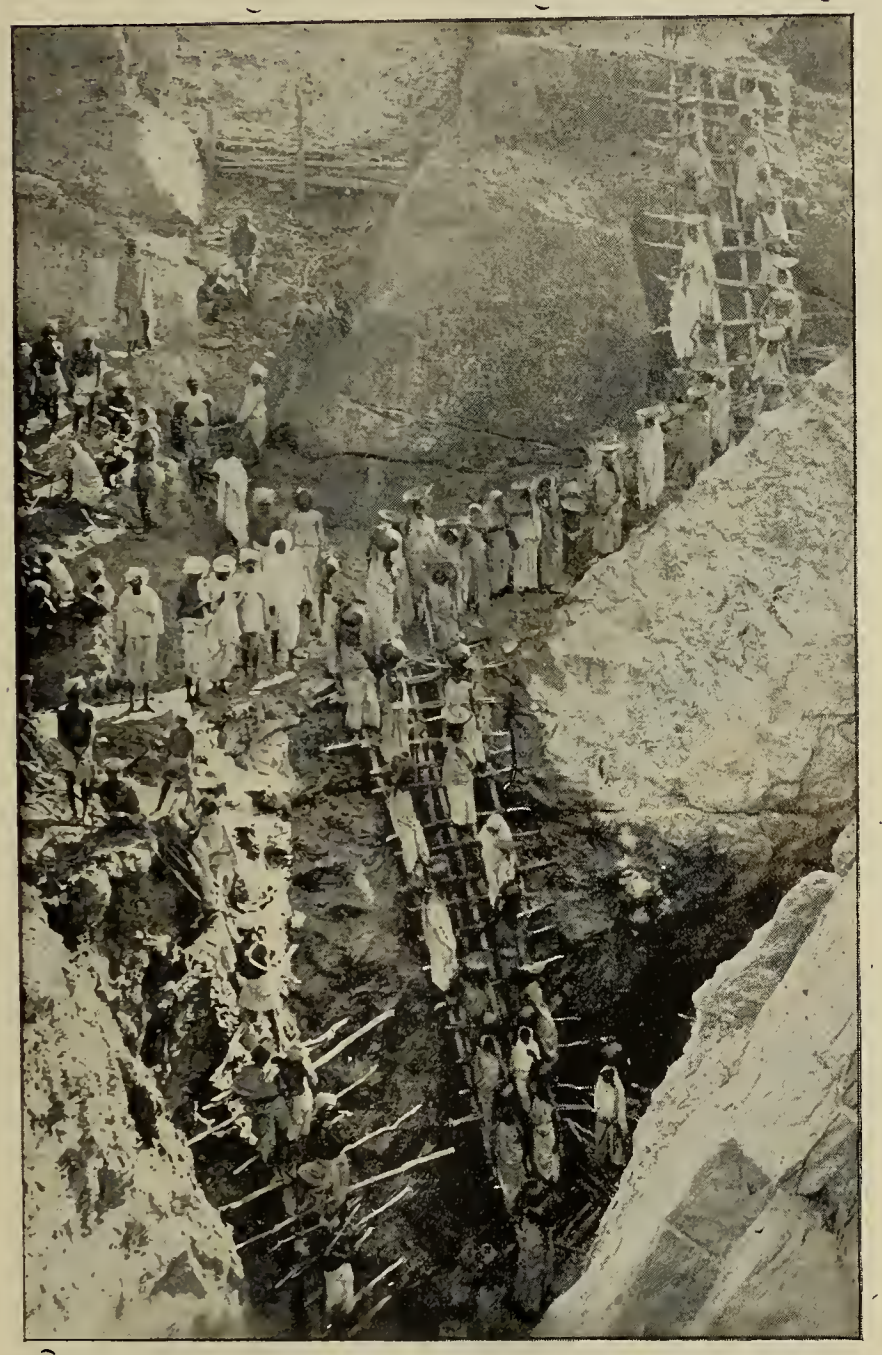
114-120 William Street, Newark, N. J.

BERLIN. European Weston Electrical Instrument Co. Ritterstrasse No. 88.

LONDON. Elliott Brothers, No. 101 St. Martins Lane.

The Electrical Age.

VOL. XXV—No. 24. NEW YORK, JUNE 16, 1900. WHOLE No. 683



Women Carrying Mica from the Mines.

INDIA MICA.

FOREIGN importations are not regarded with any undue degree of enthusiasm by the American public, yet in the case of so unique a mineral as mica, entirely a natural product, America has nothing within its confines that can compare in quality with the mica mined in India. This remarkable mineral production is supposed to owe its origin to the influence of tremendous forces whose co-ordinate effect gave to the mineral mass its laminated structure. For many thousands of years, even in the days of ancient Egypt, mica found its uses in a commercial sense and grew to be of greater importance as the years rolled by.

In the illustrations shown, which are reproductions of photographs taken in the very heart of India, miles away from any civilized settlement, the crude methods of mica mining are exposed. Strange to say mica mining is done mainly by women. Although the Holy Book claims that the curse which descended upon Adam was that he and his posterity should work by the sweat of their brows for their daily bread, in India we find an exception to this rule. Here it is not necessary to work in order to perspire, nor do the men participate any more than it is necessary in menial work which, to a large extent, is performed solely by women. They extract the mica in the rough, cut it, clean it and pack it and then, in wagons drawn by oxen, carry it through forest and over plain to the railway.

The demand for mica by electrical manufacturers has grown to enormous proportions. In fact, every year it is increasing. In the illustrations shown the famous Abruker Mine is brought to the reader's attention. It is two hundred feet deep and produces the finest grade of mica

in the world. The mine and the manufacturers are truly at the very antipodes of the earth. An eight or ten thousand mile journey, or nearly half way around the world, is the distance mica must travel before it is used. There is no known substitute for mica but air. If it were possible to transform mica so that it could be freely used as the insulator of wires many advantages would be gained. At present mica, other than its use for commutators, is used in sheets for the insulation of armatures, is ground up and mixed with a composition for special forms of sockets, handles for screw drivers and sheets of insulating material for micanite cloth. When in a powdered form it is sometimes used as a lubricator and when mixed with cement makes a solid, durable and inexpensive insulating material for joining or separating electrical conductors. It is frequently the main constitutent in the construction of insulating joints, though its use in various other respects is more or less limited. The firm of Eugene Munsell & Company, to whom we are indebted for the above illustrations, are the largest importers of mica in this country.

The illustrations were obtained through the kindness of Mr. Franklin Brooks, of the above concern, who is one of the few Americans who ever had an opportunity of witnesing the processes through which mica passes; from the mines with their picturesque surroundings to the manfacturer of electrical machinery on the other side of the globe.

Mine Owners' Bungalow.

Cutting, Cleaning and Packing Mica.

Telephony.

TELEPHONY OVER CABLES AND LONG DISTANCE AIR LINES.*

BY DR. M. I. PUPIN.

(Continued from page 179.)

Wave-length.—Consider now the distance between any two consecutive points of minimum curent or minimum potential. This distance is a half wave-length. Suppose that the impressed electromotive force is a simple harmonic of frequencv 600 periods per second. Say

*Read before the 17th general meeting of the American Institute of Electrical Engineers, Philadelphia, May 18, 1900.

that we find the wave-length to be 18 miles, the velocity of propagation will be 10,800 per second; considerably less than the velocity of propagation of light through a vacuum. To some this numerical illustration may seem as highly improbable, for we are accustomed to hear much of electricity being propagated with the velocity of light. But it should be remembered that this is true under certain particular conditions only. The velocity of propagation of electrical waves of telephonic frequencies over conducting wires may be anything from the velocity of light down to a few inches, or even less than an inch, per second, depending on the inductance, resistance and capacity of the line. The smaller the velocity the shorter, of course will be the wave-length for a given frequency. The wave-length, as will be seen presently, plays a very important part in ths investigation.

It is considered here as one of the characteristic constants of wave propagation. I am not aware that previous investigators of the propagation of long electrical waves have devoted any serious attention to this characteristic constant.

and therefore the amplitude of both current and potential become smaller as the energy progresses along the transmission line. Let U be the amplitude of the current at the transmitting end, and U_2 be the amplitude at a distance s, then if the line be considered infinitely long

$$\frac{U_2}{U} = e^{-Bs}$$

where e is the base of Naperian logarithms. The constant B is called here the attenuation constant. The mathematical expression for B is well known

Bringing Raw Material From the Mine.

where L, R, C, are the inductance, resistance, and capacity, respectively, of the wave conductor per unit length, and p is the frequency speed. Much confusion exists in the minds of physicists as to the real significance of this constant, and as to the true cause of current attenuation. It is usually stated that the capacity of the line acting as it does somewhat like a shunt, is the cause of all the trouble experienced in electrical wave transmission. This statement contains a small part of the truth only,

Taking the Finished Product to the Railroad.

Attenuation Constant.—There still remains another constant which with the wave-length completely defines electrical wave propagation. It is called here the attenuation constant. To bring out its physical meaning consider two consecutive half wave-lengths at any moment. The one nearest to the transmiting apparatus we shall denote by A and the other by B. The wave energy stored up in the medium surounding A is greater than that stored up in the medium surrrounding B. Hence wave energy is gradualy dissipated during its propagation from the transmitting to the receiving apparatus, and for that reason may and actually has become misleading. The fact that a conductor possesses inductance and capacity shows that the medium surrounding it is capable of storing up energy, which, indeed, is a blessing; it can not possibly signify that energy propagated along it will be dissipated; and if capacity can not cause a loss of energy, how can it possibly cause an attenuation of current? The dissipation is due to imperfect conductivity of the wire, and to that alone. Inductance and capacity regulate it, they do not cause it. Consider now the manner in which this regulation is effected. The dissipation

of the energy transmitted occurs at the time when it is stored up in the medium as magnetic energy; for if the medium surrounding an element ds of the transmission wire contains a quantity dW of magnetic energy, then a current x must flow in that element such that

$$d\,W = \tfrac{1}{2}\,L x^2\,d\,s$$

Let d H be the rate of dissipation in that element, then

$$d\,H = R x^2\,d\,s$$

Suppose now that by some means we increase L to n^2 L, the medium surrounding the elements ds will store up the same amount dW of magnetic energy with one n^{th} of the current, for

$$d\,W = \tfrac{1}{2}\,n^2\,L\,(x/n)^2\,d\,s$$

Let d H_1 be the rate of dissipation in this case then

$$d\,H_1 = R\,(x/n)^2\,d\,s = d\,H/n^2$$

It follows, therefore, that during the transmission of a given quantity of energy over a conducting wire the dissipation will be diminished by increasing the inductance of the wire, for if the wire have high inductance then small currents are required to transmit a given quantity of energy, and small currents incur small ohmic resistance losses.

By increasing the inductance the efficiency of transmission is increased just as effectively as by increasing the conductivity of the transmission wire.

Distortionless Wave Conductors.—Another important advantage is gained by increasing the inductance. The expression for B given above shows that attenuation depends on frequency; it increases with it. Hence, in telephonic transmission where waves of complex harmonic frequencies are propagated over the line there will be distortion of the waves, because upper harmonies will be attenuated more vigorously in a distortion of speech, which is noticed in long-distance telephonic transmission as defective articulation. Some instructive experiments bearing upon this point will be described presently. High inductance obviates this difficulty. To illustrate—suppose that the inductance is large in comparison to the resistance, the expression for B will reduce to

When everything seems dull and slow and buyers fail It is independent of the frequency. All frequencies are attenuated alike, so that high inductance not only diminishes attenuation, but also renders the circuit distortionless. Such a circuit is the ideal circuit for telephonic and telegraphic wave transmission.

(To be continued.)

Lighting Measurements.

PHOTOMETRIC VALUES OF ARC LAMPS.*

(Continued from page 178.)

At a common terminal electromotive force of 110 volts, seven of these lamps take an average current of 4.90 amperes which means an average total power consumption in each lamp of 5.39 watts. With 80 volts at the arc, this power is divided into 147 watts waste in the resistance coils and 392 watts in the arc. The average yield of light, expressed as mean spherical intensity, is:

Opalescent inner, no outer=256 H. U.
Opalescent inner, clear outer=207 H. U.
Opalescent inner, opalescent outer=177 H. U.

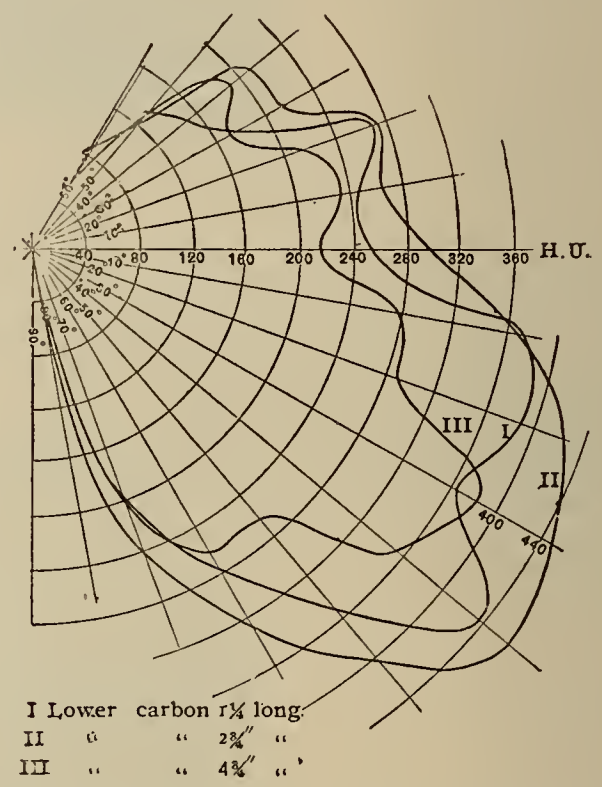
Hence the power required to produce one unit of light in this type of lamp is:

Opalescent inner, no outer=2.10 watts.
Opalescent inner, clear outer=2.66 watts.
Opalescent inner, opalescent outer=3.04 watts.

In conclusion, attention may be called to the fact that these figures give the value of this type of lamp as a light producer, and not as a light distributor. The efficiency of the type as a distributor of light can best be found from a consideration of the curves of illumination—a matter which does not form a part of this investigation.

The second investigation reported deals wth the general status of the 110-volt, alternating-current, enclosed-arc lamp in its commercial form. Conditions similar to those described in the preceding tests obtained throughout this investigation. Seven lamps were subjected to test. Of the results none are more instructive than those obtained on lamp 106 (Fig. 4).

The highly benefical effect of a shade on an alternating-current lamp is here well shown. The large upward lobe of the distribution curve is intercepted and turned into useful directions. It is to be remembered that these distribution curves represent the state of affairs when the lamp is newly trimmed. As the arc burns lower, the upward flux of light is strengthened and the value of the lamp as a light source improves, because the shade then reflects a larger flux of light into useful directions. The shade in this case extends downward to a plane about



one-half inch above the arc, when the latter is at its highest point. The horizontal intensity with shade is slightly less than with clear outer globe, showing that the latter strengthens this intensity by diffusion more than it reduces by absorption. The increase in intensity from the horizontal to 20 degrees B. is very marked when the shade is employed in the position here indicated, and these are angles of most importance in street lighting, if not in interiors. The mean hemispherical intensity is altered by the substitution of the shade for the clear outer globe in the ratio of 254:169, or 50 per cent. increase.

It is worth noting that the curvature of this shade is admirable for the effect sought. A shade which is concave outward will divert a portion of the luminous flux upward, where it is largely dissipated by absorption.

As to the efficiency of this type of lamp, the following table gives a recapitulation of the power measurements on the alternating current-lamps. The mean power consumption of seven lamps is 417 watts. The average value of the mean spherical intensity is:

With clear outer globe..... 159 H. U.
With opalescent outer globe..... 130 H. U.

Therefore, as light producers the average efficiency is:

With clear outer globe..... 2.62
With opalescent outer globe..... 3.20

*Abstract of report of N. E. L. A. committee to investigate the photometric values of arc lamps.

The Electrical Age.

ESTABLISHED 1883.

Entered at New York P. O. as second-class matter, January 18, 1891.

THE ELECTRICAL AGE PUBLISHING CO., Publishers.

TERMS OF SUBSCRIPTION:

One Copy, one Year, - - - - - - - - - - $2.50
One Copy, six months, - - - - - - - - - - 1.25
Great Britain and other Countries, - - - - 3.50

Cable Address (all Cables), "Electage," New York.

NEWTON HARRISON, E. E., EDITOR.

ASSOCIATE EDITORS:

ALFRED E. WIENER, E. E., } ELECTRIC LIGHT AND POWER.
OSBORNE P. LOOMIS, E. E., }
JOSEPH MUIR, M. D., } ELECTRO-
FREDERICK STRANGE KOLLE, M. D., } THERAPEUTICS.

ADDRESS ALL COMMUNICATIONS TO
THE ELECTRICAL AGE PUBLISHING COMPANY,
Seventh Floor, World Building,
NEW YORK.

NEW YORK, JUNE 16, 1900.

CONTENTS:

THE INDUSTRIAL SITUATION IN GREAT BRITAIN.

The great historian Gibbon, in his work on "The Rise and Fall of the Roman Empire," gave reasons acceptable to the literary and political world why great changes took place in what was considered to be the strongest political organization in the world's history. These causes when collectively considered were of such a character that their evil influences could have been partially annulled and even at a certain period in the history of this great empire many of the causes themselves might have been removed. A parallel case exists with respect to the industrial activity at present reigning in England. British supremacy in the field of manufacture and commerce has been recognized for several centuries, but the time is fast approaching when a brighter star will appear among the constellations. With the wonderful expansion in home industries and myriad developments in an agricultural, industrial and architectural sense the prospects are bright indeed for an industrial future for this country which will far outshine that of the motherland, England. It is believed by all financiers that the political and industrial future of any land rests upon its coal and iron mines. Other things being equal the country which is the fortunate possessor of these prized accompaniments of civilization is better prepared to build and develop on the basis of its own resources than countries dependent upon others for their machinery and fuel. With great plants in which steel is turned out at the rate of millions of tons a year, with great coal mines of inexhaustible capacity, it looks as though the future will give to this country what England once claimed, that is, industrial supremacy. American producers, particularly the steel kings, realize that their power to export steel billets is greater than ever at a price far below last year's quotations. What will be done by the manufacturers of Germany and England with their comparatively expensive processes and limited supply of coal and ore?

PHYSIOLOGICAL APPLICATIONS OF ELECTRICITY.

The merely hygienic benefits arising from the application of electricity have been overtopped of late by newer applications of greater importance not only to the patient but to the physician, surgeon and, in fact, the entire medical fraternity. The death dealing effect of an electric curent upon germs has been recognized, and we hear from abroad that a series of experiments have just been concluded showing how inimical electricity is to the development of deadly bacilli. On the other hand, we hear from Chicago that electricity is used in a manner more or less unique. Hypochlorites are driven into the flesh, so that they reach diseased portions of the lungs, by means of powerful static discharges. There they act upon the tuberculosis germ, destroying its vitality and freeing the patient in a very short space of time from most of the symptoms of consumption. The electro-therapeutists, who in many respects form a class by themselves, will no doubt feel supremely gratified to hear of successes as great as these yet from a logical standpoint there seems to be no reason why systematic electrical treatment given by skilled experts should not be pre-eminently successful. The greatest boon that civilization can hope for this coming generation, greater, in fact than Dr. Jenner's anti-toxin of smallpox, is a radical remedy for the stamping out of lung diseases.

ELECTRIC FANS BEHIND THE SCENES.

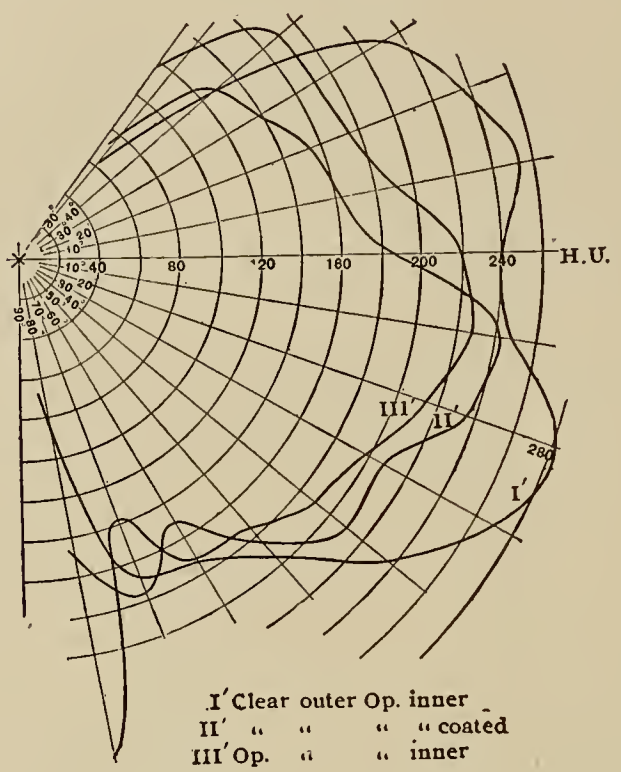
Summer and electric fans are almost synonomous hot period. This is particularly true in the case of a select circle of artists who appear in some of our theatres terms to the many unfortunates tied to the city during the during the hot spell. As a rule the theatres themselves are cooled by fans situated conveniently or great exhausts gather up the air, thereby creating a natural draught more or less refreshing. Means are certainly taken to make the audience as comfortable as possible but behind the scenes is where suffering may be witnessed. In plays calling for many changes of scenery the stage hands undergo torture and the actors try to sustain the dignity of their parts in spite of the rivulets of paint that sometimes stream from their countenances. In one of the largest theatres in New York city the private dressing rooms of the participants of the play are fully equipped with all modern conveniences. The electric light is, of course, present, but above all is the gently humming electric fan which playing upon the occupants of the room adds enormously to their comfort and self-possession just prior to their reappearance. It would seem as though plays in New York might be carried on all summer were the proper means taken to cool the theatre and the stage.

Apropos of the above statement some of the enterprising liquid air men consider it feasible to cool theatres in this manner. There are possibilities that might be utilized to advantage. The first natural inquiry will be with regard to the price of liquid air; secondly, the amount required to effectively cool the theatre, and finally, the simplest and best apparatus for this purpose. This is an opportunity the liquid air men have been looking for, and we wonder how they will take advantage of it.

in watts per mean spherical Hefner unit. The mean power in the arc is 342 watts, and in the mechanism 74 watts.

RELATIVE MERITS OF THE DIRECT CURRENT AND ALTERNATING CURRENT LAMPS.

Regarding these lamps merely as light producers, the average direct-current lamp yields, with opalescent inner and a clear outer globe, 207 H. U., whereas the average alternating-current lamp for circuits of the same pressure yields 159 H. U., which gives the former lamp an advantage as a light source, irrespective of efficiency, in the ratio of 48:159, or 30 per cent. It is pretty well demonstrated that the alternating arc is, per se, less efficient than the direct-current arc. Just what the proper ratio may be is a matter for physical research, and varies with several factors, such as current density, wave form, etc. We have no data in these investigations to furnish reliable information on this point, as there are too many variable conditions met in the lamps, as found in their commercial form.



(To be concluded.)

Electric Railways.

FOREIGN ELECTRIC RAILWAYS.

ELECTRIC STREET CARS IN NEWFOUNDLAND.

Electric cars are now in operation on the principal streets of St. Johns, and hundreds of people from the outports have come to enjoy, with the inhabitants of the city, the strange sensation of being whirled along by such peculiar motive power. The street railway is operated by the trolley system and will run twenty cars over 7 miles of track; as the traffic increases the line will be extended to all the suburbs.

The current which provides the power, as well as that for lighting, is generated 9 miles from St. Johns. The physical characteristics of the region lend themselves admirably to the success of this enterprise. There is a chain of four connecting lakes, and from the outlet of the last runs a flume which is built along a steep hillside for 3,300 feet, until it disappears into a tunnel cut 350 feet through a bluff of solid rock. At the end of the tunnel is erected a huge sluice box of timber, to the bottom of which is fixed a steel tube 6 feet in diameter. Through this, the water drops 185 feet on a large water wheel in the power house, which sets the machinery in motion. The largest of the lakes supplying the water has a superficial area of 31,000,000 square feet; the next 15,000,000; the third, 9,000,000; the fourth, 1,000,000, this being used as a regulating pond. The capacity of the plant is 1,600 horsepower, but the flume is of sufficient capacity to drive another plant of like size.

The electricity is concentrated at the power house and transmitted to the substation in St. Johns at a voltage of 15,000. The water wheel and other machinery was built by the Stillwell, Bearce, and Smith-Vail Company, of Dayton, Ohio, and the electric plant by the Westinghouse Company, of Pittsburg, Pa.

MARTIN J. CARTER, U. S. Consul.

St. Johns.

PROPOSED BRUSSELS-ANTWERP ELECTRIC RAILWAY.

The government has provided, in the estimates before the chamber, for the construction of an electric tram service between Brussels and Antwerp. The new line is considered to be the forerunner of others, which will shortly supersede steam locomotion, except for the transport of merchandise. The scheme provides for the construction and operation of an electric railway direct from Brussels to Antwerp without any intermediary stop, and asks that the duration of the concession may be sixty years.

Several bids have already been submitted to the government, which, however, reserves the right to select the offer satisfying all the conditions of the bill and presenting the most complete guaranty of good and prompt execution.

The new line must be established in a manner allowing the trains to pass over an uninterrupted line of rails without risk of any possible encounter, either from teams crossing the rails or from trains. In fact, the line must be so constructed as to avoid all obstacles that might involve stopping of the trains. The bill further provides that trains, whether composed of one motor carriage alone or with one or more trailers, must be supplied with powerful brakes. Not having any obstacle to fear they may acquire a very high rate of speed; that proposed by the bill is 100 kilometers (62.136 miles) per hour, which would permit trains to make the run between Brussels and Antwerp (27 miles) in twenty-five minutes.

Although the bill provides for a concession for sixty years, at the expiration of which the railroad and its entire equipment become the gratuitous property of the state, the government reserves the right to redeem the road after the expiration of the first ten years, or sooner, if considered advantageous. The cost of construction and equipment is estimated at about 40,000,000 francs ($7,720,000).

GEO. W. ROOSEVELT,
Brussels. U. S. Consul.

ELECTRIC TRAMWAYS IN VALENCIA.

As an evidence of the general progress of Valencia, I have to report that the business of the General Tramway Company of Valencia, embracing some 25 miles of rails, has been taken over by a French company, which is substituting electric power for the steam and horse traction hitherto employed.

Electric cars are already running between Valencia and the port, a distance of 3 miles. The system employed is the overhead cable and trolley. The cars are of Spanish construction, and the electric machinery and rails from Belgium.

The Thompson Houston Company is negotiating for the forty years' lease of some 12 miles of street rails belonging to another street car company. The Thompson-Houston Company also propose to work these lines by electricity, and their offer is being favorably considered. When the result is definitely known, I shall report again.

HORACE LEE WASHINGTON, U. S. Consul.

Valencia.

Among the Societies.

ASSOCIATION OF RAILWAY TELEGRAPH SUPERINTENDENTS.

The annual meeting of the above association will take place at Detroit, Mich., June 20, 21 and 22, and extensive preparations are being made by the committee in charge for an interesting convention.

SUMMER CONVENTION OF THE NORTHWESTERN ELECTRICAL ASSOCIATION.

The summer convention of the Northwestern Electrical Association will be held at Waupaca, Wis., June 26, 27 and 28. Steamer excursions, Olympian games, theatricals, receptions, etc., will form the lighter side of the programme, while the more substantial and earnest nature of the meeting will consist of the reading and discussion of the following papers: "Testing," by W. H. Edgar; "Advantages of Recording Wattmeters on Switchboards," by W. Worth Bean; "Storage Batteries for Small Central Stations," by Louis A. Ferguson.

Patents.

WEEKLY ELECTRICAL PATENT RECORD. PATENTS ISSUED JUNE 5, 1900.

Conducted by Otto Greenberg. Complete descriptions and drawings of any patent mentioned below will be sent on receipt of ten cents.

650,860, 650,861 and 650,862. Electrical Connector. Thos. J. McTighe, N. Y.

650,872. Electric-Arc Lamp. Wm. Silvey, Dayton, Ohio.

650,885 and 650,886. Electric Storage Battery. S. L. Wiegand, Philadelphia, Pa.

650,915. Relay. Chas. Scribner, Chicago, Ill.

650,928. Suspension-Lamp for Electric Conductors.

650,952. Electric R. R. Wm. Robinson, Boston, Mass.

650,972. Electric Conductor. Louis Hackethal, Hanover, Ger.

650,997. Electric R. R. James M. Taylor, Omaha, Neb.

651,013. Electric Telegraphy. Isidor Kitsee, Philadelphia.

651,033. Electric Conductor. Geo. Gesner, N. Y.

651,112. Electric R. R. Switch. Hermann Gorn, N. Y.

651,179. Germ-Arrester for Mouthpieces of Telephones, Chas. Branch, Philadelphia, Pa.

651,198. Telephone-Transmitter, Joseph Moore, Chatham, Ill.

651,271. Electric R. R. Thos. A. Rhodes, Langdon, B. C.

Business News.

SPECIAL EXPORT COLUMN.

TOTAL AMOUNT OF ELECTRICAL EXPORTS FROM NEW YORK CITY FOR WEEK ENDING JUNE 9, 1900, $106,062.

New York, N. Y., June 9, 1900.—The following were the exports of electrical materials and kindred lines from the port of New York for the week just ended:

Argentine Republic.—30 cases electrical machinery, $1,914

Antwerp.—2 cases electros, $15; 9 packages electrical machinery, $2,993.

Bristol.—41 cases electrical machinery, $4,500; 52 electric cable reels, $6,945.

British West Indies.—35 packages electrical material, $111.

Brazil.—165 packages electrical material, $10,002; 4 packages electrical machinery, $295.

Barcelona.—5 packages electrical material, $110.

Brussels.—1 case electrical machinery, $418.

Central America.—27 cases electrical material, $714.

Chile.—12 packages electrical material, $449.

Cuba.—26 packages electrical material, $474.

Ecuador.—1 case electrical material, $37.

Hamburg.—36 cases electrical material, $1,260.

Havre.—9 packages electrical material, $985.

Liverpool.—297 packages electrical machinery, $23,392; 11 cases electrical material, $1,380.

London.—130 packages electrical machinery, $12,221; 107 packages electrical material, $4,578.

Margate.—8 cases electrical machinery, $3,100.

Manchester.—6 cases electrical material, $1,500; 7 packages electrical machinery, $21,165.

Peru.—12 cases electrical machinery, $2,280; 13 packages electrical material, $2,073.

Porto Rico.—19 packages electrical material, $377.

Santo Domingo.—7 packages electrical material, $444.

Southampton.—2 packages electrical material, $950; 70 cases electrical machinery, $1,041; 5 cases electros, $215.

U. S. Columbia.—3 cases electrical material, $71.

Venezuela.—26 packages electrical material, $53.

NEW INCORPORATIONS.

Toledo, Ohio.—The Maumee Valley Electric Company, of Toledo, has been incorporated with a capital stock of $200,000.

Wilmington, Del.—Shawmut Construction Company, of New York, to build and equip railroad and general electrical plants; capital stock, $150,000.

Peoria, Ill.—The Hammond Gas and Electric Company has been incorporated with a capital stock of $100,000. H. W. McCoy, G. B. Franks and Walter Barker, incorporators.

Auburn, N. Y.—The Citizens' Light and Power Company, of Auburn, has been incorporated. The directors of the corporation are all from Syracuse, N. Y., and the capital is $30,000.

Rhinebeck, N. Y.—The Empire Lighting Company has been incorporated to furnish light, heat and electric power in all the towns and villages in Dutchess County. Capital stock is $100,000.

Chicago, Ill.—The Electromote Company has been chartered with a capital of $2,400 to manufacture and deal in electrical devices, etc. W. C. Jones, K. H. Eddington and C. B. Camp are directors.

Montpelier, Ind.—The Montpelier Light and Water Company has been incorporated with a capital stock of $50,000. The directors are: David A. Walmer, Alexander T. McDaniel, Joseph H. Shoemaker, William R. Page and Henry R. Brackin.

Easton, Pa.—The Consumers' Electric Light Company has been organized with the following directors: Jas. W. Correll, N. P. Cornell, H. S. Cavanaugh, Joseph S. Osterstock, John S. Osterstock and Lewis Rader, of Easton, and W. H. Walters, of Phillipsburg. The capitalization is $75,000.

Elizabeth, N. J.—The Hercules Motor Company has filed articles of incorporation with the county clerk here. The capital stock is placed at $25,000. The company will make and deal in electrical apparatus. Those named in

the incorporation papers are Charles G. Bliss, William I. Hester, of Pacific street, Brooklyn, and J. C. Wamar, of South Eleventh street, Newark.

Lockport, N. Y.—Articles of incorporation of the Lockport & Newfane Power and Water Supply Company have been filed at Albany; capital, $500,000. Directors named are: Henry J. Pierce and Burt Van Horn, of Buffalo; W. T. Ransom, John A. Merritt, H. L. Ransom and T. E. Ellsworth, of Lockport, and W. B. Rankine, of Niagara Falls. Stated objects are development and employment of hydraulic and electric power and supplying pure and wholesome water to cities, villages and towns in this country.

TELEPHONE CALLS.

Covington, Ky.—The Covington Home Telephone Company has been incorporated with a capital stock of $20,000.

Worcester, Mass.—The Citizens' Telephone and Telegraph Company has been formed, and will be incorporated under Massachusetts laws with a capital stock of $300,000.

Oklahoma City, O. T.—The Jefferson Telephone Company has been chartered with a capital of $20,000 to build lines in Oklahoma and Indian Territory, to compete with the Kansas & Missouri Telephone Company.

Ronceverte, W. Va.—The Great Briar & Organ Cave Telephone Company has been incorporated to do general telephone business, with a capital of $50,000. The incorporators are: M. A. Gates, J. H. Crawford, R. A. Level, B. F. Mann, A. E. Johnson, C. P. Nickell.

Salamanca, N. Y.—The Salamanca Telegraph and Telephone Company has been incorporated to operate throughout the counties in the western part of New York State, and to Bradford, Pa. Its circuits will include the cities of Rochester and Buffalo, as well as Salamanca. The capital is $10,000, and the directors are: Chas. R. Gibson, Edw. Bolard, Hudson Ansley and Chas. S. Fish, of Salamanca.

STREET RAILWAY NEWS.

Cleveland, Ohio.—The Portage Lakes Traction Company has been incorporated with $10,000 capital stock. David M. Glascock, Henry Lancefield T. S. Dunlap, Carl H. Nau and Chas. Stocker, incorporators.

NEW YORK NOTES.

MR. A. H. MUSTARD, manager, assisted by E. E. Goudy, of the Wagner Electric Manufacturing Company's Eastern office, at 26 Cortlandt street, are constantly on the alert for business and keep in close touch with their customers. A representative of this paper called upon them during the past week and found them engaged at the telephone, accepting an order for very nearly 100 transformers, ranging from 10 to 20 lights each. The Wagner Company's new volt, ammeters and wattmeters for alternating circuits and especially made for switchboard work are attracting unusual attention as the constantly increasing demand for them proves. These instruments are set in the switchboard in such a manner that only the face of the instrument is shown. Illustrations will be shown in our reading columns before long. The Wagner alternating generators are extremely popular and cannot be surpassed for high efficiency. They are made for all voltages and alternations.

THE KINSMAN BLOCK SIGNAL SYSTEM, on exhibition at 26 Cortlandt street, is superior in the preformance of its work to any operative system now in vogue. It is positive in its action and is operated by a dynmic current. It is being investigated by the foremost steam railroad men in the country, several of whom have signified their approval of the system and will have it installed on their roads before fall. Mr. Frank E. Kinsman, the inventor and designer of the above system, is a practical railroad man as well as an electrical and mechanical engineer of known ability.

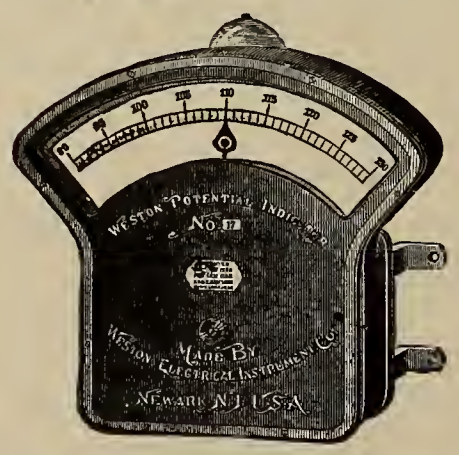
THE WEBBER ELECTRIC MANUFACTURING COMPANY, 66 Broadway, are exhibiting the only direct electric music sheet perforating machine in the world. It has been examined by a large number of electrical, machanical and musical experts, all of whom have expressed their approval in writing as to the ingenuity, skill and unique ability shown in the construction of so simple but practically operative a machine. Mr. Webber, the inventor and designer of this machine, is now completing the piano attachment for sheet music which will play the most difficult musical compositions in as natural a manner as though a performer were operating the keys. This is the only electrical attachment which operates the pedals and keys of the piano by means of the sheet music attachment. The operation of the above apparatus is as follows: A professional pianist plays the piano which is connected electrically with the sheet music attachment. The sheet is perforated automatically while playing and removed at the end of the composition. The perforated sheet is then placed in the piano attachment which then proceeds to reproduce the piece. This wonderful piece of mechanism must be seen to be appreciated and Mr. Webber invites experts to examine the same daily.

JENNEY CONSTRUCTION COMPANY, 26 Cortlandt street, installers of automatic fire protection for the home, fire escapes, fire extinguishers, etc., are sending out an attractive little booklet extolling the merits of the Montauk automatic fire detecting cable. The booklet contains a number of very flattering testimonials from prominent New Yorkers, testifying to their satisfaction with the cable. Among others there appears one from Mrs. Joseph Pulitzer, wife of the proprietor of the New York "World," expressing her approval as to the efficacy of the Montauk cable, as shown during the fire which destroyed her house in New York city. Mrs. Pulitzer states that over twenty lives were saved by the cable. Wire connections are made through the shafts or walls of a house with the locations which have been protected with the fire cable and an annunciator and large fire bells are placed on the sleeping floors. Automatically on the outbreak or threatened danger of fire, the cable which is operative at 200 degrees F. below the burning point of wood, causes the drop in the annuncitor to show the exact location of the fire and the bells to give warning to all the inmates of the house. A return postal is attached to the booklet which contains a request for a representative of the Jenney Company to call and show a practical demonstration of the Montauk fire detecting cable.

W. T. H.

WESTON STANDARD ILLUMINATED DIAL

STATION INSTRUMENTS.



THESE INSTRUMENTS are based upon the same general principle and are just as accurate as our regular Standard Portable Direct Current Voltmeters and Ammeters, but are much larger, and the working parts are inclosed in a neatly designed dust-proof cast-iron case, which effectively shields the instruments from disturbing influences of external magnetic fields.

WESTON ELECTRICAL INSTRUMENT CO.

114-120 William St., Newark, N. J., U. S. A.

BERLIN. European Weston Electrical Instrument Co. Ritterstrasse No. 88.

LONDON. Elliott Brothers, No. 101 St. Martins Lane.

The Electrical Age.

Vol. XXV—No. 25. NEW YORK, JUNE 23, 1900. Whole No. 684.

Novel Applications of Electricity.

Elevator Installed in Blooomingdale Brothers, 59th Street & 3d Avenue, New York.

THE RENO INCLINED ELEVATOR.

A great transformation is impending with respect to the new stairways which the people of this age will in all probability enjoy. History, at least as far as invention is concerned, does not repeat itself but makes progress of a definite character. But there is this to be said, that the simplest device after passing through various changes will ultimately, by the natural processes of evolution, return again to its simplest forms. The lake dwellers of Switzerland, living at a period when Europe gave evidence of being inhabited by mammoths and cavebears, this race of men were among the first to make use of an inclined plane in the manner of a stairway. From a most humble origin, dating from this pre-historic age, the stairway developed, either from the inclined plane or a rude form of ladder.

The latest invention in reference to the above is to be found in the Reno inclined elevator which is to all appearances a moving inclined plane or, as some choose to call it, a moving staircase. Viewed impartially it is certainly a valuable addition to our present mode of locomotion up and down stairs for the reason that progress is not made individually but collectively; the part composing the walk or stairway moving with a uniform speed can carry its full quota of passengers without overcrowding because of the fact that those at the upper end merely step off while those at the lower end step on. In this way a transferance is almost unconsciously made without haste or jolting or inconvenience of any description to the passenger.

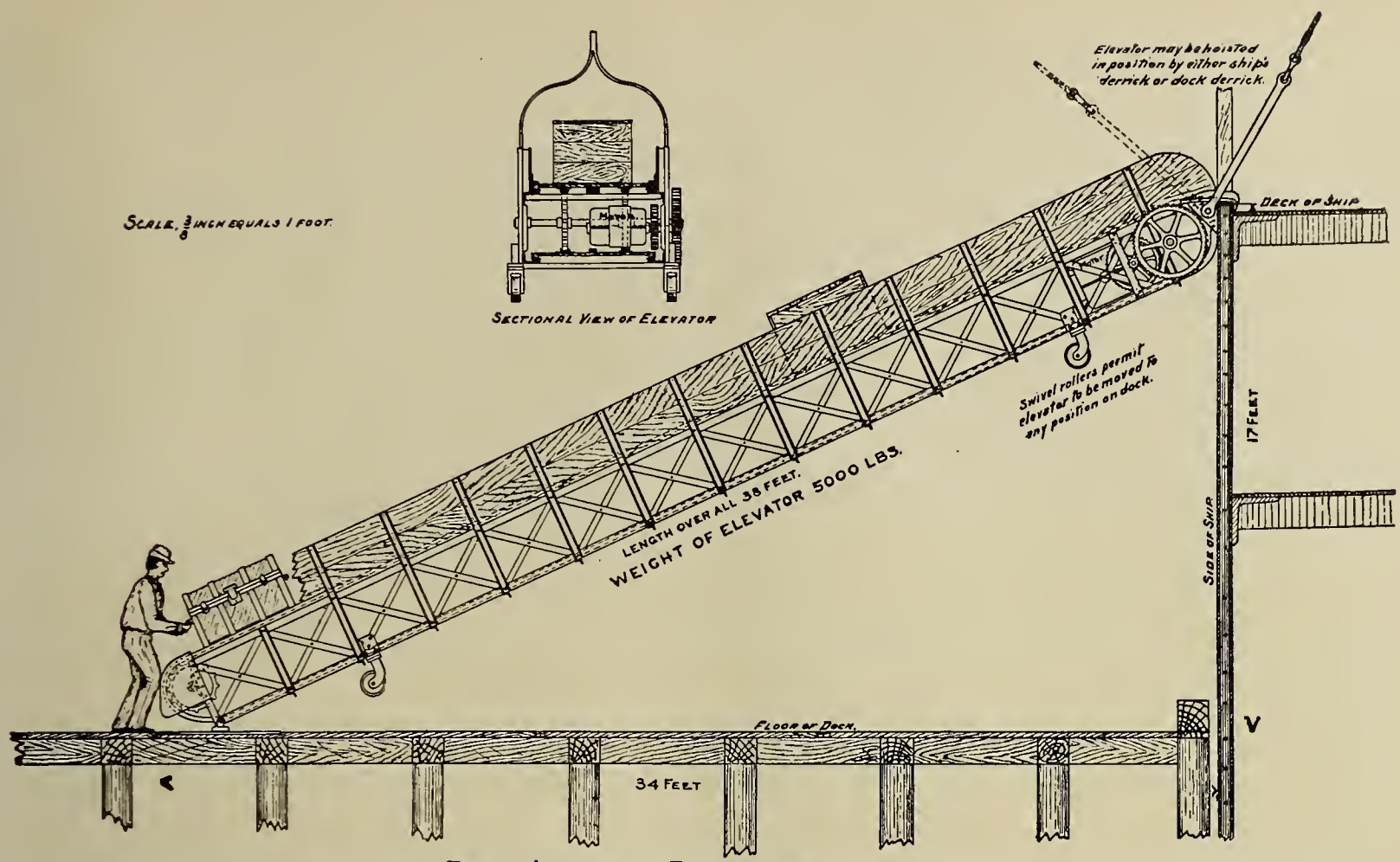
In the various illustrations are shown applications of

the Reno inclined elevator of a popular and practical nature. It is evident from the sectional sketch that it is simple in construction and operates on the principle of an endless chain passing around two geared wheels and driven by electric motors, which in this particular case are of the C. & C. enclosed type. The use of these elevators is, of course, not limited to the transferance of passengers from floor to floor merely but finds its uses for carrying freight, such as packing cases, barrels and other heavy bundles of merchandise. For this purpose it is of great value not only in department stores but for loading and unloading steamships, for large warehouses and factories. From a purely technical standpoint it has many attractive features. It is inexpensive to operate, is simple in construction, is very durable, the simple motion involved causing but little wear or tear.

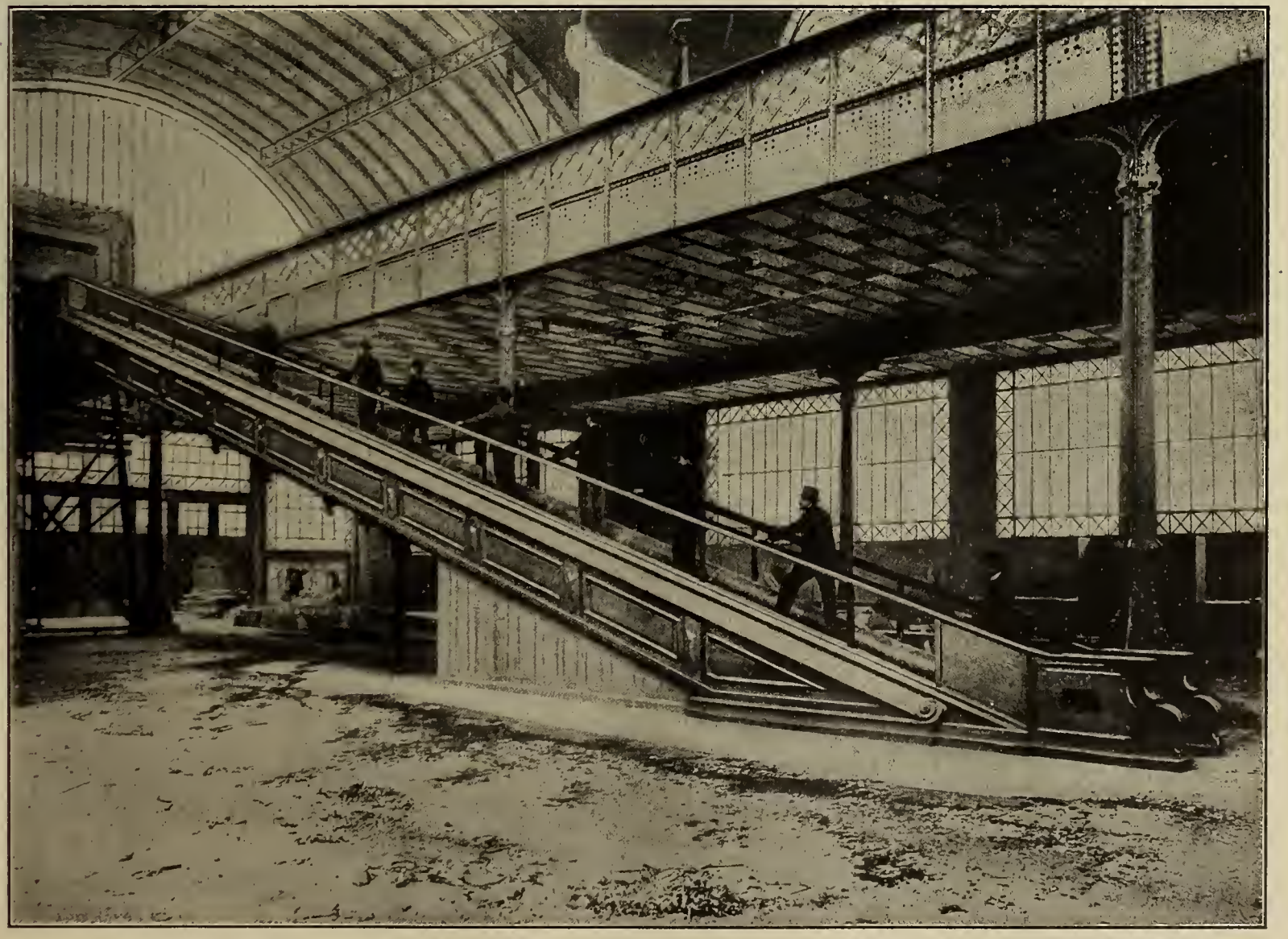
The passenger elevator requires no attention whatsoever and operates noiselessly. The balustrade is made to move at the same rate of speed as the staircase, thereby preventing danger of any description from a miscalculation on the part of a passenger. The handrail is covered with flexible rubber and seems to the passenger riding on the incline to be motionless. In fact, the operation of this stairway is far superior to that of the elevator proper which with its ever present possibilities of accident is in many cases unsafe in crowded department stores. The endless tread chain composing the moving stairway is driven through the medium of a sprocket wheel by a direct connected motor, running at 650 revolutions per minute. By means of a reduction gear this is further reduced to fourteen revolutions per minute at the driving sprocket, giving a total speed to the stairway of about ninety feet per minute which is approximately the rate at which progress can be conveniently and comfortably made. This speed can be increased, though experiment and experience have shown that a higher rate is not desirable on account of the difficulty of gaining inertia in stepping from the stationary floor to the moving inclined plane and back again from the moving plane to the upper floor.

"The elevator, when intended for single file service, is three and one-half feetin width; for double service five and one-half feet; and is built at an angle of twenty-five degrees. The structure consists of a steel frame work bolted at the top to the steel floor beam or header in the building and similarly supported at the bottom. Near the middle it is supported by a steel column, the weight at that point being about 2,100 pounds. The moving incline consists of a series of hardwood slats or treads of a special form. These slats have fastened to them a series of rubber covered longitudinal ridges, each being three-quarters of an inch wide, one-quarter of an inch high and one inch apart, serving as a secure and comfortable footing for passengers. The landing of passengers is accomplished as follows: the feet of the passenger resting upon these rubber covered ridges are impercepti-

Reno Inclined Elevator Installed in Department Store.



RENO INCLINED ELEVATOR
FOR TRANSPORTING PACKAGES ECT FROM DOCK TO SHIP AND VICE VERSA.
CAPACITY-50 PACKAGES PER MINUTE



One of Five Inclined Elevators Installed in the Paris Exposition.

bly slid off as they arrive on a comb shaped landing, consisting of cast iron prongs fitting into the groves separating the ridges. The transferance is thus made from the moving plane to the floor in a simple, gradual and agreeable manner. Experiments have been made to prove the efficiency of the machine in this respect and it has been found impossible to catch even cotton waste between the moving plane and stationary support."

The Reno Inclined Elevator Company of New York city, with works at 556 West 34th street, make six styles of inclined elevators, as follows: with right hand moving rail, with left hand moving rail, with double rail, with right and left hand moving rail, double rail with right and left hand moving rail for double file of passengers, duplex, carrying passengers in both directions, and the freight machine. Five of the double moving hand rail machines are now in use in the Main Exhibition Hall at the Paris Exhibition. The office of the above company is at 141 Broadway, New York city.

Lighting Measurements.

(Concluded from page 190.)

PHOTOMETRIC VALUES OF ARC LAMPS.*

Comparing the average performance of the lamps in the first series of tests with the average performance of the lamps in the second series of tests, one finds very nearly the same power consumption per light unit, viz.:

	D.C.	A.C.
Clear outer	2.66	2.62.
Opalescent outer	3.04	3.20

The difference is slightly in favor of the alternating current lamp in the first case, and somewhat more in favor of the direct current lamp in the second.

To compare the direct current lamp with the alternating current lamp on the basis of mean spherical intensity is not always fair. When an outer diffusing globe is used, this basis of comparison is correct enough for the reason that the distribution of intensity is fairly constant in all directions, both for the direct and alternating current types.

For outdoor use, however, lamps will be provided with inner globes only, or clear outer globes, or shades, as the case may be. In any event, the upward luminous flux which passes the globes or shades is practically of no utility. Hence, for outdoor use, the mean hemispherical intensity below a plane passing through the arc is a better basis for comparison.

Now, the average direct current lamp in this series of tests yields a mean hemispherical intensity of 273 H. U., with clear outer globe. The average alternating current lamp yields but 190 H. U. This gives the former an advantage as a useful light source represented by the ratio of 83:190, or 43.7 per cent. Moreover, the power required per unit intensity is in the two cases 1.97 watts and 2.19 watts per mean hemispherical H. U. So that not only does the direct current lamp with clear outer globe give a stronger mean intensity below the arc, but it does so at a higher efficiency. But it is wasteful to use an alternating current lamp for street lighting without a shade or reflector. The tests on lamps 102 and 106 enable one to draw certain interesting comparisons, They give mean hemispherical intensities respectively of 266 and 254 H. U., or very nearly the same as the aver-

transmitted. So that though a given cord may be properly loaded for some wave-length it will not be properly loaded for shorter wave-lengths. It is impossible to load a cord in such a way as to make it equivalent to a uniform cord for all wave-lengths; but if the distribution of the loads satisfies the requirements of a given wave-length it will also satisfy them for all longer wave-lengths. It should be observed now that the wave-length which is considered here is not the wave-length of the age direct current lamp with clear outer. This yield is obtained at a power consumption of only 418 watts, which is 1.61 watts per H. U. This emphasizes the great importance of a shade on the alternating current lamp. Finally we may compare this last result with the performance of direct current lamp No. 1, with no outer globe and no shade. Here the mean hemispherical intensity is 362 H. U., the power consumption 558 watts and the power per H. U. 1.54 watts. The conclusion based on this single comparison is that for street lighting the direct current lamp without shade gives 39 per cent. more useful light than the alternating current lamp with shade and at slightly greater economy. The accompanying table gives the summarized results of the preceding investigations. It is to be noted that lamps numbered 1 to 12 are direct current lamps and lamps numbered 101 to 110 are alternating current:

Number.	Current.	Watts Consumed In Lamp.	Watts Consumed In Arc.	Watts Consumed Mechanism.	Mean Intensity in H. U. Spherical. Opal Outer.	Mean Intensity in H. U. Spherical. Clear Outer.	Mean Int. in H.U. Lower Hemisphere Clear Outer	Mean Watts per Spherical H. U. Opal Outer.	Mean Watts per Spherical H. U. Clear Outer.	Mean Watts per Lower Hemispherical H. U. Clear Outer.
1	5.01	551	401	150	172	235 256*	332 362*	3.10	2.37 2.18*	1.66 1.52*
3	5.08	559	406	152	195	216	282	2.85	2.60	1.99
4	4.76	524	381	143	127	139	208	4.12	3.76	2.52
5	1.16	458	333	125	154	174	221	2.96	2.63	2.07
7	4.76	524	381	143	203	233	317	2.63	2.20	1.65
9	4.84	532	387	145	182	226	281	2.83	2.38	1.89
10	4.99	549	399	150	202	242	309	2 74	2.24	1.77
12	4.87	536	390	146	178	195	230	3.05	2.66	2.33
M.	4.9	529	384	144	176	207	272	3.03	2.60	1.98

			Power Factor Lamp		Power Factor Arc.						
101	6.40	448	.63	340	.82	108	127	141	206	3.52	3.17	2.17
102	6.79	459	.61	375	.73	84	146	203 176†	236 266†	3.31	2.26 2.60†	1.94 1.72†
103	5.89	424	.65	344	.75	80	116	130	147	3.66	3.15	2.88
105	6.20	414	.61	382	.80	32	128	187	219	3.24	2.20	1.89
106	6 12	378	.56	298	.70	80	132	153 152†	169 254†	2.82	2.56 2.49†	2.23 1.48†
108	6.48	457	.64	383	.80	74.5	133	175	211	3.30	2.61	2.16
110	6.18	339	.49	276	.72	63	140*	126	143	2.41*	2.68	2.37
M.	6.29	417	.60	342	.76	74.5	130	159	190	3.31	2.66	2.23

*Abstract of report of N. E. L. A. Committee to investigate photometric values of arc lamps.

*Condition of no outer globe. **Condition with shade on lamp.

Note.—All marked values not included in the mean (M).

Telephony.

TELEPHONY OVER CABLES AND LONG DISTANCE AIR LINES.*

BY DR. M. I. PUPIN.

(Continued from page 188.)

Mr. Oliver Heaviside, of England, to whose profound researches we owe most of our mathematical theory of electrical propagation, was the originator and most ardent advocate of wave conductors of high inductance. His counsel did not seem to prevail as much as it deserved, certainly not in his own country. I trust that the physical view of attenuation described above in the terms of the dissipation of energy which is transmitted over the wire will help to elucidate Mr. Heaviside's theory of high-inductance wave conductors.

Wave Propagation over Non-Uniform Conductors.—But Mr. Heaviside's proposition to employ wave conductors of high inductance contained a serious difficulty which his mathematical theory was not capable of overcoming. The difficulty is this: How can a wave con-

The Electrical Age.

ESTABLISHED 1883.

Entered at New York P. O. as second-class matter, January 18, 1891.

THE ELECTRICAL AGE PUBLISHING CO., Publishers.

TERMS OF SUBSCRIPTION:

One Copy, one Year,	$2.50
One Copy, six months,	1.25
Great Britain and other Countries,	3.50

Cable Address (all Cables), "Electage," New York.

NEWTON HARRISON, E. E., EDITOR.

ASSOCIATE EDITORS:

ALFRED E. WIENER, E. E., } ELECTRIC LIGHT AND POWER.
OSBORNE P. LOOMIS, E. E., }
JOSEPH MUIR, M. D., } ELECTRO-
FREDERICK STRANGE KOLLE, M. D., } THERAPEUTICS.

ADDRESS ALL COMMUNICATIONS TO

THE ELECTRICAL AGE PUBLISHING COMPANY,

Seventh Floor, World Building,

NEW YORK.

NEW YORK, JUNE 23, 1900.

CONTENTS:

THE ELECTRIC LIGHTING OF PRIVATE RESIDENCES.

It is manifestly impossible to anticipate the system of electric lighting which will be used in private residences. To light one's home, not as a mere matter of experiment, but with the intention of making it an economical and convenient practice is a proposition inherently interesting. It is strange to realize the efforts that are being made by concerns manufacturing small gas, gasolene and acetylene plants, to impress the general public with the direct benefit in money and convenience of such installations. Electric lighting in private residences is to us as important a problem as the illumination of homes by the above mentioned material is to those representing such interests. Domestic electric light plants at this late hour should be as familiar a feature of kitchen economy as the ice cream freezer or the gas stove. Strange to say, the interest taken by electrical engineers in this exceedingly broad and profitable enterprise is rather limited in its nature. In all probability the reason is due to the absence of a small motor, the construction of which would be so simple or at least so perfect that Bridget could be left in full charge of the apparatus. Electrical men believe that the public must be educated up to certain improvements, and learn how to use them, but this is a mistake. Engineers must be educated up to the demands of the general public and learn to accommodate them. This would save us from tons of complicated and useless machinery, which is theoretically valuable and interesting, but in practice is found to be unreliable and a general nuisance.

The three plans worthy of consideration for electric lighting in our homes are as follows: First, the use of electricity from the street circuit; second, the introduction of small electric light plants for individual lighting; third, the installation of a block system. The sale of staple articles encourages us in the idea that the sale of electricity by large central stations is in perfect harmony with modern practice. But it will only be profitable to the general masses when the price of such power will meet all criticisms and remain unaffected by it. In this respect, the price of staple articles, among which electricity will soon be considered, naturally sinks to a certain figure, generally allowed as correct and approved of by the public. In consequence of this it is but a question of time to wait until this fair price is established. On the other hand, the introduction of small electric light plants is practical and may prove to be profitable, provided the saving brought about by their use will cover the cost of two or three years' illumination otherwise obtained. Referring for a moment to the block system of electric lighting, a system in which a miniature central station is established in the yards of a city block and from which power may be obtained to light all the houses surrounding it, this system, let it be understood, possesses obvious advantages. It might be regarded as one of the outcomes of communism or merely as an effort on the part of bread winners composing a city block to co-operate for the purpose of lighting their homes in their own way and at their own expense.

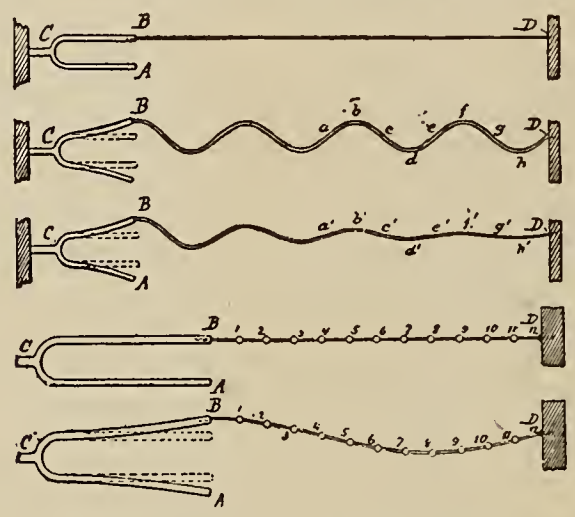
To illustrate, take a square block of city houses, numbering about fifty, let them average about ten lights apiece or a total of five hundred lights. A bill against each of $100 a year for lighting would not be considered exorbitant. At this rate the annual receipts would be $5,000. The cost of fuel and the expense of running the plant would amount to $2500. Allowing $2,500 for the plant itself, and a little wiring, would mean a complete financial balance at the end of the year of cost of installation and running expenses against the cash receipts. The second year, allowing the expense of running to equal $3,000, the cost per residence for electric lighting would average only $60, from which sum ten lights could be run eight hours a day, every day in the year. A private plant would take longer to pay off, but it seems as though it were no more sensible to pay rent for the use of furniture or necessary articles of home use than to pay for either light or power in the home. A well-designed gas or kerosene oil engine, direct connected to a small generator of about two horse-power size, costing, say, $300, would pay for itself in the course of two years, and be acceptable to 50 per cent. of the owners of private residences. To people of moderate means the proposition is certainly an interesting one, and of prime importance, if time and a slight degree of labor are freely given as the full equivalent of what may be thereby saved.

A GERMAN ELECTRIC HAULAGE PLANT.

At the Altenwald coal mines, in the Saar district, the water from an upper level is used for working a 24-H.P. Girard turbine, the horizontal shaft of which drives directly a shunt-wound dynamo which, with 480 revolutions per minute, gives out 13 kilowatts at a tension of 440 volts. The current is led to a cross-cut, where, at a distance of about 600 m. from the shaft, a 12-H.P. electromotor drives, by spur gear, an endless-rope haulage plant on gradients varying from 2 degrees to 8 degrees, conveying from 250 to 300 tons for a distance of 1,200 m. This plant has given complete satisfaction from both a technical and economical standpoint.

ductor be constructed so as to have a high inductance? Ordinary circuits can be endowed by as much inductance as may be required by simply introducing a coil of proper dimensions, with or without an iron core, into it. But this will never do in the case of a wave conductor; for a coil introduced that way will act by reflection as a barrier to electrical waves. Wave propagation experiments over long-wave conductors containing a certain number of coils in series at periodically recurring points have actually been tried by telephone engineers; the results obtained have invariably proved most disappointing. I shall return to this point later on in connection with the description of experiments given further below. Suffice it to state here that all attempts to increase the introduction of inductance coils at periodically recurring points failed, because they had no mathematical theory to guide them so as to avoid the difficulties of wave reflection by inductance coils introduced that way. It is hardly worth while to enter here into a discussion of the many other attempts at increasing the inductance of a wave conductor by devices which had neither theory nor experiment to recommend them. In fact, most of them were absurd on the face of it.

The first mathematical theory dealing with wave propagation over conductors of this kind was presented by the author before this Institute on March 22, 1899.



Figs. 1, 2, 3, 4 and 5.
Wave Transmission on a Loaded Cord.

The main features of this theory are extremely simple and can be explained by a simple mechanical illustration. Consider the arrangement of Fig. 1. A tuning fork has its handle C rigidly fixed. To one of its prongs is attached a flexible inextensible cord B D. One terminal of the cord is fixed at D. Let the fork vibrate steadily, the vibration being maintained electro-magnetically or otherwise. The motion of the cord will be a wave motion. If the frictional resistances opposing the motion of the cord are negligibly small the wave motion will be approximately that of stationary waves as in Fig. 2. The direct waves coming from the tuning fork and the reflected waves coming from the fixed point D will have nearly equal amplitudes, and by their interference form approximately stationary waves. If, however, the fractional resistances are not negligibly small, then there will be dissipation of the propagated wave energy. Hence the direct and the reflected waves will not have equal amplitudes, and, therefore, their interference will not result in stationary waves. The attenuation of the wave is represented graphically in Fig. 3. Experiments will show that other things being equal increased density of the string will diminish attenuation, because a larger mass requires a smaller velocity in order to store up a given quantity of kinetic energy, and smaller velocity brings with it a smaller frictional loss. This is a striking mechanical illustration of a wave conductor of high inductance. It should be observed here that an increase of the density will shorten the wave-length.

Suppose now that we attach a weight, say a ball of beeswax, at the middle point of the string, in order to increase the vibrating mass. This weight will become a source of reflections and less wave energy will reach the point D than before. The efficiency of transmission will be smaller now than before the weight was attached. Subdivide now the beeswax into three equal parts and place them at three equidistant points along the cord. The efficiency of the wave transmission will be better now than it was when all the wax was concentrated at a single point. By subdividing still further the efficiency will be still more improved; but a point is soon reached when further subdivision produces an inappreciable improvement only. This point is reached when the cord thus loaded vibrates very nearly like a uniform cord of the same mass, tension and frictional resistance. Such a loaded cord with a tuning fork attachment is represented in Fig. 4.

If an increase in efficiency of wave transmission over a cord thus loaded is to be obtained, it is evident that the load must be properly subdivided and the fractional parts of the total load must be placed at proper distances apart along the cord, otherwise the detrimental effects due to reflections resulting from the discontinuities thus introduced will more than neutralize the beneficial effects derived from the increased mass.

The problem of finding the proper distance at which the loads should be placed is a definite mathematical problem of Analytical Mechanics, but unfortunately it was never solved. Fig. 5 represents a cord carrying loads at proper distances apart. Experiments with cords of this kind will soon convince one that the distance between the loads should be considerably smaller than one-half of the wave-length of the wave which is to be cord without the loads, but the wave-length which the frequency under consideration will have on the properly loaded cord, or what is the same thing, on a uniform cord of the same mass, tension and frictional resistance as the loaded cord. This point is of fundamental importance, for the wave-length corresponding to a given frequency may, and generally will be, much shorter on the loaded cord than on the cord without the loads.

A cord of this kind is a mechanical analogy to an electrical wave conductor. The mathematical wave conductrical wave conductor.

The mathematical law in accordance with which such a cord moves is the same as that in accordance with which the electrical current is distributed over the wave conductor under the action of similar forces. The reason for that is not far to seek. We have the same reactions in both cases, viz.: Kinetic or mass reaction, tensional reaction and resistance reaction in the case of the cord. Electro-kinetic reaction, capacity reaction and ohmic resistance in the case of the wave conductor. The mathematical form of these reactions is the same in both cases, hence one is an exact analogy of the other.

(To be continued.)

DIRECT-CONNECTED TRIPLEX PUMP FOR SIAM.

Electric power is being extensively employed in operating pumping machinery, not only for mines, municipal water supply, office and hotel buildings, general manufacturing plants, hydraulic elevators, condensers, house supply, but also for boiler-feeding purposes. The three-throw type of triplex pump is receiving consideration for the reason that it is asserted that the continuous discharge resulting from this type of pump and the consequent decreased vibration throughout the delivery system are more advantageous for the motor than types heretofore used. Owing doubtless to these advantages, Mr. G. W. Dickie, designer of the battleship Oregon, recommended in a paper read for the 1899 annual meeting of

Batteries.

THE "NEW STANDARD" DRY BATTERY.

The story which Mr. William Roche, the noted dry battery manufacturer of 42 Vesey street, New York city, tells in his little pamphlet, entitled "Of Interest to Battery Users," is an interesting one and shows the result of patient, painstaking labor, diligent study and ceaseless experiment. In 1899 he discovered a formula for the manufacture of dry cells which revolutionized battery-making and has since practically eliminated the wet battery. Notwithstanding that in less than seven years more than 1,250,000 dry cells made according to that formula were marketed, with demand for them rapidly increasing, Mr. Roche was satisfied that still further developments were possible and therefore kept on experimenting.

In the summer of 1897 he discovered an improvement on the old formula with which he obtained results he had never dared to even hope for. He then determined to go into the dry cell manufacturing business for himself, to reap the full benefits of his own discoveries. The wisdom of this decision and the success of the "New Standard" dry batteries may be judged from the fact that in twenty-five months he has marketed more than 900,000 cells, of a quality never before equalled.

All material used in these batteries is carefully inspected and tested before being accepted. The cells will not run down while on the shelf, neither will they flow at the top after being used a short time. They will not bulge nor is there any local action when the cell is not in use.

Besides the "New Standard," which is made in seven different sizes, Mr. Roche manufacturers the "Navy Special," "Gas Engine Cell," "Automobile Cell," and special sizes of any shape, as may be required. The "Navy Special" is the cell which was used so successfully by the U. S. Navy during the late war and was highly recommended by the Navy Department. The "New Standard" dry cell is particularly adapted for electro-medical apparatus, dental surgery, gas lighting, gas or gasolene engine ignition, railroad signals, burglar alarms, automobiles; in fact, it is the cell for all open circuit work. Mr. Roche now occupies three floors at No. 42 Vesey street, and has just closed a long lease for the entire building.

"New Standard" Dry Batteries and Novelties.

Patents.

WEEKLY ELECTRICAL PATENT RECORD.
PATENTS ISSUED JUNE 12, 1900.

Conducted by Otto Greenberg. Complete descriptions and drawings of any patent mentioned below will be sent upon receipt of ten cents.

651,336. Electric Railway Axle. Henry M. Brinckerhoff and James S. Doyle, Chicago, Ill.

651,342. Commutator-Truing Device. Edgar D. Carr, Akron, Ohio.

651,343. Electric Railway. Theophilus P. Chandler, Philadelphia, Pa.

651,350. Electric Railway. William Grunow, Jr., Bridgeport, Conn.

651,361. Electric Telegraph. Isador Kitsee, Philadelphia, Pa.

651,362. Space Telegraphy. Isidor Kitsee, Philadelphia, Pa.

651,363. Method of Transmitting Electric Impulses. Isidor Kisee, Philadelphia, Pa.

651,469. Dental Motor. Oscar H. Pieper and Alphonse F. Pieper, Rochester, N. Y.

651,471. Electrode for Secondary Batteries. Paul F. Ribbe, Charlottenburg, Germany.

651,472. Electrical Appliance for the Cure of Deafness. William J. Tindall, New York, N. Y.

651,473. Electric Light Dimmer. Frank E. Woodford, Appleton, Wis.

651,476. Secondary or Storage Battery. Owen T. Bugg, Jr., New York, N. Y.

651,483. Pipe for Conduit for Electrical Conductors. Edwin T. Greenfield, New York, N. Y.

651,484. Junction-Box for Electrical Conductors. Edwin T. Greenfield, New York, N. Y.

651,494. Feeding Mechanism for Films in Kinematographs. Vilhelm Pacht, Copenhagen, Denmark.

651,498. Electric Arc Lamp. Emile Bonhivers. Lenallois-Perret, France.

651,524. Electric Railway. August Casazza, Hoboken, N. J.

651,540. Automatic Telephone Switch. Robert T. Watt, Laurel Springs, N. J.

651,545. Telegraphic Transmitting Device. John Gardner, Knott End, England.

651,561. Switch for Overhead Trolley Tracks. Paul F. Werner, Springfield, Mass.

651,575. Trolley. Frank A. Merrick, Johnstown, Pa.

651,595. Electric Switch. William Ely, Providence, R. I.

651,597. Electric Welding. Richard Syre, Johnstown, Pa.

651,602. Brake Mechanism for Electric Railway Cars. Frank W. Garrett, Johnstown, Pa.

651,610. Machine for Covering Wires or Cables with Loose Fibres Suitable for Insulation. Franklin S. Randall, Wilkes-Barre, Pa.

651,664. System of Electrical Distribution. Albert S. Hubbard, Belleville, N. J.

651,672. Electric Elevator. Alonzo B. See. New York, N. Y.

651,680. Electric Battery Attachment. Henry B. Ware and Chauncey C. Cornell, Wymore, Neb.

651,695. Contact for Incandescent Lamp Bases, etc. Waldo C. Bryant, Bridgeport, Conn.

651,697. Electric Current Shunting Device. Edward R. Cliff, New York, N. Y.

651,718. Method of Electrically Treating Ores of Nickel, etc. Henri Leleux, Paris, France.

651,733. Electric Arc Lamp. William F. Wegner, West Superior, Wis.

651,771. Electrical Measuring Instrument. Ernest C. Rimington, London, England.

651,777. Electro-Therapeutic Apparatus. Fred H. Brown, Chicago, Ill.

Business News.

NEW YORK NOTES.

THE J. JONES & SON COMPANY, manufacturers and dealers in general electrical supplies, 64 Cortlandt street, have just issued catalogue No. 10, copies of which will be mailed upon request. It contains illustrations and prices of the various supplies which they handle and keep in stock—electric bells, annunciators, general electric house furnishings, telegraph instruments, batteries, etc., and altogether reflects great credit upon the literary department of the above company.

THE BARSCHALL IMPREGNATING CO., with offices at 31 Nassau street, and works at Perth Amboy, N. J., are sending out a treatise on wood preservation, which ought to be of special interest to telephone, telegraph, electric light, power and railway engineers, as it contains a full and complete description of the Hasselmann patents for the preservation of wood. Descriptions of tests made with impregnated and non-impregnated poles are given.

OUR REPRESENTATIVE met Mr. N. P. Otis, of the noted firm of elevator builders, Otis Brothers & Company, some six weeks ago at 23d street and 6th avenue, examining the L road station in order to find out the best method of installing their moving stairway, contracts for which have since been awarded to them. The steps, running on an inclined plane, will be level instead of inclined, as in the present inclined stairway. The offices of the above company are at No. 145 Broadway.

MR. A. H. GRANGER has taken charge of the eastern department of the Shelby Electric Company, of Shelby, Ohio, manufacturers of the noted Shelby incandescent lamps. The offices are located at 145 Broadway.

THE CONTRACT FOR ALL of the electric heaters to be used on the Boston Elevated Railway Company has just been awarded to the Gold Car Heating Company of New York city. This is one of the largest orders for electric heaters that has ever been placed, and includes in addition to the elevated equipment an order for one hundred and fifty sets of car heaters. The elevated cars are to be fitted with the Gold Standard electric heaters and the street cars will be equipped with the Gold panel electric heaters. Before awarding this contract the Boston Elevated Railway officials made very extensive tests of electric heaters furnished by five different car heating companies, so that their decision in favor of the Gold heater means a great deal for the Gold Car Heating Company. W. T. H.

ELECTRICITY ON THE L ROAD.

At a meeting of the Executive Committee of the Manhattan Railway Company, held June 12, several contracts were approved which practically complete the apparatus necessary for the central power station at Seventy-fourth street and the East river.

The final report of the company's experts on the question of car equipment was considered and the committee directed the adoption of what is known as the double-end system, a motor car on each end of trains, equipped with four motors sufficiently powerful to haul six-car trains.

Contracts were authorized for an electric stairway at Fifty-ninth street and Third avenue, and for one of another type at Twenty-third street and Sixth avenue; these to be followed, after trial, at other important stations by whichever seems to best meet the public needs.

WESTON STANDARD

PORTABLE DIRECT READING

VOLTMETERS

AND

WATTMETERS

For Alternating and Direct Current Circuits.

The only standard portable instrument of the type deserving this name.

Write for our Catalogue of Portable Instruments.

WESTON ELECTRICAL INSTRUMENT CO.,

114-120 William Street, Newark, N. J.

BERLIN. European Weston Electrical Instrument Co. Ritterstrasse No. 88.

LONDON. Elliott Brothers, No. 101 St. Martins Lane.

The Electrical Age.

Vol. XXV—No. 26. NEW YORK, JUNE 30, 1900. Whole No. 685.

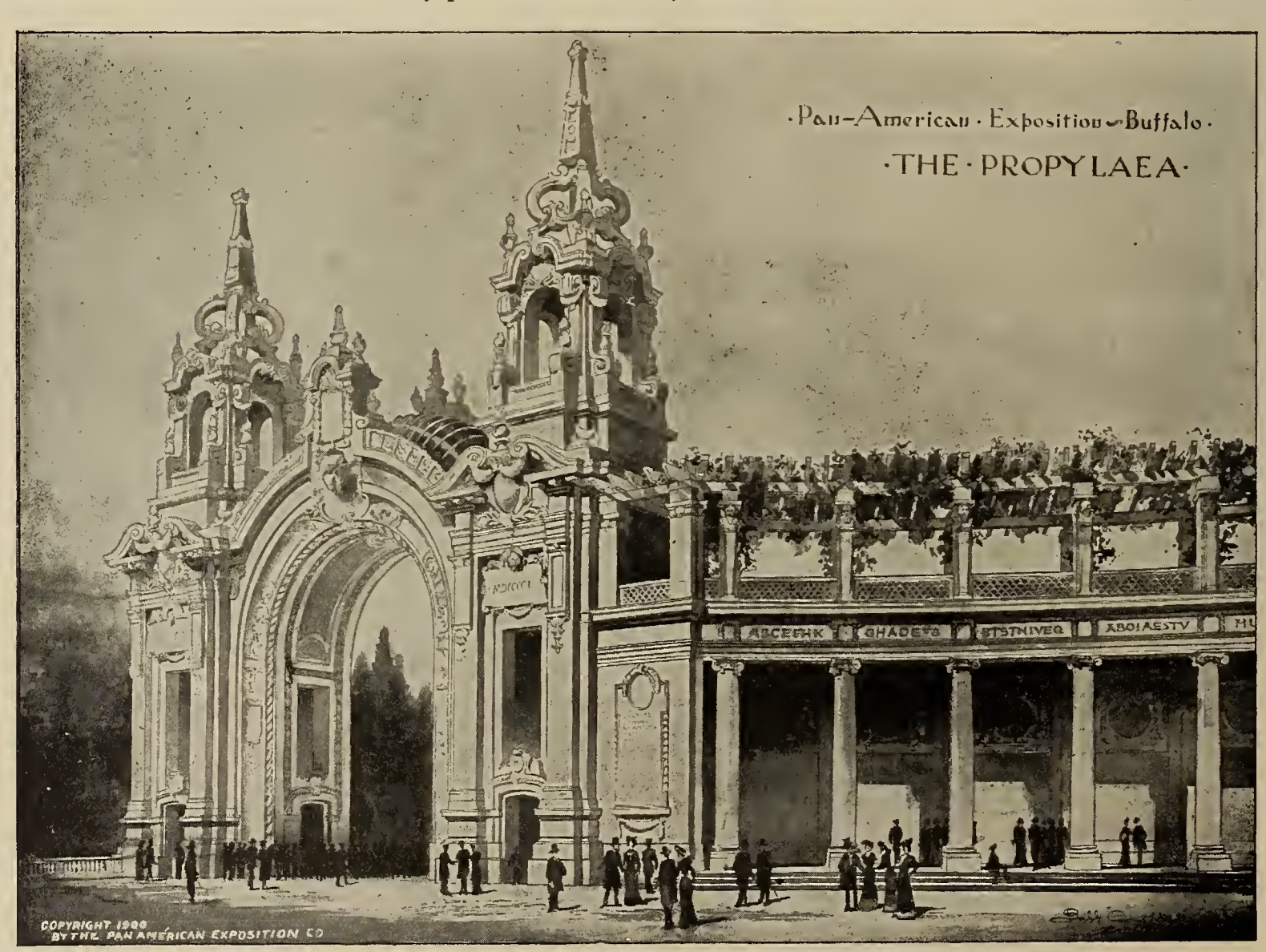
Expositions.

THE PAN-AMERICAN EXPOSITION.

Work on the Pan-American Exposition, which is to be held in Buffalo from May 1st to November 1st, 1901, is progressing very rapidly and the management promises to have a complete show ready by the time the gates are ready to be thrown open to the public. Buildings are being erected, canals cut, wires strung, etc., and the opening ceremonies will be in marked contrast to those held at the Paris Exposition, which even now is still in a state of choas.

The importance of the great Falls, Rapids and Gorge of the Niagara River as auxilaries to the many and varied attractions cannot well be overestimated. In its immense flow of waters, its grand scenery and its historic lore, the Niagara is one of the most renowned rivers of the world. Its great cataract has defied the descriptive powers of poets and philosophers and baffled the delineative skill of painters and photographers. The grandeur of their environment renders the Falls per-

ennially interesting in all seasons of the year and very few of those who visit the Pan-American Exposition but will desire also to visit them. The trip from Buffalo can be made in half an hour. There are many points of view and places of interest and the visitor can plan his itinerary according to the leisure time at his disposal. If time will permit, the cataract should be viewed from both sides of the river and trips should be made the length of the Gorge, either along the cliffs above or over the trolley road which runs close to the water's edge. Perhaps the most comprehensive near-views of the Falls are those obtained on the Canadian side of the Gorge, especially



that from Falls View station. Here is seen a complete panorama, embracing the rushing and turbulent currents of the upper rapids and the whole sweep of the falling waters, reaching from end to end nearly four-fifths of a mile, with the great Horseshoe Falls in the foreground separated by Goat Island from the American Fall, which is 158 feet high, and 1,881 feet wide. In the river below plies the little steamer "The Maid of the Mist," carrying visitors close to the foot of the Falls at various points and affording splendid views of the descending waters. The State Reservation on the American side and Queen Victoria Park, across the river in Canada, are delightful observation grounds, both open for the enjoyment of the public free of any charge. To the scientific visitor the electrical power development at the Falls will be especially interesting. On the American side there are two great corporations utilizing the current of the Niagara river for developing electric power used in many industries at the Falls. The power thus generated by one of these corporations is also transmitted to Buffalo, twenty-five miles distant, for use for the electric lighting of the city, for operating a great electric trolley car system and in many important manufacturing establishments. The power thus transmitted will likewise be extensively used for the purpose of the Exposition.

Automobiles.

A NEW STYLE OF AUTOMOBILE.

There is probably no machine more attractive to the public mind at the present time than the automobile. As a recent addition in this line, the patent granted to John Ponder, of Brunswick, Victoria, Australia, is interesting. The invention relates particulary to the driving mechanism, and provides a construction which has neither chain nor leather belts, nor continually rotating sprocket wheels. It is operated by an explosive-engine, in which oil is the actuating agent, and is so constructed that it is applicable to any class of conveyances. All the parts are accurately balanced to reduce the vibration to a minimum, and the explosions, of which there is one to each revolution of each opposite pair of cranks, are absorbed by two pistons in each cylinder. The explosive mixture is electrically ignited, and by a simple system of crank levers and connecting rods, a variable speed transmisson gear is obtained which is most effective in action. From it can be communicated to the main driving axle all speeds of variations of the same from zero to any predetermined maximum without in any way altering the speed of the motor. The maximum power for hill-climbing and rough roads, as also all changes of speed, is obtained by the movement of one lever by the driver. By a special form of clutch-box secured to the main or driving shaft, a rotary motion is imparted to the said shaft from a reciprocator slide moving along the engine-frame. By this mechanism heavy loads or steep upgrades are treated without any unusual labor, since the power transmitted from the motor can be regulated by a rocking lever. The wheels are so arranged upon their driving-shaft that one can overrun or underrun the other, and thereby allow for the major curve in turning.

Electric Railways.

IMPROVEMENTS IN THE SAFETY THIRD RAIL ELECTRIC RAILWAY SYSTEM.

Mr. John M. Murphy, of Torrington, Connecticut, has recently patented an improvement in the third rail system for electrical railways.

In surface contact railway systems having a third rail formed substantially in the nature of a continuous member, the third rail is made fast by spiking in a manner similar to the securing of the tread-rails, the sections constituting the third rail being insulated from each other by spacing blocks. This method of mounting the third rail has been found objectionable and unreliable on the score of expense and danger of short-circuiting, and the present invention seeks to provide a means of constructing the conductor or third rail in a manner that will make it lasting under all conditions of traffic, that will reduce the danger of ground short-circuiting, and that will admit of securing the feed-wire in close proximity to the third rail, whereby the connection between the switches, the third rail, and the feeder-rail is the more stable and economical, and a more complete and sightly construction of the third rail for use on block or concrete paved thoroughfares is provided.

It comprises a trough having a stone base upon which rests the rail. This trough is filled with plastic cement, which, when hardened, securely binds the rail in place and at the same time it acts as an insulator so that the danger of short circuiting is reduced to a minimum, a smooth upper surface is presented and the feeder wires may be imbedded in the filling close to the rail.

Among the Societies.

ANNUAL MEETING OF THE NEW YORK ELECTRICAL SOCIETY.

The annual meeting of the New York Electrical Society was held on June 14th. In his report, the secretary stated that there had never been so many members in good standing as now. The membership is 540. The treasurer's report showed the society to be in excellent financial condition.

The election of officers resulted as follows: President, T. Commerford Martin; vice-presidents, Arthur Williams, P. V. Henshaw, Stephen L. Coles, W. C. Burton, C. O. Baker, Jr., S. L. Nicholson; secretary, Geo. H. Guy; treasurer, Henry A. Sinclair.

The paper of the evening, which was given by Mr. E. W. Caldwell, was on "Late Advances in Ruhmkorff Coil Interrupters." At the close of Mr. Caldwell's paper, the president gave an account of some work he had done some years ago on "Electric Tempering of Steel Wheels," the apparatus employed for which really constituted an enormous Wehnelt interrupter. So powerful was the action induced by the passage of the current from the submerged wheel to the electrolyte, that all the members of the party, witnessing the experiments, which were performed at night, found the next day that they had been severely burned about the face and hands, showing symptoms identical with sunburn, with subsequent peeling of the skin. Prof. Doremus then brought from his valuable collection of apparatus, one of the original coils used by Prof. Henry, in his classical experiments of self induction. This coil was one of those shown in the early books on physics and electricity, and was also one of those with which the experiments were conducted which led Prof. Henry to discover the "extra" of self-induced current, which discovery secured for this country the naming of the unit of self-inductance after the illustrious investigator. Mr. Mailloux pointed out that the term "Impedance" was first used publicly at a meeting of the New York Society in 1882 or 1883, and that many other classical researches had been introduced to public attention through the medium of the society.

Improvements in the Incandescent Lamp.

THE FIVE HUNDRED VOLT LAMP. WILL THE CARBON FILAMENT EVER BECOME OBSOLETE?

By F. M. F. Cazin.

This inquiry is of less practical importance to the general vacuum lamp industry than is commonly assumed, unless the introduction of a superior substitute for the carbon filament would be tainted with the same trade-disturbing uncertainties that result from litigation and law jugglery, characteristic of the vacuum-lamp industry in its infancy. With the possible or eventual substitute in the exclusive control of the concern which, at present, rules the vacuum-lamp market with more or less success, a repetition of such trade disturbance might be anticipated. Handled in a liberal policy of general licensing, the new-comer would materially help the trade, because a better product always commands better prices and gives better profits. It is therefore interesting to discuss probabilities under the assumption that the day be not very far off which will find the carbon filament belonging to things obsolete and to the industrial past.

Led on by pertinent questioning nearly a decade ago an officer of the concern alluded to, whose name for obvious reasons is withheld, made the following statement:

"We might admit that, as it has been with other high-class industrial achievements, the carbon filament may one day find its superior substitute and become obsolete. But up to the present day there is nothing in view that could make it so.

"At one time Edison went to work, but with little success, with the intention of finding something which would obviate some of the practical drawbacks connected with the use of carbon. (Compare his No. 492,-150, applied for Oct. 26, 1882.) But with the improvements in the quality and economy of making carbons which we have made, we are convinced that carbon filaments are going to stay.

'Now you want us to take up your idea of using Welsbach mantle material in the making of new filament, and fix up a laboratory for you to work in, we to have a first call on anything you may make and that we might want to make use of.

"But we can see no good cause for changing our policy of letting inventors work out their own salvation. As a rule they come and go and are never heard of again.

"We save money by not meddling with them. Should at any time a successful competitor appear in the market with a really superior substitute for our carbon filament, it will then be time enough for us to spend some money that we now save by letting good enough alone. And after all, the newcomer will have to choose between our price and litigation, for which never a cause is wanting in matters of patent right.

"To be candid with you, we antagonize all so called progress in this line, and surely we do not want to help it on."

This was many years ago. Since then the issue of patents as well as technical literature have indicated the existence of activity and of vitality in the endeavors, that point to the inquiry, as expressed at the head of these lines. And evidently a change of policy has been the result. The tendency of absolute indifference, if indications are not misunderstood, has changed to a determination to foil all attempts towards material progress or change in the present lamp industry.

For obvious reasons this is neither time nor place for discussing the shape that such determined resistance has taken in regard to applications for patents, though the time for that will also come, but the opposition, as it appears on the surface of technical journalism, deserves attention and discussion.

It is the writer's intention, in this connection, to discuss two publications which have lately appeared simultaneously and in the same issue of one of the electrical and engineering weeklies.

The one is a pronunciamento through Mr. Elihu Thomson, as the medium for defining the position of his employers, to the effect that no good can be expected in electrical lighting from such a thing as rare metal oxids

The other is a statement, "A 500 Volt Lamp," published jointly by two of my former employes, one a chemist, and the other an electrician, who in my pay, for my account, and under my direction and instruction, from about August 9th, 1899, to February, 1900, did experimental work at the old Westinghouse factory in Newark, then exclusively occupied by the Manhattan General Construction Company, the general manager of which was temporarily interested in the stated experimental work, under an agreement of August 9th, 1899, by which he held an option on my lamp patents and pending applications. In this statement the two employes disclose without my permission, contrary to that which they knew to be my desire, the nature of the work that they did in the stated period of their employ and nothing else, as the diary kept and their reports to me prove beyond all possible doubt.

My relations with these two gentlemen will be well understood by the following excerpts from late correspondence. Under date of February 17th, a few days after the stated work had been terminated, I had occasion to write to Mr. Joe Hardwick in reference to a communication received from Mr. S. Marsh Young, the gentleman holding the option mentioned above, as follows:

"I have been informed by Mr. Young of the proposition you and Dr. Werner have made to him. Have you not thought of the interpretation that might be put on your entire action in consequence? After six months' employment for doing a certain thing, and after virtually accomplishing nothing, you both offer full accomplishment (a commercially acceptable rare metal—oxide luminant), if you can have a finger in the pie. Do you understand that you are about ruining your own reputation for integrity for all of your lifetime?"

To this Mr. Hardwick had no other or better answer than:

"Newark, N. J., Feb. 19, 1900.—Our contract with you expired on the 9th. It seems to me a foregone conclusion that any understanding made after that date with anybody is of no possible interest to you. Certainly your contract with Dr. Werner and myself could not have any bearing on the case, if it had already expired."

Mr. Hardwick had previously been working with me in 1895, of which fact he reminded me in his letter of Jan. 28th, 1899, when he prepared for a renewal of the engagement, as follows:

"You remember that I handled some very interesting experimenting for you while I was with the Empire Lamp Works, a couple of years ago."

A demand on my part, directed to Werner, for a written acknowledgement that all the work described in the article, "A 500-Volt Lamp," had been done under my instruction while they were in my employ, brought the following answer in part:

"Mr. Young, who paid me my salary for working out your lamp when your contract expired, invited me to work out my lamp on an entirely different basis."

This leads to the assumption that Mr. Young has been victimized by such false assertion as to a "different basis." The records in the patent office are amply suf-

The Electrical Age.

ESTABLISHED 1883.

Entered at New York P. O. as second-class matter, January 18, 1891.

THE ELECTRICAL AGE PUBLISHING CO., Publishers.

TERMS OF SUBSCRIPTION:

One Copy, one Year,	$2.50
One Copy, six months,	1.25
Great Britain and other Countries,	3.50

Cable Address (all Cables), "Electage," New York.

NEWTON HARRISON, E. E., EDITOR.

ASSOCIATE EDITORS:

ALFRED E. WIENER, E. E., OSBORNE P. LOOMIS, E. E., } ELECTRIC LIGHT AND POWER.

JOSEPH MUIR, M. D., FREDERICK STRANGE KOLLE, M. D., } ELECTRO-THERAPEUTICS.

ADDRESS ALL COMMUNICATIONS TO

THE ELECTRICAL AGE PUBLISHING COMPANY,

Seventh Floor, World Building,

NEW YORK.

NEW YORK, JUNE 30, 1900.

CONTENTS:

ELECTRICITY IN NAVAL AND MILITARY WARFARE.

The advantage of electrical apparatus in the various forms of warfare indulged in by civilized races has become more and more apparent with each new civil convulsion. Attached to the British army service at least ten years ago, if not more, was a corps of men called military engineers, whose duty it was to establish communication between the army and various points of interest in advance or behind. This work has been specialized since then and in the forces of the American, German, French and British armies of to-day telephonic as well as telegraphic communications are established, thereby facilitating the delivery of orders from point to point and enabling trusted officers to rapidly convey information, secured at a possible loss of life and limb, to superior officers.

It is remarkable to realize to what extent both army and navy are dependent upon applications of electricity. On board ship are found electric lights, electric bells, electric signalling devices and electric signals operated between the different parts of vessels. These are not only found on board of naval vessels but on any merchant marine. In naval practise proper searchlights for various purposes, electric torpedo boats, electrically exploded guns and an infinite variety of electrical apparatus is now in vogue. In fact, even the speed indicators, logs, rudder gear, regulator, etc., are controlled electrically. Various large electrical companies have found it necessary to develop departments devoted entirely to the construction of apparatus for army and navy use. A casual glance around on one of these great floating forts, such as the battleships Oregon or Illinois, will bring to the sightseer's immediate attention a great variety of electrical appliances, many of which are in constant daily use. The torpedo guns, one of which was exhibited at the World's Fair, at Chicago, are controlled to a greater or less degree by electricity. The Warth gun, on exhibition at the Columbian Fair, was unique on account of its being the first serious crystallization of an idea tending to revolutionize torpedo gun construction. This electrical torpedo gun was characterized by the novelty of its motive power, electro-magnetism, which was here for the first time used for the projection of missiles. A writer states that the gun was further characterized by the employment of a force, meaning electro-magnetism, which he describes as "the safest, most flexible, beautiful and economical of any used for the projection of high explosives." It can therefore be realized that an effort has actually been made to introduce as a practical article a torpedo gun of a character purely electrical.

For army service the employment of electricity is a boon of the greatest possible value. It is common practice now to send aloft balloons from which conversation can be exchanged with the officers on terra firma. Photographs can be taken and by means of a telescope movements of the enemy seen without the least possible risk. It is even possible, by means of these balloons, to signal readily by employing a small searchlight, the code employed being, of course, a secret one. The use of the Marconi system of wireless telegraphy during the Boer war was naturally limited on account of certain crude features still found in the apparatus, only well informed experts being able to conveniently and readily operate the same. In the department of surgery the X rays were frequently in use and by their aid assisted greatly in the setting of limbs and the extraction of bullets. Probably one of the next moves in firearm construction will be that of operating the rifle or revolver by electricity. Instead of it being necessary to pull a trigger a button may be lightly pressed and an electro-magnet, by the aid of a dry cell, will throw into operation the normal mechanism of the device. There are still many opportunities open to inventors in this particular field of work. Whatever electricity is now employed is found to a larger extent on board of men-of-war, cruisers, etc., than in the equipment of armies. The difficulty largely obviated was that originally due to a lack of portability, obtaining a ready supply of electricity for searchlights, etc. To-day we have generators so compactly built that nothing could be subtracted from them in either weight or volume, and, on the other hand, little could be added in the way of efficiency. The obvious advantage of a powerful current at certain critical moments in the history of an army's advance for signalling purposes calls for but little argument. Success in warfare on land or sea aside from the personal element is largely dependent upon the perfection of the machines through which death is sent on its way. The power of these and the ease of handling them are as important as the quality of the intellect governing their operation.

ficient for protecting me in my inventions of the use of rare metal oxids in electric lamps, of the use of pseudo-fibre, thread or fabric of such oxids in vacuum lamps, of the osmium-coating singly and in their combinations. The article described none but such, and nothing "on a different basis" is described therein. With all it is remarkable, that in the article the two men claim a joint invention, while in his letter Werner ignores Hardwick altogether. Evidently the (?) have already fallen out.

And both men at their engagement had fully understood and agreed that their position be precisely such as of late has found so pertinent a characterization in Hubel vs Bernard. (Court of Appeals, Washington, D. C., XII., 6, 1899.) Their attempt to wrongfully appropriate invention and honor that belongs to their employer will not be successful.

(To be continued.)

Twenty Four Cell "Clover Leaf" Testing Battery Ready for Use.

Twenty Four Cell "Clover Leaf" Testing Battery Disconnected.

Batteries.

THE "CLOVER LEAF" DRY CELL.

The symbol of good luck, the four leaved clover, is used as a trade mark by the Electric Contract Company for the "Clover Leaf" dry cells for testing purposes, the most delicate apparatus, there being absolutely no danger from leakage. Illustrations of the twenty-four cell battery to be used for testing purposes are shown herewith and show the compactness which is obtained in these outfits. The individual cells can be readily removed from the case by loosening four screws and a new cell quickly inserted. The high electro motive force and large amperage obtained from this cell makes it the ideal cell where such an output is required for only a short time, for testing purposes, electro-therapeutic work, etc. The voltage of the cells is 1.25 and will remain practically constant. One point in connection with the "Clover Leaf" dry cell which appeals especially to dealers is the fact that they are commercially permanent and will not run down on the shelves, a common fault with batteries of this nature. The cells are put up in cases holding 24, 49, 74 and 99, the weight ranging from four

pounds for the twenty-four cell outfit to fifteen pounds for the ninety-nine cell outfit. The following are the voltages for the various outfits: 99, 123.75 volts; 74, 92.50 volts; 49, 61.25 volts; 24, 30 volts. Each test battery is furnished with an extra cell. The cases are elegantly finished and tips are provided to hold terminals in place when not in use. The reversing switch is of the best design and all cases are equipped with lock and key and handles for carrying. The address of the Electric Contract Company is 61 Elm street, New York city.

Patents.

WEEKLY ELECTRICAL PATENT RECORD.
PATENTS ISSUED JUNE 19, 1900.

Conducted by Otto rGeenberg. Complete descriptions and drawing of any patent mentioned below will be sent on receipt of ten cents.

651,817. Telephone Toll Apparatus. John T. Belanger, Detroit, Mich.

652,827. Electrolytic System of Refrigeration. Clyde J. Coleman, Chicago, Ill.

651,849. Electrolytic Apparatus. Max Hass, Aue, Germany.

651,866. Incandescent Lamp. Isidor Kitsee, Philadelphia, Pa. This invention consists of a pencil nonconducting at low, but conducting at high temperatures, in combination with a conducting-film consisting of finely-divided platinum.

651,945. Electric Motor. Clifton S. Bundy, Philadelphia, Pa.

651,985. Electric Arc Lamp. Allyn B. Walton, Lorain, O.

652.003. Electric Railway. William Kingsland, London, Eng.

652,027. Transformer. Svend E. Johannesen, St. Louis, Mo.

652,116. Rheostat. Thomas F. Jordan, N. Y.

652,151. Automatic Electric Switch. Phill S. Tirrill.

652,194. Electrical Incandescent Lamp. Max von Recklinghausen, London, Eng.

652,214. Electric Motor. Cesar R. Loubery, Paris, France.

652,229. Telegraphic Apparatus. Alexander Muirhead, London, Eng.

652,230. Art of Reducing Attenuation of Electrical Waves and Apparatus Therefore. Michael J. Pupin, Yonkers, N. Y.

652,231. Art of Reducing Attenuation of Electrical Waves. Michael J. Pupin, Yonkers, N. Y.

Business News.

NEW INCORPORATIONS.

Keswick, Cal.—The Keswick Electric Light Company was incorporated by H. D. Scribner, A. T. Johns, P. S. Coke, H. S. Donnels and W. H. Bone, with a capital stock of $50,000, of which $50 was subscribed.

Centerville, Ia.—The Citizens' Electric Light & Gas Company has been incorporated. Capital, $35,000. Incorporators: D. C. Campbell, T. P. Shouts, J. A. Campbell and C. C. Campbell, all of Centerville.

Waterloo, Ind.—The Waterloo Electric Light & Power Company has been incorporated. Capital, $5,000. Incorporators: H. K. Leas, J. P. McCayne, M. Kiplinger, A. Kelly, all of Waterloo.

Canandaigua, N. Y.—The Ontario Light & Traction Company of Canandaigua has been incorporated. Capital, $100,000. Directors: J. Howard Burgess, Elmira; J. H. Pondee and H. B. Ferguson, Canandaigua.

Rock Hill, S. C.—The Catawba Power Company, of Rock Hill, S. C., capital stock $100,000, has been chartered. The company will develop power near Rock Hill, as already mentioned in these columns.

Sullivan, Ind.—The Sullivan Heat, Light & Power Company has been incorporated. Capital, $25,000. Incorporators: W. N. Crowder, L. A. Stewart, C. H. Crowder, P. L. Reid, E. S. Crowder, all of Sullivan.

Raleigh, N. C.—The Goldsboro Illuminating & Traction Company has been chartered. The capital stock is fixed at $15,000, with privilege of increasing it to $100,000.

Islip, N. Y.—The Sayville Electric Company of Islip, Suffolk County, has been incorporated. Capital, $15,000. Directors: Daniel D. White, J. H. Green, Jr., Francis Gerber, Joseph A. Nauert, Sewell Thornhill, of Sayville.

Jersey City, N. J.—The Massachusetts Power Company has been incorporated, with headquarters in this city. Capital, $750,000. Incorporators: R. M. Wiers, R. S. Checkley, K. A. Hammerer; R. M. Wiers & Company, attorneys, New York.

Portland, Me.—The Sagadabock Light & Power Company, of Portland, has been incorporated. Capital, $200,000. Incorporators: G. F. West, A. S. Bosworth, H. W. Ricker, all of Portland; S. C. Manley, J. H. Manley, of Augusta; Symonds, Snow & Cock, attorneys, Portland.

Los Angeles, Cal.—The Excelsior Power Company, of Los Angeles, has been incorporated. Capital, $150,000. Incorporators: C. A. Hooper, G. W. Hooper, D. C. Henry, all of San Francisco; R. P. Winters, of Riverside; F. L. Margan, F. B. Crosier, S. Borden, all of Los Angeles.

Albany, N. Y.—The Ontario Light & Traction Company has been incorporated, with a capital of $100,000. This is a reorganization of the Canandaigua Electric Light & Railroad Company. J. H. Howard Burgess, Elmira; J. H. Pardee and H. B. Ferguson, of Canandaigua, are directors.

Red Bluff, Cal.—The Red Bluff Electric Power Company has been incorporated to generate and develop electricity for heat, light, etc. Capital, $250,000. Incorporators: D. S. Cone, C. F. Foster, E. H. Ward, all of Red Bluff; J. D. Sherwood, of Spokane, Wash.; W. N. Woodson, of New York city.

TELEPHONE CALLS.

Mason City, Ia.—The Greene & Western Telephone Company has been organized here. Capital, $150,000. Incorporators: A. Kime, W. J. McAllister, H. E. Soesbe, all of Mason City.

Hartsville, Ind.—The Hartsville Telephone Company has been incorporated. Capital, $2,500. Incorporators: J. W. Anderson, J. W. Smith, F. J. Beck, J. L. Towson, all of Hartsville.

La Porte, Ia.—The La Porte Telephone System of La Porte, Ia., has been incorporated. Capital, $2,500. Incorporators: J. C. McGohran, G. M. Nesbit, E. G. Leffler, S. J. Tedford, C. F. Bennett, all of La Porte.

Cedar Rapids, Ia.—The Central Telephone & Telegraph Company has been incorporated at Cedar Rapids. Capital, $500,000. Incorporators: A. T. Averill, G. M. Averill, E. M. Scottt, all of Cedar Rapids.

Conrad, Ia.—The Conrad Telephone & Telephone Company has been organized here. Capital, $5,000. Incorporators: D. Marsh, M. M. McClain, W. H. Stark,

E. I. Guild, F. W. Alexander, E. W. Barnes, all of Conrad.

Trenton, N. J.—The Plainfield Telephone Company has been incorporated. Capital, $15,000. Incorporators: A. Dingler, R. J. Emory, both of Jersey City; H. F. Atkinson, of Red Bank; G. H. Atkinson, attorney, Jersey City.

Wills Point, Tex.—The Excelsior Telephone Company, of Wills Point, has been chartered. Capital, $6,000. Incorporators: W. M. Mitchell, F. M. Kidder, W. M. Mitchell, Jr., all of Willis Point.

Covington, Ind.—The Shawnee Telephone Company, of Covington, has been incorporated. Capital, $3,000. Incorporators: B. Brown, J. H. Meeker, H. H. Stroder, T. Purdue, all of Covington.

Greenfield, Ind.—The Citizen's Telephone Company has been incorporated. Capital, $10,000. Incorporators: W. Finnell, T. B. Piper, C. Kingan, all of Greenfield.

Vandalia, Ill.—The Farina & Vandalia Telephone Company, of Farina, has been incorporated. Capital, $2,500. Incorporators: Thomas Zinn, Charles T. Wade, Charles W. Maxon.

Baltimore, Md.—Mayor Hayes is negotiating with the Maryland Telegraph & Telephone Company for the installation of an exchange in the city hall and the replacvice throughout the municipality by Maryland telephones.

Charleston, W. Va.—The Petroleum Telephone Company has been chartered. Capital, $1,000,000. Incorporators: J. H. High, C. G. High, G. D. Chilton, J. F. Noyes, F. L. McGee, all of Charleston; J. W. Malsolm, attorney, Charleston.

Canisteo, N. Y.—The Greenwood & Canisteo Telephone Company, of Steuben County, has been incorporated. Capital, $3,000. Directors: A. P. Woodward, N. E. Coston, J. M. Atkins, J. S. Tobias, Greenwood; Frank Failing, Rexville.

Melott, Ind.—The Melott Telephone Company will put in an exchange in Mellott, Newton, Hillsboro, Stone Bluff, Veedersburg, Attica, Wingate and Waynetown. The capital stock is $3,500 and the directors are Charles Archer, S. A. Moore, H. E. Carpenter, J. W. Royal Mason Simmons, W. F. Mellott and William. F. Gerrard.

Albany, N. Y.—The Salamanca Telegraph & Telephone Company, of Salamanca, has been incorporated to operate in Salamanca and through the counties in the western part of the State, with terminus at Bradford, Pa., its circuit to include the cities of Rochester and Buffalo. The capital is $10,000, and the directors include Charles R. Gibson, Edward Bolard, Hudson Ansley and Charles S. Fish, of Salamanca.

STREET RAILWAY NEWS.

Chicago, Ill.—The Waukegan, Fox Lake & Western Railway Company has been incorporated at Springfield, with a capital of $100,000.

Toledo, O.—The Victoria Park Railway Company, of Toledo, has been incorporated. Capital, $50,000. Incorporators: C. W. Ryan, J. W. Ryan, J. D. Besly, F. J. Arbuckle, F. W. Caughling.

Columbus, O.—The Portage Lakes Traction Company, Cleveland, has been incorporated, with $10,000 capital stock, by David M. Glascock, Henry Lancefield, T. S. Dunlap, Carl H. Nau and Charles L. Stocker.

Richmond, Va.—The Virginia Conduit Railway Company, of Richmond, has been chartered. Capital, $1,000,000. Incorporators: A. Pizzini, Jr., W. S. Forbes, W. B. Davis, W. R. Johnston, P. Davis, E. A. Horn, J. D. Patton, W. F. Jenkins, all of Richmond; A. B. Guigan, attorney, Richmond.

Scranton, Pa.—The Scranton & Northeast Railroad Company has been chartered. The capital stock is $100,000. The incorporators are: T. F. Penman, president; C. C. Mattes, A. P. Bedford, M. E. McDonald, all of this city; Henry C. Riley, Jonathan Jenks, Stanley R. Ketcham, Philadelphia; B. K. Facht, Lewisburg; E. S. McNaul, Lock Haven, and C. B. Boughton, Buffalo, N. Y.

NEW YORK NOTES.

H. E. PLASS ELECTRIC CONSTRUCTION & SUPPLY COMPANY, Barclay and Church streets, dealers in electrical supplies, have an interesting hot weather exhibit in their show windows, which attracts the attention of the throngs of passersby. It consists of battery and current fans from three dollars up, adapted for all conditions of fan motor practise and many a suburbanite on his way to the ferry has fallen a ready victim to this attractive display.

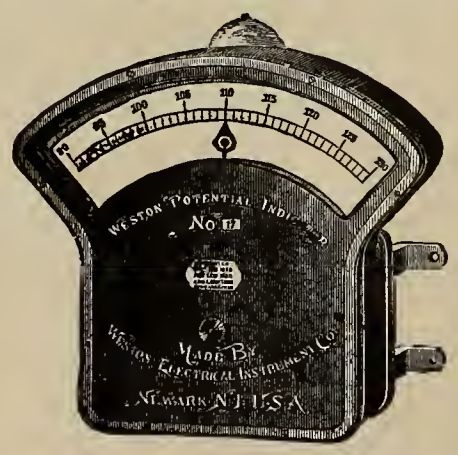
THE J. JONES & SON COMPANY, 64 Cortlandt street, are increasing their trade among the contractors of Greater New York and the State generally very extensively. Their employes are noted for their great desire to please all customers, particularly in the delivery of supplies and materials. The Jones Company carry a large stock of electric light, house, office and general equipment supplies.

J. H. BUNNELL & COMPANY, 20 Park place, the well known manufacturers of high grade telegraphic and other apparatus, are making a fine display of motors, power apparatus, searchlights, fan motors, etc., in their new show windows. They have a big stock of battery fans on their bargain table, all first class goods at the buyer's own price. The above company now occupies five floors and a cellar and subcellar under the main floor. They are gradually equipping the upper floors of their new building with all modern machinery and tools and are manufacturing all of the noted brands of Bunnell apparatus in the telegraph and electrical line.

THE OLD HOUSE of Fred Pearce, formerly of 79 John street, is as busy as a beehive at its elegant new salesrooms and factory at 22 Rose street, the great towering building alongside of Brooklyn Bride. Mr. Pearce manufactured all of the principal fire alarm apparatus and call systems now in operation throughout the world and also makes a special hotel and house auxiliary fire alarm system.

NOW IS THE TIME to buy Vetter current taps, a tapping plug and socket combined. Every user of fan motors should have them in operation, as they save time, labor, inconvenience as well as current. They can be bought from any electrical supply house or from the maker, E. B. Meyrowitz, 104 E. 23d street.

WESTON STANDARD ILLUMINATED DIAL



STATION INSTRUMENTS.

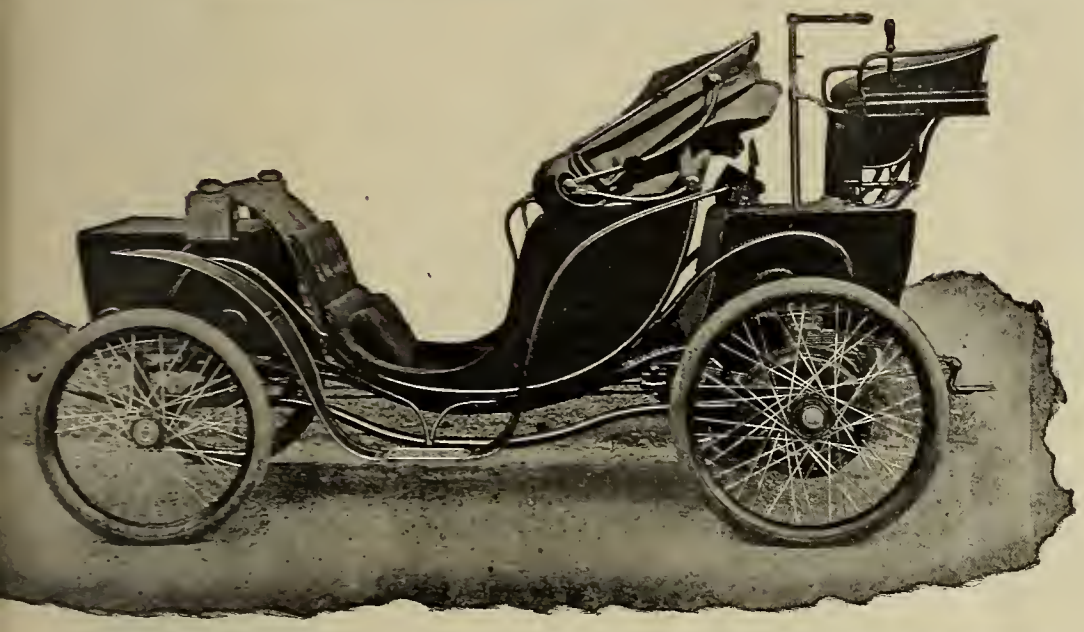
THESE INSTRUMENTS are based upon the same general principle and are just as accurate as our regular Standard Portable Direct Current Voltmeters and Ammeters, but are much larger, and the working parts are inclosed in a neatly designed dust-proof cast-iron case, which effectively shields the instruments from disturbing influences of external magnetic fields.

WESTON ELECTRICAL INSTRUMENT CO.

114-120 William St., Newark, N. J., U. S. A.

ELECTRIC VEHICLE COMPANY

....COLUMBIA AUTOMOBILES.... ELECTRIC and GASOLINE.



OPERATING AND SELLING COMPANIES:

STATE OF NEW YORK: New York Electric Vehicle Transportation Co., Sales and Show Room, 541 Fifth Ave., New York City.

STATE OF PENNA. Pennsylvania Electric Vehicle Co,, Drexel Bldg., Phila,

STATE OF ILLINOIS: Illinois Electric Vehicle Transportation Co., 173 Michigan Ave., Chicago.

NEW ENGLAND STATES: New England Electric Vehicle Transportation Co.,15 Congress St., Boston.

MANAGER FOR EUROPE: Hart O. Berg, 54 Avenue Montaigne Paris, France:

DISTRICT OF COLUMBIA: Washington Electric Vehicle and Transportation Co., 15th and Ohio Ave., Washington, D. C.

STATE OF NEW JERSEY: New Jersey Electric Vehicle Transporation Co-, 100 Broadway, New York City.

STATE OF CALIFORNIA: A. E. Brooke Ridley, Agent, Parrott Building, Market Street, San Francisco, California.

In territory not represented by local companies all communications should be addressed to

ELECTRIC VEHICLE COMPANY,

100 Broadway, - New York, U. S. A.

BUILDINGS, STORES, LOFTS & OFFICES TO LET.

A Large Number.

RULAND AND WHITING

5 Beekman St.

"CLOVER LEAF"
Dry Cell Testing Batteries.

EVERY ONE GUARANTEED.

The "Clover Leaf" Dry Cell for testing purposes is constant in voltage, which is 1.25 and may possibly deteriorate five per cent. in a year if not used.

The "Clover Leaf" Dry Test Cells are mechanically perfect, they are contained in pure drawn zinc cups, and they DO NOT LEAK OR EXPLODE.

For all purposes where a good constant cell of light weight is required, the "Clover Leaf" Test Cell is pre-eminent.

The cells are grouped in handsome hardwood cases, having hard rubber tops and nickel-plated brass fittings and connections.

24 Cell Battery 4¾x4¾x4½ weighs 4 lbs.
49 Cell Battery 9 x4¾x4½ weighs 7¾ lbs.
74 Cell Battery 14 x4¾x4½ weighs 12½ lbs.
99 Cell Battery 9½x9½x4½ weighs 15 lbs.

More efficient, lighter weight, higher voltage than any test battery ever produced.

SEND FOR BULLETIN No. 3.

Electric Contract Company, 61 ELM STREET, ... NEW YORK.

$39.00 AN INCH

PER YEAR.

BUYER'S LIST OF ADVERTISERS.

ALTERNATING GENERATORS.
Ft. Wayne Electric Works.
General Electric Works.
Stanley Electric Mfg. Co.
Westinghouse Elec. & Mfg. Co.

ARC LAMPS.
(See "Lamps.")

ARMATURES.
Bogue, C. J.
Stucky & Heck Elec. Mfg. Co. Ltd.

AMMETERS AND VOLTMETERS.
Keystone Elec. Instrument Co.
Weston Elec. Instrument Co.
Whitney Elec. Instrument Co.

BATTERIES, PRIMARY.
American Oddity Co.
Edison, Jr., Elec. Lt. & Power Co.
Gordon Battery Co.

BATTERIES, STORAGE.
Electric Stroage Battery Co.

BATTERY MATERIAL.
Gordon Battery Co.
Manhattan Elec. Supply Co.
Jones & Sons Co., The J.
Pearce, Frederick.

BELLS.
Edwards & Co.
Huebel & Manager.
Jones & Sons Co., The J.

BELTING.
Meier's Sons, Joseph

BOILERS.
Abendroth & Root Mfg. Co.

BOOKS, TECHNICAL.
Electrical Age, The.
Scientific Pub. Co.

BRUSHES, DYNAMO.
Bogue, C. J.
Jones & Sons Co., The J.
Stucky & Heck Elec. Mfg. Co., Ltd.
Schiff, Jordan & Co.
Speer Carbon Co.

CABLE HANGERS.
Standard Underground Cable Co.

CASTINGS.
Barnett Foundry Co., O.

CARBON POINTS.
Schiff, Jordan & Co.
Solar Carbon Mfg. Co.
Washington Carbon Co.

CARBON BRUSHES.
Speer Carbon Co.

CIRCUIT BREAKERS.
Cutler-Hammer Co.

CLOCKS.
Prentiss Clock Imp. Co.

COMMUTATOR BARS AND REPAIRING.
Bogue, C. J.
Morris, E. P.
Stucky & Heck Elec. Mfg. Co., Ltd.

CONNECTORS AND TERMINALS.
McIntire Co., The C.

CONDUITS.
American Circular Loom Co.
National Conduit & Cable Co.
Schiff, Jordan & Co.
Sprague Electric Co.
Vitrified Conduit Co., The American.

DYNAMOS AND MOTORS.
Bullock Elec. Mfg. Co.
Bogue, C. J.
Falcon Electric Co.
Jones & Sons Co., The J.
Sprague Electric Co.

DESK LAMPS.
Kinsman, F. E.
McCreary Co., A. A.
McLeod, Ward & Co.

ELECTRICAL SUPPLIES, NOVELTIES, ETC.
American Elec. Nov. & Mfg Co.
Bibber-White Co., The.
Bunnell & Co., J. H.
Portable Elec. House Lamp Co.
Fuller, J. E.
Holtzer-Cabot Elec. Co.
Incandescent Elec. Lt. Manipulator Co.
Jones & Sons Co., The J.
Manhattan Elec. Supply Co.
McCreary, Co., The A. A.
Schiff, Jordan & Co.

ELECTRIC FURNACES.
Electric Enameling Co.

ENGINEERS AND CONTRACTORS.
Bidstrup & Co., J. E.
Hatzel & Buehler.
Heaton, Edward.
Zimdars & Hunt.

EXPERIMENTAL AND MODEL WORK.
Bogue, C. J.
Fuller, J. E.
Stein & Langlos.

FANS AND FAN MOTORS.
Falcon Electric Co.
Fuller, J. E.
Manhattan Elec. Supply Co.
Riker Elec. Motor Co.
Schiff, Jordan & Co.
Vance Electric & Co.

FIXTURES, GAS AND ELECTRIC.
Frink, I. P.
Gleason Mfg. Co., E. P.
Vosburgh Mfg. Co., Ltd., W. C.

FOCUSSING LAMPS.
Baker & Fox.
Bogue, C. J.

FURNITURE, OFFICE.
Schwarzwaelder & Co., Wm.

FUSE WIRE AND LINKS.
McIntire & Co., The C.
Schiff, Jordan & Co.

GAS-LIGHTING APPARATUS.
Bogart Co., A. L.
Manhattan Elec. Supply Co.
Jones & Sons Co., The J.

GLOBES, SHADES, ETC.
Gleason Mfg. Co., E. P.
Phoenix Glass Co.

HOUSE GOODS.
Bunnell & Co., J. H.
Jones & Sons Co., The J.
Manhattan Elec. Supply Co.
Pearce, F.

INCANDESCENT LAMPS.
Edison Dec. & Min. Lamp Dept.
Lynn Incandescent Lamp Co.
Manhattan Elec. Supply Co.

INSTRUMENTS, ELECTRICAL.
Cherry Electrical Works.
Weston Electrical Instrument Co.

INSULATORS, INSULATING MATERIAL.
National Conduit & Cable Co.
Akron Ins. & Marble Co.
Schiff, Jordan & Co.
Standard Underground Cable Co

LAMPS, ARC.
Baker & Fox.
Bogue, C. J.
Falcon Electric Co.
General Incan. Arc Lamp Co.
Schiff, Jordan & Co.

LAUNCHES, ELECTRIC.
Electric Launch Co.

MACHINE TOOLS.
Garvin Machine Co.

MAGNETS.
Jones & Sons Co., The J.
Splitdorf, C. F.
Varley Duplex Magnet Co.

MICA.
Munsell & Co., Eugene.
Schoonmaker, A. C.

MINIATURE LAMPS.
Edison Decorative & Min. Lamp Dept.
American Endoscopic Co.

PAINTS, PROTECTING AND INSULATING.
DeRonde, F. S.
American Pegamoid Co.
Standard Paint Co.

PATENT SOLICITORS.
O'Meara & Co.
Rosenbaum, W. A.
Schatz, A. E.

Continued on Page IX.

GARVIN MACHINE COMPANY,
Spring and Varick Sts.,
New York,
MACHINE TOOLS
of all kinds for all purposes.

ELECTRICAL MACHINISTS.
Expert Repairing of Dynamos, Motors, Fields, Lamps, Etc.
Rewinding a Specialty.
The Standard Stamping & Die Co.
32d St. & 4th Ave.
Tel. 454 South. BROOKLYN.

$39.00 AN INCH

PER YEAR.

The Akron Insulator and Marble Co.
Manufacturer of
"STANDARD"
Electrical Wiring Tubes
Insulators, Cleats and Electrical Clay Specialties of all kinds.
Cheapest and Best on the Market.
Write for Prices.
AKRON, OHIO.

SAVE YOUR CASH and BUY OF DIRECT AGENT.
WIRES and Cables below combination prices.
ARC LAMPS, (enclosed,) Brass Cases, 100 to 150 hours. Complete with Globe, hung up in New York City **$8, $10, &12**
NEW and 2nd hand Dynamos and Engines in stock, 5 to 75 K. W. and 20 to 100 H. P. Direct and Belted.
Everything Electrical New and Second hand at bottom prices.
Books on Dynamo Electric Machinery, $3. to $6. each, other Electrical Books from 25 cts. up.
General Electric Agency,
121 World Building, N. Y.

The Bunnell Telegraphic and Electrical Co.

110-116 BEEKMAN STREET, NEW YORK CITY.

Sole manufacturers under patents of JESSE H. BUNNELL, Deceased.

BEWARE OF IMITATIONS.

Newly equipped factory, experienced workmen. The trade supplied with the best telegraph, railway and electrical supplies at LOWEST PRICES. Prompt attention given to all orders and immediate deliveries.

WRITE FOR PRICES.

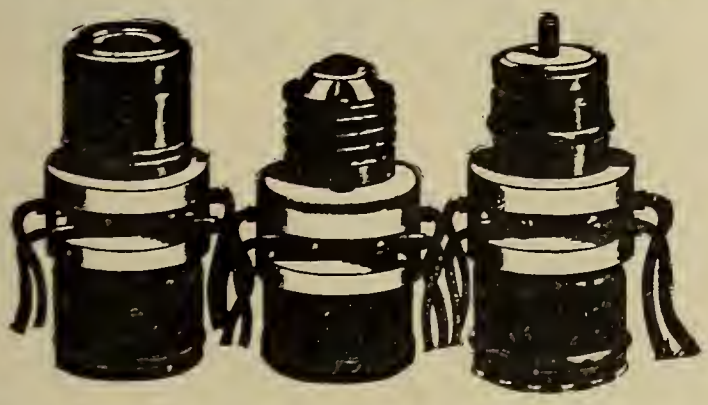
Catalogues will be issued June 1st, 1900.

Please note that we are the only authorized manufacturers under the patents of Jesse H. Bunnell, deceased.

THE VETTER CURRENT TAP.

A Tapping Plug and Lamp Socket Combined.

For Sale by all Electrical Supply Houses.



Send for Descriptive Circular and Discount Sheet.

A simple and safe device for tapping and carrying the current from any electric light fixtur eto Motors, Drop-lights and other electrical devices **Without the Loss of Lamp in Fixture.** Adapted to any system of electric lighting. When ordering, state what socket is used. Each tap is packed, with full instructions, in a neat box.

E. B. MEYROWITZ,

Manufacturer and Patentee,

104 E. 23d St. and 124 W. 42d St., New York.

604 Nicollet Ave., Minneapolis. 360 St. Peter St., St. Paul.

3 rue Soribe- Paris- France.

Separable Electric Clusters

From 2 to 6 Light.
Polished Brass.....

If you use these, we will make prices right.

E. P. GLEASON MANUFACTURING CO.,

181-189 MERCER STREET,

NEW YORK.

W. C. Vosburgh Mfg. Co.

(LIMITED)

DESIGNERS AND MANUFACTURERS OF

GAS, ELECTRIC, AND COMBINATION FIXTURES,

LICENSED

TO MANUFACTURE ELECTRIC AND COMBINATION FIXTURES

269 281 STATE STREET,

NEAR SMITH ST.

BROOKLYN, N. Y.

...LUNDELL FANS...

ARE THE

STANDARD.

SUPPLY DEALERS WHO WISH QUICK SALES AND SATISFIED CUSTOMERS SHOULD CARRY A FULL LINE OF LUNDELL FANS. THEY ALWAYS GIVE SATISFACTION AND ARE THE MOST ECONOMICAL CURRENT CONSUMING FANS ON THE MARKET. THE MOST EFFICIENT AND MOST DURABLE.

NEW MODELS AND NEW SIZES THIS SEASON.

WITH A LUNDELL FAN YOU CAN KEEP COMFORTABLE AT SMALL PRICE AND NO TROUBLE.

SPRAGUE ELECTRIC COMPANY.

GENERAL OFFICES:

527-531 West 34th Street,

NEW YORK.

"ODDO"

BATTERY MOTORS
UTILIZE

ELECTRICAL LEVERAGE

AMERICAN ODDITY CO.

MANUFACTURERS

170 & 172 West Broadway New York City.

NEW "STANDARD" DRY BATTERIES

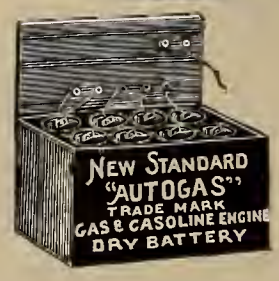
ADOPTED BY U. S. NAVY.

"Standard" Dry Cell of the World.

For Telephones, Electro-Medical, Surgical Apparatus, Bells and all open-circuit work. The NEW STANDARD of 4 to 1 over any other make of Dry Cell. WHY PAY any price for an inferior article when you can get the RIGHT cell at an honest price.

Am now making an eight cell battery for **Automobile** and **Launch gasolene engines,** and a **nine=cell battery** for **carriage** and **reading** lamps. Send for new catalogue.

LIBERAL DISCOUNTS TO THE TRADE.



WM. ROCHE,

42 VESEY STREET, NEW YORK.

COME TO THE FRONT.

Have you made a study of your business or trade? It is the quickest way to reach a responsible, high salaried position. You study "between times" and we guarantee you a thorough course through

EDUCATION BY MAIL

in Electrical, Mechanical, Steam, Mining and Civil Engineering, Metallurgy, Art, Architecture. Practical Newspaper Work, English Branches, Stenography, Machine Design and Mechanical Drawing. Low price; easy terms. Mention subjects interested in when writing to

THE UNITED CORRESPONDENCE SCHOOLS
154-56-58 Fifth Ave., N. Y., for catalogue No. 126.

CENTRAL MFG. CO.

Manufacturers and Dealers in
YELLOW PINE CROSS ARMS, LOCUST PINS, OAK PINS, ELECTRICAL MOULDINGS, OAK BRACKETS.

Chattanooga, Tenn.,

Edison Jr. Primary Batteries
and Fan Motors.

THE BEST IN THE MARKET.

On Exhibition and sale at Salesrooms of
The Manufacturers & Inventors Co.
84 NASSAU STREET, CITY.

AND ALL DEALERS.

Catalogues and full descriptions.

Edison Jr. Electric Light & Power Co.,
27 William St., New York.

OUR GREAT LAKES AND OUR MOUNTAINS.

Are all shown in marvelous detail in the "Round the World" folder just issued by the New York Central Lines. Including a map of the United States, Alaska and our islands in the Atlantic and Pacific Oceans.

A copy will be sent free, post-paid, on receipt of three cents in stamps, by George H. Daniels, General Passenger Agent, Grand Central Station, New York.

Fibre Paper Rubber **CABLES AND** High Grade Rubber Covered and Weatherproof **WIRES**

Conduits and Accessories, for Telephone, Telegraph, Electric Light and Power.

STANDARD UNDERGROUND CABLE COMPANY,

Pittsburg: Westinghouse Bldg. Philadelphia: 1225 Betz Bldg.
New York: 58 Liberty Street. Chicago: 542 The Rookery.
San Francisco, Mills Bldg.

ADAM E. SCHATZ,

COUNSEL IN

PATENT CAUSES, TRADE-MARKS and COPYRIGHTS

AMERICAN AND FOREIGN,

346 Broadway,

N. Y. Life Ins. Building. NEW YORK.

OFFICE FURNITURE AND FIXTURES

THE BEST FOR DESIGN AND QUALITY.

MANUFACTURED BY

WM. SCHWARZWAELDER & CO., 343 BROADWAY, Near Leonard St., NEW YORK.

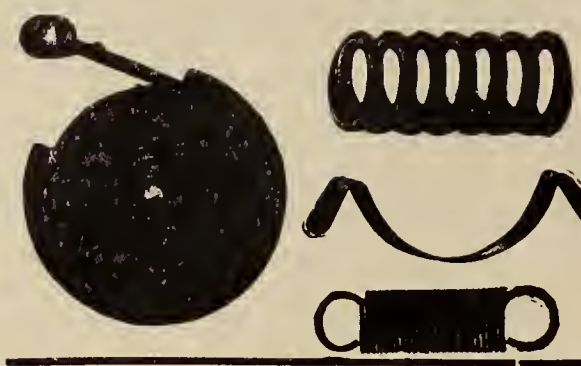
U&F M E B 33 A

The Marine Engineers' Exchange

283 Hudson Street
NEW YORK

COMPETENT Engineers may always be obtained for steamships, yachts, towboats and launches; also for power-houses, electric light plants, refrigerating plants, and for all kinds of machinery.

Telephone, 570 Spring



Cary Spring Works,

240 & 242 WEST 29TH STREET,
NEW YORK CITY,

MANUFACTURERS OF

WIRE and SPRINGS

For Machinery, Motors, Clocks, Music Boxes, and all Electrical Purposes.

THE EVERLASTING DRY BATTERY

Furnishes plenty of current for instant use or a little at a time for years. Perfection for all open circuit work

Also electric, 60-day, calendar and program clocks.

Send for Catalogue No. 668.

The Prentiss Clock Improvement Co., Dept. 66, 49 Dey St., New York City.

The Safety Insulated Wire & Cable Co.,

LEONARD F. REQUA, General Manager,
225-237 WEST 29TH ST., NEW YORK.
MANUFACTURERS OF

SUBMARINE CABLES

OF ALL SIZES AND DESCRIPTIONS.

"SAFETY" Navy Marine Wires and Cables used exclusively on the principal U. S. War Vessels.

Electric Railway Feeder Wires, "Safety" Underground Cables, "Requa White Core" and "Safety" Wire.

THE "HOGGSON"

POCKET TIME STAMP

Prints Year, Month, Day, Hour and Minute. Correctly timing every act, operation or transaction. Watchman and Employés' register, general time and check system, an absolute necessity in every business. Air cushion base. Operated without pounding. Complete with die and ink ready for use. ☞ *Guaranteed for perfect work and correct time, or money refunded.* 27 Thames St., N. Y.

THE AUDIT COMPANY

OF NEW YORK

QUEEN BUILDING, New York City. N. Y. LIFE BUILDING, Chicago.

Acting President, AUGUST BELMONT. Vice President, WILLIAM A. NASH.
Manager, THOMAS L. GREENE. Secretary and Treasurer, EDWARD T. PERINE.

The Audit Company begs to announce the opening of Western Offices as above.

Hereafter, at both the New York and Chicago Offices contracts may be made for audits and accounts, and financial and physical examinations of properties, with certificates, reports and appraisals.

The Western Board of Control of the Company and the Manager of the Western Office will be as follows:

WESTERN BOARD OF CONTROL:
JOHN J. MITCHELL, Chairman. President Illinois Trust & Savings Bank Chicago. JOHN C. BLACK, President Continental National Bank, Chicago
JAMES B. FORGAN, President First National Bank, Chicago.
JAMES H. ECKELS, President Commercial National Bank, Chicago.
EDWIN A. POTTER, President Amer. Trust & Savings Bank, Chicago.
Counsel to Western office:
L. MAYER, Moran, Mayer & Meyer, Chicago.
Western Manager: A. W. DUNNING.

THE ENGINEERING AND MINING JOURNAL

THE MOST INFLUENTIAL AND WIDELY CIRCULATED MINING PAPER IN THE WORLD.

EDITED BY
RICHARD P. ROTHWELL, M. E. C. E

ABSOLUTELY INDISPENSABLE TO THE PROSPECTOR, MINER, CHEMIST, ENGINEER, METALLURGIST, MERCHANT, BANKER, MANUFACTURER, INVESTOR AND ENGINEER.

SUBSCRIPTION PRICE, Including Postage, Per Year.

Per United States, Mexico and Canada } $5.00 Foreign Countries In the Postal Union } $7.00

PUBLISHED WEEKLY.

THE SCIENTIFIC PUBLISHING CO., PUBLISHERS.
253 Broadway, NEW YORK.

FOR SALE.

One 25 Light, 2000 C. P.

AMERICAN ARC DYNAMO.

JAY HOLMES,

39 Cortlandt St., N. Y.

PLATINUM.
Baker & Co.

POLES, BRACKETS, PINS, ETC.
Central Mfg. Co.
Jones & Sons Co., The J.

REFLECTORS.
Gleason Mfg. Co., E. P.
Frink, I. P.

REPAIRING, ELECTRICAL.
Bogue, C. J.
Electrical Motor Inspection & Repairing Co.
Fuller, J. E.
Stucky & Heck Elec. Mfg. Co., Ltd.

RHEOSTATES.
Ross, F. C.
Cutler-Hammer Mfg. Co.
Ward, Leonard, Elec. Co.

SECOND-HAND APPARATUS
Bogue, C. J.
Jones & Sons Co., The J.
Moers Sons, E. M.
Stucky & Heck Elec. Mfg. Co., Ltd.

SPRING WIRE.
Carey Spring Works.
Driver, W. B.

SWITCHBOARDS.
Bogue, C. J.
Jones & Sons Co., The J.
Zimdars & Hunt.
Falcon Electric Co.

SWITCHES.
Bogue, C. J.
Cutler-Hammer Co.
Jones & Sons Co., The J.
Ross, F. C.
Zimdars & Hunt.

TALKING MACHINES.
Columbia Phonograph Co.
Edison Mfg. Co.

TELEPHONES.
De Veau & Co.
Ericcson Telephone Co.
Mianus Elec. Co.
N. Y. Telephone Co.
Phoenix Elec. Mfg. Co.

THERMO APPARATUS.
Thermo Electric Co.

TUBES, IRON.
Kirkland, H. B.
Sprague Electric Co.
Thomas & Betts.

VEHICLES, ELECTRIC.
Electric Vehicle Co.
Riker Electric Vehicle Co.
Woods Eelectric Vehicle Co.

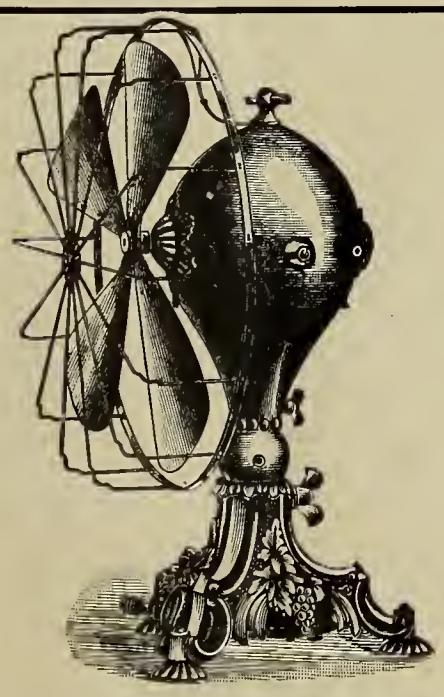
WATER AND TURBINE WHEELS.
American Impulse Wheel Co.
Leffel & Co., J.

WIRES & CABLES.
Brixey, W. R.
Driver, W. B.
India Rubber & Gutta Percha Ins. Co.
Okonite Co., Ltd., The.
Standard Underground Cable Co
Safety Ins. Wire & Cable Co.

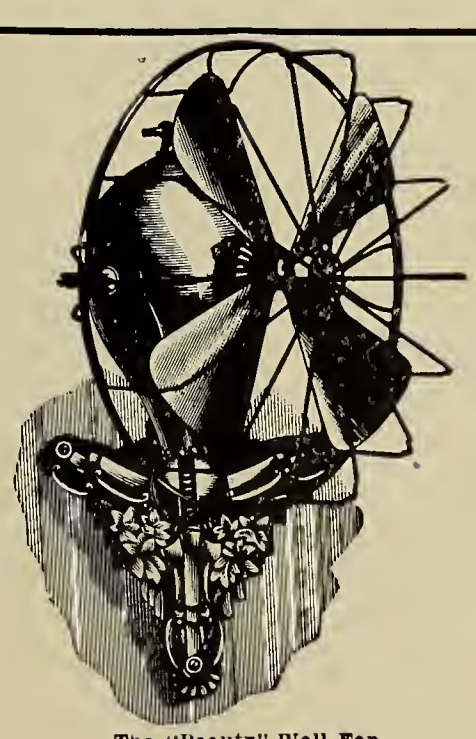
X-RAY APPARATUS.
Edison Dec. & Min. Lamp Dept.
Meyrowitz, E. B.

WANTED.

The "Beauty" Bracket Fan.



The "Beauty" Portable Fan for Desks, Tables, etc.



The "Beauty" Wall Fan.

~THE THREE "BEAUTIES"~

The "BEAUTY" ornamental Brass and Copper finished Fans, are made in Beautifully ornamented Designs, that will suit the most fastidious Tastes. The ornamentation does not detract from their strength and efficiency.

The "Beauty" Portable Fan can be changed to a Wall Fan by the simple turning of a thumb screw Back of the Ball Joint; it can be set to any angle or Horizontal Plane by the simple turning of a thumb screw. The Bracket Fan is the same in detail as the Portable except the Bracket, which is made specially ornamental. All are automatic throughout.

Three Speeds and guaranteed **Electrically** and **Mechanically perfect.**

Portable and Wall Fans, 12 inch, $25.00. Bracket Fan 12 inch, $30.00,
" " " " 16 " $30.00. " " 16 " $35.00.

SPECIAL DISCOUNT TO THE TRADE IN QUANTITIES. AGENTS WANTED IN EVERY CITY.

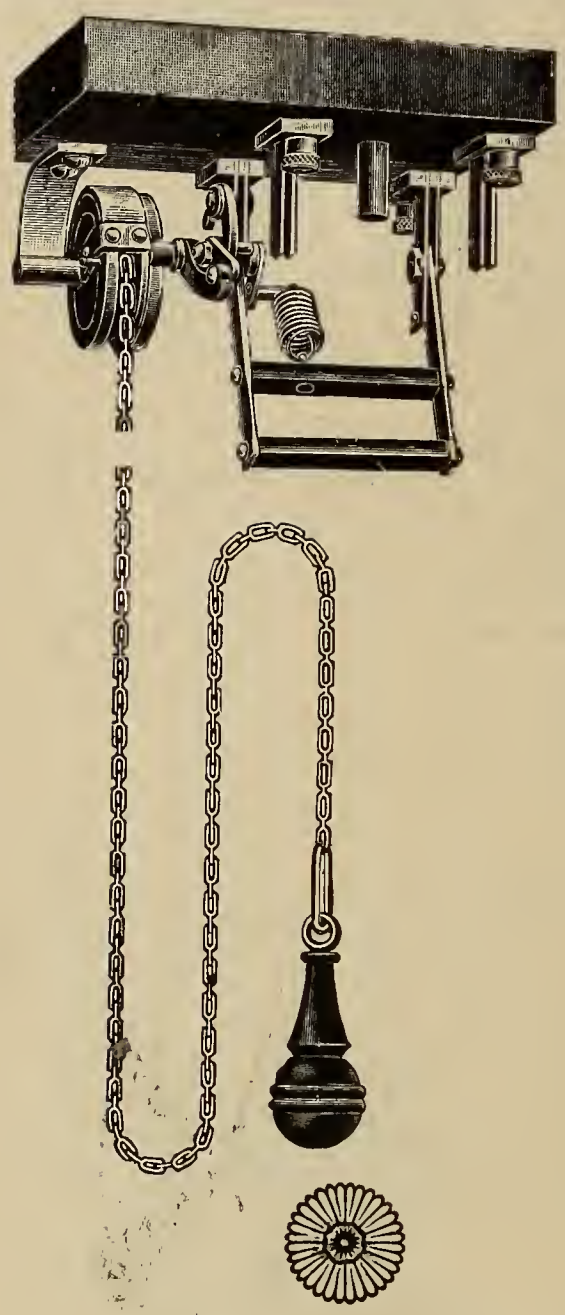
WRITE FOR NET PRICES.

Manufactured and For Sale By

L. J. WING, 95 Liberty Street, New York.

Maker of the Wing Disc Fans, Gas Engines, Etc.

ON THE CEILING.



PERFECTION
...Ceiling and Wall Switch...

Saves work in installations, as the switch is placed in the main line, and requires no wires running to **side** walls.

The only things up to the present time used in this connection, have been poor contrivances in the shape of Baby Switches or of that character. They always give trouble and always will by reasons of their construction. Added to this, is the unsightly appearance of two cords dangling from a small pulley upon which one operates. Our new switch is made for work. The parts are strong, and copper only is used in it.

A cam movement does the work of opening and closing; one pull turning on, and another turning off.

The switch is both quick make, and quick break.

APPROVED BY THE NATIONAL BOARD OF FIRE UNDERWRITERS.

CAN BE USED ON CEILING OR ON THE WALL.

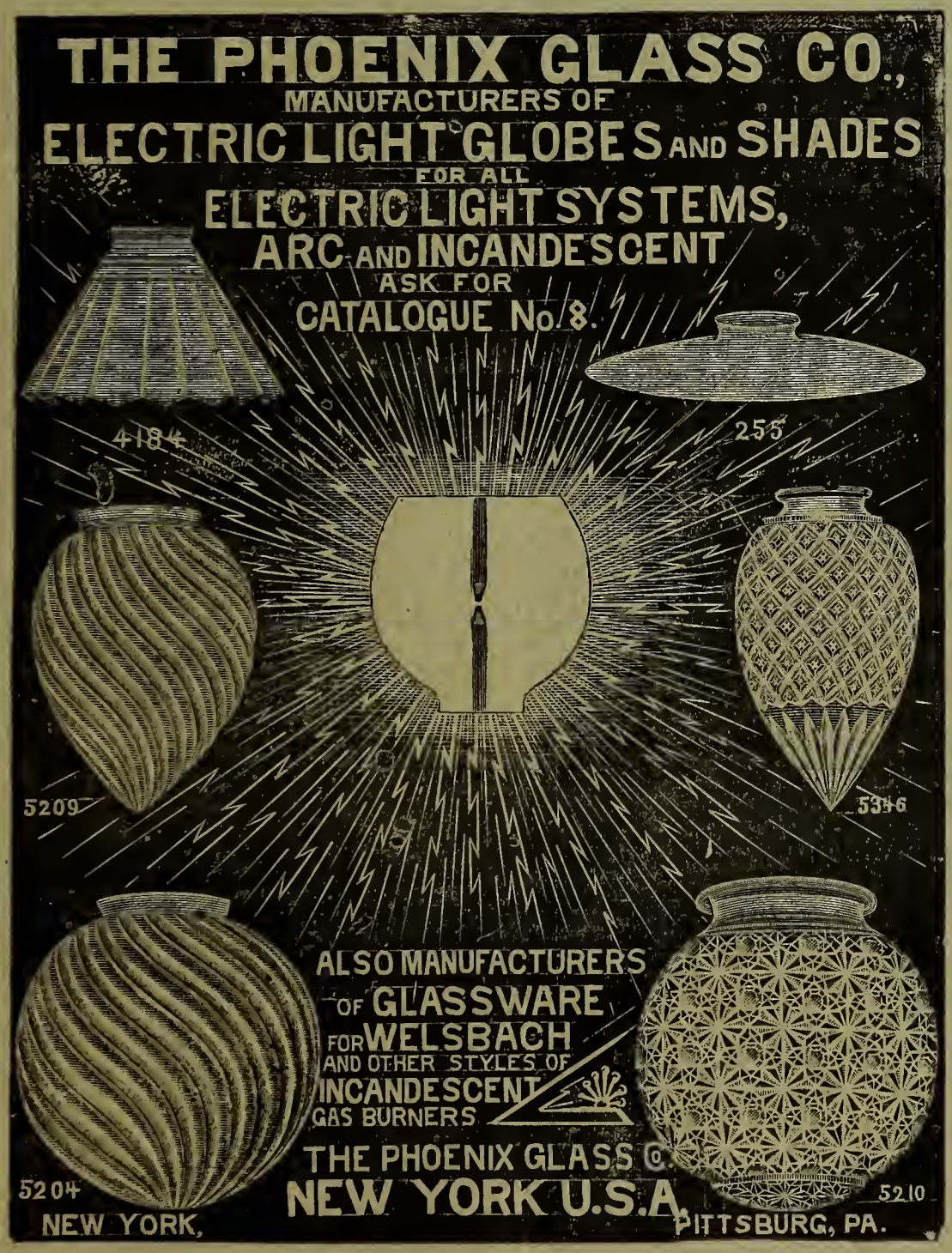
PRICES:

D. P. not fused, $3.00. 3 P. not fused, $4.00.
" fused, 3.50. " fused, 5.25.

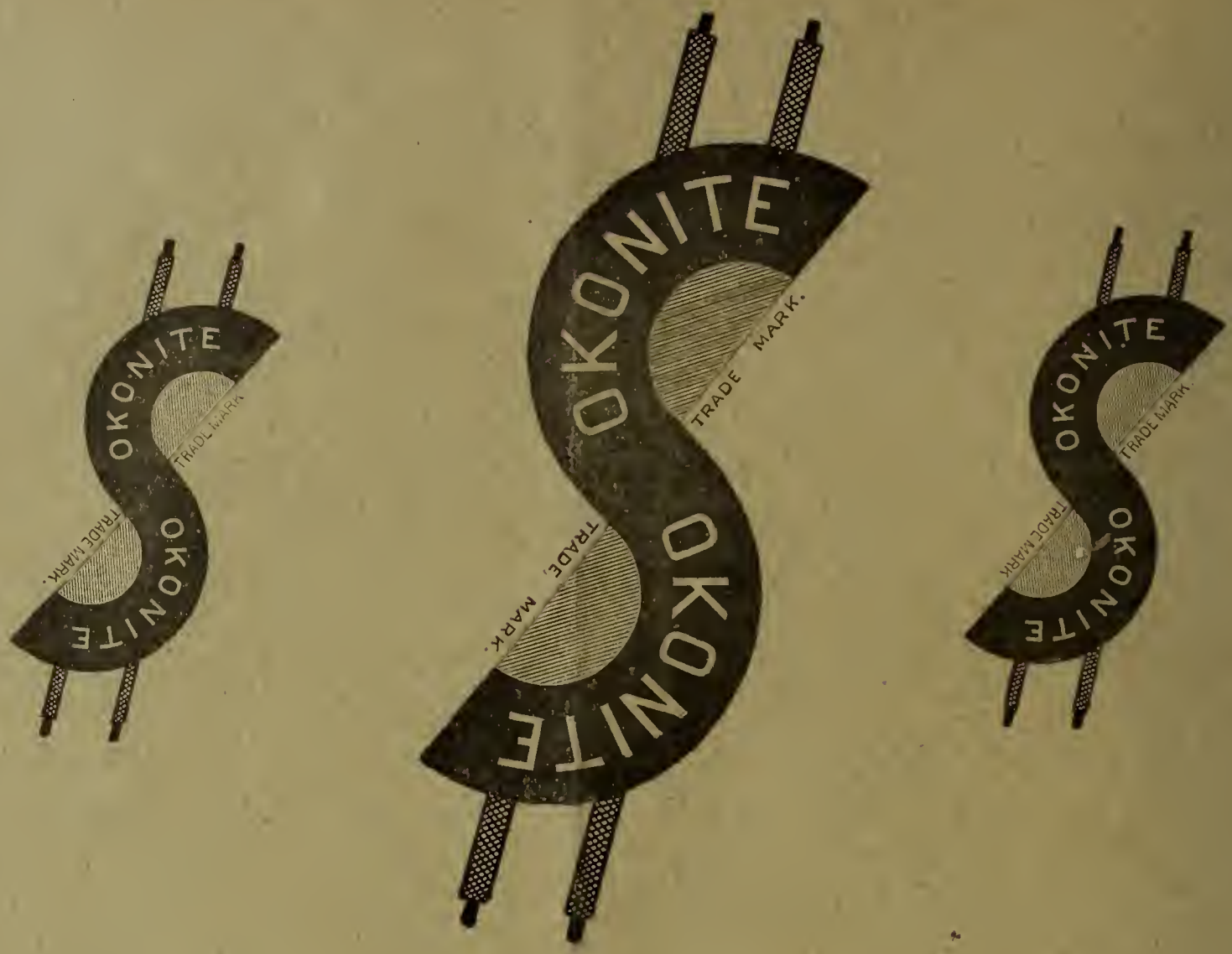
THE J. JONES & SON CO.,

MANUFACTURERS,

Factory, Brooklyn. 64 CORTLANDT ST., NEW YORK.



15 MURRAY STREET.



MARKS OF VALUE.

SOMETHING WE ALL NEED.

BEST RESULTS ARE OBTAINED WITH THIS.

THE STANDARD FOR RUBBER INSULATION.

THE OKONITE CO., Ltd.

253 BROADWAY,

NEW YORK.

OKONITE
TRADE MARK.

CENTRAL ELECTRIC CO., 264-270 Fifth Avenue, CHICAGO.

M. I. T. LIBRARY

This book is due on the last date stamped below.

Subject to fine
if kept beyond date due

DEC 10 1930

L25-10 M-8 July '29