CANADIAN

# ELECTRICAL NEWS

AND

STEAM ENGINEERING JOURNAL

OLD SERIES, VOL. XV.—No. 1.
NEW SERIES, VOL. III.—No. 1.

TORONTO AND MONTREAL, CANADA, JANUARY, 1893.

PRICE 10 CENTS
$1.00 PER YEAR.

### *STEAM USERS*

*Desiring the services of COMPETENT ENGINEERS of any class, can obtain sober, intelligent and reliable men, by applying to*

**CANADIAN ASSOCIATION STATIONARY ENGINEERS.**

A. E. EDKINS, President, care Boiler Inspection & Insurance Co., Toronto.

JAS. ROBERTSON, Secretary Montreal Branch, 1420 Mignonne Street, Montreal.

---

**EASTLAKE**
MANUFACTURED BY
METALLIC ROOFING CO
TORONTO
ILLUSTRATED CATALOGUE FREE
**STEEL SHINGLES**

---

## COTTON WASTE

For Railway, Machinist and Engineers' uses.

*ELECTRIC LONGSTOCK*

FOR ELECTRICAL USES A SPECIALTY.

**ARNOLD FENWICK & CO.**

*Factory and Office, MONTREAL.*

---

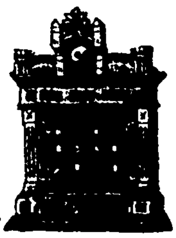
## ELECTRICAL SUPPLIES.

Send a card for

*Catalogue and Prices*

to

*C. A. Martin & Co.*
765 Craig St., Montreal.
Box 1078.



---

# F. E. Dixon & Co.

MANUFACTURERS OF

# LEATHER BELTING

*70 KING STREET EAST, TORONTO.*

**Headquarters for Electric and Dynamo Belting.**

We have the following Leather Belts in use in the works of the Toronto Electric Light Co.:—

One 36 inch belt 98 feet long.
[This belt has been in constant use since August, 1885, and looks good for another ten years yet.] Also
One 36 inch belt 100 feet long. One 38 inch belt 100 feet long.
One 36 inch belt 123 feet long. One 24 inch belt 100 feet long.
And over 1500 feet of 8 inch belting.

All the above belts are DOUBLE THICKNESS and are all giving satisfaction.
The 38 inch belt is the largest belt ever made in this Province.

The following Electric Companies are also using our Belting:

The Toronto Construction and Electrical Supply Co.
The Ball Electric Light Co.
The Hamilton Electric Light & Power Co.
The Niagara Falls Electric Light Co.
West Toronto Junction Electric Light Works.
The St. Thomas Electric Light Co.
The Barrie Electric Light Co.
The Berlin Electric and Gas Co.
The Woodstock Electric Light Co.
The Manitoba Electric and Gas Light Co., Winnipeg.
The Goderich Electric Light Co.
The Markham Electric Light Co.
The Oshawa Electric Light Co.
The Orangeville Electric Light Co.
The Port Arthur Electric Railway Co.
AND OTHERS.

**We are the only Belt Manufacturers in this Province who can show Belts of OUR OWN MAKE which have been in use AS LONG AS FIVE YEARS. We can point to belts of our own make in THIS CITY ALONE which have been in constant use for TEN, THIRTEEN and even NINETEEN years, and are still good.**

We are prepared to furnish Belts of any size, two or three ply, of any width. Every belt fully guaranteed.

Send for Discounts. Dixon's Belting Hand-Book mailed free on application.

---

## THE BROOKS MANUFACTURING CO., LTD.,

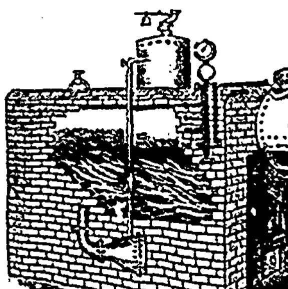
MANUFACTURERS OF

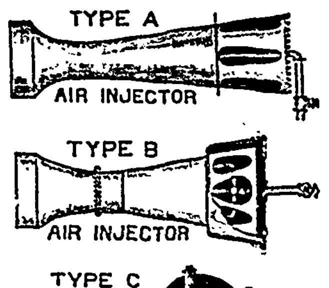
# CARBON POINTS FOR ALL SYSTEMS OF ARC LIGHT,

**PETERBOROUGH, ONT.**

---

# Earle's Air and Steam Injectors






**THE BEST DEVICE IN THE MARKET**

For burning hard or soft coal screenings under steam boilers, for working gas producers, &c., &c., exhausting gases from mines, ventilating ships, buildings, &c. Can be applied to any boiler without disturbing the present setting. Guaranteed to do the work satisfactorily. Can give the best of testimonials showing their efficiency.

THE CANADIAN OILED CLOTHING CO., (L'TD).
Manufacturers of
WATERPROOF HORSE AND WAGGON COVERS, OILED CLOTHING, ETC.

S. R. EARLE, ESQ., Belleville, Ont. PORT HOPE, June 23rd, 1892.

DEAR SIR,—We have had in use for some time, your Combined "Air Injector and Exhauster" and with pleasure we state that it is giving us the most complete satisfaction. Regarding the saving in fuel, we were burning, before using the "Injector," two tons soft coal per week, at a cost of $9.00; after we put the Injector in, we burn two ton hard coal screenings per week at a cost of $2.00 making a saving of $7.00 per week, which speaks for itself. We have a much cleaner and better fire and far less trouble in keeping steam. We consider your invention a boon to all parties using steam boilers. Wishing you every success, we are, Yours truly, (Signed) THE CANADIAN OILED CLOTHING CO.
*per S. Henderson, Manager.*

**S. R. EARLE, - - BELLEVILLE, ONT.**

**and Room 35, Bank of Commerce Building, Toronto.**

SEND FOR ILLUSTRATED CATALOGUE AND PRICES.

# G. W. HENDERSON


ELECTRICAL SUPPLIES

ESTIMATES FURNISHED FOR

**Lighting, Power and General . . .**
**. . . . . . Electrical Construction.**

CANADIAN AGENT FOR

THE ECONOMIC ELECTRIC MFG. CO.

*BOSTON.*

251 ST. JAMES STREET.
MONTREAL.

Please mention the ELECTRICAL NEWS when corresponding with advertisers . . . . . . . . .

# The "Unique" TELEPHONES

*Made especially for Exchange and Private use.*

The cheapest, simplest and most effective Electric Telephones in the world.

The "Unique" Transmitter is the only one made which does not require adjustment and that is not affected by atmospheric changes, or rust up.

## ALWAYS THE SAME.

Will transmit over the longest distance without readjustment.

"Samson" Batteries supplied with the "Unique."

***Send for Telephone Circular and Price List.***

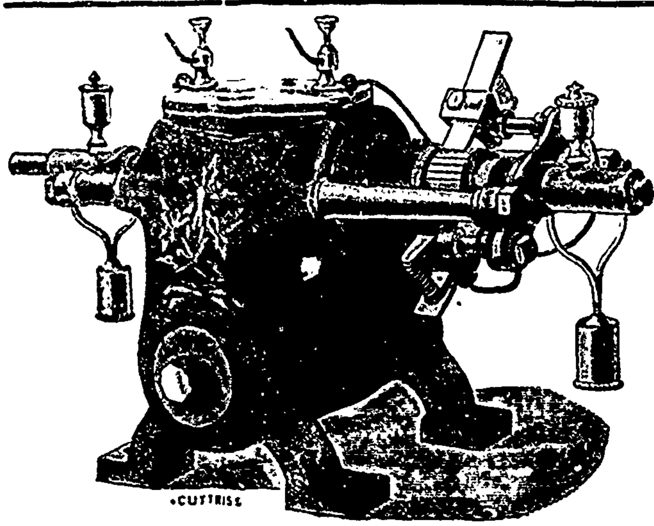
MANUFACTURED ONLY BY

**John Starr, Son & Co., Ltd.**

Manufacturers and Dealers in

ELECTRICAL APPARATUS AND SUPPLIES,

2, 4 and 6 Duke Street,
- HALIFAX, N. S.



# KAY ELECTRIC WORKS

NO. 263 JAMES ST. N. - HAMILTON, ONT.

MANUFACTURERS OF

## DYNAMOS

***For Arc and Incandescent Lighting.***

**MOTORS**

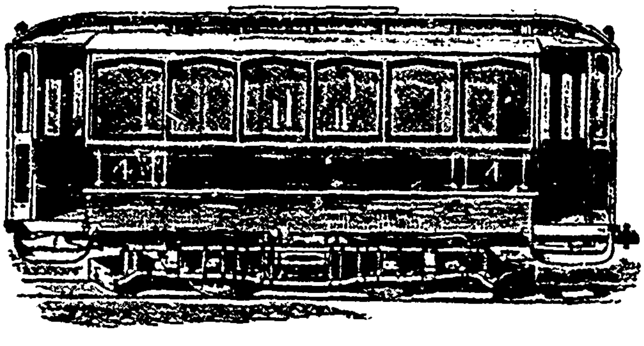
***From 1-8 H. P. to 50 H. P.***

ELECTRO PLATING MACHINES AND GENERAL ELECTRICAL APPLIANCES. SPECIAL ATTENTION TO MILL AND FACTORY LIGHTING.

*WRITE FOR CIRCULARS.*

# FINE - - ELECTRIC Street Cars

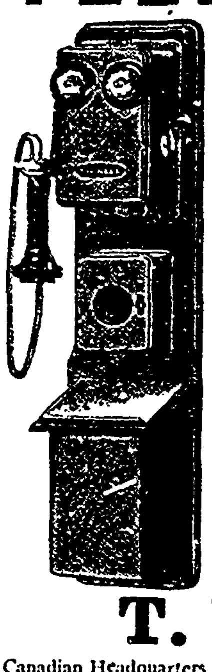
. . . . OUR SPECIALTY . . . .



We also manufacture Horse and Trail Cars of every description.

PATTERSON & CORBIN,
*ST. CATHARINES, ONT.*

# TELEPHONES



WE MANUFACTURE

Standard Bell Telephones
AND
Warehouse Telephones.
ALSO
Carbon Transmitter Telephones.

Local exchanges fitted up. All line material supplied.

STE JULIE Sept 5th, 1892

T. W. NESS, ESQ., Montreal.

DEAR SIR, We are happy to state that your telephones and switches are giving us good satisfaction. We have three sorts of switches and we find yours far preferable. There is now about forty of your telephones in operation on our line. Every one works well, and we intend to use no other.

Yours very truly,
THE MEGANTIC TELEPHONE CO.

Write us when you want anything electrical.

| | |
|---|---|
| *Key Sockets,* | *Magneto Bells,* |
| *Switches,* | *Annunciators,* |
| *Cut-outs,* | *Bells,* |
| *Wire,* | *Batteries,* |
| *Lamps,* | *Push Buttons, &c.,* |
| *Shades,* | *Dynamos and Motors* |

# T. W. NESS

Canadian Headquarters for Electrical Supplies.

749 Craig Street, MONTREAL.

CANADIAN

# ELECTRICAL NEWS

AND

## STEAM ENGINEERING JOURNAL.

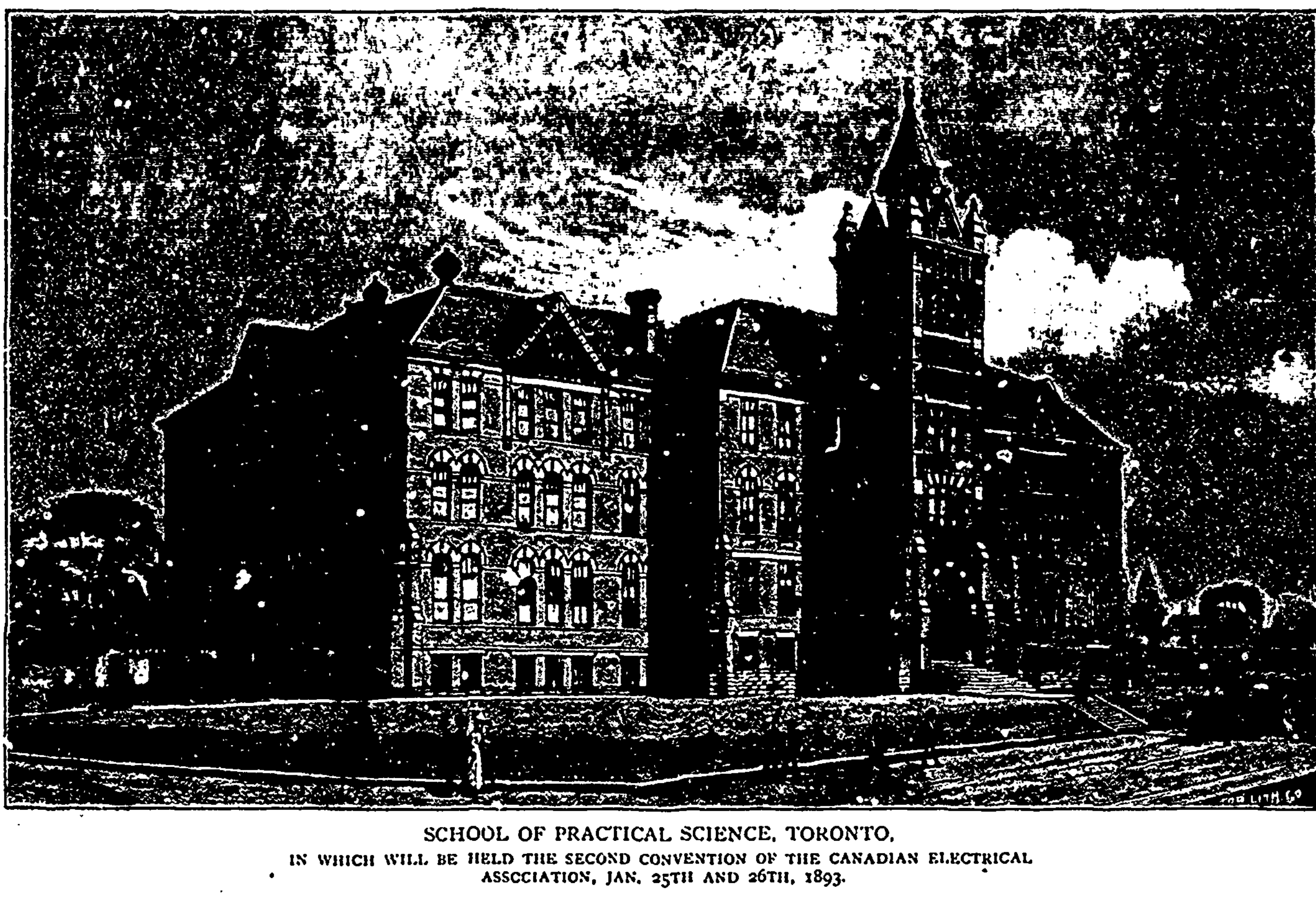
VOL. III. TORONTO AND MONTREAL, CANADA, JANUARY, 1893. No. 1.

## CANADIAN ELECTRICAL ASSOCIATION.

### January 25th and 26th the date of the Second Convention.

THE second convention of the Canadian Electrical Association will take place in Toronto on Wednesday and Thursday, January 25th and 26th, 1893.

An illustration of the School of Practical Science, in which the Association has been kindly invited to meet, is presented on this page. This institution, as the result of large expenditures made last year by the Ontario Government, is now equipped with a first-class physical laboratory, including the leading types of electrical apparatus. Members of the Association will on the occasion of the approaching convention be afforded an opportunity of thoroughly inspecting the school, which is designed to lay the foundation of a practical training for our young men, and from which will graduate many youths who will be connected with the electrical industries of the country in the future.



SCHOOL OF PRACTICAL SCIENCE, TORONTO,
IN WHICH WILL BE HELD THE SECOND CONVENTION OF THE CANADIAN ELECTRICAL ASSOCIATION, JAN. 25TH AND 26TH, 1893.

The convention will assemble in the School of Practical Science, as stated, at 2:30 o'clock on Wednesday, the 25th inst. It is expected that the balance of that day, as well as the whole of the day following, will afford little enough time in which to dispose of the business.

The Committees appointed at the Hamilton convention in June last will present their reports. Amendments to the constitution and by-laws will receive further consideration. There is likewise to be considered the important question of the division of the Association into sections representative of the various branches of the electrical industry, as suggested at the Hamilton meeting. This step is by many of the members considered to be necessary to the proper and efficient working of the Association, as well as in the best interests of the different departments of the electrical field.

A number of papers on subjects of special interest are in process of preparation for presentation and discussion at the convention. Among these may be mentioned a paper by Prof. Rosebrugh of the School of Practical Science; papers on "Testing," by Mr. Black, of the G. N. W. Telegraph Co., Hamilton; "Free Wiring," by Mr. J. M. Campbell, of the Electric Light & Power Co., Kingston, Ont.; "Underground Construction," by Mr. W. A. Tower, of the Bell Telephone Co., Toronto; "Steam Plant and Management in Electric Lighting Stations," by Mr. A. E. Edkins, President of the Executive of the Canadian Association of Stationary Engineers. Visits of inspection will be made to the central stations of the local lighting companies and also to the new Exchange of the Bell Telephone Co.

On the evening of the first day of the convention a social entertainment will be provided down town.

The headquarters of the Association during the convention will be at No. 40 York street, at which address delegates are requested to call on arrival in the city and obtain all necessary information. Programs of the convention are now being mailed direct to members' addresses, and it is hoped that as large a number as possible will be in attendance prepared to take an active part in the proceedings of the meetings.

## MONTREAL ELECTRIC CLUB.

Editor ELECTRICAL NEWS.

DEAR SIR,—The Montreal Electric Club was organized at a meeting held on the 12th inst. at Mr. W. B. Shaw's residence on Burnside street. The meeting was well attended, and the outlook of the Club is very promising. Messrs. E. Craig, A. Morgan and L. Granell were appointed a committee to formulate By-laws. The object of the club primarily is the mutual advancement of its members in knowledge of electrical science.

Mr. W. B. Shaw was appointed President, Mr. J. A. Farlinger Vice-President, Mr. J. Burnett Secretary-Treasurer.

The membership of the Club is to be confined to persons in the electrical business, it being found preferable to confine the membership to practical men and practical subjects.

Yours truly,
JAMES BURNETT,
Sec.-Treas.

## RESOLUTION OF CONDOLENCE.

*Whereas* it has pleased our allwise Creator and Heavenly Father to remove from this earth Horace, the son of our worthy friend and esteemed Bro. Geo. Fowler; be it

*Resolved*—That while we bow in humble submission to the divine will of our Heavenly Father, we at the same time extend our sincere and heartfelt sympathy to Bro. Fowler, his wife and family in this their hour of sorrow, and be it further

*Resolved*—That a copy of these resolutions be sent to Bro. Fowler and also to the ELECTRICAL NEWS for publication.

Signed on behalf of Toronto No. 1, C. A. S. E.

A. E. EDKINS
WILSON PHILLIPS } Committee.
C. MOSLEY

November 25th, 1892.

## TRY-COCKS.

TRY-COCKS on a boiler are important things, and should be so designed and arranged that they can be used with facility, and without the inconveniences and annoyance that they ordinarily give rise to. As usually made they are apt to leak continually. This in itself is a sufficient annoyance to call for some remedy, and the remedy that is too often applied is to stop up each leaking one by driving a pine plug into it. The wooden handles with which they are provided crack under the influence of the heat and moisture to which they are subjected and eventually fall off, so that the fireman has to use a pipe wrench, perhaps, to open them. Even when they are in good condition, and the fireman tries them faithfully, he is probably rewarded by seeing a voluminous spray of mud blown all over his boiler front; for mud will collect in the connections even if there is none elsewhere. This trouble is avoided, in some places, by providing a copper waste pipe, which receives the discharge from the try-cocks through small funnels brazed into it on the upper side. Such an arrangement proves very effective and satisfactory when the try-cocks are connected directly over each other, it is not easy to arrange such a waste pipe so that it will be effectual without being unsightly.

The lead or composition seats with which try-cocks are usually provided soften up under the influence of the heat to which they are subjected, especially when high pressures are used; and the fireman, in attempting to close the cocks tightly enough to prevent leakage, often jams the seats out of shape. Part of the seat is forced into the steam opening, forming a nipple, which greatly obstructs the flow of steam. In some cases these nipples are of such length that it becomes necessary to turn the cock till it nearly comes out of the thread before steam will blow freely through. It is true that the seats can be replaced, but this will usually have to be done on Sunday or a holiday, when the plumber's irons are cold. Moreover, it requires some time and patience to tin the recess for the filling and get a good job.

Another very annoying trouble is frequently experienced. Owing to the smallness of the nozzles of the cocks (usually about 5-32 or 3-16 of an inch), a slight deposit in them of scale or other similar substance will materially check the free flow of steam that should take place. The stems are usually not packed and the threads are apt to fit loosely. The result of these various circumstances is that when the fireman opens the cock a spray of hot and muddy water blows out through the loose thread and he receives it, perhaps, in his sleeve. At all events, he finds it unpleasant to use such try-cocks, and the result is apt to be that he trusts implicitly in the glass gauge, and leaves the try-cocks to themselves, plugged up, perhaps, to keep them from leaking.

There seems to be no good reason why ¾-inch and ½-inch angle valves may not be used in the place of the conventional try-cock, for there are many advantages in such an arrangement, and there is practically no difference in the expense. The angle valves are merely substituted for the ordinary cocks, and nipples, running off at an angle, are screwed into them. The nipples from the angle valves should open freely into the air.

By the use of angle valves many of the annoyances incident to the common try-cock can be avoided. The stems of the valves can be kept packed, so that no trouble from leakage in this direction need be feared. A small deposit of scale makes but little difference in the efficiency of the arrangement, on account of the enlarged area of discharge; and if a troublesome deposit should collect, the bonnet of the valve may be removed and the pipe, being of conveniently large size, can be cleaned out by a small rod or a stout wire. Another point of material advantage in the proposed arrangement is that the seats of the angle valves can be easily removed and replaced by new ones in a few minutes, so that the valves can be kept tight. (It is true that these small valves usually have solid seats, but they can be had with removable seats, if desired.) Under these conditions there will be no temptation to the fireman to neglect the try-cocks.

There is one objection to the use of angle valves that should be considered, though it does not appear to us to be very weighty. In removing and replacing the bonnet of the valve the fireman is apt to use too large a wrench and to screw the bonnet up with more force than is necessary. The result is apt to be that, after removing and replacing it a few times, the hexagonal nut becomes sheared all out of form, so that it is neither hexagonal, nor square, nor round, nor any other particular shape. Then he is apt to call loudly for a new valve. This has been the experience of some few of those who have used angle valves as suggested above, but we think this trouble can be avoided by a few words of caution to the fireman.

We may mention in this connection, another point that applies equally to angle valves and try-cocks. The tendency in these days is very noticeably toward the use of higher steam pressures than have been used in the past, and along with the higher pressures we must necessarily have higher temperatures to contend with. Thus saturated steam of 60 pounds pressure has a temperature of 307° F., while steam of 100 pounds has a temperature of about 348°, and at 125 pounds its temperature becomes 353°. Many alloys that will resist temperature of 307° for long periods of time soften up so much at 340° or 350° that they soon become unfit for use as valve seats. In such cases it is found that pure, soft copper can be substituted for the more fusible metals with good results.—*Locomotive.*

## PUBLICATIONS.

"The Mineral Industry, Its Statistics, Technology and Trade in the United States and Other Countries, From the Earliest Times to the Close of 1892." A large octavo volume bearing the above title will be issued in January, 1893, by the Scientific Publishing Co., 27 Park Place, New York, and it is claimed will be the most complete and valuable report of mineral statistics ever published, and an indispensable reference book. Price $2 and $2.50.

## OBITUARY.

The death is announced in Berlin, on the 6th of December, of Werner Von Siemens, the eminent German electrician, and founder of the firm of Siemens & Halske. The deceased was born December 13th, 1816, at Lenthe, in Hanover.

At a recent meeting of the Peterborough & Ashburnham Street Railway Company the following officers were elected: Jas. Stephenson, M. P., was elected president, and A. Stephenson, secretary treasurer.

Mr. J. W. Orme, the owner of the London and Lucan stage line, after having thoroughly looked into the matter, is about to give an order for an electric bus capable of accommodating the passenger and freight traffic of the entire line. The cost is estimated at $2,000. A storage battery and a 6 horse power motor will supply the power. It is expected that the route, a distance of 17 miles, will be covered in less than 2 hours.

## INSTRUCTIONS FOR THE MANAGEMENT OF ELECTRIC CARS*

THE TROLLEY.

A continuous metallic contact is needed between the generators at the power station and the motors on the car, and the office of the trolley is to make this contact with the overhead wire, which is, of course, directly connected with the generators. The trolley and its appendages are therefore the first things that require attention. The principal parts are "Trolley-wheel and Yoke," the "Trolley-pole," the "Trolley-stand," the "Trolley-springs," the "Trolley-pole wire" and the "Trolley-wheel pin."

The Trolley-wheel is made of a metal that will give a free passage to the electric current, and at the same time stand the hard usage to which it is subjected. As it revolves at a very high speed, it becomes a very important matter to properly lubricate it. To effect this the Trolley-wheel pin is made hollow and small holes are drilled through the bearing part on which the wheel runs. The hollow is filled with an absorbent material

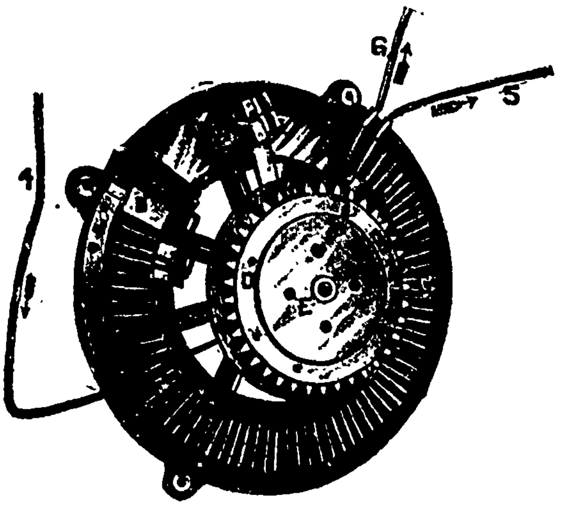



FIG. 1.—RHEOSTAT.

and the pin is then soaked in oil until a quantity is soaked up to be gradually used as needed. The trolley-wheel and pins are parts, therefore, that require very careful watching, for, if not properly lubricated and kept in good condition they will wear very rapidly and soon become useless.

The trolley-pole and trolley-stand need no description here. The stand is so constructed as to give complete freedom of movement to the pole and thereby insure the trolley-wheel remaining upon the overhead wire.

The trolley-pole wire is the wire that runs down the side of the trolley-pole and its use is to convey the current from the live wire to the machinery underneath the car. The current passes through the trolley-wire, through the wheel and pin, through the yoke, thence down the trolley-pole wire to the socket, through the trolley-stand to the wire leading to the cut out box.

The cut out box is simply a switch placed in the circuit to cut off the current, in case it is desired to work on or examine the motors or rheostat with the trolley on the wire for light or any other purpose. A car should never be left standing with the trolley on the wire unless the cut out switch is open. From the cut out box the current passes to the Fuse Box, thence to the Lightning Arrester and thence to the Rheostat.

The Fuse Box is the safety valve of the electric motor; it consists of a small wooden box containing a piece of wire, of such size and material that it will melt before the motors receive current enough to do any damage It is important that the heating effect of an electric current passing through a wire should be thoroughly understood in order to appreciate the value of the Fuse Box as a safety valve. Heat is generated in a wire by the passing of an electric current through it, and if the current that is forced through a wire is in excess of its safe carrying capacity the wire will heat to the danger point, or even become fused, and destroy the insulation, or in other words, "burn out the motor." Time is an element to take into consideration here, for heat cannot be produced without time. This must be remembered, for though generally it is proper to use a fuse wire that will melt when a current of the safe carrying capacity of the motor is reached, it is sometimes necessary to use a fuse wire of greater capacity than the maximum safe current.

The reason for this is that the motors require a much larger current for starting with a full load on a sharp curve, or on a heavy grade, than they can endure for any length of time. For this reason the fuse wire is much nearer the danger limit on motor cars than is common on stationary motors, and it will only protect the machines from sudden rushes of excessive current, therefore care should be taken in climbing long grades or in any place where the work is heavy and extends over any considerable time, that motors be subjected to no more current than is absolutely necessary.

At the ordinary voltage of the line and with the ordinary working current there is no connection with the ground; but should the voltage rise to such a point as would endanger the motors, as is the case when lightning strikes the line, provision must be made to pass the current direct to the ground before it gets to the motor.

The "Lightning Arrester" is a device through which the current passes that has a direct connection with the ground. At the ordinary voltage of the line there is no connection with the ground, but should the voltage rise to such a point as would endanger the motors the current will be shunted and pass over to the ground connection and escape.

To thoroughly understand the difference between the office of the Fuse Box and the Lightning Arrester, the difference between current and voltage must be understood. The Fuse Box is to protect from excessive current; the Lightning Arrester from excessively high voltage. A thorough understanding of this difference will also make plain the office of the "Rheostat," through which the current next passes.

THE RHEOSTAT.

The Rheostat is the throttle of the electric motor. It consists of an adjustable resistance placed in the circuit between the trolley and the motors for the purpose of cutting down or reducing the voltage or pressure on the line.

The Rheostats in use on the motors of this country are those known as the T-H, and consist, as will be seen by accompanying cut (Fig. 1), of a main casting or frame with a channel passing around the outer edge in which are laid the contact or resistance plates, C, C. Through the centre of this frame passes a spindle and engages the arm carrying the brush A by a kind of clutch.

The current enters the rheostat on the wire 4 in the direction indicated by the arrow. Wire 4 passes under the rheostat and connects with the spindle at its lower end. The spindle is insulated from the frame where it passes up through to the sprocket

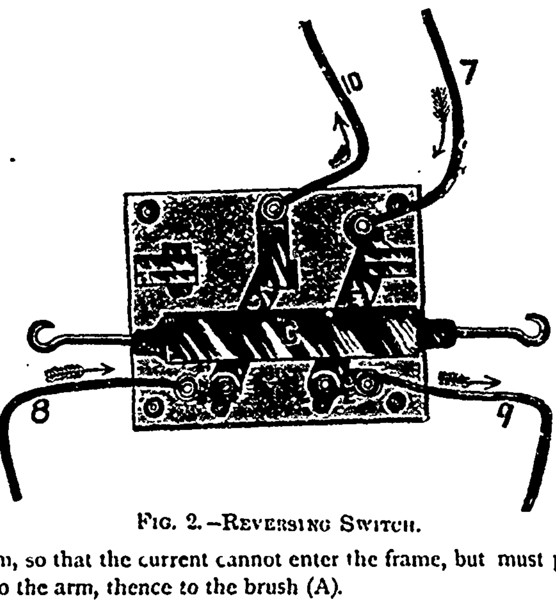



FIG. 2.—REVERSING SWITCH.

drum, so that the current cannot enter the frame, but must pass up to the arm, thence to the brush (A).

The sprocket drum has a wood centre, or other means of insulating the rim (D) from the centre and spindle so that no current can pass into the chains that connect the rheostat with the controlling stand. Under ordinary circumstances when everything is in working order and the cut out switch is closed the arm and brush (A) are "charged" when the trolley is on the wire Now, when the sprocket drum is turned the arm is carried around and the brush will be brought into contact with the "ap-

*From "Twin City Ry. Trainmen's Guide."

proach plate" (B). When the brush is on the approach plate (B) the current passes through the resistance (C C) and out on the wire (5) known as the "end wire" to the motors. The effect of the current passing this resistance is to cut down the voltage. Another effect of the current passing through this resistance is to develop heat and if long continued will burn out the resistance.

It is evident from this that the resistance of these plates should not be allowed to become impaired in any way. If this resistance gets "short-circuited" the motors will be subjected to the full voltage of the line at the start, which will start the car with a jerk and also endanger the machinery.

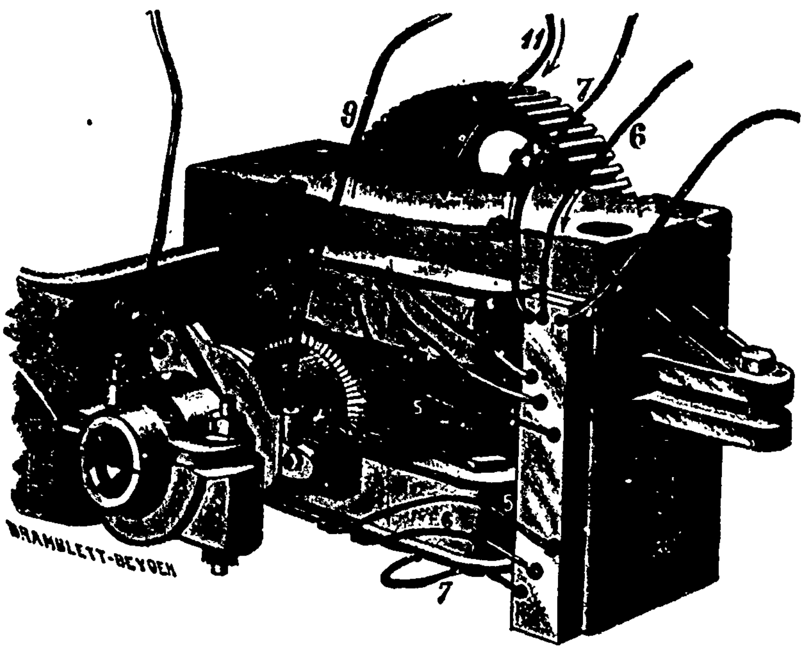



FIG. 3.—T.-H. MOTOR. S. R. G.

As the brush is moved around on the contact plate towards wires (5 and 6) this resistance becomes less and less until the brush reaches the contact to which wire (5) is connected when the resistance is all cut out, and the current at full voltage flows direct to the motors. Wire (6) is what is known as the "loop wire." The brush is moved on to the contact to which this wire is connected when a higher speed is desired. The connection of this wire at the motors will be explained in another chapter.

THE REVERSING SWITCH.

After passing the rheostat the current passes through the field coils of the motors, thence to the reversing switch, thence back to the armature and then to the ground.

The reversing switch (Fig. 2) is a device for reversing the flow of the current through the armature. It consists of a piece of well seasoned wood or other non-conducting material, upon which are mounted two oscillating levers G and F, which are connected together and operated by the insulating strip C. This method of operating the reversing switch may be seen by reference to the wiring diagrams, Figs. 5 and 6, where it is shown in the reverse position to Fig 2. The pieces D and E to which the levers G and F are pivoted, are connected by the wires 8 and 9 to the terminals of the armatures.

The contact jaw A is connected to the contact jaw B, by a wire at the back of the board. The current always enters on the wire 7 from the field coils, thence it passes through one or the other of the levers G or F, to the armatures by one of the wires 8 or 9 back on the other wire through the other lever to the ground connection, out on wire 10 to the ground.

The method of grounding wire 10 is fully shown by the wiring diagrams. In the position shown in the cut the current enters on wire 7 to the contact jaw B through lever F to the pivot E, through wire 9 to the armatures, back on wire 8 to the pivot D through lever G to the ground connection and out on wire 10 to the ground.

When the switch is reversed the lever G will be in contact with jaw A and lever F in contact with the ground connection and wire 10. In this position the current will enter on wire 7 to the contact jaw B, but this jaw not being in contact with the lever, the current passes through the wire at the back of the board to the contact jaw A, thence through the lever G to wire 8 through the armature in the opposite direction back on wire 9 through lever F to the ground contact, thence to the ground on wire 10. It is evident from the above that the wire 7 had at all times the full voltage of the line and that wire 10 makes connection with the ground.

Anything that will produce an arc across from either A or B to the ground connection will ground the line and result in the destruction of the switch. The same is true of the two points D and E. From this it is evident that two things are necessary for the preservation and proper working of the switch, viz.: 1st. That the insulation of the various parts be made and maintained perfect. 2nd. That the switch must never be moved or placed in such a position as to make an arc with either of the levers and the contact jaws.

MOTORS.

We have followed the path of the current from the trolley wire down to the motor. We have now to consider what takes place in the motors themselves. There are two different kinds of motors used on the lines of this company. The Sprague and T-H, or Thomson-Houston. Of the Sprague there is but one type. Of the T-H there are three types, viz.: Type 50 H. P., S. R. G., Type 30 H. P., S. R. G., and Type 30 H. P., D. R. G. Of the different types of the T-H the difference lies in the size of the wire and in the gearing only. The distinctive difference between the Sprague and the T-H is their field connections.

S. R. G. (single reduction gear) denotes one pair of gears.

D. R. G. (double reduction gear) denotes two pair of gears.

The two field coils of a T-H motor are in parallel with each other, while those of the Sprague are in series. Two wires or coils are said to be parallel when the current divides between the two and takes two separate paths after which it again unites.

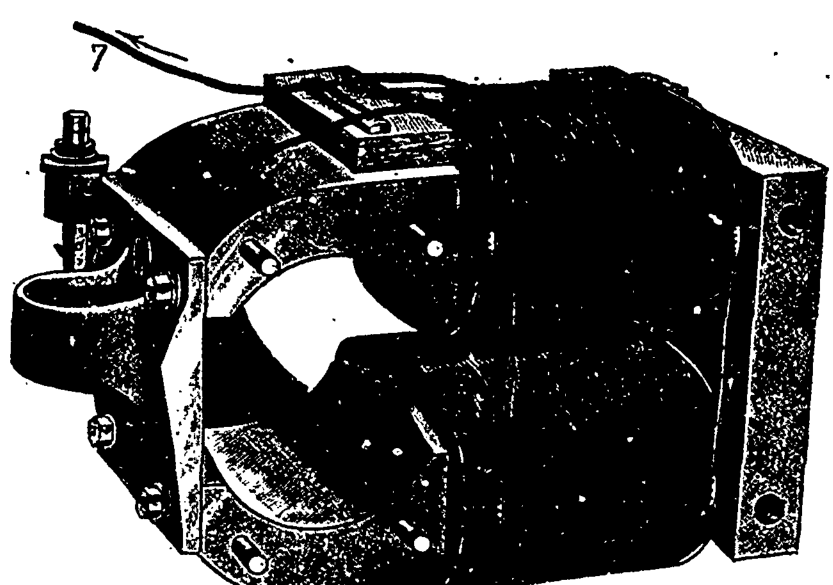



FIG. 4. FIELD MAGNETS, SPRAGUE SYSTEM.

They are said to be in series when the current passes through one and then through the other. Fig. 3 is a perspective view of the T-H, S. R. G. motor, showing the wire connections. Wires (5 and 6) connect with the rheostat. Fig. 1. Wire (7) connects with the reversing switch.

As indicated by the arrows the current flows in on wires (5 or 6) and out on (7). This is true at all times. Wires (8 and 9) connect the armature terminals with the reversing switch as shown in Fig. 2. The current in these wires is flowing in one direction when the motor is running in one way and in the opposite direction when the motor is running the other way. The current enters the armature on the wire that is toward the front of the car, in whichever way the car may be running.

In Fig. 3 the board shown at the side of the motor frame is known as the *field* board. It is made of two parts; one of which has grooves running up and down in which the wires are laid. The wires (5, 6 and 7) enter at the top and connect to three wires running up and down in the three parallel grooves. Wires (5, 6 and 7) connecting with the field coils, are connected with these wires. By this arrangement the wires (5, 5 and 5) are all connected together, also (6, 6 and 6) and (7, 7 and 7).

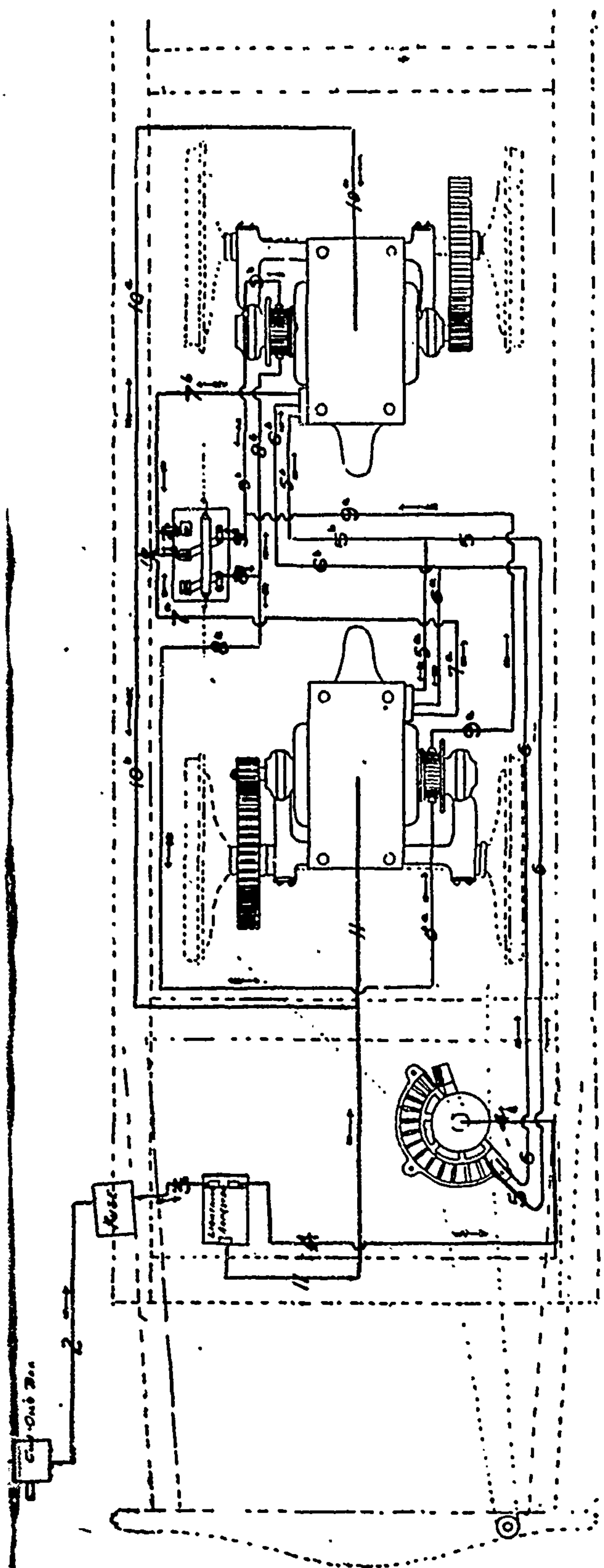


Fig. 6.—Diagram of Wiring Thomson-Houston Motor Car.—Single Reduction Gear.

Thus the current entering on (5) in the direction indicated by the arrow passes down the wire on the inside of the block and divides between the upper and lower field coils, passing through the field coils and out on wires (7, 7) reuniting and thence to the reversing switch. Thus it will be seen that of the total amount of current passing one motor, only half passes each coil.

When the rheostat is on the "loop" the current enters on wire (6), divides between wires (6 and 6) on the fields, passes through a portion of the field coils only, then out on wire (7) as before to the reversing switch. Returning from the reversing switch the current enters the armature on one of the wires (8 or 9) passes through the armature and out on the other wire, back to the reversing switch, thence to the ground.

The field wiring of a Sprague motor is shown in Fig. 4. The current enters on wire (5) passes into and through the upper field coil, thence down the connecting wire, as shown, into and through the lower coil, thence out on wire (7) as indicated by the arrow. From the field coils it flows to the reversing switch and back to the armatures in exactly the same manner as in the T-H motors.

It will be noticed that the principal electrical difference between the T-H and the Sprague motors is that the current divides between the field coils of the T-H motor, while it passes through the coils of the Sprague motor one after the other or in series.

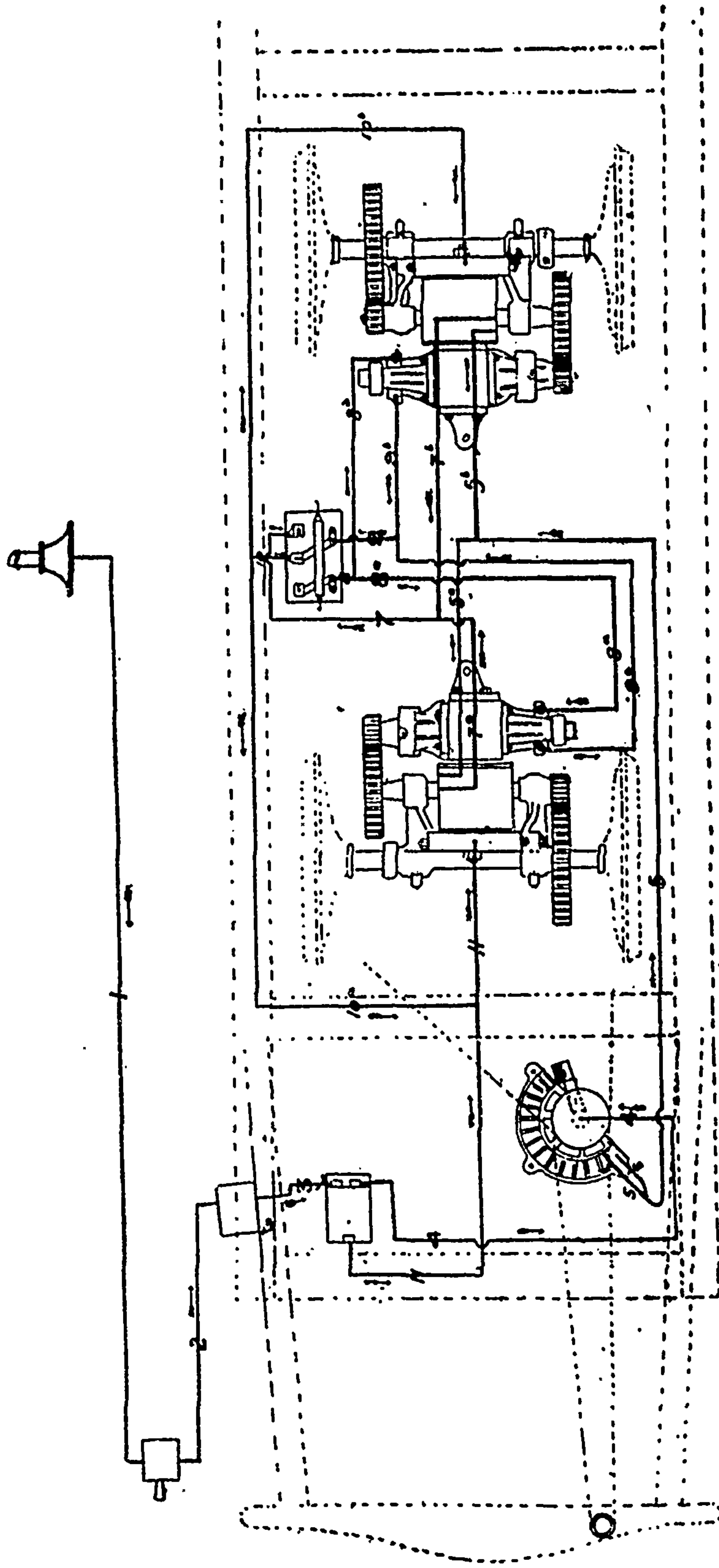


Fig. C.—Diagram of Wiring Car for Sprague D. R. G. Motors.

Fig. 5 is a diagram showing the wiring of the T.-H. S. R. G. motor car with the loop connection. When the "loop" is left out it is simply disconnected at the motor and the two connections shunted together at the rheostat as shown in the diagram of the wiring of the Sprague motor car, Fig 6.

*( To be continued. )*

CANADIAN ELECTRICAL NEWS AND STEAM ENGINEERING JOURNAL

PUBLISHED ON THE FIRST OF EVERY MONTH BY

**CHAS. H. MORTIMER,**

OFFICE: CONFEDERATION LIFE BUILDING,

*Corner Yonge and Richmond Streets,*

TORONTO, - - CANADA.

Telephone 2362.

64 TEMPLE BUILDING, - MONTREAL.

Bell Telephone 2299.

*ADVERTISEMENTS.*

Advertising rates sent promptly on application. Orders for advertising should reach the office of publication not later than the 25th day of the month immediately preceding date of issue. Changes in advertisements will be made whenever desired, without cost to the advertiser, but to insure proper compliance with the instructions of the advertiser, requests for change should reach the office as early as the 22nd day of the month.

*SUBSCRIPTION.*

The ELECTRICAL NEWS will be mailed to subscribers in the Dominion, or the United States, post free, for $1.00 per annum, 50 cents for six months. The price of subscription may be remitted by currency, in registered letter, or by postal order payable to C. H. Mortimer. Please do not send cheques on local banks unless 25 cents is added for cost of discount. Money sent in unregistered letters must be at senders' risk. Subscriptions from foreign countries embraced in the General Postal Union, $1.50 per annum. Subscriptions are payable in advance. The paper will be discontinued at expiration of term paid for if so stipulated by the subscriber, but where no such understanding exists, will be continued until instructions to discontinue are received and all arrearages paid.

Subscribers may have the mailing address changed as often as desired. *When ordering change, always give the old as well as the new address.*

The Publisher should be notified of the failure of subscribers to receive their papers promptly and regularly.

*EDITOR'S ANNOUNCEMENTS.*

Correspondence is invited upon all topics coming legitimately within the scope of this journal.

THE "CANADIAN ELECTRICAL NEWS" HAS BEEN APPOINTED THE OFFICIAL PAPER OF THE CANADIAN ELECTRICAL ASSOCIATION.

## CANADIAN ELECTRICAL ASSOCIATION.

### OFFICERS:

PRESIDENT:
J. J. WRIGHT, Manager Toronto Electric Light Company.

1ST VICE-PRESIDENT:
K. J. DUNSTAN, Local Manager Bell Telephone Company, Toronto.

2ND VICE-PRESIDENT:
JOHN CARROLL, Sec-Treas. Eugene Phillips Electrical Works, Montreal.

SECRETARY-TREASURER:
C. H. MORTIMER, Publisher ELECTRICAL NEWS, Toronto.

EXECUTIVE COMMITTEE:

D. A. STARR, Royal Electric Company, Montreal.

H. O. FISK, Electrician Electric Light Company, Peterboro', Ont.

W. A. JOHNSON, Manager Ball Electric Light Company, Toronto.

S. J. PARKER, Managing Director Owen Sound Electric Light Company, Owen Sound, Ont.

A. B. SMITH, Inspector Canadian Board Fire Underwriters, Toronto.

D. THOMSON, General Manager Hamilton Electric Light and Power Company, Hamilton, Ont.

THOS. H. WADLAND, Superintendent Construction, Bell Telephone Company, Hamilton, Ont.

L. B. McFARLANE, Bell Telephone Company, Montreal.

JOHN YULE, Manager Guelph Gas and Electric Light Company, Guelph, Ont.

## CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.

EXECUTIVE BOARD:

| | |
|---|---|
| President, A. E. EDKINS, - - | Toronto, Ont. |
| Vice-President, G. HUNT, - - - | Montreal, Que. |
| Secretary, W. G. BLACKGROVE, - | 43 Brant St., Toronto. |
| Treasurer, R. MACKIE, - - - | Hamilton, Ont. |
| Conductor, CHAS. HEAL, - - | Toronto, Ont. |
| Door Keeper, F. Brisbois, - - | Montreal, Que. |

TORONTO BRANCH NO. 1.—Meets every 2nd and 4th Friday each month in Room D, Shaftesbury Hall. W. G. Blackgrove, President; _ Phillips, Secretary, 63 Marlborough Ave.

HAMILTON BRANCH NO. 2.—Meets 1st and 3rd Friday each month, in Maccabee's Hall. W. Sweet, President; E. Nash, Secretary, 89 Little William Street.

STRATFORD BRANCH NO. 3.—John Hoy, President, Samuel H. Weir, Secretary.

BRANTFORD BRANCH NO. 4.—Meets 2nd and 4th Friday each month. Thos. Pilgrim, President; John Ogle, Secretary, G. T. car shops.

LONDON BRANCH NO. 5.—Meets 2nd Tuesday each month. F. Mitchell, President; J. McIntosh, Secretary.

BRANDON, MAN., BRANCH NO. 1.—Meets 1st and 3rd Friday each month, in City Hall. A. R. Crawford, President, Arthur Fleming, Secretary.

MONTREAL BRANCH NO. 1.—Meets 1st and 3rd Thursday each month, in Mechanics' Institute, 204 St. James street. Thos. Naden, President; Jos. G. Robertson, 1420 Mignonne street, Secretary.

ST. LAURENT BRANCH NO. 2.—Meets 1st and 3rd Tuesday each month, in Mechanics' Institute, 204 St. James street. Matthias Guimond, President; Alfred Latour, Secretary, 306 Delisle street, St. Cunegonde.

GUELPH BRANCH NO. 6.—Meets every 1st and 3rd Saturday at 7:30 p.m. J. A. Angell, President; C. Jorden, Secretary.

THE sixteenth convention of The National Electric Light Association of the United States, will be held in St. Louis, Mo., on February 28th, March 1st and 2nd.

CONSIDERABLE doubt exists regarding the relative advantages of high versus low speed engines in electric lighting stations. A number of inquiries have reached us on this subject. With a view to the elucidation of the question, we shall publish in several succeeding numbers of the ELECTRICAL NEWS a series of articles on the subject, and touching also upon the general character and arrangement of steam plant necessary to give the greatest efficiency of service at least cost of operation. We trust that these articles may prove of value to engine builders, owners and operators.

A HAMILTON company has applied for a charter to construct and operate electrical railways radiating from that city to other cities and towns in Western Ontario, and to lease and operate street railways in various municipalities. The idea with which the company was organized was that power to operate all these proposed undertakings could be generated at Niagara Falls and from thence transmitted by wire to Hamilton. As the result of having consulted Mr. W. T. Jennings, the well known engineer, the promoters learn to their disappointment that under present conditions the scheme cannot be worked on a paying basis, owing to the cost of the plant. This fact was stated in the ELECTRICAL NEWS more than a year ago in an article exposing the scheme to boom Queenston Heights as a manufacturing centre.

WHILE the electricity building at the World's Fair will probably afford too little accommodation for exhibitors of apparatus legitimately pertaining to the practical application of electricity, much space is being granted to what are known as "electrical fakes." The *Electrical Engineer* of New York enters a well founded protest against the admission of exhibits of this kind to the building, where they would appear on the same plane with those of legitimate character. The very fact that they are to be allowed to form part of the electrical display, will in the eyes of the public be regarded as evidence of their genuineness, and thus a deception which has already drawn from the pockets of the credulous vast sums of money, will be given a certificate of character by means of which the evil may be perpetuated. This condition of things, bad enough under any circumstances, when allowed to proceed at the expense of those desirous of making a satisfactory exhibit of apparatus of a legitimate character, becomes a grave injustice.

A CORRESPONDENT complains of the irregular admission of steam to an engine 12 inch, by 16 inch making 150 revolutions per minute. He says the steam is cut off for three and four strokes at a time, at quite regular intervals, and yet that he cannot detect any variation of speed. He does not give a very clear description of the kind of engine, but it would appear to be an automatic cut-off engine, probably with a spring governor controlling the position of the eccentric. If so, it might be quite possible that the speed of the engine increased sufficiently to move forward the cut-off arrangement and prevent the engine getting steam. It could not happen without some increase of speed unless the governor be so erratic in its action as not to control the engine at all. From our correspondent's statements we judge that the engine has too little to do for the size of cylinder and pressure of steam used. If the load on the engine is not to be increased, better results would be got by reducing the pressure. This is clearly a case where indicator diagrams should be taken, in order to determine what really does take place in the cylinder. Get the indicator to work, friend, and send along the diagrams, and we can then tell you better what to do.

ELECTRIC lighting companies who may be doing considerable house lighting by means of alternating system and converters, should select a central point of distribution in a block in which to locate if possible one converter to do all lighting required in such block. A much smaller converter capacity will thus be required than if every house was fed from its own converter, and as any good make of converter will carry a temporary overload of from 25 to 50 per cent., it will readily be seen that this method is surely a commendable one. As to the size required for such converter, a safe plan would be to have it of such capacity that it will be able to provide three lights out of every ten wired for. This would probably be all that would be required in the way of regular lights, but if four to every ten should be needed at times, the converter would be found to give them without any trouble, provided it were fused large enough to carry the temporary overload. In this connection we would advise even under ordinary requirements the fusing of all converters sufficiently large to carry double their rated capacity. There may be occasional cases where this rule would not apply, but in the general run it will be found to be about right. It might be argued that there might be a possibility of some one house in the block requiring all or nearly all of the lights in the house in use occasionally, but even in this case the rule would still apply, for we question if there are as a rule more than two and in many cases more than one light out of every ten in use in dwelling houses, unless at a special hour, and even then our three in ten would amply provide both for the house using nearly all their lights as well as the others.

---

THE world was startled some months since by the bold proposal to construct an electric railroad between Chicago and St. Louis, the trains on which would run at a speed of one hundred miles per hour. A company with a capital stock of seven million dollars was organized, and the work of construction commenced. Fifty thousand shares of the company are now being placed on the market, accompanied by what is termed a conservative estimate of the yearly revenue and expenditure. The revenue is estimated at $2,895,000, and the expenses, including interest charges, at $870,000, leaving the net earnings $2,025,000, or equivalent to a dividend of 29 per cent. on the capital stock. This at first glance might look like a good scheme to invest in, but on a closer view, presuming the estimated income to be properly based, $450,000 seems to be altogether too small a sum for operating expenses. Attention is also being drawn to the fact that even though it might be found practicable to construct apparatus which could be operated at such a high rate of speed—a subject on which there is the strongest reason for doubt—there has been no strong desire expressed by the public to be carried at such a rapid gait. There are already two or more railroads running parallel with the route of the proposed electric road, with which the traffic must be divided. It is likewise pointed out that if the new enterprise were likely to prove the bonanza which the promoters claim it will be, the existing railway corporations would be quick to perceive the fact and to buy up the stock. The scheme appears to be viewed with a good deal of suspicion, and the independent electrical press is fulfilling its duty by advising the public to be cautious about having anything to do with it.

---

THE dangerous and destructive influence of earth currents arising from the operation of the electric street railway has begun to attract attention in Toronto, as well as in Boston and elsewhere. A few days ago a spark was observed at the junction of the gas and water pipes in a knitting factory about a quarter of a mile distant from the Toronto Street Railway Company's power house. The current proved to be sufficiently strong to heat to a red heat a pair of pliers placed against the water pipe. An electrical expert to whom the occurrence was reported was inclined to regard it as a piece of imagination until he had satisfied himself of its truth by personal observation. There is no doubt that in this particular instance the building and its contents were in imminent danger of being burned up. How many other cases there are in which similar conditions prevail is a matter that has not been determined. It is but reasonable to suppose, however, that the case mentioned does not constitute a solitary exception. To the inequality of the grounds made use of is believed to be attributable the fact of certain pipes being so heavily charged. Whether or not means could be found of equalizing the grounds is at present a matter of speculation. It is rumored that new cables of the Bell Telephone Company's underground system are showing signs of decay as the result of electrolytic action due to these currents. In Boston, the underground gas and water mains are said to have been affected in like manner and from the same cause. If it should turn out to be true that earth currents are so destructive, street railway corporations will be compelled to do away with them by erecting additional overhead wires or by some other means. This is a subject of the greatest importance, and one which we should like to see discussed in all its bearings at the approaching convention of the Canadian Electrical Association.

---

ON the evening of Sunday, the 19th December, the people of London, Ont., were startled by a terrific noise and a shaking as if an earthquake had rushed past the city. Quite a number of windows had the glass broken, and some houses were invaded by pieces of iron or brass entering by way of the roof without ceremony. Next morning the public became aware that the disturbance had been caused by the explosion of a locomotive, which had been standing on a siding near the round house. The tender and fire-box part of the boiler were left on the track at one place, and a few feet away stood the truck supporting the cylinders of the engine and the front end of the boiler and the smoke pipe. Broken and bent boiler tubes and pieces of machinery and plates twisted into odd shapes lay between. The circular part of the boiler was gone. Nearly every window in the round house was broken and there was a piece of the brick wall about twenty feet long down. Only two men were hurt, and neither of these very badly. It is reported that one of these men was in the act of climbing up on the engine to look at the steam gauge when the explosion took place. It is a mystery that he escaped alive. The boiler must have had plenty of water in it, because the crown sheet of the fire-box was not damaged. Had the water been too low the crown sheet would have been the starting point of the explosion, and in all likelihood no other part of the boiler would have given way. The front end of the boiler shell looked to be about 4 feet in diameter and the pieces of plate scattered about appeared to be iron of good quality and to be about three eighths of an inch thick. The pressure must have been very great, and the plates would seem to have been of about equal strength, as all the round part of the boiler was blown to pieces. A good iron shell 48 inches diameter made of plates ⅜ inch thick and double rivetted would have a bursting pressure of about five hundred pounds per square inch. The fire box had screwed stays about 4½ inches centre to centre, and the plates seemed to be ⅜ inch thick. The bursting pressure of flat sides of fire box would be more than 1000 pounds per square inch. This is confirmed by the fact that when the round shell went to pieces the fire box remained quite sound. The engine had been standing on the siding to be ready for work on Monday morning with a little fire in it, as is the custom. It is apparent in this instance that the safety valves must have failed to relieve the pressure. The probability would be that the engine standing motionless all day and free from the usual shaking, the safety valves became fast in their seats and did not open at all. The steam space in a locomotive boiler is so very small that with no outlet for the steam a small fire would soon run the pressure up to the bursting point.

---

PERHAPS no part of a dynamo requires more care or attention than does the commutator if good running is the object aimed at. This not only applies to those commutators in which there are a number of segments, but particularly to those in which there are few, as a T-H Arc light dynamo, for in no one place can carelessness in cleaning or any neglect whatever result so disastrously as here. Of course in this make of dynamo the blower or blast producing mechanism becomes almost a part of the commutator, and requires the best of care and handling to produce the best results. We have known of cases where the screens that admit air into the blower have been so choked with dirt and oil that the only wonder was where the blower managed to get any air at all to deliver at the jets. The result was, flashing circuits and plenty of them, the cause of which seemed a mystery to the party who had the handling of the dynamos and who was supposed to look after and cure any tendency in this direction. As soon as the choked up screens were removed and replaced with new ones, the flashing at once vanished. Cleanliness and attention are as much a necessity with this part as oil is for the bearings. Then again to secure smooth running, the segments must not be allowed to become worn to any great extent, but when they become well marked with the track of the brushes should be replaced with others that are smooth and in good shape. The brushes must also be kept with an even smooth edge and not have too much bearing on the commutator—just enough being required to prevent them from jumping as the different sections of the commutator pass them. We have known cases where the brushes on a T-H arc dynamo were set with spring enough to exert a pressure of fully 25 lbs. (and perhaps more) on the commutator, at the end of each brush, and the wonder was expressed that the commutator segments wore away so fast at the end of each segment. The brushes being set as they should be, and new segments being put in place, the trouble was remedied at once, resulting in an almost even wear of the segments all around. These remarks do not apply to the many segmented commutators that are mostly used on non alternating incandescent dynamos and power generators, but even in these cases the greatest amount of care and attention is required at that part of the machine, it being necessary to go over them segment by segment occasionally to see if any of the mica insulation between the segment has worn out or become otherwise disturbed, leaving a slot that will fill up with carbon dust or copper from the brushes and cause a short circuiting of some of the segments. Another cause of trouble with this class of commutator will frequently be found in the dragging of a film of copper across the mica from one segment to the other, causing again short circuiting and trouble. We feel safe in asserting that there is no part of a dynamo that requires one quarter as much attention as the commutator does; of course in alternating machines proper there is none of this trouble on account of the collector rings being in one piece all the way round, but even here care and attention used in keeping them flat and smooth will be more than repaid by the little trouble they will cause when so kept, not to speak of the uneven wearing of the collecting brushes when the rings are allowed to become serrated and lumpy.

---

APPARATUS for the production of heat by application of electric current has become a commercial article and has to a certain extent passed the experimental stage. Such apparatus is at present being made by several firms for the operation of tailors' irons and a variety of utensils for use in the household, such as griddles, stew-pans, coffee and tea pots, bed and bath room heaters, in fact in some cases there have been offered for sale in the market heaters for either hot water coil heating or hot air. Perhaps the most surprising thing is that these heaters are reported as actually being operated at little or no cost above that of coal for the same purpose. Such reports however come from stations that are wholly operated by means of water power. This leads us to remark that owners or managers of light and power plants who have ample water in their dams all day long cannot employ it in a more remunerative way than to operate a dynamo or dynamos for this very purpose. Of course the current for such heating and cooking will have to be put down to rock bottom prices if the system is to be introduced, but it will still leave margin enough to pay a nice profit on the amount invested. Some of our readers after perusing the above may give more than a passing thought to the advisability or possibility of adding these heaters or cookers to their power generators or lighting circuits. In this respect there will have to be considerable judgment displayed, for while it would be possible to put any affair that would not require more than say 20 amperes on an ordinary lighting circuit, if wired heavily enough, it certainly would be detrimental to the lighting service to attach one that would require double that amount, unless a special wire was put in to feed it, as well as what might be used in producing lights. Again, with a power circuit, it would in most cases be an easy matter to put on an appliance consuming say current up to 50 amperes without disturbing the speed of any of the motors, but it might make quite an appreciable difference if 100 amperes were suddenly thrown on, unless, as mentioned above, special arrangements had been made to supply this amount of current at any one place by enlarging the mains and supply wires. Everything considered we feel that we are giving good advice when we say to station managers, take the matter up and ponder over it; there will some good come of it, if you should happen to be one of the lucky possessors of a good water power and one that is available the whole year round. It would be absurd for us to advise the same course for those who are compelled to operate their plant by means of steam power, but it can be done in a small way, even under these conditions. Those who possess even enough water for condensing purposes can perhaps add a few small heaters or cookers to their power or lighting circuits to advantage; at least the matter is worthy of consideration, and to those who care to give it some thought we heartily commend it.

## 500-VOLT MOTORS.

In most of our cities, motors are now run chiefly on 110 or 120 volt circuits, a few being found also on arc series circuits. There appears to be, however, says the *Electrical Engineer*, a marked tendency towards the use of constant potential motors, at as high a voltage as 500, not merely on railway circuits, but in regular power work. Mr. A. C. Balch, the electrical engineer of the Union Power Company of Portland, Ore., writes us that they now have in operation something over 700 h. p. of 500-volt motors. It would, he remarks, be a financial impossibility to run at any lower voltage, as the station is three miles from the centre of distribution. The 500-volt machines have given little, if any, extra trouble, as compared with the 110 or 220 volt motors.

This is interesting and encouraging, and is confirmed by the reports that reach us from another large city, where about 850 h. p. nominal is now being furnished with 500-volt motors, averaging 7½ to 10 h. p., and going up to 35 h. p. In this case the station is about midway in a system of distribution stretching 5 miles, or about 2½ miles each side of it. The demand is growing, and the motors will reach 1,000 h. p. daily this year. As overhead circuits are used, the extensions of the service are made quickly and economically. Current is metered, and also sold at a flat rate, but prices, so far as we can learn, average four or five cents per horse power hour, and perhaps shade below that for large powers, running, however, well up to ten cents for small powers.

We think the field here indicated is worthy of study by station managers. Motors of high voltage are now well built, and even in the smallest sizes are capable of yielding excellent results; while the saving of copper in the circuits is something enormous. But perhaps we shall not see the full possible development of this field until a higher volt incandescent lamp also makes its successful debut. Meantime, in planning independent power circuits, managers should, we think, concentrate their energies and attention on 500-volt work, as being safe for the public, as more economical for themselves, and as admitting of the distribution of power over a much larger territory.

## WIDTH OF BELTING.

How to find out what width of belt to get often bothers millwrights and power users; and sometimes they make great mistakes, getting belts that are much too narrow to do the work that is demanded of them, or else paying for belts and pulleys which are much too wide for the power that they have to carry. Leather belts are the most used, and they are used more on cast iron than on any other kind; and the following rules apply to these conditions. We will assume that the belts are 7/32 inch thick, and in good condition. Of course the width demanded depends in great measure upon the mode of fastening employed; for the belt itself will not carry any more strain than the lacing or other fastening will. This table will be found practically correct for the conditions named; and for an arc of contact of 180° on the pulley; that is, where the belt wraps half way round the pulley:—

For single leather lacing, the width of belt in inches is 0.0197 times the pull needed upon the pulley to carry the power at the speed at which the belt is running. For single rawhide lacing, 0.0183 times; double leather, 0.0171; double rawhide, 0.0160; for riveted joints, 0.0111 times.

The number of pounds pull required to carry any number of horse power, at any speed per minute, is found by multiplying the number of horsepower by 33,000, and dividing by the speed in feet per minute. Thus suppose it be required to carry 290 horse power at 2700 feet belt speed, by a leather belt 7/32 inch thick, running on a cast iron pulley upon which it wraps 180°, the lacing being single leather, then the pull will be $290 \times 33,000 \div 2700 = 354.4$ pounds. The belt width in inches will be $354.4 \times 0.0197 = 7.02$, or practically 7 inches.

If the belt was laced with double rawhide, then the width required would be only $354.4 \times 0.0111 = 3.93$ or practically 4 inches. —*Power and Transmission.*

## THE COST OF ELECTRIC SUPPLY.*

By Dr. John Hopkinson, F.R.S.

Electrical engineers now realize that they have to provide the same plant and no more to give a steady supply day and night, as to give a supply for one hour out of the twenty-four. They also now realize that if they are to be ready to give a supply at any moment, they must burn much coal and pay much wages *for however short a time the supply is actually taken.* Indeed, the term "load-factor" proposed by Mr Crompton is as constantly in the mouths of those who are interested in the supply of electricity, as volt or ampere or horse-power. The importance of the time during which a supply of electricity is used was so strongly impressed on my mind years ago, that in 1883 I had introduced into the provisional orders with which I had to do, a special method of charge intended to secure some approach to proportionality of charge to cost of supply. Unfortunately the orders of that day all came to nought.

A supply of electricity must be delivered at the very moment when the consumer chooses to use it, and as long as and no longer than he pleases to use it; it cannot be very readily or cheaply stored, and much of the cost of production is the fixed charge for plant and conductors. Furthermore, the provisional orders require that the supply shall be available at all hours; hence coal must be consumed and workmen must attend, though but few customers are drawing a supply. The service of supplying electricity has from an economic point of view a great deal of similarity to the service of providing a breakwater for a harbour A great deal of the expense is independent of the number of hours in the day during which the supply is used. To put it in another way, the cost of supplying electricity for 1,000 lamps for ten hours is very much less than ten times the cost of supplying the same 1,000 lamps for one hour, particularly if it is incumbent on the undertaker to be ready with a supply at any moment that it is required.

The actual importance of considerations of this kind can only be realized by examining figures. The figures may as well be estimated figures, because the circumstances vary from one neighborhood to another. No criticism of the details of the figures will affect the general character of the conclusion. Let us then imagine a station capable of supplying 40,000 16-candle lamps at one time, with mains and spare machinery enough to ensure that the supply shall not fail, and let us see what the charge for running such a station will be; firstly, on the hypothesis that it is always to be ready to supply the 40,000 lights at half-an-hour's notice, day or night, but the lights are hardly ever actually required, secondly, on the hypothesis that the 40,000 lights are steadily and continuously supplied day and night. These are the two extreme cases possible. In the former, the load factor is nil; in the latter it is 100 per cent. If the charge is by meter at 8d. per unit in the former case, the revenue will be nil; in the latter it will be £730,000 a year.

We are going to divide the cost of supplying electricity into two parts, a part which is independent of the hours the supply is used, and a part which is directly proportional thereto, and we are going to estimate the amount of each element. It is for the purpose of ascertaining these elements that we consider two quite hypothetical cases; cases which can themselves never actually occur.

We must first have an idea of the capital outlay required. To provide the maximum of 40,000 lamps we need to deliver 2,500 units per hour, and we may estimate the capital outlay as follows.

| | |
|---|---|
| Land | £25,000 |
| Buildings | 15,000 |
| Boilers and pipes | 14,000 |
| Engines | 24,000 |
| Dynamos | 15,000 |
| Switchboard and instruments | 2,000 |
| Feeders and mains | 50,000 |
| | £145,000 |

Let us deal with the annual charge for each item of capital separately on the two hypotheses. The charge for land and for buildings, including repairs, is clearly the same in the two cases, say at 4 per cent. £1,000 for the land, and at 10 per cent. £1,500 for the buildings. The boilers, engines and dynamos will have a charge for interest and a charge for writing off, or amortisation as the French call it, that is, for writing off the value of the plant before the time at which it becomes antiquated—exactly the same in the two cases. The boilers too will require exactly the same repairs whether they are merely keeping steam or whether they are generating steam continuously, but the machinery will certainly require more for repairs and renewals if it is all running than if a part only is running without load and the rest is standing ready for a load if required. I take 4 per cent. as the charge for interest; 3 per cent. for amortisation; 8 per cent. for repairs and maintenance. Of the repairs of engines and dynamos I assume that 2 per cent. will be applicable if the plant runs light, the remaining 6 per cent. if it is fully and continuously loaded. The expenses connected with conductors, switchboard, etc., will be exactly the same whether the current is passing or not; these I take at 15 per cent. The rates I put down at £500 a year. The account then for the fixed charges already enumerated would stand as follows:

| | Running light. | Fully loaded. |
|---|---|---|
| Land | £1,000 | £1,000 |
| Buildings | 1,500 | 1,500 |
| Rates | 500 | 500 |
| Boilers | 2,100 | 2,100 |
| Switchboard and conductors | 7,800 | 7,800 |
| Engines | 2,160 | 3,600 |
| Dynamos | 1,350 | 2,250 |
| | £16,410 | £18,750 |

*Presidential Address to the members of the Junior Engineering Society, delivered November 4th, 1892.

We now come to a most important item in the account, the coal. There is no doubt that with uniform and continuous load a unit of electric energy—1⅓ horse-power for one hour—can be produced for less than 3 lbs. of coal; it is also pretty much admitted that with a load factor of about 12 per cent., but continuous maintenance of pressure, the consumption of coal in good practice is something like 7 lbs. That is to say to keep the boilers warm, turn round the machinery for 24 hours, and deliver full current for 24 hours, will require 72 lbs. of coal per kilowatt, whereas, to keep the boilers warm, turn round the machinery, and deliver current for three hours, will require 21 lbs. of coal. The boilers being kept warm, it will take 51 lbs. of coal to generate steam enough to give a unit per hour for 21 hours, 58 lbs. to give a unit per hour for 24 hours; subtracting this from 72 lbs., the amount required both to generate steam and keep the boiler warm, we may infer that to keep the boiler warm and merely turn the machinery in readiness to meet a demand will take about 14 lbs. of coal per day for every unit per hour the plant is capable of producing. In 1889, for the Society of Arts, tests were made of a Paxman compound engine, from which it appears that a boiler which, when fully loaded, consumed 40 lbs. of coal per hour, required 4 lbs. per hour to keep steam up to normal pressure when the engine was standing; that is, 10 per cent. of the coal used was used to maintain the steam pressure. Remembering that in addition we keep some of our machinery moving, this may be said to confirm the figures adopted. *Thus, if the plant runs light all the year round 12,775,000 lbs*, or let us say 6,000 tons of coal will be consumed. If the plant runs fully loaded 65,700,000 lbs., or let us say 30,000 tons would be consumed. If we suppose the coal to be the best smokeless it might cost 20s per ton. Next we have water, oil and petty stores; say £600 and £3,000 in the two cases. Wages will be a little less if we run light than if we run fully loaded, and of course will largely depend on local circumstances; let us say £5,000 and £7,500 in the two cases. This gives us substantially all the expenses which have to to be met, and our account will then stand thus.—

| | Running light. | Fully loaded. |
|---|---|---|
| Fixed charges | £16,410 | £18,750 |
| Coal | 6,000 | 30,000 |
| Stores | 600 | 3,000 |
| Wages | 5,000 | 7,500 |
| | £28,010 | £59,250 |

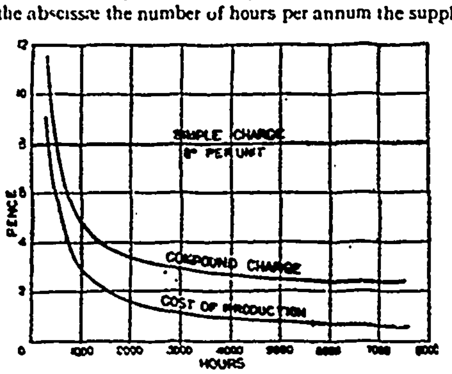
Thus the cost of merely being ready to supply 2,500 units per hour at any moment throughout the year will be £28,010, and the cost of actually supplying 2,500 units per hour for every minute in the year will be £59,250. The undertaker, therefore, who incurs the liability to supply, ought to receive £11 per annum per unit per hour from those on whose behalf he incurs the liability, and if he receives the £11 he need not charge more than 1/3d. per unit for what he actually supplies, to cover his expenses. That these figures are fair approximations can be seen as follows. According to this calculation the cost of supplying 2,500 units for one hour per day is £28,010 + 2,500 × 365 × 1/3d. = £25,277, and the charge for the service at 8d. a unit would be £30,417; it is doubtful if such a supply would pay. On the other hand an indicated horse-power on such a scale could certainly be supplied continuously for from £12 to £14 per annum, and according to this calculation an electrical horse-power will cost just under £18 per annum. No account is taken of expenses peculiar to companies, such as directors' fees and the cost of forming the company. It will also be noted that it is assumed that accumulators are not used.

The charge for a service rendered should bear some relation to the cost of rendering it. If it is a matter of open competition the matter will settle itself, for no one will for long be able to supply some customers at a loss, and recoup himself by exorbitant profits from others. If the matter be a case more or less of monopoly, the adjustment is less certain, thus the Post Office charges ½d. postage for a printed circular and 1d. for a written letter, the two costing the Post Office exactly the same. What a boon to the public it would be, if the Post Office would charge more for printed trade circulars, which in nine cases out of ten are a nuisance to those who receive them The supply of electricity is not quite a monopoly; companies compete with each other, and there is always the competition with other methods of illumination such as gas and paraffin. It is clearly to the advantage of the undertaker to secure all those customers whom it pays best to supply, and as far as may be, to compel those who are unremunerative to adopt these other methods. The ideal method of charge then is a fixed charge per quarter proportioned to the greatest rate of supply the consumer will ever take, and a charge by meter for the actual consumption. Such a method I urged in 1883 and obtained the introduction into certain provisional orders of a clause sanctioning "a charge which is calculated partly by the quantity of energy contained in the supply, and partly by a yearly or other rental depending upon the maximum strength of the current required to be supplied." In fixing the rates of fixed charge it must not be forgotten that it is improbable that all consumers will demand the maximum supply at the same moment, and consequently the fixed charge named might be reduced or some profit be obtained from it. There is no object in reducing the cost of electricity for lighting in the case of any customer much below the cost of equivalent lighting by gas, unless there are competitors in the field willing to do it, hence the current charge proportioned to the power supplied may safely be increased. *In certain recent cases in which I am acting as engineer*, the Board of Trade have sanctioned, on my application, "for each unit per hour in the maximum power demanded, a charge not exceeding £3 per quarter, and in addition for each unit supplied, a charge not exceeding two-pence." It is sometimes said as an objection to this method of charge, the public will object to paying a fixed charge whether they make use of their lights or not, and that in fact they will not pay it. The best answer that can be made is to give everyone the choice of being charged the maximum simple rate provided by the order, or by the compound rate as they prefer. What is wanted is not so much an increased charge for those consumers whose lights are used for a short time, as such a special reduced charge for those whose lights are used long as will induce them to use the supply.

It is instructive to compare the cost to different classes of consumers of electricity and gas for lighting with 16 candle gas. Flat flame burners must be large and of first rate quality to give mere than two candles per cubic foot of gas per hour; the large majority of burners give much less than this even at their best, and, as a rule, the pressure of gas is not regulated, and much gas is wasted as far as the production of light is concerned. Incandescent lamps give about one-quarter of a candle per watt; hence a Board of Trade unit is equivalent to 125 cubic feet of gas. Thus we readily arrived at the following comparative table, the charge being at the rates recently sanctioned by the Board of Trade:—

| Hours of use per annum. | Load factor. | Price of gas at which cost of lighting by electricity and 16-candle gas are equal. |
|---|---|---|
| 480 | 5.5 | 5s. 4d. |
| 960 | 10·9 | 3s. 4d. |
| 1,440 | 16·4 | 2s. 8d. |
| 1,920 | 21·9 | 2s. 4d. |
| 2,880 | 32·9 | 2s. 0d. |
| 3,840 | 43·8 | 1s. 10d. |
| 7,680 | 87·6 | 1s. 7d. |

In the accompanying curves are shown the cost of production, and the charge per unit at the compound and simple rate. The ordinates represent pence, and the abscissæ the number of hours per annum the supply is used.




It is obvious that these whose user is long will find the electric light economical to themselves, and that it will be profitable to the undertaker. With a cheap light which is free from the products of combustion there will be extensions for the hours of use. Shops may find it worth while to continue the light after closing, as an advertisement.

We have so far assumed that the supply of electricity is carried on without the aid of accumulators. Let us first compare the cost of an electric accumulator with the cost of a gas-holder containing the same possibility of producing light. A gas-holder is at present being put up in Manchester to hold 7,000,000 cubic feet of gas, and is to cost, complete with its tank, £60,000. With 16-candle gas, seven million cubic feet are equivalent to 56,000 Board of Trade units. Accumulators capable of storing a ten hours' supply, cost about £50 per unit. The equivalent accumulator will, therefore, cost about £280,000. But this is not all; the gas-holder is comparatively permanent, the accumulators require frequent renewals and repairs; the gas-holder gives back all the energy put into it; the accumulators waste at least 20 per cent.; the gas holder may be emptied as fast as you please; the accumulators, not faster than a certain rate without diminishing their capacity. Taking all into consideration, the cost of storing energy by the aid of accumulators, and storing it in a gas-holder are quantities of a different order of magnitude. If no gas-holders were used, and all the gas had to be made just as it was wanted, its cost for lighting would be several fold what it now is, even if gas producers could be found capable of instantly varying the supply as the demand varies. The gas-producing plant would have to be enormously increased; so would the size of the mains, and so would the wages of labour. If electric power could be stored as cheaply as gas, there would soon be little hope that the gas companies would maintain their dividends.

Let us see from a financial point of view whether accumulators can be used economically for storing up electrical power continuously produced during the 24 hours, and used rapidly for a short time.

Assume that the whole of the plant with the accumulators is capable of supplying 40,000 lights for ten hours continuously, and that during that time half the power is supplied from the accumulators. Ten hours in the twenty-four hours is not an unreasonable allowance, for we have melancholy experience in London of continuous fogs for days, and this would tax the plant we are considering to the utmost. We are to be ready then any time on short notice to supply 40,000 lights, and to continue to supply them for ten hours. Compare the cost, firstly, of maintaining this state of readiness with the accumulators and with a plant without accumulators. We shall require a battery capable of giving 1250 units for ten hours, such a battery costs not less than £50 per unit, or in all £62,500. To maintain it will cost from 10 to 15 per cent. on the cost; there will also be nterest on the outlay and amortisation, say in all 20 per cent or £12,500 a year. If we assume that the batteries are distributed at the various points of the system of conductors, we may also assume that the charges for land and buildings will be much the same as for the plant without accumulators. The boilers, engines and dynamos will be just one-half. The switchboard and instruments will be much the same. But the conductors will be reduced, smaller or shorter feeders being necessary, probably £40,000 will go as far with accumulators as £50,000 without. The coal bill may be dispensed with entirely, as we may assume that steam could always be got up during the time in which the demand increased from nothing to one half of the maximum, and that therefore all the coal burned can be assumed to be burned for producing current. That is to say, we assume the quantity of coal burned is proportional to the quantity of electric energy, and that therefore when no electricity is actually used, no coal will be burned. The wages may be reduced, for we have only to be ready to run half the plant, and a small wage will suffice for attendance on the accumulators. The wages of linesmen and the like will remain the same. Assume the total wages to be £3,500 instead of £5,000. The account will then stand thus:—

| | |
|---|---|
| Land | £1,000 |
| Buildings | 1,500 |
| Rates | 500 |
| Accumulators | 12,500 |
| Boilers | 1,050 |
| Engines | 1,080 |
| Dynamos | 675 |
| Switchboard | 300 |
| Conductors | 6,000 |
| Wages | 3,550 |
| | £28,105 |

practically the same result as we obtained before.

Now consider another hypothetical case, which of course can never occur in practice. We are to supply 40,000 lamps for 10 hours every day with the plant just described, charging the accumulators during 12½ of the 14 hours during which the lights is not required, 12½ hours charging giving 10 hours discharge of the same energy. The coal would cost the half of £30,000 if the machinery had to run the whole of the 24 hours. It has to run 22½ hours, but the boilers have to be kept warm the whole time, hence the coal will cost the half of £6,000 for keeping the boilers warm, and 22½-24 of the half of £24,000 for generating steam. The wages may fairly be taken as £4,750, and the account will stand:

| | |
|---|---|
| Land | £1,000 |
| Buildings | 1,500 |
| Rates | 500 |
| Accumulators | 12,500 |
| Boilers | 1,050 |
| Engines | 1,800 |
| Dynamos | 1,125 |
| Switchboard | 300 |
| Conductors | 6,000 |
| Wages | 4,750 |
| Coal | 14,250 |
| Stores | 1,425 |
| | £46,200 |

The cost of supply for the same 10 hours without accumulators would be as follows:—

| | |
|---|---|
| Land | £1,000 |
| Buildings | 1,500 |
| Rates | 500 |
| Boilers | 2,100 |
| Switchboard and Conductors | 7,800 |
| Engines | 2,760 |
| Dynamos | 1,725 |
| Coal | 16,000 |
| Stores | 1,600 |
| Wages | 6,000 |
| | £40,985 |

a cost of about 11 per cent. less than where accumulators are used.

Putting it another way, the cost of being ready to supply and to continue to supply, is about the same whether accumulators are used or not; the additional cost of actually supplying current is about 40 per cent. more where accumulators are used than where they are not used. It may be safely inferred that the use of accumulators does not seriously alter the conclusions I have drawn as to the proper method of charging consumers for a supply of electricity.

The question of whether the great cost of a supply for short hours can be removed by the use of accumulators, may be looked at in another way. Will it pay a consumer to put in his own accumulators and charge them from the station supply? We may reasonably suppose the undertaker will remit the fixed charge in consideration of the consumer only taking his current at slack times. His accumulators, if they are to be of capacity to maintain his supply through a foggy day, will cost him £50 per unit per hour (or per kilowatt) and the annual charge in respect of them will be £10 per year, to which, if we add a rent for the space the battery occupies, gives us a charge not differing materially from the fixed charge made or suitable to be made by the undertaker. But in order to obtain 2d. worth of electricity he must purchase 2½d. worth for charging his battery.

A word or two more about the use of accumulators. These have certainly improved, and they will continue to improve. They will become more durable and more economical of power in working, and their first cost will become less. An inspection of my tables of cost shows that a very little improvement would render them valuable even in very large stations for the mere purpose of diminishing the machinery required, by storing the energy developed at slack times to be used in busy times. The certainty of improvements in accumulators, and the possibility that the improvement may be considerable, is a strong argument for the use of the direct current, wherever it is not precluded by the distance of transmission being too great.

It will be noted that I have assumed a very large station. Accumulators have another use which greatly increases their advantage in smaller stations. There are many hours in the twenty-four when it is absolutely certain that the demand will be small. If accumulators are used the attendance of the staff may be dispensed with during those hours, and a considerable sum in wages will be saved. The proportion of wages to the whole charges is much greater in small stations than in large. In most small stations giving continuous supply, accumulators ought to be used notwithstanding their expenses and defects, and I believe the day is not far distant when they ought to be used in connection with most large stations also.

If instead of a continuous current, an alternating current with transformers will have to be added. If the distances are small, the increased cost of transformers will exceed the saving in the conductors; if the distances are considerable, the cost of transformers will be less than the saving of conductors. In both cases the general character of the result will be the same as before, the cost of being prepared to give a supply will be considerable, and the cost of actually giving the supply will be much smaller than is generally supposed. Indeed, with the alternating current this peculiarity will be even more marked, for the machinery has not only to be kept in motion, however small the consumption may be, but a certain current must be maintained in every transformer. With the best transformers, this current may only have an energy 1½ per cent, of the energy of the current when the transformer is fully loaded. This would increase the coal bill in the case cousidered by about £500 per year, whether the supply was used or not.

It is possible, indeed probable, that some of my assumed figures may be shown to be too high or too low for the generality of cases. It is of no moment; let each one take any figures he pleases, within reason; let him assume that the supply of electricity is made by any system he pleases; he will arrive at a result broadly similar to mine. To be ready to supply a customer with electricity at any moment he wants it, will cost those giving the supply not much less than £11 per annum for every kilowatt, that is for every unit per hour, which the customer can take, if he wishes, and afterwards to actually give the supply, will not cost very much more than ½d per unit. This is the point I have been labouring to impress, for I take it, it is essential to the commercial success of electric supply. It is hopeless for electricity to compete with gas in this country all along the line, if price is the only consideration. But with selected customers, electricity is cheaper than gas. Surely it is the interest of those who supply electricity to secure such customers by charging them a rate having some sort of relation to the cost of supplying them.

## HOW STEAM ACTS IN AN ENGINE.

Probably the majority of engineers would like to know how the steam acts in the cylinder of their engine, whether it flows in and moves the piston by a steady push like a solid column, or whether there is a turmoil and excitement inside the cylinder. Much has been said about condensation of the entering steam on the cold surface of the cylinder, and, as the piston moves, the presenting of new and cold surfaces. It has been claimed that a thin film of steam around the outside of the mass of steam became condensed, but that the interior of the column was comparatively dry. An English engineer has been trying some experiments to prove these matters, and they are certainly interesting if they are not conclusive. The problem was to look at the interior of the cylinder, but as a glass cylinder could not be maintained intact, with a movable piston in it, some other means must be tried. A large engine was selected, about fifty revolutions per minute, and near it was set up a glass cylinder. This cylinder was provided with steam and an exhaust valve, but had no piston working in it. The valves wese connected with the

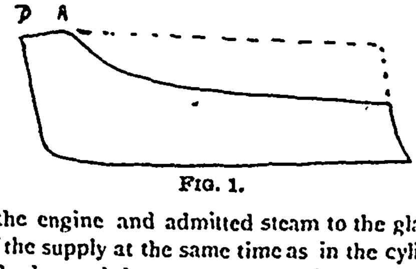



FIG. 1.

valves of the engine and admitted steam to the glass cylinder and cut off the supply at the same time as in the cylinder of the engine, and exhausted the steam at the end of the engine stroke. When the steam valve opened on the engine it opened to the glass cylinder and completely filled this glass cylinder with steam. It was just as though the glass cylinder had been attached to the head of the engine cylinder. It would then be a part of the engine clearance, and any action that might take place in this glass cylinder might be taken as showing the action of steam in the clearance space of the engine. There are facilities for superheating the steam entering this glass cylinder, and also for condensing the exhaust from it. The steam is admitted to this cylinder, and there is, of course, no difficulty in watching the phenomena, which is described in English engineering journals. The steam enters in the centre of the upper end of the cylinder, and a minute's observation suffices to dispose of the idea that thin uniform films of moisture accumulate on the cylinder walls. On the contrary, we see that a species of hurricane rages within the cylinder. The moment the steam valve opens there is an in-rush which blows all the water remaining in the cylinder in every direction. The interior of the cylinder is filled

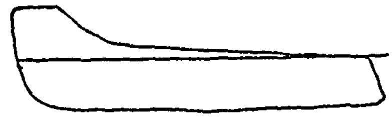


FIG. 2.

with a storm-tossed cloud. Water quickly deposits itself in big drops on the glass, some of which drops run down to the bottom. The exhaust opens and the clouds disappear like magic; violent ebullitions take place and a good deal of water disappears, and so the process is continued stroke by stroke. The first point almost to strike the observer is that under no circumstances do the surfaces inside the cylinder become wholly dry. Condensation and ebullition take place alternately, but there are always drops of water on the glass and metallic surfaces. These neither increase nor diminish in quantity. So far we have spoken of nothing more than might be expected to happen. But the matter does not end here. To begin with, it might be supposed that the presence or absence of a vacuum would greatly influence the results. But this does not appear to be the case. The ebullition which goes on when the exhaust opens is more pronounced, but so far as can be seen the formation of cloud and the deposit of water in drops on the cylinder walls is about the same in both cases. Again, it might be concluded that by super-heating the steam condensation would be wholly averted. Nothing of the kind. It is diminished, but not entirely got rid of; and yet it is very puzzling to understand how and why condensation can take place when the steam contains so large a reserve of heat. The glass cylinder is fitted with a small indicator, by the aid of which diagrams may be taken in the usual way. These are shown in Figs. 1, 2 and 3. At first sight they might easily be taken for ordinary engine-indicator diagrams, but this is a mere coincidence. There is no expansion curve for the steam fills the glass cylinder at the start. The length of the

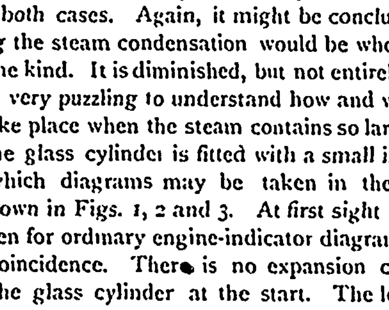


FIG. 3.

card is the engine stroke reduced. Steam is admitted, and as the valve remains open, the condensation is all made up through the open valve, but at A the engine cuts off the supply to this cylinder, and any further condensation would cause a loss in pressure. If no further condensation occurred then the line B A would be prolonged as dotted. The pressure falls, however, the instant cut off takes place and goes on falling to about half the initial pressure. The curves are not expansion, but condensation. It would be fair to assume that the cylinder had been thoroughly heated during the admission period, so no further condensation would occur, but such is not the case. It shows that in that short time the walls of this cylinder were not heated entirely during the admission period, but continued to demand heat long after cut-off, or else that condensation may ensue from some other cause.

Fig. 2 was taken when the cylinder was worked condensing, and Fig. 3 with superheated steam and condenser. The superheating of the steam does not seem to have prevented the loss in pressure, but it required less steam than the others. The experiment would seem to indicate that in a steam engine, the steam is in violent commotion at all times and that with expanding steam following a quick receding piston, and continuously opening up new surfaces of comparatively new cold iron, that condensation is going on at all times down to the point re-evaporation commences, and that the cylinder walls are never heated enough to reach a point that they will not extract heat from the steam until it has expanded to a low temperature. The deductions of the eminent engineer who is making the experiments will be awaited with interest. *Boston Journal of Commerce*

## L. P. & D. SYSTEM OF DRIVING DYNAMOS.

By W. W. Nugent, Chicago, Ill.

The practice of enclosing machinery in confined spaces has made some new system of transmitting power from engines to machines necessary. Numerous devices have been tried for this purpose, all of which have been more or less successful, but many of those, which have been put in extensive practical operation have not wholly complied with the requirements, for they have left other things to be desired.

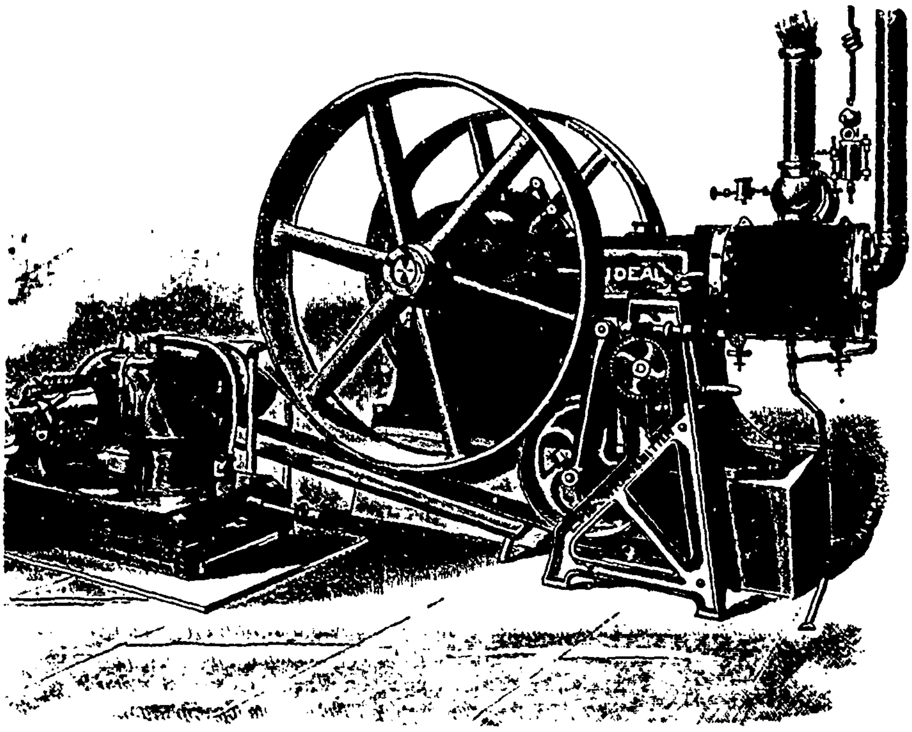



Fig 1.—The L. P. D. System of Driving Dynamos.

The accompanying illustration clearly shows the L. P. & D. system, which has been found to operate most satisfactorily under all conditions where a similar method of transmission would be required. The first illustration represents this method applied in the Siegel & Cooper electric installation, Chicago. The dynamo is a 400 light incandescent Western Electric machine driven by an Ideal high speed engine, having a 72" driving pulley. A light double leather belt, 19' long and 8' wide is, employed. The space between the dynamo and engine pulley is 6", while the whole space occupied by dynamo, engine and transmitter is 8'x11'.

It will be seen that but very little space is required in transmitting the power from driving to the driven pulleys. Where space is limited, this device becomes most valuable, for the whole plant is made quite compact and the arrangement is most convenient. If more space can be conveniently employed, a longer belt can be used, but there is no particular gain in the use of long belts.

Among the numerous methods for transmitting power from engine to dynamo, belting is conceded to be superior, as it is less injurious on the bearings of the machine. By the use of transmission the bearings are relieved of a great deal of the strain that would otherwise be necessary, for the belt does, in all cases, encircle more than one half the circumference of the driven pulley, while the contact of the belt with driving pulley, gives at all times a greater surface in contact than is employed on the driven pulley; consequently the strain is less than as though longer belts, running direct from driving to driven pulley were employed. From being in contact with the under side of of the driving pulley, the belt carries a portion of the weight of shaft and pulleys that would otherwise rest on the bearings, thus relieving them of a portion of the friction that would result from other methods of transmitting power.

It will be seen that the driven machinery, whether dynamo or other device, can be readily stopped or started without in any way changing the speed of the engine, for the pulley on the transmitter is capable of being raised or lowered by the feed screw. fitted with crank as shown in the illustration. By lowering the pulley of the transmitter, the belt is thrown out of contact with the driving pulley and the machine comes to rest. When in position, the belt can be readily removed from the pulley of the machine, or put in position and the machine started by raising the pulley of the transmitter.

The device is most simple and complete, and is applicable in many ways to various kinds of plants. It may also be applied to the pulleys of jack shafts, and by its use a large number of machines can be operated on small floor space as shown in Fig. 2. The use of short belts makes this possible, as the machines can be brought as close as desired to the driving pulleys, and pulleys can be placed as close together on the jack shaft as required. The other machines can be placed at a convenient distance to give the necessary room for conveniently getting around the machines to do such work as is required.

Fig. 3 clearly shows the principles of the system in outline. From this drawing it will be seen that the length of belt in contact with the driving pulley is greater than that in contact with the driven pulley, while the contact on the driven pulley is greater than is found in the more common systems of belt transmission. This system is easily applied to any existing plant, for all that is necessary is to fasten the transmitter so that its pulley will be about 2" from the floor and ½" from the driving pulley. The pulley of the driving machine should be placed as near the driving pulley as possible and a line drawn from the under side of this pulley to the lower side of transmitter pulley should pass about 2" from the bottom of the driving pulley on engine or shaft. If the dynamo or other machine is mounted on a base in

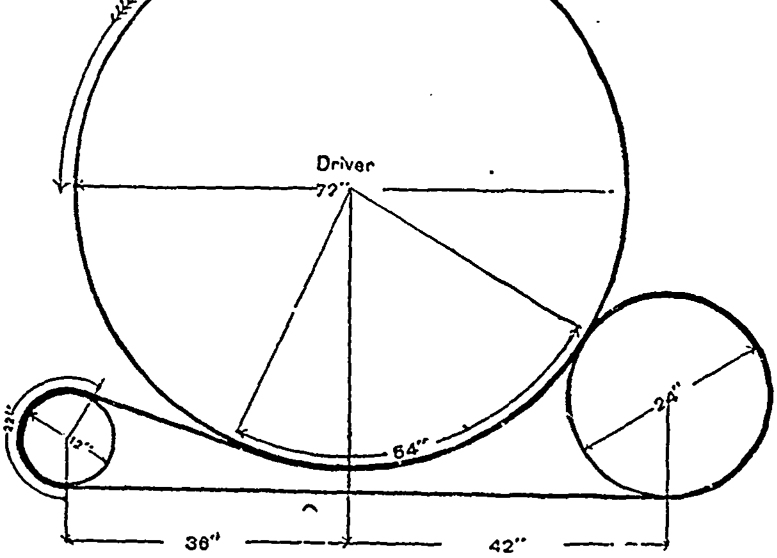



Fig. 2.—Principle of the L. P. & D. System.

such a manner that it may be moved, the same purpose may be served as though the transmitter pulley was moved. The use of this device, will in some cases, increase the driving power, because a greater contact between the belt and driven pulley can always be obtained and the contact of belt upon the driver will still be greater than that upon the driven pulley, so that in case of slipping of belt, this will always take place upon the driven pulley. From this it will seem that it is always safe to calculate a larger load than can be driven with the same width of belt and size of pulley, as is the case in direct belting.

This arrangement works equally well where the driving pulleys are below the floor that supports the dynamos and it is practicable to run as many as eight dynamos from an engine equipped with two driving pulleys of 24" face.—*Stationary Engineer.*

## SPARKS.

The Stanton Electric Company has been incorporated with a capital stock of $50,000.

The Peoples Electric Light Co. of Windsor, Ont., is making arrangements to erect a new power house.

The Toronto Industrial School has lately installed an electric plant and will in future do its own lighting.

The annual report of the Dominion Telegraph Co. presented at the 23rd annual meeting, is regarded as being a satisfactory one.

It is reported that the Niagara Falls Power Co. has recently acquired a controlling interest in the Canadian Niagara Power Co.

The Evangelical Alliance has instructed counsel to bring action to compel the Halifax Street Railway Co. to discontinue running horse cars on Sunday.

The syndicate which owns the Montreal, Toronto and Winnipeg Street Railways, has also obtained control of the London Street Railway. It is stated that the stock was purchased at about 100 per cent. premium.

A franchise covering a period of 30 years and including exemption from taxation has been granted to Mr. A. J. Corriveau, by the municipality of Notre Dame de Grace, for the construction of an electric railway and for street lighting.

Mr. James Stark, of Ottawa, manager of the Ottawa District and Perth Mica Mines, owned by an English syndicate, states that it is the intention to start a factory in Ottawa or Perth, and ship the material to England and the United States.

The C. P. R. have agreed to build a telegraph line along the Oxford Mountain Railway, from Eastman to Richmond, Quebec, provided the railway company will supply the poles and place them in position to be erected along the line.

The promoters of the Port Arthur Electric Railway, as well as the officials of both municipalities, are endeavoring to secure from the Ontario Government, a statement of the terms upon which the road-bed shall be constructed, and also a decision in other matters in dispute.

The Quebec legislature, at its next session, will be asked to change the corporate name of the Quebec and Levis Electric Light Co., and to grant power to the company to purchase or lease lands or water powers, to lease or sell dams, flumes, canals, electrical appliances, etc.

The City Council of Vancouver has been asked to guarantee for 25 years

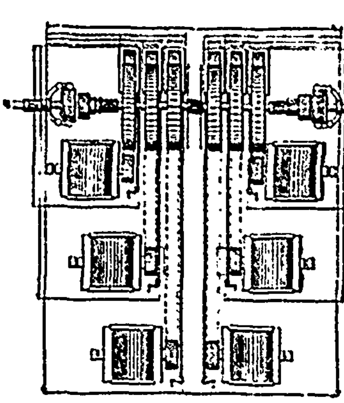


FIG. 3.—PLAN FOR SETTING SIX DYNAMOS.

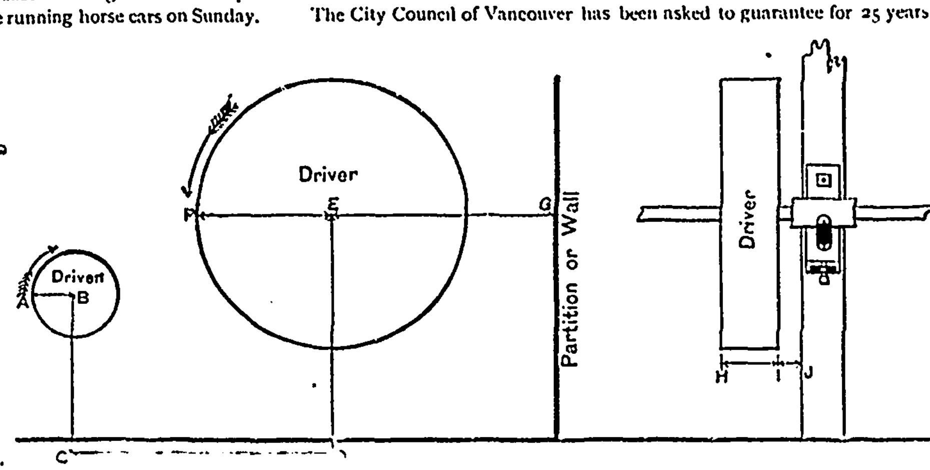



FIG. 4

5 per cent. bonds of the Electric Street Railway & Light Co., to the amount of $600,000. Should the Council consent to do so, the company will derive a substantial advantage, inasmuch as the bonds are at present bearing interest at the rate of 7 per cent.

A writ of foreclosure has been issued in the Supreme Court against the Halifax Street Railway Co., at the instance of certain bondholders, for the sum of $225,000. The company claim that the bonds held by the parties bringing the action are illegal, and have been repudiated.

The borrowing powers of the Hamilton Street Railway Co., are at present limited to an amount not exceeding the total paid up stock. The legislature will be asked at its coming session to amend the Company's act of incorporation so as to increase its borrowing power, thus enabling the directors to improve and extend the system.

An unknown steamer, on the night of the 9th of November, cut in two the Pelee Island telephone cable. The superintendent of the Government telegraphic service at Ottawa, was communicated with, and the promptness with which, notwithstanding rough weather, his staff succeeded in re-establishing communication with the mainland, is a matter of much satisfaction to the inhabitants of the island.

The Mayor of Montreal has refused to confirm the action of the city council in renewing the electric lighting contract without calling for tenders.

The Hamilton Street Railway Co. propose to test the efficiency of electric heaters, and should they be found satisfactory, all their cars will be equipped with them.

It is said to be the intention of the owners of the St. Catharines and Thorold Electric railway to reconstruct the line next spring, and possibly to extend it to Port Dalhousie.

Mr. Wm. Gibson, M. P., of Beamsville, Ont., and the Messrs. Hendrie, of Hamilton and Detroit, are negotiating for the purchase of the Sandwich, Windsor and Amherstburgh Railway.

The construction of underground metallic circuits and the removal of overhead wires has been largely accomplished by the Bell Telephone Co. in the northern part of the City of Toronto.

A Mrs. Collins, of Hamilton, has been awarded by the courts $5,000 damages against the Hamilton Street Railway Company on account of her husband having been killed by a trolley car.

A committee of Brantford manufacturers has been appointed to ascertain the cost of an electric plant and of power, with a view to establishing a central power station to furnish power to manufacturers.

The Bell Telephone Co. has recently placed small iron boxes in the drug stores throughout the City of Toronto, and a notice thereon requesting persons not connected with the establishment who may desire to use the telephone to place 5 cents in the box. So far as can be learned, the request is not being complied with.

## PERSONAL.

Mr. John Langton, formerly Superintendent of the Edison Works at Peterborough, Ont., makes the announcement in our advertising pages that he has opened an office in the Canada Life Building, Toronto, and is prepared to contract for all kinds of electrical work.

## NOTES ON A PROBLEM IN WATER POWER.*

The present paper is a non-scientific one, and in other respects is not to be classified among the contributions such as are commonly presented before this society. Neither are its objects the same. The purpose is to present some thoughts upon a very important subject, with a view to calling out further and more able discussion. There being nothing exact or determinate to deal with, there will be neither figures nor quantities included, so that no severe mental strain need be apprehended in following the remarks.

The subject is water motors, or, as we commonly say, water wheels, for utilizing the action of gravity of water, and inquiry into the probable condition, inferences or deductions which have led up to and established modern practice as it now exists in this country.

Water wheels, as we have to deal with them, may be classed as gravity wheels, including (1) overshot breast wheels, and perhaps the Poncelet type; (2) pressure wheels, including what we call inclosed turbines and reaction wheels; (3) impulse wheels, driven by spouting water.

The classification thus assumed is, for short, gravity, pressure and impulse wheels. These may be said to cover the various types in common use.

In modern practice the class called pressure turbine wheels constitute perhaps four-fifths of the whole. These can be divided into three general types, namely. The Fourneyron, or outward radial discharge, the Jonval, or downward discharge parallel to the axis of rotation; and the American or inward flow wheels. These have come into general use all over the world, and have a literature of surprising completeness. They are by common consent regarded as the most efficient, and, indeed, until recently, have been the only wheels which were considered in connection with an efficiency beyond 60 per cent.

The question to be presented, and the main point in this communication is, what has produced this particular form in water-wheel practice, and why has pressure instead of impulse been the principle or mode of operation followed in all countries.

Before attempting any answer to this inquiry, it will be well to further examine or explain, in as simple a manner as possible, the nature of the class called turbine wheels.

A column of water resting upon the vanes of a turbine wheel, which are free upon their reverse side, and meet no resistance there, represents complete efficiency less machine friction, and the science of turbines, to so call it, is directed to removing the impeding water and its resistance on the reverse side of the vanes— that is, on the discharge side, after the function of pressure has ceased or has been utilized. It is common to divide the effect of the water, or its functions, in this class of wheels, into gravity, impulse and reaction, but there is no need of such assumption or of introducing the complex nature of these forces thus combined, because the whole is explained as simple pressure, and all observed phenomena point to this as the "mode of action" in pressure turbines.

I am in this assumption, no doubt, transgressing upon what are called established data, but the issue is not important to the subject, and it will be sufficient to call the active force one of pressure alone, and the resistance or loss a result of the imperfect riddance of the water on the reverse or discharge side of the vanes, after it has performed its work by pressure, impulse or otherwise.

Following this method of operating to its constructive features, it involves closed vessels, or conduits, not only to the water wheels, as in other cases, but around them. The wheels must be enveloped in the fluid that drives them, and contained in cases strong enough to sustain not only the static head, but also the effect of water concussion, and in most cases afford support for the wheels themselves and their shafts.

The bearings of the wheels have to sustain the weight of the running parts, also, in many cases, a pressure of the head equal to area of issues multiplied into the head. The wheels are submerged, placed at the bottom of the head or near it, inaccessible to observation, and also for repairs, calling for unusual and expensive provision in the way of bearings and other constructive features, including extra strength of all parts. The hydrodynamic conditions both of entrance and discharge call for complicated forms which cannot with safety be built up, and pressure turbine wheels in this way become large and expensive castings, the value of which depends upon the integrity of every part. If a vane be broken or imperfect, the whole wheel is lost. The diameter being limited because of first cost, a limit of rotative is reached at a head of 50 feet or so, and even at that head the bearings have to run under undesirable conditions; in other words this type of wheels does not permit control of rotative speed, that being limited by both first cost and operating conditions.

Turning now to the other type of wheels, but little known in this country, except on the Pacific coast, the impulse class, and assuming that the force of spouting water is equal to its gravity less an inconsiderable friction in orifices, the question arises, why has not the evolution of water wheels followed on this line instead of pressure for all except low heads?

This is a very important question, one that may well engage the attention of this society, and one that calls for explanation such as will be by no means easy or apparent. It is true that with the class of impulse wheels called "undershot," and some other cruder forms operating by the impulse of spouting water, the efficiency attained has been so low as to lead to the conclusion that the losses were inherent in the method or mode of operation, and this opinion has, it seems, become general without any one very closely inquiring into the matter.

That the efficiency of tangential wheels driven by impulse is as high as can be attained by pressure turbines, has been proven by numerous experiments here, also by some recent experiments at Holyoke, Mass., and is beyond controversy. It has long been settled on this coast, and as a problem no longer exists. No one here would expect under a head of 50 feet or more to attain with any known type of pressure water wheels a higher efficiency than is given out by tangential impulse wheels; but this state of opinion and practice is confined to narrow limits now, and is the more to be wondered at when we consider the rapidity and completeness of investigation in other branches of dynamic engineering at the present day, especially when the economic and constructive conditions in favor of the impulse type of water wheels are taken into account. These we will now consider in a brief way.

There is a wide difference between a water wheel driven by impulse and one operating on the pressure system. The first cost of the former, for a given power, is one half as much, and its maintenance is still less, in proportion.

Figuratively speaking, when a wheel is turned from a pressure to the impulse system, it is taken out of its case, mounted in the open air, in plain sight. All the various inlet fittings are dispensed with and are replaced by a plain nozzle and stop-valve. Its diameter is made to produce the required rotative speed, whatever that may be. The shaft and its bearings are divested of all strains except those of gravity and the stress of propulsion when the water is applied at one side only. Most important of all, there are no running metallic joints to maintain against the escape of water, no friction and no leaks; there are, indeed no running joints or bearings whatever, except the journals of the wheel shaft.

The effect of grit and sand is eliminated, both as to vanes and bearings and there are no working conditions that involve risk or call for skill. If a vane is broken, another one is applied in a few minutes' time. If a large or small wheel is wanted, the change is inexpensive and does not disturb the foundations or connections. Capacity is at complete control; the wheel can be of 10,000 or 1,000 horse power, without involving expensive special patterns. The speed of rotation is not confined to commercial dimensions because of patterns and other causes. It is merely a matter of choice with the purchaser or maker.

Now, granting the efficiency of impluse wheels, which, as before remarked, can hardly be called in question for all heads exceeding 50 or even 30 feet, and conceding the constructive and operating advantages just pointed out, the question at first named rises, why has the evolution of water wheels during 50 years past been confined to the pressure class? Also, why has it been proposed at Niagara Falls to employ pressure turbine wheels under a head of 100 feet or more, when the conditions point to the better adaptation of open or impluse wheels?

It is not necessary in such an inquiry to discuss the problem of horizontal and vertical axis, or other local conditions, in the

* Paper read before the American Society of Mechanical Engineers at the meeting of May, 1892, by John Richards, of San Francisco.

case of the Niagara plant, or in any other, further than to say that the pressure class of wheels offers no advantages not balanced by equal or greater disadvantages, as will no doubt appear if there should be discussion of this subject before the society. Besides the object of this communication first named, there is the further one of calling the attention of the members present to the impluse or open water wheels so extensively employed on this coast, and to suggest that if possible, they manage to see such wheels in operation under various heads, especially under high heads. In observing a machine of any kind in motion, there are impressions gained which cannot be conveyed by description, but I warn every one against inference from this remark that the tangential water motor wheels on this coast are not scientifically understood and treated. The problems involved may not be so many or so intricate as in the case of pressure turbine wheels, and this is fortunate, because the literature of the latter is one of much complexity to any but skilled mathematicians, and for that reason has not been so much used as it ought to have been.

In this country, and it is a most commendable thing to mention, the pressure turbine by an inward flow, or an inward draft, has been greatly simplied in construction, cheapened in first cost, and at the same time better adapted to impure water without losing anything in efficiency. I believe the inward flow turbines made by the Risdon Company at Mount Holly, N. J., have in public tests on more than one occasion shown an efficiency as high, or even higher, than the more finely fitted Fourneyron and Jonval types.

The record of American engineers in this branch is one of which they may well be proud; and now that impulse wheels of the Girard type have made much progress abroad, and have here in California been modified much as the Fourneyron and Jonval wheels have been in the Eastern states, it is quite time more attention was bestowed upon the subject in other parts of the country. Analogy in the two cases is marked. By an inward flow, American makers reduced the running parts, or the wheel proper, of pressure turbines to a small diameter, increasing its speed accordingly. This lessened the weight and cost of the wheels in the proportion of their diameters, and at the same time dispensed with the accurate fitting involved in the outward and downward flow turbines; and this, as before said, has been done without sacrificing efficiency.

The tangential type of open wheels has been similarly dealt with here in California. The running-water joints have been wholly dispensed with. The construction has been cheapened one-half. The round jet has been applied in the most simple manner, with an increased dynamic effect, and the efficiency attained is believed to be more than is reached by the finest examples of Girard wheels in Europe.

Conceding these statements and facts brings us back again to the query forming the subject of this communication—namely, Why has the evolution of water wheels followed on the line of *pressure* instead of *impulse*?

## SPARKS.

The Central Electric Light Co., of Montreal, has been gazetted by letters patent.

The Lunenburg, N. S., Electric Light Co. has recently placed in position a new 70 horse power boiler.

There is no difference in the heating effect between a continuous and an alternating current.—*Electric Age.*

The Chaudiere Electric Light and Power Company, of Ottawa, is seeking power to increase its capital to $1,000,000.

Mr. D. C. Waters, of Ottawa, is said to have recently purchased for $2,000 a valuable mica mine near Templeton.

The Ottawa City Passenger Railway Company declines to join with the city in an application to Parliament to convert the road into an electric one.

Messrs. John A. Willis and A. M. Wickens have been re-elected representatives of the stationary engineers on the Toronto Technical School Board.

A patent for a self-lubricating trolley wheel, was recently granted to Messrs. John Chas. Mullin, John Bell McRae, and Sydney Leroy Keighley, of Ottawa, Ont.

A contract has recently been signed by the Corporation of Iberville and the St. Johns Electric Light Co., whereby the latter engage themselves to light the town by electricity.

The Ottawa Electric Railway Company have placed in the power house at the Chaudiere another 400 horse power electric generator, making two of that size, the largest of the kind in Canada.

An electric club has been organized in connection with the Peterboro' works of the Canadian General Electric Co.

The Halifax Street Car Company, The Nova Scotia Power Company, and Halifax Illuminating and Motor Company have been sold to an American syndicate, who will operate the street railway by electricity.

In view of the introduction of the electric street car system, the Bell Telephone Co. propose to lay a conduit for the company's wires, from the head office, on Dundas street in London, to the corner of Dundas and Richmond streets.

The Roads Committee of the Montreal City Council has recommended that permission be granted the St. Jean Baptiste Electric Co., the Citizens' Electric Co., the St. Henri Electric Co. and the Merchants' Telephone Co. to erect poles on the streets.

Exclusive telegraphic privileges have been secured by the G. N. W. Telegraph Co., from the new road just opened on the Adirondack and St. Lawrence Railway Co. The G. N. W. Telegraph Co. is at present engaged in constructing a line from St. Johns to Farnham, Quebec.

By resolution of the Board of Directors, the capital stock of the Sherbrooke Telephone Association has been increased to $100,000. The following officers were recently elected: Mr J. A. Achambault, President; J. C. Meagher, Vice-president; D. McManany, Secretary-treasurer; C. Skinner, manager.

A by-law will be introduced in the Winnipeg City Council consenting to the terms of the Bell Telephone Co.'s proposition to establish a metallic circuit, on condition that the city will not grant permission to any other company to construct and operate a telephone system in the city during the next five years.

Mr. Justice Bain has refused to grant the injunction asked for by the Winnipeg Street Railway Co., for the purpose of restraining the Winnipeg Electric Street Railway Co. from operating their lines until such time as the plaintiffs' charter had expired. The case will probably be carried to the highest court of appeal.

The Water Works Committee of the Ottawa City Council propose to impose a tax of $2.00 per car per annum on the Ottawa Electric Railway Co. This action appears to be taken with a view to even things up between the railway company and the hackmen, the latter having to pay $2.00 per annum for water for each horse.

The officers of the Peterboro Carbon and Porcelain Co., which is successor to the Brooks Manufacturing Co., are as follows. Mr. Cluxton, president; Mr. Kendry, vice president, Mr. J. W Taylor, managing director.

The Smiths Falls Electric Power Co. (limited) has been incorporated by letters-patent of the province, with a capital stock of $60,000. The chief promoters are Messrs. Francis Theodore Frost, Wm. Henry Frost, Charles Berih Frost, Jas. Maitland Clark, Adam Foster and Frederick Arthur Bethune, of Smiths Falls. The company proposes to supply electricity for power and light.

A clutch pulley in the power house of the Rat Portage Electric Light Co. burst recently, seriously injuring John Hegley, J. G. Rushton and L. Stewart. H. Ridout was also slightly injured. Several fragments of the pulley went through the ceiling, and as there were a number of persons in the building, it is considered fortunate that the results were not even more serious.

A large new driving pulley while in process of testing in the Standard Electric Company's power house at Ottawa, on Dec. 20th, suddenly went to pieces. The fragments were hurled in all directions, two of them going through the ceiling. An armature of a new one hundred light dynamo was destroyed, and several things about the establishment damaged, but the dozen employees miraculously escaped injury.

The power house of the Windsor and Sandwich Electric Railway and its contents was destroyed by fire on the night of the 26th of December. The building was of solid brick. This and the fact that the power house stood alone in an open field and that the engine house did not form part of the station proper but was located in a brick addition thereto, makes it difficult to imagine how the fire could have started.

An ingenious method was recently employed in wiring a building for electricity at Rockland, Mass. It was desired to run wires between the flooring and for that purpose a hole was cut at both ends of the room; then a half-grown kitten, with a slender string attached, was put in at one of the holes, and readily crawled through to the other. A stronger string was then drawn through, then the wire, and the job was done.

She kept the biggest boarding house,
Of any in the city;
If any person couldn't board
With her, it was a pity;
But she gave up one winter day—
Did Miss Melinda Molly—
And quit the business when she found
She couldn't board a trolley

Owners of isolated plants cannot be too careful in their selection of an engineer. In most cases the engineer must be electrician and dynamo tender. The necessity of having a competent man is obvious. If it is necessary to put ice on the bearings of your dynamos, the engineer should know enough to keep water out of the armature and to see that the floor is kept wiped up. He should not imagine that the commutator is put on an armature for the purpose of being "turned down" in grooves by the brushes. —*N. Y. Electrical Review.*

## NOTES.

Mr. George Munro, of Peterboro', Ont., was recently granted a patent on a turbine water wheel.

A cylindrical foot of water weighs 49.1 pounds, while a cubic foot weighs 62.5 pounds, still in the same ratio. We append a few useful multipliers.

Cubic feet of water × 62.5 = pounds.
Cubic inch of water × .03617 = pounds.
Cylindrical inch × .02842 = pounds.
Cylindrical feet × 49.1 = pounds.
183.346 circular inches = 1 sq. foot.
2200 cylindrical inches = 1 cubic foot.

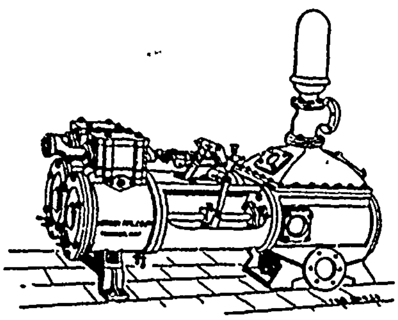
These will give a very accurate approximation and will help in many calculations.

It will pay to set them down in the note book and to memorize those likely to be useful in every day practice.

Journals that have been heated, then cooled with cold water, often break afterward without apparent cause. It has been shown that many such fractures are due to the water treatment, which changes the structure of the metal.

Mrs. Wm. Collette has taken an action for $5,000 damages against the Montreal Elevating Co., on account of the death of her husband, who was an engineer in their service, and was killed by the explosion of a boiler, which, she alleges, had not been inspected.





## SPARKS.

An order in council of the Ontario Government has been passed, changing the name of the Brooks Mfg. Co. of Peterboro', Ont., to the "Peterboro' Carbon & Porcelain Co., Ltd."

The Chaudiere Electric Light Co., of Ottawa, have recently put in a new 2,500 light machine, and are putting in another 5,000 incandescent light machine. The latter is said to be the largest electric light machine in Canada.

At a meeting of shareholders of the Victoria Electric Co., Ltd., Victoria, B. C., it was decided to increase the capital stock of the company to $75,000, paid up, and the directors were empowered to incur an expenditure not exceeding $40,000 for increasing the plant and improving the premises. A contract has since been entered into with the Canada General Electric Company. The plant purchased includes two Edison dynamos 3,340 light capacity, 16 candle power each; two 150 h. p. slow speed engines, capable of giving nearly 400 h. p., and three 150 h. p. boilers, tubular. By providing three new boilers there will be one to spare. The new plant will about double the present capacity and service. The contract includes $6,000 to $7,000 worth of wire to put all mains, feeders and distributors in thorough and efficient working order. It is also contemplated in the near future to add to the arc plant by the introduction of an all night, all year round service, Sundays included; these lights to be of 2,000 candle power. A lease of the brick premises at the corner of Langley and Fort streets has been secured by the company for ten years on very favorable terms. The old building on Langley street is being bricked and improved. The contract is to be completed in 90 days from the 9th of November, 1892. A friendly understanding has been arrived at between the National Electric Light and Tramway company, and the Victoria Electric Company, that fair prices shall be maintained, so as to put the business of supplying electric light on a commercial basis by making the stock pay a commercial dividend. At the same time consumers will be given first class light and the best possible satisfaction at a reasonable price.

Please mention the ELECTRICAL NEWS when corresponding with advertisers.

## SPARKS.

The Wes.ville, N. S., Electric Light Co. is substituting incandescent for arc lights.

We are indebted to the *Electrical World* for a large size colored lithographic illustration of the Electricity Building in connection with the World's Fair.

The Woolley Electrical Appliance Company at Barrie, Ont., are applying for incorporation with a capital stock of $25,000, to manufacture the Woolley electric magnetic apparatus and other electrical appliances.

A petition has been sent to the Montreal City Council against the running of electric cars all winter. The plea for this is that the streets on which the cars run will almost be bare of snow and prevent sleighing, while other streets will be covered with snow and forbid wheeling.

A change in the directorate of the St. Johns', Que., Electric Light Company has recently been made, Messrs. Trotter and Turnbull retiring. The vacancies thus created have been filled by Messrs. J. B. Tresidder, of Iberville, and J. B. Hutchison, of Montreal. Considerable improvements are being made in the electric light station.

The County Council of York have granted the right of way on the Kingston road from the Woodbine corner to Highland Creek to the Toronto & Scarboro Electric Railway and Lighting Co., providing the rate of passenger fare shall not exceed 3c. per mile from Toronto to Scarboro Junction, and 2c. per mile for the remainder of the distance.

The difficulty of maintaining schedule time with a large number of cars is well recognized; and on many lines if a car be delayed by an accident for a quarter of an hour or 20 minutes, the whole line would be so deranged that schedule time will not be overtaken during the whole of the day. In Denver where there are 74 miles of electric and 13 miles of cable tracks, requiring about 103 trains in daily operation, this is especially important. It was found that a breakdown of any kind on the road inevitably disorganized the traffic, since the making up of time rested chiefly with the conductors. To obviate this a system of telephone circuits has been arranged with various call points, all communicating with the head office. Every conductor on arriving at the terminus of his route immediately reports to headquarters the number of his car, and receives in reply his proper leaving time and any instructions that may be necessary. The dispatch clerk is thus advised of the whereabouts of each car, and is able often to fill up a space of from 30 to 60 minutes caused by a "parade." Of course it is impossible for one car to jump another by the cable or electric systems, and hence the proper control of the cars is of more importance than with horse service. As a set off against the expense of the telephones may be taken the saving of starters at the various termini. The telephones are estimated by the Denver Company to give a saving of at least 80 per cen over the cost of the old system.

### New Facts about the Dakotas

is the title of the latest illustrated pamphlet issued by the Chicago, Milwaukee & St. Paul R'y regarding those growing states, whose wonderful crops the past season have attracted the attention of the whole country. It is full of facts of special interest for all not satisfied with their present location. Send to A. J. Taylor, Canadian Passenger Agent, No. 4 Palmer House Block, Toronto, Ont., for a copy free of expense.

# VULCANIZED FIBRE CO.

**ESTABLISHED 1873.**

SOLE MANUFACTURERS OF **HARD VULCANIZED FIBRE**

***In Sheets, Tubes, Rods, Sticks and special shapes to order. Colors, Red, Black and Grey.***

SEND FOR CATALOGUE AND PRICES.

**THE STANDARD ELECTRICAL INSULATING MATERIAL OF THE WORLD.**

Factory: WILMINGTON, DEL. OFFICE: 14 DEY ST., NEW YORK.

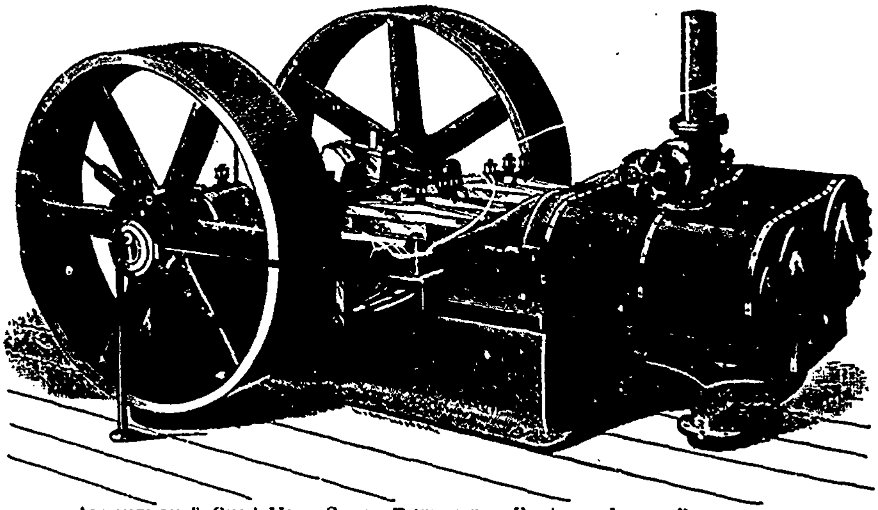
---

## THE CANADIAN LOCOMOTIVE & ENGINE CO., Ltd.

*KINGSTON, - ONTARIO.*

MANUFACTURERS OF

## Locomotive, Marine and Stationary Engines

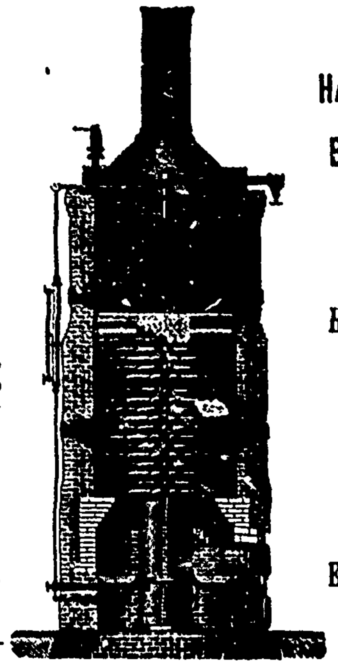


ARMINGTON & SIMS' HIGH SPEED ENGINE FOR ELECTRIC LIGHT PLANT ETC.,

**NOTICE.**

The Canadian Locomotive & Engine Co., Limited, of Kingston, Ontario, have the exclusive license for building our Improved Patent High Speed Engine for the Dominion of Canada, and are furnished by us with drawings of our latest improvements.

PROVIDENCE, R. I. Nov. 18th, 1889. (Signed) ARMINGTON & SIMS.



**THE HAZLETON BOILER.**

The Handiest, Safest, and Most Economical Boiler.

**"CYCLE" GAS ENGINE**

IMPULSE EVERY REVOLUTION without a separate pump. NO SLIDE.

Descriptive Catalogues of the above on application.

---

**Equip your Electric Plants, Factories and Mills with**

# *Waterous*

# FAMOUS GRIP PULLEYS

INSTANTANEOUS IN ACTION.

SIMPLE AND THOROUGHLY PRACTICAL.

THE ONLY REALLY SUCCESSFUL GRIP PULLEY AND COUPLING.

SAVES TIME, BELTING, POWER.

**BRANTFORD CANADA**